

***Juniperus* Subject Bibliography by Keywords**

Juniperus (201)

1. Admasu E.; Thirgood S. J.; Bekele A., and Karen Laurenson M. Spatial ecology of golden jackal in farmland in the Ethiopian Highlands. *African Journal of Ecology*. 2004; 42(2):144-152.
Keywords: *Juniperus*/ jackal/ *Canis aureus*/ Ethiopia
Abstract: The spatial ecology of golden jackal *Canis aureus* was studied on farmland adjacent to the Bale Mountains National Park in southern Ethiopia during 1998-2000. Three adult and four subadult jackals were captured in leghold traps and radiotagged. The range size of the adult jackals varied from 7.9 to 48.2 km² and the subadults from 24.2 to 64.8 km². These ranges are the largest recorded for this species. Range overlap of the tagged jackals averaged 54%, which, in conjunction with observations of associations between individuals, suggested that all the tagged jackals belonged to one social group. Tagged jackals were observed alone on 87% of occasions despite the extensive overlap in individual ranges. Pairs consisting of a male and female were the most commonly observed group and larger groups were seen on only five occasions. Jackals in this population appeared less gregarious than observed elsewhere. The jackals used all the habitats available to them, particularly at night when they foraged in *Artemesia* and *Hypericum* bush and farmland. During the day they were more frequently found in *Hagenia* and Juniper woodland and their diurnal resting sites were characterized by thick cover. This is the first detailed study of golden jackals in a human-modified landscape in Africa and further demonstrates the flexibility in behaviour and ecology exhibited by this species throughout its range.
2. Aldon E. F. and Springfield H. W. The southwestern Pinyon-Juniper ecosystem: a bibliography. USDA Forest Service General Technical Report, Rocky Mountain Forest and Range Experiment Station. (RM-4). 1973; RM-4(II):20 pp.
Keywords: *Juniperus*/ *Pinus*/ ecosystem/ silvics/ management/ wildlife/ rangeland/ insects/ diseases
Abstract: Includes references to the end of 1972 relevant to the Pinyon/Juniper woodlands of the south-western USA arranged by subject (without cross-references): ecological investigations, silvics and management aspects, product utilization, range characteristics and wildlife values, water yield and sediment, and insects and diseases.
3. Anderson J. J. and Cobb N. S. Tree cover discrimination in panchromatic aerial imagery of pinyon-juniper woodlands. *PEandRS, Photogrammetric Engineering and- Remote Sensing*. 2004; 70(9):1063-1068.
Keywords: *Juniperus*/ pinyon / Arizona/ aerial photography/ canopy/ photointerpretation.
Abstract: Responding to an increasing interest in studying vegetation

changes over time, we review current methods of processing black and white digital aerial photographs in order to classify tree cover in pinyon-juniper woodlands in northern Arizona, USA. Besides applying commonly used clustering and supervised maximum-likelihood methods, we have developed a new classifier, nearest edge thresholding, which is unsupervised and based on the principals of edge detection and density slicing. Comparison of the three methods' abilities to predict field values at plot scales of 100 to 900 m² shows this new method is better or comparable to others at all scales, can be easily applied to digital imagery, and has high correspondence with ground-truthed field values of tree cover.

4. Anonymous 2. Papers at a conference on the problem of the restoration and development of the Juniper forests of Central Asia, 15-22 July 1970. Materialy soveshchaniya po problem vosstanovleniya i razvitiya archovykh lesov Srednei Azii, 15-22 iyulya 1970 g. Materialy Soveshchaniya Po Probleme Vosstanovleniya I Razvitiya Archovykh Lesov Srednei Azii, 15-22 Iyulya 1970 G. 1972. 181. 1972; 181 pp.
Keywords: *Juniperus*/ biology/ regeneration/ restoration/ Central Asia
Abstract: A collection of 23 papers dealing with various aspects of biology and regeneration of *Juniperus* spp., the condition of the Juniper forests of Kirghizia, Uzbekistan, Tadzhikistan, Azerbaijan and Turkmenia, and measures for their preservation and improvement.
5. Arnold W.; Bosch B., and Schmid H. Present condition and objectives for the conservation of the juniper heathlands of the Swabian Mountains. Zustand und Zielvorstellungen fur die Erhaltung der Wacholderheiden auf der Schwabischen Alb. Forstwissenschaftliches Centralblatt. 1982; 101(5):311-346.
Keywords: *Juniperus*/ West Germany/ conservation/ heathlands
Abstract: The juniper heathlands on the Swabian Mountains, W. Germany, are endangered, as sheep grazing on the land has declined, and forest cover is encroaching. A study by the Tubingen regional office of the Baden-Wurttemberg forest service is presented. Six stand types are distinguished, and the functions of the heathland are described. Recommendations are made for the preservation of some of the remaining heathland, and of examples of the successional stages, from open heathland to forest pasture.
6. Austin, D D Reprint author. Plant community changes within a mature pinyon-juniper woodland. Great Basin Naturalist. 1987; 47(1):96-99.
Keywords: *Juniperus*/ pinyon-juniper woodland/ community/ plant/ composition
Abstract: Vegetal composition was determined during 1974 and 1984 using 60 permanent 50 m² plots within a mature pinyon-juniper community in northeastern Utah [USA]. Results indicated that not only was there little significant change in community composition, but with

many species frequency and density remained nearly the same during the decade

7. Badenhop, M B. Effects of changes in selected factor prices on the cost of growing pfitzer junipers. *Tennessee Farm and Home Science*. 1979; 10920-21.
Keywords: *Juniperus*/ pfitzer juniper/ cost analysis / budgets
Abstract: Enterprise budgets showing the inputs required and costs for producing selected woody ornamentals have been developed under the S.103 regional research project. This paper shows the effect of changes in factor prices (land, capital and labor) on plant cost. It is illustrated by a comparative cost analysis for growing pfitzer junipers using partial budgeting. Changes in factor prices on total cost per saleable plant are detailed. Technical coefficients were held constant and factor prices were varied separately.

8. Bader, Nicholas E. Pollen analysis of death valley sediments deposited between 166 and 114 ka. *Palynology*. 2000; 2449-61.
Keywords: *Juniperus*/ palynomorph/ fossil/ pollen/ *Quercus*/
Chenopodiaceae/ *Amaranthus*/ *Ambrosia*/ Death Valley
Abstract: Salt Core DV93-1, from Badwater Basin in California's Death Valley, is a nearly complete sedimentary record of mud and evaporite deposits spanning the past 192 ka. Fossil palynomorph assemblages from core depths of 151.8 m (ca. 166 ka) to 103.5 m (ca. 114 ka) have been analyzed as part of a larger study which will eventually include all of core DV93-1. The palynological analysis discussed here reveals four pollen zones between 151.8 m and 103.5 m. Zone 1, the "Cheno-Am" zone (151.8 m to 143.5 m depth, 166-154 ka), has high percentages of *Chenopodiaceae*/*Amaranthus* (Cheno-Am) pollen, and is correlative with the end of marine Oxygen Isotope Stage (OIS) 7. Zone 2, the juniper zone (143.5 m to 117.3 m, 154-124 ka), correlates with OIS 6, as evidenced by high percentages of juniper (*Cupressaceae*) pollen and low percentages of *Ambrosia* pollen. Equivalent pollen assemblages are found at higher elevations in Death Valley today, where temperatures are 11 ° C cooler and rainfall is eight times greater. At the top of Zone 2 (124 ka), a simultaneous drop in juniper and increase in oak (*Quercus*) pollen occurs, followed by a replacement of *Artemisia* with *Ambrosia* in Zone 3, the oak zone. This event corresponds to warming associated with Termination II. The estimated age of this warming event is in agreement with the Termination II event visible in the pollen record from nearby Owens Lake (Litwin et al., 1997). Zone 4, the *Asteraceae* zone (108.8 m to 103.5 m, 119-115 ka), contains higher percentages of *Asteraceae* and Cheno-Am pollen, indicating further warming during this time.

9. Baker, M. B. Jr. Changes in streamflow in an herbicide-treated juniper watershed in Arizona. *Hydrology and Water Resources in Arizona and the Southwest*. 1982; 1219-25.
Keywords: *Juniperus*/ soil water balance/ deforestation/ crops.

Abstract: A 147-ha juniper watershed in north-central Arizona was sprayed with a herbicide mixture to kill all overstory vegetation. After the area was sprayed, annual water yield increased significantly when flow was greater than 12 mm. The ratio of mean annual quick flow to event flow prior to treatment was 0.88 and remained essentially the same after treatment. The herbicide treatment reduced evapotranspiration losses and increased water yield by killing the overstory trees and leaving them in place. These dead trees provided some shade and wind resistance and created a microclimate that reduced evaporation and enabled the soil below 30 cm to remain above its soil moisture wilting point. Although mean annual water yield increased by 27% (6 mm, 8-year mean), this increase may not be practical from a management view point. The amount of treated acreage will depend on the demand for water and on the value of water in the market place. The area treated will also be constrained by consideration of other resource values and desires of the public.

10. Baker, W. L. and Shinneman, D. J. Fire and restoration of pinon-juniper woodlands in the western United States: a review. *Forest Ecology and Management*. 2004; 189(1/3):1-21.

Keywords: *Juniperus*/ pinyons/ *Pinus edulis*/ environmental assessment/ grasslands.

Abstract: Pinyons and junipers, that dominate many semi-arid landscapes in the western United States, have invaded some sagebrush and grassland areas and possibly increased in density since EuroAmerican settlement. Exclusion of fire by livestock grazing and intentional suppression is thought to have been a cause of these changes. National assessments suggest that many woodlands have missed one or more low-severity surface fires and are thus in poor condition, requiring restoration. We undertook a systematic review of seven questions about fire history, fire severity, and the role of fire in these woodlands to evaluate the scientific basis for the national assessment. First, unless pinons and junipers record fire by means of fire scars, it will be difficult to reconstruct fire history. Evidence suggests that most species of pinons and junipers can record fire by means of scars, but scars may be uncommon or absent in some cases and common in others. This variability in scarring has competing explanations that are poorly substantiated. Second, evidence exists for at least three modes of low-severity surface fires in these woodlands: (1) spreading surface fires, (2) patchy surface fires of small extent, and (3) an absence or near absence of surface fires. Methodological problems limit our ability to assess how common each mode is, but spreading, low-severity surface fires were likely not common. Third, there are no reliable estimates of mean fire intervals for low-severity surface fires in these woodlands because of methodological problems. Fourth, fires can kill small trees in true savannas and grasslands, helping to maintain a low tree density, but in most pinon-juniper woodlands low-severity surface fires do not consistently lower tree density and may become high-severity fires. Fifth, nearly all observed fires since EuroAmerican

settlement in these woodlands were high-severity fires. In only two studies is there sufficient information to allow a conclusion about whether high-severity fires have or have not increased since settlement, and in these cases the authors conclude they have not. Sixth, the fire rotation for high-severity fires is estimated in only two studies, 400 years in one case, 480 years in the other. Finally, fires may in some cases burn with mixed severity. In conclusion, national fire plans and assessments of the condition and health of pinon-juniper woodlands in the western United States are based on premature and likely incorrect conclusions about the natural fire regime in pinon-juniper woodlands. Local research is essential, at the present time, if effective, scientifically based restoration prescriptions are to be derived.

11. Balda R. P. and Masters N. Avian communities in the pinyon-juniper woodland: a descriptive analysis. US Forest Service, Intermountain Forest and Range Experiment Station, General Technical Report. (INT-86). 1980. 146-169.
In Workshop Proceedings, Management of Western Forests and Grasslands for Nongame Birds, February 11-14, 1980, Salt Lake City, Utah (R. M. DeGraff and N. G. Tilghman, Compilers). 1980; INT-86:146-169.
Keywords: *Juniperus/ Pinus/* avian/ birds/ ecology/ plant communities/ arid regions.
Abstract: The expansive range and elevational distribution of the pinyon-juniper woodland in the western United States contributes to the wide variety of forms of this habitat type. Similarly, the breeding-bird community expresses this variety. A total of at least 73 different bird species are known to breed here. About 31 of these species breed with regularity in pinyon-juniper woodlands. Only about 5 of these species are restricted to this habitat type. Usually less than half of the breeders are permanent residents. A high proportion of the breeding birds forage for seeds or insects on the ground. The number of species that breed in cavities and/or forage on trunks and branches is positively correlated with pinyon pine density. Seasonal densities of breeding birds vary greatly depending on annual fluctuations in precipitation and seed and berry production. Winter diversity and density is strongly correlated with juniper berry production. Both junipers and pinyons.
12. Behrens, V and Buenemann, G. Cold storage of unrooted coniferous cuttings I. Pretreatments and packing. *Gartenbauwissenschaft*. 1985; 50(4):161-169.
Keywords: *Juniperus/ Chamaecyparis lawsoniana/ Taxus/ Picea glauca/* cuttings/ rooting/ pretreatments
Abstract: The influence of a four month storage of unrooted cuttings of 10 different conifer species and cultivars was investigated. Furthermore, the preparation and packing of the cuttings before storage was examined. The cuttings were stored from the middle of November until the end of February in a jacketed cold store at a temperature of -2° C. The percentage of well rooted cuttings in June served as the criterium for

judging the influence of the treatments. Those cuttings grew to liners normally. Only the easy to root cultivars of *Chamaecyparis pisifera* and *Thuja occidentalis* could be stored without problems for 4 months. A prestorage treatment with fungicide and rooting hormones was of benefit. It was slightly better for some species when applied after storage (*Chamaecyparis lawsoniana*, *Taxus* .times. media). Cultivars which are susceptible to fungal attack (*Picea glauca* 'Conica' and cultivars of *Juniperus*) could be sufficiently protected by a combined hormone and fungicide treatment of the base of the cuttings; a fungicide treatment of the whole cutting was not advantageous. On the other hand, particular attention had to be paid to hygiene in those cuttings during rooting. The cuttings of the various species reacted differently to being stored in sealed plastic bags. Storage in perforated plastic bags would appear to be the best compromise, because in this case gas exchange is possible and a reduced transpiration is attained. Antitranspirants were not very effective. The cuttings should not be bundled or tightly packed in the store. This would lead to fungal attack and a lower rooting percentage. Cold storage resulted in breaking of dormancy. This could have influenced the rooting capacity, especially where the cuttings made shoot growth before rooting. Possibilities of preventing this are discussed. In principle it is possible that the storage of conifer cuttings can be worked into the propagation program.

13. Bertoldi, Remo. Pre-holocene and holocene palynological outlines of Western Padania. *Allionia* (Turin). 1996; 34(O):137-147.
Keywords: *Juniperus/ Ephedra/ Artemisia/ Hippophae/ Italy/ Betula/ Abies/ pollen/ Pleistocene/ Pliocene*
Abstract: Little is known about the primitive vegetal colonization of Western Padania. Recent palynological researches have provided evidences of the vegetation of the Western Po valley during the Lower and Middle Pliocene, however there is a large gap in the history of the vegetation from this time to the end of Pleistocene. To outline the vegetational history of this long period several deposits, embracing the entire Late- and Postglacial and backed by absolute 14 Carbon datings, were chosen as standard pollen diagrams in the oldest Dryas the landscape was dominated by an *Artemisia* steppic formation, with *Gramineae*, scattered *Ephedra*, *Juniperus* and *Hippophae* shrubs, and single or local groups of pine and birch trees. All the lateglacial and postglacial periods following the oldest Dryas show the dominance or predominance of arboreal over non-arboreal plants. Pollen analysis also offers a picture of the dynamics of forest during these periods and allows to understand the pattern of migration and diffusion into the Po Valley; this was usually from East to West for the majority of species, whereas *Betula* and *Abies* moved in the opposite direction. Hypotheses on the probable glacial refuges for these two last species are suggested.
14. Bhattacharyya, A. Vegetation and climate during the last 30000 years in Ladakh

India. *Palaeogeography Palaeoclimatology Palaeoecology*. 1989; 73(1-2):25-38.

Keywords: *Juniperus* / pollen / India

Abstract: Pollen analysis was carried out from a 23 m core dating from about 30,000 to 9000 yr B.P. from the alpine Tsokar lake about 4572 m above sea level in Ladakh, Trans-Himalayan Region. This study reveals the continuation of the alpine steppe with four periods of expansion of *Juniperus* communities during 28,000-30,000 yr B.P., 21,000-18,375 yr B.P., slightly before 15,800 yr B.P. and at 10,000 yr B.P. These phases of *Juniperus* expansion were interpreted as events of amelioration of climate within the alpine steppe during the later part of the last (Weichselian) glaciation in the Alpine Trans-Himalayan Region.

15. Björse, Gisela Reprint author; Bradshaw, Richard H. W. Reprint author, and Michelson, Daniel B. Author. Calibration of regional pollen data to construct maps of former forest types in southern Sweden. *Journal of Paleolimnology*. 1996; 16(1):67-78.

Keywords: *Juniperus*/ pollen/ Sweden/ *Alnus*/ *Betula*/ *Carpinus*/ *Corylus*/ *Fagus*/ *Fraxinus*/ *Picea*/ *Pinus*/ *Populus*/ *Quercus*/ *Salix*/ *Tilia*/ *Ulmus*

Abstract: A method was developed to construct maps of former forest types based on regional pollen data in southern Sweden. The considered species were *Alnus*, *Betula*, *Carpinus*, *Corylus*, *Fagus*, *Fraxinus*, *Juniperus*, *Picea*, *Pinus*, *Populus*, *Quercus*, *Salix*, *Tilia* and *Ulmus*. A network of 37 regional pollen sites with high data quality from lakes and peat deposits were selected from Sweden south of 60 ° N. Pollen percentage values were calculated and converted into estimates of tree composition. For controlling the reliability of the reconstruction, the estimates from the core-tops were compared with present day forest inventory data, and local pollen diagrams were compared with the regional pollen diagrams. An inverse distance weighted interpolation algorithm was used to generate maps for each tree species distribution at 2000 BP, 1500 BP, 1000 BP, 500 BP and 0 BP. A supervised classification routine was implemented to generate nine different forest types common to the five studied time intervals. The maps show that the amounts and patterns of distribution of the species and the forest types have varied in a significant but systematic manner through time. The changes are due to human activities, migrational patterns and changes in climate. These maps will be of value as a basis for future landscape planning, forestry and conservation of biodiversity.

16. Bohncke, S.; Wijmstra, L.; Van Der Woude, J., and Sohl, H. The late-glacial infill of three lake successions in the Netherlands regional vegetational history in relation to northwest European vegetational developments. *Boreas* (Oslo). 1988; 17(3):385-402.

Keywords: *Juniperus*/ Netherlands/ *Hippophae*/ autecology/ pollen

Abstract: Pollen analyses of three late Weichselian Late-Glacial lake

sediment successions provided a basis for the construction of pollen assemblage zones for The Netherlands. Special attention is paid to the behaviour of *Populus* in the Allerod boreal forest. Some aspects of the autecology of *Juniperus* and *Hippophae* and the dynamics of birch and pine forests are discussed in the light of the observed succession. The Late-Glacial vegetational succession in The Netherlands is compared with data published for neighboring NW European countries. It is concluded that differences in precipitation (snow cover) along a west-east transect to a great extent determined the inferred differences in vegetational development.

17. Borghesio, L.; Giannetti, F.; Ndang'ang'a, K., and Shimelis, A. The present conservation status of *Juniperus* forests in the South Ethiopian Endemic Bird Area. *African Journal of Ecology*. 2004; 42(2):137-143.
Keywords: *Juniperus*/ Ethiopia/ Endemic Bird Area/ conservation
Abstract: Field survey data and Landsat satellite imagery were used to evaluate the conservation status of two *Juniperus* forests (Mankubsa and Arero) in the south Ethiopian Endemic Bird Area. Forest cover and dense woodland decreased in both areas between 1986 and 2002, but rates of habitat change and human impact were greater at Mankubsa than at Arero. We suggest that at Mankubsa increased grazing pressure, agricultural expansion, commercial fuelwood and timber exploitation are threatening forest persistence, while most of the degradation at Arero is because of the grazing of domestic animals. Conservation efforts should focus on creating tree plantations and improving forest resource use efficiency at Mankubsa, while at Arero better results could be obtained by improving pasture quality in the habitats surrounding the forest.
18. Bortenschlager, S. Aspects of pollen morphology in the *Cupressaceae*. *Grana*. 1990; 29(2):129-138.
Keywords: *Juniperus*/ *Cupressaceae*/ pollen/ *Callitris*/
Chamaecyphris/ *Cupressus*/ *Libocedrus*/ *Thuja*/ *Thujopsis*
Abstract: The pollen grains of seven genera in the *Cupressaceae* were examined by means of light and scanning electron microscopy. The pollen is spheroidal, intectate, monoporate and scabate, microverrucate to microgemmate. The uniformity of the pollen morphology supports the systematic unity of this family. The single pore with an annulus and the sexinous elements (orbicules) are here considered as the characteristic traits. A further subdivision at the generic or sectional level, based on pollen morphology, is impossible. [The 7 genera were the following: *Callitris*, *Chamaecyphris*, *Cupressus*, *Juniperus*, *Libocedrus*, *Thuja*, and *Thujopsis*.].
19. Botman, K. S. Penetration of precipitation below the canopy of Juniper forest. *Lesnoe Khozyaistvo*. 1974; 744-47.
Keywords: *Juniperus*/ canopy/ precipitation/ Central Asia
Abstract: Gives results of measurements of through fall and stemflow

from April to Nov. in 1967-70 in Central Asian Juniper forests of varying canopy density and age. Mean through fall was calculated as 73.2%, and this gave excellent agreement with measured values. Stemflow was only 0.65%. The variation of through fall with intensity of rainfall and with stand density is described, and the pattern of through fall below the crown in relation to wind direction is plotted. Estimates are made of the water-holding capacity of the litter, and of the water-regulating role of these montane Juniper forests in general.

20. Bozilova, E. D. and Tonkov, S. B. E-mail bozilova@biofac. uni-sofia. bg. Pollen from Lake Sedmo Rilsko reveals southeast European postglacial vegetation in the highest mountain area of the Balkans. *New Phytologist*. 2000 Nov; 148(2):315-325.
Keywords: *Juniperus/ Pinus/ Acer/ Fagus/ Quercus/* Holocene/ Bulgaria/ pollen
Abstract: A lacustrine sequence from Lake Sedmo Rilsko (altitude 2095 m) in the northwest of Rila Mountain, Bulgaria, was analyzed on the basis of 84 pollen spectra and three ¹⁴C accelerator mass spectrometry dates. The lower part of the sequence (413-530 cm) corresponds to the Late-glacial. Three phases, two stadial and one interstadial, are characterized by the dominance of mountain-steppe herb vegetation composed of *Artemisia*, *Chenopodiaceae* and *Poaceae*, with single trees of *Pinus* and shrub land of *Juniperus* and *Ephedra*. The identification of pollen grains of *Abies*, *Quercus robur*-type, *Corylus*, *Acer*, *Fagus* and other mesophilous trees suggests that they survived the harsh Late-glacial conditions in refuges below an altitude of 1000 m, where moisture was sufficient for their growth. In the early Holocene period, *Betula* forests at high altitudes and, below them, closed deciduous forests with *Quercus*, *Tilia*, *Ulmus* and *Corylus*, occurred from 11800 until approx. 6700 cal. BP. The formation of the coniferous belt dominated by *Pinus sylvestris*, *Pinus peuce* and *Abies alba* lasted from between 6700 and 5000 cal. BP. The forest dynamics in the Subboreal and the Subatlantic ended with the invasion of *Fagus sylvatica* and *Picea abies* after approx. 4500 and 3300 cal. BP, respectively. Indications of anthropogenic activities, expansion of agriculture in the lowland foothills, and livestock grazing in the mountain meadows and pastures, are clearly evident from the pollen diagram from 2400 cal. BP onwards.
21. Brauning, A. Climate history of the Tibetan plateau during the last 1000 years derived from a network of juniper chronologies. *Dendrochronologia*. 2001; 19(1):127-137.
Keywords: *Juniperus/* Tibet/ climate history
Abstract: A network of 15 *Juniperus* chronologies has been developed in eastern Tibet. The sampling locations cover a wide range of different climatic conditions from the moist eastern and southern fringes of the Tibetan plateau to the semiarid part of southern central Tibet. The time-span of the ring width chronologies varies between 230 and more than

1500 years, seven chronologies cover more than 700 years. Due to the position of eastern Tibet at the northwestern margin of the influence of the Indian summer monsoon, some chronologies show both high correlation coefficients to rainfall deviations over India as well as to the Eurasian snow cover in winter, the latter being a crucial factor in controlling the strength of the monsoon circulation in the following summer. Therefore they are a link between the circulation system of the northern latitudes of Central Asia and the subtropical monsoon circulation. Moreover, these chronologies provide a basis for dating historical buildings in central Tibet which contain juniper wood. This offers the possibility to extend the existing tree-ring series to a length of approximately 2000 years.

22. Breshears, David D. Reprint author; Rich, Paul M. Author; Barnes, Fairley J. Reprint author, and Campbell, Katherine Reprint author. Overstory-imposed heterogeneity in solar radiation and soil moisture in a semiarid woodland. *Ecological Applications*. 1997 Nov; 7(4):1201-1215.
- Keywords:** *Juniperus*/ solar radiation/ biomass/ New Mexico/ pinyon-juniper woodlands
- Abstract:** Degradation of semiarid ecosystems is a major environmental problem worldwide, characterized by a reduction in the ratio of herbaceous to woody plant biomass. These ecosystems can be described as a set of canopy patches comprising woody plants and the intercanopy patches that separate them, yielding an overstory with intermediate closure. Field measurements of microclimate at the scale of canopy patches, particularly for near-ground solar radiation and soil moisture, are largely lacking from both nondegraded and degraded ecosystems. We tested for relationships among spatial patterns of the overstory, near-ground solar radiation, and soil moisture in a semiarid pinyon-juniper woodland in northern New Mexico that had a highly heterogeneous overstory (approx 50% canopy cover) and was not degraded with respect to ground cover and erosion rates. We used measurements taken every 1 m along a 102-m transect-solar radiation indices were estimated monthly and annually using hemispherical photographs, and soil moisture was measured over 4 yr using time-domain reflectometry (TDR)-and analyzed the data using general least squares linear models that accounted for spatial autocorrelation and temporal heteroscedasticity. Time-averages of solar radiation and of soil moisture both were spatially autocorrelated at scales of up to 4 m ($P < 0.05$), corresponding approximately to the average lengths of both canopy and intercanopy patches and to the scale of spatial autocorrelation in the canopy/intercanopy pattern of the overstory (3 m; $P < 0.05$). For near-ground solar radiation, we found expected spatial variation between patches (canopy < intercanopy; $P < 0.0001$) and within patches for centers vs. edges (canopy center < canopy edge and intercanopy center > intercanopy edge; $P < 0.0001$) and for north vs. south edges (canopy north edge < canopy south edge and intercanopy south edge < intercanopy north edge; $P < 0.0001$). For soil moisture, canopy locations were significantly drier than intercanopy locations ($P <$

0.0001), and edge locations were significantly wetter than center locations both overall and within both patch types ($P < 0.0001$). Spatial heterogeneity in soil moisture was attributed primarily to canopy interception and drip on the basis of large differences in snow cover between canopy and intercanopy locations. Spatial autocorrelation in the residuals for soil moisture of up to 7 m was attributed to transpiration by woody plants at scales corresponding to belowground root distributions. The spatial heterogeneities in near-ground solar radiation and soil moisture are of sufficient magnitude to affect biotic processes of woody and herbaceous plants, such as growth and seedling establishment. Because land degradation problems in semiarid shrublands and woodlands appear to result from differential impacts to intercanopy vs. canopy patches, our results can be used to help design effective mitigation and remediation strategies. More generally, our results demonstrate how the physical presence of woody canopies reinforces spatial heterogeneity in microclimate and, because our site has intermediate closure of the overstory, bridge the gap along a grassland-forest continuum between related studies in relatively open savannas and in forests with nearly closed canopies.

23. Brock, J. H. Control of juniper in north-central Arizona using tebuthiuron, hexazinone and picloram herbicides. *Proceedings of the Western Society of Weed Science*. 1985; 168.

Keywords: *Juniperus*/ herbicide/ tebuthiuron/ picloram/ hexazinone/ mortality

Abstract: In a study of herbicide rates for use in brush management ranging from maximal control to suppression to provide fuel for later prescribed burning treatments on a range site in Arizona infested with juniper following chaining 20 years previously, 0.25-4.0 kg pelleted tebuthiuron or picloram was broadcast or hexazinone was placed in a grid pattern on 15 x 30 m plots. Mortality was estimated 18, 30 and 42 months later. Canopy reduction was in the range 1-95%. Mortality ranged from about 90% with 4.0 kg tebuthiuron/ha to no mortality on plots receiving picloram in 2% a.i. pellets. Herbicides and rates of application which would provide high mortality or suppress brush growth were identified.

24. Buckhouse J. C. Water quality impact of burning and grazing on a chained pinyon-juniper site in south-eastern Utah. *Dissertation Abstracts International*, B. 1975; 36(1):28-29.

Keywords: *Juniperus*/ *Pinus*/ water quality/ burning/ infiltration

Abstract: In 1973-4 water quality was investigated at a site which had been double chained 6 years earlier and the debris left in place or the debris windrowed and with burning and grazing treatments imposed in autumn 1973 and spring 1974. Run-off K and P contents were increased by burning. Infiltration rates were not affected by chaining possibly due to the lapse of the time since the treatment, but grazing and burning decreased infiltration.

25. Buckhouse J. C. and Gifford G. F. Sediment production and infiltration rates as affected by grazing and debris burning of chained and seeded pinyon-juniper. *Journal of Range Management*. 1976; 29(1):83-85.
Keywords: *Juniperus/ Pinus/* infiltration/ sediment/ rainfall/ grazing/ woodland
Abstract: Rates of sediment production and infiltration obtained in 1973 with simulated high-intensity rainfall on pinyon-juniper plots chained in 1967 with the debris windrowed or left in place and protected from grazing did not differ significantly between treatments or from undisturbed woodland. In 1974 after the windrowed plots had been grazed and those with debris left in place burned, infiltration rates were lower on grazed plots, apparently as the result of trampling, than in adjacent woodland and lower still on burned plots.
26. Burga, Conradin A. Reprint author and Egloff, Manuela Author. Pollen analytic investigations to the vegetation and climate history of Pustertal-Sarntal (Southern Tyrol, Italy). *Berichte Des Naturwissenschaftlich-Medizinischen Vereins in Innsbruck*. 2001 Oct; 88:57-86.
Keywords: *Juniperus/ Pinus/ Betula/ Fagus/ Carpinus/ Fraxinus/ Castanea/ Juglans/ Picea/ Larix/* pollen/ Italy/ Holocene
Abstract: In the lower part of Pustertal region and the northern Sarntal Alps (Southern Tyrol/Trentino-Alto Adige, Italy) two peat bog profiles (Astalm 1955 m a.s.l. and Penser Joch 2230 m) have been investigated pollen analytically. The main steps of the late-glacial and holocene flora and forest history are as follows: Oldest Dryas: Pioneer, steppe and tundra vegetation with kryocratic and protocratic taxa like *Artemisia*, *Chenopodiaceae*, *Rumex/Oxyria*, *Helianthemum*, *Saxifraga oppositifolia*, *Thalictrum*, *Plantago alpina*, *Poaceae* and *Ephedra*. Bolling: Steppe, tundra, pioneer shrubs (*Hippophae*, *Juniperus* and *Salix*) and first trees (*Pinus* und *Betula*) up to 1400 - 1500 m a.s.l. Transition Bolling/Allerod and Allerod: Reforestation up to ca. 1900 m a.s.l. or higher with *Betula*, *Pinus sylvestris/mugo*, *P. cembra* and *Larix*. Younger Dryas: Revival of the kryocratic and protocratic species, especially of *Artemisia*. Lowering of the tree limit of about 200 m related to the former position during the Allerod. Preboreal (first part): In the hill belt and the lower montane belt developed mixed oak forest with *Corylus*, whereas in the subalpine belt coniferous forests of *Pinus cembra*, *Larix* and *Pinus mugo* with a position of the forest line in ca. 2100 m a.s.l. occurred. *Picea* immigrated in the low land around Bozen. Preboreal (second part): Immigration of spruce into the subalpine belt and recession of pioneer and grassland species. End of Preboreal, Boreal, Older Atlantic (beginning): Mixed oak forest and *Corylus* reached their widest range, whereas spruce dominated in the subalpine belt. During the Boreal, *Alnus viridis* immigrated and more long-distance pollen transport of *Abies* and *Fagus* has been noted. Older Atlantic, Younger Atlantic, Subboreal (middle): During the Older Atlantic, *Abies* and *Fagus* immigrated in the Eisack valley; *Picea* reached its widest range, whereas the *Larix-Pinus cembra*-forest has been reduced. During

the Younger Atlantic and at the transition to the Subboreal, the spread of silver fir and a recession of spruce have been recognized. Subboreal (middle) - Older Subatlantic (beginning): In the hill and the montane belt occurred the main spread of *Carpinus*, *Fagus* and *Fraxinus*. At the end of the Subboreal, more intensified anthropogenic impacts on the vegetation (lowering of the forest line) have been recognized. Older Subatlantic: More intensified forest clearings and widest spread of *Alnus viridis*, whereas *Picea* is still dominant. During Roman times and Middle Ages, *Castanea* and *Juglans* have been introduced. Younger Subatlantic: Change of the dominance from *Picea* to *Pinus*; more indicators of forest clearings, pastures, ruderal and cultivated plant species (*Cerealia*, *Zea mays*). During the Mid-Holocene, the position of the tree limit was approximately 50 - 100 m higher than its present potential position. The profile of Astalm gives clear evidence to the holocene Piora-/Rotmoos cold phases I and II, whereas the Goschenen cold phases I and II show an overlap with anthropogenic impacts. Activities of first humans are shown by mesolithic and neolithic evidence (archaeologic finds, pollen records). In the profile Astalm, three clearing phases (late Bronze Age/ early Iron Age, Roman times and early Middle Ages/modern times) have been recognized.

27. Campbell R. B. Jr; Monsen S. B., and Stevens R. Ecology and management of pinyon-juniper communities within the Interior West: overview of the "Ecological Restoration" session of the symposium. Proceedings Rocky Mountain Research Station, USDA Forest Service. (RMRS-P-9). 1999; RMRS -P -9271-277.
Keywords: *Juniperus/ Pinus edulis/* woodlands/ restoration
Abstract: Restoration of pinyon and juniper landscapes is a complex subject. Notable strides made during the past decade provide information to restore many sites. An array of treatments and plant materials are available for restoration of a variety of sites and plant associations. Restoration will not be successful without commitment and proactive treatments on a broad scale. This session included oral papers, poster presentations, and portions of an informative field trip. A total of 29 presentations are summarized, emphasizing the general areas of site selection, treatments, and species composition and selection.
28. Carpenter C. and Zomer R. Forest ecology of the Makalu-Barun National Park and Conservation Area, Nepal. Mountain Research & Development. 1996; 16(2):135-148.
Keywords: *Juniperus/ Abies/ Quercus/* Nepal/ ecology/ forests
Abstract: Makalu-Barun National Park and Conservation Area, recently established by His Majesty's Government, Nepal, protects a broad range of Eastern Himalayan forest types, ranging from near-tropical dipterocarp monsoon forest (400 m) to subalpine conifer stands (4,000 m). Forests span five bioclimatic zones (tropical, subtropical, lower and upper temperate, and subalpine), but ecotones are poorly defined. Below 2,000 m forests are strongly affected by subsistence agriculture, although some

ecologically significant stands remain at those elevations. Above 2,000 m, a cool, humid climate suppresses agricultural activity and forests are usually extensive. An interesting transition occurs in the temperate zone from forests dominated by broadleaf evergreen (*Quercus-Lauraceae*) to broadleaf deciduous (Acer-Magnolia) taxa. Subalpine stands show an increased dominance by conifers (*Juniperus*, *Abies*) along a transect from outer, southern slopes to the inner valleys. Aspect is ecologically important at all elevations, but controls different ecological variables (seasonal moisture availability, temperature, snow cover) at different elevations. The Makalu-Barun area exhibits the high regional diversity expected of a physiographically complex, low-latitude mountain region.

29. Carrion, J. S. Reprint author; Riquelme, J. A. Author; Navarro, C. Author; Munuera, M. Author, and E-mail: carrion@um.es]. Pollen in hyaena coprolites reflects late glacial landscape in southern Spain. *Palaeogeography Palaeoclimatology Palaeoecology*. 176(1-4). 25 December, 2001. 2001; 176(1-4):193-205.
Keywords: *Juniperus*/ pollen/ hyaena coprolites/ Spain
Abstract: The presence of coprolites and bone remains of spotted hyaena (*Crocuta crocuta*) together with bone remains of alleged preys in Las Ventanas Cave (Granada) indicates that the spotted hyaena persisted in southern Spain until the Lateglacial. Pollen analysis of hyaena coprolites is used in conjunction with existing pollen records to improve our picture of the vegetation in the region at c. 12 780 cal yr BP. Although many coprolites were sterile, 10 of them showed good pollen preservation, relatively high pollen concentration and diversity of both herbaceous and arboreal types. Because of the relatively high pollen concentration of several coprolites, it is postulated that pollen is largely incorporated into the coprolite through the stomach contents of plant-consuming prey. Dietary behaviour does not preclude palaeoenvironmental reconstruction. The coprolite pollen record compares closely with pollen spectra from lateglacial sediments in the adjacent Carhuela Cave and other regional pollen records. It depicts a mosaic landscape comprising pine forests, steppes of *Artemisia* with juniper, and grassland. Lower frequencies of *Quercus*, *Betula*, *Abies*, *Corylus*, *Alnus*, *Acer*, *Taxus*, *Myrtus*, *Olea*, *Pistacia*, *Ephedra fragilis*, and *Rhamnus*, among others, suggest that oak forests with temperate trees and thermo-Mediterranean scrub persisted in less continental situations of the Betic cordilleras.
30. Catanzaro C. J.; Skroch W. A., and Henry P. H. Rooting performance of hardwood stem cuttings from herbicide-treated nursery stock plants. *Journal of Environmental Horticulture*. 1993; 11(3):128-130.
Keywords: *Juniperus*/ nursery/ herbicides/ cuttings
Abstract: Bed-grown nursery stock was treated with preemergence herbicides semiannually for 3 years at maximum label use rates. Herbicides included Devrinol, Pennant, Ronstar, Southern Weedgrass Control, Surflan, Treflan, Ornamental Herbicide 2, Rout, and XL.

Hardwood cuttings were taken after two and four herbicide applications ('Nellie R. Stevens' holly), or after two and six applications (shore juniper, Pfitzer juniper, glossy privet). Herbicides did not affect rooting of cuttings or growth of stock plants of the taxa tested.

31. Catling P. M.; Freedman B., and Lucas Z. The vegetation and phytogeography of Sable Island Nova Scotia Canada. Proceedings of the Nova Scotian Institute of Science. VII-VIII. 1984; 34(3-4):182-249.

Keywords: *Juniperus*/ Canada/ vegetation

Abstract: Sable Island is a crescent-shaped emergent sandbar 42.5 km long 1.4 km wide, occupying 3400 ha and located about 160 km east of the Nova Scotia mainland. Since at least 1505, the island has been treeless with low herb and shrub cover, and with erosion and shifting sand. Substrates are alkaline or acidic sand, with very little organic matter and low levels of nutrients. Wetland and aquatic habitats are either acidic or brackish with high sodium levels. The climate is maritime and moderate, with relatively little snow cover, high average wind speeds, and less sunshine than on mainland sites. It is possible that a larger precursor of Sable Island was unglaciated during the Wisconsin epoch, and acted as a refugium for flora and fauna. Introduction of livestock and settlement have undoubtedly influenced the vegetation, but the effects are not easily assessed. Other biotic factors including the occurrence of bird colonies and pollinator availability have probably also affected floristic composition. Erosion has apparently increased recently, and both the size of the island and the total area of vegetation have decreased. Periodic connections between many inland pools and the sea have resulted in changes favoring halophytes and/or depauperate vegetation. The vegetated terrain of the island accounts for approximately 40% of the land surface of 3425 ha. Several distinctive plant communities were identified, described, and mapped. These include (i) a community dominated by *Honckenya peploides* comprising 0.6% of the island surface; (ii) Marram-Forb grasslands dominated by *Ammophila breviligulata*, *Lathyrus maritimus*, *Achillea lanulosa*, and *Solidago sempervirens* comprising 8.7% of the island; (iii) sparse grasslands, comprising 22.5%, within which two types are readily discernable. Marram Grasslands are dominated by *Ammophila breviligulata*, while Marram-Fescue grasslands also have abundant *Anaphalis margaritacea*, *Festuca rubra*, *Fragaria virginiana*, *Myrica pensylvanica* and *Rosa virginiana*; (iv) Shrub Heath vegetation is dominated by *Empetrum nigrum*, *Juniperus communis*, *Myrica pensylvanica*, *Rosa virginiana*, and *Vaccinium angustifolium*, with many other species as well as lichens and bryophytes also present; and (v) Cranberry Heath communities dominated by *Vaccinium macrocarpon*. The two heath communities together cover a 4.3% of the island. In terms of plant association these Heath communities appear quite different from mainland communities, and they deserve protection and further study. Freshwater pools with pH 5.0-5.7 have *Potamogeton epihydrus*, *P. oblongus*, *Polygonum hydropiperoides* var. *psilostachyum*,

Myriophyllum tenellum, and *Fontinalis sullivantii*. Such ponds cover 0.8% of the island. Pond edge communities are dominated by a variety of forbs, graminoids and bryophytes. Brackish ponds cover 1.5% of the island surface. Characteristic submersed species include *Zostera marina*, *Ruppia maritima* and *Potamogeton pectinatus*. Shallower water and edges have dense swards of *Eleocharis parvula*. Various halophytic forbs and graminoids occur along the pool edges. Circumstantial evidence based largely on the locations of different vegetation types, and patterns of sand deposition, suggests a succession from Marram-dominated communities to Marram-Fescue, and with lessening sand accumulation to Shrub Heath. This sere can be reversed by increased rates of sand deposition. It also appears that there is a succession from brackish to freshwater vegetation in ponds without recent influence of the sea. Approximately 63% of the native island flora of 154 is characteristic of the general region, while 16% is boreal in affinity, 5% is southern, 2% is amphi-atlantic, and 9% is restricted. Three taxa are endemic. Of the restricted taxa, two (*Epilobium nesophilum* var. *sabulonense* and *Lathyrus palustris* var. *retusus*) were not found during our survey and are apparently extinct, while three (*Bartonia paniculata* var. *sabulonensis*, *Calopogon tuberosus* var. *latifolius*, and *Juncus pelocarpus* var. *sabulonense*) are rare on the island. Seventeen of the 19 s.

32. Chambers, Jeanne C.; Vander Wall, Stephen B., and Schupp, Eugene W. Seed and seedling ecology of pinyon and juniper species in the pygmy woodlands of Western North America. *Botanical Review*. 1999 Jan-1999 Mar 31; 65(1):1-38.

Keywords: *Juniperus*/ pinyon/ seedling/ seed

Abstract: Knowledge of the seed and seedling ecology of the pinyon and juniper woodlands of western North America is essential for understanding both the northward migration and expansion of the woodlands during the Holocene (<11,500 B.P.), and the accelerated expansion of the woodlands since settlement of the West by Anglo-Americans around 200 years ago. We follow the fates of seeds and seedlings of the different pinyon and juniper species within the woodlands from seed development to seedling establishment, and discuss the implications of this information for the past and present expansion of the woodlands. While seed development requires about two and one-half years in pinions, it is species-dependent in junipers and can take one, two, or even three years. Substantial seed losses can occur during seed development due to developmental constraints, and before or after seed maturation as a result of insects, pathogens, or predatory animals. In pinyon pines, the primary seed dispersers are scatter-hoarding birds (corvids) and rodents that harvest seeds from the trees or after seed fall and cache them in the soil. In contrast, most junipers appear to be dispersed primarily by frugivorous birds and mammals that ingest the seeds and defecate them onto the soil surface. We have recently documented that scatter-hoarding rodents also disperse juniper seeds.

Disperser effectiveness, or the contribution a disperser makes to the future reproduction of a plant population, may vary among species of pinions and especially junipers. Pinyon seeds are short-lived and exhibit little dormancy, and they probably only germinate the spring following dispersal. Juniper seeds are long-lived and seed dispersal can occur over one or more years. Seed germination can be delayed for several years due to impermeable seed coats, embryo dormancy, or the presence of inhibitors. Seedling establishment of pinyon pines is facilitated by nurse plants but, while junipers often establish beneath nurse plants, they are capable of establishing in open environments. In the southwestern United States, higher establishment of juniper occurs in open environments due to more favorable precipitation, and competition may be more important than facilitation in determining establishment. When considering the mechanisms involved in the past and present expansion of the woodlands, short-distance dispersal, local population growth, and long-distance dispersal are all important. Different classes of dispersers, some of which appear to have coevolved with the tree species, appear to be responsible for local (short-distance) vs. long-distance dispersal in pinions and junipers. Because ecotones form the interface between the woodlands and adjacent communities, they can provide valuable information on both the seed dispersal and seedling establishment processes responsible for tree expansion. Disturbance regimes and, recently, the effects of humans on those regimes have major effects on the expansion and contraction of the woodlands. Before Anglo-American settlement, fires occurred as frequently as every 50-100 years throughout much of the woodlands. During this century, fire frequencies have been reduced due to the indirect effects of livestock grazing and the direct effects of removing Native Americans from the ecosystem and implementing active fire-prevention programs. The result has been an increase in tree-dominated successional stages at the expense of grass-dominated stages. Various management techniques, including controlled burning and chaining, have been implemented to reduce tree dominance, but their effects depend largely on the life histories of the tree species and the disturbance characteristics. Several areas relating to the seed and seedling ecology of the pinyon and juniper require additional research if we are to truly understand the dynamics of the woodlands.

33. Christensen N. K.; Sorenson A. W.; Hendricks D. G., and Munger R. Juniper ash as a source of calcium in the Navajo diet. *Journal of the American Dietetic Association*. 1998; 98(3):333-334.
Keywords: *Juniperus*/ calcium/ ash/ Navajo
34. Chung-MacCoubrey, A. L. Monitoring long-term reuse of trees by bats in pinyon-juniper woodlands of New Mexico. *Wildlife Society Bulletin*. 2003; 31(1):73-79.
Keywords: *Juniperus*/ *Pinus*/ bats/ wildlife conservation; wildlife management.

Abstract: Information on long term reuse of tree roosts by forest-dwelling bats (*Chiroptera*) is needed to better understand their roost ecology and to manage their habitats more effectively. To examine long term reuse of tree roosts by bat colonies in pinyon-juniper woodlands (*Pinus edulis-Juniperus* spp.) in New Mexico, USA, 15 maternity roost trees were monitored with exit counts every 2-4 weeks for 2-4 summers from 1995-98. Although the use of trees within summers was intermittent, colonies reused trees an average of 75.0% of the summers they were monitored, suggesting long term fidelity to trees. Alternative methods for detecting summer roost use with less effort were evaluated with existing data. The first method focused sampling (1-2 exit counts) around the date the colony was present the prior year. The second method examined whether there was a 2-week period during the summer when exit counts were more likely to detect colonies. Neither of the alternative sampling schemes identified 100% of roosts that were reused. Exit counts performed during the 2-week period from 16-29 June resulted in the highest percentage of trees correctly identified as used (71.4+or-14.3%), suggesting that sampling effort may be reduced with the least impact on detection rates by monitoring trees when females are approaching parturition. Nonetheless, results also show that summer use of trees by bat colonies can be difficult to detect, greater levels of effort should be used whenever possible, and reuse rates determined by periodic exit counts should be considered conservative estimates.

35. ---. Use of pinyon-juniper woodlands by bats in New Mexico. *Forest Ecology and Management*. 2005; 204(2-3):209-220.

Keywords: *Juniperus*/ bats/ New Mexico

Abstract: In recent years, the demand has grown for information on how to conserve bat populations in forested ecosystems. Many researchers have responded with studies of bats in forests, but few have studied bat communities in arid-adapted forest types, such as pinyon-juniper woodlands, which are widespread and abundant throughout the west. In this study, I evaluated the relative use and importance of pinyon-juniper woodlands to bats in west-central New Mexico by comparing bats captured in pinyon-juniper woodlands with those captured in ponderosa pine forest. I compared species richness and relative abundance of bats captured in these vegetation types and evaluated the relative importance of each based on its use as reproductive habitat by females. Bats were mistnetted over stock tanks in pinyon-juniper woodlands for 55 nights during 1995-1997 and in ponderosa pine forest for 22 nights in 1998-1999. Although overall capture rates (bats per net hour) were not different between study sites, more species were captured in pinyon-juniper woodlands. The bat community of this pinyon-juniper woodland was dominated by species typically found in upper elevation forests, but also included species from lower elevation shrublands and grasslands. A greater proportion of females was reproductively active in pinyon-juniper woodlands than ponderosa pine, suggesting that females prefer woodlands

for rearing their young or that fecundity rates of females are higher in this vegetation type. Results of this study demonstrate that pinyon-juniper woodlands support abundant and diverse bat communities and provide important summer habitat to reproductive females. Thus, biologists and land managers should plan activities in pinyon-juniper woodlands with greater attention and consideration to bats and their habitat requirements.

36. Ciesla W. M. Juniper forests - a special challenge for sustainable forestry. *Forests, Trees and Livelihoods*. 2002; 12(3):195-197.

Keywords: *Juniperus*/ community involvement/ deforestation/ forest management.

Abstract: The genus *Juniperus* consists of 54 species distributed throughout the northern hemisphere and one African species extending its range deep into the southern hemisphere. Members of this genus range from prostrate shrubs to tall forest trees and produce many products of value to human societies. Many junipers are xerophytes and grow in arid and semi-arid climates unsuitable for establishment and growth of other trees. Case histories from juniper forests in Kenya, Krygyzstan, Morocco, Pakistan and the USA illustrate problems facing the world's juniper forests. Most juniper forests are fragile ecosystems. They are open grown; trees often have poor form; natural regeneration is sparse; and they are affected by damaging agents which are often not well understood. Moreover, they have endured long periods of heavy human use, primarily for grazing of livestock and gathering. Increasing human populations have put increased pressure on these ecosystems resulting in degradation and loss of forest area at accelerating rates. Several potential solutions to effective management and protection of juniper forests are identified. Prohibiting the cutting of junipers is difficult to enforce and is effective only if alternative sources exist. The involvement of local people who rely on the juniper forests is essential in the development of effective management and protection tactics. The establishment of plantations of faster growing trees near villages could provide alternative sources of wood products, reducing pressures on juniper forests. Periodic assessments are needed to monitor the status and health of juniper forests and a comprehensive programmed of research and technology transfer is needed to generate and implement new knowledge. Finally, an international network of people concerned with the management and protection of juniper forests is needed to facilitate the exchange of information on the status, management and protection of these fragile ecosystems.

37. Clary W. P.; Baker M. B. Jr.; O'Connell P. F.; Johnson T. N. Jr., and Campbell R. E. Effects of Pinyon-Juniper removal on natural resource products and uses in Arizona. USDA-Forest-Service-Research-Paper,-Rocky-Mountain-Forest-and-Range-Experiment-Station. (RM-128). 1974; RM-128(II):28 pp.

Keywords: *Juniperus*/ *Pinus*/ management/ economics/ chemicals/

hydrology.

Abstract: Reviews experiments on several catchment areas in Beaver Creek, Arizona, to study the effects on water yield of removing the overstorey of the Pinyon (*Pinus edulis*)/Juniper (*Juniperus* spp.) woodland by mechanical treatments (cabling or felling) or aerial application of herbicide (after which the dead trees were left standing). Effects on water quality, sediment yield, the vegetation and its value as forage for cattle and wildlife, and changes in deer populations are also reported. Herbicide treatment significantly increased water yield, but mechanical treatments did not. Water quality and flood peaks were not significantly affected by the treatment. Nearly all treatments increased yields of herbage and forage plants, but potential livestock carrying capacity varied greatly. Estimates suggest that for the more successful treatments the benefits will just cover costs.

38. Clary W. P.; Goodrich S., and Smith B. M. Response to tebuthiuron by Utah juniper and mountain big sagebush communities. *Journal of Range Management*. 1984; 38(1):56-60.
Keywords: *Juniperus*/ *Artemisia*/ *Purshia*/ *Chrysothamnus*/ *Tetradymia*/ *Agropyron*/ control/ herbicides.
Abstract: In field trials in Fishlake National Forest, Utah, 0-27 kg tebuthiuron/ha was applied aerially in 40% pellets to *Juniperus* spp. stands and 0-13 kg/ha was applied in 10% pellets to *Artemisia tridentata* subsp. *vaseyana* stands in autumn 1979 and the response was studied until 1982. Percentage kill of *Juniperus* spp. increased from 39.0-52.5% in 1980 to 80.1-99.1% by 1982 with control increasing with increase in herbicide rates. Crown kill was less in trees <0.5 m high, possibly due to their smaller root systems not coming into contact with the herbicide pellets. Percentage kill of *A. tridentata* increased from 59.5-79.4% in 1980 to 79.9-92.6% by 1982. Mortality of *Purshia tridentata* was similar to that of *Juniperus* spp. *Chrysothamnus nauseosus* was not controlled by <less or =>1.3 kg tebuthiuron/ha, but *C. viscidiflorus* subsp. *puberulus* and *Tetradymia canescens* were controlled at this rate. Understorey production did not respond to control of *Juniperus* spp. or *A. tridentata* suggesting herbicide phytotoxicity still remained after 3 years. The largest decrease in production occurred in *Agropyron spicatum* [*Elymus spicatus*] and the largest increase in *Bromus tectorum*.
39. Clayden, S. L. Reprint author; Cwynar, L. C. Author; MacDonald, G. M. Author, and Velichko, A. A. Author. Holocene pollen and stomates from a forest-tundra site on the Taimyr Peninsula, Siberia. *Arctic & Alpine Research*. 1997; 29(3):327-333.
Keywords: *Juniperus*/ *Larix*/ *Picea*/ stomates/ pollen/ Siberia/ Holocene
Abstract: A lake sediment core from forest-tundra on the Taimyr Peninsula, Siberia, was analyzed for pollen and coniferous stomate content to reconstruct Holocene vegetation history. It had a basal age of 9200 yr

BP *Larix* stomates indicate *L. sibirica* trees were present at the site since before 9200 yr BP. Both low total pollen accumulation rates from approx 9200-6500 yr BP and *Juniperus* stomates at approx 9000 yr BP indicate the site was likely forest-tundra. Stomates indicate that *Picea obovata* trees arrived by 7600 yr BP. Combined pollen and stomate evidence suggest that *Picea* and *Larix* were more abundant during the mid-Holocene than today; *Picea* is now rare at the site.

40. Countryman, C. M. Thermal characteristics of pinyon pine and juniper fuels used in experimental fires. Proceedings Of Tripartite Technical Cooperation Program Panel Number 3. 1949.
Keywords: *Juniperus/ Pinus/* burning fuel/ fire behavior
Abstract: The energy derived from burning fuel provides the basic driving force for fire behavior and phenomena associated with free burning fires the physical characteristics of the fuel particles and fuel bed are important factors in determining the amount of energy and the rate at which this potential energy of the fuel is released and hence exert a major control on fire behavior pinyon pine and juniper trees were analyzed to determine such physical characteristics as amount of material of different sizes, total surface area, surface to volume ratio of fuel particles, heating value of various parts of the tree, ash content, and amount of ether soluble constituents analytical procedures are described.
41. Crosti, R; Ladd, P. G.; Dixon, K. W., and Piotto, B. Post-fire germination: The effect of smoke on seeds of selected species from the central Mediterranean basin. Forest Ecology and Management . 2006; 221: 306-312.
Keywords: *Juniperus/* Mediterranean basin/ smoke/ chaparral/ fynbos/ kwongan/ matorral/ *Erica*
Abstract: In regions with a Mediterranean-type climate wildfires are a frequent occurrence: in such environments fire tolerant/favored species are frequently encountered. In the Mediterranean basin, many species of fire prone habitats are resprouters while other are known to germinate after fire. Fire causes an enhancement of seed germination in many species from fire prone habitats in the other regions with a Mediterranean-type vegetation such as Western Australia, California, and South Africa. Seeds of a number of these species are stimulated to germinate by the smoke generated from burning of plant material in either an aerosol or aqueous form. However, for species from the Mediterranean basin the role of smoke in germination is poorly known, despite the fact that in the field many species seem to be encouraged to germinate after fire. We examined the germination of 10 species native to the Mediterranean basin that were treated with aerosol smoke. Some species were from fire prone habitats while others were not. In relation to the controls, increased germination occurred in three of the species (e.g. *Cistus incanus*), three had more rapid germination but no total increase (e.g. *Rhamnus alaternus*), two showed reduced germination (e.g.

Asphodelus ramosus) and two exhibited no difference in germination (e.g. *Clematis flammula*). There was additionally no consistent pattern of germination behavior depending on the habitat from which the species came. Comparison is made between the results of this study and those of other studies on seed germination response to heat and smoke in other areas of Mediterranean-type climate. An understanding of the importance of fire in relation to other disturbances in the vegetation dynamics in the Mediterranean basin needs to be clarified by further detailed studies of the effect of heat and smoke products on seed germination of Mediterranean species. Outcomes of further research, also on a broader range of species, would have important impacts also for conservation, environment management, horticulture and ecosystem restoration.

42. Davenport, D. W.; Breshears, D. B.; Wilcox, B. P., and Allen, C. D. Viewpoint: Sustainability of pinon-juniper ecosystems - A unifying perspective of soil erosion thresholds. *Journal of Range Management*. 1998; 51(2):231-240.
Keywords: *Juniperus/ erosion/ Pinus edulis*
Abstract: Many pinon-juniper ecosystem in the western U.S. are subject to accelerated erosion while others are undergoing little or no erosion. Controversy has developed over whether invading or encroaching pinon and juniper species are inherently harmful to rangeland ecosystems. We developed a conceptual model of soil erosion in pinon-jumper ecosystems that is consistent with both sides of the controversy and suggests that the diverse perspectives on this issue arise from threshold effects operating under very different site conditions. Soil erosion rate can be viewed as a function of (1) site erosion potential (SEP), determined by climate, geomorphology and soil erodibility; and (2) ground cover. Site erosion potential and cove act synergistically to determine soil erosion rates, as evident even from simple USLE predictions of erosion. In pinon-juniper ecosystem with high SEP, the erosion rate is highly sensitive to ground cover and can cross a threshold so that erosion increases dramatically in response to a small decrease in cover. The sensitivity of erosion rate to SEP and cover can be visualized as a cusp catastrophe surface on which changes may occur rapidly and irreversibly. The mechanisms associated with a rapid shift from low to high erosion rate can be illustrated using percolation theory to incorporate spatial, temporal, and scale-dependent patterns of water storage capacity on a hill slope. Percolation theory demonstrates how hill slope runoff can undergo a threshold response to a minor change in storage capacity. Our conceptual model suggests that pinion and juniper contribute to accelerated erosion only under a limited range of site conditions which, however, may exist over large areas.
43. Davenport, D. W.; Breshears, D. D.; Wilcox, B. P., and Allen, C. D. Sustainability of pinon-juniper ecosystems-a unifying perspective of soil erosion thresholds. *Journal of Range Management*. 1998; 51(2):231-240.
Keywords: *Juniperus/ Pinus/ soil erosion/ rangeland*
Abstract: Controversy has developed over whether invading or

encroaching pinyon and juniper species are inherently harmful to rangeland ecosystems. A conceptual model of soil erosion in pinyon-juniper (*Pinus-Juniperus*) ecosystems that is consistent with both sides of the controversy was developed. It is suggested that the diverse perspectives on this issue arise from threshold effects operating under very different site conditions. Soil erosion rate can be viewed as a function of (1) site erosion potential (SEP), determined by climate, geomorphology and soil erodibility; and (2) ground cover. Site erosion potential and cover act synergistically to determine soil erosion rates, as evident even from simple USLE predictions of erosion. In pinyon-juniper ecosystems with high SEP, the erosion rate is highly sensitive to ground cover and can cross a threshold so that erosion increases dramatically in response to a small decrease in cover. The sensitivity of erosion rate to SEP and cover can be visualized as a cusp catastrophe surface on which changes may occur rapidly and irreversibly. The mechanisms associated with a rapid shift from low to high erosion rate can be illustrated using percolation theory to incorporate spatial, temporal, and scale-dependent patterns of water storage capacity on a hill slope. Percolation theory demonstrates how hill slope runoff can undergo a threshold response to a minor change in storage capacity. It is suggested that pinyon and juniper contribute to accelerated erosion only under a limited range of site conditions which, however, may exist over large areas.

44. Davis, J. N. Seedling establishment biology and patterns of interspecific association among establishment seeded and nonseeded species on a chained juniper-pinyon woodland in central Utah. Dissertation Abstracts International, B Sciences and Engineering. 1988; 49(6):2020B.
Keywords: *Juniperus/ Pinus/ Utah/ Sanguisorba/ Onobrychis/ Ranunculus/ Elymus/* shrub density/ seeds/ native species
Abstract: 92% elimination of tree competition was achieved by chaining a juniper-pinyon woodland near Ephraim, Utah. Seedling establishment was increased by higher sowing rates only in 2 forbs, *Sanguisorba minor* and *Onobrychis viciifolia*. *Ranunculus testiculatus* may have interfered with establishment of sown species by allelopathy. *Elymus hispidus* was unaffected by *R. testiculatus* and became the dominant sown species. As native and sown perennial grass densities increased, the density of weedy annuals decreased sharply. Shrub density steadily increased during the 3-year study. While the sown species were compatible with each other, the native species showed positive and negative interactions among themselves and negative interactions with some of the sown species. High densities of native perennial grasses and introduced weeds reduced the establishment of the sown species.
45. Davis, O. K. Climate and vegetation patterns in surface samples from arid western U.S.A.: Application to Holocene climatic reconstructions. Palynology. 1995; 19(0):95-117.
Keywords: *Juniperus/ Abies/ Picea/ Pinus/ Pseudotsuga/*

Sequoiadendron/ Tsuga/ Cyperaceae/ Umbelliferae/ Salix/ Quercus/
vegetation patterns/ arid climate/ western United States

Abstract: Nearly 1,400 samples from over 50 sources have been assembled and analyzed to characterize the contemporary pollen rain of the and western U.S.A. Of the nearly 300 pollen types recorded, *Pinus*, *Quercus*, and *Cupressaceae* are the most common arboreal types; *Chenopodiaceae - Amaranthus, Gramineae, Artemisia, Ambrosia*, and "Other *Compositae*" are the most frequent non-arboreal pollen types. Forest vegetation is represented by 661 samples, steppe by 450 samples, and desert by 116 samples. *Ambrosia, Cactaceae, Cruciferae, Leguminosae, Larrea, Malvaceae, Nyctaginaceae*, and *Prosopis* achieve maximum percentages in hot - dry climate (> 20 °

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°

degree C mean annual temperature and < 250 mm mean annual precipitation); *Artemisia, Juniperus, Sarcobatus, Caryophyllaceae, Liguliflorae*, Other *Compositae*, and *Polygonaceae* have minor peaks in cold dry climate (< 15 ° C and < 250 mm); *Arceuthobium, Abies, Picea, Pinus, Pseudotsuga, Sequoiadendron, Tsuga heterophylla*, and *T. mertensiana* reach maxima in cool moist climate (10-15 ° C, 500 - 2000 mm); and *Cyperaceae, Umbelliferae*, and *Salix* reach maxima in cold wet climate (< 5 ° C and > 2000 mm). The frequency distribution of dissimilarity values among vegetation types is similar to that of other surface sample studies, with squared-chord-distances < 0.15, five times more likely to be same-type comparisons than different-type. Holocene temperature and precipitation curves for three western U.S.A. sites, based on the closest analogs in the contemporary surface samples, exhibit the "early Holocene Xerothermic" of the Pacific Northwest and early Holocene moistness of the Southwest.

46. Davis, Owen K. Palynological evidence for vegetation cycles in a 1.5 million year pollen record from the Great Salt Lake, Utah, USA. *Palaeogeography Palaeoclimatology Palaeoecology*. 1998 Apr; 138(1-4):175-185.
Keywords: *Juniperus/ Pseudotsuga/ Abies/ Picea/ Ambrosia/ Sarcobatus/ pollen/ Utah*
Abstract: Pollen analysis of the mid-lake Indian Cove well in the Great Salt Lake, collected by Amoco Production Co., provides a 1.5 Ma record of climatic change, correlative with the deep-sea oxygen isotope record. Chronologic control for Indian Cove is provided by the Lava Creek B (0.60 Ma), Bishop (0.76 Ma), and Huckleberry Ridge (2.06 Ma) volcanic ashes. The processing of close-interval (3 m, ca. 8 ka) samples is complete for the upper 628 m (1.5 Ma) of the Indian Cove well. During the last 750 ka, interglacial-glacial cycles are expressed as the ratio of *Juniperus + Ambrosia + Sarcobatus* (interglacial) vs. *Picea, Abies*, and *Pseudotsuga* (glacial). Correlating the peak abundances of this ratio with the odd-numbered oxygen isotope stages has refined the time control provided by three volcanic tephra. The average Pleistocene sedimentation rate is 0.39

m ka-1 (Huckleberry Ridge, 2057 ka, 797 m). Based on the refined time scale, resulting from correlation with the marine chronology, sedimentation reached maximum values during isotope stages 11-9, and was slow between stages 13 and 11 and stages 9-7. Development of the Bonneville Pluvial cycles, from 759 to 600 ka, is recorded by changes in wetland and aquatic palynomorphs. Increased pollen concentration above 150 m (310 ka) may result from the diversion of the Bear River into the Great Salt Lake Basin.

47. ---. Pollen analysis of Tulare Lake, California: Great Basin-like vegetation in Central California during the full-glacial and early Holocene. *Review of Palaeobotany & Palynology*. 1999; 107(3-4):249-257.
Keywords: *Juniperus/ Cupressaceae/ Artemisia/ Sarcobatus/ Holocene/ pollen/ Pinus/ Quercus*
Abstract: Pollen analysis and nine radiocarbon dates of an 853-cm core from historically drained Tulare Lake, south-central California are reported prior to 7000 yr B.P., the vegetation of the southern San Joaquin Valley (central California) resembled that of the contemporary Great Basin, including abundant greasewood (*Sarcobatus*), which currently does not occur west of the Sierra Nevada. The early-Holocene pollen assemblage is dominated by *Cupressaceae* (>40%), *Pinus* (>20%), *Quercus* (5-20%), *Artemisia* (>15%), and *Sarcobatus* (>5%), suggesting pinyon-juniper-oak woodland in the uplands, with greasewood on the saltflats near the lake. Giant sequoia was widespread along the Sierra Nevada streams draining into Tulare Lake, prior to 9000 yr B.P. as *Sequoiadendron* pollen is greater than 4%. The pollen assemblages before 18,500 yr B.P. are similar to those of the early Holocene (*Cupressaceae*, *Artemisia*, and *Sarcobatus*), but a gap in sedimentation from ca. 18,500-10,500 yr B.P. prohibits characterization of full-glacial vegetation. The end of Great Basin-like pollen assemblages 7000 yr B.P. (demise of *Sarcobatus*) coincides with increased frequency of charcoal; i.e., greater fire frequency in the Holocene woodland and grassland. From 7000-4000 yr B.P. the pollen assemblage is dominated by Other *Compositae* and *Chenopodiaceae-Amaranthus* pollen, suggesting expansion of xerophytic steppe at the expense of oak woodland. Higher percentages of littoral pollen (*Cyperaceae*, Typha-Sparganium) and lower percentages of pelagic algae (Botryococcus + Pediastrum) during the middle Holocene indicate lake levels generally lower than during the early Holocene. The late Holocene begins with a cold-wet period 3500-2500 yr B.P. followed by progressive drying of the lake. Climate estimates based on modern pollen analogs confirm the climate implications of the vegetation and lake history. Early Holocene climate was cold and wet, and maximum Holocene temperature and drought occurred between 7000 and 4000 yr B.P. Cool-moist climate from 4000 to 2000 yr B.P. is followed by a return to aridity and high temperature ca. 1000 yr B.P.
48. de Merleire, H. A dangerous pest of junipers.

Un hôte dangereux des genévriers. *Phytoma*. 1978; 30(294):9.

Keywords: *Juniperus/ Dichomeris marginella/* agricultural entomology/ arthropods/ Mediterranean-Region.

Abstract: Larvae of a gelechiid that were found causing severe damage to the foliage of juniper (*Juniperus*) in a hedge in France at the end of May, 1977 were identified as *Dichomeris marginella* (F.). A spray application of malathion was effective in preventing the destruction of the hedge. The larva and adult of the gelechiid are illustrated, together with the damage they cause to juniper.

49. Debano, L. F. USDA forest service pinyon-juniper research: watershed and soil management. In: 1991 Pinyon Conference, April 23, 1991, Santa Fe, New Mexico. 1991; 53-54.
Keywords: *Juniperus/ Pinus/* watershed/ soil management
50. Debussche and Isenmann P [Author]. The autumn and winter diet of the Song Thrush *Turdus philomelos* in the Garrigues of southern France its role in seed dispersal. *Revue D'Ecologie La Terre Et La Vie*. 1985; 40(3):379-388.
Keywords: *Juniperus/ Turdus philomelos/* France/ diet/ omnivorous/ Song Thrush/ fruits/ seed
Abstract: The autumn and winter diet of the omnivorous Song Thrush (*Turdus philomelos*) around Montpellier (Southern France) is mostly made up of fruits. Two species are preferably consumed, grapes in autumn (found in 64% of the stomachs containing fruits), and the berry-like fruits of *Juniperus* spp. in winter (found in 45% of the stomachs containing fruit). The fleshy fruits of 16 other species were also consumed and their seeds dispersed by the song thrushes. Together with the Blackcap, the Sardinian Warbler, the Blackbird and the Robin, the Song Thrush plays a major role in the dissemination of fleshy-fruited plants in our study area, and probably in the whole Mediterranean Region as well.
51. Degeyter, L. Influence of increasing dosage rates of slow-release manurial substances on the growth and quality of *Thuja* and *Juniperus*. *Verbondsnieuws*. 1998; 42(9):35.
Keywords: *Juniperus/ Thuja plicata /* containers/ Osmocote/ growth
Abstract: Cuttings of *T. plicata* cv. *Atrovirens* and *J. media* cv. *Old Gold* were taken in January 1995, potted-on in March, planted in 3-litre containers in December, and in May 1997 they received Osmocote plus [slow release fertilizer] (16N-8P-12K + 2MgO) at 3, 4 or 5 g/litre of substrate in a trial at the Proefcentrum voor Sierteelt. With *T. plicata*, average shoot length by October had increased from 55 to 96 cm, with no significant difference between application rates; nor were there any differences in plant growth or quality. With *J. media*, however, the percentages of plants in the higher size grade (40/50 cm) were markedly increased by the higher application rates.
52. Demske, Dieter and Mohr, Barbara E-mail dieter.demske@rz.hu-berlin.de barbara.mohr@rz.hu-berlin.de. Palynological studies on late

Pliocene/Early Pleistocene sediments from Lake Baikal (Siberia). *Acta Palaeobotanica Supplementum*. 1999; 2471-473.

Keywords: *Juniperus/ Tsuga/ Artemisia/* pollen/ spore/ palynological analysis

Abstract: Palynological analysis of sediment samples from the BDP-96-1 drilling (Lake Baikal, Academician Ridge) was performed focusing on the time interval 3.6 to 2.2 Ma B.P. (million years before present). Pollen and spore data revealed the vegetation development from conifer forests with associated broadleaved trees to forests with declining participation of hemlock firs (*Tsuga*). Spread of fir, shrub alders and juniper as well as of steppe vegetation (*Artemisia*) reflect climatic changes (dry, cold) in the Baikal region, which are related in time to the intensification of northern hemisphere glaciations.

53. Derr J. F. and Wilcut J. W. Control of yellow and purple nutsedges (*Cyperus esculentus* and *Cyperus rotundus*) in nursery crops. *Weed Technology*. 1993; 7(1):112-117.
- Keywords:** *Juniperus/* nutsedge/ herbicides/ chlorimuron/ holly/ barberry/ azalea/ photinia/ pyridate/ flurtamone/ imazaquin/ imazethapyr
- Abstract:** Experiments were conducted to evaluate selective herbicides for yellow and purple nutsedge control in nursery crops. Chlorimuron at 0.03 and 0.06 kg ai ha⁻¹ suppressed yellow and purple nutsedge shoot growth either PRE or POST and did not reduce growth of barberry, Burford holly, Compacta holly, azalea, juniper, or photinia, although shoot tip chlorosis was noted in all species except Burford holly and juniper. Imazaquin at 0.25 and 0.5 kg ha⁻¹ and imazethapyr at 0.06 and 0.21 kg ha⁻¹ reduced growth of azalea. Imazethapyr also reduced growth of barberry, juniper, and photinia. Chlorimuron, imazaquin, and imazethapyr inhibited liriopse and daylily growth. Pyridate applied at 1.0 and 2.0 kg ha⁻¹ POST did not control purple nutsedge. Pyridate and flurtamone applied POST did not control yellow nutsedge as effectively as chlorimuron, imazaquin, or imazethapyr. Flurtamone at 0.5 and 1.0 kg ha⁻¹ applied PRE or POST controlled purple nutsedge. Both pyridate and flurtamone visibly injured most nursery crops tested, although plants generally outgrew the damage.
54. Despain, D. W. History and results of prescribed burning of pinyon-juniper woodland on the hualapai indian reservation in Arizona. In: Everett, Rl, Compiler Proceedings--Pinyon-Juniper Conference; 1986 January 13-16; Reno, Nv-General Technical Tep-Int-215-Ogden, Utah: S Department Of Agriculture, Forest Service, Intermountain Research Station. 1987; INT-215145-151.
- Keywords:** *Juniperus/ Pinus edulis/* Arizona/ prescribed burning/ Indian reservation
55. Dia, Y-S. Identification and control of juniper seedling diseases. *Forest Pest and*

Disease. 1988; 436-37.

Keywords: *Juniperus*/ *Phomopsis* diseases/ forest pests/ arthropod pests/ plant diseases/ forest trees/ plant pathogens/ transmission/ vectors/ seedlings/ fungal diseases/ symptoms

Abstract: Symptoms, morphology of pathogen and disease cycles of the commonest 3

juniper [*Juniperus*] seedling diseases in China, blight (*Phomopsis juniperivora*), leaf blight (*Cercospora sequoiae* var. *juniperi*) and bud blight caused by a mite, *Trisetacus juniperinus*, are described, illustrated and compared. Control methods are suggested.

56. Dierend, W; Hovel, B; Bischoff, J, and Spethmann, W. N-uptake of *Forsythia*, *Juniperus* and *Malus* during the growing period. Gartenbauwissenschaft. 1997; 62(5):224-228.

Keywords: *Juniperus*/ *Malus*/ *Forsythia*/ nitrogen uptake/ shoot growth

Abstract: N-uptake by *F. x intermedia* cv. *Spectabilis*, *J. x media* cv. *Mint Julep* and apples (cv. *Elstar* on *J9* rootstocks) during the growing period was investigated. In *F. x intermedia* intensive shoot growth began. At the same time N-uptake started. In *F. x intermedia* the period of intensive N-uptake continued to August. In *J. x media* the period of intensive N-uptake continued to September and in apples N-uptake continued to October. Each of the 3 species took up the most N between May and August. The relevance of these results for fertilization in nurseries is discussed..

57. Donovan S. E.; Eggleton P., and Martin A. Species composition of termites of the Nyika plateau forests, northern Malawi, over an altitudinal gradient. African Journal of Ecology. 2002; 40(4):379-385.

Keywords: *Juniperus*/ termites/ Malawi/ *Apicotermatinae*/ *Termitinae*

Abstract: Termites were surveyed at three altitudes (*Brachystegia* woodland at 1676 m and 1905 m, and Juniper woodland at 2210 m) in forests within the Nyika Plateau, northern Malawi. Sampling was by a standardized 100 m transect protocol. Termite diversity was highest in the mid-altitude site and lowest in the Juniper forest. The assemblages were dominated by soil-feeding termites in the *Termitidae* subfamilies *Apicotermatinae* and *Termitinae*, and included one new soldierless *Apicotermatinae* genus. The structure of the assemblages was clearly due to a mixture of altitudinal and site history factors. This was especially true of the lowest altitude forest where burning and other anthropogenic disturbance factors appear to have reduced termite diversity relative to the mid-altitude site. The Nyika plateau shows a much higher diversity at mid-altitudes than similar SE Asian sites, probably due to the larger area of highland in Africa than in SE Asia. In addition, the clade composition of the Nyika assemblages differs completely from that found at similar altitudes in SE Asia. This preliminary study supports the hypothesis that mid- to high- altitude assemblages in both SE Asia and Africa appear to be derived from depauperated random subsets of the lowland fauna rather

than from clades specifically adapted to higher altitudes.

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Keywords: *Juniperus/ Cupressaceae/ Pinopsida/ gymnosperms/ Spermatophyta/ plants/ pollination/ chemistry/ metabolism/ amino acids/ ovules/ pollen/ growth/ fertilization/ conifers*
59. Duncan, R. W. Common insects damaging junipers, cedars and cypresses in British Columbia. Forest Pest Leaflet Pacific Forestry Centre, Canadian Forest Service. 1996; 708.
Keywords: *Juniperus/ Thuja/ Chamaecyparis/ Cupressus/ insect damage/ British Columbia*
Abstract: Notes are given on *Argyresthia cupressella*, *Dichomeris marginella*, *Epinotia subviridis*, *Carulaspis juniperi*, *Phloeosinus sequoiae* and *Phyllobius intrusus* on *Juniperus* spp., *Thuja* spp., *Chamaecyparis* spp. and *Cupressus* spp. in British Columbia.
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Keywords: *Juniperus/ rice hulls/ containers/ compost/ growing media*
Abstract: Juniper seedlings were transplanted into containers with various proportions of cracked rice hulls and greenhouse potting soil, or rice hulls and rice hull compost, and the effects on growth were compared at intervals during a 2-yr period. Growth was best in 50% rice hulls + 50% soil, or 40% rice hulls + 60% compost. Rice hull compost provided more effective insulation than soil for the plant roots during a severe winter, and no plants were lost when the compost content was 40% or more. Data are also presented on the pH and nutrient content of the soil and compost at the beginning and end of the trial.
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Keywords: *Juniperus/ Artemisia tridentata/ Pinus/ chemical control/ establishment/ cultural control.*
Abstract: Three range improvements (resowing *Agropyron desertorum*, burning and chemical brush control) for big sagebrush [*Artemisia tridentata*] and pinyon-juniper [*Pinus* spp. -*Juniperus* spp.] on upland loam and upland shallow loam range sites were studied from interview data from 96 Utah cattle ranches. Net present value and a linear programming model were used to identify the most efficient alternative, the limiting constraints, and the optimum levels and combinations of alternatives. The optimal solution ran 238 brood cows compared with 196 for the typical Utah ranch. Burning big sagebrush or pinyon-juniper

infestations on *A. desertorum* foothill ranges was the most profitable range improvement. Annual net returns after burning sagebrush or pinyon-juniper on the upland loam site were \$37 873 and \$37 770, respectively, compared with \$31 278 on the typical Utah cow-calf operation. The model designed was applicable to specific ranches from which the data were obtained.

62. Everett, R. L. and Sharrow, S. H. Response of understory species to tree harvesting and fire in pinyon-juniper woodlands. *Managing Intermountain Rangelands Improvement of Range and Wildlife Habitats* [Monsen,-SB;-Shaw,-N-Compilers]. 1983; 62-66.
Keywords: *Juniperus/ Pinus/* fire/ harvesting/ forage
Abstract: The use of fire and tree harvesting to improve forage availability of pinyon-juniper [*Pinus* spp. + *Juniperus* spp.] woodlands is reviewed. Increases in forage production of 0.45-1.23 t/ha have been reported after burning or tree clearing.
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Keywords: *Juniperus/ Phomopsis juniperovora/* blight/ fungus/ needles/ infection
Call Number: 275.29
Abstract: Juniper blight is caused by the fungus (*Phomopsis juniperovora*) which infects young tissue. The fungus penetrates the needles, and small yellow spots appear 3 to 5 days after invasion. Infection occurs best when the temperature is around 75 ° F. with moisture supplied by rain or sprinklers. Symptoms may not be visible until June, July, or August. Spray with a copper-containing compound in the spring when the new growth starts. Repeat at 2-week intervals until dry weather. The disease can be confused with drought or winter injury.
64. Fowells, H. A. Silvics of forest trees of the United States. USDA Forest Service, Agricultural Handbook 271. 1965; 762 pp.
Keywords: *Juniperus/* silvics
Abstract: Three native juniper species are described.
65. Frischknecht, N. C. Native faunal relationships within the pinyon-juniper ecosystem. [Proceedings,] *The Pinyon-Juniper Ecosystem: a Symposium*, May 1975. 1975; 55-65.
Keywords: *Juniperus/ Pinus/* fauna/ seed dispersal/ flora
Abstract: A general review is given of mammals, birds, reptiles and invertebrates and their relations with the flora of this ecosystem. Particular attention is given to their role in seed dispersal.
66. Fuhlendorf S. D. and Smeins F. E. Long-term vegetation dynamics mediated by herbivores, weather and fire in a *Juniperus-Quercus* savanna. *Journal of Vegetation Science*. 1997; 8(6):819-828.

Keywords: *Juniperus/ Quercus/ herbivores/ fire/ grazing/ Texas*

Abstract: Long-term (45-year) basal area dynamics of dominant grasses were analyzed across three grazing intensity treatments (heavily grazed, moderately grazed and ungrazed) on the Edwards Plateau, Texas, USA. Grazing intensity was identified as the primary influence on long-term variations in species composition. Periodic weather events, including a severe drought (1951-1956), had little direct influence on composition dynamics. However, the drought interacted with grazing intensity in the heavily grazed treatment to exacerbate directional changes caused by grazing intensity. Species response to grazing was individualistic and imprecise. Three response groups were identified. Taller, more productive mid-grasses were most abundant under moderate or no grazing. Short grasses were most abundant under heavy grazing. Intermediate species were most abundant under moderate grazing and opportunistic to weather patterns. Graminoid diversity increased with the removal or reduction of grazing intensity. The moderately and ungrazed treatments appeared most resistant to short-term weather fluctuations, while the heavily grazed treatment demonstrated significant resilience when grazing intensity was reduced after over 110 years of overgrazing. Identification of a 'climax' state was difficult. Significant directional change, which took nearly 20 years, appeared to continue in the ungrazed treatment after 45 years of succession. The observed, relatively linear patterns of perennial grass composition within the herbaceous patches of this savanna were generally explained by traditional Clementsian succession. However, when dynamics of the herbaceous community were combined with the woody component of this savanna, the frequency and intensity of fire became more important. Across the landscape, successional changes followed several pathways. When vegetation change was influenced by several factors, a multi-scale model was necessary to demonstrate interactions and feedbacks and accurately describe successional patterns. Absence of fires, with or without grazing, led ultimately to a *Juniperus/Quercus* woodland with grazing intensity primarily influencing the fuel load and hence fire intensity.

67. Gascho, Landis A. and Bailey, J. D. Reconstruction of age structure and spatial arrangement of pinon-juniper woodlands and savannas of Anderson Mesa, northern Arizona. *Forest Ecology and Management*. 2005; 204(2-3):221-236.

Keywords: *Juniperus/ Pinus/ woodlands/ Arizona/ age structure/ density*

Abstract: We examined age structure and spatial arrangement of pinon-juniper woodlands and savannas on six plots distributed across three different soil types in northern Arizona. These stands, as typical of many others in pinon-juniper ecosystems, have experienced increases in tree densities since the arrival of European settlers. The goal of this study was to reconstruct stand conditions in 1860, prior to livestock grazing, using stem-mapping to determine tree arrangement and tree-ring analysis to

examine age structure and density. Ripley's $K(t)$, Ripley's $K^*(t)$, and Moran's I were used to analyze nearest neighbor distances, spatial association, and spatial autocorrelation, respectively. All sites have long term presence of juniper and pinon trees, with a pulse of establishment and survival occurring between 1860 and 1880 on basalt- and sandstone-derived soils. In contrast, limestone-derived soil had no pulse of tree establishment in 1860, but rather a steady increase in tree establishment since ca. 1700. Spatial arrangement of juniper trees in 1860 showed strong clumping patterns from a minimum distance of 15 m to all spatial scales. Pinon pine varied in spatial arrangement from clumping at all spatial scales to random at all spatial scales. Positive spatial autocorrelation was determined for age of juniper trees to a minimum distance of 21 m in current stand conditions, in contrast to no strong trends of spatial autocorrelation in 1860. By comparing the age structure and spatial results for the forest reconstruction of 1860 to current conditions, we were able to show variation among soil types in nurse tree association between pinon and juniper trees and unable to support the density dependent mortality hypothesis for these sites. Presettlement (1860) diameter distributions and basal areas can be used to develop structure control (BDq) prescriptions unique to each soil type to restore either savanna or woodlands condition. However, identifying one blanket prescription for tree reduction in pinon-juniper ecosystems of the southwestern United States, or even the Anderson Mesa landscape, would reduce the range of variability present in the form of woodlands and savannas.

68. Gauquelin, T.; Bertaudiere, V.; Cambecedes, J., and Largier, G. *Juniperus thurifera* in the Pyrenees: conservation status and stands management. Le Genevrier thurifere (*Juniperus thurifera* L.) dans les Pyrenees: etat de conservation et perspectives. Acta Botanica Barcinonensia. 2003; 4983-94.
Keywords: *Juniperus*/ Mediterranean/ *Quercus*/ nature conservation/ plant competition.
Abstract: Thuriferous juniper (*Juniperus thurifera*), a dioecious bush or tree, is only found in isolated parts of the Western Mediterranean: France, Spain, Algeria and Morocco. As a botanical rarity in France, thuriferous juniper is only found in three specific areas: the Corsican highlands, the Alps, and the Pyrenees, where only two extensive locations have so far been identified: Montagne de Rie and Quie de Lujat. In these two locations, this heliophilous and xerothermic species colonizes limestone, rocky south facing slopes, but also former pastures or terraces. The decline in human and livestock activities over recent decades has led to a recolonization of some of these stands by oaks (*Quercus pubescens* in Rie and *Quercus ilex* in Quie de Lujat); their competition with juniper trees are responsible for the regression of *J. thurifera*, outside rocky stands where it is not under threat, since it is the only tree species able to grow on such biotopes. Long-term management, including subsidized grazing

and/or periodic manual clearing of the meadows, must be considered if we want ensure its survival not only in the rocky stands.

69. Gauquelin, T.; Fromard, F.; Badri, W., and Dagnac, J. Contribution of mineral elements to the soil via litter, rainfall and through fall in a juniper population (*Juniperus thurifera* L.) in the western High Atlas, Morocco. Apports d'elements mineraux au sol par l'intermediaire de la litiere, des pluies et des pluviolessivats dans un peuplement a genevrier thurifere (*Juniperus thurifera* L.) du Haut Atlas occidental (Maroc). Annales Des Sciences Forestieres. 1992; 49(6):599-614.
Keywords: *Juniperus*/ Morocco/ rainfall/ litter/ minerals
Abstract: The amount of nutrient reaching the soil below the crown of a juniper tree located at an altitude of 2450 m in the western High Atlas and showing a characteristic 'open structure' was estimated from 1987 to 1989. The amount of nutrient returned to the soil was high (42 gm yr⁻¹ m⁻² for the macroelements). Input from rainfall, through fall and stemflow constituted 20% of this amount and a clear increase was noted in the nutrient concentration in through fall compared to rainfall (X 3.8). The high input from litter (80% of the total input) was linked to the high mean annual litterfall and to the particularly high concentration of calcium in the litter.
70. Gifford, G. F. Impact of burning pinyon-juniper debris on select soil properties. Journal of Range Management. 1981; 34(5):357-359.
Keywords: *Juniperus*/ *Pinus*/ debris/ burning/ Utah/ soil properties/ *Agropyron cristatum*
Abstract: Burning of pinyon-juniper rangeland in southeastern Utah, USA had the greatest impact on soils beneath burned debris piles. Electrical conductivity, phosphorus, potassium, percent nitrogen, and percent organic carbon increased significantly at all soil depths the first year after burning debris piles. No impact was evident on phosphorus, percent nitrogen, and percent organic carbon by the second year. Impacts on burned interspace areas were generally less pronounced and few impacts were measured the second year. Impact of burning on soil pH was minor.
[See FA 39, 1712] An area in Utah, which had been double-chained in 1967, sown with crested wheatgrass (*Agropyron cristatum*) and enclosed to exclude livestock, was burned in Sept. 1974. Below piles of debris, electrical conductivity, P, K, % N and % organic C increased significantly at most soil depths in the first year after burning; effects were reduced in the second year. Changes in burned areas between piles of debris were less pronounced, with fewer effects persisting until 1976.
71. Gottfried G. J. Ecology and management of the Southwestern pinyon-juniper woodlands. General Technical Report, US Department of Agriculture, Forest Service.. RM-218. 1992; 21878-86.
Keywords: *Juniperus*/ *Pinus*/ woodlands/ ecology/ management

Abstract: Pinyon-juniper woodlands cover large areas of Arizona and New Mexico. Management of these lands is shifting from a single-resource emphasis to recognizing the value of the woodlands for a number of valuable resources. Proper management for combinations of fuelwood, range, wildlife, and recreation must be based on sound ecological information.

72. Gottfried, G. J. and Severson, K. E. Managing pinyon-juniper woodlands. *Rangelands*. 1994; 16(6):234-236.
Keywords: *Juniperus/ Pinus/* management/ woodlands
Abstract: Pinyon-juniper [*Pinus/ Juniperus*] woodlands have been managed for various resources, including livestock forage alone, or multiple resources and amenities. Multiresource goals have been legally mandated on most public lands in the USA. Conflict and confusion over managing pinyon-juniper woodlands suggest that attitudes towards woodlands need to be reevaluated. The differences among pinyon-juniper sites must be recognized during development and implementation of management strategies. This paper briefly describes management options and discusses information shortcomings that could affect implementation, particularly in the southwest USA.
73. Grigorov, A. N. An instrument for comminuting juniper berries. *Izmel'chitel' shishkoyagod mozhzhevel'nika. Lesnoe Khozyaistvo*. 1979; 862-63.
Keywords: *Juniperus/* seeds/ extraction/ equipment/ berries
Abstract: An illustrated description is given of the design of an instrument developed in the Crimea for extracting the seeds from juniper berries. It is a small, electrically driven mill, with one fixed and one moving millstone separated by a steel collar 7 mm thick. The berries are fed from a hopper to the millstones, which grind them up; the seeds pass out in the pulpy mass to a container. Output depends on the m.c. of the berries, averaging 30 kg/h.
74. Hagan, A. Common disease of juniper in Alabama.
Keywords: *Juniperus/* disease/ container/ nursery/ plants
Abstract: Junipers are widely used as screens, hedges, ground covers, foundation plants, and occasionally as specimen plants in the majority of residential, recreational, highway, and commercial landscape planting across Alabama. In addition, junipers rank among Alabama's top container and field-grown nursery crops. These versatile landscape plants, whose many cultivars have a variety of growth habits, range in size from creeping dwarfs to medium-size tree. Typically, junipers will tolerate a wide range of soil types and landscape settings but tend to perform best in well drained soils on sunny sites. Disease not only have a major impact on survival and market value of container and field-grown nursery stock but can also have a detrimental impact on the health and beauty of juniper in landscapes. This publication describes the disease common noted on

junipers as well as recommended control procedures.

75. Hall, M. T. A new species of *Juniperus* from Mexico. *Fieldiana*. 1971 Aug 31; 34(4):45-53; ISSN: 0015-0746.
Keywords: *Juniperus*/ species/ Mexico
Call Number: 500 C432B
76. Hall, M. T.; Mukherjee, A., and Crowley, W. R. Chromosome numbers of cultivated junipers (*Juniperus*) . *Botanical Gazette*. 1979 Sep; 140(3):364-370; ISSN: 0006-8071.
Keywords: *Juniperus*/ chromosomes/ cultivated
Call Number: 450 B652
77. Hall, Stephen A. Author. Modern pollen influx in tallgrass and shortgrass prairies, southern Great Plains, USA. *Grana*. 1994; 33(6):321-326.
Keywords: *Juniperus*/ *Quercus*/ *Chenopodiaceae*/ *Pinus*/ *Poaceae*/ *Artemisia*/ *Ambrosia*/ pollen/ Great Plains
Abstract: Annual pollen-influx data from two series of Tauber trap studies in the shortgrass and tallgrass prairies in the southern Great Plains show that shortgrass vegetation is characterized by low influx values of *Ambrosia* and high influx of *Artemisia*, compared with those in tallgrass vegetation. The shortgrass prairie further differs from tall grasses by higher percentages of *Chenopodiaceae* pollen. Arboreal pollen influx and percentage values are related to abundance and nearness of trees to the grasslands; the tallgrass prairie is marked by high influx of *Quercus* and *Juniperus*, and the shortgrasses have higher influx and percentages of *Pinus*. *Poaceae* pollen influx values in both shortgrass and tallgrass prairies are identical, although *Poaceae* percentages in the tall grasses are lower owing to the higher influx of pollen from non-grass taxa.
78. Harner, R. F. Species diversity relations in Pinyon-Juniper ecosystems. *Dissertation Abstracts International, B*. 1975; 35(7):3165.
Keywords: *Juniperus*/ *Pinus*/ diversity/ communities/ Utah/ New Mexico
Abstract: Discusses abiotic and biotic influences on the diversity of plant species within the shrub-dominated communities of the Pinyon/Juniper ecosystem. The first part evaluates the role of area, environmental heterogeneity and adorability in influencing species diversity at 30 sites in central Utah and northern New Mexico. The second part evaluates the role of various groups of life forms in species-diversity relations at 20 sites in central Utah.
79. Harrington, J. T. and Fisher, J. T. Nursery and landscape performance of ornamental junipers in the southern Rocky Mountains. *HortTechnology*. 1999; 9(1):40-44.
Keywords: *Juniperus*/ cultivars/ nursery/ Rocky Mountains
Abstract: Supplying landscape plants for expanding urban centers in the southern Rocky Mountains in the USA provides a solution to limited-

resource producers wishing to convert from traditional agricultural crops to higher value horticultural crops in this region. Thirty-five cultivars of ornamental junipers (*Juniperus* sp.) were planted in an abandoned agricultural field in Mora, New Mexico, USA, to evaluate their suitability for nursery production in this region. The plantings were measured after 4 years, and cultivars were ranked for nursery suitability. The planting was then grown for an additional 16 years to examine landscape performance. Nineteen cultivars were considered suitable for nursery production with 5 cultivars being highly recommended based on survival and growth. Twenty-five of the cultivars were considered suitable for landscape use in the foothill region of the southern Rocky Mountains based on the 20-year measurements. Nine cultivars were classified as highly recommended.

80. Harris, A. T.; Asner, G. P., and Miller, M. E. Changes in vegetation structure after long-term grazing in pinyon-juniper ecosystems: integrating imaging spectroscopy and field studies. *Ecosystems*. 2003; 6(4):368-383.
Keywords: *Juniperus*/ rangelands/ remote sensing/ satellite imagery.
Abstract: We used field studies and imaging spectroscopy to investigate the effect of grazing on vegetation cover in historically grazed and ungrazed high-mesa rangelands of the Grand Staircase-Escalante National Monument, Utah, USA. Airborne hyperspectral remote sensing data coupled with spectral mixture analysis uncovered subtle variations in the key biogeophysical properties of these rangelands: the fractional surface cover of photosynthetic vegetation (PV), nonphotosynthetic vegetation (NPV), and bare soil. The results show that a high-mesa area with long-term grazing management had significantly higher PV (26.3%), lower NPV (54.5%), and lower bare soil (17.2%) cover fractions in comparison to historically ungrazed high-mesa pinyon-juniper rangelands. Geostatistical analyses of remotely sensed PV, NPV, and bare soil were used to analyze differences in ecosystem structure between grazed and ungrazed regions. They showed that PV was spatially autocorrelated over longer distances on grazed areas, whereas NPV and bare soil were spatially autocorrelated over longer distances on ungrazed areas. Field data on the fractional cover of PV, NPV, and bare soil confirmed these remote sensing results locally. Field studies also showed a significantly higher percentage composition of shrubs (27.3%) and forbs (30.2%) and a significantly lower composition of grasses (34.4%) and cacti (1.1%) in grazed areas. No significant difference between grazed and ungrazed mesas was found in percentage composition of trees or in the number of canopies per hectare. Our combined remote sensing and field-based results suggest that grazing has contributed to woody thickening in these pinyon-juniper ecosystems through an increase in shrubs in the understorey and intercanopy spaces. These results improve our understanding of broad-scale changes in pinyon-juniper ecosystem structural composition and variability due to long-term grazing.
81. Haskins, K. E. and Gehring, C. A. Interactions with juniper alter pinyon pine ectomycorrhizal fungal communities. *Ecology*. 2004; 85(10):2687-2692.

Keywords: *Juniperus/ Pinus edulis/* ectomycorrhizal fungi/ roots/ biomass

Abstract: Belowground interactions can affect plants either directly or indirectly via their associated mycorrhizal fungi. However, few studies have experimentally examined the consequences of interspecific root interactions for these important mutualists in the field. We used a trenching experiment to examine how belowground interactions between pinyon pine and one-seed juniper affected the ectomycorrhizal (EM) fungal communities of pinyon pine. Three major findings emerged: (1) pinyons responded to the reduction of juniper roots with a near doubling of fine root biomass in just two years, (2) this increase in pinyon roots translated into a potential two-fold increase in EM abundance, and (3) the EM fungal communities of trenched trees differed significantly from controls largely due to a decrease in ascomycete fungi. Because species of EM fungi vary in the benefits they provide, changes in EM communities could have long-term consequences for host-plant establishment, growth, and survival. Belowground interactions with juniper may contribute to the high mortality of pinyons and the reduced diversity of EM fungi associated with recent droughts.

82. Hellqvist, Magnus Reprint author and Eriksson, Jemt Anna Author. Land-use history in Gamla Uppsala, southeast Sweden, established on subfossil Coleoptera remains and pollen in fluvial deposits. *Grana*. 2001; 40(3):142-153.

Keywords: *Juniperus/* pollen/ Sweden

Abstract: Insect and pollen remains in fluvial sediments from the stream bank of river Fyris and one tributary brook, Samnan, in south-eastern Sweden, were studied. The deposits cover the last 400 years, according to ¹⁴C dates. The insects, dominated by subfossil beetles, originate foremost from stream environments, indicating aquatic development. Scarce finds from a wider area are recorded, particularly in samples from the banks of Fyris river there is a strong influence from surrounding land. Pollen originates from the surrounding cultivated field and grazing areas as well as wet meadows. The dominance of the stream environment changes along the examined core. The land-use history as it is reflected by deposited subfossils are compared with old maps from the area. It is demonstrated that the source areas for subfossil beetle and pollen have changed over time. Consequently, it is difficult to estimate the area for which the land-use history is accurate. For test purposes, the Mutual Climatic Range (MCR) method has been used for reconstructing mean temperatures based on the beetle record.

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Keywords: *Juniperus / Bougainvillea/* growth retardants

84. Hulle, J. Van and Blomme, R. Manuring of *Juniperus*.

Bemesting van *Juniperus*. BVO Mededelingen. 1973; 728 pp.

Keywords: *Juniperus*/ manure/ potassium/ nitrogen/ phosphorus

Abstract: The results are given of 3-year trials on the response of 7 *Juniperus* spp. and cvs to N (0-300 kg/ha), P (0-600 kg/ha) and K (0-300 kg/ha). The optimum N dosage rate was 150 kg/ha. There was little response to K in the first year, but in the second and third years the optimum rates were 150 and 300 kg/ha, respectively. There was no response to P, even at the highest application rate.

85. Ismailov, M. I. The systematics of the genus *Juniperus*. Vopr Ekol I Geogr Rast. 1974; 138-168.
Keywords: *Juniperus*/ systematics/ classification
Abstract: After a detailed survey of existing systems, a new system for classifying the genus is presented.
86. Jameson, D. A. Heat and dessication resistance of tissue of important trees and grasses of the pinyon-juniper type. Botanical Gazette . 1961; 122174-179.
Keywords: *Juniperus*/ *Pinus*/ heat/ dessication/ tissue
87. Jiang, Zeping and Wang, Huoran. A review of exotic species of Cupressaceae grown in China. Forest Research. 1997; 10(3):244-252.
Keywords: *Juniperus*/ *Cupressaceae*/ *China*/ *Chamaecyparis*/ *Cupressus*/ *Thuja occidentalis*/ *Thujopsis dolabrata*
Abstract: *Cupressaceae* composed of 131 species and 33 Varieties belonged to 21 genera, of which 32 species and 9 varieties from 7 genera are naturally distributed in China. About 52 species and 11 varieties of 5 genera have been introduced into China since 1900's, however, Only' 25 species and 4 varieties of 2 genera have survived. Successful exotic species in China are mainly from genera *Chamaecyparis*, *Cupressus* and *Juniperus*. At present, *Chamaecyparis obtusa*, *Ch. pisifera*, *Cupressus arizonica* and *C. lusitanica* have become important plantation species in eastern subtropical zones. *Juniperus virginiana* has widely been planted in central and northern China. A ornamental species, *J. procumbens* and *J. communis* are excellent in northern cities, while *Thuja occidentalis*, *Th. standishii*. and *Thujopsis dolabrata* in the south for urban plantings. Two major problems for the conservation and utilization of the genetic resources of *Cupressaceae* are as follows: (1) little attention has been paid to the domestication of indigenous species, (2) narrow genetic bases of exotic species need to be broadened because a few seed sources of some species have been used in plantation forestry.
88. Johnsen, T. N. and Alexander, R. A. *Juniperus* L. Editor, Schopmeyer, C.S. Seeds of Woody Plants in the United States. USDA Forest Service Agriculture Handbook No. 450. 1974; 460-469.
Keywords: *Juniperus*/ seed / germination/ pretreatments/ nursery practice/ seed collection/ seed cleaning
Abstract: Review of seed characteristics of native *Juniperus* species.

89. Johnsen, T. N Jr. Herbicidal control of junipers. Western Society of Weed Science, Proceedings. 1979; 3279.
Keywords: *Juniperus*/ herbicides/ encroachment/ rangeland
Abstract: Attempts to reduce or prevent juniper encroachment on grazing lands have been made since near the beginning of this century. A variety of chemicals were tried, but systematic testing was not begun until the late 1930's. Since then a large number of herbicides have been evaluated for effectiveness in controlling junipers, but most have failed the tests. Some, such as arsenic, are too dangerous to use. Others, such as various chlorinated benzoic acids, were excessively expensive or difficult to make. Then others, such as fenuron and karbutilate, were withdrawn from the market for various reasons. There are presently two herbicides which show promise for controlling junipers: picloram and tebuthiuron. Both are effective as either individual plant or as broadcast applications. Tebuthiuron is applied to the soil as a pelleted formulation, being effective with applications of two lb a.i./A. Tebuthiuron is still in the experimental stage of development and is not yet available for juniper control. Picloram controls junipers both as foliage or soil applications.
90. Johnsen, T. N. Jr. and Dalen, R. S. Controlling individual junipers and oaks with pelleted picloram. Journal of Range Management. 1984; 37(4):380-384.
Keywords: *Juniperus*/ *Quercus*/ picloram/ herbicide/ juniper/ oak
Abstract: Applications of pelleted picloram to individual plants of alligator juniper, one-seed juniper, Utah juniper, gambel oak and shrub live oak [*Juniperus deppeana*, *J. monosperma*, *J. osteosperma*, *Quercus gambelli*, *Q. turbinella*] in north central Arizona [USA] showed that a high rate application, 3.6 g acid equivalent (a.e.) picloram (4-amino-3,5,6-trichloropicolinic acid) m of juniper height or m² of oak clump crown cover, controlled each of the species. Only Utah and alligator junipers were consistently controlled by lower rates, 1.8 g a.e./U of plant height. Regression formulas were developed to determine estimates of the amount of herbicide needed for effective control. Large scale pilot trials were done to expand application of results.
91. Johnson, M P; Potter, D A, and Gilmore, G S. Suitability of juniper cultivars for survival and growth of the bagworm. Journal of Environmental Horticulture. 1993; 11(4):167-170.
Keywords: *Juniperus*/ bagworm/ psychid/ *Thyridopteryx ephemeraeformis*
Abstract: The varietal susceptibility of 23 cultivars of juniper (*Juniperus* spp.) to the psychid *Thyridopteryx ephemeraeformis* was investigated in the laboratory and field in Kentucky during 1991-92. Weight gain, development and survival differed significantly among groups of larvae fed on the foliage of different cultivars. The cultivars *Expansa* and *Hibernica* were considered the least suitable for survival and development of the psychid, whereas Broadmoor and Emerald Isle were consistently among the most suitable. The results presented suggest that the use of certain

juniper cultivars may be useful in managing this perennial insect pest in urban landscapes.

92. Johnson, W. G. The basic biology of *Juniperus* seed production. in: Landis, T.D. Tech. Coords. National Proceedings, Forest and Conservation Nursery Associations. General Technical Report Rm -Xxx, Fort Collins, CO; USDA Forest Service, Rocky Mountain Forest and Experiment Station. 1995.
Keywords: *Juniperus*/ biology/ dormancy/ seed
Abstract: Understanding the basic biology of seed production will help to find better ways to overcome seed dormancy. Seed dormancy hinders nursery production and many viable seed do not germinate. Junipers have seed coat and chemical dormancy. The seedcoat is semipermeable and the embryo requires after-ripening to germinate.
93. Kearns, H. S. J. and Jacobi, W. R. Impacts of black stain root disease in recently formed mortality centers in the pinon-juniper woodlands of southwestern Colorado . Canadian Journal of Forest Research. 2005; 35(2):461-471.
Keywords: *Juniperus*/ *Leptographium*/ *Ips*/ *Pinus edulis*/ black stain/ Colorado
Abstract: Thirty discrete black stain root disease (BSRD) mortality centers, caused by *Leptographium wagneri* (Kendr.) Wingf. var. *wagneri*, were examined in 1999 to determine the effects of BSRD on the composition and structure of pinon-juniper woodlands at the tree, shrub, and herbaceous plant levels and on tree-seedling regeneration. In these recently formed mortality centers, the majority (68%) of all pinon (*Pinus edulis* Engelm.) was dead, 76% of pinion were affected by BSRD, and 70% had evidence of pinon ips bark beetle (*Ips confusus* Leconte) attack. BSRD mortality centers had a mean area of 0.28 ha (range 0.07 to 0.63 ha). There were no statistically significant ($p > 0.05$) differences in shrub composition, cover, or diversity between mortality centers and the unaffected surrounding woodlands. Herbaceous plant cover was significantly greater ($p < 0.001$) within mortality centers and frequency responses were species specific. There were no significant ($p = 0.629$) differences in the density of pinon regeneration inside mortality centers compared with outside mortality centers. The pathogen was regularly isolated from pinon roots dead for 5-8 years and once from a root dead for 16 years. The rate of radial expansion of mortality centers averaged 1.1 m/year (0.07 SE). The rate of mortality center expansion was not significantly ($p > 0.05$) related to available water-holding capacity, percent organic matter, pH of soils, pinon density, or any other site data recorded.
94. Ketenoglu, O.; Kurt, L.; Akman, Y., and Serin, M. A new alliance from Central Anatolia, 'Minuartion juniperino-pestalozzae'. Turkish Journal of Botany. 1996; 20(5):457-464.
Keywords: *Juniperus* / steppes/ plant communities/ plant genetic resources
Abstract: A description is given of the alliance, which is formed by

montane steppe communities on the calcareous soils in the alpine and subalpine zones of Hacbaba mountain, located near Kazm Karabekir and Karaman, SW Central Anatolia, Turkey.

95. Klopatek, C. C.; DeBano, L. F., and Klopatek, J. M. Impact of fire on the microbial processes in pinyon-juniper woodlands: management implications. General Technical Report, US Department of Agriculture, Forest Service. RM-191. 1990; RM-191197-205.
Keywords: *Juniperus/ Pinus/* soils/ bacteria/ burning/ microbes
Abstract: Plants grown in soils burned when dry had a lower VAM colonization than soils burned when wet. Juniper soils demonstrated the greatest reduction (>95%). Nitrifying bacteria were less affected by burning when wet than dry, again with juniper soils showing the greatest reduction (>80%). Temperature effects and associated reductions in VAM and nitrifying bacteria were related to amount of litter burned in each microcosm and the moisture content of the soils.
96. Kolstrup, E. and Havemann, K. Weichselian *Juniperus* in the Froslev alluvial fan (Denmark). Bulletin, Geological Society of Denmark. 1984; 32121-131.
Keywords: *Juniperus/* Denmark/ alluvial fan
Abstract: In S Jutland pieces of juniper wood were found which, using radiocarbon-dating, comparison with palaeobotanical records and the stratigraphical sequence in the area, point to a probable age of approx 45 000yr BP.
97. Koniak, S. Broadcast seeding success in eight pinyon- juniper stands after wildfire. Research Note, US Department of Agriculture, Forest Service. 1983; INT 3344 pp.
Keywords: *Juniperus/ Pinus edulis/* seeding/ wildfire/ elevation
Abstract: The early plant communities following wildfire on low-elevation sites were dominated by annual forbs. Seeded grasses were present in small quantities on most sites, with highest occurrence on north slopes. On older burns annual forb production has decreased and seeded and annual grasses and shrubs shared dominance. The effectiveness of broadcast seeding varied with each burn, aspect, and elevational class. Successful seedlings generally can occur on all aspects and elevations if precipitation is normal or above normal the growing season following seeding. If precipitation is below normal, moderate seeding success may be achieved on high-elevation N- and W-facing sites and low -elevation N- and E-facing sites.
98. Kozhakhmetov, S. Effect of mineral fertilizers on the growth of juniper plantations. Lesnoe Khozyaistvo. 1983; 337-38.
Keywords: *Juniperus/* fertilizer/ plantations
Abstract: A note on fertilizer trials in 1976-80 in plantations of Central

Asian juniper established in 1970 on cinnamon-brown soil containing carbonates, at 1700-2500 m alt. Various doses and combinations of N, P and K were applied, and data are tabulated on height increment. The best response was achieved with NPK at rates of 50 kg/ha of each element.

99. Kruse, W. H. Community development in two adjacent pinyon-juniper eradication areas twenty-five years after treatment. *Journal Of Environ Manage.* 1979; 8237-247.
Keywords: *Juniperus* / eradication/ *Pinus*
100. Lacourse, T. and Gajewski, K. Late Quaternary vegetation history of Sulphur Lake, southwest Yukon Territory, Canada. *Arctic.* 2000 Mar; 53(1):27-35.
Keywords: *Juniperus*/ *Picea*/ *Alnus*/ paleoecology / pollen/ Yukon Territory/ Canada
Abstract: Palaeoecological studies based on the analysis of pollen in lake sediments offer the potential for high resolution and well-dated independent records of past vegetation and climate. A 5 m sediment core was raised from the deepest section of Sulphur Lake, located in the southwest Yukon (60.95 °N, 137.95 °W; 847 m a.s.l.). The pollen spectra indicate that before 11250 yr BP, the vegetation was a herbaceous tundra marked by the presence of *Artemisia*. However, the date of the establishment of this initial vegetation cannot be secured because of problems with the basal radiocarbon date and the lack of a reliable chronology of regional deglaciation. A birch shrub tundra prevailed between 11250 and 10 250 yr BP and was then replaced by a discontinuous poplar woodland. *Juniperus* populations expanded at 9500 yr BP, and by 8400 yr BP, *Picea* invaded the region. The white spruce forest that occupies the region today was established by approximately 8000 yr BP. *Alnus crispa* increased at 6000 yr BP, but the simultaneous increase in *Picea mariana* found at most sites in the Yukon was not present at Sulphur Lake. Black spruce was never a dominant component of the vegetation in the southwest Yukon, as it was in the south-central Yukon between 6100 and 4100 yr BP.
101. Ladyman, J. A. R. and Muldavin, E. Terrestrial cryptogams of pinyon-juniper woodlands in the southwestern United States: a review. General Technical Report Rocky Mountain Forest and Range Experiment Station, USDA Forest Service. (RM-GTR-280). 1996; RM-GRT -28033 pp.
Keywords: *Juniperus* / *Pinus*/ cryptogams/ soil stabilization/ nutrient cycling/ pinyon-juniper woodlands
Abstract: This literature review indicates that there is a substantial amount of quantitative evidence supporting the premise that cryptogamic crusts perform important ecological functions, particularly with respect to soil stabilization and nutrient cycling in pinyon-juniper woodlands of the SW USA.
102. Larina, T. G. and Bagrova, L. A. Investigation of recreational loads on the herbaceous cover of Juniper-Oak forests in the southern coast of the

Crimean oblast Ukrainian SSR USSR. Lesovedenie. 1987; 219-25.

Keywords: *Juniperus/ Quercus/* herbaceous cover/ Crimean/ restoration

Abstract: Resistance of herbaceous cover to recreative loads in juniper-oak forests of the Crimean South coast was studied. Digression stages and pattern of grass cover restoration have been revealed during a year after removing loads. The herbaceous cover of juniper-oak forests is found to be resistant to recreation.

103. Lavin, F.; Gomm, F. B., and Johnsen, T. N. Jr. Cultural, seasonal, and site effects on pinyon-juniper rangeland plantings. *Journal of Range Management*. 1973; 26(4):279-285.

Keywords: *Juniperus/ Pinus/ Agropyron trichophorum/ Agropyron desertorum/ Atriplex canescens/* rainfall

Abstract: In field trials in 1964-6, emergence and survival of *Agropyron trichophorum* cv. Luna and *A. desertorum* cv. Nordan were on average higher when sown in autumn than in summer but were much influenced by the pattern of rainfall. *Atriplex canescens* always emerged and survived better when sown in summer than in autumn. Ploughed seedbeds were best for controlling plant competition and for emergence and survival, which decreased progressively on seedbeds undercut with a weeder blade, seedbeds undercut with natural vegetation left in strips, and those pre-sprayed, sprayed and left untreated. Emergence and survival were always better in *A. canescens* and usually better in *A. desertorum* with surface drilling than with drilling into furrows on tilled but not on untilled seedbeds. Furrows were best when wide and shallow. There were some significant interactions among treatment combinations. Practical applications of results are discussed.

104. Laycock, W. A.; Monsen, S. B., and Stevens, R. Ecology and management of pinyon-juniper communities within the Interior West: overview of the "Ecological Session" of the symposium. *Proceedings Rocky Mountain Research Station, USDA Forest Service.*; (RMRS-P-9). 1999; RMRS -P-97-11.

Keywords: *Juniperus / Pinus/* ecological change/ succession/ seed banks/ seedling

Abstract: Categories of the 25 papers in the "Ecological Session" were history and ecological change, distribution, classification, ecology and physiology, succession and diversity, and disease. Substantial changes have taken place in pinyon-juniper (dominated by about 7 species of *Pinus* and 17 species of *Juniperus*) woodlands of the Interior Western USA over the past 150 years. Coinciding with and following early extensive localized harvesting, these woodlands have been dramatically expanding and thickening. Several authors predicted future large, severe fires. Ecological research reported included seed dispersal and banks, seedling establishment, and ecophysiological relations of pinyon and juniper. One model presented illustrated the process of increases in tree density and

cover and corresponding decreases in understory. This model would explain most of the processes and results reported in the other papers.

105. Layton, D. E. Methods of revegetation and restoration following a juniper wild fire. Society Of Range Management, Boise, Idaho. 1973.
Keywords: *Juniperus*/ revegetation/ restoration/ wild fire
106. Lee, Scott A.; Cregg, Bert M., and Fleege, Clark. Propagation of *Juniperus*: Challenges to propagation and opportunities for improvement. U S Forest Service General Technical Report Pnw. 1995; 36547-51.
Keywords: *Juniperus*/ propagation/ nursery/ germination
107. Lotter, Andre F. Late-glacial and Holocene vegetation history and dynamics as shown by pollen and plant macrofossil analyses in annually laminated sediments from Soppensee, central Switzerland. Vegetation History & Archaeobotany. 1999 Sep; 8(3):165-184.
Keywords: *Juniperus*/ pollen/ plant macrofossil/ sediments/ Holocene/ Switzerland
Abstract: The palynostratigraphy of two sediment cores from Soppensee, Central Switzerland (596 m asl) was correlated with nine regional pollen assemblage zones defined for the Swiss Plateau. This biostratigraphy shows that the sedimentary record of Soppensee includes the last 15 000 years, i.e. the entire Late-glacial and Holocene environmental history. The vegetation history of the Soppensee catchment was inferred by pollen and plant-macrofossil analyses on three different cores taken in the deepest part of the lake basin (27 m). On the basis of a high-resolution varve and calibrated radiocarbon chronology it was possible to estimate pollen accumulation rates, which together with the pollen percentage data, formed the basis for the interpretation of the past vegetation dynamics. The basal sediment dates back to the last glacial. After reforestation with juniper and birch at ca. 12 700 B.P., the vegetation changed at around 12 000 B.P. to a pine-birch woodland and at the onset of the Holocene to a mixed deciduous forest. At ca. 7000 B.P., fir expanded and dominated the vegetation with beech becoming predominant at ca. 500 14C-years later until sometime during the Iron Age. Large-scale deforestation, especially during the Middle Ages, altered the vegetation cover drastically. During the Late-glacial period two distinct regressive phases in vegetation development are demonstrated, namely, the Aegelsee oscillation (equivalent to the Older Dryas biozone) and the Younger Dryas biozone. No unambiguous evidence for Holocene climatic change was detected at Soppensee. Human presence is indicated by early cereal pollen and distinct pulses of forest clearance as a result of human activity can be observed from the Neolithic period onwards.
108. Lozano-Garcia, Maria Socorro E-mail mslozano@servidor.unam.mx; Ortega-Guerrero, Beatriz, and Sosa-Najera, Susana. Mid- to late-Wisconsin pollen record of San Felipe basin, Baja California. Quaternary Research (Orlando). 2002 Jul; 58(1):84-92.

Keywords: *Juniperus/ Pinus/ Artemisia/* pollen/ California/ sedimentation

Abstract: A lacustrine sequence from Laguna Seca San Felipe, Baja California, in the southwestern Sonoran Desert, provides the first record of mid- to late-Wisconsin vegetation in one of the driest regions of North America. Pollen analysis was performed in the intermediate part of the sequence from ca. 44,000 to ca. 13,000 ¹⁴C yr B.P. according to six ¹⁴C radiocarbon dates. Sedimentation of eolian sands prior to 44,000 ¹⁴C yr B.P. indicates dry conditions. High pollen concentration of montane and chaparral species in the pollen assemblages contrast with the modern desert vegetation. Sixty-four pollen types were identified. The source of mid- to late-Wisconsin sedimentation must have been the plant communities in the surrounding highlands of the basin. Mid-Wisconsin pollen assemblages dominated by pines, junipers, and *Artemisia* reflect humid conditions in the area. By late Wisconsin time, a significant increment in junipers indicates a lowering in the altitudinal ranges of woodlands/chaparral. Pollen from wind-pollinated species is abundant while desert plants, specifically animal or insect pollinated species, are poorly represented. The San Felipe record does not identify the Last Glacial Maximum as the time of greatest effective moisture, as suggested by pluvial lake levels and other palaeoclimatic evidence in the southwestern United States.

109. Lymbery G. A. Ecology of pinyon-juniper vegetation in south-central New Mexico. Dissertation Abstracts International, B. 1980; 41(4):1190.
Keywords: *Juniperus/ Pinus edulis/ Lycurus phleoides/* blue grama/ sideoats grama/ ecology/ New Mexico
Abstract: The influence and significance of topographic, edaphic and climatic variables on the structure of *Pinus edulis-Juniperus* spp. woodlands were determined and the understory characteristics were evaluated. The understory comprised 35% blue grama, 14% sideoats grama and 7% *Lycurus phleoides*.
110. Madar, Z.; Kimchi, M., and Solel, Z. Fusarium canker of Italian cypress. European Journal of Forest Pathology. 1996; 26(2):107-112.
Keywords: *Juniperus/ Cupressus/ Tetraclinis/ Thuja/ Cedrus/ Pinus/* Israel/ *Fusarium compactum/* disease
Abstract: A new disease, causing mortality of Italian cypress (*Cupressus sempervilens*) trees cv. 'Totem', was observed in an Israeli nursery. *Fusarium compactum* was isolated from cankers, and its pathogenicity was confirmed by Koch's test. The fungus readily formed conidia and chlamydospores in DDA culture. Growth of *F. compactum* was fastest at 26-30 ° C. Artificial inoculations with *F. compactum* caused severe cankering of several species of each of the following coniferous genera: *Cupressus, Juniperus, Tetraclinis, Thuja, Cedrus and Pinus*. Canker development was significantly enhanced when extreme water stress was imposed on cypress saplings prior to inoculation.

111. McDaniel, P. A. and Graham, R. C. Organic carbon distributions in shallow soils of pinyon-juniper woodlands. *Soil Science Society of America Journal*. 1992; 56(2):499-504.
Keywords: *Juniperus/ Pinus edulis/* soils/ organic carbon distributions/ woodlands
Abstract: Properties of soils associated with pinyon (*Pinus edulis*) juniper (*Juniperus*) communities of the western USA reflect a mosaic of canopy and interspace environments. The influence of these contrasting environments on organic carbon (OC) distributions and associated soil properties of shallow soils in a pinyon-juniper woodland of east-central Utah was examined. The mosaic of interspace and canopy environments results in a complex of soils with two distinct OC distribution patterns. In both interspace and canopy soils, color values and root distributions are related to measured OC. Tree roots are concentrated just above the lithic contact in transitional R/A and Cr/A horizons in all soils. Decay of this root material represents the dominant organic-matter input to interspace soils, which are essentially devoid of vegetation and lack O horizons. As a result, OC increases with depth and the highest OC contents and darkest soil colors are found in R/A and Cr/A horizons of these soils. Canopy soils also have relatively high OC contents just above lithic contacts but contain maximum OC and darkest soil colors in Al horizons underlying litter layers. All soils exhibit increases or irregular decreases in OC with depth and have similar distribution patterns for total N and NaHCO₃-extractable P. The OC distribution patterns result in inappropriate classification of some of these shallow upland soils as Fluvents according to the USA soil taxonomy.
112. Meeuwig, R. O. Stand dynamics and managements alternatives for pinyon-juniper woodlands. *Managing Intermountain Rangelands Improvement of Range and Wildlife Habitats* [Monsen S. B.; Shaw N. Compilers]. 1983; 172-175.
Keywords: *Juniperus/ Pinus/* wildlife/ livestock/ fuelwood
Abstract: Management of *Pinus/Juniperus* woodlands for wildlife or livestock range and for fuelwood and woodland products is discussed. The disadvantages are considered.
113. Mehra, P. N. Conifers of the Himalayas with particular reference to the *Abies* and *Juniperus* complexes. *Nucleus, India*. 1976; 19(2):123-139.
Keywords: *Juniperus/ Abies pindrow/ Abies spectabilis/ Abies forrestii* / woody plants/ genetics/ chromosome morphology.
Abstract: Information is presented on (1) hybridization between *A. pindrow* and *A. spectabilis* in a zone in the western Himalayas around 3000 m altitude and intermediate to the distribution zones of these species; (2) caryotypes of *A. pindrow*, *A. spectabilis* and *A. forrestii*; (3) the taxonomy of the nine Himalayan species of the genus *Juniperus*, and (4) chromosome numbers of some of these species.

114. Meirovitch, A. Techniques for grafting junipers. *Hassadeh*. 1985; 65(11):2247-2249.
Keywords: *Juniperus/ Cupressus sempervirens/* rootstocks/ grafting/ propagation
Abstract: After briefly reviewing the advantages of propagating *Juniperus* by grafting, various techniques are described and illustrated. Rootstocks of *Cupressus sempervirens* seedlings and other *Cupressaceae* were suitable. Scion take was > 80%.
115. Meng-Zhu, L.; Szmidt, A. E., and Wan, X. R. RNA editing in gymnosperms and its impact on the evolution of the mitochondrial *coxI* gene. *Plant Molecular Biology*. 1998; 37(2):225-234.
Keywords: *Juniperus/ Larix/ Ginkgo/* gymnosperms/ mitochondria/ molecular evolution/ nucleotide substitution/ RNA editing.
Abstract: Sequence analysis of the mitochondrial *coxI* gene in eight gymnosperm species revealed a high rate of non-synonymous nucleotide substitutions with a strong (98%) predominance of C-T substitutions. Further analysis of the corresponding *coxI* cDNA sequences showed that all the non-synonymous C-T changes in the *coxI* genomic DNA sequences were eliminated by RNA editing in nearly identical mRNA (amino acid) sequences among the species. Pronounced variation in the number and location of edited sites were found among species. Most species had a relatively large number of edited sites (from 25 to 34). However, no RNA editing of the *coxI* sequence was found in *Ginkgo biloba* or *Larix sibirica*. The sequence composition of the investigated *coxI* fragment suggests that the *coxI* gene in *G. biloba* and *L. sibirica* originated from edited mitochondrial *coxI* transcripts by reverse transcription followed by insertion into the nuclear genome or back into the mitochondrial genome. Our results also demonstrate that where there are a large number of edited sites, RNA editing can accelerate the divergence of nucleotide sequences among species.
116. Meyer, J.; Mac Carthaigh, D., and Rosocha, C. Climatic conditions in plastic film greenhouses for the overwintering of nursery stock. *Gartenbauwissenschaft*. 1988; 53(1):17-21.
Keywords: *Juniperus/* greenhouse/ nursery/ temperature
Abstract: The course of the air temperature and the temperature in plant substrates in pots was examined in PE-greenhouses, low-tunnels and in the open. Daily temperature differences of up to 35 K occurred on days with high solar radiation in the PE-greenhouse. The temperature in the low tunnels remained much more even so that neither very high nor very low temperatures occurred. A 2 cm layer of sphagnum peat or styromull insulated the substrate from the extremes of high and low temperature. The evergreen, *Juniperus*, showed a similar effect on substrate temperature. The daily temperature variations on the substrate of pot plants at the edge of the beds were considerably higher than in the center.

117. Mieke, G.; Mieke, S.; Koch, K., and Will, M. Sacred forests in Tibet: Using geographical information systems for forest rehabilitation. Mountain Research & Development. 2003; 23(4):324-328.
Keywords: *Juniperus*/ Tibet/ GIS/ rehabilitation
Abstract: The treeless desertlike environments of southern Tibet are assumed to be naturally unsuitable for forests. Yet, climatic conditions do allow for the growth of indigenous trees in Lhasa and many parts of southern Tibet, even where there is no high groundwater table or irrigation. This was discovered and proven in a Sino-German research project launched in 1997. The project made an inventory of forest relics, correlated residual tree stands with climatic data, and successfully cultivated nonirrigated indigenous junipers and cypresses. The eroded semi-desert landscape of southern Tibet appears to have a huge potential for reforestation. The area with a potential for tree growth was investigated using the Geographical Information System known as GRASS (Geographical Resource Analysis Support System). Reforestation measures could meet the heavy demand for timber and firewood, help combat erosion on overgrazed slopes, and restore the degraded pastures. Grazing must be excluded on reforestation plots. Simultaneously, rangelands may regenerate after overgrazing. The optimum duration of the ungrazed period varies with altitude, humidity, soil conditions, and the degree of degradation. Successional trends observed on exclosure plots suggest that the drier the climate and the lower the initial degree of herbaceous vegetation cover, the longer the ungrazed period will be beneficial for pasture regeneration. Challenges in research and practice resulting from these preliminary results are highlighted.
118. Miller, G. R. Reprint author; Cummins, R. P. Author, and Hester, A. J. Author. Red deer and woodland regeneration in the Cairngorms. Scottish Forestry. 1998; 52(1):14-20.
Keywords: *Juniperus*/ red deer/ Scotland/ regeneration
Abstract: Many of the few remaining patches of natural woodland in the Cairngorms are failing to regenerate because tree and shrub saplings are repeatedly checked or killed by browsing red deer. Liability to browsing is governed by a complex of interacting factors including a sapling's physical and chemical properties, season of year, availability of alternative foods, soil conditions, nature of surrounding vegetation and local red deer density. Amongst common native tree and shrub species in the Cairngorms, deer prefer to eat rowan but generally take juniper only when alternative foods are scarce. Young Scots pine saplings are the most easily killed by browsing whereas birch and rowan can survive repeated damage. Many saplings, including pines, are maintained in a suppressed state by repeated browsing. These plants constitute an often long-lived 'sapling bank' from which rapid growth can occur once browsing pressure has been relieved. On unburned ground in the Cairngorms, conditions for tree regeneration are currently most favorable at altitudes greater than 550 m because here there are (a) fewer deer and (b) more gaps for seedling

establishment than is the case on lower ground. Reducing red deer density to fewer than about 5 animals per km² increases the possibility of woodland regeneration everywhere. However, this in itself may be insufficient to produce good seedling establishment in dense ericoid or graminoid vegetation with its associated deep moor humus layer. Ground preparation by fire or by mechanical disturbance may be necessary in such circumstances if rapid and extensive regeneration is required.

119. Min S. H.; Han J. S.; Shin E. W., and Park J. K. Improvement of cadmium ion removal by base treatment of juniper fiber. *Water Research Oxford*. 2004; 38(5):1289-1295.
Keywords: *Juniperus*/ cadmium/ fiber
Abstract: Juniper is a small-diameter underutilized lignocellulosic material. We evaluated the efficacy of base-treated juniper fiber (BTJF) for cadmium (Cd²⁺) sorption and the viability of juniper fiber as a sorbent for removing Cd²⁺ from water. Fourier transform infrared spectroscopy analysis indicated that carboxylate ion is a major functional group responsible for Cd²⁺ sorption. The apparent ideal sodium hydroxide concentration for base treatment is approximately 0.5 M. A batch sorption isotherm test showed that equilibrium sorption data were better represented by the Langmuir model than the Freundlich model. After base treatment, the maximum Cd²⁺ sorption loading, Q_{max}, was greatly improved (9.18-29.54 mg/g), despite a decrease in specific surface area. A pseudo-second-order kinetic model fitted well for the sorption of Cd²⁺ onto BTJF. Initial metal ion concentration and treatment alkalinity were found to be major parameters influencing the kinetics of the sorption reaction. As a result of its strong ability to bind cadmium and its faster kinetics in low concentration, BTJF could be an inexpensive and efficient sorbent for removing heavy metals from stormwater runoff.
120. Mitchell R.; Britton C.; Racher B.; Fish E., and Atkinson E. Prescribed fire costs on Juniper-Infested Rangeland. *Rangelands*. 2000; 22(5):7-10.
Keywords: *Juniperus* / prescribed fire/ costs/ Texas
Abstract: What are the true costs of prescribed fire on juniper infested rangelands? Redberry juniper is a basal sprouting, multistemmed evergreen tree growing on rocky slopes with shallow soils. Although several options are available for managing redberry juniper, prescribed fire is considered the least expensive. Many professionals recommend the application of prescribed fire without knowledge of the actual total costs. Individuals considering contract burning for producers have no guidelines for estimating costs. Factors such as total labor hours, miles driven, torch fuel, and food costs influence the actual cost of burning, but are often overlooked or difficult to estimate without experience. Texas Tech University has 30 years of experience conducting burns for producers in Texas, New Mexico, and Oklahoma. This experience is applied to 3 examples which illustrate the total costs for applying prescribed fire. The pastures used were infested by redberry juniper and burned in the spring

1998. These pastures represented a spectrum of pastures capable of being ignited from the ground with drip torches.

121. Monsen S. B. and Stevens R. Proceedings: Ecology and management of pinyon-juniper communities within the Interior West, September 15-18, 1997, Brigham Young University Conference Center, Provo, Utah. Proceedings Rocky Mountain Research Station, USDA Forest Service. (RMRS-P-9). 1999; RMRS -P-9(VII):409pp.
Keywords: *Juniperus/ Pinus/* forest management/ plant communities/ synecology
Abstract: Papers and posters given by scientists, land managers and educators were presented in four sessions on ecology, resource values, ecological restoration and management implications.
122. Muderrisoglu, S. The species and varieties of *Juniperus* occurring in Turkey. Ormancilik Arastirma Enstitusu Dergisi. 1971; 17(1):3-54.
Keywords: *Juniperus/* Turkey/ taxonomy/ anatomy/ ecology/ silviculture
Abstract: Gives an illustrated systematic account of the species and subspecies of *Juniperus* occurring in Turkey, with details of their taxonomy, anatomy, distribution, ecology, silviculture, etc.
123. Mukhamedshin, K. D. Variation in the increment of Juniper in the high mountains of the Tien-Shan over the last millennium of the Holocene. Tr 5 Go Vses Soveshch Po Probl' Astrofiz Yavleniya I Radiouglerod 1973'. 1974; 149-161.
Keywords: *Juniperus/* dendrochronology/ Soviet Central Asia/ ring width
Abstract: Gives results of dendrochronological studies on 1580 specimens of free-standing Junipers in Soviet Central Asia. From 18 trees aged 452-1214 years, felled at an altitude of 2900-3500 m on a N. slope, a 1214-year chronology was established. Positive extremes in ring width coincided with the explosions of novae and supernovae.
124. Mukhamedshin, K. D. and Kozhukhov, V. P. Statistical characteristics and correlations of mensurational characteristics of Juniper forests in the Kopet-Dag. Zap Zabaikal Fil Geogr o Va SSSR. 1972; 7157-59.
Keywords: *Juniperus/* distribution/ Soviet Central Asia/ diameter/ height/ crown diameter/ regeneration/ stand density
Abstract: Gives details of the distribution and variation of d.b.h., height, and crown diameter in three different types of Juniper forests in Soviet Central Asia. Analyses are also made of variation in age, regeneration, stand density, etc., and of correlations between height, d.b.h., and crown diameter by forest types.
125. Mukhamedshin. K. D.; Nabatov. N. M., and Shamshiev. B. N. Condition of the juniper forests of Kirghizia, and measures to conserve and regenerate

them. *Lesnoe Khozyaistvo*. 1996; 627-29.

Keywords: *Juniperus*/ nature conservation/ national parks/ rehabilitation/ Kyrgyzstan

Abstract: The history of utilization of the *Juniperus* forests of Kyrgyzstan during this century is reviewed, and data are presented on changes in the area and standing volume from 1941 to 1993 (161 100 ha and 3.82 million m³ of tree-like junipers, and 41 300 ha and 0.55 million m³ of shrubby junipers in 1993). Details are given of distribution by age-classes, viz. young middle-aged, approaching maturity, and mature or overmature. The problem of forest grazing is discussed, with data on the numbers of cattle, sheep, goats and horses grazed, and the categories of ownership (state farms, private farmers etc). Various conservation measures have been taken in recent years, viz. the establishment of a national (juniper) park on 11 172 ha, and the transfer of 11 166 ha of badly eroded land to forest enterprises for long-term rehabilitation and regeneration (target 300 ha per annum).

126. Neal, J. C. and Senesac, A. F. Preemergent weed control in container and field grown woody nursery crops with gallery. *Journal of Environmental Horticulture*. 1990; 8(3):103-107.

Keywords: *Juniperus*/ gallery/ weed control/ herbicide/ injury/ container

Abstract: Two container and four field tests were conducted to evaluate Gallery (isoxaben) for preemergent weed control in container and field grown woody nursery crops. Gallery was applied to newly potted nursery crops at 0.56 and 1.1 kg ai/ha (0.5 and 1 lb ai/A) alone and in combination with Surflan (oryzalin) or Treflan (trifluralin). No injury was observed on container grown azalea 'Coral Bells', Rhododendron 'Roseum Elegans', rockspray cotoneaster, forsythia, potentilla 'Tangerine', Japanese dwarf garden juniper, 'Old Gold' juniper, or plaintain lily 'Albo-marginata.' Gallery, applied alone, caused no injury to field grown sawara false cypress, honey locust, Japanese yew, California privet, 'San Jose' holly, white pine, Douglas fir, white fir, green ash, or Japanese rose. Gallery injured field grown common lilac. When combined with Surflan, temporary reduction in white fir and Japanese barberry quality resulted. Douglas fir was injured significantly by Surflan, alone or in combination with Gallery. Gallery provided excellent control of many broadleaf weeds including pigweed, common groundsel, and dandelion, but poor control of annual grasses such as crabgrass, goosegrass, and fall panicum. The combination of Gallery plus Sarflan provided an expanded spectrum and weed control with excellent safety on most container and field grown woody nursery crops.

127. Newton, S. F. and Newton, A. V. Seasonal changes in the abundance and diversity of birds in threatened juniper forest in the southern Asir mountains, Saudi Arabia. *Bird Conservation International*. 1996; 6(4):371-392.

Keywords: *Juniperus*/ *Turdus menachensis*/ *Parisoma buryi*/ *Carduelis*

yemenensis/ Saudi Arabia/ birds

Abstract: Juniper forest once covered much of the upper slopes (2000-3000 m) of the Rift Valley escarpment. One of the best preserved is at Raydah near Abha, where a complete altitudinal floristic zonation persists. Although only 125 bird species have been recorded in the area, the community is of considerable conservation interest due to high densities of endemic species and resident or breeding Afrotropical forest species, together with a wide range of diurnal raptors, owls and nightjars. The forest does not support many Palearctic-African migrants during periods of passage, although several Palearctic species overwinter in considerable numbers. Scrub and mixed deciduous and riparian forest scattered throughout the junipers hold highest bird diversities but the juniper stands are vitally important to the well-being of Yemen thrush *Turdus menachensis*, Yemen warbler *Parisoma buryi* and Yemen linnet *Carduelis yemenensis* populations. The disappearance of juniper forest from neighboring Yemen necessitates that highest priority conservation action should be given to remaining intact forests.

128. Novak, D. and Potucek, V. Some effects of juniper oils on mosquitoes and flies. Einige Wirkungen von Wacholderolen an Stechmücken und Fliegen. Dipterologica Bohemoslovaca 1 Proceedings of the IVth Meeting of Czechoslovak Dipterists. 1978; 189-192.
Keywords: *Juniperus*/ *Diptera*/ *Aedes*/ *Anopheles*/ *Culex*/ *Musca*/ *Fannia*/ essential oils
Abstract: Juniper oils are known to contain substances that repel mosquitoes and other species of *Diptera*. The authors review the literature on the subject and describe tests in Czechoslovakia in which two fractions, a light and a heavy one, were investigated for repellency to mosquitoes and flies. The composition of the fractions was unknown, but the light one was colorless and the heavy one a light green. The heavy fraction was found to have some toxic effect on second-instar larvae of *Aedes* and *Anopheles*, and a smoke candle impregnated with it killed adults of *Culex pipiens* L. in cages within 1 h. In a field test in a wood, one hand of the experimenter was treated with an oil mixture containing the heavy fraction. Mosquitoes of the genus *Aedes* attacked the untreated hand readily, while the treated one was completely protected for 5 min. When a window pane was treated with the heavy fraction in a room, it was avoided by adults of *Musca domestica* L., and a chandelier was similarly protected from *Fannia canicularis* (L.). Further work is suggested, particularly since juniper oils are known to possess also antimicrobial, phytocide and antiprotozoa properties.
129. Osipov, Yu. S.; Abseitov, S. Yu.; Stenyukov, A. B., and Kozlov, L. A. The MIS-0,2 machine for extracting seeds from the arils of juniper. Lesnoe Khozyaistvo. 1985; 954-55.
Keywords: *Juniperus*/ seeds/ arils/ extraction machinery/ Turkmen/ berries

Abstract: An account is given of the design of an experimental machine developed in the Turkmen SSR for extracting seeds from the 'berries' of Central Asian junipers. The extraction is done by means of rasping discs and a flotation tank. In trials the quantity of seeds extracted was close to 100%, and the quality of the work was high. The output was 97 kg/h.

130. Pacini, E.; Franchi, G. G., and Ripaccioli, M. Ripe pollen structure and histochemistry of some gymnosperms. *Plant Systematics & Evolution*. 1999 May 31; 217(1-2):81-99.
Keywords: *Juniperus*/ gymnosperms/ pollen/ histochemistry
Abstract: Some aspects of pollen cytology at dispersal were studied in 12 species of gymnosperms. The pollen grains differed in: 1. volume and cell number; 2. polarization of external structure and internal cell components; 3. wall thickness, especially of the intine, and the resulting percentage of cell volume with respect to total pollen grain volume; 4. stratification and chemical nature of the various intine layers; 5. nature and location of polysaccharide reserves; 6. morphological differences between the dry and hydrated states and phenomena related to hydration; 7. presence and site of orbicles. The various characters are compared and discussed in relation to the length of the reproductive cycle and the relations between the male gametophyte and its female counterpart.
131. Padien, Daniel J. and Lajtha, Kate. Plant spatial pattern and nutrient distribution in pinyon-juniper woodlands along an elevational gradient in Northern New Mexico. *International Journal of Plant Sciences*. 1992; 153(3 Part 1):425-433.
Keywords: *Juniperus*/ pinyon/ New Mexico/ spatial pattern/ nutrient distribution
Abstract: Plant and soil resource spatial patterns were measured in pinyon-juniper communities in northern New Mexico (USA) over an elevational gradient that also served as a water-availability gradient to examine the role of resource competition and resource availability in determining plant spatial patterns. Total canopy coverage increased with increasing elevation. Percent coverage of juniper declined with elevation and, with the exception of one site, that of pinyon increased. Water appeared to be a strong factor in the maintenance of stand structure and plant distribution in this pinyon-juniper ecosystem. Plant water stress was greater during the dry season at the low-elevation, low-density sites than at the upper-elevation, higher-density sites. At the upper-elevation sites, plant distributions were significantly more clumped than at the drier sites; only at these low-elevation sites was there a significantly negative relationship between plant size and distance to nearest neighbor and a trend toward regular spacing. Juveniles were significantly clumped with respect to adults at all sites, with this trend most significant in seedlings, but seedlings did not show an affinity for the canopy of conspecific adults. Nitrogen availability was greater in canopy soils than in intercanopy soils, although a significant water-availability gradient was not seen across a

canopy-intercanopy transect. Thus, seedling establishment patterns could result from nutrient-availability differences, shade protection, or seed-dispersal and germination patterns, but probably not from microsite water differences.

132. Pandza, M. Vegetation of Phoenician juniper macchia - *Pistacio lentisci-juniperetum phoeniceae* Trinajstic 1987 (*Oleo-Ceratonion* Br.-Bl.) on the island of Murter and the small surrounding islands. *Natura Croatica*. 2004; 13(3):201-212.
Keywords: *Juniperus*/ Croatia/ botanical composition/ plant communities.
Abstract: Through plant geography research into the evergreen macchia vegetation on the island of Murter (Croatia) done in the last ten years, two clearly differentiated alliances inside the class *Quercetea ilicis-Quercion ilicis* and *Oleo-Ceratonion* were determined. In the alliance *Quercion ilicis* are the following associations: *Myrto-Quercetum ilicis*; *Fraxino orni-Quercetum ilicis*; *Ostryo-Quercetum ilicis* and in the alliance *Oleo-Ceratonion*, the associations of the xerothermal Phoenician juniper macchia - *Pistacio lentisci-Juniperetum phoeniceae* and *Quercus ilicis-Pinetum halepensis*. Xerothermal Phoenician juniper macchia constitutes a stage of the progression towards the development of evergreen forest vegetation after the termination of anthropogenic impact. It develops in the neglected olive-groves, vineyards, garrigues and rocky pasture lands on the island and the surrounding small islands. A total of 27 phytocoenological releves were made and analyzed using the classical Braun-Blanquet method.
133. Pellant, M.; Monsen, S. B., and Stevens, R. Ecology and management of pinyon-juniper communities within the Interior West: overview of the "Management Implications Session" of the symposium. *Proceedings Rocky Mountain Research Station, USDA Forest Service.*; (RMRS-P-9). 1999; RMRS-P-9357-360.
Keywords: *Juniperus*/ *Pinus*/ ecology/ management
Abstract: Categories of the 12 papers in the "Management Implications Session" were (1) ecological guidelines and thresholds, (2) collaboration, (3) rehabilitation after wildfire, (4) weed management, and (5) miscellaneous management topics. The application of science, experience, and collaboration is a necessity for properly managing these diverse and ecologically complex ecosystems. Failure to undertake this task could result in woodland landscapes dominated by weeds and frequent and intense disturbance events.
134. Penalba, M. Cristina; Arnold, Maurice; Guiot, Joel; Duplessy, Jean-Claude, and De Beaulieu, Jacques-Louis. Termination of the last glaciation in the Iberian Peninsula inferred from the pollen sequence of Quintanar de la Sierra. *Quaternary Research* (Orlando). 1997 Sep; 48(2):205-214.
Keywords: *Juniperus*/ *Betula*/ *Pinus*/ pollen/ Spain/ Younger Dryas

Abstract: A 4.5-m-thick late-glacial pollen sequence, supported by 17 AMS ^{14}C dates, has been investigated at the Quintanar de la Sierra marshland (Iberian cordillera, north-central Spain). Pollen zones were defined that correspond to successive phases in vegetation history during the end of the Late Wurm, late-glacial interstade, and Younger Dryas periods. A transfer function approach has been adopted to derive quantitative climate estimates from the pollen assemblage data. A first expansion of *Juniperus* and *Hippophae*, about 13,500 ^{14}C yr B.P., indicates the beginning of the late-glacial interstade which is characterized by a *Juniperus-Betula-Pinus* succession that suggests higher temperatures and moisture than during full-glacial time. The Younger Dryas interval is recorded by a 120-cm-thick sediment unit that is dominated by herbaceous pollen. Transfer function estimates suggest that the climate during this period was cold, with low precipitation during most of the year, although not in summer. The Holocene arboreal recolonization in the area started about 10,000 ^{14}C Yr B.P., with a renewed *Juniperus-Betula-Pinus* succession related to a strong increase in annual temperature and precipitation. The start of this process was synchronous with mean sea-surface temperature changes, as recorded from the nearby SU 81-18 marine core. The strong affinity with other European late-glacial pollen sequences demonstrates that the pattern of climatic changes during the last glacial-interglacial transition was similar in both northwestern and southwestern Europe.

135. Peternel, Renata E-mail renata.peternel@publichealth-zagreb.hr; Culig, Josip Mitic Bozena, and Hrga, Ivana Vukusic Ivan. Airborne pollen spectra at three sites in inland Croatia, 2003. Botanical Bulletin of Academia Sinica (Taipei). 2005 Jan; 46(1):53-59.
- Keywords:** *Juniperus/ Taxus/ Carpinus/ Quercus/ Poaceae/ Betula/ Ambrosia/ Corylus/ Artemisia/ Urticaceae/ pollen/ Croatia*
- Abstract:** The aim of this study was to determine whether there were major differences in the seasonal incidence and abundance of pollen grains and pollen types in pollen fall between sites of different land use. The material was collected from 5 January until 20 December 2003 at three sites in central Croatia. The sampling sites were located in an average urban setting (Zagreb), a rural setting (Ivanic Grad), and a small town surrounded by a large woodland with partially thermophilic vegetation (Samobor). Using the volumetric method of pollen collection, pollen grains of 3537 taxa were identified, depending on the sampling site, eight of them producing the greatest amount of pollen (*Alnus* sp., *Ambrosia* sp., *Betula* sp., *Carpinus* sp., *Poaceae*, *Quercus* sp., *Taxus/Juniperus*, and *Urticaceae*). Differences among the sampling sites were recorded according to seasonal pollen concentration, total monthly pollen count, and total annual pollen count. The proportion of particular plant classes (tree, grass and weed) was quite comparable among the three sampling sites because of their relative geographic proximity (i.e. within the same climatic region). A difference was observed in the air pollen

concentration. All three monitoring sites revealed the total annual airborne pollen concentration in inland Croatia to be dominated by highly allergenic pollen (Zagreb 54%, Samobor 58% and Ivanic Grad 82%) of the following taxa: *Alnus* sp., *Ambrosia* sp., *Betula* sp., *Carpinus* sp., *Corylus* sp., *Poaceae*, *Urticaceae* and *Artemisia* sp. Accordingly, there were no distinct phenologically induced differences in pollen species recorded at the three monitoring sites. However, substantial differences were observed in seasonal pollen grain count and in the percentage proportion of some allergenic pollen grains (*Ambrosia* sp., *Betula* sp., *Carpinus* sp., *Poaceae*), providing valuable information to individuals suffering from pollen allergy.

136. Peterson, G. W. Pine and juniper diseases in the Great Plains. General Technical Report, Rocky Mountain Forest and Range Experiment Station, USDA Forest Service. (RM-86). 1981; RM-86(II):47.
Keywords: *Juniperus/ Scirrhia/ Diplodia / Endocronartium/ Phomopsis/ Cercospora/ Kabatina/ Pratylenchus/* diseases/ Great Plains
Abstract: Symptoms, biology and control are described for: Dothistroma needle blight [*Scirrhia pini*], brown spot needle blight (*Scirrhia acicola*), Naemacyclus needle cast (*N. minor*), *Diplodia* blight (*D. pinea*) and western gall rust [*Endocronartium harknessii*] attacking *Pinus* in the USA; and *Phomopsis* blight (*P. juniperivora*), *Cercospora* blight (*C. sequoiae*), and *Kabatina* blight (*K. juniperi*) attacking *Juniperus*. Nematode (*Pratylenchus penetrans*) damage to the roots of both genera is also discussed.
137. Pini, Roberta Author Reprint Author and E-mail: cnrbg@uninetcom.it]. A high-resolution Late-Glacial: Holocene pollen diagram from Pian di Gembro (Central Alps, Northern Italy). Vegetation History & Archaeobotany. 2002 Dec; 11(4):251-262.
Keywords: *Juniperus/ Abies/ Fagus/ Castanea/ Corylus/ Alnus/* pollen/ Italy
Abstract: The local and regional history of vegetation and climate, from the Late Glacial to the present, is represented in a new, high-resolution pollen diagram from Pian di Gembro (1350 m asl), ten 14C dates providing a reliable time control. An open pioneer vegetation dominated by *Artemisia*, *Gramineae*, and *Chenopodiaceae* followed the retreat of the glaciers after the Last Glacial Maximum. Shrub vegetation with *Juniperus*, *Alnus viridis*, and *Salix* expanded soon after. Denser *Betula*-*Pinus* forests were present in Pian di Gembro around 12,320 B.P. Their extent was greatly reduced by the climatic cooling of the Younger Dryas, when open vegetation spread again. The beginning of the Holocene was marked by a considerable expansion in mixed oak taxa. *Corylus* immigrated to the site at 9,250 B.P. *Picea* and *Abies* expanded at 7,370 B.P., recording an abrupt change in the structure of the vegetational belts. A coeval climatic change is evidenced in the GRIP records and also detectable through oscillations of the timberline. Signs of human impact are present since late Atlantic,

becoming more intense around 2,200 B.P. As pasture lands increased, *Abies* and *Fagus* slowly disappeared. The introduction of *Castanea* and *Juglans* is dated to Roman times, and *Secale* to the Middle Ages.

138. Pridnya, M V Reprint author. Populational and biological aspects of the preservation of the pool of the genes and the cenoses of relict forests in the western Caucasus USSR. *Ekologiya* (Moscow). 1986; 63-8.
Keywords: *Juniperus/ Betula/ Pinus/ Fagus/ Quercus/ Abies/ Rhododendron/ Fraxinus/ Sorbus/ Carpinus/ Tilia/ Caucasus/ genes*
Abstract: The state of the protection of the pool of the genes and cenoses of Ancient Tertiary forests was considered. The forests are represented in the nature-preservation pool insufficiently. The danger of the loss of unique species and phytocenoses was shown. Need for the development of population-biological methods for preserving forest ecosystems was substantiated. Oak, Nordmann fir, oriental and European beech, *Pinus hamata*, *Betula litwinivii*, red-bud maple. Caucasian rhododendron, juniper, mountain ash, hornbeam, linden and ash were mentioned.
139. Proskuryakova, G. M. *Juniperus* spp. of Turkmenstan and their conservation problems. *Akademiia Nauk Turkmenskoi SSR, Ashkhabad, Izvestiya, Seriya Biologicheskikh Nauk.* 1978; 434-41.
Keywords: *Juniperus/ Turkmenstan/ conservation*
Abstract: Several species of juniper are described and measures necessary to preserve them are discussed.
140. Rankin W T [Reprint author] and Pickett S T A [Author]. Time of establishment of red maple *Acer rubrum* in early oldfield succession. *Bulletin of the Torrey Botanical Club.* 1989; 116(2):182-186.
Keywords: *Juniperus/ Fraxinus/ Carya/ Quercus/ Ulmus/ Prunus/ red maple/ Acer rubrum*
Abstract: All woody stems in an old field 14 years after abandonment were cut and all individuals aged at ground level. Ninety per cent of established red maple, the structural and numerical dominant in the field, had invaded within the first 7 years since abandonment. *Fraxinus americana*, the second most important woody species, showed the reverse skew, with the majority of individuals being recent invaders. The remaining woody species, including species of *Carya*, *Quercus*, *Ulmus*, *Prunus*, and *Juniperus*, also showed delayed invasion. Young saplings were clumped in space, whereas old saplings were regularly distributed. To determine whether predation by small mammals was responsible for the cessation of establishment of red maple, partially caged seedlings were set out in a 2-yr old field, the 14-yr old field, and the adjacent old-growth forest. The highest predation intensity was found in the youngest field, a pattern the reverse of that expected if predation were responsible for the closure of the maple establishment window. That predation on seedlings had differential impact along the successional gradient represented by the different adjacent sites calls attention to the potential for impact of

seedling predation in succession.

141. Reille, M. Reprint author and Andrieu, V. Author. The late Pleistocene and Holocene in the Lourdes Basin, Western Pyrenees, France: New pollen analytical and chronological data. *Vegetation History & Archaeobotany*. 1995; 4(1):1-21.
Keywords: *Juniperus/ Betula/ Artemisia/ Quercus/ Ulmus/ Corylus/ pollen/ Holocene/ Pleistocene/ Poaceae*
Abstract: In the Lourdes Basin, pollen analytical results and 41 ¹⁴C dates from three sites (four profiles, 538 spectra) have enabled a coherent biostratigraphy to be established from the last Pleniglacial to the present. The end of the Wurm Pleniglacial is characterized by a long phase dominated by *Poaceae* that extended from ca. 20 000 to ca. 15 000 B.P. Another phase with *Poaceae*, in the context of a treeless environment, is recorded during the late-glacial between the *Juniperus* optimum (ca. 13 000 B.P.) and the *Betula* optimum (after ca. 12 500 B.P.). A marked decline in *Betula* and a rise in *Artemisia* values suggest a significant cooling of the climate during the Younger Dryas, an event which is now clearly recorded at several sites in southern Europe. The beginning of the Holocene is characterized by the minor role of *Pinus* and the early arrival of *Quercus* which achieves an absolute maximum before the arrival of *Ulmus* and *Corylus*. A critical assessment of previously published data is made in the light of these new results.
142. Richard, H. Pollen evidence of an early Neolithic presence on the Jura range at the VIth and Vth millenia. *Quaternaire*. 1997; 8(1):55-62.
Keywords: *Juniperus/ Ulmus/ Corylus/ pollen/ Jura range/ Plantago lanceolata/ Artemisia/ Rumex/ Chenopodiaceae/ Urticaceae*
Abstract: Pollen revealing human influence on the vegetation cover have been systematically sought out in pollen records from the Jura range. These anthropogenic indicators are: cereals, *Plantago lanceolata* and major/media, *Artemisia*, *Rumex*, *Chenopodiaceae*, *Urticaceae*, and variations of some shrubs and trees pollen like *Ulmus*, *Corylus* and *Juniperus*. The first cereals pollen evidence are dated to about 5800 cal. BC, but in only one site and with a few other anthropogenic indicators. Consequently, this first phase should be confirmed on other sites. Then, three phases are demonstrated: around 5500 cal. BC, between 5100 and 4500-4400 cal. BC (with a maximum around 4900 cal. BC, exactly at the older-younger Atlantic transition), and the last from 4300 cal. BC. The archaeological research carried out within the Jura range shows classically that the early Neolithic is influenced by two different cultures: the Linear Bandkeramik coming from the alsacian plain and a Mediterranean tradition from the Saone-Rhone valleys. In the 'Trouee de Belfort', a region located at low altitude, the mesolithic communities are deeply affected by the neolithic process from mid VIth millenium. In spite

of a much higher altitude, Neolithic influence is perceived in the Swiss Jura at an altitude of 1100 m as soon as the early Vth millenium. The Mesolithic-Neolithic transition can be considered complete at an altitude between 700-1000 m from around 4000 cal. BC. The comparison of the lake level fluctuations in the Jura and subalpine ranges with the recessions or the advances of the glaciers and timber line in the Swiss and Austrian Alps, together with the percentage of ¹⁴C in the atmosphere, made it possible to establish that the lakes fluctuations reflect climatic oscillations following variations in the solar activity (Magny, 1995). Comparison of the lake fluctuations with the pollen evidences of human activity revealed on the Jura range shows that the phases of cultivation seem to be connected with the lakes regressions. This correlation raises once more the question of climate as a determinant factor in the advent of the first farmers in Western Europe, and, more generally, the question of the role of the climatic influence in the settlement of primitive cultivators communities in regions where the climatic conditions limited the development of already precarious agrosystems. Moreover, the possible impact of socio-economic and demographic events, especially from 4300 cal. BC, has to be considered in the successes and failures of the neolithic process.

143. Rivas-Martinez S. and et-al. Oromediterranean broom, dwarf juniper and pine woods, *Pino- Cytision oromediterranei*, of the Sistema Central, Spain). Piornales, enebrales y pinares oromediterraneos (*Pino-Cytision oromediterranei*) en el Sistema Central. Lazaroa. 1985; 793-124.
Keywords: *Juniperus*/ association/ subassociations/ Spain
Abstract: One suborder, 1 association and 6 new subassociations are proposed. The main syntaxa of the *Pino-Juniperetea* class are typified.
144. Robertsson, Ann-Marie Author. Reinvestigation of the interglacial pollen flora at Leveaniemi, Swedish Lapland. Boreas (Oslo). 1997; 26(2):81-89.
Keywords: *Juniperus*/ *Populus*/ pollen/ Sweden/ vegetation history
Abstract: The till-covered organic sediments at Leveaniemi, Swedish Lapland have been reinvestigated by pollen analysis in order to gather more detailed information on vegetation history and climatic conditions during the interglacial period represented at this site. A partly different picture of the vegetation succession has arisen compared to earlier studies and results. The organic sequence is still correlated with the Eemian, but the forests were probably more open during the initial and later parts of the interglaciation than suggested earlier. This is based on the higher values of *Juniperus* pollen noted, and a continuous curve for *Populus* pollen during the PAZ representing the later part of the interglaciation. Comparisons are made with other sites in northern Sweden, Finland and northern Norway, and the possibilities of separating Eemian deposits from those formed during the Holsteinian interglaciation are discussed.
145. Rodriguez-Alfaro, R. and Huerta-Crespo, J. Industrial uses of *Juniperus* wood.

Usos industriales de la madera de *Juniperus*. Revista Chapingo Serie Ciencias Forestales y Del Ambiente. 1995; 1(1):27-30.

Keywords: *Juniperus*/ wood/ industrial uses/ furniture/ paneling/ pencil slats/ hardboard

Abstract: This paper is the result of the review of literature on the properties and uses of *Juniperus* wood with no consideration of the economics. Some aspects are explained, such as the characteristics of the genus, its habitat and distribution; anatomic structure, and the manufacture of products such as furniture, pencil slats, paneling, hardboard and essential oils. It also gives a wide description of use as biomass obtaining solids, liquids and gaseous fuels for heat and energy generation, as well as for the operation of internal combustion engines.

146. Roller, J. B. Rooting Juniper softwood cuttings under mist. Combined Proceedings, International Plant Propagators' Society. 1971; 21340-342.
Keywords: *Juniperus*/ rooting/ mist/ vegetative propagation/ nurseries
Abstract: Describes the propagation in Tennessee of 18 *Juniperus* cultivars from cuttings taken in July-August in time to provide rooted plants by the winter. Mist propagation in nursery beds was more economical than rooting in the greenhouse and was equally effective.
147. Russell; Susan K. [Reprint author]; Schupp, and Eugene W. [Reprint author]. Effects of microhabitat patchiness on patterns of seed dispersal and seed predation of *Cercocarpus ledifolius* (Rosaceae) . Oikos. 1998 Apr; 81(3):434-443.
Keywords: *Juniperus*/ *Cercocarpus*/ seed/ dispersal/ survival/ spatial patterns
Abstract: Structural heterogeneity of habitats is thought to influence spatial patterns of seed dispersal and of seed survival, two critical processes influencing seedling recruitment. Using the wind-dispersed tree *Cercocarpus ledifolius* in northeastern Utah, USA, we investigated patterns of initial seed arrival, seed survival, and longer-term seed accumulation among four structurally distinct microhabitats (beneath *Cercocarpus Juniperus*, and woody shrubs, and in open interspaces). Initial density of seedfall into seed traps was generally greater beneath *Cercocarpus* than in the remaining microhabitats, which did not differ from one another. Patterns of initial seedfall density appear to be more affected by distance from a seed source than by the physical structure of the microhabitat. The total numbers of seeds arriving in a microhabitat type, however, likely differ greatly among sites due to large differences in the relative abundances of microhabitat types. Experiments with tethered seeds indicated that overall levels of post-dispersal seed predation were low. However, seed loss in 1995 differed significantly among microhabitats, with open microhabitats generally having greatest seed loss. Patterns of accumulated seeds on the ground, in the litter, and in the soil showed greater differences among microhabitats than did patterns of initial seed arrival. Open microhabitats had the fewest accumulated seeds

and beneath *C. ledifolius* had the most. The redistribution of the seed shadow through time is likely a consequence of both secondary seed movement over winter and the disproportionately high levels of post-dispersal seed predation in open microhabitats. By following seeds through multiple phases of early recruitment, we demonstrated that seed distributions and the processes affecting seeds are heterogeneous in space and temporally dynamic. These findings are important for understanding processes leading to the ultimate quantity and patterning of adult plant populations.

148. Sarangzai A. M. Occurrence of juniper dwarf mistletoe, *Arceuthobium oxycedri* (DC.) M. Bieb., in Baluchistan Province, Pakistan. *Pakistan Journal of Weed Science Research*. 2004; 10(1/2):73-78.
Keywords: *Juniperus* / *Arceuthobium oxycedri* / infestation/ parasitic plants
Abstract: *A. oxycedri* is distributed in central Spain, across southern Europe, North Africa, the Near East, the Himalayas and western China, where it infects *Juniperus* species and other hosts of the family *Cupressaceae*. In Pakistan, *A. oxycedri* is presently known from a single location, the Ziarat Forest, which encompasses an area of approximately 3500 ha (4% of the total forest area of the province). It occurs on much of the upper headwaters of the Chasnak and the Sasnamana valleys of the Ziarat district. A survey conducted in the area revealed that in the infested portions of the Chasnak Valley, an estimated 31.76% of the host trees were infected, with a mean area dwarf mistletoe rating (DMR) of 1.53 and an estimated annual mortality rate of 2.03%. Nearly 50% of the infected trees had a DMR of 6. An estimated 22% of the trees in the Sasnamana Valley were infested, with a mean area DMR of 0.52. No recent tree mortality directly attributable to this parasite was detected in Sasnamana Valley, and nearly 50% of the infected trees had a DMR of 1. This parasite was also detected in portions of 4 adjoining drainages. It was estimated that these infections have been present for at least 25 to 30 years. In either of the 2 valleys, the host tree was widely scattered and there was only a limited potential for tree-to-tree spread. In the associated areas of these 2 valleys, the infections occurred in relatively well-stocked forests and there was a high potential for tree-to-tree spread.
149. Savich, O. V. Method of assisting natural regeneration of Juniper. *Tr Chatkal' Sk Gorno Les Zapovedn*. 1972; 3122-127.
Keywords: *Juniperus*/ planting/ topsoil/ survival/ nursery stock/ Soviet Central Asia
Abstract: Recommends the following method for planting *Juniperus* spp. in the mountain regions of Soviet Central Asia. Holes are bored 1 m deep, the topsoil is placed in the bottom of the hole and pressed down, and then the plants are planted. Survival of 5-year-old planting stock was superior to that of 3-year-old stock.

150. Sayre, R W Reprint author; Decker, D J Author, and Good, G L Author. Deer damage to landscape plants in New York state perceptions of nursery producers landscape firms and homeowners. *Journal of Environmental Horticulture*. 1992; 10(1):46-51.
Keywords: *Juniperus/ Picea/ Pieris/ Buxus/ Thuja occidentalis/ Taxus/ Odocoileus virginianus/* New York/ deer/ damage/ nursery/ plants
Abstract: Damage to landscape plants by white-tailed deer (*Odocoileus virginianus* Raf.) is widespread in many areas in the northeastern U.S. A mail survey to assess the extent and impact of deer damage to nursery producers, landscape firms and homeowners was conducted in suburban areas of southeastern and western New York in 1989. About two-thirds of producers and landscape firms, and slightly fewer than one-fourth of homeowners reported damage by deer during 1988. Yews, (*Taxus* spp.) and white cedar, [*Thuja occidentalis* L.), were listed most frequently by respondents as plants damaged by deer. The majority of respondents believed that damage was most severe during winter or spring. Some producers and homeowners reported severe economic losses from deer damage. Use of damage prevention was widespread among respondents who had experiences with deer and deer damage. Browse-resistant plants, such as spruce (*Picea* spp.) juniper (*Juniperus* spp.), andromeda (*Pieris* spp.), and boxwood (*Buxus* spp.) were used by some respondents. Many people also wanted additional information and research to improve damage prevention. Damage to landscape plants was a primary concern to a majority of primary concern to a majority of producers, but was less of a concern of landscape firms and homeowners. Instead, these latter groups were most concerned about risks they associated with deer such as Lyme disease or deer-vehicle collisions.
151. Schiffhauer, D E and Mizell, R F III. Bionomics of *Glyphidocera juniperella* (*Lepidoptera: Blastobasidae*), a newly discovered pest of container-grown juniper. *Florida-Entomologist*. 1987; 70(3):310-316.
Keywords: *Juniperus /* nursery/ *Glyphidocera juniperella/* damage/ *Olethreutes cespitana / Orgilus/* pest/ Florida
Abstract: The life history is given of *Glyphidocera juniperella*, the larvae of which were recently found to be serious pests of container-grown ornamental *Juniperus* spp. in nurseries in Florida, causing twig dieback and reducing the value of the plants. Typical damage caused by the blastobasid included removal of the outer bark and phloem, resulting in girdling in the autumn and eventual production of red needles by girdled branches in the following spring. The head capsule measurements of the larvae indicated the existence of 6 instars in the 2 summer generations and 7 instars in the partial 3rd or overwintering generation. The tortricid *Olethreutes cespitana* [*Celypha cespitana*] was sometimes found infesting the same tree as *G. juniperella*, feeding on the green needles; its larvae were similar to those of the blastobasid and were found mainly in spring and early summer. A braconid parasitoid of the genus *Orgilus* was reared from the tortricid.

152. Schimidtke P. S. and Santillan-Perez J. The use of prescribed burning for the control of populations of *Pinus edulis* and *Juniperus* in Guadeloupe, New Mexico.
El uso de quemas prescritas para el control de poblaciones de *Pinus edulis* y *Juniperus* sp. en Guadalupe, Nuevo Mexico. *Revista Chapingo Serie Ciencias Forestales y Del Ambiente*. 2000; 6(1):69-70.
Keywords: *Juniperus/ Pinus edulis/* brush control/ controlled burning/ vegetation management.
Abstract: The US Forest Service has, since 1998, carried out an ambitious programmed of prescribed burning to control populations of *Pinus edulis* and *Juniperus* that have invaded the pasture and grassland areas of the mountains of Guadeloupe in SE New Mexico. This paper describes the planning of the operation and the results achieved in 1999.
153. Schlutz, F. and Zech, W. Palynological investigations on vegetation and climate change in the Late Quaternary of Lake Rukche area, Gorkha Himal, Central Nepal. *Vegetation History & Archaeobotany*. 2004; 13(2):81-90.
Keywords: *Juniperus/ Abies/ Picea/ Pinus/ Betula/ Rhododendron/ Quercus/* lignin biomarkers/ Nepal
Abstract: Palynological data and pedological investigations including stable isotopes and lignin biomarkers (Glaser et al. in press) from a 4 m core of Lake Rukche (3500 m a.s.l.) enhance our palaeoecological knowledge of the time since the LGM in the Gorkha Himal, Central Nepal. Even before 15000 B.P. forest types became established which prove the existence in Central Nepal of a temperate-humid climate with a considerable amount of winter and spring precipitation from westerly disturbances. Lignin input and pollen data point to a patchy vegetation cover around Lake Rukche with meadow-steppes dominated by *Poaceae*. Around 15000 B.P. *Quercus* and *Pinus roxburghii* dominated the lower altitudes while the vegetation around Lake Rukche was more steppe-like (*Chenopodiaceae, Artemisia*). Subsequently the climate became warmer and drier as winter and spring precipitation decreased while summer rain remained low. Later on more resource-demanding forests became established under improved temperature and precipitation conditions (Engelhardia). Around Lake Rukche coniferous forests (*Abies, Picea*) occurred beside meadow-steppes. The transition from the Pleistocene to the Holocene is not recorded. In the Holocene alpine Kobresia-meadows stabilized the soil surface causing sand accumulation to end. During the mid-Holocene (7800-2750 B.P.) humid oak forests with demanding elements (*Ilex, Coriaria, Myrsine* and *Engelhardia*) dominated the vegetation cover. A charcoal layer and a marked emergence of fire-induced communities with *Pinus roxburghii, Poaceae, Ericaceae* and *Pteridium* are proofs of a first strong anthropogenic change in vegetation which coincided with the climatic deterioration at the onset of the Subatlantic. Since 900 B.P. grazing pressure and the frequency of fires increased, resulting in a replacement of *Betula utilis*-forests by meadows and woods

of *Juniperus* and *Rhododendron*. While previous anthropogenic influence increased the biodiversity by promoting replacement communities, recent developments have led to a decrease in biodiversity through loss of natural vegetation communities.

154. Schoene, Bernd R. Reprint author; Schweingruber, Fritz H. Author, and E-mail: bernd.schoene@excite.com]. Dendrochronological studies of natural reforestation of the alps exemplified on an inner-alpine dry valley (Ramosch, Lower Engadine, Switzerland). *Botanica Helvetica*. 2001 Dec; 111(2):151-168.
Keywords: *Juniperus*/ *Pinus sylvestris*/ *Larix decidua*/ *Picea abies*/ reforestation/ Swiss Alps/ dendrochronological
Abstract: Since the end of World War II, especially between 1960 and 1980, the natural reforestation of the Swiss Alps accelerates. Predominant causes are connected to socio-economic changes, population shift to urban areas, abandonment of limited yield stands and changes in land management methods. The reforestation history of abandoned lands of the Inn Valley can be precisely reconstructed by dendrochronological methods. Initially, pioneer copses (*Juniperus* sp.) grew adjacent to rocks. Protected by juniper shrubs, Scots pine (*Pinus sylvestris*) established. Larch (*Larix decidua*) settled in open meadows. Grass and shrubs disappeared as pioneer tree stands expanded and provided new germination sites. The patches of forest merged with each other and formed extended forest areas. Today, fast growing pine dominates over spruce (*Picea abies*) on pioneer tree stands, but slow growing spruce dominates on stands reforested more than 80 years ago. Although browsing of wild and domesticated animals may have slowed the natural reforestation process, rates of reforestation continued to accelerate due to disruption of the grass cover by human and animal activity.
155. Schulz C.; Jagel A., and Stuetzel T. Cone morphology in *Juniperus* in the light of cone evolution in *Cupressaceae* s.l. *Flora (Jena)*. 2003; 198(3):161-177.
Keywords: *Juniperus*/ cone morphology/ cone evolution/ ovules/ cones/ seed scales
Abstract: The interpretation of the berry-like, fleshy cones of *Juniperus* was up to now based on concepts about the conifer cone which are dismissed since FLORIN (1951). Comparative morphological and developmental studies showed that ovules alternating with the last whorl of cone scales cannot be regarded as part of a sporophyll (cone scale; pre-FLORIN interpretation). These alternating ovules are inserted directly on the cone axis and continue the phyllotactic pattern of the cone scales. If the usual seed scale is regarded as an axillary brachyblast (short-shoot) bearing ovules, the ovules alternating with ultimate whorls of cone scales in *Juniperus* sect. *Juniperus* can be regarded as a brachyblast terminating the cone axis. This interpretation allows to establish a standard bauplan for *Cupressaceae* in which species of *Cupressus* and *Juniperus* form a transition series towards more and more reduced cones. This series

coincides with phylogenetic trees based on molecular studies.

156. Scott, V. E. and Boeker, E. L. Responses of Merriam's turkey to pinyon-juniper control. *Journal of Range Management*. 1977; 30(3):220-223.
Keywords: *Juniperus/ Pinus ponderosa/ Pinus edulis/ Meleagris gallapavo merriami/ Arizona/ roosting/ population/ controlled burning/ wildlife habitat*
Abstract: Merriam's turkeys (*Meleagris gallapavo merriami*) inhabit much of the pinyon-juniper (*Pinus edulis/ Juniperus* spp.) woodland in Arizona where ponderosa pines (*Pinus ponderosa*) are available for roosting. A 64% reduction in turkey populations was observed following a programmed for control of *P. edulis* and *Juniperus*, that isolated roost sites 300 m or more from cover. It is concluded that, in turkey habitat, cleared areas should not be wider than 90 m and strips of cover should be retained as travel lanes to established roosting areas.
157. Severtoka, I I Reprint author. Effective method for the reproduction of *Juniperus* spp. *Izvestiya Akademii Nauk Turkmenskoi Ssr Seriya Biologicheskikh Nauk*(6). 1987; 672-74.
Keywords: *Juniperus/ reproduction/ rooting/ cuttings*
Abstract: The authors studied 23 species and 11 forms of *Juniperus* genus, capable of rooting. Among them, 13 species and 7 forms turned out easily rooted and may be successfully reproduced by cuttings.
158. Shaw J. D.; Steed B. E., and DeBlander L. T. Forest Inventory and Analysis (FIA) annual inventory answers the question: What is happening to pinyon-juniper woodlands?. *Journal of Forestry*. 2005; 103(6):280-285.
Keywords: *Juniperus/ forest inventory/ mortality/ pinyon-juniper*
Abstract: Widespread mortality in the pinyon-juniper forest type is associated with several years of drought in the southwestern United States. A complex of drought, insects, and disease is responsible for pinyon mortality rates approaching 100% in some areas, while other areas have experienced little or no mortality. Implementation of the Forest Inventory and Analysis (FIA) annual inventory in several states coincided with the onset of elevated mortality rates. Adjunct inventories provided supplemental data on damaging agents. Preliminary analysis reveals the status and trends of mortality in pinyon-juniper woodlands.
159. Sheikh, M I. Filled and empty juniper seed can be separated by water flotation. *Pakistan Journal of Forestry*. 1981; 31(2):78; ISSN: 0030-9818.
Keywords: *Juniperus/ seeds/ processing/ conifers*
Abstract: Partial separation can be achieved.
160. ---. Germination trials of juniper seed. *Pakistan Journal of Forestry*. 1983; 33(1):41-43; ISSN: 0030-9818.
Keywords: *Juniperus/ nurseries/ seeds/ germination/ collection/ treatment/ seed-treatment/ seed-collection*
Abstract: The results of work over 6-7 yr are described on the collection,

characteristics, treatment, germination and sowing of seeds, and on seedling transplantation. Seed can be collected in Nov.-Dec. The ripe berries are graded into 4 sizes of diam. 0.6-1.1 cm. They are depulped immediately after collection by rubbing on a mesh with a stone. Washed seed (discarding any that float after soaking in water for 24 h) is better sown in beds than tubes. Germination is low (0-6%) and starts after 60 days continuing from Dec. to March, with none in May and June. It starts again with the onset of the monsoon and continues for a further 2 yr in the same pattern. Scarification and other treatments do not improve germination. Seedling growth is slow and seedlings do not survive cold winters or hot summers, being best raised in nurseries with neither. Field planting should not take place until seedlings are over 2 yr old.

161. Short, H. L. and McCulloch, C. Y. Managing pinyon-juniper ranges for wildlife. USDA Forest Service General Technical Report, Rocky Mountain Forest and Range Experiment Station. 1977; RM-4710.
Keywords: *Juniperus/ Pinus edulis/ Pinus monophylla/ Pinus cembroides/* wildlife/ habitat management
Abstract: The pinyon/juniper association is formed by *Pinus edulis*, *P. monophylla* and *P. cembroides* with at least 4 *Juniperus* spp. in Mexico and southwestern USA. This general account comprises the following sections; Extent and composition of pinyon/juniper woodlands; Animals inhabiting pinyon/juniper woodlands; Wildlife habitat management in pinyon/juniper woodlands (economic considerations, livestock vs. wildlife, role of fire, role of herbicides, recommendations); and Management implications.
162. Skousen, J G Reprint author; Davis, J N Author, and Brotherson, J D Author. Pinyon-juniper chaining and seeding for big game in central Utah USA . Journal of Range Management. 1989; 42(2):98-104.
Keywords: *Juniperus/* pinyon-juniper/ seeding/ big game/ mortality
Abstract: Vegetation and soils were evaluated on 5 different-aged, mechanically treated and seeded pinyon-juniper sites and compared to adjacent untreated areas. Plant cover was significantly changed after treatment: trees were reduced from 26 to 6% total ground cover; shrubs were increased from 2 to 8% ground cover; and herbaceous plants increased from 2 to 13% ground cover. Annuals and perennial forbs were 75% of the total plant cover on the 2-year-old site, perennial grasses and shrubs dominated the plant cover (52 to 83%) on three, 14- to 20-year-old sites, while shrubs and trees combined for 84% of the plant cover on the 24-year-old site. Two *Agropyron* grass species showed good establishment and persistence after seeding. Seeded forbs contributed about 5% of the total plant cover on the 2-year-old treated site and they declined on older treated sites. Seeding of shrubs was only successful on sites where the shrub species was already present in the understory naturally. Seeding of nonnative shrub seed did not produce stands. Even though tree cover was reduced after treatment, total tree density was not. Shrub density

increased from an average of 800 plants/ha on untreated areas to 2,750 plants/ha on treated areas. Juniper mortality during mechanical treatment varied from 60 to 91% and was related to the percentage of trees estimated to be 60+ years old ($r = 0.97$) and with the number of trees greater than 5 cm in stem diameter ($r = 0.71$) on the adjacent untreated sites. Big game pellet group counts were not different between untreated and treated sites, suggesting that big game make use of these treated areas because of increased forage and browse and in spite of reduced security cover.

163. Skousen, J Reprint author; Davis, J N Author, and Brotherson, J D Author. Comparison of vegetation patterns resulting from bulldozing and two-way chaining on a Utah, USA pinyon-juniper big game reserve. *Great Basin Naturalist*. 1986; 46(3):508-512.
Keywords: *Juniperus/ Pinus/* big game/ bulldozing/ Utah/ pinyon-juniper
Abstract: Two adjacent mechanically treated pinyon-juniper (*Pinus* spp. and *Juniperus* spp.) big game winter range sites in central Utah were sampled in 1981 to estimate vegetational differences and tree mortality from the two treatments. One site was treated by selectively bulldozing in 1957 and the other was double chained in 1965. Both treatments significantly reduced tree and litter cover, whereas significant increases were found for native grasses and shrubs compared to a nearby untreated site. Juniper cover for the untreated site was 35.5% compared to only 1.4% for the bulldozed area and 4.1% for the two-way chained area. Browse species densities were increased by the mechanical treatments. The use of different mechanical treatments on separate smaller portions of critical areas of big game winter range would help provide: (1) for both long-term and short-term use of a critical wintering area, (2) greater overall productivity and carrying capacity, and (3) greater diversity by creating more edge effect between the differently treated and untreated areas.
164. Smith, M. A. and Schuster, J. L. An annotated bibliography of Juniper (*Juniperus*) of the western United States. International Center for Arid and Semi-Arid Land Studies, Texas Tech University. 1975; 75(2):37 pp.
Keywords: *Juniperus/* management/ rangeland/ ecosystem
Call Number: Z5356.T8S6
Abstract: Bibliography of *Juniperus* in the western United States up to 1975.
165. Soika G. and Abanowski G. Two species of juniper eriophyids new to Poland Dwa nowe dla Polski szpeciele na jaowcach . *Ochrona Roslin*. 1998; 42(11):12-13.
Keywords: *Juniperus/* arthropod pests/ plant pests/ *Trisetacus/ Eriophyes*
Abstract: *Trisetacus juniperinus* and *Eriophyes junipereti*, both of which infest several species of *Juniperus*, were recorded from Poland for the first time in 1998. They are described, and some morphological characters are

illustrated.

166. Springfield, H. W. Characteristics and management of southwestern pinyon-juniper ranges: the status of our knowledge. Research Paper, USDA Forest Service. 1976; RM-16031.
Keywords: *Juniperus/ Pinus/* vegetation sub-types/ Arizona/ New Mexico/ grazing/ species
Abstract: The 4 vegetation sub-types in pinyon-juniper woodland in N. Arizona and New Mexico are described and data are presented on land use, range condition class and estimated grazing capacities, season of use, grazing systems and species adapted for sowing in this area.
167. Stanosz G. R.; Swart W. J., and Smith D. R. Similarity between fungi identified as *Diplodia pinea* f.sp. *cupressi* in Israel and *Botryosphaeria stevensii* or *Diplodia mutila* on *Juniperus* in the United States. European Journal of Forest Pathology. 1998; 28(1):33-42.
Keywords: *Juniperus/* random amplified polymorphic DNA/ genetic markers/ *Diplodia pinea/ Cupressus/ Diplodia mutila*
Abstract: A fungus identified as *B. stevensii* causes a canker disease that results in dieback of *Juniperus* spp. in the USA. A fungus identified as *D. pinea* f.sp. *cupressi* causes a similar disease of *Cupressus* spp. in Israel and elsewhere. Cultural characteristics, pycnidia and conidia of isolates of these 2 pathogens were compared. The ability of each fungus to produce cankers on *C. sempervirens* was investigated. RAPD marker patterns were analyzed using *D. pinea* isolates as an outgroup. It is suggested that the fungus identified as *D. pinea* f.sp. *cupressi* in Israel is the same as the fungus identified as *B. stevensii* from the USA. Analysis of RAPD markers suggested relatively low similarity between these isolates and those of *D. pinea*. As these results are consistent with a previous report, it is suggested that the use of the name *D. pinea* f.sp. *cupressi* should be discontinued.
168. Steinhauer, J. R. Arthropod pests on Juniper. Journal of Arboriculture. 1975; 1(11):205-207.
Keywords: *Juniperus/ Oligotrophus betheli/ Aleuropteryx juniperi/ Carulaspis/* arthropods/ Pennsylvania
Abstract: A preliminary report of a survey by the Pennsylvania Bureau of Plant Industry as part of a programmed of research on the chemical protection of 'environmental' (ornamental) plants. During the first season, 54 species of arthropods were collected from Junipers [*Juniperus* spp.]; of these, 20 species were regarded as plant feeders and the rest as potentially beneficial. Notes are given on the more important species, including two pests of primary importance: *Oligonychus ununguis* and *Carulaspis juniperi*. *C. minima* (a new record for Pennsylvania) was found locally. Contarina [*Contarinia*] juniperina caused a severe, but not lethal, dieback of branches (as a result of larval boring) which was previously suspected to be a fungal blight. Another midge, tentatively identified as *Oligotrophus betheli*, attacked only the branch tips. *Aleuropteryx juniperi* (Neuroptera,

Coniopterygidae) recorded in N. America for the first time was an efficient predator of *Carulaspis* spp.

169. Stevens, R. Species adaptation for seeding mountain brush, big, black, and low sagebrush, and pinyon- juniper communities. Managing Intermountain Rangelands. Proc. Symposia: 1981, Twin Falls, 1982, Elko. (USDA, Forest Service, General Technical Report, INT-157). . 1983; INT-15778-82.
Keywords: *Juniperus*/ sagebrush/ seeding/ *Pinus edulis*
Abstract: Successful range improvement depends on the seeding of plants adapted to a specific site and for which ample seed is available.
170. Stuchlick, L. and Moncada, M. Pollen morphology of Cuban Gymnosperm species. Acta Botanica Hungarica. 1983; 29(1-4):75-90.
Keywords: *Juniperus*/ *Zamia*/ *Microcycas* / *Podocarpus*/ *Pinus*/ pollen / morphology/ Cuba
Abstract: Pollen morphology of 13 spp. belonging to the Gymnosperms in Cuba and to the genera *Zamia*, *Microcycas*, *Podocarpus*, *Pinus* and *Juniperus* is described. In *Podocarpus* 2 types of pollen grains can be distinguished, suggesting the existence of not more than 2 spp. or species group in Cuba. In the Cuban species of *Pinus* there are differences in size as in the pattern of the reticulum.
171. Sudworth, Gb. The cypress and juniper trees of the rocky mountain region. U. S. Department Of Agriculture, Bulletin Number 207, Washington, Dc. 1915. Article Available at the Fire Research Institute. 1915; 207.
Keywords: *Juniperus*/ *Cupressaceae*/ Rocky Mountains
172. Suslova, O. P. Author. Some aspects of the cycle of coniferous generative development under the conditions of the Ukrainian South-East. Ukrayins'Ky Botanični Zhurnal. 1996; 53(5):619-621.
Keywords: *Juniperus*/ embryogenesis/ seed scales/ seed-buds/ pollen
Abstract: While introducing coniferous plants a particular attention is paid to the study of particularities of sexual reproduction of introduced species under new condition. It is established that not all the studies species of coniferous give seeds of high quality. The deterioration of pollen viability indices, presence of sterile complexes of seed scales with seed-buds, different breaches during embryogenesis call the decrease of an output of good quality seeds.
173. Tausch, R. J. and Tueller, P. T. Plant succession following chaining of pinyon-juniper woodlands in eastern Nevada. Journal of Range Management. 1977; 30(1):44-49.
Keywords: *Juniperus*/ *Pinus edulis*/ woodlands/ Nevada/ plant succession/ chaining/ cabling/ understory composition
Abstract: Information was required concerning secondary succession after cabling or chaining with the debris left in place of pinyon-juniper woodlands, in comparison with the succession and persistence of understory following forest fires. Changes in plant species during

succession were observed following treatment in 6 areas of similar topography. The changes were due to relative differences in growth rates and competitiveness of the species concerned. As the trees maintained increasing growth rates longer than did any of the understory species, understory production was steadily reduced after 5-8 yr. Chaining or cabling left many surviving plants with established root systems, and trees became dominant again after 15 yr compared with 50 yr following fire. The dominance of perennial grass was highest in the 4th yr and that of shrubs 1-3 yr later, compared with 30 yr before shrub dominance was attained following fire.

Plant succession following debris-in-place chaining was essentially the same as that following fire, but the peaks in abundance of the various stages followed more rapidly. Up to 4 years after treatment annual and perennial forbs dominated; 1 to 3 years after that shrubs reached a peak and in less than 15 years trees again dominated with a decline in understory abundance. Differences in growth rate and competitive ability account for this succession pattern: since trees maintain increased growth following fire or chaining for two to three times as long as any understorey species covered, there is a steady reduction in the latter from the fifth to eighth year following treatment.

174. Taylor, R D; Kneen, H H; Smith, E M; Hahn, D E, and Uchida, S. Costs of producing field rapid-growing evergreens (*Juniperus*) in Ohio. Special Circular Ohio Agricultural Research and Development Center. 1988; 11521-29.

Keywords: *Juniperus*/ nursery/ height/ costs

Abstract: Annual production costs for [unspecified] junipers intended for hedges and landscaping were determined by synthesizing 2 model field nurseries (50 and 200 acres) using an economic engineering approach. The data for the study were obtained in 1985 from wholesale nurseries and nursery suppliers. In the 50-acre nursery, junipers were allocated 8 acres of growing space and in the 200-acre nursery they were allocated 35 acres. A total of 5810 salable plants, 18-24 inches in height, could be produced annually in the 50-acre nursery and 25 418 in the 200-acre nursery. Based on 1985 figures, the total cost/salable plant was \$12.51 and \$7.09, respectively.

175. Teed, Rebecca Reprint author. A > 130,000-year-long pollen record from Pittsburgh Basin, Illinois. Quaternary Research (Orlando). 2000 Sep; 54(2):264-274.

Keywords: *Juniperus*/ pollen/ *Quercus*/ *Carya*/ *Picea*/ *Pinus*/ Illinois

Abstract: Pittsburg Basin, in south-central Illinois, contains a sediment record extending from the present back to the end of the late Illinoian glaciation, when central Illinois was covered with *Picea/Pinus* forest. During the last interglaciation, a temperate deciduous forest more diverse than Holocene *Quercus/Carya* forest replaced the Illinoian late-glacial boreal forest. Prairie pollen types and the charcoal/pollen ratio, indicating

fire frequency, temporarily increased. Then forest, with high *Juniperus* percentages, became dominant once more, as the charcoal/pollen ratio dropped. After the last interglaciation, the charcoal/pollen ratio increased again and prairie and wetland surrounded Pittsburg Basin through the entire Wisconsin glacial age. The area was still prairie in late Wisconsin time, but with some *Picea* and *Pinus*. During the Holocene, the region has been a mixture of prairie and *Quercus/Carya* forest. During the last interglaciation, Pittsburg Basin was surrounded by vegetation different from that surrounding it during the present interglaciation. Rather than indicating substantial differences in climate between analogous phases of different glacial/interglacial cycles, this variation may be due to changes in fire frequency, which could be caused by small changes in climate, human activity, or differences in soil.

176. Theocharopoulos, M Author and Georgiadis, T Author. Vegetation from eastern Attica Nea-Makri in Greece the effects of urbanism and tourism . *Ecologia Mediterranea*. 1984; 10(3-4):133-158.
Keywords: *Juniperus*/ urbanism/ tourism/ Greece
Abstract: The vegetation of Nea Makri (Attica, Greece) was studied. This vegetation belongs to the thermo-Mediterranean zone and particularly to the association of Prasio-Ceratonietum. Within this association and according to the ecological conditions of the area of a number of groups can be distinguished: Prasio-Ceratonietum typicum, Prasio-Ceratonietum Pinetosum halepensis, Prasio-Ceratonietum Juniperetosum lyciae, and degraded formations of *Quercus macrolepis*. All the ecosystems examined have been influenced by the urban and the touristic development of the area.
177. Tonkov, Spassimir Author Reprint Author and E-mail: tonkov@biofac.uni-sofia.bg]. Holocene palaeovegetation of the Northwestern Pirin Mountains (Bulgaria) as reconstructed from pollen analysis. *Review of Palaeobotany & Palynology*. 2003 Apr; 124(1-2):51-61.
Keywords: *Juniperus*/ *Betula* / *Pinus*/ *Alnus*/ *Ulmus*/ *Tilia*/ *Corylus*/ *Carpinus*/ *Acer*/ *Fagus*/ *Picea*/ *Abies*/ Bulgaria/ pollen/ palaeovegetation
Abstract: Pollen analysis and radiocarbon dating were performed on a sequence 150 cm deep from a peat bog (Mozgovitsa, 1800 m above sea-level) in the Northwestern Pirin Mountains, Bulgaria. The palaeovegetational reconstruction focused on the main stages of forest development starting from approximately 8700 years BP. The vegetational response to the amelioration of the climate in the Early Holocene until 7500 cal BP resulted in the spread of birch forests (*Betula pendula*) that occupied large areas at high altitudes forming the upper tree-line together with pine (*Pinus sylvestris*, *Pinus peuce*, *Pinus mugo*), juniper (*Juniperus*), alder (*Alnus*), and willow (*Salix*). Below them were mixed deciduous oak forests with some *Ulmus*, *Tilia*, *Corylus*, *Carpinus*, and *Acer*. The continuous Early Holocene pollen record of mesophyllous demanding trees (*Abies alba*, *Fagus sylvatica* and *Picea abies*), though in

low frequencies, suggests that groups of these trees survived in environmentally favourable habitats with sufficient moisture such as deep mountain valleys. The most important change in the vegetation cover started ca. 7500 cal BP when birch forests declined and coniferous vegetation dominated by *Pinus sylvestris*, *Pinus peuce* and *Abies alba* invaded the slopes. The spread of the conifers and the expansion of their areas presume an increase in humidity and precipitation, and the development of soils with humic horizons. The last trees to establish after ca. 4000 cal BP in the study area were *Picea abies* and *Fagus sylvatica*. Their expansion in the Northwestern Pirin Mountains started at the Subboreal/Subatlantic transition ca. 3000 cal BP when average temperatures dropped and precipitation increased. Deforestation in historic times resulted in the appearance of new pasture land and the lowering of the upper tree-line.

178. Ture C.; Tokur S., and Ketenoglu O. Contributions to the syntaxonomy and ecology of the forest and shrub vegetation in Bithynia, northwestern Anatolia, Turkey. *Phyton - Annales Rei Botanicae*. 2005; 45(1):81-115.
Keywords: *Juniperus/ Quercus/* vegetation types/ releves/ ecology/ syntaxonomy
Abstract: The forest vegetation of the investigated area has been studied using the BRAUN-BLAUNQUET approach. The following associations were described: Two shrub associations, the *Junipero oxycedri-Quercetum pubescentis* ass. nova and the *Hieracio pannosi-Cistetum laurifolii* ass. nova were included in the alliances *Quercion anatolicae* and *Pino-Cistion laurifolii* respectively. They are together with *Carpino-Acerion* united in the order *Querco-Carpinetalia orientalis*, which comprises the mesophilous forest and shrub vegetation types of NW Anatolia. The forest associations *Argyrolobio biebersteinii-Quercetum cerridis* ass. nova, *Stellario holostea-Pinetum pallasianae* ass. nova, *Daphno ponticae-Pinetum sylvestris*, and *Fago orientalis-Abietetum bornmuelleriana* were attached to the alliance *Carpino-Acerion*, the *Junipero foetidissimae-Juniperetum excelsae* ass. nova to the alliance *Quercion anatolicae* of the class *Quercetea pubescentis*. Only the *Trachystemo orientalis-Fagetum orientalis* belongs to the order *Rhododendro-Fagetalia orientalis* of the class *Querco-Fagetea*. The manually sorted releves have been classified on the basis of their floristical and ecological peculiarities. All forest stands in the area develop under a semi-dry and less rainy type of Mediterranean climate and on soils derived from limestone and schistous parent rock.
179. U.S. Department of Agriculture. Seeds. USDA Yearbook 1961. 1961; 556.558.
Keywords: *Juniperus/* seed
Abstract: Seed characteristics and other data.
180. Van Auken O. W. Characteristics of intercanopy bare patches in *Juniperus* woodlands of the Southern Edwards Plateau, Texas. *Southwestern*

Naturalist. 2000; 45(2):95-110.

Keywords: *Juniperus*/ soil chemical properties; plant communities

Abstract: Intercanopy bare patches are small, relatively circular communities with an exposed central bedrock, shallow soil, low plant cover, and dominated by non-vascular plants, annual grasses, and forbs. Although these patches are relatively common in the Edwards Plateau of central Texas (USA), their characteristics have never been described. Twelve circular, intercanopy bare patches in the Hill Country State Natural Area in Bandera and Medina counties, were examined using the line-point procedure. Mean cover (+or-SD) of plant, litter, rock, and bare soil was 23+or-3%, 23+or-5%, 44+or-9%, and 10+or-4%, respectively. Approximately half of the total plant relative cover consisted of forbs with 25% grasses and 25% non-vascular plants. Fifty-seven species of flowering plants from 30 families were identified, including 27 annuals and 30 perennials. The most common families were the *Poaceae* (9 species), *Asteraceae* (5 species), *Euphorbiaceae* (5 species) and *Labiatae* (4 species). Flowering plant species encountered in 10 to 12 of the intercanopy bare patches sampled were *Chaetopappa bellidifolia*, *Evax prolifera*, *Croton monanthogynus*, *Spermolepis intermis*, *Centaurium texense*, *Galium virgatum*, *Sida abutifolia*, and *Schizachyrium scoparium*. *Nostoc commune*, a common soil blue-green algae, was found in every intercanopy bare patch. Non-vascular plant cover was highest near the edge of the central bedrock and decreased with distance. Total plant and litter cover increased with distance from the central bedrock. Total annual cover was five times higher than total perennial cover and both increased with distance from the central bedrock. Mean number of species found per intercanopy patch was 31+or-4 with a mean Simpson's diversity of 9.2+or-2.8. Soil depth increased with distance from the central bedrock, whereas rock cover decreased. Total plant, annual and perennial cover, and litter cover were positively related to soil depth; rock cover was negatively related to soil depth. *Nostoc commune* relative cover decreased with distance, but *Chaetopappa bellidifolia* relative cover increased with distance from the patch center, and then decreased near the outer edge of the patch. *Heliotropium tenellum* and *Bothrichloa ischaemum* relative cover increased with distance from the center of the patch, with no indication of a decrease near the outer edge. *Nostoc commune* relative cover was inversely related to soil depth. Relative cover of *Chaetopappa bellidifolia*, *H. tenellum* and *B. ischaemum* was positively related to soil depth. Almost all soil chemical characteristics were the same from near the central bedrock area to the outer edge of the patch. Soils were slightly basic, high in calcium, low in nitrogen and organic matter. Shallow soil depth and intermittent water availability are probably the main factors that determine composition, including low cover and the high proportion of annuals, in these communities.

181. Van Leeuwaarden W. and Janssen C. R. Differences between valley and upland vegetation development in eastern Noord-Brabant the Netherlands during

the late glacial and early Holocene. Review of Palaeobotany & Palynology. 1987; 52(2-3):179-204.

Keywords: *Juniperus/ Betula/ Populus/ Pinus/ Corylus/ Alnus/ Tilia/ Ulmus/ Quercus/* succession/ Netherlands/ pollen/ macrofossil/ peat cores

Abstract: Analysis of pollen, including the determination of pollen concentrations and of relative pollen values, macrofossil analysis of peat cores from oxbows in river valleys and of pingo melt holes on the upland, and the application of recent surface samples from northern Finland have enabled the establishment of two different lines of vegetational succession, one for the valley and another for the upland. In the valley, the succession is from *Betula-*, *Betula + Populus-*, *Betula + Pinus-*, *Pinus + Betula + Corylus-*, *Pinus + Corylus* to *Alnus + Tilia*. On the upland, the succession is from *Betula-*, *Betula + Corylus-*, *Corylus + Quercus* to *Corylus + Quercus + Ulmus*. The order of appearance of pollen of the main forest trees is similar in all the pollen diagrams, but they differ in time of appearance. Radiocarbon dates indicate that *Pinus*, *Corylus*, *Quercus*, *Ulmus*, *Tilia* and *Alnus* appear in the valley 300-700 years earlier than on the upland. *Juniperus* occurred mainly on the upland. Taxa that were restricted to the upland include *Empetrum*, *Erica tetralix* and *Arctostaphylos uva-ursi*. *Populus* occurred only on the valleys.

182. Venzke, J. F. Pinyon- juniper woodland and the lower forest unit in SW USA - a geo-ecological overview).

Der Pinyon-Juniperus-Trockenwald und die untere Waldgrenze im Sudwestern der USA - ein geokologische Uberblick. Geokodynamik. 1985; 6(3):321-345.

Keywords: *Juniperus/ Pinus edulis/* woodlands/ distribution/ shrub/ grass/ understory

Abstract: Describes the distribution of pinyon-juniper woodland, which amounts to c1/3 of the wooded area of the Rocky Mountains in the W and SW USA. The woodland is essentially varied by the plant-sociological structure of the shrub and grass story. The pinyon-juniper woodland is the lowermost forest formation in the mountains close to the arid limit of tree growth and therefore an ecotone where floristic and geo-ecological elements of both the woodlands and the formation without any trees interfere.

183. Vieri, M. Results from trials using portable equipment for the mechanical harvesting of juniper berries. Rivista Di Ingegneria Agraria. 1986; 17(3):174-181.

Keywords: *Juniperus/* berries/ mechanical harvesting/ cleaning

Abstract: Three prototype low-cost systems were constructed for the mechanical harvesting of juniper berries [*Juniperus* spp.] - (1) a threshing comb with vibrating pegs, attached to a brush-clearing machine, (2) a bush-shaker attached to a chainsaw and (3) a harvesting umbrella to catch the berries as they fell. All 3 systems gave better results under field

conditions than hand-harvesting and the equipment was easy to use.

184. Vladychenskii, A. S.; Vlasova, N. Yu., and Dronova, N. Ya. Some features of pedogenesis and soils under *Juniperus* forests in Tian-Shan mountains. *Pochvovedenie*. 1991; 315-27.
Keywords: *Juniperus*/ Kyrgyzstan/ soils/ slope aspect/ soil thermal regime/ soil moisture
Abstract: Data are presented for mountain-forest cinnamonic-brown soils under juniper (*Juniperus*) in the Tien Shan Mountains (Kyrgyzstan). Slope aspect, soil thermal regime and moisture influenced the formation of various soil types
185. Vladychenskiy A. S.; Ul'-yanova T. Yu.; Balandin S. A., and Kozlov I. N. Effect of grazing on juniper forest soils of the southwestern Tyan-Shan region. *Eurasian Soil Science*. Translated From *Pochvovedeniye*. 7. 1994. 45-51. 1995; 27(7):1-9.
Keywords: *Juniperus*/ grazing/ Russia/ soil
Abstract: Alteration of juniper forest ecosystems by grazing is discussed. In the early stages of grazing-caused degradation, a secondary lateral nonuniformity of the soil cover and vegetation occurs. Changes in the properties of soils, in the supply of phytomass and in the species composition of plant communities as a result of grazing are described. Soils and plant communities of northern and southern slopes differ in their tolerance of grazing. Even when areas are protected, the recovery of the soil cover and vegetation is very slow.
186. Vladychenskiy, A. S.; Vlasova, N. Yu., and Dronova, N. Ya. Some characteristics of soils and soil formation in juniper forests of the Tyan-Shan range. *Soviet Soil Science*.
Translated From: *Pochvovedeniye*, 3. 1991. 15-27. 1991; 23(10):1-14.
Keywords: *Juniperus*/ soils/ Tyan-Shan range/ phytomass/ litter
Abstract: An investigation of soils under juniper forests of the Tyan-Shan range reveals some of the distinctive characteristics of formation of these mountain-forest cinnamon-brown/brown soils. The types of soils that are formed differ depending on the exposure of the slopes, temperature conditions, and the moisture content of the soil. Juniper forests have certain characteristics that distinguish them from other forests, primarily the large contribution of the herbaceous cover to phytomass and litter an order of magnitude greater than that for other forest ecosystems. This is the reason for the distinctive features of the soils under juniper forests, and in particular the type of profile of organic matter.
187. Wahlmueller, N. Contributions to the vegetational history of Tyrol Austria V. Northern Limestone Alps region. *Berichte Des Naturwissenschaftlich-Medizinischen Vereins in Innsbruck*. 1985; 72101-144.
Keywords: *Juniperus*/ *Hippophae*/ *Picea*/ *Pinus*/ *Fagus*/ *Abies*/ *Corylus*/ pollen/ Austria
Abstract: Diagrams showing the relative and absolute pollen percentages

and the pollen influx values are presented for profiles from five mire and lake sites situated at low and at moderate altitudes in the Northern Limestone Alps region of Tyrol. Radiocarbon (^{14}C) dates for a total of 17 samples were obtained. The Late-Glacial is represented in the profiles from the three lakes, commencing with a pioneer and steppe vegetation in the Older Dryas period. The spread of *Pinus* started in the Bolling, in conjunction with a shrub phase, with increased pollen values of *Juniperus* and *Hippophae*. The Older Dryas is not represented in the profiles and the Younger Dryas is only weakly distinguishable. Peat formation at the two mire sites started early during the Post-Glacial. Traces of human influence (pollen of anthropochorous plants), were found at a remarkably early date at both sites. A marked regional differentiation in the forest composition along the Inn valley was found in the Post-Glacial period. The inner-alpine coniferous forest zone was predominantly composed of *Picea* and *Pinus* in pollen zone VI/VII, with a variable admixture of *Fagus* and *Abies* in zone VIII, whereas the outer-alpine deciduous forest zone was predominantly *Corylus* and mixed oak forest (EMW) in zone VI/VII and *Fagus* in zone VIII.

188. Warren, Yvonne and Britton, Carlton. Evaluation of a nondestructive seed fill determination method for use with native juniper seed. *Seed Technology*. 2001; 23(1):85-87; ISSN: 1096-0724.
Keywords: *Juniperus*/ seed/ juniper/ x-ray
Call Number: SB113.2.J6
Abstract: A common nondestructive method to obtain filled seed is to place them in water and select the seeds that sink. We used two techniques to evaluate this method in determining native juniper seed fill. Seeds were placed in water and separated into groups that sank and floated. The fill status of the two groups was determined by opening and visually inspecting the contents of 100 seeds from each group and by viewing x-ray films of 1935 seed that sank. Though more filled seeds sank than floated ($\chi^2 = 313.72$, $p < 0.05$) and the number of filled seeds observed in opened versus x-rayed seeds did not differ ($\chi^2 = 1.2281$, $p > 0.05$), approximately 30% of seeds that sank were not filled. This error can be attributed to empty seeds that sank having thickened coats. Use of this nondestructive method in conjunction with x-ray eliminated the error and allowed selection of 100% filled seed.
189. West, N. E. Successional patterns and productivity potentials of pinyon [*Pinus edulis*]-juniper ecosystems. Developing Strategies for Rangeland Management A Report Prepared by the Committee on Developing Strategies for Rangeland Management, National Research Council/National Academy of Sciences. 1984; 1301-1332.
Keywords: *Juniperus*/ *Pinus*/ fires/ succession
Abstract: In parts of semi-arid W. USA, 11 spp. of *Pinus* and 9 spp. of *Juniperus* dominate 325 000 km² of woodland as a result of reduced frequency of fires, and reduced competition from herbaceous plants due to

livestock grazing. The historical reasons for this, and recommendations to restore forage spp. and reduce erosion are presented.

190. West, N. E.; Tausch, R. J.; Rea, K. H., and Southard, A. R. Soils associated with pinyon-juniper woodlands of the Great Basin. *Forest Soils and Land Use*. 1979; 68-88.
Keywords: *Juniperus/ Pinus/* Great Basin/ soils
Abstract: The results of an analysis of soils from 18 ranges in the western USA, each containing at least 25 juniper and/or pinyon pine trees per ha.
191. West, N. E.; Tausch, R. J.; Rea, K. H., and Tueller, P. T. Taxonomic determination, distribution, and ecological indicator values of sagebrush within the pinyon-juniper woodlands of the Great Basin. *Journal of Range Management*. 1978; 31(2):87-92.
Keywords: *Juniperus/ Pinus/* Great Basin/ sagebrush/ understory/ chromatography
Abstract: Various sagebrush taxa are major understory components of most Great Basin pinyon-juniper woodlands. Improved understanding of their identification, distribution, and ecological indicator significance is necessary to interpret site differences for these ranges. Current information on the geographic distribution of sagebrush taxa and their relationships to environmental factors within the Great Basin pinyon-juniper woodlands is summarized. In order to further synecological investigations in the Great Basin, sagebrush samples from 66 of the approximately 200 mountain ranges were collected. Chromatography was used in making identifications due to the fact that the morphology within sagebrush taxa is so variable. Climatic differences were found to explain the basin-wide distributions much more than geologic, landform, or soil conditions, soils and exposure becoming more important on the local scale. It was concluded that the presence of a particular sagebrush taxon within pinyon-juniper woodlands could be used for comparisons of site favorableness provided one understands the general distribution of the other sagebrush taxa.
192. Wood, M. K.; Hereford, D.; Souders, C., and Hill A. Variations in plants, soils, water, and erosion in a Pinyon Pine and Juniper dominated range site. *Variability in Rangeland Water Erosion Processes Proceedings*, Minneapolis, Minnesota, 1-6 November, 1992. 1994; 93-106.
Keywords: *Juniperus/ Pinus edulis/* geology/ size/ erosion/ variation.
Abstract: Surface erosion on pinyon pine (*Pinus edulis*)-juniper (*Juniperus* spp.) dominated rangelands varied spatially and temporally due to the confounding effects of erratic climate, topographic changes, incongruities of soil and geological substrate, and various other perturbations. Measurement of spatial variation was affected by plot size. Small plots (1 m²) were influenced by differences in soils, geological substrate, and plant community structure. Therefore, many plots were needed to stratify vegetation, soil, and geological differences.

Run-on and runoff processes between coppice dune and dune interspaces could not be measured. Large watershed size plots (a few hectares) were highly influenced by topographic features such as watershed slope, aspect, and shape. Plots that were 4 by 25 m could be located to minimize topographic changes, yet were large enough to include changes in soil, geological substrate, and plant community structure.

193. Wright, H. A.; Neunschwander, L. F., and Britton, C. M. The role and use of fire in sagebrush-grass and pinyon-juniper plant communities: a state of the art review. US Forest Service, Intermountain Forest and Range Experiment Station, General Technical Report. (INT-58). 1979; INT-5848.
Keywords: *Juniperus*/ sagebrush/ *Pinus*/ prescribed burning/ management/ vegetation
Abstract: The current knowledge of the effects of fire on vegetation in sagebrush-grass and pinyon-juniper communities is summarized. Data are presented both from an ecological perspective and by individual species. There are sections on prescribed burning, management implications, and state-of-the-art knowledge for sagebrush-grass and pinyon-juniper vegetative types.
194. Yakimenko, N A. The degree of ecological adaptation of arthropods living in seeds and berries of juniper (*Juniperus* L.). Section 11 Forest Entomology. 1972; 45
XIIIth International Congress of Entomology, Moscow, 2-9 August, 1968
Proceedings Volume 3: Rafes, P M. 1972; 45.
Keywords: *Juniperus*/ arthropods/ adaptation/ trees/ agricultural entomology
195. Yemane, K.; Robert, C., and Bonnefille, R. Pollen and clay mineral assemblages of a late Miocene lacustrine sequence from the Northwestern Ethiopian highlands. Palaeogeography Palaeoclimatology Palaeoecology. 1987; 60(1-2):123-142.
Keywords: *Juniperus*/ *Podocarpus*/ *Chilga palaeoflora*/ gymnosperms / pollen/ Ethiopian
Abstract: A unique pollen/spore flora from a lacustrine deposit overlying an 8 myr old basalt flow on the Northwestern Ethiopian highlands is described. A total of 126 pollen taxa is recorded. The pollen flora presents strong characteristics of a lowland rainforest and lacks the diagnostic elements of upland forests, the gymnosperms *Podocarpus* and *Juniperus* in East Africa. The commonest savanna element that characterizes the pollen diagrams from East Africa, the *Gramineae*, is very weakly represented. The pollen/spore diagram, which is constructed from 20 selected taxa, shows six distinct developments of the palaeovegetation during the deposition of the lake-beds. Semiquantitative evaluation of the distribution of three diagnostic clay minerals shows developments parallel to that of the microflora. Kaolinite and illite are dominant in the humid

pollen zone and an increase of smectite towards the end of the sedimentation period seems to agree with the observed general aridity trends in the clay mineral assemblages of equatorial zones towards the end of the Miocene. The flora most probably predates the Late Cenozoic global cooling and the Mediterranean desiccation. The northerly presence of lowland rainforest-type vegetation, as suggested by the composition of the *Chilga palaeoflora*, as recent as the latest Miocene is of great interest for the phytogeographic evolution of the continent.

196. Young, J. A. Historical uses of Great Basin pinyon-juniper woodlands. Society for Range Management, 33rd Annual Meeting, San Diego, California, February 11-14 -1980, Abstracts and Position Statements. 1980; 7.
Keywords: *Juniperus*/ Great Basin/ *Pinus*/ woodlands/ Nevada/ wood products/ energy source
Abstract: The pinyon-juniper woodlands of the Great Basin were a vital source of wood products for the mining industry from the 1860's to the 1920's. Pinyon and juniper were cut extensively for the production of charcoal, the only available fuel or energy source for the smelters of central Nevada. Firewood, fencing, and sundry ranching and mining uses were also important. Deforestation by cutting and wildfire continued unabated until the 1920's and 1930's, when fossil fuels, wood substitutes, and fire control combined to decrease use of this vegetation type. The vestiges of a once-flourishing wood products industry haunt the current managers of the pinyon-juniper zone.
197. Yu, Zicheng. Late quaternary paleoecology of *Thuja* and *Juniperus* (*Cupressaceae*) at Crawford Lake, Ontario, Canada: Pollen, stomata and macrofossils. Review of Palaeobotany & Palynology. 1997; 96(3-4):241-254.
Keywords: *Juniperus*/ *Cupressaceae*/ *Thuja*/ stomata/ macrofossils
Abstract: In northeastern North America, palaeoecological records of *Thuja* and *Juniperus* are problematic due to their indistinguishable and poorly preserved fossil pollen grains. However, macrofossils and stomata of *Thuja* and *Juniperus* are distinctive. Difficulties with macrofossil data are that the analysis is time-consuming, and macrofossils are usually scarce in lake sediments. Using stomata as a proxy of macrofossils has two advantages: (1) stomata are more abundant than macrofossils; and (2) they can be counted from pollen preparations. Crawford Lake has 5-15% *Thuja-Juniperus* (*Cupressaceae*) pollen through most of the past 13,000 yr except for a dearth during the *Pinus* pollen zone at ca. 10,000-7500 1 degree C Yr BP. Macrofossil, stomatal and pollen results showed the late glacial (ca. 13,000-10,000 14C yr BP) pollen mostly was derived from *Juniperus* (likely *J. communis*) indicated by smaller pollen, a few *Juniperus* stomata, and absence of *Thuja* stomata and macrofossils, whereas pollen at 7500-0 14C yr BP was from *Thuja occidentalis* indicated by larger pollen, and abundant *Thuja* stomata and macrofossils. This bimodal stratigraphic pattern of *Cupressaceae* pollen appears at other

sites in southern Ontario, which suggests the possibility of separating these taxa to an earlier *Juniperus* and later *Thuja* at these sites. The late glacial *Thuja* macrofossils reported in previous studies may indicate early immigration of a small population via favourable habitats along Ontario's Niagara Escarpment. Alternatively, these *Thuja* macrofossils may be derived from younger sediments, as suggested by the questionable stratigraphies and puzzling 1° C dates. The separation of two genera would provide valuable information in palaeoecological interpretation of pollen data because the taxa occupy different habitats.

198. Yu, Zicheng E-mail ziy2@lehigh. edu. Late Quaternary dynamics of tundra and forest vegetation in the southern Niagara Escarpment, Canada. *New Phytologist*. 2003 Feb; 157(2):365-390.
Keywords: *Juniperus/ Alnus/ Dryas/ Cyperaceae/ Salix/ Picea/ Pinus/ Tsuga/ forest/ vegetation/ late quaternary/ Canada*
Abstract: Here, palaeoecological studies from southern Ontario, Canada, are detailed to reconstruct vegetation history of the last 13 000 14C year, with emphasis on late-glacial treeless vegetation. Two sites (Crawford Lake and Twiss Marl Pond) were investigated using combined pollen and plant-macrofossil stratigraphic data. Comparison of multivariate analysis of pollen data with climate variations inferred independently from oxygen isotopes at the same site facilitated systematic evaluations of climate-vegetation interactions during different stages of vegetation development. Pollen results show a distinctive successional change from *Alnus-Dryas-Cyperaceae* sparse tundra or periglacial desert to *Salix-Juniperus-Cyperaceae* dense tundra, with abundant arctic/alpine plant macrofossils, during the first few centuries after ice retreat. The area around the two sites was then dominated by *Picea* (c. 12 000-10 000 14C BP). Vegetation shifts, summarized by log-contrast principal component analysis of the pollen record, indicated a lagged response of forests to deglacial climate warming. The major vegetation shift at c. 7500 14C BP from coniferous *Pinus*-dominated to mixed forests probably corresponded to a major shift from deglacial to full post-glacial climates. Vegetation during the mid- and late Holocene responded more directly to natural (drought-triggered pathogen-induced *Tsuga* decline) and human disturbances (aboriginal and EuroCanadian settlements). This study demonstrates that bedrock basins most faithfully recorded the earliest vegetation change because they usually experienced a short delay in lake formation after ice retreat.
199. Zarn M. Ecological characteristics of pinyon-juniper woodlands on the Colorado plateau: a literature survey. Technical Note T/n 310-Denver, Colorado: S Department Of The Interior, Bureau Of Land Management, Denver Service Center. 1977; 183.
Keywords: *Juniperus/ Pinus/ woodlands/ Colorado plateau*
200. Zhang, J. W.; Klopfenstein, N. B. Author, and Peterson, G. W. Genetic variation

in disease resistance of *Juniperus virginiana* and *J. scopulorum* grown in eastern Nebraska. *Silvae Genetica*. 1997; 46(1):11-16.

Keywords: *Juniperus/ eastern redcedar/ J. virginiana/ J. scopulorum/ Cercospora blight/ Pseudocercospora juniperi/ Rocky Mountain Juniper/ heritabilities*

Abstract: *Juniperus* trees were examined in a plantation located in Horning State Farm, near Plattsmouth in eastern Nebraska, USA. Trees were grown from seeds collected from 131 open-pollinated families within 39 seed-zones in eastern redcedar (*J. virginiana* L.) and 25 open-pollinated families within 14 seed-zones in Rocky Mountain juniper (*J. scopulorum* SARG.) from their native ranges in the Great Plains of USA. The plantation was established in spring 1980 to examine genetic variation among genotypes for resistance to *Cercospora* blight caused by *Pseudocercospora juniperi* (ELLIS and EVERH.) SUTTON and HODGES, comb. nov. (formerly *Cercospora sequoiae* var. *juniperi*), a major disease that threatens juniper survival east of the Rocky Mountains. All plantation plots were inoculated with *P. juniperi* in 1982, 1984, 1985, and 1986. Infection was scored in 1987. Kabatina tip blight caused by *Kabatina juniperi* SCHNEIDER and v. ARx, which occurred naturally, was scored also. Between the two juniper species, we found significant differences in survival and resistance to both diseases ($P < 0.05$). All traits differed among seed-zones and among families within seed-zones of eastern redcedar ($P < 0.01$). With Rocky Mountain juniper, variation was significant among seed-zones for survival ($P < 0.01$), and among families within seed-zones for *Cercospora* blight and survival in 1994 ($P < 0.05$). Heritabilities and gene correlations were high for both disease resistance traits in eastern redcedar. Geographic patterns of genetic variation were identified; seed sources from southeastern collection sites of lower elevations tended to exhibit higher resistance to both diseases than seed sources from northwestern collection sites of higher elevations. Disease resistance traits were not correlated with height growth ($r < 0.20$, $P > 0.05$) for either species. The relationship between *Cercospora* blight resistance and survival in 1994 was significant ($r = 0.59$, $P < 0.05$). Results indicate that *Cercospora* blight resistance in eastern redcedar can be improved by selecting resistant seed sources or families for direct reforestation programs or future breeding programs in eastern Nebraska. Additionally, Kabatina tip blight levels were lower on genotypes selected for resistance to *Cercospora* blight. Moreover, because resistance to *Cercospora* and *Kabatina* blights can be selected independently of height growth and survival, there is apparently no need to sacrifice growth and survival characteristics.

201. Zhang Q.; Sodmergen; Hu Y. S., and Lin J. X. Female cone development in *Fokienia*, *Cupressus*, *Chamaecyparis* and *Juniperus* (*Cupressaceae*). *Acta Botanica Sinica*. 2004; 46(9):1075-1082.

Keywords: *Juniperus/ Cupressus/ Chamaecyparis/ Fokienia/ cone*

development/ female cones/ ovules/ reproduction

Abstract: The ontogeny and vascular systems of female cones of the *Fokienia*, *Cupressus*, *Chamaecyparis* and *Juniperus* were investigated in detail using scanning electron microscopy (SEM) and conventional light microscopy. In the species examined, in the axils of the bracts, the first recognizable structure was a broad meristematic swelling, from which ovules developed. No ovuliferous scales developed during the ontogeny of the female cones. The number of ovules and ovule developing sequence displayed considerable variation in different species. However, development of the bracts was similar in all of the investigated species. Following pollination, the foliage-like bracts became peltate bract scales due to intercalary expansion, and globose cones formed. In addition, the vascular system in the bract scales became intricate, and inverted vascular bundles emerged in the adaxial of the mature bracts. Based on these observations, a morphological interpretation and possible evolutionary trend of the *Cupressaceae* female reproductive structures was discussed.

***Juniperus africana* (1)**

1. Adams R. P.; Mumba L. E.; James S. A.; Pandey R. N.; Gauquelin T., and Badri W. Geographic variation in the leaf oils and DNA fingerprints (RAPDs) of *Juniperus thurifera* L. from Morocco and Europe. *Journal of Essential Oil Research*. 2003; 15(3):148-154.
Keywords: *Juniperus thurifera*/ *Juniperus foetidissima*/ *Juniperus africana*/ Morocco/ Europe/ leaf oils/ populations/ seeds/ cones
Abstract: Samples of *J. thurifera* were collected from the Atlas Mountains, Morocco, northern and southern Spain, the Pyrenees, France, French Alps and Corse Island, France. The leaf oils were analyzed and were found to be polymorphic for several major compounds (sabinene, limonene, linalool, piperitone, linalyl acetate and sesquiterpenes). In general, the Moroccan trees were higher in sabinene, gamma -terpinene, cis-sabinene hydrate and terpinen-4-ol, but lower in limonene, delta -2-carene, and piperitone than trees from Europe. Analysis based on random amplified polymorphic DNAs (RAPDs) for the aforementioned population plus *J. foetidissima* (as an outgroup), revealed that the Moroccan *J. thurifera* populations were most similar to plants from southern Spain, then to populations from France. Although the trees generally clustered by populations, there appear to be some differentiation in the RAPDs between the European *J. thurifera* populations and the Moroccan populations. Combining previous studies on seeds per cone, proanthocyanidins, and the current report on the leaf essential oils and RAPDs, there is some support for the continued recognition of *J. thurifera* var. *africana* syn. *J. africana*; *J. thurifera* subsp. *africana* in Algeria and Morocco.

***Juniperus angosturana* (1)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/* essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana, J. ashei, J. californica, J. coahuilensis, J. comitana, J. deppeana, J. durangensis, J. flaccida, J. gamboana, J. jaliscana, J. monosperma, J. monticola, J. osteosperma, J. occidentalis, J. pinchotii, J. saltillensis,* and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

***Juniperus arborescens* (1)**

1. Mohr and Charles Theodore. Notes on the Red Cedar. 1901; 3137.

Keywords: *Juniperus virginiana/ eastern red cedar/ Juniperus caroliana/ Juniperus arborescens/ Juniperus barbadensis/ Juniperus faetida/ Juniperus australis/ Juniperus sabina/ juniper/ cedar/ savin*
Call Number: 1

Abstract: Botanical analysis and distribution of eastern red cedar in the early 1900's

***Juniperus ashei* (37)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus*

pinchotii/ *Juniperus saltillensis*/ *Juniperus standleyi*/ essential oils/
DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. *Sabina*) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

2. Alexander H. Controlling juniper: fire and goats, a combination? *Rangelands*. 1993; 15(6):257-259.
Keywords: *Juniperus pinchotii*/ *Juniperus ashei*/ *Juniperus virginiana* / fire/ goats
Abstract: Control of *Juniperus pinchotii*, *J. ashei* and *J. virginiana* in Texas rangelands using fire and goats, and the ecological impact of these methods, are discussed.
3. Bryant F. C.; Launchbaugh G. K., and Koerth B. H. Controlling mature ashe juniper in Texas with crown fires. *Journal Of Range Management*. 1983; 36(2):165-168.
Keywords: *Juniperus ashei*/ Texas/ crown fire
4. Chavez Ramirez; Felipe [Author]; Slack, and R. Douglas [Author]. Carnivore fruit use and seed dispersal of two selected plant species of the Edwards Plateau, Texas. *Southwestern Naturalist*. 1993; 38(2):141-145.
Keywords: *Juniperus ashei*/ Ashe juniper/ seed dispersal/ carnivore fruit use/ Texas/ persimmon/ *Diospyros texana*
Abstract: Ashe juniper (*Juniperus ashei*) and Texas persimmon (*Diospyros texana*) fruit use and seed dispersal potential by four carnivores were studied on the Edwards Plateau region of Texas (USA). Feces were examined to determine presence of seeds and frequency of occurrence by month from August 1989 to February 1990. Use of fruit species by month followed the pattern of fruit ripening of the two plant species. Texas persimmon fruit was consumed primarily between September and January while Ashe juniper fruit was consumed from October through February. Because larger numbers of seeds are present in feces and few are destroyed in mastication and digestion all carnivores studied are considered legitimate dispersal agents of Ashe juniper and Texas persimmon. Dispersal efficiency of carnivores, however, is low due

to the location of dispersed seeds (feces) and the clumped seed dispersal patterns.

5. Chavez Ramirez, F and Slack, R D. Effects of avian foraging and post-foraging behavior on seed dispersal patterns of Ashe juniper. *Oikos*. 1994; 71(1):40-46; ISSN: 0030-1299.
Keywords: *Juniperus ashei*/ birds/ woody-weeds/ weeds/ seeds/ seed dispersal/ seed predation
Abstract: The effects of avian foraging and post-foraging behaviour on seed dispersal patterns of Ashe juniper (*Juniperus ashei*) in the Edwards Plateau, Texas, were examined. It was predicted that (1) flocking species would be more efficient at dispersing seeds than non-flocking species, and (2) among flocking species, flock attributes such as size, structure, and post-foraging behaviour would determine efficiency of seed dispersal by each species. It was not possible to evaluate single forager species because of low sample sizes. Among flocking species foraging behaviour of birds (time spent feeding, number of fruit taken per visit, number of visits, and flock size and cohesion) determined the quantity of the seed crop removed by each species. Post-foraging behaviour (departure direction from feeding trees, perch type selected, and distance moved from feeding trees) determined the probability that seeds dispersed by a dispersal agent will land in a safe site for germination. Two of 15 species of avian frugivores that fed on Ashe juniper, the American robin (*Turdus migratorius*) and cedar waxwing (*Bombycilla cedrorum*), were the most important dispersers. Differences in foraging and post-foraging behaviour between *T. migratorius* and *B. cedrorum* yielded two distinct seed dispersal patterns, "clumped" (high density) by *C. cedrorum* and "scattered" (low density) by *T. migratorius*.
6. Diamond, D. D.; Rowell, G. A., and Keddy-Hector, D. P. Conservation of Ashe juniper (*Juniperus ashei* Buchholz) woodlands of the central Texas hill country. *Natural Areas Journal*. 1995; 15(2):189-197.
Keywords: *Juniperus ashei*/ synecology/ in situ conservation/ Texas
Abstract: Ashe juniper (*Juniperus ashei*) is important in woodlands that harbor a diverse biota. Old-growth woodlands in which Ashe juniper is codominant have decreased in area within the central Texas hill country since European settlement. Juniper is often viewed as undesirable because it readily colonizes open spaces and is not highly palatable to domestic livestock. Land stewardship difficulties arise when managers attempt to reduce juniper abundance on a variety of sites where it is a component of stable communities. At least four different ecological site types support communities with Ashe juniper as an important component: (1) uplands with deep, continuous soils that support mainly evergreen savannas and woodlands; (2) uplands with shallow or discontinuous soils that support mixed evergreen/deciduous shrublands and woodlands; (3) uplands with reddish, chert-rich soils that support mainly deciduous or mixed woodlands and savannas; and (4) canyon systems and escarpments that

support evergreen or mixed forests and woodlands. Development of ecologically sound, cost-effective conservation strategies for parks, nature reserves, or working ranches requires (1) recognition of different ecological site types and changes in site potentials caused by historical disturbances such as repeated clearing, domestic livestock, and erosion; (2) an understanding of the composition of stable community types on different site types, including acceptance of Ashe juniper as a natural and desirable component of the vegetation; and (3) an awareness of the dynamics of different community types. Fire and drought were two large-scale processes that regulated pre-European vegetation dynamics. Drought often operated on a decades-long return interval. Frequent ground fires burned in open savannas where fine fuel accumulated, whereas some sites experienced crown fires at decades-long return intervals. Fire was nearly absent from the most mesic forests. Managers must try to accurately identify ecological site types and the potentially stable vegetation they support, and then devise strategies to mimic landscape-scale, decades-long disturbance patterns within compact conservation areas.

7. Dugas W. A.; Hicks R. A., and Wright P. Effect of removal of *Juniperus ashei* on evapotranspiration and runoff in the Seco Creek watershed. *Water Resources Research*. 1998; 34(6):1499-1506.
Keywords: *Juniperus ashei*/ evapotranspiration/ runoff
Abstract: The effect was measured of removing an individual species of tree, *Juniperus ashei*, on the runoff (RO) and evapotranspiration (ET) from two adjacent, unreplicated 15-ha areas (termed untreated and treated) in Texas, USA. Daily ET from the two areas, measured from 1991 to 1995 using the Bowen ratio-energy balance method, varied from near 0 to 6 mm/d. All *J. ashei* taller than 0.5 m were cut with a chain saw in the treated area in September 1992. During both the pretreatment period (prior to September 1992) and the post treatment period, the slope of treated ET as a function of untreated ET was ~1, suggesting that for the entire period of measurements, brush removal had no significant effect on ET. Average daily ET from the area to be treated was 0.05 mm/d lower than that from the untreated area during the 2-year pre-treatment period, while it was 0.12 mm/d lower during the 3-year posttreatment period. The ET difference (untreated minus treated) was 0.3 mm/d in the first 2 years following removal of *J. ashei* and decreased thereafter. Removal of *J. ashei* had no consistent effect on RO. Vegetation management increased the potential for greater water yields in the short-term from these rangelands by decreasing ET for the first 2 years after imposition of treatment.
8. Engle D. M.; Bernardo D. J.; Hunter T. D.; Stritzke J. F., and Bidwell T. G. A decision support system for designing juniper control treatments. *AI-Applications*. 1996; 10(1):1-11.
Keywords: *Juniperus virginiana*/ *Juniperus ashei*/ weed control/ computer techniques/ physical control/ chemical control.
Abstract: Juniper (*Juniperus virginiana* and *J. ashei*) encroachment

into grasslands of the central USA represents a major threat to these ecosystems. Considerable control technology is available for treating grasslands subject to juniper encroachment, but reluctance by land managers to initiate juniper control technology results from the many control alternatives plus the uncertain economic return on the investment in the control treatment. Research literature on juniper control was used to develop an interactive decision support system targeted at managers of tallgrass prairies. The program computes forage and cattle production and economic returns based on inputs on range site, current juniper population, and landscape goal (i.e., populations of juniper after treatment). The system employs heuristics to select technologically feasible control methods from an array of available technologies, including mechanical control methods, herbicides and fire. A forage response model for a 10-year planning horizon is derived from user-supplied data on productivity potential of range sites and modeled juniper population following application of various technologically feasible control practices. Annual cash flows from the user-selected livestock enterprise are discounted and summed to arrive at a net present value for each control practice.

9. Fuhlendorf S. D.; Smeins F. E., and Grant W. E. Simulation of a fire-sensitive ecological threshold: a case study of Ashe juniper on the Edwards Plateau of Texas, USA. *Ecological Modeling*. 1996; 90(3):245-255.
Keywords: *Juniperus ashei*/ Texas/ fire-sensitive species
Abstract: A model was developed to represent the establishment of a fire-sensitive woody species from seeds and subsequent survival and growth through five size classes. Simulations accurately represent structural changes associated with increased density and cover of the fire-sensitive Ashe juniper (*Juniperus ashei*) and provide substantial evidence for multiple steady states and ecological thresholds. Without fire, Ashe juniper increases and herbaceous biomass decreases at exponential rates until a dense-canopy woodland is formed after approximately 75 years. Maintenance of a grass-dominated community for 150 years requires cool-season fires at a return interval of less than 25 years. When initial cool-season fires are delayed or return intervals are increased, herbaceous biomass (fuel) decreases below a threshold, and consequently a change from grassland to woodland become irreversible. With warm-season fires, longer return intervals maintain grass dominance, and under extreme warm-season conditions even nearly closed-canopy stands can be opened up with catastrophic wildfires.
10. Fuhlendorf, S. D.; Smeins, F. E., and Taylor, C. A. Browsing and tree size influences on Ashe juniper understory. *Journal of Range Management*. 1997; 50(5):507-512.
Keywords: *Juniperus ashei*/ grazing/ synecology/ size.
Abstract: Ashe juniper (*Juniperus ashei*) is increasing on most sites across the Edwards Plateau of Texas. The influence of Ashe juniper tree

size on understory vegetation, and the means by which the interaction between tree size and browsing by domestic goats and white-tailed deer (*Odocoileus virginianus*) modifies overstory/understory relationships, were investigated. Trees were randomly selected from 2 long-term treatments (browsed and unbrowsed) and analyzed with univariate analysis of covariance and multivariate repeated-measures analysis. Without browsing, Ashe juniper is more abundant and its individual influence increases as the size of the tree increases; trees with a canopy diameter < 6.0 m expressed minimal influence on understory vegetation compared to larger trees. When browsers are present at sufficient stocking rates to create a browse line on large trees, encroachment of Ashe juniper is slowed, rate of increase of all woody species is reduced, and large trees cause a shift in species composition directly under the canopy, however cover of all herbaceous species is not reduced. Immediately under the canopy of small browsed trees, herbaceous cover is lower than for unbrowsed trees. Environmental variables responsible for these patterns were litter depth and light penetrating the canopy when the sun is at an angle (during the winter). The increased cover of several herbaceous species under the canopy of large browsed trees and at the canopy edge of browsed and unbrowsed trees, indicates the importance of the interaction between canopy cover and the presence of a browse line. Browse lines on large trees enhance growth and production of cool season species, such as Texas wintergrass (*Stipa leucotricha*) and reduce negative influences (low light, thick leaf litter, etc.) on other herbaceous species. At this level of browsing many other palatable species could be reduced or lost from the plant community.

11. Hall, M. T. Variation and hybridization in *Juniperus*. Annual of Missouri Botanical Gardens . 391-64.
Keywords: *Juniperus ashei*/ *Juniperus virginiana* / ashe juniper/ eastern redcedar/ hybridization
Abstract: Evidence of hybridization of *Juniperus ashei* and *Juniperus virginiana* is the character recombinations in many trees found where those species grow together.
12. Hicks, R. A. and Dugas, W. A. Estimating ashe juniper leaf area from tree and stem characteristics. Journal of Range Management. 1998; 51(6):633-637.
Keywords: *Juniperus ashei*/ leaf area/ Texas/ biomass
Abstract: Ashe juniper (*Juniperus ashei*) is increasing in density and areal coverage on the Edwards Plateau of Texas. This is causing changes in community leaf area that could impact the ecosystem water balance through increased transpiration and interception of precipitation. Methods of estimating leaf area of trees and shoots in a range of size and age classes using nondestructive methods were investigated. All leaf material was harvested from 9 trees ranging in height from 0.8 to 4.8 m, and tree height and canopy diameter were recorded. Each tree was divided

into 6 sections based on 3 horizontal strata and 2 vertical hemispheres. Projected leaf area of subsamples, collected from each section, was multiplied by pi to give full cylinder leaf area which was used to calculate specific leaf area ($\text{cm}^2 \text{g}^{-1}$). Dried leaf biomass for each stratum, hemisphere, and tree was multiplied by the specific leaf area to determine the leaf area. Leaf biomass was harvested from shoots and stem diameters were measured in situ, and the dried leaf biomass was multiplied by the specific leaf area to determine shoot leaf area. There was no significant effect of stratum or hemisphere on specific leaf area or of hemisphere on leaf area. The middle stratum had a significantly greater percentage of total leaf area (52%). Total tree leaf area was best predicted ($r^2 = 0.97$) by canopy area. Shoot leaf area was best predicted ($r^2 = 0.93$) by stem area. It is concluded that canopy and stem area measurements are rapid, nondestructive means of accurately estimating Ashe juniper tree and shoot leaf area, respectively.

13. Jackson; J. T. [Author]; Van Auken, and O. W. [Author]. Seedling survival, growth and mortality of *Juniperus ashei* (Cupressaceae) in the Edwards Plateau region of Central Texas . Texas Journal of Science. 1997 Nov; 49(4):267-278.
Keywords: *Juniperus ashei*/ mortality/ seedlings/ survival
Abstract: This study examined the survival, growth and mortality of various spatial cohorts of seedlings of *Juniperus ashei*. The greatest mortality occurred during the hot, dry summer months. In addition, a large number of *J. ashei* seedlings with reduced growth was found beneath the canopy of mature *J. ashei* trees. These seedlings appear to serve as a seedling bank, providing a source of recruitment of new individuals into the population with the death of the overstory trees. Higher seedling growth rates were found at the edge of established woodlands, suggesting that edge habitats may be best for growth beyond the seedling stage. No seedlings survived in the associated grasslands. Thus, *J. ashei* woodlands appear to be expanding more by way of the growth of new individuals at the edges of established woodlands, rather than from new individual plants establishing in associated grasslands.
14. Jessup, K. E.; Barnes, P. W., and Boutton, T. W. Vegetation dynamics in a *Quercus-Juniperus* savanna: an isotopic assessment. Journal of Vegetation Science. 2003; 14(6):841-852.
Keywords: *Juniperus ashei*/ *Quercus virginiana*/ biogeochemistry/ carbon sequestration
Abstract: Woody plants are increasing in many grassland and savanna ecosystems around the world. As a case in point, the Edwards Plateau of Texas, USA, is a vast region (93 000 km²) in which rapid woody encroachment appears to be occurring. The native vegetation (prior to the Anglo-European settlement 150-200 years ago) and the biogeochemical consequences of woody encroachment in this region, however, are poorly understood. To assess these matters we measured plant and soil $\delta^{13}\text{C}$,

soil organic C and soil N content from grasslands and two important woody patch types (mature *Quercus virginiana* clusters and *Juniperus ashei* woodlands) in this region. Soil delta 13C values showed that relative productivity of C3 species has increased in grassland and both woody habitats in recent times. delta 13C of SOC in grasslands and *Q. virginiana* clusters increased with depth from the litter layer to 30 cm (grasslands=-21 to -13 per mil; *Q. virginiana* clusters=-27 to -17 per mil) and were significantly different between habitats at all depths, indicating that *Q. virginiana* has been a long term component of the landscape. In *J. ashei* woodlands, soil delta 13C values (at 20-30 cm depth) near the woodland edge (-13 per mil) converged with those of an adjacent grassland (-13 per mil) while those from the woodland interior (-15 per mil) remained distinct, indicating that the woodland has been present for many years but has recently expanded. Concentrations and densities of soil organic carbon (SOC) and total N were generally greater in woody patches than in grasslands. However, differences in the amount of SOC and N stored beneath the two woody patch types indicates that C and N sequestration potentials are species dependent.

15. Kishikawa, R.; M-Horiuti, T.; Togawa, A.; Kondoh, Y.; Janzy, P. D.; Goldblum, R. M.; Kotoh, E.; Shimoda, T.; Shoji, S.; Nishima, S., and Brooks, E. G. Juniper pollen monitoring by Burkard sampler in Galveston, Texas, USA and Japanese Cedar pollen counting in Fukuoka, Japan - Introduction of Pan American Aerobiology Association protocol counting technique. Japanese Journal of Allergology. 2004; 53(6):582-588.
Keywords: *Juniperus ashei*/ *Juniperus virginiana*/ pollen/ monitoring
Abstract: We have monitored Juniper pollen which caused winter allergy symptoms by Burkard sampler in Galveston, Texas. We identified and counted Juniper pollen grains by PAAA protocol which was a comprehensive guideline for the operation of Hirst-Type suction bioaerosol sampler, (original of Burkard sampler) in the USA. In Galveston we were able to detect the Mountain Cedar (*Juniperus ashei*) pollen from December to of January, and Eastern Red Cedar (*Juniperus virginiana*) which has cross reactivity to MC from almost middle of January to February. There is no MC vegetation in Galveston. We found the pollen grains were transported from west at Edward Plateau in West Texas where it was thickly wooded. Then, we tried to monitor Japanese Cedar (JC) pollen grains in Fukuoka, Japan according with the same method. We found the significant positive correlation between the pollen counts using one single longitudinal traverse counting technique in the PAAA protocol and the JC pollen counting on the whole of Melinex tape per 24 hours ($R^{2} = 0.9212$, $p = 0.0001$), and the gravitational method that is Durham sampler's pollen counting in 2002 ($R^{2} = 0.489$, $p = 0.0001$), and in 2003 ($R^{2} = 0.948$, $p = 0.0001$) respectively. We suggested that we can use the PAAA protocol for airborne pollen investigation in Japan by Burkard sampler.

16. Lacovacci, P.; Afferni, C.; Barletta, B.; Tinghino, R.; Di Felice, G.; Pini, C., and Mari, A. *Juniperus oxycedrus*: A new allergenic pollen from the *Cupressaceae* family. *Journal of Allergy and Clinical Immunology*. 1998; 101(6I):755-761.
Keywords: *Juniperus oxycedrus*/ *Cupressus*/ *Juniperus ashei*/ pollen/ allergy/ Italy
Abstract: Cupressaceae allergy is a worldwide pollinosis caused by several species. Some species in limited geographic areas pollinate in fall and winter. *Juniperus oxycedrus* matches these features. Objective: We sought to define the immunochemical, allergologic, and environmental aspects of *J. oxycedrus* pollen. Methods: Pollen extract from *J. oxycedrus* was prepared and characterized by biochemical analysis and human specific IgE binding by means of ELISA and immunoblotting. A 3-year phenological study was conducted to define the pollinating period of *J. oxycedrus*. Forty consecutive patients allergic to cypress were recruited in two areas and divided into two groups according to their exposure to *J. oxycedrus* pollen. Clinical evaluation, skin prick tests, and specific IgE determination with *J. oxycedrus*, *J. ashei*, and *Cupressus arizonica* extracts were carried out on both groups. Results: *J. oxycedrus* pollen extract was obtained, and it showed specific IgE binding and wide cross-reactivity with other Cupressaceae species. The extract caused a positive skin test response in all the patients tested, with about 80% of them having detectable specific IgE. Symptoms related to *J. oxycedrus* pollen exposure were recorded in 72% of the directly exposed patients and occasionally in 9% of the nonexposed patients. In the Mediterranean coastal area considered, *J. oxycedrus* was the first *Cupressaceae* species that started to pollinate at the beginning of November and ended in the first part of December. Conclusions: *J. oxycedrus* represents a newly characterized pollen species of the *Cupressaceae* family that cross-reacts with other members of the same family. Subjects with cypress allergy have in vivo and in vitro positive test responses for *J. oxycedrus* and can show symptoms when exposed to its pollen. Finally, the most important feature of *J. oxycedrus* is its early pollinating period in southern Europe (Italy), causing a further extension of the cypress pollen season in areas where other *Cupressaceae* species are present.
17. Launchbaugh, G. K. and Bryant, F. C. Prescribed burning of Ashe juniper on the Edwards Plateau region of Texas. *Research Highlights 1979, Noxious Brush and Weed Control; Range and Wildlife Management*. 10. 1979; 12-13.
Keywords: *Juniperus ashei*/ Texas/ fire suppression/ prescribed burning
Abstract: As a result of fire suppression, *Juniperus ashei* has become the dominant tree in parts of central Texas, with a consequent reduction in the productivity of herbaceous plants. A study was initiated to test mechanical control in combination with prescribed burning. Junipers were bulldozed to form a windrow against live trees and left for 2 months to dry out and to

provide fuel for igniting the remaining tree canopy. Fires were set in June and October and temp., humidity and the direction and speed of the wind were recorded. An attempt was to be made to correlate environmental factors with effectiveness of burns in order to develop a satisfactory prescription for controlled burning.

18. McKinley, D. and van Auken, O. W. Growth and survival of *Juniperus ashei* (*Cupressaceae*) seedlings in the presence of *Juniperus ashei* litter. Texas Journal of Science. 2004; 56(1):3-14.

Keywords: *Juniperus ashei*/ seedlings/ litter/ survival

Abstract: A greenhouse experiment was conducted to determine the effect of *Juniperus ashei* litter on the growth and survival of *J. ashei* seedlings. Incremental additions (0-250 g) of *J. ashei* tree litter or vermiculite (control) were placed on 15 by 15 cm pots, which contained transplanted *J. ashei* seedlings in 800 g of mineral soil. There were no significant differences in the mean absolute differences in growth of *J. ashei* seedling considering basal diameter, seedling height and number of branches between the *J. ashei* tree litter additions and the vermiculite additions, or the amounts of both types of litter. However, there were non-significant positive increases in the seedling growth in the 50 g treatment of both litter types followed by a decrease at higher levels. Mortalities were highest at greater levels of both types of litter, but were still non-significant. The responses of the *J. ashei* seedlings with respect to growth and survival in the *J. ashei* litter and vermiculite suggest that there is no allelopathic component in the *J. ashei* litter affecting seedling growth and survival or if there is, it is transient.

19. McKinley D. C. and Van Auken O. W. Influence of interacting factors on the growth and mortality of *Juniperus* seedlings. The American Midland Naturalist. 2005; 15(2):320-330.

Keywords: *Juniperus ashei*/ seedling/ growth/ mortality

Abstract: The influence of environmental factors on *Juniperus* seedling growth and mortality in *Juniperus* woodlands and their role in community replacement or succession is poorly understood. A full factorial field experiment was set up to investigate the influence of adult tree canopies, light levels and water and nutrient additions on *Juniperus ashei* seedling growth and mortality. Relative growth rates calculated from basal diameter, height and number of seedling branches were used as response variables in a four- way multivariate analysis of variance, using canopy, light levels, water and nutrient manipulations as factors. The pattern of seedling growth in the experiment was best explained with two significant three- way interactions between the canopy, light level and water treatments ($F = 2.21$, $P = 0.04$) and light level, water and nutrient treatments ($F = 3.01$, $P = 0.03$). Greatest seedling relative growth rates occurred with modified light levels associated with canopies removed, with supplemental water and nutrients. Mortality was increased by shading with supplemental water, added nutrients or a combination of

supplemental water and nutrients. Conversely, mortality was not affected by canopy treatment, but it was reduced with high light levels, the additions of nutrients, water or combinations of nutrients and water. Evidence suggests that growth of *J. ashei* seedlings and eventual replacement of the adults is most strongly influenced by light levels, and at higher light levels, both water and nutrients interact to support continued growth.

20. McLemore, C.; Kroh, G. C., and Pinder, III J. E. *Juniperus ashei* (Cupressaceae): Physiognomy and age structure in three mature Texas stands. SIDA, Contributions to Botany. 2004; 21(2):1107-1120.
Keywords: *Juniperus ashei*/ Texas/ mature stands/ physiognomy/ age structure
Abstract: Despite the abundance of *Juniperus ashei* Buchholz in Texas, mature, intact stands are relatively rare. This study compares structural patterns and growth dynamics among three mature stands on the Edwards Plateau and documents relationships between structural changes and temporal development of these forests. Each stand has varied physiognomic characteristics and age-related structure. By identifying and comparing these properties, this study provides information relevant to conservation and management decisions relating to *J. ashei*.
21. Owens, M. K. The role of leaf and canopy-level gas exchange in the replacement of *Quercus virginiana* (Fagaceae) by *Juniperus ashei* (Cupressaceae) in semiarid savannas. American Journal of Botany. 1996; 83(5):617-623.
Keywords: *Juniperus ashei*/ *Quercus virginiana*/ savanna/ gas exchange/ leaf area
Abstract: Photosynthesis, transpiration, and leaf area distribution were sampled in mature *Quercus virginiana* and *Juniperus ashei* trees to determine the impact of leaf position on canopy-level gas exchange, and how gas exchange patterns may affect the successful invasion of *Quercus* communities by *J. ashei*. Sampling was conducted monthly over a 2-yr period in 12 canopy locations (three canopy layers and four cardinal directions) in woodlands in south-central Texas. Photosynthetic and transpiration rates of both species were greatest in the upper canopy and decreased with canopy depth. Leaf photosynthetic and transpiration rates were significantly higher for *Q. virginiana* than for *J. ashei* in every canopy level and direction. Leaves on the south and east sides of both species had higher gas exchange rates than leaves on the north and west sides. Although *Q. virginiana* has a greater mean canopy diameter than *J. ashei* (31.3 vs. 27.7 msuperscript 2), *J. ashei* had significantly greater leaf area (142 vs. 58 msuperscript 2/tree). A simple model combining leaf area and gas exchange rates for different leaf positions demonstrated a significantly greater total canopy carbon dioxide uptake for *J. ashei* compared with *Q. virginiana*. Total daily water loss was also greater for *Juniperus* (125 vs. 73 liters/tree). Differences in leaf gas exchange rates were poor predictors of the relationship between the invasive *J. ashei* and

the codominant *Q. virginiana*. Leaf area and leaf area distribution coupled with leaf gas exchange rates were necessary to demonstrate the higher overall competitive potential of *J. ashei*.

22. Owens, M. K. and Schliesing, T. G. Invasive potential of ashe juniper after mechanical disturbance. *Journal of Range Management*. 1995 Nov; 48(6):503-507; ISSN: 0022-409X.
Keywords: *Juniperus ashei*/ ashe juniper/ seed/ seed rain/ seedbank
Call Number: 6D.10.J02
Abstract: Reinvasion of mechanically disturbed juniper communities is possible through contributions from the soil seedbank, seed rain, and the juvenile seedling bank. We compared spatial distribution of the seedbank and seed rain of undisturbed communities to sites where trees were deliberately left as single trees, small mottes of less than 5 trees per group, or large mottes of 5-10 trees per group. Seed density in the litter layer ranged from 1,197 to 1,436 seeds/ m² and in the soil layer from 318 to 617 seeds/ m². Seed rain ranged from 275 to 366 seeds/ m² over all tree arrangements. The treatment associated with single trees caused the litter layer to be removed resulting in the removal of that portion of the seedbank, consequently most seeds (>80%) were found under the canopy of mature, seed-producing trees. Soil disturbance was less severe in small and large motte arrangements, so only 65% of the soil seed bank was under mature trees. In undisturbed communities, the seed population was distributed evenly under tree canopies and in interspaces. Viability and germinability within the seedbank were low (4% and 0%, respectively). Viability of new seed was 47% and germinability was approximately 5%. The juvenile seedling bank contained a sufficient number of seedlings (408 seedlings/ ha²) for ashe juniper to regain dominance on the site through growth. There was no advantage to any spatial pattern of tree distribution in terms of invasive potential when fewer than 10 trees/ ha² were left on a site. However, when 20-50 trees/ ha² are left on a site, tree spatial arrangement has a significant effect on reinvasion rates.
23. Owens, M. K.; Wallace, R. B., and Archer, S. R. Landscape and microsite influences on shrub recruitment in a disturbed semi-arid *Quercus-Juniperus* woodland. *Oikos*. 1995; 74(3):493-502.
Keywords: *Juniperus ashei*/ *Quercus*/ *Leucaena*/ *Acacia*/ microsite/ seedling/ seed
Abstract: Seedling demography of the leguminous shrubs *Leucaena pulverulenta* and *Acacia berlandieri* was monitored to determine the functional role of microsites in the restoration of disturbed semiarid woodlands. Seeds were sown on replicated landscapes during 1989 and again in 1990 into four microsites after brush clearing: 1) Rocky, with shallow soils (< 10 cm) and low vegetative cover (mchlt 50%), 2) Herbaceous, with shallow soils (10 to 20 cm) and nearly 100% cover of perennial short-grasses, 3) Tree, with deep soils (20-30 cm) and 5-10 cm of duff under *Quercus virginiana* /*Juniperus ashei* mottes, and 4)

Cleared, resulting from mechanical removal of *Quercus/Juniperus* mottes, with deep soils (20-30 cm) and 2-10 cm of duff. Within a landscape, recruitment was greatest on Cleared and Tree (> 80%), intermediate on Rocky (65%), and lowest on Herbaceous (36%) microsites. Desiccation appeared to be the primary cause of first-season mortality. Differences between the microsites in seedling height and number of leaves were significant the first planting but not the second. Overwinter mortality of *Leucaena* and *Acacia* seedlings was lowest on Cleared microsites (55 and 7%, respectively) and greatest on microsites dominated by Herbaceous vegetation (100 and 87%, respectively). Survival of established seedlings during the second growing season exceeded 80% for both species on all microsites. *A. belandieri* had the highest establishment potential and the greatest ecological amplitude, with recruitment after two years being comparable on Cleared, Rocky and Tree microsites (72-78 seedlings). *L. pulverulenta* showed marked preferences for Cleared microsites (47 seedlings established) relative to Rocky (13 seedlings), Tree (12 seedlings) and Herbaceous microsites (0 seedlings). Spatial variability in emergence between replicated landscapes (range 35 to 78%) was greater than the variability between microsites within a landscape (48 to 62%). Differences in seed disappearance associated with surface runoff from high intensity storms and losses to granivory on Tree microsites were the primary causes of differences in recruitment between landscapes. Inter-landscape variability in granivory and precipitation runoff therefore overshadowed the effects of within-landscape seed placement among first year seedlings. Generalizations of seedling "safe site" characteristics based solely on short-term (one year), pseudo-replicated, within-landscape studies may therefore be misleading. Failure to account for variability in important processes at greater spatial scales may significantly influence the robustness of experimental microsite study results derived from small-scale research.

24. Rasmussen, G. A. and Wright, H. A. Succession of secondary shrubs on Ashe juniper communities after dozing and prescribed burning. *Journal of Range Management*. 1989; 42(4):295-298.

Keywords: *Juniperus ashei*/ *Rhus lanceolata*/ Texas/ prescribed burning/ bulldozing/ secondary species

Abstract: Secondary brush species (found as minor components of the climax community and those from lower seral stages) have increased after most prescribed burns on the Edwards Plateau of Texas. Originally, most of this area was dominated by *Juniperus ashei*. Line and belt transects were used to estimate brush canopy cover and density on 4 soil series located on 5 topographical positions in untreated, bulldozed, and bulldozed plus prescribed burning areas. Total canopy cover and density were not correlated with time following bulldozing (13, 16, or 18 years) or burning (8, 9, 10, 12, 13, or 14 years). Recovery of brush canopy cover to untreated levels was dependent on the topographical location and treatment. Total brush canopy cover was not different among untreated,

bulldozed, and bulldozed plus burned treatments on the Speck soil series occurring on the plateau tops. However, brush canopy cover was reduced by burning on soil series occurring on the sideslopes (Oplin and Brackett variant series) and drainage area. Species composition was altered with *J. ashei* being reduced to approx. 80% on bulldozed plus burned areas. *Rhus lanceolata* did not occur on untreated areas but comprised an average of 38% of the woody cover on all burned areas. Other secondary brush species increased, the amount depending on the topographical position. It was suggested that future management could have to include spot treatment on upland soil series where secondary brush species quickly increase.

25. Reineke, R K. Ashe juniper seed production and germination, seedling dynamics and response of live oak/juniper mottes to summer fire. M. S. Thesis, Texas A & M University. 1996; 111 pages.
Keywords: *Juniperus ashei*/ Ashe juniper/ seed production/ germination/ seedlings/ fire

26. Rogers, C. A. Author and Levetin, E. Reprint author. Evidence of long-distance transport of mountain cedar pollen into Tulsa, Oklahoma. International Journal of Biometeorology. 1998 Dec; 42(2):65-72.
Keywords: *Juniperus ashei*/ pollen/ Oklahoma/ transport/
Cupressaceae
Abstract: Previous study of *Cupressaceae* pollen in the Tulsa atmosphere during December and January suggested that the source of this pollen is the *Juniperus ashei* (mountain cedar) populations that occur mainly in southern Oklahoma and central Texas. The present investigation examined the evidence of long-distance transport of pollen from these populations during the 1996/1997 season at three sites in Oklahoma using Burkard traps. Two of the pollen-monitoring stations were operated in conjunction with Mesonet meteorological stations. It was found that the December and January *Cupressaceae* pollen occurs outside of the local season at Tulsa. Pollen concentrations are intermittent and correspond to days of peak concentrations at sites nearer the mountain cedar populations. Peak concentrations are associated with winds coming from the south over the mountain cedar areas. Diurnal rhythms show night-time peaks with a delay in timing at the northern-most site. These results are all consistent with the hypothesis that pollen is being transported over long distances from the mountain cedar populations to Tulsa, Oklahoma. These findings are important as they represent one of the few incidences of long-distance transport of pollen in significant concentrations to an area where the source vegetation is not present. Pollen-monitoring sites located in conjunction with Mesonet meteorological stations provide a unique opportunity to further examine atmospheric conditions during long-distance transport events. This will aid future studies of the spatial modeling of long-distance dispersal of pollen.

27. Russell, F. Leland Author Reprint Author; E-mail: frussell@unlnotes.unl.edu], and Fowler, Norma L. Author. Effects of white-tailed deer on the population dynamics of acorns, seedlings and small saplings of *Quercus buckleyi*. *Plant Ecology*. 2004 Jul; 173(1):59-72.
Keywords: *Juniperus ashei*/ *Quercus buckleyi*/ white-tail deer
Abstract: To measure the effects of white-tailed deer (*Odocoileus virginianus*) herbivory on seeds, seedlings, and young saplings of *Quercus buckleyi* on the eastern Edwards Plateau of central Texas, USA, experimental fenced deer enclosures were constructed. Acorns or small *Q. buckleyi* transplants were placed in each enclosure and in each unfenced control plot. Deer did not significantly affect acorn survival and germination, but did significantly reduce transplant survival and growth rates. The results support the hypothesis that deer are responsible for the failure of recruitment into adult size classes in *Q. buckleyi* populations in this region. Without adult recruitment of *Q. buckleyi*, the species composition and possibly even the physiognomy of woodlands on the eastern Edwards Plateau will change markedly. The results of this experiment also indicate that, although juniper (*Juniperus ashei*) and *Q. buckleyi* presumably compete for water, light, and nutrients, in the presence of deer junipers can have a positive effect on seedlings and saplings of *Q. buckleyi*, a case of facilitation. In the presence of deer the transplants increased in height significantly more slowly away from juniper saplings than they did beneath juniper saplings, probably due to the physical protection from browsing that junipers provided to the transplants.
28. Straka E.; Scott C. B.; Taylor C. A.; , Jr, and Bailey E. M. Jr. Biological control of the toxic shrub juniper. *Poisonous Plants and Related Toxins*. 2004; 436-442.
Keywords: *Juniperus ashei*/ *Juniperus pinchotii*/ biological control
Abstract: This chapter presents an overview of the biological control of juniper (*Juniperus ashei* and *J. pinchotii*) using goats, briefly discussing the toxicological effects of juniper and methods for increasing juniper consumption.
29. Van Auken, O. W. Size distribution patterns and potential population change of some dominant woody species of the Edwards Plateau Region of Texas. *Texas Journal of Science*. 1993; 45(3):199-210.
Keywords: *Juniperus ashei*/ *Taxodium*/ *Quercus*/ seedlings/ Texas
Abstract: Little documented information is available to demonstrate changes in plant populations of the Edwards Plateau Region of Texas. Photographic documentation is presented to show a lack of *Juniperus ashei* seedlings in an Edwards Plateau evergreen woodland and a high number of *J. ashei* seedlings in heavily grazed Edwards Plateau grasslands. Population size distribution analyses of four of five *J. ashei* stands examined showed a non-normal distribution and suggested a negative exponential population structure, which may be indicative of a

species with an expanding population. Inspection of the structure of the fifth stand suggested the self-thinning stage of population growth, with a lack of recruitment into the population. Population structure of *Quercus texana*, *Q. glaucoides* and *Taxodium distichum* stands also suggested the self-thinning stage and a lack of recruitment into the population. Reasons for changes are varied and depend on the community type, but little actual proof is available. High density of *J. ashei* seedlings in grasslands appears to be related to low grass biomass caused by heavy grazing and a concomitant reduction in fire frequency. Lack of recruitment of *J. ashei* seedlings into an apparently mature *J. ashei* stand may be due to seedling shade intolerance. Low recruitment of *Quercus* seedlings in deciduous woodland communities is more than likely due to an increased density of large herbivores. Lack of seedlings of *T. distichum* in riparian forest communities may be caused by light limitations in the understory or lack of safe sites for seedlings.

30. Van Auken, O. W.; Jackson, J. T., and Jurena, P. N. Survival and growth of *Juniperus* seedlings in *Juniperus* woodlands. *Plant Ecology*. 2005; 175(2):245-257; ISSN: 1385-0237.

Keywords: *Juniperus ashei*/ seedling emergence/ canopy/ survival/ growth/ regeneration

Abstract: *Juniperus* woodlands are widely distributed in western North America. Few studies of seedling emergence, long-term survival, growth or mortality of the dominant *Juniperus* spp. in these woodlands have been carried out. Consequently, regeneration dynamics in these woodlands are poorly understood. *Juniperus ashei* is the dominant woody plant in the majority of woodland and savanna communities of the Edwards Plateau region in central Texas. We examined the emergence, mortality and growth of various spatial and temporal cohorts of *J. ashei* seedlings over an eight or nine-year period. Greatest emergence was found during the cool, mostly winter months and under the canopy of mature *J. ashei* trees. Emergence was significantly inversely related to temperature and significantly linearly related to rainfall, but only if the monthly rainfall and emergence were offset by one to four months. Greatest survival occurred below the *J. ashei* canopy, but greatest growth was at the canopy edge. Emerging seedlings were not from the current year's seed crop, but from one or more previous year's seed crops. Greatest mortality occurred mostly during the summer months and in the grassland habitat. There was a significant inverse logarithmic or exponential relationship between mean monthly temperature and mean monthly mortality. A large number of *J. ashei* seedlings or immature plants with reduced growth were found beneath the canopy of mature trees. These plants seem to serve as a seedling bank, providing the source of recruitment into the population should the overstory trees be removed. Survival of the two canopy cohorts with known emergence dates declined with time (negative exponential function) and was 1.0-3.4% after eight or nine years depending on the cohort. The pre-existing cohort seemed to have constant mortality (and

presumably replacement), with about 8% of the population dying each year. Higher growth rates for seedlings were found at the edge of the established woodland canopy, which suggests that conditions in the edge habitat or possibly in canopy gaps are best for growth beyond the seedling stage.

31. Van de Water, Peter K. Reprint author; Levetin, Estelle Author, and E-mail: petekv@home.com]. Contribution of upwind pollen sources to the characterization of *Juniperus ashei* phenology. Grana. 2001; 40(3):133-141.

Keywords: *Juniperus ashei*/ pollen/ phenology/ Oklahoma

Abstract: Local and long-range components of *Juniperus ashei* pollen deposition were isolated to provide a more accurate record of local pollination activity in the Arbuckle Mountains of south central Oklahoma. An aerobiological sampler recorded airborne pollen concentrations and deposition at the sample site from mid-December 1998 to the end of January 1999. Grid-based weather data was used to model the movement, position, and elevation (air mass trajectories) across the region. While a normal concentration distribution is expected for a pollination event at a single site, "very high" concentrations (>1500 pollen grains per cubic meter) creating "peaks" in the deposition record were identified using bi-hourly sample analysis of the pollen registrations in the sampler. These occurrences happened over a 2 1/2 week period beginning January 11 and are coincident with the occurrence of southerly winds throughout the region. Modeled trajectories indicate that the air masses associated with those occurrences traveled at ground level through the *J. ashei* population on the Edwards Plateau, some 200 kilometers to the south in Texas, then gained altitude prior to crossing the sample site, thus introducing a long-range pollen component at the sample site. Peaks with "high" concentrations (90 to 1500 pollen grains per cubic meter) were evaluated using the same methodology. Those peaks associated with trajectories having the potential of introducing a long-range component to the pollen deposition record were removed from the aerobiological record. The resulting adjusted aerobiological record shows a more normal pollen concentration distribution, reduced hourly variability, and a marked shift in the pollination initiation date. Based on the comparison of non-adjusted and adjusted aerobiological records, contributions from upwind pollen sources account for 55% of the total pollen record.

32. Water P. K. van, de; Keever T.; Main C. E., and Levetin E. An assessment of predictive forecasting of *Juniperus ashei* pollen movement in the Southern Great Plains, USA. International Journal of Biometeorology. 2004; 48(2):74-82.

Keywords: *Juniperus ashei*/ Oklahoma/ allergens/ dispersal/ forecasting/ pollen

Abstract: *Juniperus ashei* pollen, a significant aeroallergen, has been recorded during December and January in Tulsa, Oklahoma, over the past

20 years. The nearest upwind source for this pollen is populations growing in southern Oklahoma and central Texas, at distances of 200 km and 600 km respectively. Long-distance dispersal of *J. ashei* pollen into the Tulsa area shows a strong correlation with the trajectories of wind blowing across southern populations before traveling north towards eastern Oklahoma. The strong tie between climatic conditions and the occurrence of this aeroallergen within the Tulsa, Oklahoma, atmosphere provided a unique opportunity to forecast the dispersal, entrainment, and downwind deposition of this significant aeroallergen. Forecasts of long-distance *J. ashei* pollen dispersal began during the winter of 1998/1999. Each forecast uses defined climatic parameters to signal pollination at each source site. Coupled to these estimates of pollen release, forecast weather conditions and modeled wind trajectories are used to determine the threat of dispersal to downwind communities. The accuracy of these forecasts was determined by comparing the forecast "threat" to aerobiological records for the same period collected in the "Tulsa region". Analysis of the two seasons revealed only a single occurrence of "high" or "very high" pollen concentrations in Tulsa not directly linked to "moderate" or "severe" forecast threats from the southern source areas.

33. Wayne R. and Van Auken O. W. Spatial and temporal abiotic changes along a canopy to intercanopy gradient in central Texas *Juniperus ashei* woodlands . Texas Journal of Science. 2004; 56(1):35-54.
Keywords: *Juniperus ashei*/ seedling emergence/ growth/ Texas / canopy/ intercanopy
Abstract: *Juniperus ashei* (ashe juniper), in the southern Edwards Plateau region of central Texas, exhibits both spatial and temporal trends in seedling demography, emergence, growth and physiology which vary in relation to patterns of woodland overstory: the canopy patches of woody plants vs. the intercanopy patches of grasses and herbs between them. This study reports gradients of abiotic factors found from below *J. ashei* canopy trees into associated intercanopy patches. There were significant differences in soil organic content, soil field capacity, soil temperature, soil water content and surface light levels along this gradient from April through December 1997, but not soil depth. Mean soil organic content was highest under the canopy (32.0 +/- 6.9%) and lowest in the intercanopy patch (12.5 +/- 0.8%) as was the field capacity (108.5 +/- 2.8% and 82.9 +/- 1.6% respectively). Mean midday light levels were highest in the intercanopy (1183 +/- 149 $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$) and were lowest below the canopy (346 +/- 99 $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$ and 219 +/- 77 $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$, canopy and midcanopy respectively). Mean midday soil temperature varied seasonally, but was highest in the intercanopy (32.6 +/- 2.1°C) and lowest at the canopy edge (27.6 +/- 1.4°C). Mean soil water content also varied seasonally (with rainfall), and was highest under the canopy (43.4 +/- 3.0%) and lowest in the intercanopy (30.3 +/- 2.1%). Reduced light levels under the canopy, coupled with high soil organic content may ameliorate high soil temperatures and promote higher soil water content,

possibly resulting in reduced water stress and increased *J. ashei* seedling survival. However, increased growth at the canopy edge may be attributed to increased surface light levels at this location. Low seedling emergence and survival in the intercanopy patch may be due to a combination of factors, in particular seasonal high soil surface temperatures and low soil water content.

34. Wayne R. and Van Auken O. W. Spatial and temporal patterns of xylem water potential in *Juniperus ashei* seedlings. *Southwestern Naturalist*. 2002; 47(2):153-161.
Keywords: *Juniperus ashei*/ seedlings/ xylem water potential / germination / seed
Abstract: *Juniperus ashei* woodlands are found extensively throughout the Edwards Plateau of central Texas. Prior studies indicate that seed germination and seedling survival in *J. ashei* was greatest under the canopy whereas growth was greatest at the canopy edge. To investigate the cause of these spatial differences, measurements of percent soil moisture and plant predawn xylem water potential (PSIp) for *J. ashei* seedlings were made along transects from under a woodland canopy into an intercanopy patch. A soil moisture gradient was detected, with soil moisture highest under the woodland canopy and decreasing into the intercanopy patch. Soil moisture was lowest during the summer drought along this gradient. Mean soil moisture was highest at 68.4 +- 7.0% (+-SE) under the *Juniperus* canopy in May 1997 and lowest at 12.5 +- 1.9% in the intercanopy patch during July 1997. Seedling PSlp under the *Juniperus* canopy ranged from values of -0.51 +- 0.02 MPa in May to -6.59 +- 0.00 MPa in August. Plant PSlp at the canopy edge was -0.72 +- 0.03 MPa in May and -6.50 +- 0.00 MPa in August. No seedlings were found in the intercanopy patch. Spatial and temporal differences in seedling PSlp between the *Juniperus* woodland and canopy edge did exist, but differences were small (<0.20 MPa). Temporal decreases in soil moisture were followed by more negative seedling PSlp values. Differences in observed PSlp along this woodland to intercanopy patch gradient probably cause reductions in photosynthesis and growth rates in *J. ashei*, and are likely due to an interaction of several abiotic factors, including soil temperature, soil depth, soil moisture, surface light levels, and soil organic content.
35. Wink, R. L. and Wright, H. A. Effect of fire on an Ashe juniper community. *Journal of Range Management*. 1973; 26(5):326-329.
Keywords: *Juniperus ashei*/ seedlings/ fine fuel/ grasses/ water stress/ soil moisture
Abstract: In trials in 1970-1 (wet and dry years, respectively), at least 1 t/ha of fine fuel was needed to carry a fire to kill *Juniperus ashei* seedlings and to burn piles of bulldozed junipers. Grasses recovered quickly in 1970, but in 1971 burning increased plant water stress, reduced herbage yields and exposed soil to erosion for a long period while soil moisture was low.

36. Wright, H. A.; Churchill, F. M., and Stevens, W. C. Effect of prescribed burning on sediment, water yield, and water quality from dozed juniper lands in central Texas. *Journal of Range Management*. 1976; 29(4):294-298.
Keywords: *Juniperus ashei*/ prescribed burning/ soil loss/ turbidity/ watersheds/ slope
Abstract: Prescribed burning of Ashe juniper (*Juniperus ashei*), after stands were bulldozed in 1967, was applied in 1972 on 6 'mini-watersheds' each of 0.06 to 0.48 acre, classified as (a) level (1-4% slope), (b) moderate (8-20% slope), or (c) steep (37-61% slope), on limestone soils. Hydrological data over the next 2-3 yr were compared with data for similar unburned sites in a control group of 6 other small catchments. Soil losses after burning occurred only in (b) and (c) and declined after resp. 9-15 and 15-18 months. Cover reached 66-68% in 15 months in (b) but took 21-30 months to do so in (c). Nutrient losses from the upper 6 inches of soil in (c) were only 0.53, 1.78 and 1.13% resp. for N, P and K. Water from burned areas showed increased turbidity for 1.5 yr in (b) and at least 2.5 yr in (c). Water remained soft in (a) but became moderately hard for 6 months in (b) and for over 30 months in (c); pH showed little change. Slopes of over 45% lost 6-8 tons/acre soil with consequent lowering of water quality: it is recommended that such slopes should be left undisturbed as cover for wildlife and catchment protection.
37. Yager, L. Y. and Smeins, F. E. Ashe juniper (*Juniperus ashei*: *Cupressaceae*) canopy and litter effects on understory vegetation in a juniper-oak savanna. *Southwestern Naturalist*. 1999; 44(1):6-16.
Keywords: *Juniperus ashei*/ seeds/ shrubs/ vegetation management/ understory / Texas/ litter/ canopy / *Bouteloua curtipendula*/ *Leptochloa dubia*/ *Sophora secundiflora*
Abstract: A study was conducted in two 24-ha pastures near Sonora, Texas, to examine effects of juniper (*Juniperus ashei*) canopy, shade, soil alteration (release of allelopathic compounds by the juniper), and litter accumulation on recruitment and establishment of understory herbaceous species. The pastures had been managed under a Merrill four-pasture, three-herd (cattle, sheep and goats) grazing system since 1948. Soils are shallow Lithic Haplustolls. Four canopy treatments (with juniper canopy, juniper canopy removed, juniper canopy removed and artificial shade added, and grassland control with herbaceous vegetation killed with glyphosate) and two litter treatments (present or absent) were studied from April 1991. Recruitment of planted *Bouteloua curtipendula*, *Leptochloa dubia*, and *Sophora secundiflora* seeds was monitored. Thirteen months after planting, a subset of the intact juniper canopy, juniper canopy removed, and grassland treatments was sampled for plant density by species. Removal of Ashe juniper canopies resulted in increased recruitment of planted *B. curtipendula* and *L. dubia*. Shade initially did not affect recruitment adversely, but restricted it over time. Reduced recruitment of sown species in Ashe juniper litter appeared to be due primarily to the interaction of physical features of the litter and the

moisture regime rather than chemical alteration or allelopathy. Grass and forb establishment increased with removal of the Ashe juniper canopy and litter. Establishment of *S. secundiflora* or other shrubs was not affected by the presence of shade, juniper canopy, or juniper litter.

Juniperus australis (1)

1. Mohr and Charles Theodore. Notes on the Red Cedar. 1901; 3137.
Keywords: *Juniperus virginiana*/ eastern red cedar/ *Juniperus caroliniana*/ *Juniperus arborescens*/ *Juniperus barbadensis*/ *Juniperus faetida*/ *Juniperus australis*/ *Juniperus sabina*/ juniper/ cedar/ savin
Call Number: 1
Abstract: Botanical analysis and distribution of eastern red cedar in the early 1900's

Juniperus baimashanensis (1)

1. Yu Y. F. and Fu L. K. Notes on Gymnosperms II. New taxa and combinations in *Juniperus* (*Cupressaceae*) and *Ephedra* (*Ephedraceae*) from China. Novon. 1997; 7(4):443-444.
Keywords: *Juniperus chengii*/ *Juniperus baimashanensis*/ *Juniperus pingii*/ *Juniperus squamata*/ *Ephedra*/ China/ varieties
Abstract: Two new species, *Juniperus chengii* L. K. Fu and Y. F. Yu and *J. baimashanensis* Y. F. Yu and L. K. Fu, and three new varieties, *J. pingii* Cheng ex Ferre var. *carinata* Y. F. Yu and L. K. Fu, *J. squamata* Buchanan-Hamilton ex D. Don var. *parvifolia* Y. F. Yu and L. K. Fu, and *J. squamata* var. *hongxiensis* Y. F. Yu and L. K. Fu, are described. Two new combinations in *Juniperus* and one in *Ephedra* are proposed.

Juniperus barbadensis (1)

1. Mohr and Charles Theodore. Notes on the Red Cedar. 1901; 3137.
Keywords: *Juniperus virginiana*/ eastern red cedar/ *Juniperus caroliniana*/ *Juniperus arborescens*/ *Juniperus barbadensis*/ *Juniperus faetida*/ *Juniperus australis*/ *Juniperus sabina*/ juniper/ cedar/ savin
Call Number: 1
Abstract: Botanical analysis and distribution of eastern red cedar in the early 1900's

Juniperus bermudiana (1)

1. Rueger, Bruce F. Reprint author and Von Wallmenich, Theodore N. Author. Human impact on the forests of Bermuda: The decline of endemic cedar and palmetto since 1609, recorded in the Holocene pollen record of Devonshire Marsh. Journal of Paleolimnology. 1996; 16(1):59-66.
Keywords: *Juniperus bermudiana*/ *Sabal bermudana*/ pollen/ Bermuda/ forests
Abstract: The wreck of the Sea Venture on Bermuda reefs in 1609

initiated continuous habitation by humans on these islands. Colonization brought significant changes to the native and endemic flora of Bermuda. Original floral diversity was low, due to the effects of isolation and lack of previous anthropogenic influences. Two dominant endemic components of the flora, Bermuda cedar (*Juniperus bermudiana*) and Bermuda palmetto (*Sabal bermudana*), were extensively utilized by the colonists. Cedar was used for housing, furniture, shipbuilding and export, while the palmetto was used for roof thatch, basketry, food and drink. Exploitation of these species occurred to such extent that the General Laws of Bermuda included resolutions protecting them as early as 1622. Later, in the period between 1946 and 1951, two accidentally introduced scale insects eliminated 95% of the existing cedar population. While the flora and geography of upland habitats on Bermuda have been drastically modified by humans, the peat marsh basins have remained relatively unaffected. From the peats of one of these, Devonshire Marsh, a 9-m core was extracted for pollen analysis and to evaluate the potential for further study. The pollen record below 1.6 m indicated very little change in the native and endemic flora of Bermuda, but above that depth statistically significant changes in the relative abundances of pollen of Bermuda cedar and Bermuda palmetto are noted. Relative abundances of both species decreases significantly above this depth. This decrease is interpreted to represent the arrival of colonists and their impact on the cedar and palmetto populations. A second decrease in relative abundance of Bermuda cedar is recorded above 0.7 m. This reflects the scale infestation and decimation of the remaining cedar population. Coincident with decreases in cedar and palmetto are increases in relative abundance of Poaceae and Asteraceae, indicative of cleared land and the spread of weedy taxa. A radiocarbon date of 520 +/- 70 yr BP at a depth of 1.7 m and major changes in relative abundance of palynomorphs in proximity to the marsh surface allows their interpretation as a record of human impact on the endemic flora of Bermuda.

Juniperus blancoi (2)

1. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. Acta Horticulturae. 2003; 61291-106.

Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.

Abstract: Several cases involving apparent discordance in morphological, chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var. *microsperma*, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var.

squamata, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.

2. Zandoni, T. A. and Adams, R. P. The genus *Juniperus* in Mexico and Guatemala: numerical and chemosystematic analysis. *Biochemical Systematics and Ecology*. 1976; 4(3):147-158.

Keywords: *Juniperus patoniana*/ *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus blancoi*/ *Juniperus scopulorum*/ plant composition/ terpenoids.

Abstract: The leaf constituents, mainly terpenoids, of each of the taxa of *Juniperus* in Mexico and Guatemala were analyzed by numerical taxonomic methods and the results compared with those of a previous study utilizing morphological characters. The two sets of data were generally in agreement on the major groups. Differences between more closely related species were more apparent with the chemical data. Four major groups were detected. The study confirmed the morphological data indicating that *J. patoniana* should be reduced to a variety of *J. deppeana*. No samples typical of *J. monosperma* were found in Mexico, and *J. monosperma* var. *gracilis* was not closely allied with *J. monosperma* from the USA, but had some uncertain affinities with species of the one-seeded complex. *J. blancoi* appears to be closely related to *J. scopulorum*.

***Juniperus brevifolia* (2)**

1. Haggard, J. P. The structure composition and status of the cloud forests of Pico Island in the Azores Portugal. *Biological Conservation*. 1988; 46(1):7-22.

Keywords: *Juniperus brevifolia*/ composition/ Portugal/ population structure

Abstract: The physiognomy, composition and size structure of the cloud forests of Pico in the Azores were assessed to investigate the variation in the montane forests and their requirements for conservation. A series of point center quarter transects were made through the forest fragments recording composition, density, size structure and abundance of seedlings and saplings at different sites. The population structure of the trees suggested that some areas of the forest may be successional communities from *Juniperus brevifolia* forest to a mixed broadleaved forest. The classification of forest types, in relation to altitude, was found to correlate most closely with that described by Grubb and Tanner (1976) *J. Arnold Arb.*, 52, 313-68, for tropical montane forests. Together the successional, altitudinal and geological variation in the forests produces a mosaic of vegetation types from which a representative selection needs to be

protected in the face of the current forest clearance.

2. Lebreton, Philippe; Perez De Paz; Pedro Luis , and Barbero, Marcel. Systematic study of the subgenus *Oxycedrus* (oxycedroides section) of the genus *Juniperus* (*Cupressaceae*). *Ecologia Mediterranea*. 1998; 24(1):53-61.
Keywords: *Juniperus oxycedrus*/ *Juniperus cedrus*/ *Juniperus brevifolia*/ prodelphinidin content/ proanthocyanic/ seed/ galbulus/ *Juniperus macrocarpa*
Abstract: Some biochemical (foliar proanthocyanidins) and morphometric (seeds and galbulus) parameters of the taxa *Juniperus oxycedrus* L. sensu lato (Mediterranean area), *Juniperus cedrus* Webb. and Berth. (endemic of the Canary Islands and Madeira) and *Juniperus brevifolia* (Seub.) Antoine (endemic of the Azores Islands), section oxycedroides, subgenus *Oxycedrus*, genus *Juniperus* (*Cupressaceae*, Conifers), have been studied. Due to their low prodelphinidin content, *Oxycedrus* junipers from Turkey and Cyprus can be considered as the extreme representatives to the subspecies oxycedrus. Reversibly, the Cretan population studied, with high prodelphinidin content, appears to be the maximum homozygotic expression of the proanthocyanic biosynthesis (subspecies *macrocarpa*). Proanthocyanic content and the number of the seeds unquestionably link *J. brevifolia* to the *J. oxycedrus* complex; however, we propose to maintain this taxon as a species in view of the small size of its needles. *J. cedrus* generally contains one seed only by galbulus; moreover, there is a contradiction between the absolute proanthocyanic content (low) and the relative prodelphinidin content (fairly high). This confers it an unquestionable specific originality. In the end, we propose to consider all the representatives of the Mediterranean-atlantic group of the oxycedroides section (*J. oxycedrus*, *J. macrocarpa*, *J. cedrus*, *J. brevifolia*) as diversely related taxa within a *Juniperus* aggr. *oxycedrus* complex, with a good chemical and morphogenetical consistency. A parallel has been established with *J. aggr. communis*, an other representative of the same sub-genus *Oxycedrus*.

***Juniperus californica* (3)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.
Keywords: *Juniperus angosturana*/ *Juniperus ashei*/ *Juniperus californica*/ *Juniperus coahuilensis*/ *Juniperus comitana*/ *Juniperus deppeana*/ *Juniperus durangensis*/ *Juniperus flaccida*/ *Juniperus gamboana*/ *Juniperus jaliscana*/ *Juniperus monosperma*/ *Juniperus monticola*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Juniperus pinchotii*/ *Juniperus saltillensis*/ *Juniperus standleyi*/ essential oils/ DNA/ RAPD
Abstract: The volatile leaf essential compositions of all 17 serrate leaf

margin species of *Juniperus* (sect. *Sabina*) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

2. Alfieri F. J. and Kemp R. I. The seasonal cycle of phloem development in *Juniperus californica*. American Journal of Botany. 1983; 70(6):891-896.

Keywords: *Juniperus californica*/ phloem/ sieve cells/ cambium

Abstract: Samples were collected from major branches of trees in Joshua Tree National Monument, California. All sieve cells of the previous season's phloem increment overwintered in a mature state. Cambial activity began in early Mar.; by the end of Mar. the oldest overwintering sieve cells lost their contents and died. All sieve cells of the previous season's increment had lost their contents by mid-Apr. The period of greatest cambial activity started in the second half of Apr. and continued during May. With the slowing of cambial activity in June, callose began to collect on the sieve areas of the first-formed sieve cells of the new increment. By July, the cambium and phloem were dormant. Initiation of phloem production preceded that of xylem by approx. 1 month, but production of new xylem and phloem ceased simultaneously in July. The seasonal cycle of phloem development was similar to that of members of the *Pinaceae*.

3. Zanoni, T. A. and Adams, R. P. Distribution and synonymy of *Juniperus californica* Carr. (Cupressaceae) in Baja California, Mexico. Bulletin of the Torrey Botanical Club. 1973; 100(6):364-367.

Keywords: *Juniperus californica*/ *Juniperus cedrosiana*/ *Juniperus cerrosianus*/ distribution/ Mexico

Abstract: The distribution and synonymy of this species in Baja California, Isla de Cedros and Isla de Guadalupe are reviewed. *J. cedrosiana* Kellogg and *J. cerrosianus* Kellogg are considered synonymous with *J. californica* Carr."

***Juniperus caroliana* (1)**

1. Mohr and Charles Theodore. Notes on the Red Cedar. 1901; 3137.

Keywords: *Juniperus virginiana*/ eastern red cedar/ *Juniperus*

caroliniana/ Juniperus arborescens/ Juniperus barbadensis/ Juniperus faetida/ Juniperus australis/ Juniperus sabina/ juniper/ cedar/ savin
Call Number: 1

Abstract: Botanical analysis and distribution of eastern red cedar in the early 1900's

Juniperus cedrosiana (1)

1. Zanoni, T. A. and Adams, R. P. Distribution and synonymy of *Juniperus californica* Carr. (Cupressaceae) in Baja California, Mexico. Bulletin of the Torrey Botanical Club. 1973; 100(6):364-367.

Keywords: *Juniperus californica/ Juniperus cedrosiana/ Juniperus cerrosianus/* distribution/ Mexico

Abstract: The distribution and synonymy of this species in Baja California, Isla de Cedros and Isla de Guadalupe are reviewed. *J. cedrosiana* Kellogg and *J. cerrosianus* Kellogg are considered synonymous with *J. californica* Carr. "

Juniperus cedrus (5)

1. Cavaleiro, C; Salgueiro, L; Barroso, J G; Figueiredo, A C; Pedro, L G; Fontinha, S S; Bighelli, A; Casanova, J; Looman, A, and Scheffer, J J C. Composition of the essential oil of *Juniperus cedrus* Webb & Berth. grown on Madeira. Flavour and Fragrance Journal. 2002; 17(2):111-114.

Keywords: *Juniperus cedrus/* essential oil/ Portugal

Abstract: The essential oils isolated from twigs of *J. cedrus* grown on Madeira, Portugal were analyzed by GC, GC-MS and ¹³C-NMR. The oils consisted mainly of monoterpene hydrocarbons (53.1-87.8%), the main components were alpha -pinene (19.6-55.3%), limonene (17.3-32.7%) and Delta -3-carene (5.5-15.7%). The sesquiterpenoid fraction (4.1-22.3%) was dominated by E-caryophyllene (1.6-7.4%), while sandaracopimaradiene (0.1-6.1%), isoabienol (0.5-1.3%) and trans-totarol (0.4-2.2%) were the main diterpenoids (2.2-11.9%). Oct-1-en-3-ol (1.0-2.2%) was the major constituent of the non-terpenic fraction (1.3-2.7%). The composition of our oil samples differed to some extent from that reported for *J. cedrus* oil grown on the Canary Islands.

2. Guido, M. and Roques, A. Impact of the phytophagous insect and mite complex associated with cones on junipers (*Juniperus phoenicea* L. and *J. Cedrus* Webb and Berth.) in the Canary Islands. Ecologia Mediterranea. 1996; 22(1-2):1-10.

Keywords: *Juniperus phoenicea/ Juniperus cedrus /* Canary Islands/ Phoenician juniper

Abstract: Five stands of the Phoenician juniper, *Juniperus phoenicea*, and 2 of the endemic *J. cedrus* were surveyed in 4 islands of the Canarian archipelago for cone and seed pest damage. A total of 4 phytophagous species, 3 insects and 1 mite, were observed in cones of the Phoenician

juniper while those of *J. cedrus* hosted the same species except a cone moth. A cone weevil was the dominant pest in both junipers but differences in cone colonization were observed among the surveyed islands. The Canarian entomofauna was not endemic and seemed comparatively poor with respect to that observed in southern Europe and North Africa. Pests significantly decreased the mean number of seeds and the mean number of filled seeds per cone in both juniper species. Because the two junipers differed by the number of seeds per cone, pest damage resulted in a different impact on the potential of juniper regeneration. The consequences of pest attack on the survival of *J. cedrus*, a species under protection that usually produces only 1 filled seed per cone, are discussed.

3. Harry, Indra S.; Pulido Martinez, Carolina, and Thorpe, Trevor A. Plantlet regeneration from mature embryos of *Juniperus cedrus*. *Plant Cell, Tissue and Organ Culture* . 1995 Apr; 41(1, no. 1):75-78; ISSN: 0167-6857.
Keywords: *Juniperus cedrus*/ explants/ regeneration/ embryos
Call Number: QK725.P53
Abstract: A protocol is described for plantlet regeneration using embryonic explants of *Juniperus cedrus* Webb & Berth. An average of 6 adventitious buds were induced on whole excised embryos cultured for 15 days on Quorin and LePoivre(QP) half-strength medium supplemented with 5 μ M N⁶ - benzyladenine. For bud development, explants were transferred to phytohormone-free 1/2 QP medium. For shoot elongation, explants were cultured on 1/2 QP with 0.05% activated charcoal and 2% sucrose. Adventitious shoots were rooted successfully in peat-vermiculite-perlite (1:1:1) moistened with 1/4 QP containing 1% sucrose and 5 μ M α -naphthaleneacetic acid, pH 5.0. Axillary shoots elongated spontaneously in culture from leaf axils.
4. Lebreton, Philippe; Perez De Paz; Pedro Luis , and Barbero, Marcel. Systematic study of the subgenus *Oxycedrus* (oxycedroides section) of the genus *Juniperus* (*Cupressaceae*). *Ecologia Mediterranea*. 1998; 24(1):53-61.
Keywords: *Juniperus oxycedrus*/ *Juniperus cedrus*/ *Juniperus brevifolia*/ prodelphinidin content/ proanthocyanic/ seed/ galbulus/ *Juniperus macrocarpa*
Abstract: Some biochemical (foliar proanthocyanidins) and morphometric (seeds and galbulus) parameters of the taxa *Juniperus oxycedrus* L. sensu lato (Mediterranean area), *Juniperus cedrus* Webb. and Berth. (endemic of the Canary Islands and Madeira) and *Juniperus brevifolia* (Seub.) Antoine (endemic of the Azores Islands), section oxycedroides, subgenus *Oxycedrus*, genus *Juniperus* (*Cupressaceae*, Conifers), have been studied. Due to their low prodelphinidin content, *Oxycedrus* junipers from Turkey and Cyprus can be considered as the extreme representatives to the subspecies oxycedrus. Reversibly, the Cretan population studied, with high prodelphinidin content, appears to be the maximum homozygotic expression of the proanthocyanic biosynthesis (subspecies *macrocarpa*). Proanthocyanic content and the

number of the seeds unquestionably link *J. brevifolia* to the *J. oxycedrus* complex; however, we propose to maintain this taxon as a species in view of the small size of its needles. *J. cedrus* generally contains one seed only by galbulus; moreover, there is a contradiction between the absolute proanthocyanic content (low) and the relative prodelphinidin content (fairly high). This confers it an unquestionable specific originality. In the end, we propose to consider all the representatives of the Mediterraneo-atlantic group of the oxycedroides section (*J. oxycedrus*, *J. macrocarpa*, *J. cedrus*, *J. brevifolia*) as diversely related taxa within a *Juniperus* aggr. *oxycedrus* complex, with a good chemical and morphogenetical consistency. A parallel has been established with *J. aggr. communis*, an other representative of the same sub-genus *Oxycedrus*.

5. Nogales, Manuel Hernandez Elizabeth C. Valdes Francisco. Seed dispersal by common ravens *Corvus corax* among island habitats (Canarian Archipelago). *Ecoscience*. 1999; 6(1):56-61.

Keywords: *Juniperus cedrus*/ *Juniperus turbinata*/ germination/ ravens/ *Corvus*/ seed dispersal/ seeds/ Canary Islands/ *Lycium*/ *Opuntia*/ *Rubia*/ *Plocama*/ *Phoenix*/ *Asparagus*/ *Myrica*

Abstract: The role of the common raven (*Corvus corax*; Corvidae) as a seed dispersal agent for plants in the Canary Islands was studied by analyzing 2672 pellets collected from all islands of the archipelago. Seeds of 16 species of phanerogams were found (four endemic to the Canaries, three endemic to the Macaronesian islands, six not endemic, and three introduced by man). Vegetation in this archipelago is highly structured according to altitude creating different types of macrohabitats. The quality of the transport of seeds between habitats was evaluated in a preliminary way by making use of the very high fidelity of the plant species to particular macrohabitats. Of the 102 580 potentially fertile seeds (excepting the other 51 061 infertile *Ficus carica* seeds) transported by common ravens, 76.5% were regurgitated in theoretically suitable habitat while the remaining 23.5% were taken to habitats that were not appropriate for the establishment. Common ravens improved germination of six species, whereas an opposite effect was observed for three others. The percentage of viable seeds did not differ for any species between pellet seeds and seeds collected directly from the plants. Considering results from germination and viability experiments and macrohabitat patterns of dispersal, the common raven seems to be an important disperser for nine plant species: *Lycium intricatum* (*Solanaceae*), *Opuntia ficus-indica* (*Cactaceae*), *Rubia fruticosa* and *Plocama pendula* (*Rubiaceae*), *Juniperus turbinata* and *J. cedrus* (*Cupressaceae*), *Phoenix canariensis* (*Arecaceae*), *Asparagus pastorianus* (*Liliaceae*), and *Myrica faya* (*Myricaceae*).

***Juniperus centrasiatica* (1)**

1. Adams R. P. and Turuspekoy Y. Taxonomic reassessment of some Central Asian

and Himalayan scale-leaved taxa of *Juniperus* (*Cupressaceae*) supported by random amplification of polymorphic DNA. *Taxon*. 1998; 47(1):75-83.

Keywords: *Juniperus centrasiatica*/ *Juniperus turkestanica*/ *Juniperus pseudosabina*/ *Juniperus indica*/ RAPD/ DNA/ taxonomy

Abstract: Analysis of central Asian *Juniperus* using RAPD revealed that *J. centrasiatica*, *J. turkestanica*, and *J. pseudosabina* appear to belong to a single species, to be named *J. pseudosabina*. This conclusion is also supported by previous work on terpenoids. Putative *J. indica* from Nepal (shrub form) was found to be distinct from *J. pseudosabina*. It appears that the common scale-leaved shrub or tree juniper of the Himalayas should be called *J. indica* not *J. pseudosabina*.

***Juniperus cerrosianus* (1)**

1. Zandoni, T. A. and Adams, R. P. Distribution and synonymy of *Juniperus californica* Carr. (*Cupressaceae*) in Baja California, Mexico. *Bulletin of the Torrey Botanical Club*. 1973; 100(6):364-367.

Keywords: *Juniperus californica*/ *Juniperus cedrosiana*/ *Juniperus cerrosianus*/ distribution/ Mexico

Abstract: The distribution and synonymy of this species in Baja California, Isla de Cedros and Isla de Guadalupe are reviewed. *J. cedrosiana* Kellogg and *J. cerrosianus* Kellogg are considered synonymous with *J. californica* Carr."

***Juniperus chemgii* (1)**

1. Yu Y. F. and Fu L. K. Notes on Gymnosperms II. New taxa and combinations in *Juniperus* (*Cupressaceae*) and *Ephedra* (*Ephedraceae*) from China. *Novon*. 1997; 7(4):443-444.

Keywords: *Juniperus chemgii*/ *Juniperus baimashanensis*/ *Juniperus pingii*/ *Juniperus squamata*/ *Ephedra*/ China/ varieties

Abstract: Two new species, *Juniperus chemgii* L. K. Fu and Y. F. Yu and *J. baimashanensis* Y. F. Yu and L. K. Fu, and three new varieties, *J. pingii* Cheng ex Ferre var. *carinata* Y. F. Yu and L. K. Fu, *J. squamata* Buchanan-Hamilton ex D. Don var. *parvifolia* Y. F. Yu and L. K. Fu, and *J. squamata* var. *hongxiensis* Y. F. Yu and L. K. Fu, are described. Two new combinations in *Juniperus* and one in *Ephedra* are proposed.

***Juniperus chinensis* (40)**

1. Adams, Robert P.; Hsieh, Chang-Fu; Murata, Jim, and Pandey, Ram Nanresh. Systematics of *Juniperus* from eastern Asia based on Random Amplified Polymorphic DNA's (RAPDs). *Biochemical Systematics and Ecology*. 2002 Mar; 30(3):231-241; ISSN: 0305-1978.

Keywords: *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus conferta*/ *Juniperus formosana*/ *Juniperus procumbens*/ *Juniperus*

rigida/ Juniperus taxifolia/ RAPS's/ DNA/ Taiwan/ China
Call Number: QD415.A1B5

Abstract: DNA was examined by RAPD banding for *Juniperus chinensis*, *J. c. var. sargentii*, *J. c. var. tsukusiensis*, *J. communis*, *J. c. var. nipponica*, *J. c. var. saxatilis*, *J. conferta*, *J. formosana*, *J. procumbens*, *J. rigida*, *J. taxifolia*, and *J. t. var. lutchuensis*. The DNA data readily separated junipers of section *Sabina* from section *Juniperus*. *J. c. var. tsukusiensis* from Taiwan was found to be sufficiently different from *J. c. var. tsukusiensis* (Yakushima) to warrant the recognition of a new variety: *J. chinensis var. taiwanensis* R.P. Adams and C-F. Hsieh *nov. var.* *Juniperus formosana* from mainland China was found to be different from *J. formosana* from Taiwan and a new variety is recognized: *J. formosana var. mairei* (Lemee and Lev.) R.P. Adams and C-F. Hsieh *comb. nov.* *Juniperus communis var. nipponica* was found to be distinct from *J. communis* and this supports its recognition as a variety. The recognition of *J. conferta* as a variety of *J. rigida* [*J. rigida var. conferta* (Parl.) Patschke] is supported by the data. The data also supports the recognition of *J. lutchuensis* Koidz. [= *J. taxifolia var. lutchuensis* (Koldz.) Satake] and *J. morrisonicola* Hayata [= *J. squamata var. morrisonicola* (Hayata) H.L. Li and H. Keng] at the specific levels.

2. Badenhop, M B. A production budget for container-grown Pfitzer junipers in Tennessee. Tennessee Farm and Home Science. 1979; 11015-19.
Keywords: *Juniperus chinensis/* pfitzer juniper/ propagation/ production costs
Abstract: Estimates are given of nursery production costs for *Juniperus chinensis* pfitzeriana, grown in 1-gal containers. The plants are propagated from cuttings: all required operations are detailed and time input per 12 800 plants is shown.
3. Badenhop, M. B. Southern regional production advantages for Pfitzer junipers. Tennessee Farm and Home Science. 1979; 11239-41.
Keywords: *Juniperus chinensis/* planting stock/ nurseries
Abstract: 1977 production and transport costs are given for *Juniperus chinensis* var. pfitzeriana produced in N. Carolina and Tennessee for landscape planting. Favorable climatic and other conditions made southern-produced plants competitive with home-produced plants in the mid-west and north-east.
4. Banko, T. J. Propagation of upright junipers. Combined Proceedings, International Plant Propagators' Society. 1982; 31658-666.
Keywords: *Juniperus chinensis/ Juniperus virginiana/* cuttings/ rooting/ seasonal variation.
Abstract: *Juniperus chinensis* cv. Hetzii cuttings were rooted at monthly intervals over 2 years, with IBA treatments of 0, 2000, 4000, or 8000 p.p.m. Rooting varied greatly but was consistently poor in early spring (March). IBA did not significantly improve rooting percentages when

rooting capacity was low, but did increase numbers of roots/cutting during favorable rooting periods. Trimming the upper half of the leaf had no effect on rooting. In another experiment, rooting medium temperatures of 20 ° or 25 ° C improved rooting of cuttings of *J. virginiana* cvs Skyrocket and Hillspire and *J. chinensis* cv. Kaizuka, compared with rooting at 15 °C. Cuttings of *X Cupressocyparis leylandii* rooted equally well at all 3 temperatures.

5. Behrens, V. Cold storage of unrooted coniferous cuttings II. storage temperature and atmosphere. *Gartenbauwissenschaft*. 1986; 51(3):118-125.

Keywords: *Juniperus chinensis*/ *Picea glauca*/ storage/ temperature/ cuttings

Abstract: Unrooted cuttings of ten different species and varieties of conifers were stored in jacketed cold stores from November until March. The percentage of well rooted cuttings as influenced by different storage temperatures (+2° .degree. C to -4° C) and a controlled atmosphere (CA: 3% CO₂, 3% O₂) was investigated at the end of June. After ascertaining the rooting percentages in June, no further influence of the treatments on the development of the plants to saleable liners was found. There was no significant advantage in CA-storage, except in the case of *Picea glauca* 'Conica'. Storage at +2° C was least satisfactory, storage at -4° C gave conflicting results, varying from one year to another and from species to species. If cuttings are to be stored, they have to be hardy enough throughout the storage period. Dissimilation of food-reserves proceeds also at below 0° C temperatures. This may lead to freezing damage, especially if the stock plants had not built up a sufficient frost-hardiness. Choosing a suitable storage temperature mean keeping balance between reduced dissimilation and avoiding frost-damage. Temperatures between 0° C and -2° C proved to be safest. Only *Juniperus chinensis* rooted better after the standard propagation procedure in comparison to rooting after storage. A propagation programmed including storage should take into account the following points: Collection of cuttings only after reaching sufficient frost-hardiness, preparation of cuttings ready for insertion, packing loosely in perforated poly-bags, storage in a jacketed cold store at -2° C to 0° C up to 4 months, potting-up from June to July.

6. Bigras, F J; Paquin, R; Rioux, J A, and Therrien, H P. Influence of photoperiod and temperature on the development of frost tolerance, growth, and contents of water, sugars, starch and proline of shoots and roots of juniper (*Juniperus chinensis* L. 'Pfitzerana'). *Canadian Journal of Plant Science*. 1989; 69(1):305-316.

Keywords: *Juniperus chinensis*/ photoperiod/ growth chamber/ cuttings/ frost tolerance/ proline

Abstract: Rooted cuttings of *Juniperus chinensis* were exposed to a combination of 3 temperatures (1, 8 and 15 ° C) and two photoperiods (8 and 16 h) for 42 d in growth chambers in order to study the influence of

these factors on growth and on changes in water, sugar, starch and proline contents of stems and roots during the cold-hardening process. The acclimatization process for stems was different from that for roots. At 15 and 8 ° under a short photoperiod, stems hardened, even though growth continued. Water, sugar and starch contents remained constant. At 1 ° C, stem hardening was not influenced by photoperiod, growth was negligible and sugars accumulated. Root hardening was only affected by temperature. At 15 ° under long days, no hardening was observed and water, sugar and starch contents remained constant while growth continued. At 8 °, the beginning of hardening was noted: the water content decreased and growth slowed, but sugar and starch contents did not increase. At 1 °, growth stopped, sugars and starch accumulated and hardening reached its maximum. Proline contents increased in stems and roots under all treatments except for stems exposed to 15 ° and a 16 h photoperiod.

7. Bigras, F J; Rioux, J A; Paquin, R, and Therrien, H P. Effect of extending fertilizer application into the autumn on frost tolerance and spring growth of container-grown *Juniperus chinensis* 'Pfitzerana'. *Phytoprotection*. 1989; 70(2):75-84.
Keywords: *Juniperus chinensis*/ containers/ growing media/ frost tolerance/ fertilization
Abstract: Eighteen-month-old plants growing outdoors in containers in a sand:perlite:peat (1:1:2) mix received 0 or 1.8 g of N, P₂O₅ and K₂O in a factorial experiment. Decreasing doses of ammonium nitrate, superphosphate, and potassium chloride and sulphate (1:1 for K₂O) were applied from Aug. to Oct. Frost tolerance of young and mature shoots was not reduced by N application and spring growth of shoots was increased. P and K application had no effect on frost tolerance or spring growth. No increase in K content was observed in the tissues following K application. The water content of the shoots and roots decreased during hardening; this decrease was not affected by nutrient application. The temperatures at which 50% of shoots, mature roots and young roots were affected by frost were -29.5, -18.1 and -6.8 degrees C, respectively, on 22 Nov.

8. Calkins, James B. Author; Jarvis, Beth R. Author, and Swanson, Bert T. Author. Compost and rubber tire chips as peat substitutes in nursery container media: Growth effects. *Journal of Environmental Horticulture*. 1997; 15(2):88-94.
Keywords: *Juniperus chinensis*/ *Juniperus sabina*/ *Juniperus horizontalis*/ *Physocarpus*/ *Lamiastrum galeobdolon*/ container/ nursery/ rubber tire chips/ growth/ compost
Abstract: This research investigated the feasibility of using composted yard wastes, composted municipal solid waste and shredded rubber tire chips in nursery container media. Containerized *Physocarpus opulifolius* 'Dart's Gold', Forsythia times 'Meadowlark', *Spiraea* times billiardii, *Juniperus chinensis* 'Seagreen', *J. sabina* 'Mini Arcade', *J. horizontalis*

'Hughes', and *Lamiastrum gakobdolon* were grown in media amended with five recycled waste materials used as peat substitutes in a standard container medium of composted woodchips, peat, and sand (3:2:1 by vol). Waste materials used included three yard waste composts, one municipal solid waste compost and shredded rubber tire chips. Fifty or 100% of the peat in the standard growing medium was replaced with each amendment. Ten treatments (five amendments, each at 50% and 100% peat replacement) and a control (standard medium) were used for all seven plant species. Visual ratings, height and width measurements (crown volume), number of growing points and plant dry weights indicated that media in which 50% of the peat was replaced by an amendment produced larger plants of superior quality compared to the control. Rubber tire chips were acceptable as a 50% peat substitute for plants that prefer well-drained conditions, while 100% peat substitution with tire chips was detrimental to plant growth and performance. Use of immature compost in container media negatively influenced plant growth.

9. Chrustic, G A and Wright, R D. Influence of liming rate on holly, azalea, and juniper growth in pine bark. *Journal of the American Society for Horticultural Science*. 1983; 108(5):791-795.
Keywords: *Juniperus chinensis/ Ilex crenata/ Rhododendron obtusum/* cuttings/ pine bark/ dolomitic limestone/ growth
Abstract: Rooted cuttings of *Ilex crenata* cv. Helleri, *Rhododendron obtusum* cv. Rosebud and *Juniperus chinensis* cv. San Jose were grown in a 100% pine bark medium amended with dolomitic limestone (DL) at 0 to 8 kg/m³ with resulting pH from 3.4 to 7.2. Except for juniper at 2 kg DL/m³, growth was not increased by liming, and 8 kg DL/m³ tended to reduce shoot and root growth. This reduced growth was attributed in part to greater NH₄ adsorption by the bark, reducing the amount available for plant uptake, and a higher nitrification rate, leading to an elevated NO₃ to NH₄ ratio in the medium. It is suggested that liming of pine bark to improve growth of these species may be unnecessary.

10. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secrest Arboretum. *Special Circular Ohio Agricultural Research and Development Center*. 1992; 14032-34.
Keywords: *Juniperus horizontalis/ Juniperus sabina/ Juniperus conferta/ Juniperus communis/ Juniperus procumbens/ Juniperus chinensis/ Juniperus davurica/ Juniperus virginiana/ Juniperus scopulorum/ Juniperus squamata/* growth habit
Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate or

convergent. All plants were also evaluated for growth characteristics of open or closed outline.

11. D'Albro, J. A. Forcing juniper growth by modifying the environment. *American Nurseryman*. 1981; 154(8):72-74.
Keywords: *Juniperus chinensis*/ temperature/ height/ diameter/ photoperiod
Abstract: Studies were made of the effects of long-day (16 h) treatment on greenhouse-grown plants of *Juniperus chinensis*, cv. Mint Julep, from 8 February to 3 June, compared with control plants grown outside in full sun: minimum night temperatures were 65 deg F and about 40 deg , respectively. Average plant height increased from 5.2 inches to 8.3 and 7.2 inches, respectively, and average plant diameter increased from 4.2 inches to 11.0 and 9.4 inches, respectively.
12. Dai, Y. S. A nursery blight of Sabina [*Juniperus*] virginiana. *Journal of Nanjing Institute of Forestry*. 1986; 237-46.
Keywords: *Juniperus virginiana*/ *Juniperus chinensis*/ *Phomopsis juniperovora*/ nurseries/ diseases/ fungi.
Abstract: A fungus producing pycnidia on dead shoots and leaves of seedlings in nurseries in Jiangsu, China, was identified as *Phomopsis juniperovora* [*P. juniperivora*] and described. Seedlings of *S. chinensis* [*Juniperus chinensis*] cv. 'pyramidalis' *Fokienia hodginsii*, *Cupressus funebris* and *C. gigantea* were infected as well as *J. virginiana*.
13. Derr, J. F. Tolerance of woody nursery stock to classic chlorimuron and harmony thiameturon. *Journal of Environmental Horticulture*. 1991; 9(1):9-13.
Keywords: *Juniperus chinensis*/ *Juniperus conferta*/ *Senecio vulgaris*/ *Cyperus esculentus*/ *Ilex crenata*/ *Rhododendron*/ *Photinia*/ classic chlorimuron/ harmony thiameturon/ preemergence/ postemergence
Abstract: Classic and Harmony applied at rates ranging from 0.009 kg ai/ha (0.008 lb ai/A) to 0.067 kg/ha (0.06lb/A) provided excellent preemergence and postemergence control of common groundsel (*Senecio vulgaris* L.) 5 weeks after application to container-grown nursery plants. Classic at 0.034 kg/ha (0.03 lb/A) and 0.067 kg/ha (0.06 </A) reduced yellow nutsedge (*Cyperus esculentus* L.) growth by 50 to 77% 5 weeks after preemergence or postemergence treatments. Harmony did not affect yellow nutsedge from either type of application. 'Seagreen' juniper (*Juniperus chinensis* L.), 'Blue Pacific' juniper (*Juniperus conferta* Parl.) and 'Bennetts Compacta' holly (*Ilex crenata* Thumb.) tolerated all rates of Classic and Harmony. 'Girard's Rose' (*Rhododendron kaempferi* Planch.) and 'Coral Bells' azalea (*Rhododendron obtusum* (Lindl.) Planch.), and redbtip photinia (*Photinia .times. fraseri* Dress) were initially injured by these herbicides, but outgrew the foliar damage.
14. Duhoux, E. and Norreel, B. The isolation of callus tissue from pollen from male cones of *Juniperus chinensis*, *J. communis* and *Cupressus arizonica*

cultured in vitro. Comptes Rendus Hebdomadaires Des Seances De L' Academie Des Sciences, France, D. 1974; 279(8):651-654 .

Keywords: *Juniperus chinensis*/ *Juniperus communis*/ *Cupressus arizonica*/ pollen/ parthenogenesis/ male cones/ callus

Abstract: Male parthenogenesis has hitherto been achieved in only ca. 15 angiosperms, none of them tree species. The authors report the successful laboratory culture of abnormal callus tissue derived from pollen grains of *Juniperus chinensis*, *J. communis* and *Cupressus arizonica*. Attempts will be made to raise haploid male parthenogenetic plants of these species from such tissue.

15. Evans, G. E. and Rasmussen, H. P. Anatomical changes in developing graft unions of *Juniperus* L. Journal of the American Society for Horticultural Science. 1972; 97(2):228-232.

Keywords: *Juniperus chinensis* / *Juniperus horizontalis*/ vegetative propagation/ grafting

Abstract: A study was made on three ornamental cultivars, one of *J. horizontalis* and two of *J. chinensis*, to determine the anatomical sequence of graft-union formation in the nine possible rootstock/scion combinations, and the origin of callus tissue in the union. Histological studies over 60 days showed differences only in the time, delayed with increasing ploidy of the tissue, at which each stage occurred; there was no difference in developmental sequence. Callus-tissue formation, from both rootstock and scion, began 10-20 days after grafting. Soon afterwards, isodiametric cells from uninjured cambia began to grow across the injured graft surfaces by an alternating series of radial and tangential divisions. By 40-50 days this new xylem had produced, by radial divisions, organized cells that filled gaps between the graft partners, crushing the intervening callus, and subsequently forming 'xylem bridges' of mixed origin. Tracheids with abnormally numerous pits developed in the 'bridges'. Up to the 50th day after grafting most new tissue arose from the rootstock, but after 60 days the contributions from rootstock and scion were equivalent.

16. Gilman, E F and Kane, M E. Growth dynamics following planting of cultivars of *Juniperus chinensis*. Journal of the American Society for Horticultural Science. 1991; 116(4):637-641.

Keywords: *Juniperus chinensis* / root growth/ shoot growth/ containers/ diameter

Abstract: Shoot and root growth were measured on *J. chinensis* cultivars *Torulosa*, *Sylvestris*, *Pfitzeriana* and *Hetzii* 1, 2, and 3 years after planting from 11-litre black plastic containers. The mean diameter of the root system expanded quadratically, whereas the mean branch spread increased linearly. Three years after planting, root spread was 2.75 times branch spread, and roots covered an area 5.5 times that covered by the branches. The % of total root length located within the dripline of the plants remained fairly constant for each cultivar during the 3 years following planting. Root length density increased over time but decreased

with distance from the trunk. During the first 2 years after planting, shoot mass increased faster than root mass. In the 3rd year, the root system increased in mass at a faster rate than the shoots. Root length was correlated with root weight. Root spread and root area were correlated with trunk cross-sectional area, branch spread and crown area.

17. Gonzalez, Ronald F. Author and Cooperband, Leslie R. Author Reprint Author. Compost effects on soil chemical properties and field nursery production. *Journal of Environmental Horticulture*. 2003 Mar; 21(1):38-44.
Keywords: *Juniperus chinensis/ Berberis thunbergia/ Spirea japonicum/* compost/ nursery
Abstract: Field production of ornamental shrubs results in significant topsoil removal and degradation of soil chemical properties. We amended field soils with compost to evaluate effects on soil chemical properties and shrub biomass production. We applied either duck manure-sawdust (DM), potato cull-sawdust-dairy manure (PC) or paper mill sludge-bark (PMB) composts to a silt loam soil as a) incorporated 2.5 cm (1 in) of compost tilled into the top 15 cm (6 in) of soil or b) incorporated + mulched 2.5 cm (1 in) tilled into soil + 2.5 cm (1 in) applied over the soil surface. We grew *Spirea japonicum* 'Gumball', *Juniper chinensis* 'Pfitzeriana' and *Berberis thunbergia* 'Atropurpurea' seedlings and measured total and plant available nutrients and shrub biomass production and nutrient contents over two growing seasons. Total soil C was 15-21% higher in all mulched treatments compared to incorporated-only and no-amendment control treatments. Total soil N, P and Cu, available P, S, Ca, Mg, K, pH and EC increased with increasing TC. Mulched DM compost produced significantly higher DTPA-extractable Zn relative to other treatments. In the second growing season, mulched DM compost produced 39-42% greater total barberry biomass than all other treatments. Among all shrub species, the best soil chemical predictors of plant growth were TC, TS, soluble P, exchangeable Ca and K and DTPA-Zn. The best tissue nutrient-content predictors of plant growth were total shoot N, P and Zn and root Zn. The unique growth response of barberry to mulched DM compost suggests that all shrubs may not respond to compost amendments, particularly over the short term.
18. Hall, G C and Whitcomb, C E. Rooting of *Juniperus scopulorum* utilizing antitranspirants as a replacement for mist and growth of resulting plants. Research Report, Oklahoma Agricultural Experiment Station. 1974; P-70444-46.
Keywords: *Juniperus scopulorum/ Juniperus chinensis/* cuttings/ rooting/ IBA/ antitransparents
Abstract: Hardwood cuttings of *J. scopulorum* 'Blue Heaven' and *J. chinensis* 'Hetzi' were treated with combinations of 5 levels of IBA, 3 levels of shading from nil to 62%, and 5 levels of transpiration control. The use of proprietary antitranspirants as a replacement for intermittent mist was unsatisfactory; the highest percentage (60%) of cuttings rooted under mist

applied for 3 sec/min plus a basal treatment with 16 000 p.p.m. IBA in talc. In another trial cuttings of *J. chinensis* 'Hetzi' and *Ligustrum japonicum* were treated with 0, 10 or 20% levels of each of 3 antitranspirants (Folicote, Foli-Gard and Wilt-Pruf), allowed to dry and weighed at 48-h intervals to determine protection against water loss. All 3 antitranspirant coatings proved ineffective and were found to have ruptured..

19. Hsiang T. and Huang J. The use of RAPD markers to distinguish among juniper and cedar cultivars. *Canadian Journal Botany* . 2000; 78:655-659.
Keywords: *Juniperus scopulorum/ Chamaecyparis/ Juniperus chinensis/* DNA/ RAPD/ cultivars/ markers
Abstract: Two species of *Chamaecyparis* and six cultivars each of *Juniperus chinensis* L. and *Juniperus scopulorum* Sarg. (Cupressaceae) were subjected to random amplified polymorphic DNA (RAPD) analysis using seven primers. Un-weighted pair group method with averages (UPGMA) and principal component analyses of genetic distances between cultivars showed that 42 polymorphic RAPD bands could distinguish among all cultivars and properly group them by species and genera. Where the origin of a specific juniper cultivar is uncertain, analysis of genetic distance can pinpoint close relatives. For example, we were unable to trace the origin of *J. chinensis* 'Alps', and we initially thought it was a mislabeled *J. chinensis* 'Blue Alps'. However, we found 'Alps' to be closer to *J. chinensis* 'Fairview' and 'Mountbatten' than to 'Blue Alps'. Similarly, 'Wichita Blue' has an unknown origin, but it had the highest genetic similarity with 'Medora'.
20. Jarvis, Beth R. Author; Calkins, James B. Author, and Swanson, Bert T. Author. Compost and rubber tire chips as peat substitutes in nursery container media: Effects on chemical and physical media properties. *Journal of Environmental Horticulture*. 1996; 14(3):122-129.
Keywords: *Juniperus chinensis/ Juniperus sabina/* compost/ rubber tire chips/ nursery/ containers
Abstract: *Physocarpus opulifolius* 'Dart's Gold', *Forsythia* times 'Meadowlark', *Spiraea* times *billiardii*, *Juniperus chinensis* 'Seagreen', *J. sabina* 'Mini Arcade', *J. horizontalis* 'Hughes', and *Lamiastrum galeobdolon* were grown in container media amended with three yard waste (YW) composts, one municipal solid waste (MSW) compost and shredded rubber tire chips. Each of the five amendments was used to replace 50% or 100% of the sphagnum peat in a standard container medium resulting in eleven media treatments. Effects of peat replacement with compost or tire chips were compared relative to chemical and physical media characteristics. Amendments evaluated had limited long term nutritional value. Initial pH was increased when peat was replaced with compost or rubber tire chips; the increase in pH was proportional to the amount of peat replaced (50 or 100%). Over time, pH of all media equilibrated with irrigation water pH. Soluble salts were reduced for

media amended with rubber tire chips while peat replacement with compost had variable effects on soluble salt levels based on compost source. Media amended with compost exhibited increased bulk density and decreased porosity, water infiltration capacity and water holding capacity compared to the standard, peat-based control medium. Peat replacement with rubber tire chips increased bulk density and porosity and decreased water holding capacity compared to the standard control medium. Water infiltration capacity was greatly increased and water holding capacity decreased when peat was replaced 100% with rubber tire chips.

21. Klett, J E. Nitrogen nutrition of junipers. Combined Proceedings of the International Plant Propagators Society. 1977; 27377-382.
Keywords: *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus sabina*/ *Juniperus horizontalis*/ nitrogen/ nutrition/ ornamental plants/ ornamental conifers
Abstract: Five dwarf juniper cultivars (*Juniperus procumbens* cv. Nana, *J. chinensis* cv. Pfitzeriana, *J. communis* cv. Repanda, *J. sabina* cv. Broadmoor and *J. horizontalis* cv. Wiltonii) responded differently when they were supplied with ammonium sulphate, ammonium nitrate or potassium nitrate each at 200 or 400 p.p.m., as N sources in the glasshouse and outdoors. At a given rate potassium nitrate caused more toxicity than the ammonium fertilizers. The cvs Repanda and Broadmoor, which showed the least dry weight increment, were the first to develop symptoms of N toxicity. Potassium nitrate had a greater effect than other compounds on nitrate concentrations in the tissue. Repanda had the highest nitrate concentration, whereas Wiltonii had the lowest and showed very little toxicity. Plants treated with potassium nitrate or ammonium nitrate suffered more winter damage than those treated with ammonium sulphate. Plants treated with nitrate N were the slowest to break dormancy.

22. Lemieux, Nicole C.; Maynard, Brian K., and Johnson, William A. Evaluation of commercial deer repellents on ornamentals in nurseries. Journal of Environmental Horticulture. 2000 Dec; 18(4):5-8.
Keywords: *Juniperus chinensis*/ *Taxus*/ deer repellents/ nursery
Abstract: The efficacy of several new commercial deer repellents in a nursery setting was evaluated from October through March. Repellents evaluated were Deer-Away™, Tree Guard™, Holly Ridge, Bobbex™, and Deer-Off™. Damage was evaluated on yew (*Taxus X media* L. 'Densiformis', *Taxus X media* Rehd. 'Nigra', *Taxus baccata* Rehd., and *Taxus baccata* L. 'Repandens'), holly (*Ilex X meserveae* S.Y. Hu 'Blue Princess' and *Ilex X meserveae* S.Y. Hu 'China Girl') and Juniper (*Juniperus chinensis* L. 'Keteleeri'). Plots received between 0% and 96% deer browse damage. Both Deer Away™ and Holly Ridge significantly reduced browsing. Tree Guard™ and Deer Off™ reduced browsing when feeding intensity was low.

23. Neal, Joseph C. and Senesac, Andrew F. Cultivar differences in postemergence graminicide phytotoxicity to *Juniperus*. HortScience. 1989 Feb; 24(1):96-98; ISSN: 0018-5345.

Keywords: *Juniperus horizontalis*/ *Juniperus chinensis*/ *Juniperus conferta*/ herbicides/ phytotoxicity

Call Number: SB1.H6

Abstract: Several juniper species and cultivars were compared by sensitivity to labeled and experimental postemergence graminicides. The junipers treated were: *Juniperus horizontalis* Moench. 'Wiltonii' (blue rug), *J. h.* 'Bar Harbor', *J. h.* 'Youngstown' (Youngstown Andorra), *J. chinensis* L. ; 'Pfitzeriana' (Pfitzer), *J. c.* 'Parsonii' (Parson's), *J. c.* 'Sargentii' (Sargent's), and *J. conferta* Parl. (shore). The herbicide treatments were fluazifop-p, sethoxydim, haloxyfop, quizalofop, cycloxydim, and fenoxaprop at recommended rates for annual grassy weed control, with recommended spray adjuvants. 'Bar Harbor' juniper was injured, in decreasing order of severity, by haloxyfop, fenoxaprop, quizalofop, and fluazifop. Sethoxydim and cycloxydim produced no reduction in plant fresh weight for the juniper cultivars tested. However, sethoxydim plus adjuvants did reduce 'Bar Harbor' juniper visual quality ratings in 1986. Pfitzer juniper was slightly injured by haloxyfop in 1985 and by fenoxaprop in 1986. The other junipers were unaffected by herbicide treatments. Chemical names used: (R) -2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoic acid (fluazifop), (±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy] propanoic acid (fenoxaprop), 2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoic acid (haloxyfop), (±) -2-[4-[(6-chloro-2-quinoxalanyl) oxy] phenoxy] propanoic acid (quizalofop), 2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one (sethoxydim), and 2-[1-(ethoxyimino)butyl]-3-hydroxy-5-(2H-tetrahydrothiopyran-3-yl)-2-cyclohexen-1-one (cycloxydim).

24. Niemiera, A. X and Wright, R. D. The influence of nitrification on the medium solution and growth of holly, azalea, and juniper in a pine bark medium. Journal of the American Society for Horticultural Science. 1986; 111(5):708-712.

Keywords: *Juniperus chinensis*/ pine bark/ container/ *Ilex*/ *Rhododendron*/ nitrification/ fertilizer/ shoot dry weight

Abstract: *Ilex crenata*, *Rhododendron obtusum* and *Juniperus chinensis* plants were container-grown in a pine bark medium. Pine bark was amended or unamended with nitrapyrin (NI) and fertilized with an NH₄-N fertilizer. Medium solution NH₄-N concentrations of bark without NI decreased rapidly for the first 3 to 5 weeks with a concomitant increase in NO₃-N concentrations. Medium solution pH at zero NI decreased by 0.8 unit during periods of rapid NO₃-N accumulation. The low medium solution pH of the zero NI treatment resulted in solution Ca, Mg and Mn concentrations that were several times greater than at 82 mu g of NI. Correspondingly, tissue concentrations of these ions were generally

greater at the zero NI treatment than at the 82 mu g of NI treatment. In general, there were no differences in shoot dry weight in response to NI treatment.

25. Patrick, C. R. *Periploca mimula* infesting junipers [*Juniperus chinensis* var. *keteleeri*] at a nursery in Tennessee (*Lepidoptera: Gelechioidea*). *Journal of the Georgia Entomological Society*. 1973; 8(4):316.
Keywords: *Juniperus chinensis*/ periploca mimula/ infestation/ Tennessee

26. Roncadori, R W and Pokorny, F A. Growth of *Juniperus chinensis* var. *sargentii* as influenced by vesicular-arbuscular mycorrhizae and soil fertility. *HortScience* . 1982; 17(6):917-918.
Keywords: *Juniperus chinensis*/ fertilizer/ mycorrhizae/ *Gigaspora margarita*/ *Glomus fasciculatus*/ *Glomus mosseae*
Abstract: Total fresh weight and crown spread of *Juniperus*, grown in micro plots containing a low fertility medium of 4 soil:1 sand:1 milled pine bark amended with a 10N--4.4P--8.3K fertilizer at rates of 0, 110 or 220 mu g/g, were significantly increased by inoculation with a spore mixture of *Gigaspora margarita* , *Glomus fasciculatus* and *G. mosseae*. Higher fertilizer concentrations improved crown spread but did not affect plant growth. Root colonization by the endophytes ranged from 24.4 to 39.2% and was unaffected by fertilization rates.

27. Rueda, L. M.; Osawaru, S. O.; Georgi, L. L., and Harrison, R. E. Natural occurrence of entomogenous nematodes in Tennessee nursery soils. *Journal of Nematology*. 1993; 25(2):181-188.
Keywords: *Juniperus chinensis*/ *Magnolia grandiflora*/ *Galleria mellonella*/ *Acheta domesticus*/ *Alphitobius diaperinus*/ *Musca domestica*/ *Heterorhabditis bacteriophora*/ *Steinernema carpocapsae* / *Lagerstroemia indica*/ nematodes/ nursery/ Tennessee
Abstract: To isolate potential insect biocontrol agents, entomogenous nematodes were surveyed in Tennessee plant nurseries in 1991. Soil samples from 113 nursery sites were baited with greater wax moth (*Galleria mellonella*) larvae, house cricket (*Acheta domesticus*) adults, lesser mealworm (*Alphitobius diaperinus*) adults, and house fly (*Musca domestica*) larvae. *Heterorhabditis bacteriophora* and *Steinernema carpocapsae* were each recovered from 17 soil samples. *Heterorhabditis bacteriophora* was more common in habitats with crape myrtle (*Lagerstroemia indica*) and Chinese juniper (*Juniperus chinensis*) than other nursery plants, and *S. carpocapsae* was more frequently recovered from habitats with juniper and Southern magnolia (*Magnolia grandiflora*). Bulk density, electrical conductivity, organic matter, pH, temperature, and moisture content of the entomogenous-nematode positive soil samples were compared. Other nematode genera recovered with insect baits included *Rhabditis* sp., *Pelodera* sp., *Cryptaphelenchoides* sp., and *Mesodiplogaster* sp., which was recovered

from a greater percentage of soil samples than the other five genera.

28. Ruter, J. M. Growth and landscape establishment of *Pyracantha* and *Juniperus* after application of paclobutrazol. HortScience. 1994; 29(11):1318-1320.
Keywords: *Juniperus chinensis*/ *Pyracantha*/ paclobutrazol/ drench/ planting stock/ production/ cultural methods.
Abstract: The long-term effects of paclobutrazol applied to *Pyracantha* cv. Mojave and *J. chinensis* cv. San Jose plants were investigated. Paclobutrazol was applied as a drench to container-grown (2.8 litre) plants at 0, 5, 10, 20 or 40 mg a.i./pot in June 1991 and plants were transplanted to the field in Feb. 1992. *Pyracantha* plant height, shoot and root DW and total biomass (shoot DW + root DW) decreased quadratically as rate of paclobutrazol increased during nursery production. Paclobutrazol had no effect on plant height or shoot DW of *J. chinensis*, although width indices were reduced. Ratings for root quality for *J. chinensis* in containers increased as rate of paclobutrazol increased. After 9 months in the landscape, paclobutrazol still influenced plant height, width and shoot DW for *Pyracantha* but had no effect on *J. chinensis*. As rate of application increased, fruit retention on *Pyracantha* increased. Paclobutrazol applied as a container medium drench at 5 mg a.i./pot was excessive during nursery production of *Pyracantha* and *J. chinensis*.
29. Saito, T. and Yamamoto, S. Note on two new species attacking the cone of *Juniperus chinensis*. Proceedings of the Kanto Tosan Plant Protection Society. 1985; 32219-220.
Keywords: *Juniperus chinensis*/ *Megastigmus*/ *Argyresthia*/ cones/ yponomeutid
Abstract: Observations are given from Japan on a species of torymid in the genus *Megastigmus* and a species of yponomeutid in the genus *Argyresthia* causing damage to the cones of *Juniperus chinensis*.
30. Schmidt, G. New methods for propagation by summer cuttings of certain *Juniperus* spp. and [broadleaved] evergreens. Kerteszeti Egyetem Közleményei. 1974; 37(5):71-75, 2 plates.
Keywords: *Juniperus chinensis*/ *Juniperus sabina*/ *Juniperus communis*/ vegetative propagation/ nurseries/ protected cultivation.
Abstract: Preliminary results are given of one year's trials with cuttings taken on 1-3 July and set in seed boxes in sand. *J. chinensis* 'Hetzii' (a), *J. sabina* 'Blaue Donau' (b) and *J. communis* 'Suecica' (c) rooted better in a plastic tunnel with mist than under a plastic sheet without mist. The results without mist were, however, satisfactory and less costly. The application of certain growth substances and fungicides improved rooting in (a) and (b) but not in (c).
31. Shrewsbury, Paula M. Author Reprint Author; E-mail: pshrewsb@umd.edu], and Hardin, Mark R. Author. Evaluation of predatory mite (*Acar*: *Phytoseiidae*) releases to suppress spruce spider mites, *Oligonychus*

ununguis (Acari: Tetranychidae), on juniper. Journal of Economic Entomology. 2003 Dec; 96(6):1675-1684.

Keywords: *Juniperus chinensis*/ *Oligonychus ununguis* / *Galendromus occidentalis*/ *Cupressaceae*/ spider mites/ *Neoseiulus fallacis*

Abstract: A laboratory trial evaluated four phytoseiid species for their potential as biological control agents of spruce spider mite, *Oligonychus ununguis* (Jacobi) (Acari: Tetranychidae). An augmentative biological control approach, using the predatory mites *Neoseiulus fallacis* Garman and *Galendromus occidentalis* Nesbitt (Acari: Phytoseiidae), was evaluated for reducing pest mite densities and injury, and economic costs on *Juniperus chinensis* 'Sargentii' A. Henry (*Cupressaceae*) in an outdoor nursery. Sequential releases of predator species, individually and in combination, were tested and compared with two commonly used miticides, a low-toxicity miticide, horticultural oil, and a conventional miticide, hexythiazox. Timing of treatments was based on grower-determined need, and predator release rates were based on guidelines in literature received from producers of beneficial organisms. Predator releases were more expensive and provided less effective suppression of spruce spider mites, resulting in greater spider mite injury to plants, compared with conventional pesticides. However, spider mite damage to plants did not differ in an economically meaningful way between treatments. Unsatisfactory levels of control seem related to under estimations of actual spider mite abundance based on grower perceptions and the beat sampling technique used to estimate predator release rates. These data suggest that when initial populations of spruce spider mite are high, it is unlikely that sequential releases of predator species, individually or in combination, will suppress spider mite populations. In this trial, augmentative biological control was 2.5-7 times more expensive than chemical controls.

32. Smith, E M. Fertilizing *Taxus* and juniper in the nursery. Research-Summary, Ohio Agricultural Research and Development Center. 1974; 7933-34.
Keywords: *Juniperus chinensis*/ *Taxus media*/ fertilizer/ growth
Abstract: A 16-16-16 NPK fertilizer was applied at 9 rates on 22 December, 1971 and 3 January, 1973, to *Taxus media* cv. *Densiformis* and *Juniperus chinensis* cv. *Pfitzeriana* planted out in May, 1971. When assessed on 6 October plant growth in both spp. was best where 5 lb each of actual N, P and K was applied/1000 ft² (equivalent to 1 375 lb of 16-16-16 compound/acre). Plant growth was sparse where 9 or 10 lb of each had been applied, which suggested that these high rates damaged the roots.
33. Spangler, Ronald Lee. Graft success as influenced by environmental conditions affecting physiological changes in *Juniperus* L. PhD. Thesis, Michigan State University . 1971; 139 pp.
Keywords: *Juniperus horizontalis*/ *Juniperus chinensis*/ Andorra/ Hetzi/ Pfitzer/ scion/ graft survival/ rootstock/ temperature/ cold storage
Abstract: *Juniperus horizontalis* 'Andorra', *J. chinensis* 'Hetzi' and *J.*

chinensis 'Pfitzer' were self-grafted following varying temperature storage treatments to the scion and understock. Treatments consisted of two temperatures, greenhouse stored (18 ° C) and cold dark storage (2° C). Storage periods for the cold treatment were four, nine or twelve weeks.

Graft survival data indicated decreasing order of clonal survival was Andorra, Hetzi, Pfitzer. Decreasing order of graft survival for temperature-storage treatments was nine, four, and twelve weeks of cold storage. Data from the scion/stock treatments indicated whenever greenhouse (18° C) scion or stock was involved in the graft treatment, graft survival was greater than if (2° C) scion or stock material was involved regardless of the length of cold treatment. Application of different concentrations of auxin: gibberellin: kinetin solutions resulted in equally poor graft survival.

In Andorra, four weeks of cold storage did not affect total growth when compared to greenhouse natural day length plants. Nine and twelve weeks of cold caused the growth rate of Andorra to be greatly reduced when compared to growth of natural day length. In comparison, Hetzi and Pfitzer shoot growth rate was accelerated by increasing the cold storage period to nine or twelve weeks.

Changes in growth promoters were determined by the mung bean bioassay. By partitioning the crude methanol extract into its acidic, basic and neutral ether fractions only R_f 0.80-0.93 was found to be active from the mung bean bioassay. This region was designated cofactor 4 which was found to be present in the shoots and roots of all clones.

In Andorra, the pattern of change in relative concentration of cofactor 4 for greenhouse plants from October through May was found to be very similar to the pattern of change of Andorra outdoor plants from April through November. When these curves were superimposed on each other a shift of six months by the greenhouse plants was noted. A shift of one month and two months was noted for Hetzi and Pfitzer, respectively. All clones exposed to four weeks of cold showed a decline in cofactor 4 concentration after being moved into the greenhouse for one month. Plants exposed to nine weeks of cold increased in cofactor 4 concentration after one month in the greenhouse.

34. Tereshkovich, George. *Juniperus* species: evergreen ground covers . Research Report. University of Georgia, College of Agriculture Experiment Stations. 1969; 3610 .

Keywords: *Juniperus conferta*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus horizontalis*/ *Juniperus japonica*/ *Juniperus procumbens*/ *Juniperus sabina*/ *Juniperus scopulorum*

Call Number: S51.R22

Abstract: The following *Juniperus* spp. cultivars are better adapted for the Georgia Piedmont: *Juniperus* Blue Pfitzer, *Juniperus conferta* (Shore Juniper), *Juniperus chinensis* Sargenti, *Juniperus chinensis pfitzeriana aurea* (Golden tip Pfitzer), *Juniperus davurica* (Squamata expansa) *parsoni*, *Juniperus horizontalis andorra*, *Juniperus horizontalis andorra*

compacts, *Juniperus horizontalis andorra*, (Aunt Jamina), *Juniperus horizontal plumosa*, (Andorra juniper), *Juniperus horizontalis* 'Douglasi' (Waukegan), *Juniperus japonica* (San Jose), *Juniperus procumbens*, *Juniperus sabina* 'Arcadia', and *Juniperus scopulorum*, (White Silver King). These species are very hardy plants, able to withstand extremes in temperature, and provide excellent ground cover for landscaping around the home, in parks, and in highway beautification programs.

35. Walker, K L and Williams, D J. Weed interference in container-grown 'San Jose' juniper. HortScience. 1990; 25(6):650-651.
Keywords: *Juniperus chinensis*/ *Digitaria*/ *Setaria*/ *Echinochloa*/ weed/ container
Abstract: Experiments in 2 consecutive years indicated that *Echinochloa crus-galli*, *Digitaria sanguinalis* and *Setaria faberi* reduced growth of container-grown *Juniperus chinensis* cv. San Jose 83 days after transplanting weed seedlings into the containers. Densities of 1-6 weeds/container reduced *J. chinensis* growth. By 83 days of weed interference, *J. chinensis* shoot DW was reduced by as much as 43% with 6 weeds/container.
36. Wang T.; Zheng X. Y.; Yin X. Z.; Jian A. Q.; Wang T. L.; Gui F., and Zhang J. L. An experiment on stimulating the rooting of ageing callus of Sabina [*Juniperus*] *chinensis* cuttings. Forest Science and Technology Linze Keji Tongxun. 1984; 53-6.
Keywords: *Juniperus chinensis*/ regulators/ vegetative propagation/ treatment/ China
Abstract: Three treatments were carried out in nurseries at Beijing, China. The best rooting occurred in cuttings stimulated by making a cut on the callus and soaking in 50 p.p.m. ABT sol. for 2 h. The rooting percentage of cuttings was respectively 96.1% and 87.5% for 1- and 2-yr-old calli.
37. Wetherington, J. L. Propagation of *Juniperus chinensis* 'Torulosa' using bottom heat. Combined Proceedings, International Plant Propagators' Society. 1984; 33589-594.
Keywords: *Juniperus chinensis*/ bottom heat/ cuttings/ rooting/ Florida/ planting stock/ production/ techniques.
Abstract: Poor results with rooting of cuttings in Florida were thought initially to be attributable to climate, stock plants or propagation techniques, but successful rooting was obtained eventually by using bottom heat. A closed circulation system (described) was designed to provide the heat economically. Tip cuttings were taken on 21 January and dipped in Hormodin 2 [IBA] powder. Cuttings on the heated bench started to callus and root considerably earlier and showed a higher rooting percentage than those on an unheated control bench. The rooted cuttings produced with bottom heat were also healthier and grew better.
38. Whitcomb, C E. A comparison of Osmocote 18-6-12, 18-5-11 and IBDU-K frit on

growth of Pfitzer juniper and Dwarf Burford holly. Research Report, Agricultural Experiment Station, Oklahoma State University. 1977; P-76091-95.

Keywords: *Juniperus chinensis/ Ilex cornuta/* container/ Osmocote/ fertilizer

Abstract: The best growth of young container-grown plants of *Juniperus chinensis* cv. Pfitzeriana and *Ilex cornuta* cv. Burford Dwarf was obtained by incorporating Osmocote 18-5-11 NPK at 12.5 lb/yd³ or IBDU (31% N) [isobutylidene diurea] + K frit at 8.5 + 6 lb/yd³ plus 1.5 lb Par-Ex (a granular formation of IBDU) into the growing medium.

39. Whitcomb, C. E. Effects of pot sizes on rooting of juniper cuttings. American Nurseryman. 1974; 139(2):73-75.

Keywords: *Juniperus chinensis/ Euonymus japonicus/* rooting/ containers

Abstract: Root cuttings of *Juniperus chinensis* rooted best in containers with a volume of 36.5 in³; larger container sizes made little difference. With *Euonymus japonicus*, however, rooting was not affected by container size.

40. Whitcomb, C E. Response of *Juniperus chinensis* 'Pfitzeriana' and *Ilex cornuta* 'Burford' to 3 levels of dolomite and 3 levels of single superphosphate in the growing medium in 3 container sizes. Research Report, Oklahoma Agricultural Experiment Station. 1974; P-70430-34.

Keywords: *Juniperus chinensis/ Ilex cornuta/* superphosphate/ fertilizer/ containers/ dolomite

Abstract: Juniper and holly were planted in 1-, 3- or 5-gal containers with 4, 8 or 12 lb dolomite/yd³ and 4, 8 or 12 lb single superphosphate. With holly most bud breaks were produced initially in plots with 4 lb superphosphate plus 4 or 8 lb dolomite/yd³. A year later the top and root growth were shown to be unaffected by the dolomite levels, and more than 4 lb superphosphate was detrimental to all growth. With juniper the superphosphate levels had no effect on growth but rising dolomite levels were inhibitory. Increasing the container size was more noticeably beneficial to juniper than to holly plants.

***Juniperus coahuilensis* (1)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). Biochemical Systematics and Ecology. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus*

pinchotii/ Juniperus saltillensis/ Juniperus standleyi/ essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

***Juniperus comitana* (1)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/ essential oils/ DNA/ RAPD*

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

***Juniperus communis* (116)**

1. Adams R. P. and Pandey R. N. Analysis of *Juniperus communis* and its varieties based on DNA fingerprinting. *Biochemical Systematics and Ecology*. 2003; 31(11):1271-1278.
Keywords: *Juniperus communis*/ Spain/ DNA fingerprinting/ RAPD/ Sicily
Abstract: Plants of *Juniperus communis* L. var. *communis*, *J. c.* var. *depressa* Pursh, *J. c.* var. *hemispherica* J. & C. Presl, *J. communis* var. *megistocarpa* Fern. & St. John, *J. c.* var. *nipponica* (Maxim.) Wils., *J. c.* var. *oblonga* hort. ex Loudon and *J. c.* var. *saxatilis* Pall. were sampled and DNA fingerprinting (RAPDs, Random Amplified Polymorphic DNAs) was performed. Based on 191 RAPD bands, there was little evidence to support the recognition of *J. communis* var. *hemispherica*, *J. c.* var. *oblonga* and *J. c.* var. *nipponica*. *Juniperus communis* var. *communis* (Sweden) was found to be most similar to *J. c.* var. *hemispherica* from Sicily, and also very similar to *J. c.* var. *saxatilis*. The recognition of *J. c.* var. *saxatilis*, sensu stricto, and var. *hemispherica* (from Sicily) was not supported by the RAPD data in this study. All of the *J. c.* var. *depressa* populations sampled from the Western Hemisphere formed a distinct group. *Juniperus communis* var. *megistocarpa*, endemic to maritime eastern Canada, was the most distinct variety of *J. communis*. *Juniperus communis* var. "saxatilis" populations from the Kamchatka peninsula and *J. c.* var. "hemispherica" from the Sierra Nevada, Spain, were very distinct from other *J. c.* var. *communis*-*saxatilis* populations.
2. Adams R. P.; Pandey R. N.; Leverenz J. W.; Dignard N.; Hoegh K., and Thorfinnsson T. Pan-Arctic variation in *Juniperus communis*: historical biogeography based on DNA fingerprinting. *Biochemical Systematics and Ecology*. 2003; 31(2):181-192.
Keywords: *Juniperus communis*/ RAPD/ DNA/ biogeography
Abstract: Twelve populations of *Juniperus communis* L. were sampled from throughout the arctic, worldwide and DNA fingerprinting (RAPDs, Random Amplified Polymorphic DNAs) was performed. Based on 152 RAPD bands, all of the populations (*J. communis* var. *depressa* Pursh and *J. communis* var. *megistocarpa* Fern. and St. John) from the western hemisphere formed one group and all of the populations of the eastern hemisphere (including Greenland and Iceland), formed another group that included *J. communis* var. *communis* and *J. communis* var. *saxatilis* Pall., except for the Kamchatka population that was quite dissimilar to any population examined. Most likely, the current sites of all of the populations were covered with ice or otherwise inhospitable, up to or during the late Pleistocene (~12 000 BP). Therefore, these populations are recent in origin. The path of recolonization appears to have been northward in North America. Greenland appears to have been colonized from Iceland plants, which in turn came from northern Europe. The Kamchatka population seems likely to have come from Japan.
3. Adams, Robert P.; Hsieh, Chang-Fu; Murata, Jim, and Pandey, Ram Nanresh.

Systematics of *Juniperus* from eastern Asia based on Random Amplified Polymorphic DNA's (RAPDs) . Biochemical Systematics and Ecology . 2002 Mar; 30(3):231-241; ISSN: 0305-1978.

Keywords: *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus conferta*/ *Juniperus formosana*/ *Juniperus procumbens*/ *Juniperus rigida*/ *Juniperus taxifolia*/ RAPS's/ DNA/ Taiwan/ China

Call Number: QD415.A1B5

Abstract: DNA was examined by RAPD banding for *Juniperus chinensis*, *J. c.* var. *sargentii*, *J. c.* var. *tsukusiensis*, *J. communis*, *J. c.* var. *nipponica*, *J. c.* var. *saxatilis*, *J. conferta*, *J. formosana*, *J. procumbens*, *J. rigida*, *J. taxifolia*, and *J. t.* var. *lutchuensis*. The DNA data readily separated junipers of section *Sabina* from section *Juniperus*. *J. c.* var. *tsukusiensis* from Taiwan was found to be sufficiently different from *J. c.* var. *tsukusiensis* (Yakushima) to warrant the recognition of a new variety: *J. chinensis* var. *taiwanensis* R.P. Adams and C-F. Hsieh *nov. var.* *Juniperus formosana* from mainland China was found to be different from *J. formosana* from Taiwan and a new variety is recognized: *J. formosana* var. *mairei* (Lemee and Lev.) R.P. Adams and C-F. Hsieh *comb. nov.* *Juniperus communis* var. *nipponica* was found to be distinct from *J. communis* and this supports its recognition as a variety. The recognition of *J. conferta* as a variety of *J. rigida* [*J. rigida* var. *conferta* (Parl.) Patschke] is supported by the data. The data also supports the recognition of *J. lutchuensis* Koidz. [= *J. taxifolia* var. *lutchuensis* (Koldz.) Satake] and *J. morrisonicola* Hayata [= *J. squamata* var. *morrisonicola* (Hayata) H.L. Li and H. Keng] at the specific levels.

4. Ashworth V. E. T. M.; O' Brien B. C., and Friar E. A. Survey of *Juniperus communis* (*Cupressaceae*) L. varieties from the Western United States using RAPD fingerprints. Madrono. 2001; 48(3):172-176.
Keywords: *Juniperus communis*/ RAPD/ DNA
Abstract: RAPD fingerprints were generated from seven wild populations of *Juniperus communis* to assess whether molecular data support subdivision into vars. *saxatilis*, *jackii* and *sibirica*, members of California Floristic Province, and *depressa*, a component of the Great Basin Floristic Province. Results from UPGMA and Neighbor Joining cluster analyses showed little correspondence between RAPD-derived distances and varietal boundaries. *J. communis* var. *jackii*, in particular, was highly heterogeneous, lending support to the hypothesis that the characteristic growth habit of this serpentine dweller (elongated, sparsely branched lateral branches) is environmentally induced. In contrast to the RAPD results, nucleotide sequences of the ITS1 region of nuclear ribosomal DNA were identical in four of five var. *jackii* individuals sequenced, and the fifth exhibited three base substitutions.
5. Atanasova, L Y; Pissarska, M G; Popov, G S, and Georgiev, G I. Growth and endogenous cytokinins of juniper shoots as affected by high metal concentrations. Biologia Plantarum. 2004; 48(1):157-159.

Keywords: *Juniperus communis*/ cytokinin/ growth/ metal content

Abstract: The growth and the content of endogenous cytokinins (CKs) of current-year-old shoots from juniper (*Juniperus communis*) plants growing over and off ore site were compared. The juniper shoots from ore site (M plants) had higher metal content and exhibited delayed growth. Less bases and nucleosides of trans-zeatin (Z)- and N6-isopentenyladenine (iP)-type CK and more iP-conjugates were present in the M shoots. These changes were probably due to inhibited CK export from the roots and/or altered CK metabolism forming less biologically active CKs.

6. Austad I. and Hauge L. Juniper fields in Sogn, Western Norway, a man-made vegetation type. *Nordic Journal of Botany*. 1990; 9(6):665-683.

Keywords: *Juniperus communis*/ Norway/ vegetation

Abstract: Juniper fields (populations of columnar *Juniperus communis* in fairly open grass-dominated pastures) are still a common vegetation type in some districts of Norway, especially in the west. However, they are rapidly disappearing because of changes from traditional agricultural practices. Four main types of juniper fields in Sogn are identified, based on structure, soil conditions and traditional use.

7. Bakker, J. P.; Bakker, E. S.; Rosen, E.; Verweij, G. L., and Bekker, R. M. Soil seed bank composition along a gradient from dry alvar grassland to *Juniperus* shrubland. *Journal of Vegetation Science*. 1996; 7(2):165-176; ISSN: 1100-9233.

Keywords: *Juniperus communis*/ *Trifolium repens*/ *Cerastium fontanum*/ *Achillea millefolium*/ seed longevity/ plant succession/ sward renovation/ botanical composition/ weed control/ grasslands/ limestone grasslands/ seed banks/ seeds/ longevity/ scrub control/ control/ woody weeds/ weeds/ population dynamics/ spread/ fodder plants

Abstract: Dry alvar grasslands on limestone on the Baltic island of Oland, SE Sweden,

are very species-rich provided that the traditional agricultural exploitation of grazing and fire wood collection is continued. After abandonment, encroachment of *Juniperus communis* starts and a closed woodland can develop within 100 years. A chronosequence, representing a successional series, was used for the comparison of sites still grazed, and sites ungrazed for about 20, 55 and 80 years. Out of the 58 characteristic dry alvar grassland species, 55% disappeared from the established vegetation after 80 year of abandonment, and 80% also vanished from the seed bank. *Arenaria serpyllifolia*, *Trifolium repens*, *Agrostis vinealis*, *Linum catharticum*, *Polygala vulgaris*, *Cerastium fontanum*, *Luzula campestris*, *Achillea millefolium* and *Potentilla tabernaemontani* were the only species left in the seed bank. More than 75% of the dry alvar grassland

species were classified as having a transient or short-term persistent seed bank. It is concluded that cutting junipers on overgrown dry alvar

grassland is insufficient for restoration of alvar grassland because of inadequate seed longevity. The success of sward renovation would depend on seed dispersal by wind or grazing animals.

8. Balashov, L. S. *Juniperus communis* in the forests of the Poles'e reserve [Ukraine], and its phytocoenotic role. *Ukrains' Kii Botanichnii Zhurnal*. 1974; 31(4):525-527.
Keywords: *Juniperus communis*/ Ukraine/ phytocoenotic
Abstract: A note reporting the occurrence of *J. communis* in these forests, and discussing its role in the community and its main growth forms.
9. Barkman, J. J. Geographical variation in associations of juniper scrub in the central European plain. *Vegetatio*. 1985; 59(1-3):67-71.
Keywords: *Juniperus communis*/ associations/ juniper scrub
Abstract: Dense scrub of *Juniperus communis* is assigned to many associations, ungrazed lowland juniper scrub on level, dry, poor, acid sandy soil in NC Europe to 2 vicarious associations, the *Helichryso-Juniperetum* in Poland and the *Dicrano-Juniperetum* occupying an area from E Germany and S Sweden to the central Netherlands. The former is characterized by 20 differential species, mostly xerophytic herbs, the latter by 25 species. The shares of cryptogams are 20% and 44% respectively. The *Dicrano-Juniperetum* is differentiated into a NE group of 2 subassociations (vicariants) and a SW group of 6 subassociations. The 2 associations, as well as the two sub association groups of *Dicrano-Juniperetum* are found in similar habitats and are obviously controlled by climate alone. The eight subassociations of the DJ, however, also differ, at least in part, by soil factors. The geographical variation of the constancy (presence degree) and abundance (cover degree) of a number of species within the 2 vicarious associations throughout the European area is given. Within a narrowly delimited habitat and group of plant communities the geographical indicator values of species may become much greater than if only their geographical occurrence is considered, irrespective of habitat.
10. Barrett, J. A review of juniper conservation in North-East England. *Scottish Forestry*. 1998; 52(3/4):185-187.
Keywords: *Juniperus communis*/ England/ plant genetic resources/ surveys/ nature conservation
Abstract: The changing (declining) status of juniper (*Juniperus communis*) in NE England since the early 1970s is reviewed, based on surveys made in 1973 and 1994. Population changes are quantified, and the measures implemented to sustain and enhance the populations described.
11. Bobinski, J. Characteristics and properties of *Juniperus communis* L. Cechy i wasciwosci jaowca pospolitego *Juniperus communis* L. *Rocznik Sekcji Dendrologicznej Polskiego Towarzystwa Botanicznego*. 1979; 32:33-49.

Keywords: *Juniperus communis*/ medicinal plants/ wood properties

Abstract: A review with special reference to natural stands in Poland. Sections of particular forestry interest deal with stem increment up to 100 yr old, variation in form, sex ratio, wood properties, and the collection of berries for medicinal use.

12. Broome, A. Growing juniper: propagation and establishment practices. Information Note Forestry Commission. 2002; 5012.
Keywords: *Juniperus communis*/ propagation/ Great Britain
Abstract: Juniper (*Juniperus communis*) is of conservation concern and while there is interest in the expansion and re-introduction of this species in Britain, there is uncertainty over establishment methods. This Note reports results from recent propagation and establishment trials, and gives interim guidance on best practice.
13. Browicz K. and Zielinski J. New forms of *Juniperus communis* subsp. *nana* from Pilsko. Arboretum Kornickie. 1974; 1939-43.
Keywords: *Juniperus communis*/ Poland/ subspecies
Abstract: A note describing thickets of a Juniper in the Zywiec Beskid Mts. of Poland that differs in habit from the typical subspecies and is described as *J.c.* subsp. *nana* var. *recta* var. nov. Some individuals had wavy needles curving round the shoot axis, and this form is named f. *crispa* f. nov.
14. Busby F. E. J. Effects of livestock grazing on infiltration and erosion rates measured on chained and unchained pinyon-juniper sites in southeastern Utah. Dissertation Abstracts International, B. 1978; 38(9):3986-3987.
Keywords: *Juniperus communis*/ *Pinus edulis*/ grazing/ erosion/ Utah
Abstract: There was no significant effect of grazing on infiltration rates of unchained pinyon-juniper [*Pinus edulis*/*Juniperus communis*] sites, sites chained with debris in place, or chained and windrowed sites. Infiltration rates increased with period of rest from grazing. Erosion rates were not significantly affected by forage removal or by soil compaction.
15. Caramiello, R. Author; Potenza, A. Author, and Siniscalco, C. Author. Relationship between distribution of *Juniperus communis* ssp. *communis* in Western Alps, its pollen morphology and viability. Allionia (Turin). 1990; 30(0):65-74.
Keywords: *Juniperus communis*/ germination/ pollen/ viability
Abstract: *Juniperus communis* L. ssp. *communis* grows in a wide ecological range, especially as far as altitude is concerned. The aim of the present paper is to study the morphology, assess the viability and germinability of the pollen samples from several stations located at various altitudes so as to identify significant differences among the populations if any. Viability tests with fluorochromatic reagents and the measurement of redox activity gave comparable results. Samples were no longer viable after two months in storage conditions resembling those found in their natural environment. The pollens from the population collected at an

average altitude (600-800 m) were the most viable, and in a few cases (6% max) grains germinated in vitro after about four weeks. Sample grain sizes varied considerably although such differences could not be correlated directly to altitude. Morphological data suggest the possible existence of ecological races, more than values related to macroscopic parameters do (Pignatti, 1982). More detailed studies on the relationship between ecotypes and on their distribution could contribute to the knowledge of the biogeography of *Juniperus communis* ssp. *communis*.

16. Clifton S. J.; Ward L. K., and Ranner D. S. The status of juniper *Juniperus communis* L. in north-east England. . Biological Conservation. 1997; 79(1):67-77.
Keywords: *Juniperus communis*/ overgrazing/ browsing/ land use/ agriculture/ England
Abstract: Comprehensive surveys of juniper *Juniperus communis* colonies in NE England (excluding the large stands of Upper Teesdale) were undertaken in 1973 and 1994. Data were compared from 83 sites to determine the extent of demographic change and confirm suspected trends towards fragmentation and scarcity in juniper populations across the region. The results of both surveys are presented for County Durham and Northumberland. There had been a 30% decline in the juniper population over the 21-yr period. Losses of 36 and 24% were recorded for the 2 counties respectively; 54% of colonies in the region had declined while 16% had been lost completely. Extant colonies were small in terms of population size and overwhelmingly even-aged, being dominated by mature and old bushes, and there were very few indications of active natural regeneration - largely as a result of intensive agricultural practices. Most colonies were characterized by scattered individuals. The main factors thought to account for this decline (heavy grazing and browsing, removal for livestock pasture, erosion and landslips, fragmentation, burning for grouse management) are considered and measures to promote the conservation of juniper in NE England are discussed.
17. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secret Arboretum. Special Circular Ohio Agricultural Research and Development Center. 1992; 14032-34.
Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus virginiana*/ *Juniperus scopulorum*/ *Juniperus squamata*/ growth habit
Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate or convergent. All plants were also evaluated for growth characteristics of

open or closed outline.

18. Dar, G. H. and Christensen, K. I. Gymnosperms of the Western Himalaya. 1. The genus *Juniperus* (*Cupressaceae*). Pakistan Journal of Botany. 2003; 35(3):283-311.
Keywords: *Juniperus communis*/ *Juniperus squamata* / *Juniperus recurva*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus wallichiana*/ *Juniperus pseudosabina*/ Himalaya
Abstract: A thorough study of an extensive collection of herbarium specimens and literature of *Juniperus* (*Cupressaceae*) from the Western Himalaya, during our work on gymnosperms of this region, has revealed that the taxonomy of West Himalayan Junipers has been confusing. A total of up to 6 taxa have been reported from this region by various earlier workers under a large number of specific and infraspecific names, most of which are synonyms. Seven taxa are recognized from the Western Himalaya in the present study: one belonging to *Juniperus* Sect. *Juniperus*, *J. communis* var. *saxatilis*, and the other six to *Juniperus* Sect. *Sabina*. The latter section includes two acicular-leaved species, *J. squamata* and *J. recurva*, and four scale-leaved species: two multiseed, *J. semiglobosa* and *J. polycarpus*, and two monoseed, *J. wallichiana* and *J. pseudosabina*.
19. Dearnley, T. C. and Duckett, J. G. Juniper in the Lake District National Park. A review of condition and regeneration. Watsonia. 1998; 22(3):261-267.
Keywords: *Juniperus communis*/ England/ natural regeneration/ plant competition/ seeds/ artificial regeneration
Abstract: *Juniperus communis* is a native British species of evergreen dioecious conifer, threatened by extensive grazing, competing tree species and lack of sites to colonize. This study assesses the present status of juniper in the Lake District, northern England. Ten large stands (>1000 bushes) recorded as in good condition in 1975 were compared with five smaller stands (<1000 bushes), and a reference stand protected from grazing for 70 years. Recorded values of the number of berries produced by large stands and seed viability of these berries were combined as a seed viability index. Analysis showed that the seed viability indices of large stands were significantly higher than the small stand values, but significantly lower than the reference stand. These results suggest low reproductive potential may be indicative of a senescing population, and that grazing pressure is limiting reproduction. The absence of regeneration is attributed to stands becoming substantially moribund at a similar time without replacement. Seedling propagation and planting in fenced areas is suggested as the best strategy for juniper conservation.
20. Dodd R. S. and Poveda M. M. Environmental gradients and population divergence contribute to variation in cuticular wax composition in *Juniperus communis*. Biochemical Systematics and Ecology. 2003; 31(11):1257-1270.

Keywords: *Juniperus communis*/ Pyrenees/ wax composition/ cuticular lipids

Abstract: The alkane fraction of cuticular lipids was analyzed in populations of *Juniperus communis* var. *saxatilis* and var. *montana* from the Pyrenees, the Alps, Corsica and California. The New World and Old World populations showed highly divergent alkane chain length distributions that were not correlated with climatic variables, suggesting a strong phylogeographic pattern to this holarctic species. Within Europe, the Corsican populations formed a distinct clade, but there was no consistent separation of populations from the Alps and from the Pyrenees. An elevational transect within the Pyrenees revealed a complex pattern for weighted mean alkane chain length (N) which was greatest at both low and at high elevations. Dispersion about this mean (d) showed a linear increase with elevation. A matrix of distances based on alkane composition for the Pyrenees populations was correlated with a distance matrix of temperature and an aridity index. Greater weighted mean alkane chain length at low and at high elevations was possibly a result of adaptation to minimize cuticular permeability due to high summer temperatures at low elevation and freezing causing physiological drought at high elevations. It seems probable that environment interactions determining selection forces, together with direct environmental effects may lead to the complex patterns of N and d observed over this elevational transect.

21. Duhoux, E. The division of the reproductive cell and the release of its products in the pollen tubes of *Juniperus communis* and *Cupressus arizonica*. *Revue Generale De Botanique*. 1974; 81(962/963/964):193-204.
Keywords: *Juniperus communis*/ *Cupressus arizonica*/ reproduction/ pollen tubes
22. Duhoux, E. Structural growth of the wall of the pollen grain of *Juniperus communis* (Cupressaceae), grown in vitro, during the hydration phase. [II] Formation of the cell wall of the pollen tube during germination of pollen in *Juniperus communis* grown in vitro. *Comptes Rendus Des Seances Hebdomadaires De L' Academie Des Sciences, France, D.* 1972; 274(20,24):2767-2770; 3238-3241.
Keywords: *Juniperus communis*/ pollen/ physiology/ conifers
23. Duhoux, E. and Norreel, B. The isolation of callus tissue from pollen from male cones of *Juniperus chinensis*, *J. communis* and *Cupressus arizonica* cultured in vitro. *Comptes Rendus Hebdomadaires Des Seances De L' Academie Des Sciences, France, D.* 1974; 279(8):651-654 .
Keywords: *Juniperus chinensis*/ *Juniperus communis*/ *Cupressus arizonica*/ pollen/ parthenogenesis/ male cones/ callus
Abstract: Male parthenogenesis has hitherto been achieved in only ca. 15 angiosperms, none of them tree species. The authors report the successful laboratory culture of abnormal callus tissue derived from pollen grains of *Juniperus chinensis*, *J. communis* and *Cupressus arizonica*. Attempts will

be made to raise haploid male parthenogenetic plants of these species from such tissue.

24. Falke, B. The problem of missing seedling regeneration of juniper in north-west Germany: assessing the impact of seed predating insect and mite species. Die Verjüngungsproblematik des Wacholders in Nordwestdeutschland: Welchen Einfluss haben spezialisierte Samenpradatoren? Mitteilungen Der Deutschen Gesellschaft Fur Allgemeine Und Angewandte Entomologie. 2004; 14(1-6):49-52.
Keywords: *Juniperus communis*/ Germany/ plant pests/ seed abortion/ viability/ seedlings
Abstract: For approximately four decades already, populations of juniper (*Juniperus communis*) have been showing a lack of seedling regeneration in the western parts of Lower Saxony, Germany. The causes of this are as yet unclear. The aim of this study was to analyze predisersal seed predation. The variation of seed production, viability, abortion and predation was investigated for 6 populations without seedling regeneration in Emsland and 7 sexual reproducing populations in Luneburger Heide. Three species, which attack seeds and cones of juniper, were found in both regions: *Trisetacus quadrisetus* (Acari, Nalepellidae), *Megastigmus bipunctatus* (Hymenoptera, Torymidae) and *Argyresthia praecocella* (Lepidoptera, Yponomeutidae). Compared to sound cones, pest attack significantly decreased the mean number of filled seeds per cone in damaged ones. Between both regions, only minor differences concerning seed predation rates, seed viability and abortion could be detected. Therefore, seed predation is a limiting factor for the potential of natural regeneration, but cannot be considered to be the decisive cause for the lack of natural regeneration in Emsland.
25. Fitter, A H and Jennings, R D. The effects of sheep grazing on the growth and survival of seedling Junipers (*Juniperus communis* L.). Journal of Applied Ecology. 1975; 12(2):637-642.
Keywords: *Juniperus communis*/ browse/ conifers/ forage/ sheep
Abstract: Reports the effects of seasonal grazing by sheep on young *Juniperus communis* for seven years from 1966 on IBP grazing plots at Aston Rowant national nature reserve, Oxfordshire. Grazing in autumn and winter increased mortality and stunted the plants; summer grazing was apparently beneficial. Mortality on ungrazed plots was similar to that on plots grazed in autumn and winter, but the causes were different. Losses on ungrazed plots ceased after five years. The implications for conservation of *J. communis* are discussed
26. Froment, A. The juniper heath of Cour at Stoumont Ardennes Belgium and its interest for nature conservation . Bulletin De La Societe Royale De Botanique De Belgique. 1984; 117(1):122-134.
Keywords: *Juniperus communis*/ heath/ Belgium/ regeneration

Abstract: An interesting site of dry heath (Calluno-Vaccinietum vitis-idaeae with *Juniperus communis* is described from the Hautes Fagnes in eastern Belgium. A vegetation map is presented and the demographic characteristics of the juniper population are analyzed. Due to the absence of juniper regeneration, measures of conservation must be considered.

27. Garanovich, I. M. and Antonova, E. V. Features of propagating junipers by cuttings. *Lesnoe Khozyaistvo*. 1997; 239-40.
Keywords: *Juniperus communis*/ *Juniperus rigida*/ *Juniperus sabina*/ *Juniperus virginiana*/ vegetative propagation/ shoot cuttings/ rooting.
Abstract: Cuttings of junipers (including *Juniperus communis*, *J. rigida*, *J. sabina*, *J. virginiana*) were rooted in various substrates under mist, with the use of various growth regulators. Data are presented on rooting success and the development of the cuttings. The best substrate was a peat/sand mixture (1:1).
28. Garcia, D.; Gomez, J. M.; Zamora, R., and Hodar, J. A. Do empty *Juniperus communis* seeds defend filled seeds against predation by *Apodemus sylvaticus*? *Ecoscience* . 2000; 7(2):214-221; ISSN: 0028-0798.
Keywords: *Juniperus communis*/ *Apodemus sylvaticus*/ rodents/ seed predation/ seed quality/ cones/ predators/ wild animals/ seed production/ reproductive behaviour/ forest pests/ defense mechanisms/ mountain
Abstract: *Juniperus communis*, a dominant plant in the high mountains of SE Spain, produces a high proportion of empty seeds within well-developed cones. The hypothesis was tested that the production of empty seeds by the juniper reduces seed predation by the woodmouse *Apodemus sylvaticus*, thereby benefiting the plant. Laboratory and field experiments were performed to determine (i) woodmouse discrimination ability between filled and empty seeds, and (ii) woodmouse response to changes in the proportion of empty versus filled seeds and in the seed density in seed clusters. In addition, estimates were made, for 6 juniper populations over 3 years, of whether plants or populations showing a higher proportion of empty seeds suffered reduced woodmouse predation. Experiments showed that woodmice can eventually discriminate externally between filled and empty seeds, but in most cases had to bite the seeds to identify and reject empty ones. The probability of predation for filled seeds was independent of changes in the proportion of empty versus filled seeds and in seed density per cluster. Seed predation suffered by plants in the field was unrelated to the proportion of empty seeds per plant for all populations and years. The presence of empty seeds did not benefit juniper against woodmouse predation, either in terms of individual reproductive output or in terms of offspring escape probability. The study suggests that the effect of empty seeds on seed predation should be rare in plant-seed predator interactions where predators are polyphagous and eventually able to discriminate against empty seeds, and therefore suffer a

low cost when coping with empty seeds.

29. Garcia, D. and Zamora, R. Persistence, multiple demographic strategies and conservation in long-lived Mediterranean plants. *Journal of Vegetation Science*. 2003; 14(6):921-926.
Keywords: *Juniperus communis*/ *Pinguicula vallisneriifolia*/ Mediterranean/ conservation
Abstract: Persistence by longevity has been rarely considered as an alternative to regeneration by seeding for plants showing multiple demographic strategies. We propose a conceptual model of multiple demographic strategies for long-lived plants in stable habitats, shifting from regeneration by seeding to persistence by longevity and/or vegetative reproduction, along gradients of abiotic stress or interspecific competition. Regeneration by seeding would be promoted under low abiotic stress or under low competition, whereas persistence by longevity and/or vegetative reproduction would predominate at high levels of abiotic stress or competition. We test this model with two threatened species of the Mediterranean region, the shrub *Juniperus communis*, a widely distributed species which maintains relict populations in the Mediterranean mountains thanks to great adult longevity and *Pinguicula vallisneriifolia*, a palaeo-endemic herb relying on a perennial habit and vegetative reproduction under drought imposed stress or high competition at late successional phases. As a consequence, multiple demographic strategies enhance a plant's ability to exploit environmental heterogeneity at different spatial (patches, localities, regions within the species' distribution area) and temporal (individual life span, glacial-interglacial cycles) scales. The potential of multiple demographic dynamics based on persistence and regeneration must be considered as a major ecological trait determining the long-term viability of peripheral populations of relict species as well as the inertia against extinction of many threatened endemisms, thereby contributing to the maintenance of the high plant diversity characterizing the Mediterranean region.
30. Garcia, D.; Zamora, R.; Gomez, J. M., and Hodar, J. A. Annual variability in reproduction of *Juniperus communis* L. in a Mediterranean mountain: relationship to seed predation and weather. *Ecoscience*. 2002; 9(2):251-255; ISSN: 0028-0798.
Keywords: *Juniperus communis*/ mountain areas/ pollination/ reproduction/ seed abortion/ seed dispersal/ seed predation/ seed set/ seeds/ temporal variation/ weather
Abstract: The interannual patterns of reproductive output were analyzed for a population of *Juniperus communis* in the Mediterranean mountains of southern Spain. Cone production, number of seeds per cone, predispersal seed predation, seed abortion, and final seed set were studied for six consecutive years (1992 -97). Interannual variation in reproduction was assessed in relation to weather conditions during pollination and cone

development. All the reproductive components varied strongly among years. Ripe cone production correlated positively to seed set and seed predation but was independent of the percentages of empty and filled seeds. The percentage of empty seeds positively correlated to precipitation during the month of pollination. Interannual patterns in reproductive output proved inconsistent with the predator satiation hypothesis. Mediterranean mountain weather affected juniper reproduction at a local scale, acting in a narrow range of variation, since seed emptiness is governed primarily by factors acting at a broader geographical scale..

31. ---. Bird rejection of unhealthy fruits reinforces the mutualism between juniper and its avian dispersers. *Oikos*. 1999; 85(3):536-544.
Keywords: *Juniperus communis* / seed dispersal/ mountain forests/ seed predation/ damage
Abstract: Fruit damage by insects as well as fruit abortion were investigated in relation to the mutualism between *Juniperus communis*, a fleshy-fruited plant dominant in the high mountains of SE Spain, and its bird disperser assemblage. For 2 yr field experiments were carried out analyzing fruit selection by birds, offering birds different types of anomalous fruits (unripe, aborted, pulp-sucker infested and seed-predator attacked) and comparing the removal rate to that of ripe, healthy, control fruits. In addition, the proportion of fruits attacked by the seed predator was examined in samples of fruits which, after manipulation and rejection by birds, were found lying underneath plants. These data were compared with values in samples of fruits taken directly from plants. Finally, over 4 yr, the abundance of predispersal-depredated seeds in the seed rain dispersed by birds was compared with the abundance in seeds taken directly from plants. Fruit-choice experiments showed that unripe, aborted and fruits attacked by pest insects (both pulp sucker and seed predator) were strongly counterselected by these frugivorous birds. The proportion of fruits attacked by seed predators in the sample of fruits manipulated and rejected was significantly higher than in the fruits taken from plants. For all study years, the proportion of depredated seeds was significantly lower in the sample of seeds dispersed by birds than in the sample of seeds taken from plants. Bird response to pests was not categorically to accept or reject fruit, but rather was influenced by pest density. Birds showed two levels of fruit selection, depending on the type of fruit: visual discrimination, against fruits that are unripe, aborted and infested by the pulp sucker; and within-beak discrimination, against fruits attacked by the seed predator. In the study, both pests either died or left the fruit when ripe, and therefore frugivorous birds did not interfere directly with frugivorous insects. On the contrary, insects did interfere indirectly with birds, by promoting the rejection of pest-attacked fruits by birds. Bird dispersers overcame the predispersal interference of pest fruit damage and fruit abortion and increased the proportion of healthy seeds in the seed rain. This fact, together with the great quantity of seeds dispersed by birds, reinforces the importance of birds as plant mutualists.

32. ---. Frugivory at *Juniperus communis* depends more on population characteristics than on individual attributes. *Journal of Ecology* Oxford. 2001; 89(4):639-647.
Keywords: *Juniperus communis*/ *Turdus*/ *Apodemus*/ frugivores
Abstract: We investigated the spatio-temporal variation in the interaction between the juniper *Juniperus communis* and its vertebrate frugivores (avian dispersers *Turdus torquatus* and *Turdus viscivorus*, and predatory rodent *Apodemus sylvaticus*) in the Mediterranean mountains of southeast Spain. Frugivore activity was evaluated at six sites and for 3 years (1994-96), in relation to both plant reproductive traits (plant size, cone crop and cone size) and characteristics of the immediate environment (distance to the nearest female, abundance of perches, fruiting environment and habitat). Plant characteristics and levels of frugivory varied strongly among the six populations. Cone production, cone size and frugivory also differed significantly among years for the same population. Avian frugivory was only occasionally affected by density of cones per plant, abundance of perches or abundance of other fruiting species, or by habitat. Rodent predation was positively related only to the density of cones per plant and then only in two sites. Levels of both avian frugivory and rodent predation significantly increased in populations with higher cone production. Both groups of vertebrate frugivores responded to the spatio-temporal variation in cone abundance at a regional scale, discriminating more between juniper populations than between individual plants within a population. The outcome of interactions with frugivores at the individual plant level thus proved more dependent on the whole-population characteristics than on individual attributes.
33. Garcia, D; Zamora, R; Gomez, J M; Jordano, P, and Hodar, J A. Geographical variation in seed production, predation and abortion in *Juniperus communis* throughout its range in Europe. *Journal of Ecology* Oxford. 2000; 88(3):436-446; ISSN: 0022-0477.
Keywords: *Juniperus communis*/ seed production/ drought/ geographical variation/ latitude/ natural regeneration/ seed predation/ seeds/ geographical distribution/ seed germination/ seed abortion/ shrubs/ phytogeography
Abstract: The geographical variation of seed production, predation and abortion was analyzed in *Juniperus communis* for 31 populations in seven distinct regions throughout the species' distribution range in Europe, including both the northern and southern boundaries. The number of seeds per cone and the number of filled seeds per cone varied significantly between geographical regions and among populations within regions. Populations from the Mediterranean mountains (south-east Spain) showed the highest values in the number of seeds per cone but the lowest values in the number of filled seeds per cone. Losses due to predispersal seed predation varied significantly among populations within a region but not between regions, suggesting that predation incidence depends on local-scale

factors. Seed abortion rates were higher in southern Iberian populations than in the other regions, and varied significantly among populations and regions. As a result of predation and abortion, seed production was lowest in the Iberian regions. Seed abortion showed a significant quadratic relationship with latitude, with higher values of abortion at either end of the gradient, but particularly at the southern limit. The production of filled seeds declined gradually towards both northern and southern distribution limits. In the Mediterranean mountains (southern limit), low seed production coincided with a marked limitation placed upon natural regeneration by summer drought, leading to a demographic bottleneck in populations. Although seed abortion levels were relatively high in the subarctic tundra (northern limit) populations, they were free from predispersal seed predators, suggesting that population viability here may be under less pressure.

34. Garcia, Daniel. Effects of seed dispersal on *Juniperus communis* recruitment on a Mediterranean mountain. *Journal of Vegetation Science*. 2001 Dec; 12(6):839-848.
Keywords: *Juniperus communis*/ seed / seedling/ Mediterranean
Abstract: The recruitment of the relict shrub *Juniperus communis* on a mountain in SE Spain was studied during the period 1994-1998. The main objective was to determine both the quantitative and qualitative effects of bird dispersal on seedling establishment. Seed removal by birds, seed rain, post-dispersal seed predation, germination, and seedling emergence and survival were analyzed in different microhabitats. Birds removed 53 - 89% of the seeds produced by plants. Seed rain was spatially irregular as most seeds accumulated near stones used by birds as perches and below mother plants while a few seeds were dropped in wet meadows and open ground areas. Post-dispersal seed predation by rodents affected < 10% of dispersed seeds but varied significantly among microhabitats. Only 3.6 - 5.5% of dispersed seeds appeared viable, as many seeds had aborted or showed wasp damage. Seeds germinated in the second and third springs after sowing, reaching a germination percentage of 36%. Seedling emergence was concentrated in wet meadows. Seedling mortality was high (75 - 80%), but significantly lower in wet meadows, the only microhabitat where seedlings could escape from summer drought, the main mortality cause. Seed abortion, germination and seedling mortality proved to be the main regeneration constraints of *J. communis* on Mediterranean mountains. Birds exerted a strong demographic effect, although their qualitative effect was limited by abiotic factors which caused the pattern of seed rain to differ from the final pattern of recruitment between microhabitats.
35. ---. Interaction between juniper *Juniperus communis* L. and its fruit pest insects: Pest abundance, fruit characteristics and seed viability. *Acta Oecologica*. 1998 Nov-1998 Dec 31; 19(6):517-525.

Keywords: *Juniperus communis*/ Spain/ fruit pests/ fruit/ seed

Abstract: The relationships between the fruit features of *Juniperus communis* and the presence of fruit pests were studied in Sierra Nevada, SE Spain. The abundance of two insect species - a pulp-sucking scale and a seed-predator wasp - was surveyed with respect both to fruit characteristics and to viability of seeds contained therein. Seed-predator pressure was not significantly related to any fruit characteristics; however, pulp suckers tended to be more abundant in plants with low pulp:seed ratios and high fruit-water content. In addition, fruits with high levels of pulp-sucker attack tended to have higher water content. A multi-factor ANOVA, considering the identity of the plant and the attack of the different pests as factors, showed that plant identity accounts for most of the variation in fruit characteristics. The viability of seeds tended to be lower in plants strongly attacked by both pests. Fruits attacked by seed predators showed significantly lower proportions of viable and unviable seeds than did unattacked fruits. Seed viability was also lower in those fruits heavily attacked by pulp suckers, but this pattern is strongly mediated by plant identity. Pest activity proved to be clearly associated with a direct decrease in juniper reproductive capacity. This loss involved a reduction of the viable-seed number, mainly related to the seed predator, as well as a reduction of fruit attractiveness to frugivorous dispersers, related to the pulp sucker.

36. Garcia, Daniel; Zamora, Regino; Hodar, Jose A., and Gomez, Jose M. Age structure of *Juniperus communis* L. in the Iberian Peninsula: Conservation of remnant populations in Mediterranean mountains. *Biological Conservation*. 1999 Feb; 87(2):215-220.

Keywords: *Juniperus communis*/ Spain/ viability/ populations

Abstract: We examined the demographic structure of *Juniperus communis* L. populations in the Mediterranean high mountains of southern Spain in order to analyze its population viability. For this, we compared the age structure of these Mediterranean populations with those of northern Spain (Atlantic), and, on a local scale, the populations of different habitats within the Sierra Nevada. The populations from northern Spain showed age structures with high proportions at young stages. In contrast, the Mediterranean populations proved to be dominated by adult and senescent individuals, except for the few habitats with higher water availability during the summer, which have larger proportions of seedlings and juveniles. Dry habitats showed a lower seedling survival rate than did wet ones, mainly due to summer drought. Both the difference between Atlantic and Mediterranean categories, and the difference between habitats in Sierra Nevada reflect a serious limitation on recruitment of *J. communis* in Mediterranean mountains due to climatic stress imposed by summer drought. The Mediterranean populations provide a clear example of remnant dynamics, surviving for long periods due to great individual longevity which partially offsets losses to unfavorable environmental conditions. The low ability to recover after

anthropic disturbances emphasizes the need for conservation of *J. communis* populations in southeastern Spain.

37. Gilbert, O. L. Juniper in Upper Teesdale. *Journal of Ecology*. 1980; 68(3):1013-1024.
Keywords: *Juniperus communis*/ England/ autecology/ natural regeneration/ nature conservation
Abstract: The distribution and ecology of *Juniperus communis* in the Upper Teesdale National Nature Reserve in NE England are described. Methods are discussed for improving regeneration, which is poor, probably due to heavy grazing.
38. Gotz, V. Tending the juniper heaths on the Munsingen Alb. *Pflege von Wacholderheiden auf der Munsinger Alb. Mitteilungen Des Vereins Fur Forstliche Standortskunde Und Forstpflanzenzuchtung, German Federal Republic*. (27). 1979. 1979; 49-54.
Keywords: *Juniperus communis*/ plant succession/ nature conservation.
Abstract: The history of these *Juniperus communis* heaths in the Swabian Alb region (S. Baden-Wurtemberg) is described, with particular reference to the role of sheep grazing. If grazing ceases, two kinds of succession may occur: reversion to the former original beech forest (if sufficient beech seed trees are present), or semi-spontaneous succession via juniper to heath forest of Scots pine and Norway spruce. Practical measures to preserve at least some of these juniper heaths against succession to forest are outlined.
39. Grigor'ev, V. P. and Poplavskaya, L. F. *Juniperus communis* and its phytocoenotic role in the forests of Byelorussia. *Lesovedenie*. 1987; 478-81.
Keywords: *Juniperus communis*/ Byelorussia/ phytocoenotic role/ distribution/ forests
Abstract: Details are given of the distribution of juniper in Belorussia, and on its age structure, incidence, mensurational characteristics and natural regeneration in various forest types, especially pine types.
40. Grigor'ev, V. P. and Poplavskaya, L. F. Reserves of *Juniperus communis* phytomass and the content of chlorophyll carotenoids and ascorbic-acid in its needles Belorussian SSR USSR. *Rastitel'Nye Resursy*. 1985; 21(2):164-168.
Keywords: *Juniperus communis*/ phytomass/ chlorophyll/ Belorussian
Abstract: Phytomass reserves and the contents of N, mineral elements, chlorophyll, carotenoids and ascorbic acid were determined in *J. communis* in 1974-1983. *J. communis* is widespread in pine forests of the Belorussian SSR. The density of its reserves is small, .apprx. 1.8 tons/ha; 50-70% are trunks and branches. Measures are recommended for efficient utilization and protection of *J. communis* in the Belorussian SSR.
41. Gross, K. A. and Ezerietis, E. Juniper wood as a possible implant material.

Journal of Biomedical Materials Research Part A. 2003; 64(4):672-683.

Keywords: *Juniperus communis*/ wood/ implant material

Abstract: Natural materials, such as wood and bone, possess structures fulfilling the requirements of support and transport of nutrients. Similarity in function and properties provides inspiration for investigating the possible use of wood as an implant material. *Juniperus communis* wood is dense, durable, and strong and has naturally impregnated essential oils that display antiseptic properties. This study investigated the toxicity of the oil, the effect of sterilization on the mechanical properties of the wood, and bone attachment with animal studies. The possible toxicity of the oil was determined orally and by intravenous injection. At low concentrations, the dose that would be released by the wood in the body could be tolerated without any detrimental effects. Sterilization of the wood in boiling water lowered the elastic modulus and modulus of rupture to a level at which the elastic modulus could be better matched to bone. Wood shaped into the form of femoral implants were implanted into rabbits and displayed good acceptance by the body up to a period of 3 years, indicating bone apposition, abutment into pores, and growth into drilled cavities.

42. Grubb, P. J.; Lee, W. G.; Kollmann, J., and Wilson, J. B. Interaction of irradiance and soil nutrient supply on growth of seedlings of ten European tall-shrub species and *Fagus sylvatica*. Journal of Ecology. 1996; 84(6):827-840.
- Keywords:** *Juniperus communis*/ *Crataegus*/ *Fagus*/ *Rosa*/ *Rhamnus*/ *Viburnum*/ *Cornus*/ *Prunus*/ growth/ seedlings/ irradiance/ soil nutrient supply
- Abstract:** Seedlings were grown at 0.3, 1.6, 11, and 63% daylight for 110 days on chalk grassland soil, and on a more nutrient-rich soil developed under hawthorn *Crataegus monogyna*. *Crataegus*, beech *Fagus*, juniper *Juniperus communis*, dogwood *Cornus sanguinea*, privet *Ligustrum vulgare* and dog rose *Rosa canina* suffered high mortality in 0.3% daylight, but only the first three had losses in 1.6%. Overall mortality in deep shade (0.3, 1.6%) was considerably lower in spindle *Euonymus europaeus*, buckthorn *Rhamnus catharticus*, wayfaring tree *Viburnum lantana* and guelder rose *V. opulus*. Average mortality in deep shade on grassland soil was negatively correlated with embryo-cum-endosperm dry mass (EEM). Overall mortality in deep shade was significantly greater with higher nutrient supply. In 63% daylight relative growth rate (RGR) was negatively correlated with log EEM, and positively with specific leaf area at time of planting but not at final harvest, ie differences in RGR were determined more by unit leaf rate (rate of dry mass gain/leaf area) in the latter part of the experiment. *Cornus*, *Ligustrum*, blackthorn *Prunus spinosa*, *Rhamnus*, and *Rosa* increased yield strongly under high irradiance on nutrient-poor soil, and responded also markedly to nutrients. *Viburnum lantana* and *Euonymus* grew relatively slowly in all treatments, but the former was responsive to nutrients, even in deep shade. *Viburnum opulus* was more responsive to irradiance but

responded to nutrients only in 11% daylight. *Crataegus* grew more slowly on its 'own' soil than on grassland soil. *Juniperus* grew slowly, and responding strongly to irradiance. *Fagus* responded moderately to irradiance and not to nutrient supply.

43. Grzesik, M and Joustra, M. Effects of gibberillic acid and different levels of nitrogen and potassium on the growth of *Juniperus communis* 'Suecica'. *Folia-Horticulturae*. 1991; 3(1):61-66.
Keywords: *Juniperus communis*/ gibberillic acid/ nitrogen/ potassium
Abstract: Two-year-old plants of *J. communis* cv. Suecica were grown in a sphagnum peat medium in 14-cm-diameter containers. They received a weekly application of 50 ml nutrient solution/container from 12 May to the end of Aug. Four N:P:K ratios were compared as follows: 3:1:3, 4.5:1:3, 6:1:3 and 4.5:1:4.5. In addition, GA₃ was applied at 400 p.p.m. when growth began or when new shoots were 7 cm long; controls were not sprayed. Plant growth was assessed monthly from May to Oct. and the nutrient status of the substrate was determined in mid-Aug. GA₃ treatment, particularly the later application, resulted in taller plants and longer shoots; treated plants also assimilated more macroelements than the controls. Increasing the N and K dosage slightly improved unsprayed controls but had no effect on the growth of GA₃-treated plants.
44. Grzesik, M and Joustra, M K. Effect of GA₃ concentration and time of application on the growth of *Juniperus communis* 'Suecica' in the greenhouse and outdoors. *Gartenbauwissenschaft* . 1990; 55(6):272-275.
Keywords: *Juniperus communis*/ gibberillic acid/ growth/ greenhouse/ height
Abstract: An experiment was carried out to ascertain how the growth of *J. communis* cv. Suecica is affected by GA₃ applied in different concentrations and at different times in spring. Plants were grown in the greenhouse and outdoors. They were treated with 400 or 800 mg GA₃/litre at 4 different stages of growth, ranging from 2 weeks before new growth started till when new apical shoots were 7 cm long. Plants treated indoors were placed outdoors at different times during spring and summer and their growth was recorded. Application of GA₃ increased plant height more when GA₃ was applied later in spring. When GA₃ was applied before growth started, 800 mg GA₃/litre resulted in taller plants than 400 mg/litre. When GA₃ was applied at later stages of growth, there was no effect of concentration of GA₃. GA₃ depressed branching and thus the plant diameter at all stages of growth. High temperatures depressed growth in the greenhouse. Forcing in the greenhouse increased the final maximum diameter of the untreated plants but not that of the treated plants.
45. Hessel, A. E.; Weisberg, P. J., and Baker, W. L. Spatial variability of radial growth in the forest-tundra ecotone of Rocky Mountain National Park, Colorado. *Bulletin of the Torrey Botanical Club*. 1996; 123(3):206-212.

Keywords: *Juniperus communis*/ *Vaccinium*/ Rocky Mountain National Park/ radial growth

Abstract: Radial growth in trees has often been used to measure the relationship between climate and tree growth. Variation in radial growth with respect to environmental variables may indicate how trees in diverse landscapes may respond to climate change. The purpose of this study is to determine whether radial growth is spatially heterogeneous throughout the forest-tundra ecotone of Rocky Mountain National Park and whether this spatial variability can be related to environmental variables.

Increment cores were taken from 5-10 of the largest trees in 59 sampling locations distributed across the forest-tundra ecotone of Rocky Mountain National Park. Mean annual ring width for 1978-1987 was measured in the laboratory. Stepwise weighted least squares linear regression was used to relate mean annual growth to 25 environmental variables measured at each sampling location. Mean radial growth is higher at sampling locations with higher soil pH values and where there is small rock material but varies with zone and associated shrub species. When all statistically significant variables are considered, radial growth is slowest in the krummholz zone, intermediate in the patch forest zone, and fastest in the closed forest zone. Within each zone, the presence of *Juniperus communis* indicates slow radial growth, *Vaccinium* spp. indicate intermediate radial growth, and *Salix* spp. indicate rapid radial growth. These results differ from previous studies of vertical seedling leader growth in the FTE, which found higher rates of growth in the krummholz zone. Differing rates of radial and vertical growth may reflect different settings or different responses, though both may indicate tree "success."

46. Hoeg, O. A. Juniper in nature and tradition in Norway. Eieren i Norsk natur og tradisjon. Norsk Skogbruksmuseums Saerpublikasjon. 1981; 5150 pp.
Keywords: *Juniperus communis*/ Norway/ distribution/ growth/ uses
Abstract: A monograph on *Juniperus communis* in Norway, covering distribution, habit, growth rate, uses, and associated customs and folklore. The main part of the study deals with the numerous and varied traditional and historical uses of the wood, branches, foliage, bark, and berries.
47. Houle, G. and Duchesne, M. The spatial pattern of a *Juniperus communis* var. *depressa* population on a continental dune in subarctic Quebec, Canada. Canadian Journal of Forest Research. 1999; 29(4):446-450.
Keywords: *Juniperus communis*/ dune/ Canada/ Ontario/ spatial pattern
Abstract: We performed a nearest-neighbor analysis to determine the population dispersion pattern and the association between males and females in a *Juniperus communis* L. var. *depressa* Pursh population occupying a continental dune in subarctic Quebec, Canada. The overall dispersion pattern was contagious, and males (or females) were proportionately as likely to have a male as they were to have a female

nearest neighbor. Crown size was positively related to nearest-neighbor distance for the male-male comparison only, suggesting a somewhat stronger intrasex competition between males. Nearest-neighbor distance increased with crown size (significantly related to age) suggesting a change in the intensity of aggregation with age possibly related to self-thinning. Higher mortality as a result of stronger male-male competition could explain the female-biased sex ratio and the absence of spatial segregation between sexes. The overall contagious dispersion pattern in the population may be related to the fact that most seed cones fall directly underneath the mother plant. Birds can eat the cones of *J. communis* and thus disperse seeds. However, these seeds are deposited in clumps, a process that may also explain contagion within the population.

48. Huppe, J. The problem of juniper (*Juniperus communis*) regeneration influenced by wild rabbits in pastoral areas of the Pleistocene sandy landscapes.
Zur Problematik der Verjüngung des Wacholders (*Juniperus communis*) unter dem Einfluss von Wildkaninchen in Hudegebieten pleistozaner Sandlandschaften. Zeitschrift Für Ökologie Und Naturschutz. 1995; 4(1):1-8.
Keywords: *Juniperus communis*/ *Oryctolagus cuniculus*/ Germany/ regeneration/ feeding/ fencing
Abstract: The present contribution deals with the problem of juniper regeneration being suppressed by the feeding habits of rabbits *Oryctolagus cuniculus* in heathlands of E Westphalia, Germany. Consisting of a disproportionately high number of old individuals, the juniper shrub formations hardly tolerate the feeding pressure exerted by the rabbit populations. This poses a real problem of protection of the species. As a solution, the planting out of young plants cultivated from autochthonous seed material and full protection of the individual plant by appropriate fences is recommended. These fences should have a minimum height of 1.2m above ground and 0.5m below ground to exclude rabbits.
49. ---. Problems of the regeneration of juniper (*Juniperus communis*) under the influence of wild rabbits in heathlands on Pleistocene sands.
Zur Problematik der Verjüngung des Wacholders (*Juniperus communis*) unter dem Einfluss von Wildkaninchen in Hudegebieten pleistozaner Sandlandschaften. Zeitschrift Für Ökologie Und Naturschutz. 1995; 4(1):1-8.
Keywords: *Juniperus communis*/ Germany/ regeneration/ rabbits/ seedlings/ girdling/ seeds
Abstract: An account is given of the problems in the regeneration of *Juniperus communis* in the heathlands of N. Germany. Damage by rabbits is identified as the main difficulty, and the rabbits not only destroy seedlings and young plants, but also harm larger junipers by girdling branches and even stems. Juniper regeneration is virtually impossible in areas where rabbit populations are high. The only possibility is to raise

plants from native seed, and plant out with individual protective fencing which must be at least 1.2 m above the ground and at least 0.5 m below ground.

50. Iqbal, S H and Shahbaz Nasim, G. State of mycorrhizae in some ornamental gymnospermous tree species of Pakistan. *Pakistan Journal of Forestry*. 1990; 40(3):237-246.
Keywords: *Juniperus communis*/ mycorrhizae/ Pakistan/ *Abies*/ *Cupressus*/ *Pinus*/ *Podocarpus* / *Taxodium*/ *Auracaria*/ *Cycas*/ *Ephedra*/ *Zamia*
Abstract: Multiple mycorrhizal infections were found in association with root systems scale leaves, decaying micro sporophylls and epidermal tissues of *Abies pindrow*, *Auracaria cunninghamii*, *Cycas circinalis*, *C. revoluta*, *Cupressus torulosa*, *Ephedra gerardiana*, *E. regeliana*, *Juniperus communis*, *Pinus helepensis*, *P. roxburghii*, *Podocarpus chinensis*, *Taxodium mucronatum*, *Thuja orientalis* and *Zamia floridana*. Endomycorrhizae were prevalent in species of most families including *Pinaceae* which normally forms the ectomycorrhiza. Fungal hyphae colonized the young roots and formed coils, arbuscules and vesicles inside the cortical cells. Coiled and linear hyphae were very common, digestion stages were observed. Extramatrical mycelium was also found. Some endophytes other than VA, with septate, hyaline or colored mycelium were found penetrating into the root. A mixture of endogonaceous spores formed the rhizosphere mycoflora.
51. Jain, K. K. A taxonomic revision of the Himalayan Junipers. *Indian Forester*. 1976; 102(2):109-188.
Keywords: *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ *Juniperus communis*/ *Juniperus pseudosabina*/ taxonomy/ Himalayas
Abstract: Discusses the taxonomy of *Juniperus* in the Himalayas. On the basis of morphological and anatomical studies (including studies of wood anatomy) eight taxa were identified. Of the species that are trees, *J. wallichiana*, *J. recurva* and *J. fargesii* [*J. squamata* var. *fargesii*] are restricted to the eastern Himalayas and *J. macropoda* and *J. excelsa* to the western Himalayas. Of the shrubs, *J. communis* subsp. *nana* occurs only in the western Himalayas, but *J. pseudosabina* and *J. squamata* occur throughout the area. Each species is briefly described.
52. Jordano, P. Geographical ecology and variation of plant-seed disperser interactions: southern Spanish junipers and frugivorous thrushes. *Vegetatio*. 1993; 107-10885-104; ISSN: 0042-3106.
Keywords: *Juniperus communis*/ birds/ *Juniperus phoenicea*/ *Juniperus sabina*/ *Turdus merula*/ *Turdus pilaris*/ seed dispersal/ seeds/ Wildlife
Abstract: Results are presented from a study of interaction patterns between 6

species of strongly frugivorous thrushes (*Turdus iliacus*, *T. merula*, *T. viscivorus*, *T. philomelos*, *T. pilaris*, *T. torquatus*) and their major winter food plants (*Juniperus communis*, *J. phoenicea*, *J. sabina*) in 1985-89 at 6 localities in the highlands of southern Spain. Data are presented on feeding

records of thrushes on juniper and other fruits, geographical variation in local thrush/juniper assemblages on regional and local scales, temporal variation in local assemblages, and mutual congruency of distribution patterns and interaction strengths. In the context of seed dispersal, it is concluded that the strong uncoupling of biogeographical attributes of plants and frugivores makes taxon-specific coevolved interactions unlikely, and restricts interactions between two species to particular subsets of their respective populations with extremely variable outcomes in space and time.

53. Kalapos, T. and Mazsa, K. Juniper shade enables terricolous lichens and mosses to maintain high photochemical efficiency in a semiarid temperate sand grassland. *Photosynthetica*. 2001; 39(2):263-268.
Keywords: *Juniperus communis*/ *Festucetum*/ lichens/ mosses/ shade
Abstract: On a semiarid sand in Hungary, grassland (*Festucetum vaginatae*) colonized by juniper (*Juniperus communis*) shrubs terricolous lichens and mosses segregate strongly between microhabitats: certain species grow in the open grassland, others almost exclusively in the shade of junipers. The contrasting irradiances of these microhabitats influence much the metabolism of these organisms, and thus affect their small-scale distribution. This was confirmed by determining the efficiency of photochemical energy conversion by measuring chlorophyll a fluorescence parameters. In the open grassland maximum photochemical efficiency of photosystem 2 (PS₂, F_v/F_m) declined from the humid spring to the hot and dry summer in all species, and this was caused by an increase in base fluorescence (F₀), but not by the decrease in fluorescence maximum (F_m). In summer, mosses and lichens growing in the open grassland generally possessed lower F_v/F_m than cryptogams growing in the shade cast by juniper shrubs. Thus mosses and lichens in the open grassland suffer lasting reduction in photochemical efficiency in summer, which is avoided in the shade of junipers. Juniper shrubs indeed influence the composition and small-scale spatial pattern of sympatric terricolous lichen and moss communities by - among others - providing a shelter against high light in summer.
54. Kaushal, P. S. Studies in the Western Himalayan junipers: I. distribution pattern and taxonomic considerations. *Research Bulletin of the Panjab University, Science*. 1994; 44(1/4):53-62.
Keywords: *Juniperus communis*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ taxonomy/ India
Abstract: Five taxa of *Juniperus*, of which two with tree habit, are recorded from Western Himalaya in the States of Himachal Pradesh and

Jammu and Kashmir, India and are studied for their morphological variation and distribution. The genus is represented by two distinct tree species (*J. macropoda* and *J. excelsa*) and three with shrubby forms (*J. communis*, *J. squamata* and *J. pseudosabina*). Several variants are observed in the polymorphic *J. squamata*. *Juniperus communis* and *J. pseudosabina* are morphologically conservative. A putative hybrid, intermediate in characters between *J. squamata* and *J. pseudosabina*, has also been recorded.

55. Khantemirov, R. M.; Shiyatov, S. G., and Gorlanova, L. A. The dendroclimatic potential of *Juniperus sibirica*. . Lesovedenie. 1999; 633-38.
Keywords: *Juniperus sibirica*/ *Juniperus communis*/ Russia/ Picea/ Larix/ dendroclimate
Abstract: Discs were taken from the best developed branches of 26 of the oldest bushes of *Juniperus sibirica* [*Juniperus communis* var. *montana*] growing in sparse larch forests in the Polar Urals. Discs were also taken from dead branches found near the living juniper bushes. Analysis of the discs allowed a 636-year ring-width chronology to be produced, revealing the mean May/June/July temperature of the current year to be the main climatic factor affecting radial increment. Comparison of the juniper chronology with the chronologies for *Larix sibirica* and *Picea obovata* revealed similarities and differences between the bushes and the trees. Constructing a combined chronology based on juniper and larch provided a much more reliable reconstruction of mean June/July temperatures than a chronology based on larch alone.
56. Kishore, N.; Singh, S. K., and Dubbey, N. K. Fungitoxic activity of essential oil of *Juniperus communis*. Indian Perfumer. 1989; 33(1):25-29.
Keywords: *Juniperus communis*/ *Pythium aphanidermatum*/ essential oil/ germination/ seedling/ *Lycopersicum esculentum*
Abstract: The essential oil of *Juniperus communis* was tested for different antifungal properties against *Pythium aphanidermatum*. Its minimum concentration for absolute inhibition (MCAI) of the test fungus was found to be 1000 ppm. At MCAI the oil exhibited fungistatic nature but turned fungicidal at higher concentrations. It was found to exhibit narrow antifungal spectrum at lower concentration (1000 ppm) but broad range of activity at higher concentration (33 ppm). Further, at 1000 ppm it was nonphytotoxic to the germination and seedling growth of *Lycopersicum esculentum* - the host plant.
57. Klett, J E. Nitrogen nutrition of junipers. Combined Proceedings of the International Plant Propagators Society. 1977; 27377-382.
Keywords: *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus sabina*/ *Juniperus horizontalis*/ nitrogen/ nutrition/ ornamental plants/ ornamental conifers
Abstract: Five dwarf juniper cultivars (*Juniperus procumbens* cv. Nana, *J. chinensis* cv. Pfitzeriana, *J. communis* cv. Repanda, *J. sabina* cv.

Broadmoor and *J. horizontalis* cv. Wiltonii) responded differently when they were supplied with ammonium sulphate, ammonium nitrate or potassium nitrate each at 200 or 400 p.p.m., as N sources in the glasshouse and outdoors. At a given rate potassium nitrate caused more toxicity than the ammonium fertilizers. The cvs Repanda and Broadmoor, which showed the least dry weight increment, were the first to develop symptoms of N toxicity. Potassium nitrate had a greater effect than other compounds on nitrate concentrations in the tissue. Repanda had the highest nitrate concentration, whereas Wiltonii had the lowest and showed very little toxicity. Plants treated with potassium nitrate or ammonium nitrate suffered more winter damage than those treated with ammonium sulphate. Plants treated with nitrate N were the slowest to break dormancy.

58. Klett, J. E. Superior ground cover junipers for the Great Plains region. *American Nurseryman*. 1978; 147(11):9, 52-55, 58.
Keywords: *Juniperus sabina/ Juniperus horizontalis/ Juniperus communis/ Juniperus procumbens/* hardiness/ disease resistance/ Great Plains
Abstract: The characteristics are described of several prostrate junipers, evaluated from trials with about 70 cvs. *Juniperus sabina*, cvs Arcadia, Broadmoor and Skandia have been selected for their hardiness, distinctive green foliage and resistance to juniper blight. *J. horizontalis*, cvs Glauca (blue creeping juniper), Blue Rug (Wiltonii) and Plumosa (Andorra juniper); *J. communis* var. repanda (creeping common juniper) and *J. procumbens* var. nana (dwarf Japanese juniper) are also briefly described.
59. Knyazeva S. G. Sexual variability of *Juniperus communis*. *Lesovedenie*. 2004; 673-75.
Keywords: *Juniperus communis/* Siberia/ sexual variability/ population/ male/ female
Abstract: Studies were made on four populations of *J. communis* in Siberia. In all four populations, only diclinous (dioecious) trees were observed. At high altitudes the female trees had larger needles and greater annual increments than male trees. A similar though less pronounced trend was also observed in the plains populations. Only in the high-altitude populations did correlative differences exist between male and female plants: in female plants needle length and/or shoot increment was inversely correlated with cone size, whereas in male plants a direct correlation was observed.
60. Komendar, V. I. and Fodor, S. S. Study of the restoration of the upper forest limit in the Carpathians Ukrainian SSR USSR. *Tiscia* (Szeged). 1987; 2255-60.
Keywords: *Juniperus communis/* Carpathians/ restoration/ forest / *Sorbus/ Abies/ Pinus/ Acer/ Fagus/ Pseudotsuga/ Nardus/ Picea/ Larix/ Alnus*
Abstract: The results of a 30 yr, study on the methods of restoration of

the upper forest limit in the Carpathians are presented. Experiments were begun in 1959 on the southern slope of Polonina Rovnaya (1200-1400 m, above sea level), where the natural limit has dropped 150-200 m. Data on the variety of the species composition of tree species, cultivation methods and the planting hole method of planting seedlings, adaptability to extreme conditions, and the rate of the growth and growth increment of cultivated trees is presented. Recommendations for the restoration of the upper forest limit in mountains are made. Species studied include *Abies alba*, *Pinus cembra*, *Juniperus communis*, *Sorbus aucuparia*, *Acer pseudo-platanus*, *Fagus sylvatica*, *Pseudotsuga taxifolia*, *Nardus stricta*, *Picea schrenkiana*, *Pinus sibirica*, *Larix polonica*, *Pinus mughus*, and *Alnus viridis*.

61. Kositsyn V. N. Morphometric characteristics and cone yield of *Juniperus communis* L. in the southern taiga subzone (Tver region). *Rastitel' Nye Resursy*. 1999; 35(4):13-20.
Keywords: *Juniperus communis*/ Russia/ cone yield
Abstract: The dynamics of the main morphometric and bioproduction characteristics of *J. communis* were investigated in cowberry-type pine forests and clear cuttings (along high-tension power lines) in the southern taiga subzone (the northern regions of Tver district, Russia). Four forms of juniper (shrub-like, broad-pyramidal, narrow-pyramidal, arboreal) were distinguished. The yield of medicinal material (cones) was about 8 times higher (209.3 kg/ha of air-dry substance) in the clear cuttings than in the forest. There was a close positive correlation between cone yield/shrub and stem diameter. Regression models for open and forest areas were estimated.
62. Larsen, A. C. Norsemen's use of juniper in Viking Age Faroe Islands. *Acta Archaeologica*. 1991; 6154-59.
Keywords: *Juniperus communis*/ *Salix*/ *Calluna*/ *Picea*/ Norway/ uses
Abstract: At the time of the Norse landnam (introduction of agriculture and animal husbandry on a large scale) in the Faroe Islands (about AD 850), the islands were covered by juniper (*Juniperus communis*), heather (*Calluna*), willow (*Salix*), grasses and sedges. As well as being used as fodder [leafy branches] for sheep and as fuel, juniper was probably used extensively as a raw material. A large amount of juniper was recovered during the excavation at Toftanes. Several ropes and pieces of wickerwork were found made from juniper twigs. A plate made from spruce [*Picea*] and repaired with juniper twigs was also found. A brief botanical description (distribution, taxonomy, wood properties, wood anatomy) is given.
63. Lauterer, Pavel E-mail ento. kub@volny. cz. Citrus flatid planthopper: *Metcalfa pruinosa* (Hemiptera: Flatidae), a new pest of ornamental horticulture in the Czech Republic. *Plant Protection Science*. 2002 Sep; 38(4):145-148.
Keywords: *Juniperus communis*/ *Thuja occidentalis*/ *Sorbus*/ *Lilium*/

Metcalfa pruinosa/ twigs/ Czech Republic

Abstract: In late August of 2001 a population of *Metcalfa pruinosa* (Say, 1830) consisting of several dozens of adults and larvae was observed in a nursery of ornamentals at Brno-Bystrc. The species occurred mostly on young twigs of cultivars of *Thuja occidentalis* L., *Juniperus communis* L. and *Sorbus aucuparia* L. but also *Lilium* spp. and singly on other various wood and herbal ornamental plants. The damage was rather of an aesthetic kind: young twigs were covered by 5-10 cm long spots of waxy fluff produced by the larvae. The pest is native to North America and was introduced in the late 1970's to Italy, from where it spread to southern France, Slovenia and southern Austria. The Brno population might have been imported, in the egg stage, on ornamental shrubs from Italy. The polyphagous pest is very common in Southern Europe, causing damage especially on fruit trees by the secretion of honeydew that, being colonized by *Capnodiaceae* molds, inhibits the transpiration. The species could stay permanently in the Czech Republic or could be repeatedly imported again.

64. Livingston, R. B. Influence of birds, stones and soil on the establishment of pasture Juniper, *Juniperus communis*, and Red Cedar, *J. virginiana*, in New England pastures. Ecology. 1972; 53(6):1141-1147.
Keywords: *Juniperus communis*/ *Juniperus virginiana*/ natural regeneration/ seeds/ dispersal/ birds
Abstract: Describes a study showing that on grazed pastures exposed stones offer advantages to nearly all plants adjacent to the stones, and are virtually essential for the establishment of *J. communis* var. *depressa*. The stones protect seedlings from grazing or trampling damage, and also provide a micro-environment that may save the seedlings from desiccation while still satisfying the stratification requirements for Juniper seed. Robins rest on exposed stones, and their droppings become concentrated on them. Birds are the effective disseminators of Juniper seed, and though their digestive action has a marked inhibitory effect on germination, the depositing of seeds on stones introduces them to a micro-habitat that more than compensates for the reduced germination. Seed is washed from the droppings and carried downward into cracks caused by frost heaving round each stone. Here the seed remains moist during the long period necessary for double stratification. Seedlings growing in the cracks are under the influence of a stone micro-catchment that can provide extra water to aid survival during drought periods. *J. virginiana* var. *crebra* also benefits in the same way but since its germination requirements are less exacting, its seed can germinate even on the surface. Thus, when grazing pressures are light or non-existent, *J. v.* var. *crebra* may become established without the benefit of stones.
65. Lukasik, I. Investigation of *Juniperus communis* L. growing in an environment polluted by industrial emissions. Prace Naukowe Uniwersytetu Slaskiego W Katowicach. 1990; 116724-36.
Keywords: *Juniperus communis*/ pollution/ industrial emissions/ heavy

metals/ seed production/ biomass

Abstract: The *Juniperus communis* L. was investigated in the forests polluted by Huta "Katowice" steelwork. The material was collected from 3 stands localized in a different distance from the emitter: I: "Losien" - 2.5 km NE of the emitter II: "Mitrega" - 20 km NE of the emitter III: "Czekanka" - 18 km NE of the emitter. Analyzed parameters: - the content of chlorophyll a+b in the needles 1- and 2-years old, - the concentration of heavy metals in the biomass, - the acidity and the buffer capacity in the aqueous homogenates of the needles 1- and 2-years, - the seeds production. The concentration of chlorophyll a+b, similarly as in other species is submitted to certain seasonal variability and decrease when approaching to the source of emission. Buffer capacity is negatively correlated with the age of the needles. In the young needles buffer capacity is positively correlated with the distance from the emitter. pH is positively proportional to the age of the needles. The concentration of heavy metals in the biomass of *Juniperus communis* is 1.5-3 times lower comparing to *Pinus sylvestris* and it increases with the age of the needles. The lower number of seeds in fruit near the emitter was stated and their weight was bigger when comparing with the seeds originating from other polluted stands.

66. Malenica, A.; Kos, J., and Husar, J. Tinctures of juniper, thyme, and the leaf of plantain as means of disinfection in states of emergency. Tinkture borovice, timijana te lista trputca kao sredstva dezinfekcije u izvanrednim prilikama. Priopćenja 5 Znanstveno Strucni Skup Iz DDD a s Meunarodnim Sudjelovanjem Pouzdan Put Do Zdravlja Zivotinja, Ljudi i Njihova Okolisa, Mali Losinj, Hrvatska, 5-8 Svibnja 2004. 2004; 387-396. **Keywords:** *Juniperus communis*/ *Thymus vulgaris*/ *Plantago major*/ *P. lanceolata*/ *P. media*/ disinfectants/ disinfection/ human diseases. **Abstract:** This paper describes the uses of tinctures of juniper (*Juniperus communis*), thyme (*Thymus vulgaris*), and leaf and flower of plantain (*Plantago major*, *P. lanceolata* and *P. media*) in the disinfection of injuries/wounds in case of emergency, general disinfection, and in the treatment of respiratory system diseases.
67. Mallik, A. U. and Gimingham, C. H. Ecological effects of heather burning two effects on seed germination and vegetative regeneration. *Journal of Ecology*. 1985; 73(2):633-644. **Keywords:** *Juniperus communis*/ burning/ seed/ germination/ regeneration/ *Genista anglica*/ *Hypericum pulchrum*. **Abstract:** In *Calluna*-dominated heathlands managed by periodic burning, vegetation composition is influenced by the ability of species to regenerate rapidly after a fire. Experiments were carried out, using a number of heathland species, to investigate the effects on germination of exposing seeds to short periods of heat treatment and to determine the influence of fire temperature on vegetative regeneration. In two species, *Genista anglica* and *Hypericum pulchrum*, evidence was obtained of

stimulation of germination following short periods (30 s-2 min) of pre-treatment at 100.degree. C. There was some indication that in *Vaccinium vitis-idaea* a vernalization requirement might be over-ridden by a very short period of heating at 100.degree. C. Apart from these instances, there was little evidence of 'fire-adaptation' of this kind. Treatments at 200.degree. C, or for more than 2 min at 100.degree. C, either killed seeds or reduced germination in most of the species tested. All tested species (except *Juniperus communis*) regenerated vegetatively after burning at 600.degree. C, but in most cases a temperature of 800.degree. C resulted in less recovery. These findings emphasize the importance of controlling management fires so that canopy temperatures are held within the range 400-600.degree. C and ground surface temperatures rise little above 100.degree. C. These conditions should be sustained for no more than 2 min as the fire passes through the vegetation.

68. Marion C. and Houle, G. No differential consequences of reproduction according to sex in *Juniperus communis* var. *depressa* (*Cupressaceae*). American Journal of Botany. 1996; 83(4):480-488.

Keywords: *Juniperus communis*/ sexual reproduction/ reproductive behavior/ Quebec/ sex ratio

Abstract: In dioecious plant species, males and females are thought to have dissimilar allocation patterns. Females are believed to invest more in reproduction and less in growth and maintenance than males. This differential investment between sexes could result in distinct growth patterns and contrasting survival rates, thereby affecting the sex ratio of a population and the age and size distribution of males and females, possibly leading to habitat segregation according to sex. These effects might become more apparent under particularly limiting conditions, such as in nutrient-deficient soils or in climatically stressed environments. To verify these predictions, growth patterns, microsite characteristics, and age and size distribution of male and female individuals were compared, and population sex ratio was determined in 3 populations of the dioecious shrub *Juniperus communis* var. *depressa* along a short latitudinal gradient on the eastern coast of Hudson Bay, northern Quebec. The northernmost population had a male-biased sex ratio, but the southernmost one had a higher proportion of females. The results failed to reveal any significant differences in radial growth patterns, mean sensitivity, annual elongation of the main axis, and sizes and age frequency distribution between males and females in any population. Furthermore, there was no evidence of microhabitat segregation according to sex as indicated by the lack of differences in the physicochemical characteristics of the substrate under males and females. Clearly, the expected ecological consequences of a presumed greater investment of females in reproduction were not apparent even under the very stressful conditions prevailing on subarctic dunes. Many factors could reduce differences in the cost of reproduction between males and females, such as the number and quality of reproductive structures produced annually by individuals of each sex, the

possible photosynthetic activity of the immature female cones, and the complexity of the source/sink relationships within individuals. Alternatively, there may be no differences between sexes in their reproductive investment.

69. Matovc, M. M. and Lavadinovic, V. Essential oil of the fruit of *Juniperus communis* L. growing in Yugoslavia. *Journal of Essential Oil Bearing Plants*. 1999; 2(3):101-106.
Keywords: *Juniperus communis*/ Yugoslavia/ fruit/ regeneration/ oil
Abstract: *Juniperus communis* is widely distributed in the forest region of Yugoslavia (especially degraded and devastated forests and abandoned farmlands). In addition to its ecological significance as a pioneer species in forest regeneration, it is also of high economic interest. Its fruit (*Juniperi fructi*) produces a valuable essential oil (*Juniperi aetherolium*). Samples of *J. communis* fruits were collected from different sites in Yugoslavia and their essential oil contents were determined. Mature (3-8 mm) fruits were analyzed, with the content of unripe fruits being up to 5%. Three quality classes were recognized; their compositions are tabulated. The essential oil content on a DW basis ranged between 2.30 and 2.66%.
70. Matrai, K.; Altbacker, V., and Hahn, I. Seasonal diet of rabbits and their browsing effect on juniper in Bugac Juniper Forest (Hungary). *Acta Theriologica*. 1998; 43(1):107-112.
Keywords: *Juniperus communis*/ *Oryctolagus cuniculus*/ Hungary/ browsing/ seasonal diets
Abstract: Seasonal foods of European rabbits *Oryctolagus cuniculus* (Linnaeus, 1758) were studied by microhistological analysis of pellets in a protected area Bugac Juniper Forest, Hungary. Field experiments were also conducted to examine the role of rabbit foraging on common juniper *Juniperus communis*. The proportion of grasses, forbs and browse changed significantly throughout the seasons ($p < 0.0001$). Spring diet was dominated by grasses (89%), summer diet by grasses (30%) and forbs (42%), whereas in autumn grasses (60%) and browse (24%) were the main diet components. Juniper appeared only in winter diet (19%) together with other browse (60%). The high proportion of aromatic thyme *Thymus glabrescens* in summer diet (30%) and juniper in winter diet indicates that monoterpenoids of these plants did not keep rabbits from consumption even when other food sources were available. Planted juniper seedlings disappeared within weeks due to the browsing by rabbits.
71. McBride, A. and Trust, B. F. The status of common juniper (*Juniperus communis* L.) in the Scottish borders. *Scottish Forestry*. 1998; 52(3/4):178-182.
Keywords: *Juniperus communis*/ Scotland/ stand characteristics/ forest management/ planting
Abstract: Juniper scrub is recognized as a nationally scarce woodland type by the UK Nature Conservancy Council. This paper gives the results of a survey of the status of the juniper population in the Scottish Borders,

which involved 80 sites in the Vice Counties of Peebleshire, Roxburghshire, Berwickshire and Selkirkshire. Information was used from County recorders, the Biological Recording Centre and local botanists and foresters. The basic unit adopted for the survey was the colony (an area of juniper where no sharp topographical distinction in bush age structure can be detected, and where other vegetation is uniform), and the whole population surveyed (80 colonies, 4273 bushes) was mapped as colonies (by age class), outlier bushes and individual bushes. Regeneration was assessed along several transects through the colonies and around the periphery, but was not always apparent, especially on steep slopes. Twelve new colony records were added to the existing list, although 12 of the old records no longer exist. Generally colonies were small with 45% composed of <50 bushes, and there were a large number of scattered individuals with a few large colonies (one with 31% of the total Borders population). Information is given on demography and stand density, and colony distribution. Conservation management of the species is discussed, with strategies including fencing, livestock reduction, habitat management, and core planting areas (5 or 6 are suggested). Management recommendations are made based on these.

72. McGowan, G. M.; Bayfield, N. G., and Olmo, A. The status of *Juniperus communis* ssp. *nana* (dwarf juniper) communities at six sites in North and North-west Scotland. *Botanical Journal of Scotland*. 1998; 50(1):21-28.
Keywords: *Juniperus communis*/ dwarf juniper/ Scotland
Abstract: Sites with semi-natural vegetation containing *Juniperus* species are becoming scarce in Britain. The prostrate subspecies *Juniperus communis nana* (dwarf juniper) occurs in remote areas with a cool oceanic climate, in the NVC community H15 (*Calluna vulgaris Juniperus communis* ssp. *nana*). Evidence suggests that dwarf juniper is considerably less widely distributed than in the past, and the subspecies is absent from large areas of seemingly suitable habitat in north-west Scotland. Dwarf juniper communities were compared at altitudes ranging from sea level to c. 600 m. Sites ranged in area from 0.15-2.0 km² and showed few signs of management. The physiognomy of individual plants and plant density varied within and between sites. The communities appear to be at risk because of a lack of seedling recruitment and from possible impacts of grazing or burning. Environmental change and nitrogen deposition may also affect the dynamics of dwarf juniper populations.
73. McGowan, G. M.; Joensalo, J., and Naylor, R. E. L. Differential grazing of female and male plants of prostrate juniper (*Juniperus communis* L.). *Botanical Journal of Scotland*. 2004; 56(1):39-54.
Keywords: *Juniperus communis*/ grazing/ sex proportion/ United Kingdom
Abstract: Females and males of dioecious species may not allocate the same proportions of assimilate to plant protection and so may be

differentially grazed. The distribution range of the dioecious, coniferous shrub, juniper (*Juniperus communis*) is declining in the UK and populations are becoming fragmented. The main aims of this study were to (i) assess the sex structure of populations of prostrate juniper at four sites in northern Scotland and (ii) assess the extent of grazing on individual plants. A total of 518 prostrate juniper plants were inspected in the four populations. The sex of 30-85% of them could not be determined. There were differences between the sites in grazing intensity, plant density, plant size, and the proportion of females. Between June and September, there was almost no grazing of current growth and no difference between males and females in the amount of grazing. Most grazing took place over winter. This was supported by the observation that dung counts over summer did not correlate with grazing of current or old shoots. Female, male and unsexable plants had similar size ranges. Female and unsexable plants had similar numbers and proportions of old shoots grazed but male plants had significantly less. This suggests that many of the unsexable plants were non-reproducing females and that the greater grazing on unsexable plants might be responsible for the cessation of reproduction. The impact of differential winter grazing of prostrate female and male juniper plants is discussed in relation to the conservation of this species in Scotland and the UK.

74. Mikheeva, N. A.; Muratova, E. N., and Efremov, S. P. Characteristics of the karyotype of *Juniperus communis*. *Lesovedenie*. 2005; 3(7):2-76.
Keywords: *Juniperus communis*/ Siberia/ chromosomes
Abstract: A study was made based on 22 junipers growing in pine forests in the Tomosk region of Siberia. The morphological types of chromosomes of *Juniperus communis* ($2n = 22$) are quite uniform, as in most species of the genus Junipers.
75. Mikkelsen, Vald M. Development of vegetation in an overgrown common before and after nature conservation. *Kongelige Danske Videnskabernes Selskab Biologiske Skrifter*. 1944; 44(0):1-68.
Keywords: *Juniperus communis*/ *Quercus*/ *Betula*/ *Carpinus*/ *Populus* / *Prunus*/ *Salix*/ vegetation/ conservation/ Denmark
Abstract: Borrellyngen is part of the former common Hojilyngen (The Highland Heath) on Bornholm, a Danish island in the Baltic Sea. From about AD 1200, human influence changed vegetation in the central part of Bornholm from forest to common dominated by *Calluna* heath and open grassland, Hojilyngen. Intensive grazing stopped at the end of the 19th century and most of Hojilyngen became cultivated. Some areas, e.g. Borrellyngen, were not used by farmers and changed gradually to woodland. The overgrowing is studied by determining the time of germination by counting the annual rings of trees felled after the start of nature conservation management in 1974. At that time sheep grazing began. Development of the vegetation after the clearing of two areas was examined by analyses of the vegetation in 1981, 1984, and 1989 in the first

area (Habbedam) and in 1986, 1991, 1992, and 1993 in the second (Knaegten). The thickness of the soil and its nutrient content was examined in both areas. The differences between the Habbedam area with Calluna heath generally on thin soil and a small number of species and the Knaegten area with both thick and thin soil and with many more species in the heath as well as in the other communities are discussed. The influence of sheep on the stump shoots, root-suckers and seedlings was investigated. The development of about 340 stumps of deciduous trees was followed in periods of 6 and 8 years. After 6-8 years about 20% of the stumps of *Quercus robur* were still alive, while the stumps of *Betula pendula*, *Carpinus betulus*, *Populus tremula*, *Prunus avium*, *Salix caprea*, and *Sorbus intermedia* were dead. Root-suckers of *Populus* were eaten and dead, as were all the seedlings of woody plants except *Juniperus communis*, which was avoided by sheep. *Juniperus* may thus be the prominent species in new overgrowing. The influence of the sheep grazing on the rest of the vegetation was also investigated, as was the selection of food plants by sheep.

76. Miles, J. and Kinnaird, J. W. The establishment and regeneration of birch, juniper and Scots pine in the Scottish Highlands. Scottish Forestry. 1979; 33(2):102-119.
Keywords: *Juniperus communis*/ *Betula pendula*/ *Betula pubescens*/ seeds/ seedlings/ regeneration/ fire control/ grazing
Abstract: A detailed review of the ecology of seed production and seedling establishment and the silvicultural regeneration of birch (*Betula pendula* and *B. pubescens*), Scots pine and juniper (*Juniperus communis*), including previously unpublished data. Control of grazing and fire are the main keys to encouraging natural regeneration. Where seed sources are not adjacent, direct sowing may be successful if seed predation is not excessive. Direct planting in tubes [see FA 32, 5908] is possible where grazing is limited.
77. Miller G. R. and Cummins R. P. Browsing by red deer on naturally regenerated birch and juniper saplings on wintering ground at Glen Feshie. Scottish Forestry. 1998; 52(3/4):138-145.
Keywords: *Juniperus communis*/ *Betula*/ *Alnus*/ *Sorbus*/ *Pinus*/ browse/ deer/ Scotland/ woodlands/ natural regeneration/ forest pests.
Abstract: Persistent browsing by red deer (*Cervus elaphus*) checked the development of young trees and shrubs on wintering ground of woodland and scrub at Glen Feshie in the Cairngorm Mountains of Scotland, and so maintained a stock of stunted saplings. This 'sapling bank' was composed predominantly of birch (*Betula pendula* and *B. pubescens*), with rowan (*Sorbus aucuparia*), alder (*Alnus glutinosa*) and juniper (*Juniperus communis*) as the main subsidiary species. Saplings of Scots pine (*Pinus sylvestris*), the dominant tree in the relict ancient Caledonian forest in the area, were rare. Damage to birch during winter was broadly correlated with local densities of red deer, one deer per hectare being roughly

equivalent to 2% of saplings browsed per week. However, relatively few birches were taken during winter and almost none at all in April. They were mostly eaten during summer following a peak of browsing at bud-break in May-June. Annual birch mortality was 15%. Junipers, on the other hand, were browsed mainly in mid-late winter when preferred forage had become scarce. They were then more severely browsed than were birches but their annual mortality was only 6%. Neither species grew in height during 32 months of observation (October 1968-June 1971). The findings are discussed in relation to the problem of regenerating woodland in deer wintering areas. It is concluded that the sapling banks at Glen Feshie and elsewhere confer a potential for rapid woodland development if red deer numbers were to be reduced. However, the initial tree species composition is likely to differ from that of existing relict woodland.

78. Miller, H. J. Anatomical studies of *Juniperus communis* L. ssp. *communis* and *J. communis* L. ssp. *nana* Syme. Acta Botanica Neerlandica. 1974; 23(2):91-98.

Keywords: *Juniperus communis*/ wood anatomy/ tracheid length/ rays
Abstract: The wood anatomy of *J. c.* subsp. *communis* is described and is compared with descriptions by earlier authors. The mean and maximum tracheid lengths and the height distribution frequencies of the rays offer a means of separating the wood of *J. c.* subsp. *communis*, which has an erect growth habit, from that of subsp. *nana*, which is prostrate.

79. Myking, Tor E-mail tor.myking@skogforsk.no. Evaluating genetic resources of forest trees by means of life history traits: A Norwegian example. Biodiversity & Conservation. 2002 Sep; 11(9):1681-1696.

Keywords: *Juniperus communis*/ *Betula*/ *Pinus*/ *Alnus*/ *Salix*/ *Populus*/ *Corylus*/ *Sorbus*/ *Prunus*/ *Fraxinus*/ *Acer*/ *Taxus*/ *Ilex*/ *Fagus*/ *Ulmus*/ *Tilia*/ *Malus*/ Norway/ genetic variability/ heritability/ genetics/ life history

Abstract: Additive variation in adaptive traits is a prerequisite for selection and adaptation to future environmental changes, but distribution of adaptive genetic variability between and within populations is poorly known in most forest trees. Owing to this deficiency, life history traits such as geographic range, pollination vector and seed dispersal capability, which significantly affect gene flow and thus the distribution of genetic variability, were used to evaluate the genetic resources in 23 Norwegian native forest tree species. Based on the combination of life history traits the species' genetic resources were classified either as viable, potentially vulnerable or vulnerable, assuming a decrease in within-population variability in this sequence. Twelve widely distributed species with generally effective dispersal of pollen and seeds were considered viable (*Pinus sylvestris*, *Picea abies*, *Juniperus communis*, *Betula pubescens*, *B. pendula*, *Alnus incana*, *A. glutinosa*, *Salix caprea*, *Populus tremula*, *Corylus avellana*, *Sorbus aucuparia*, *Prunus padus*) and have as such no particular conservation needs. Effective seed dispersal of these species, as

inferred from post-glacial migration rates, may be partly responsible for their generally early post-glacial appearance, and may, in combination with the wide ranges and relatively large evolutionary potential, indicate that viable species are best able to cope with climatic change. Among species with restricted ranges and more limited gene flow eight were considered potentially vulnerable (*Quercus petraea*, *Q. robur*, *Fraxinus excelsior*, *Acer platanoides*, *Taxus baccata*, *Ilex aquifolium*, *Fagus sylvatica*, *Ulmus glabra*) and three were considered vulnerable (*Tilia cordata*, *Malus sylvestris*, *P. avium*). Application of different intensities of a multiple population breeding system (MPBS) is considered the most appropriate mode of conserving genetic resources in these species.

80. Oleshko, G. I. and Dontsov, A. A. Reserves of *Juniperus communis* L. fruits in the Sverdlovsk district and their rational utilization. Rastitel' Nye Resursy. 1991; 27(3):31-36.
Keywords: *Juniperus communis*/ fruit/ Sverdlovsk/ diuretic/ medicine
Abstract: A survey was carried out between 1980 and 1986 in 45 regions of the Sverdlovsk district to determine the distribution of *J. communis* and the yield of air-dry fruits, used in medicine as a diuretic. *J. communis* was found in 15 regions but only 8 regions had sufficiently large stands to exploit commercially. The total area amounted to 163.37 ha, annually yielding 8.12 t of air-dry fruits.
81. Oostermeijer, J. Gerard B. Author Reprint Author; E-mail: oostermeijer@science.uva.nl], and De Knegt, Bart Author. Genetic population structure of the wind-pollinated, dioecious shrub *Juniperus communis* in fragmented Dutch heathlands. Plant Species Biology. 2004 Dec; 19(3):175-184.
Keywords: *Juniperus communis*/ Netherlands/ genetic variation/ sex ratio/ pollen/ seeds
Abstract: The wind-pollinated, dioecious shrub *Juniperus communis* L. is declining in Dutch heathlands, mainly because recruitment is scarce. Aside from ecological factors, inbreeding associated with reduced population size and isolation in the currently fragmented landscape might explain this decline. However, the breeding system of this species largely prevents inbreeding. We assessed variation in 18 allozyme loci in 12 Dutch juniper populations to investigate population structure and to test the hypothesis that small populations have less genetic variation and show more inbreeding than large populations. Variation was high for a species with a fragmented distribution, but similar to values observed in other juniper species. The proportion of polymorphic loci (P) ranged between 0.72 and 0.83, expected heterozygosity (He) ranged between 0.16 and 0.27 and the mean effective number of alleles per locus (A) ranged between 2.5 and 3.3. Population size was not correlated with genetic variation or with sex ratio. Deviations from Hardy-Weinberg expectations, mainly heterozygote deficiencies, were mostly observed in larger populations, which appear to have been broken up into smaller subunits.

Differentiation among populations was small ($F_{ST} = 0.026$) and there was a significant departure from random mating ($F_{IS} = 0.174$). Geographic and genetic structures were not related. Our data suggest that gene flow in this wind-pollinated shrub was high during the establishment phase of the current populations. Gene exchange by pollen and seeds may be less extensive in the present-day landscape. However, juniper decline is not likely to be caused by genetic factors. Alternative hypotheses include changed heathland disturbance regimes, pollen limitation, seed predation and age-related fecundity reductions. Implications for the restoration of juniper populations are discussed.

82. Ottley, A. M. The development of the gametophytes and fertilization in *Juniperus communis* and *Juniperus virginiana*. Botanical Gazette. 1909; 4831-46.
Keywords: *Juniperus communis*/ *Juniperus virginiana*/ common juniper/ eastern redcedar/ gametophytes/ fertilization
Abstract: Cytological study.
83. Pack, D. A. After-ripening and germination of *Juniperus* seeds. Botanical Gazette. 1921; 7132-60.
Keywords: *Juniperus communis*/ *Juniperus virginiana*/ *Juniperus prostrata*/ germination/ after-ripening/ temperatures
Abstract: Seed biology from *Juniperus communis*, *Juniperus virginiana*, *Juniperus prostrata*, were examined with after-ripening treatments. Freezing and thawing has no forcing action on the germination of juniper seeds, nor did it hasten after-ripening. Freezing causes injury to after-ripened seeds. After-ripening occurred at temperatures between 0 ° C to 10 ° C , although fastest at about 5 ° C. When after-ripened seeds were transferred from 5 ° C to temperatures above 15 ° C , seeds were thrown into a state of secondary dormancy. Seeds that have not split open and developed a short hypocotyl should not be transferred to a germinator above 5° C. Inhibitors were found in the endosperm and embryo but not in the seedcoat.
84. Parent, J. and Richard, P. J. H. Pollen morphology of *Cupressaceae* from eastern Canada and northeastern United States applied to the study of Quaternary sediments. Canadian-Journal-of-Botany. 1990; 68(1):79-89; ISSN: 0008-4026.
Keywords: *Juniperus communis*/ *Juniperus horizontalis*/ *Juniperus virginiana*/ *Chamaecyparis thyoides*/ *Thuja occidentalis*/ *Taxodium distichum*/ *Cupressaceae*/ *Pinopsida*/ pollen/ morphology/ identification/ palaeoecology
Abstract: Light microscopy was used to study pollen morphology of *Chamaecyparis thyoides*, *Juniperus communis* var. *depressa* and var. *montana*, *J. horizontalis*, *J. horizontalis* f. *alpina*, *J. virginiana* and *Thuja occidentalis*. Pollen of *Taxodium distichum* (*Taxodiaceae*), which is

present in the study area, was also studied. Four pollen types were identified: *J. communis*/*Thuja occidentalis*, *C. thyoides*, *J. horizontalis*/*J. virginiana* and *Taxodium distichum*. Five shapes of pollen grains, representing different stages of hydration, were found in all species and could not be used for identification. A key is included for identifying pollen in fossil sediments.

85. Parfenov, V. I. and Belomesyatseva, D. B. The consortive relationship between fungi and higher arboreous plants represented by *Juniperus communis* L. Vestsi Natsyyanal' Nai Akademii Navuk Belarusi Seryya Biyalagichnykh Navuk. 2003; 458-65.
Keywords: *Juniperus communis*/ fungi
86. Poveda M. M.; Souqual M. C.; Fauvel M. T.; Gamisans J., and Gauquelin T. Alkane composition diversity among populations of dwarf forms of *Juniperus communis* L.: comparison between western Europe and northern American populations. Botanical Journal of the Linnean Society. 2002; 140(2):165-168.
Keywords: *Juniperus communis*/ dwarf / alkanes/ Pyrenees
Abstract: The cuticular wax composition of leaves has been analyzed in three western European populations (Corsica, central Pyrenees, northern Alps) of *Juniperus communis* var. *saxatilis* Pall. (= *J. nana* Willd., nom illeg.) and in one population of *J. communis* L. var. *depressa* Pursh. From North America (Sierra Nevada) Gas chromatography shows the presence of 13 alkanes in all samples ranging from C23 to C35 with important intraspecific polymorphism in alkane content. The dominant alkanes range from C33 to C35. Alkanes C21 and C22 were found only in Corsica and Sierra Nevada populations. Canonical discriminant analysis separated the *J. communis* L. var. *depressa* Pursh. of the population of Sierra Nevada from other populations of *J. communis* var. *saxatilis* Pall. on the basis of their higher C31 content and the constant presence of C21 and C22 alkanes. *J. communis* var. *saxatilis* Pall. populations from the Pyrenees are close to northern Alps populations characterized by high concentrations of C33, C34 and C35 alkanes. This paper confirms the existence of *Juniperus* var. *saxatilis* Pall. in the Pyrenees (France).
87. Quezel, P. and Barbero, M. The juniper formations of Djurdjura (Algeria): their ecological, dynamic and syntaxonomic significance for the Kabylia cedar forests as a whole.
Les formations a genevriers rampants du Djurdjura (Algerie). Leur signification ecologique, dynamique et syntaxonomique dans une approche globale des cedraies kabyles. Lazaroa. 1989; 1185-99.
Keywords: *Juniperus communis*/ *Juniperus sabina*/ Cedrus/ Algeria/ ecology/ associations
Abstract: A new phytosociological interpretation is proposed for the *Juniperus communis* subsp. *hemisphaerica* and *J. sabina* scrub in this region. They form two associations belonging to a new alliance in the order

Quercus-Cedretalia atlanticae. The floristic and phytosociological organization of the two associations is described. These associations form the pre-forest stage of the Kabylean cedar [*Cedrus atlantica*] forests, which belong to a new association, *Senecio perralderiani-Cedretum atlanticae*. Changes in these communities over the last 30 years are discussed.

88. Raatikainen; Mikko [Author]; Tanska, and Tuula [Author]. Cone and seed yields of the juniper (*Juniperus communis*) in southern and central Finland. Acta Botanica Fennica. 1993; 149(0):27-39.
Keywords: *Juniperus communis*/ Finland/ seed yields/ cone/ female flowers
Abstract: In juniper (*Juniperus communis* L.) population examined in southern and central Finland, female flowers were found on individuals of age 7 to 52 years. The male flowering period in southern Finland in 1984-1986 extended from 23 May to 19 June, with the onset varying by 20 days according to the effective temperature sum. Flowering occurred earlier in open areas than in forests. Two equations constructed to explain the differences in pollen quantities accounted for 41% of the variation in southern Finland and 59% in central Finland. Flowering, pollen quantities and cone yields were greater for the junipers in open areas than those in forests. The cone yield was most influenced by illumination and the age and size of the junipers. Needles and flower primordia suffered damage in the severe winter 1984-1985, while the failures in cone yield were attributable as well to inadequate wind pollination, plant diseases and pests. The cone yield was in the ranges 10-248 g per juniper and 40 000-2 210 000 cones per ha, and the number of seeds was 85-5 425 per juniper and 85 000-5 425 000 per ha. Three regression models that were constructed accounted for 60-66% of the variation in cone yield.
89. Reisaeter, O. *Juniperus communis*. New cultivars have been put into circulation from NLH (Norwegian Agricultural University).
Juniperus communis. Nye kultivarer vert spreidde fra NLH. Gartneryrket. 1977; 67(6):169-171.
Keywords: *Juniperus communis*/ Norway/ cultivars
Abstract: Five outstanding dwarf juniper cvs have been raised in Norway and registered: they are Smoerbukk, Oskelladen, Bukken Bruse, Lurvehaetta and Erik.
90. Rioux, J A.; Richer, C., and Lamy, M P. Tolerance evaluation of eleven junipers (*Juniperus* sp.) under north-eastern Canadian climatic conditions. Canadian Journal of Plant Science. 2004; 84(4):1135-1153.
Keywords: *Juniperus communis*/ *Juniperus sabina*/ *Juniperus squamata*/ *Juniperus horizontalis*/ Canada/ winter hardiness/ growth
Abstract: Young plants of 11 species and cultivars of junipers were planted between 1987 and 1994 in six or eight sites distributed in northeastern Canadian climatic zones 2a to 5b (the most populated zones

of Quebec). These plants were evaluated over a 5-yr period to provide more detailed information about the winter hardiness and growth under these climatic conditions. *Juniperus sabina* 'Blue Danube', the control, was established five times and compared to the 10 other junipers. These plants were observed for a 5-yr period in order to determine their winter hardiness and growth under these climatic conditions. Survival and usage potentials of *J. sabina* and its cultivars Blue Danube and Broadmoor, *J. horizontalis* 'Douglasii', *J. communis* 'Rependa' and 'Depressa Aurea' and *J. squamata* 'Blue Carpet' were established in zone 2a. These potentials could be extended to zone 1b for *J. sabina*, *J. s.* 'Blue Danube' and 'Douglasii' and 'Rependa' cultivars, no mortality was observed in the coldest zone (2a). *J. squamata* 'Blue Star' is the less hardy cultivar, and its survival and usage potentials were fixed to zone 4. Furthermore, *J. sabina* 'Wapiti' can survive and be used in zone 2b. *J. x media* 'Pfitzeriana' and *J. squamata* 'Meyeri' can survive in zone 2b, but can be used in zone 4. The three *J. squamata* cultivars and *J. x media* 'Pfitzeriana' are often affected by foliage desiccation in their respective usage zones. The full ornamental potential was observed in zone 2a for *J. horizontalis* 'Douglasii', in zone 2b for *J. sabina*, his 'Blue Danube' and 'Broadmoor' cultivars and *J. communis* 'Rependa', and in zone 5b for *J. x media* 'Pfitzeriana', *J. squamata* 'Blue Carpet' and 'Blue Star'. This potential has been observed only in zone 4a for *J. communis* 'Depressa Aurea', *J. sabina* 'Wapiti' and *J. squamata* 'Meyeri', snow cover being an important factor.

91. Rosen E. and Sjogren E. Plant cover in alvar junipers on Oland. Distribution features correlated to shrub size and shape. Acta Phytogeographica Suecica. 1988; 76:101-112.
Keywords: *Juniperus communis*/ grasslands/ pH/ drought tolerance/ limestone/ Stora Alvaret
Abstract: A survey of the plant cover inside junipers was carried out in the limestone grasslands of Stora Alvaret. Four main clusters for *Juniperus communis* habitats were obtained by cluster analysis. Small differences in plant cover due to the geographic position of investigated areas were found. Number of deciduous forest species with low drought tolerance and preference for high pH is unexpectedly high. Their epigeic or epiphytic presence within the shrubs is probably due primarily to the efficient shelter provided. Conditions of normally low bark and litter pH in the shrubs are compensated by frequent short-term supply of calcareous dust, thus being of minor importance as an obstacle to their colonization and survival. Several bryophyte species typical of shrubless alvar communities apparently survive in the junipers for several years. They become slowly out competed by species with more pronounced needs for shelter.

92. Rosen E. and Van der Maarel E. Restoration of alvar vegetation on Oland, Sweden. Applied Vegetation Science. 2000; 3(1):65-72.
Keywords: *Juniperus communis*/ *Potentilla*/ alvar vegetation/ Sweden

Abstract: Alvars in the Baltic region, particularly on the Swedish islands of Oland and Gotland and in western Estonia, are well-known for their plant species richness and extensive populations of rare species. Grasslands make up most of alvar vegetation. The extent of these grasslands decreases because of bush encroachment which takes place in most alvars when traditional land use practice changes, notably when grazing is ceased. The main threat for the alvar grassland is formed by the rapid expansion of *Juniperus communis* and *Potentilla fruticosa* in dry and wet sites, respectively. Applied research has been carried out during several years in order to develop plans for the restoration of alvar grassland. Thus it was shown that species richness in areas with a mixture of grassland and shrubland decreases in relation to the increased cover by shrubs. In the case of *Juniperus* there is a distinct drop in species number as soon as the cover exceeds 75 - 80%, while the decrease is more gradual with increased cover of *Potentilla*. The seed banks under dense stands of these shrubs only contain ca. 20% of the species found in dry and wet alvar meadows. This was confirmed by clearing experiments. Long-term recordings have shown that establishment of juniper seedlings takes place mainly in half-open areas between already existing junipers. Intermediate-sized junipers expanded faster than old and big shrubs. *Potentilla* shrubs recover fast from cutting or burning. After 2 - 4 yr they have almost attained their former size. This recovery can be prevented when cattle grazing is introduced. In the framework of a local alvar restoration project on Oland, covering 7000 ha, grazing regimes are re-established, fences erected and large-scale clearings carried out. Recently established juniper shrubs are being cleared, intermediate sized junipers (30 - 50 yr old) are selectively removed while creating a mosaic landscape with high biological diversity. Older dense juniper stands are left alone or are only partly cleared. *Potentilla* stands in moist areas are cut to create moist meadows which are breeding grounds for waders, and to establish corridors between remaining open areas. Three items are discussed (1) the importance of the Store Alvar area; (2) re-introduction of grazing and (3) re-introduction of species. The outstanding importance of the area regarding species richness and endemism should be recognized through a 'golden list' to be used along with red and blue lists.

93. Rosen E [Reprint author]. Development and seedling establishment within a *Juniperus communis* on Oland Sweden . Acta Botanica Neerlandica. 1988; 37(2):193-202.

Keywords: *Juniperus communis*/ seedling/ regeneration

Abstract: Development and regeneration in an expanding *Juniperus communis* stand was recorded in two permanent plots (each 50 .times. 50 m) during 1970/71-1986. One plot was cleared, showing an uneven age distribution: 14-116 years (seedlings not included). In the uncleared control plot the juniper stand increased its cover from 10.0 to 18.3% (1971-1986). Young shrubs increased more in height and diameter than older ones. Seedling establishment was recorded in the two plots from 1971 and

in a cattle-grazed plot from 1983. The latter had the highest number of seedlings (814) but also the highest mortality (24%) due to drought. Aggregations of seedlings were found in areas between old shrubs. Correlation between stem diameter and age was calculated ($r = 0.84$).

94. Rouchaud, Jean Reprint author; Neus, Olivier Author; Van Labeke, Marie C. Author; Cools, Karoliene Author, and Bulcke, Robert Author. Isoxaben and BAS 479 14H retention/loss from peat substrate of nursery plants. *Weed Science*. 1999 Sep-1999 Oct 31; 47(5):602-607.
Keywords: *Juniperus communis*/ nursery/ peat/ irrigation/ container/ herbicide
Abstract: Weed management for nursery ornamental plants requires several applications of preemergence herbicides to control recurring weed emergence and to counter chemical dissipation and leaching losses. Herbicide losses from plant containers in runoff water may pose risks to surface and groundwater supplies. Sphagnum peat is a frequently used rooting medium. Limited information exists on the fate of herbicides applied to peat. The leaching of two commonly used chemicals in Europe by the containerized ornamental plant industry, isoxaben and BAS 479 14H, was measured. Herbicides were applied to 1-yr-old conifers (*Juniperus communis*, cv. Repanda (common juniper)) grown in pots containing sphagnum peat. The isoxaben-treated pots were placed on 1- by 1-m lysimeters that were buried in the center of replicated field plots. Pots were also placed in subirrigated sandbeds to determine herbicide dissipation and movement in irrigation water. With overhead irrigation, isoxaben had a half-life of 2 mo in the 0- to 5-cm depth of the peat container. More than 96% of applied isoxaben was recovered in the 0- to 5-cm depth. Less than 4% of the amount applied was found in the 5- to 10-cm depth, and none was detected in the 10- to 15-cm depth. No isoxaben residues were detected in water percolating through the field lysimeters. In subirrigated sandbeds, no isoxaben was detected in the water rising by capillary tension. Most of the applied isoxaben was found in the 0- to 5-cm layer of the peat container, where its half-life was also 2 mo. Similar results were observed in containers treated with BAS 479 14H, which had a half-life of 1.2 mo. The high organic matter content of the peat medium strongly absorbed both isoxaben and BAS 479 14H, and these herbicides remained primarily in the near-surface zone of the peat containers. No significant herbicide leaching or loss from the containers was found when subirrigated or irrigated by sprinkler.
95. Rousset, Olivier Author and Lepart, Jacques Reprint author. Positive and negative interactions at different life stages of a colonizing species (*Quercus humilis*). *Journal of Ecology*. 2000 Jun; 88(3):401-412.
Keywords: *Juniperus communis*/ *Quercus humilis*/ France
Abstract: 1 The downy oak *Quercus humilis* has recently recolonized the Causse du Larzac plateau in southern France. We studied the influence of the shrubs *Buxus sempervirens* and *Juniperus communis* on *Q. humilis*

establishment, and of *Buxus* on the growth of established *Q. humilis* individuals. 2 Percentage germination of experimentally planted *Q. humilis* was higher under shrubs than in nearby open areas and higher on the north than the south side of the canopy. Germination where part of the canopy has been removed was similar to that away from the shrubs, suggesting that the facilitation mechanism is related to changes in microclimate rather than to a soil effect. 3 When exposed to sheep for 1 month, 100% of 326 unprotected oak seedlings were grazed, causing 44% mortality. The presence of *Buxus* and *Juniperus* improved seedling survival by protecting them against sheep grazing and summer drought. Predation by rodents was however greater under shrub cover. 4 The highest leaf dry mass of oak seedlings was recorded under *Juniperus* where light conditions seem more favorable for growth than under *Buxus* (direct effect) or in grassland (indirect effect). The growth of naturally established individuals of *Q. humilis* (in terms of total leaf mass per annual branch and width of rings) was lower under *Buxus* than in grassland but the values became similar once the canopy was overtopped. 5 The balance between positive and negative interactions varied in relation to the life stage of *Q. humilis* and the two shrub species. Regeneration of *Q. humilis* in open grassland was prevented by grazing. The protection offered by shrubs continues to offset the negative interference on growth, particularly under *Buxus*, so that plants could survive to overtop the shrub canopy and reach maturity. The succession pathway therefore depends closely on the distribution of shrubs in the grassland.

96. Schmidt, G. New methods for propagation by summer cuttings of certain *Juniperus* spp. and [broadleaved] evergreens. *Kerteszeteki Egyetem Közleményei*. 1974; 37(5):71-75, 2 plates.
Keywords: *Juniperus chinensis*/ *Juniperus sabina*/ *Juniperus communis*/ vegetative propagation/ nurseries/ protected cultivation.
Abstract: Preliminary results are given of one year's trials with cuttings taken on 1-3 July and set in seed boxes in sand. *J. chinensis* 'Hetzi' (a), *J. sabina* 'Blaue Donau' (b) and *J. communis* 'Suecica' (c) rooted better in a plastic tunnel with mist than under a plastic sheet without mist. The results without mist were, however, satisfactory and less costly. The application of certain growth substances and fungicides improved rooting in (a) and (b) but not in (c).
97. Schneider I.; Gibbons S., and Bucar F. Inhibitory activity of *Juniperus communis* on 12(S)-HETE production in human platelets. *Planta Medica*. 2004; 70(5):471-474.
Keywords: *Juniperus communis*/ methylene chlorida extracts
Abstract: Extracts of *Juniperus communis* L. (*Cupressaceae*) have been evaluated for their inhibitory activity on human platelet-type 12(S)-lipoxygenase [12(S)-LOX]. The methylene chloride extracts of *Juniperi lignum*, *Juniperi pseudo-fructus* and the ethyl acetate extract of *Juniperi pseudo-fructus* showed a significant inhibition on the production of 12(S)-

HETE [12(S)-hydroxy-5,8,10,14- eicosatetraenoic acid] at 100 μ g/mL (54.0 ± 6.73 , 66.2 ± 4.03 and $76.2 \pm 3.36\%$, respectively). From the methylene chloride extract of the wood, cryptojaponol and β -sitosterol were isolated as compounds with inhibitory activity (inhibition at 100 μ g/mL = $55.4 \pm 2.80\%$ [IC₅₀ = 257.5μ M] and $25.0 \pm 2.15\%$, respectively). In addition, a lipid fraction containing unsaturated fatty acids contributed to the in vitro activity of the crude extract.

98. Scholler, M. Studies on juniper dieback on the island of Fahrinsel
 \Untersuchungen zum Wacholdersterben auf der Fahrinsel. Zeitschrift
 Fur Mykologie. 1993; 59(2):155-163.
Keywords: *Juniperus communis*/ Germany/ *Gymnosporangium
 clavariiforme*/ *Crataegus monogyna*/ plant diseases/ plant pathogens/
 host
Abstract: .Fahrinsel is a small island belonging to Germany, situated in
 the Baltic Sea, and having a large *Juniperus communis* population. In
 1988, extensive dieback was observed at 2 sites. Results of studies carried
 out in spring and summer 1992 suggested that the dieback was mainly
 caused by *Gymnosporangium clavariiforme*, and was related to the
 presence at the sites of the alternate host of the pathogen, *Crataegus
 monogyna*. Reasons for the unusually severe outbreak are discussed, with
 possible measures for eradicating the fungus on Fahrinsel.
99. Signorini, M A and Ciampi, C. Biosystematic characteristics of common juniper
 (*Juniperus communis* subsp. *communis*) in relation to rooting potential.
 Annali, Accademia Italiana Di Scienze Forestali. 1982; 31193-209.
Keywords: *Juniperus communis*/ rooting/ roots/ cuttings
Abstract: Natural rooting of low branches touching the ground and
 induced rooting of cuttings is studied. In low branches, adventitious roots
 arise during annual ring differentiation, and root traces persist in the ring.
 Roots do not arise at predetermined sites; however, at the start of the root
 trace some parenchyma cells persist and can be interpreted as a
 connection between the branch wood and the root trace. In cuttings,
 rooting starts with the formation of wound tissue, a woody ring rich in
 parenchyma in which the root traces remain embedded.
100. Southworth, D. Pollen exine substructure III. *Juniperus-communis*. Canadian
 Journal of Botany. 1986; 64(5):983-987.
Keywords: *Juniperus communis*/ *Lilium longiflorum*/ *Fagus sylvatica*/
 pollen/ acetolyzed exines
Abstract: Acetolyzed exines of *Juniperus communis* extracted with hot 2-
 aminoethanol were prepared for electron microscopy. The strongly
 osmiophilic, heterogeneous exine first becomes granular. With further
 extraction, granules are observed to surround unstained polygonal
 regions. The connections between granules are then broken leading to
 compound polygons, open polygons, and finally detached pieces. Orbicules

and exine-1 are completely removed. The pattern of structural change is similar to that observed in *Lilium longiflorum* and in *Fagus sylvatica*.

101. Stypinski, P. and Michalczyk, J. Distribution of *Juniperus communis* in state forests on the Masurian Plain.
Występowanie jaowca pospolitego (*Juniperus communis* L.) w lasach państwowych na Równinie Mazurskiej. Sylwan. 1984; 128(3):25-33.
Keywords: *Juniperus communis*/ Poland/ podosols/ soil/ understory
Abstract: Juniper forms an understorey on 22 845 ha of forest in this region of NE Poland, most successfully on fairly moist poor and fairly poor coniferous sites with podzolic soils. A reserve is proposed to protect juniper in the neighborhood of Jagocin lake in Pisz forest district.
102. Szabo, M. and Keszei, E. Some properties of rainfall and through fall water in undisturbed juniper and poplar forests in Bugac. Acta Botanica Hungarica. 1985; 31(1-4):35-44.
Keywords: *Juniperus communis*/ *Populus alba*/ *Populus canescens*/ *Ligustrum vulgare*/ Hungary/ rainfall
Abstract: Studies in stands in S. central Hungary, dominated by *Juniperus communis* or *Populus alba*, *P. canescens* and *Ligustrum vulgare*, showed that there was considerable dry deposition of Cl⁻ onto tree crowns.
103. Timofeev V. V.; Lantratova A. S., and Samodurova N. S. Characteristics of coenopopulations of *Juniperus communis* L. in plant cover of Zaonezh'e territory, Karelia, Russia. Rastitel' Nye Resursy. 2001; 37(4):48-62.
Keywords: *Juniperus communis*/ *Pinus*/ *Picea*/ plant communities/ population dynamics.
Abstract: *J. communis* is widely used as a source of valuable timber and essential oils. Plant communities with *J. communis* and features of its coenopopulations were investigated during 1999-2000. Surveys were conducted in schungite alvars (rock consisting of 30% carbon and 70% silicates, unique to Karelia), and pine [*Pinus*] and spruce [*Picea*] forests. *J. communis* was found in 65-70% of plant associations in pine forest, 50% in spruce forests, and all plant associations in alvars. Average *J. communis* stand density in spruce forests was 124 plants/ha, while densities in alvars and pine forest were 15-20 times higher. The age structure and crown shape variations of *J. communis* populations are also described.
104. van der Merwe, M.; Winfield, M. O.; Arnold, G. M., and Parker, J. S. Spatial and temporal aspects of the genetic structure of *Juniperus communis* populations. Molecular Ecology. 2000; 9(4):379-386.
Keywords: *Juniperus communis*/ genetic structure/ seeds/ birds/ populations/ AFLP
Abstract: *Juniperus communis* is a dioecious, wind pollinated shrub or small tree that produces 'berries' (female cones) containing a small number of seeds that are thought to be dispersed by birds. The expectation, therefore, would be that populations of Juniper are

genetically diverse with little structuring between them. In Britain, the species has two main centers of distribution: a highland zone in the north and west in which populations are still large and sexually reproducing, and a southern zone on chalk downlands in which populations are small and fragmented and individuals suffer from a decline in fertility. Thus, one would expect the large sexually viable populations in the north to exhibit high levels of within-population genetic variation, while the declining southern populations would be genetically depauperate. The analysis of amplified fragment length polymorphisms (AFLPs) was used to test this hypothesis. Surprisingly, all populations studied showed high levels of genetic variation although there was clear structuring between populations. On the basis of the geographical structuring of the populations it was hypothesized that *J. communis* colonized Britain via three separate routes.

105. Vardhini, D; Raja, S S; Varalakshmi, K, and Quddus, K M A. Sujiol, a new potent insect growth regulator from *Juniperus communis* L. against last instar larvae of *Spodoptera litura*. Journal of Applied Entomology. 2001; 125(8):479-481.
Keywords: *Juniperus communis*/ Sujiol/ berries/ *Spodoptera litura*/ larvae
Abstract: Sujiol, a terpenoid isolated from the berries of *Juniperus communis*, exhibited growth regulating activity in the last instar larvae of *Spodoptera litura*. The larvae were treated with 0.1, 0.25, 0.5, 0.75, 1, 2 and 4% concentrations of Sujiol, in solvent acetone. Formation of non-viable adults, interference in ecdysis and development of mosaics were the important morphogenetic peculiarities observed. The resultant forms were ruled out from further development and reproduction.
106. Verdu, M.; Villar-Salvador, P., and Garcia-Fayos, P. Gender effects on the post-facilitation performance of two dioecious *Juniperus* species. Functional Ecology. 2004; 18(1):87-93.
Keywords: *Juniperus sabina*/ *Juniperus communis*/ gender/ sex ratio/ Spain
Abstract: Plant facilitation usually changes to competition as plants age. In dioecious plants, females should be affected more negatively than males by stressful conditions because of the greater costs of female reproduction. We investigated the gender effects on the post-facilitation performance of adult plants of two dioecious *Juniperus* species from the high mountains of eastern Spain: *J. sabina* acts as a nurse plant for *J. communis*. We compared physiological (water potential, carbon isotope discrimination and nitrogen concentration), vegetative (shoot growth) and reproductive (number of male flowers, and number of fruits and seeds) characters of associated and non-associated plants of both species, to test the hypothesis that this association represents a more stressful condition for females than for males because of the greater costs of female reproduction. Despite their close phylogenetic relatedness, both species showed a distinct

performance pattern after the facilitation phase. Association with the nurse plant reduced the growth and reproductive capacity of both genders in *J. communis*, the facilitated species. In contrast, the association with *J. communis* did not affect the fitness of the nurse plant, *J. sabina*, although in accordance with our hypothesis a gender effect was found on several physiological parameters. Thus *J. sabina*-associated females had a more negative water potential and carbon isotope discrimination than the associated males, but there were no differences between genders when growing in isolation. The consequences of the post-facilitation interaction between the two long-lived woody Juniperus species are asymmetrical: harmful for the facilitated species, but harmless for the nurse. Gender had also asymmetrical consequences on some functional traits of the nurse - but not the facilitated species.

107. Verdu, M. E-mail miguel.verdu@uv.es and Garcia-Fayos, P. Frugivorous birds mediate sex-biased facilitation in a dioecious nurse plant. *Journal of Vegetation Science*. 2003 Feb; 14(1):35-42.
Keywords: *Juniperus sabina/ Juniperus communis/* birds/ seed/ fruit
Abstract: Facilitation by dispersal occurs if the nurse plant acts as a focus which is actively selected by seed dispersers and enhances the fitness of the facilitated plant. Sex-biased facilitation may be produced if seed dispersers tend to concentrate the seeds under female, fruit-bearing plants of dioecious species more often than under conspecific males. *Juniperus sabina* is a dioecious shrub with a prostrate growth form from Mediterranean high mountains that modifies many microhabitat characteristics related to seedling establishment and survival. Soil water availability, maximum soil temperature in summer, organic matter and total nitrogen content, were different on open ground as compared with beneath *J. sabina* shrubs, irrespective of its sex. Other studied characteristics such as soil bulk density and soil compaction after rain did not differ between the microhabitats considered. Some species, such as *Juniperus communis*, *Pinus nigra*, *Helleborus foetidus* and *Euphorbia nicaeensis*, are spatially associated to *J. sabina* shrubs, strongly suggesting a facilitative role. The anemochorous *P. nigra* and myrmecochorous *H. foetidus* and *E. nicaeensis* did not associate preferentially to any sex of *J. sabina*. Only *J. communis*, an endozoochorous species sharing the same bird dispersers as *J. sabina*, presented a female-biased spatial association with the nurse plant. Seed dispersal mediated by birds attracted by the fruit-rewarding females of *J. sabina* explains the sex-biased spatial pattern of *Juniperus communis*.
108. Verheyen, K.; Schreurs, K.; Vanholen, B., and Hermy, M. Intensive management fails to promote recruitment in the last large population of *Juniperus communis* (L.) in Flanders (Belgium). *Biological Conservation*. 2005; 124(1):113-121.
Keywords: *Juniperus communis/* cutting/ forest management/ seed germination/ Belgium

Abstract: In this study, the effectiveness of management measures aimed at promoting recruitment in the last large Flemish juniper (*Juniperus communis*) population at Heiderbos (Belgium) is evaluated. We resurveyed demographic plots 23 years after their establishment in 1980 and linked the population changes with detailed records of the intensive management during the same period. The management regimes implemented in the area were: mowing, rotary cultivation, sod cutting and sod cutting + mowing. Between 1980 and 2003 the population size has decreased by 36% and has changed from a relatively immature to a mature population with very few young individuals. Based on a simple model that simulated height growth between 1980 and 2003, the recruitment and mortality rates were estimated to be 5 and 24 ha⁻¹ year⁻¹, respectively. Intensive management has thus not been able to promote recruitment and the population might go extinct within 40 years if these rates remain unchanged. Furthermore, some measures, notably the working of the soil, have increased mortality of established junipers. The reasons for the limited recruitment are not entirely clear yet, but it may be due to a combination of the limited availability of bare ground for germination and the extremely low viability of juniper seeds. The latter fact may be a common characteristic of many threatened juniper populations in northwestern Europe.

109. Vorob'eva, T. I. Some data on the morphogenesis of *Juniperus communis*. Biologicheskije Nauki. 1975; 164-70.

Keywords: *Juniperus communis*/ Moscow/ seedlings/ morphogenesis

Abstract: Distinguishes and describes the following stages in the tree life form of *J. communis* in the Moscow region: seedlings, juvenile plants (1-6 years), immature plants (6-13 years), semi-mature plants (14-17 years), mature vegetative plants (18-22 years), and sexually mature plants (23-50 years). Scrubby and prostrate life forms are also described.

110. Vries B de. Resupinate fungi on juniper, a provisional balance. Resupinate fungi op Jeneverbes, voorlopige balans. Coolia. 2001; 44(4):208-214.

Keywords: *Juniperus communis*/ Netherlands/ fungi

Abstract: Changes in the presence of resupinate fungi in eight stands of juniper (*Juniperus communis*) bushes in the province of Drenthe, Netherlands, were tabulated and analyzed on the basis of visits made pre-1980 and during 1999-2000. Of the 83 species found, 17 had increased and 14 declined, both in presence per plot and in numbers. Comparison with Barkman's study of 1985 indicates that the type of vegetation classified as *Squarroso-Juniperetum* (often old river-dunes, grazed, and therefore not so nutrient-poor) was more favourable to the development of that part of the mycoflora which was on the increase, whilst the nutrient-poorest types of vegetation (*Dicrano-Juniperetum* and *Helichryso-Juniperetum*) were more favourable to those fungi which were on the decrease.

111. Ward, L. K. The conservation of Juniper. I. Present status of Juniper in southern England. *Journal of Applied Ecology*. 1973; 10(1):165-188.
Keywords: *Juniperus communis*/ distribution/ density/ England
Abstract: Gives the results of a detailed survey, between 1968 and 1971, of the distribution, density and concentration of populations of *Juniperus communis* subsp. *communis* in southern England. Aspects of the age structure of colonies have been considered, especially the tendencies of colonies to be even-aged. The survey indicates the regions where Juniper has decreased to a critical degree and, for less critical areas, shows where local examples of stands of Juniper could be conserved.
112. ---. The conservation of juniper: longevity and old age. *Journal of Applied Ecology*. 1982; 19(3):917-928.
Keywords: *Juniperus communis*/ England/ age/ longevity/ growth rate/ populations
Abstract: The life-span of *Juniperus communis communis* appears to be c.100 yr in southern England on the chalk; in the north of England exceptional individuals reach >200 yr. Slower growing junipers can live longer, and the life-span can be correlated with the growth rate in the early years. Variability of growth rates makes comparison of trunk girths of specimens from different sites unreliable as a basis for estimating age. Seed production in older junipers is reduced. Sex ratios are often not 1:1; past history may be a factor in explaining sex ratios of present-day populations. Juniper populations are often roughly even-aged; in these cases study of age and expected longevity of the bushes allows for prediction of the ultimate life-span of such populations in the absence of regeneration. This is relevant to management of juniper on nature reserves.
113. ---. The conservation of juniper: the associated fauna with special reference to southern England. *Journal of Applied Ecology*. 1977; 14(1):81-120.
Keywords: *Juniperus communis*/ *Ligustrum bulgare*/ *Rosa canina*/ *Sambucus nigra*/ *Thelycrania sanguinea*/ *Viburnum lantana*/ arthropods/ nature conservation/ plant ecology.
Abstract: Phytophagous arthropods on *Juniperus* are listed together with their parasitic and predaceous arthropods [see FA 34, 6805]. Also listed are general predators, species associated with epiphytic algae and lichens, overwintering fauna and sheltering fauna. Over 100 common species are included. The faunas of *Juniperus communis*, *Ligustrum vulgare*, *Rosa canina* aggr., *Sambucus nigra*, *Thelycrania sanguinea* and *Viburnum lantana* are compared. From the results, the conservation of juniper and its fauna is discussed emphasizing the importance of species specific to this host.
114. Ward, L. K. and Lakhani, K. H. The conservation of juniper: the fauna of food-plant island sites in southern England. *Journal of Applied Ecology*. 1977; 14(1):121-135.

Keywords: *Juniperus communis*/ *Oligonychus ununguis*/ *Cinara juniperi*/ *Eupithecia pusillata*/ *Cyphostethus tristriatus*/ *Megastigmus bipunctatus*/ *Argyresthia praecocella*/ arthropod pests/ plant ecology/ England

Abstract: In southern England, 25 sites of indigenous juniper (*Juniperus communis*) visited in 1968-69 were considered as islands, since they tended to consist of concentrated groups somewhat isolated from one another. Since juniper is declining in numbers and conservation measures may be appropriate, the relationship between the specifically phytophagous fauna and the characteristics of the sampled sites were investigated in the light of biogeographical theories. Lists are given (with the frequency at each site) of 14 arthropod species found on sites in the North Downs in 1968, and of the same species with 1 additional one found on sites in the Chilterns in 1969. *Oligonychus ununguis* (Jac.), *Cinara juniperi* (Deg.) and *Eupithecia pusillata* (Den. & Schiff.) were the most common species in both regions, and the 3 species feeding on juniper fruits (*Cyphostethus tristriatus* (F.), *Megastigmus bipunctatus* (Swed.) and *Argyresthia praecocella* Zell.) were the species most rarely found. The number of species per site tended to vary according to the size of the site; bush age appeared to affect species composition on the North Downs but not on the Chilterns sites; and the degree of isolation of the site was not usually an important factor in species composition.

115. Wikus, E. P. Observations on the decline of *Pinus nigra* and *Juniperus communis* in the province of Trieste.

Osservazioni sulla moria di *Pinus nigra* Arn. e di *Juniperus communis* L. nella provincia di Trieste. *Economia Montana Linea Ecologica*. 1990; 22(6):14-17.

Keywords: *Juniperus communis*/ *Pinus nigra*/ Italy/ foliage loss/ natural regeneration

Abstract: Decline symptoms (foliage loss) of black pine (*P. nigra*) were monitored in spring, 1989, in 17 stands in NE Italy; for 3 of these stands the condition of juniper (*J. communis*) was also noted. For both species, 15% were classified as dead, and the same percentage were heavily damaged. The serious decline of juniper, which is the most common natural regeneration species, in the karst ecosystems of the region, is briefly discussed.

116. Zheronkina, TA. Structure of the seed-coat of Juniper and its role in germination. *Byulleten Glavnogo Botanicheskogo Sada*. 1974; 9167-72; ISSN: 0366-502X.

Keywords: *Juniperus communis*/ *Juniperus virginiana*/ seeds/ physiology/ germination/ anatomy/ conifers

Abstract: In continued work on sowing of unripe seed of *Juniperus communis* and *J. virginiana* [cf. FA 33, 549], an illustrated account is given of the structure of the seed-coat of seeds of these two species collected in May, June, July and October, and the process of the deposition

of lignin in the seed-coat is described. In Kazakhstan, the seeds are best able to germinate in early August (*J. communis*) and late Sept./early Oct. (*J. virginiana*) when the lateral suture of the seed-coat is open. When the 'berry' is morphologically ripe, the seeds enter deep dormancy, with closure of the suture, deposition of lignin in the stone cells, and lignification of the parenchyma.

***Juniperus communis* L. susp. *communis* (1)**

1. Klimko, Malgorzata and Jankowska, Anita. Variability of berry-like of *Juniperus communis* L. subsp. *communis* of West Pomerania. Biological Bulletin of Poznan. 1998; 35(2):85-102.

Keywords: *Juniperus communis* L. susp. *communis*/ West Pomerania/ seeds/ berry-like/ resin canals

Abstract: This work presents study results on the variability of berry-like and seeds from *Juniperus communis* L. subsp. *communis*. Thirty samples originated from two localities: Bukowa Virgin Forest and Goleniowska Virgin Forest (West Pomerania). The material was analyzed regarding six features: length, width, width-to-length ratio of berry-like, number of seeds, type of seed arrangement and the number of resin canals. In result of detailed biometrical and statistical studies, a distinct correlation of the following features was found: length and width of berry-like, number of seeds and number of resin canals. Berries-like are characterized by a small variability both within and between the samples.

***Juniperus communis* var. *depressa* (1)**

1. Houle, Gilles and Babeux, Patrice. Variations in rooting ability of cuttings and in seed characteristics of five populations of *Juniperus communis* var. *depressa* from subarctic Quebec. Canadian Journal of Botany. 1994; 72(4):493-498.

Keywords: *Juniperus communis* var. *depressa*/ Canada/ Quebec/ cuttings/ seed/ seedlings

Abstract: *Juniperus communis* var. *depressa* is a species with potential for site restoration in the Canadian subarctic and low arctic. We assessed this potential by evaluating the rooting ability of cuttings and the seed quality of five populations of the species along the east coast of Hudson Bay, in subarctic Quebec. Cuttings of male and female plants were sampled from each site. Cones were collected, and seeds were extracted, weighed, and then tested for viability. Cuttings from female plants rooted more easily than those from male plants. At high indolyl-3-butyric acid concentration, rooting of female cuttings was inhibited. Among-population differences in rooting ability were large: cuttings from the northernmost population rooted more easily than those from sites further south. Seed number per cone and seed mass and viability also varied significantly among sites. Of the populations studied, the northernmost one produced the lightest seeds and the southernmost one produced the

heaviest seeds. *Juniperus* presents some potential for restoration, but transplant (cutting or seedling) performance in the field should be evaluated before any definite recommendations are made. There is some evidence that seed quality and rooting ability are characteristics that are negatively related in *Juniperus*, although the basis of such a trade-off has not been investigated.

Juniperus conferta (19)

1. Adams, Robert P.; Hsieh, Chang-Fu; Murata, Jim, and Pandey, Ram Nanresh. Systematics of *Juniperus* from eastern Asia based on Random Amplified Polymorphic DNA's (RAPDs) . Biochemical Systematics and Ecology . 2002 Mar; 30(3):231-241; ISSN: 0305-1978.
Keywords: *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus conferta*/ *Juniperus formosana*/ *Juniperus procumbens*/ *Juniperus rigida*/ *Juniperus taxifolia*/ RAPS's/ DNA/ Taiwan/ China
Call Number: QD415.A1B5
Abstract: DNA was examined by RAPD banding for *Juniperus chinensis*, *J. c.* var. *sargentii*, *J. c.* var. *tsukusiensis*, *J. communis*, *J. c.* var. *nipponica*, *J. c.* var. *saxatilis*, *J. conferta*, *J. formosana*, *J. procumbens*, *J. rigida*, *J. taxifolia*, and *J. t.* var. *lutchuensis*. The DNA data readily separated junipers of section *Sabina* from section *Juniperus*. *J. c.* var. *tsukusiensis* from Taiwan was found to be sufficiently different from *J. c.* var. *tsukusiensis* (Yakushima) to warrant the recognition of a new variety: *J. chinensis* var. *taiwanensis* R.P. Adams and C-F. Hsieh *nov. var.* *Juniperus formosana* from mainland China was found to be different from *J. formosana* from Taiwan and a new variety is recognized: *J. formosana* var. *mairei* (Lemee and Lev.) R.P. Adams and C-F. Hsieh *comb. nov.* *Juniperus communis* var. *nipponica* was found to be distinct from *J. communis* and this supports its recognition as a variety. The recognition of *J. conferta* as a variety of *J. rigida* [*J. rigida* var. *conferta* (Parl.) Patschke] is supported by the data. The data also supports the recognition of *J. lutchuensis* Koidz. [= *J. taxifolia* var. *lutchuensis* (Koldz.) Satake] and *J. morrisonicola* Hayata [= *J. squamata* var. *morrisonicola* (Hayata) H.L. Li and H. Keng] at the specific levels.
2. Clay H. Quality shore juniper varieties. American Nurseryman. 1976; 143(9):69-70.
Keywords: *Juniperus conferta*/ growth/ varieties
Abstract: Descriptions are given of the growth habit and other characteristics of 4 *Juniperus conferta* selections.
3. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secrest Arboretum. Special Circular Ohio Agricultural Research and Development Center. 1992; 14032-34.
Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus*

chinensis/ Juniperus davurica/ Juniperus virginiana/ Juniperus scopulorum/ Juniperus squamata/ growth habit

Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate or convergent. All plants were also evaluated for growth characteristics of open or closed outline.

4. Creech, John L. Asian natives for American landscapes . American Nurseryman. 1984 Jun 1; 159(11):55-56; ISSN: 0003-0198.
Keywords: *Juniperus conferta/* shore juniper/ Japan/ cultivars
Call Number: 80 AM371
Abstract: *Juniperus conferta* is found in solid mats along sandy beaches in Japan all the way north to Sakhalin Island. Two cultivars are available to the American nursery trade, 'Blue Pacific' and 'Emerald Sea'. In 1968 the author arranged to get cuttings from Japanese junipers and they were propagated by the Soil Conservation Service and have been named 'Emerald Sea', and now appear in commercial nursery trade.
5. Derr, J. F. Tolerance of woody nursery stock to classic chlorimuron and harmony thiameturon. Journal of Environmental Horticulture. 1991; 9(1):9-13.
Keywords: *Juniperus chinensis/ Juniperus conferta/ Senecio vulgaris/ Cyperus esculentus/ Ilex crenata/ Rhododendron/ Photinia/* classic chlorimuron/ harmony thiameturon/ preemergence/ postemergence
Abstract: Classic and Harmony applied at rates ranging from 0.009 kg ai/ha (0.008 lb ai/A) to 0.067 kg/ha (0.06lb/A) provided excellent preemergence and postemergence control of common groundsel (*Senecio vulgaris* L.) 5 weeks after application to container-grown nursery plants. Classic at 0.034 kg/ha (0.03 lb/A) and 0.067 kg/ha (0.06 lg/A) reduced yellow nutsedge (*Cyperus esculentus* L.) growth by 50 to 77% 5 weeks after preemergence or postemergence treatments. Harmony did not affect yellow nutsedge from either type of application. 'Seagreen' juniper (*Juniperus chinensis* L.), 'Blue Pacific' juniper (*Juniperus conferta* Parl.) and 'Bennetts Compacta' holly (*Ilex crenata* Thumb.) tolerated all rates of Classic and Harmony. 'Girard's Rose' (*Rhododendron kaempferi* Planch.) and 'Coral Bells' azalea (*Rhododendron obtusum* (Lindl.) Planch.), and redtip photinia (*Photinia .times. fraseri* Dress) were initially injured by these herbicides, but outgrew the foliar damage.
6. Dirr, Michael A. Effects of P-ITB and IBA on the rooting response of 19 landscape taxa. Journal of Environmental Horticulture. 1990 Jun; 8(3):83-85; ISSN: 0738-2898.
Keywords: *Juniperus conferta/* shore juniper/ rooting/ propagation
Call Number: SB1.J66

Abstract: A new root promoting chemical P-ITB (phenyl indole-3-thiolobutyrate) was compared with IBA (1*H*-indole-3-butanoic acid) for activity on 19 woody taxa. P-ITB at 0.5% was as effective as 0.5% IBA for the plants tested. For difficult-to-root taxa like *Amerlanchier arborea*, *Photinia x fraseri* and *Zelkova serrata*. P-ITB promoted excellent rooting. The chemical is as effective as IBA and was not injurious at the 2.0% level.

7. Fravel, D. R. and Benson, D. M. Etiology of shore juniper decline. *Phytopathology*. 1979; 69(5):527 pp.
Keywords: *Juniperus conferta*/ *Phytophthora cinnamomi*/ etiology
Abstract: Typical decline symptoms are described for *Juniperus conferta*. Similar symptoms were observed after infection by *Phytophthora cinnamomi*, water stress (excess or depletion), and exposure to NO₂, SO₂, and O₃.
8. Fravel, D. R.; Benson, D. M., and Bruck, R. I. Edaphic parameters associated with shore juniper decline. *Phytopathology*. 1983; 73(2):204-207.
Keywords: *Juniperus conferta*/ plant disorders/ nutrient deficiencies/ water stress/ plant pathology
Abstract: In the absence of a biotic agent as the primary cause of decline of *Juniperus conferta*, a popular landscape shrub, abiotic factors were examined to determine their roles in contributing to the disorder. Of 20 edaphic components measured in 20 landscape plantings, 6 (Ca, clay + silt content, Mg, nitrate, P and Zn) were significantly interrelated to decline index in a multivariate principal axis factor analysis. Where soil horizons could be distinguished, parameters of the A + B horizon were better indicators of decline than those of the C horizon. Supportive evidence for the involvement of these components was provided by tissue nutrient analysis from landscape plantings and from glasshouse studies of nutrient deficiencies and water stress in which N deficiency and, in 1 case, both water excesses and deficiencies, induced symptoms resembling decline.
9. Fravel, D. R.; Benson, D. M., and Reinert, R. A. Response of shore juniper to ozone alone and in mixture with sulfur dioxide and nitrogen dioxide. *HortScience*. 1984; 19(5):694-695.
Keywords: *Juniperus conferta*/ air pollution/ pollutant interaction/ pollution; damage.
Abstract: A single 4 hour exposure of shore juniper, *Juniperus conferta* Parl., to 0.3 ppm O₃, alone or in combination with 0.15 ppm nitrogen dioxide and/or sulfur dioxide, produced a significant number of small (<3mm), elongate, tan foliar lesions 2 to 4 days after exposure. The injury symptoms were not identical to those associated with shore juniper decline.
10. Gill, D. L. Root and crown rot of shore juniper (*Juniperus conferta*): cause and control. *Plant Disease Reporter*. 1977; 61(7):584-587.
Keywords: *Juniperus conferta*/ *Phytophthora cinnamomi*/ P.

nicotianae/ Pythium irregulare/ Pythium sylvaticum/ roots/ crowns/
Pyroxychlor/ fungicides/ foliar spray/ drench

Abstract: *Phytophthora cinnamomi*, *P. nicotianae* var. *parasitica*, *Pythium irregulare* and *P. sylvaticum* attacked roots and crowns of *J. conferta* plants in containers. Pyroxychlor, used as a drench immediately after planting or sprayed on infested media before planting, reduced the effect of *P. cinnamomi*, but it was not effective as a foliar spray. A drench of ETMT also reduced *P. cinnamomi* damage. Pyroxychlor, ETMT, and thiophanate-methyl + ETMT drenches also controlled root and crown rot in a commercial nursery, but foliar sprays of pyroxychlor, ETMT and zinc ion-maneb complex did not.

11. Johnson, C. R. and Hamilton, D. F. Effects of media and controlled-release fertilizers on rooting and leaf nutrient composition of *Juniperus conferta* and *Ligustrum japonicum* cuttings. *Journal of the American Society for Horticultural Science*. 1977; 102(3):320-322.
Keywords: *Juniperus conferta/ Ligustrum japonicum/* plant composition/ nurseries/ propagation/ cuttings/ Osmocote/ fertilizer
Abstract: Semi-hardwood cuttings of *Ligustrum japonicum* and *Juniperus conferta* were propagated in sand or sand-peat (1:1 by volume) and top-dressed with 18-6-12 or 14-14-14 Osmocote (18N-2.6P-10K and 14N-6P-16.6K, respectively). Percent rooting was improved by Osmocote after 8 weeks although all *L. japonicum* cuttings were rooted after 12 weeks. Fresh weight of roots and dry weight of tops were improved by Osmocote treatment. N and P levels of leaf tissue increased with Osmocote top dressing compared to unfertilized controls. Percent rooting was initially superior in sand but after 10 weeks all cuttings were rooted and root development was greater in sand-peat.
12. Keever, G. J. and Cobb, G. S. Comparison of propagation and transplanting sequences for container production of our woody landscape plants. *Applied Agricultural Research*. 1989; 4(3):222-225.
Keywords: *Juniperus conferta/ Lagerstroemia/ Rhododendron/* containers/ cuttings/ transplanting
Abstract: Seven propagation and transplanting sequences were compared for the container production of "Basham's Party Pink" crapemyrtle (*Lagerstroemia indica* .times. *L. fauriei*), "Blue Pacific" juniper (*Juniperus conferta* Parl.), 'George Tabor' azalea (*Rhododendron* .times. sp.), and "Hino Crimson" azalea (*Rhododendron* .times.sp). Cuttings propagated in 3-L (0.8-gal) containers were slower to root than those propagated in cell pacs or 8-cm (3-in.) containers; however, percent rooting did not differ among treatments. After 12 months, shoot and root growth were generally greatest for cuttings propagated in larger containers and least when cuttings were rooted in cell pacs and subsequently transplanted into 8-cm and then into 3-L containers. Two cuttings per container increased growth per container for azalea and juniper but not for crapemyrtle.

13. Kozhevnikova, Z. V. Anatomical structure of the stem of Far Eastern species of juniper in relation to the features of root formation in cuttings. Byulleten' Glavnogo Botanicheskogo Sada. 1991; 16034-41.
Keywords: *Juniperus rigida*/ *Juniperus sibirica*/ *Juniperus conferta*/ *Juniperus dahurica*/ *Juniperus sargentii*/ vegetative propagation/ roots/ adventitious roots.
Abstract: Anatomical studies were made of the stems (often trailing or prostrate) of *Juniperus rigida*, *J. sibirica*, *J. conferta*, *J. dahurica* and *J. sargentii*, with special reference to the bark and the initiation of roots. All five species are capable of propagation by cuttings, and all of them produce a few or numerous root primordia on the stems in the crown, except for *J. rigida*. In lignified cuttings of *J. sibirica*, *J. conferta* and *J. sargentii* the root system is formed by adventitious roots all along the part of the stem in the soil and also from wound callus at the cut surface. *J. dahurica* forms roots mainly along the stem in the soil, and *J. rigida* mainly from the wound callus. In green cuttings in all five species the roots are formed only from the wound meristems.
14. ---. Seed anatomy and some peculiarities of germination in Soviet Far Eastern species of juniper. Byulleten' Glavnogo Botanicheskogo Sada. 1986; 14199-107; ISSN: 0366-502X.
Keywords: *Juniperus conferta*/ *Juniperus rigida*/ *Juniperus davurica*/ *Juniperus sargentii*/ *Juniperus sibirica*/ seeds/ morphology/ germination/ seed anatomy/ conifers
Abstract: Seeds of *Juniperus conferta*, *J. davurica*, *J. rigida*, *J. sargentii* and *J. sibirica* were collected in the Far East and examined by light microscopy and SEM. Data are tabulated on the max., min. and mean seed dimensions, spermoderm thickness and size of resin capsules, and the mean cell sizes in the tissues of the seed coat. In *J. davurica* and *J. sargentii*, the spermoderm was differentiated into 3 layers with a fleshy outer layer (sarcotesta). Observations are reported on seasonal reproductive behaviour, and anatomical development of the seed and ripening of the fruits are described. The resin capsules of the seed were derived from fruit tissue. Seeds from ripe fruits were in a state of deep rest. For rapid germination, seed extraction is recommended 1.5-2 months before the ripening of the fruits.
15. ---. Vegetative propagation of Far Eastern junipers in the southern Maritime Province. Byulleten' Glavnogo Botanicheskogo Sada. 1991; 16190-98.
Keywords: *Juniperus rigida*/ *Juniperus conferta*/ *Juniperus sibirica*/ *Juniperus dahurica*/ *Juniperus sargentii*/ cuttings/ propagation/ rooting
Abstract: An account is given of experience in propagating *Juniperus rigida*, *J. conferta*, *J. sibirica*, *J. dahurica* and *J. sargentii* by cuttings. It is best to use lignified cuttings taken from the terminal part of stout shoots containing two complete annual extensions. Green cuttings are only feasible with *J. dahurica* and *J. sargentii*. Cuttings should be rooted at the beginning or in the first half of the growing season; summer/autumn

rooting is preferable only for *J. rigida*. The cuttings should be inserted at an angle - greatest for cuttings of prostrate species and least (i.e. nearly upright) for arborescent species. *J. dahurica*, *J. sibirica* and *J. conferta* root easily, mainly from the rudiments of adventitious roots and also from wound meristems, in one growing season; *J. rigida* and *J. sargentii* are more difficult to root, forming only wound callus in the first growing season and rooting in the second year.

16. Neal, J. C.; Skroch, W. A., and Monaco, T. J. Effects of plant growth stage on glyphosate absorption and transport in ligustrum (*Ligustrum japonicum*) and blue pacific juniper (*Juniperus conferta*). Weed Science. 1986; 34(1):115-121.
Keywords: *Juniperus conferta*/ *Ligustrum*/ glyphosate/ growth/ absorption/ transport
Abstract: 14C-labelled glyphosate was applied to the foliage of *L. japonicum* and *J. conferta* cv. Blue Pacific at various growth stages. At shoot elongation, *J. conferta* plants absorbed 2% of applied 14C by 14 days after treatment (DAT). Applications at other growth stages resulted in no significant absorption of 14C by *J. conferta*. Within 7 DAT the amounts of radioactivity absorbed by *L. japonicum* were significant and depended upon growth stage in the following order: budbreak < shoot termination < shoot elongation. Absorption by overwintered leaves occurred at budbreak but not at elongation or termination. Transport of absorbed 14C in *L. japonicum* was primarily acropetal and occurred only in budbreak and flowering treatments. Differences in tolerance to glyphosate between *J. conferta* and *L. japonicum* appear to be related to differential absorption. Seasonal differences in *L. japonicum* tolerance also appear to be associated with differences in absorption. Although growth stage affected transport in *L. japonicum*, differential transport does not appear to play a major role in seasonal influences on long-term glyphosate phytotoxicity.
17. Neal, Joseph C. and Senesac, Andrew F. Cultivar differences in postemergence graminicide phytotoxicity to *Juniperus*. HortScience. 1989 Feb; 24(1):96-98; ISSN: 0018-5345.
Keywords: *Juniperus horizontalis*/ *Juniperus chinensis*/ *Juniperus conferta*/ herbicides/ phytotoxicity
Call Number: SB1.H6
Abstract: Several juniper species and cultivars were compared by sensitivity to labeled and experimental postemergence graminicides. The junipers treated were: *Juniperus horizontalis* Moench. 'Wiltonii' (blue rug), *J. h.* 'Bar Harbor', *J. h.* 'Youngstown' (Youngstown Andorra), *J. chinensis* L. ; 'Pfitzeriana' (Pfitzer), *J. c.* 'Parsonii' (Parson's), *J. c.* 'Sargentii' (Sargent's), and *J. conferta* Parl. (shore). The herbicide treatments were fluazifop-p, sethoxydim, haloxyfop, quizalofop, cycloxydim, and fenoxaprop at recommended rates for annual grassy weed control, with recommended spray adjuvants. 'Bar Harbor' juniper was injured, in decreasing order of severity, by haloxyfop, fenoxaprop,

quizalofop, and fluazifop. Sethoxydim and cycloxydim produced no reduction in plant fresh weight for the juniper cultivars tested. However, sethoxydim plus adjuvants did reduce 'Bar Harbor' juniper visual quality ratings in 1986. Pfitzer juniper was slightly injured by haloxyfop in 1985 and by fenoxaprop in 1986. The other junipers were unaffected by herbicide treatments. Chemical names used: (R) -2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoic acid (fluazifop), (±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy] propanoic acid (fenoxaprop), 2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoic acid (haloxyfop), (±) -2-[4-[(6-chloro-2-quinoxalanyl)oxy]phenoxy] propanoic acid (quizalofop), 2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one (sethoxydim), and 2-[1-(ethoxyimino)butyl]-3-hydroxy-5-(2*H*-tetrahydrothiopyran-3-yl)-2-cyclohexen-1-one (cycloxydim).

18. Normandy, Philip M. *Juniperus conferta*. Public Gardens Journal, American Association of Botanical Garden Arboretums. 1991 Oct; 6(4):36-37; ISSN: 0885-3894.
Keywords: *Juniperus conferta*/ shore juniper/ *Juniperus horizontalis*/ cultivar
 Call Number: QK71.P83
Abstract: *Juniperus conferta* 'Silver Mist' was selected in Japan for its bright silver-blue needles and sent to Brookside Gardens in 1982. The importance of this cultivar is that it provides useful color, habit, and texture variations from both the standard "blue rug" types of *Juniperus horizontalis* and existing forms of *Juniperus conferta*.
19. Tereshkovich, George. *Juniperus* species: evergreen ground covers. Research Report. University of Georgia, College of Agriculture Experiment Stations. 1969; 3610.
Keywords: *Juniperus conferta*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus horizontalis*/ *Juniperus japonica*/ *Juniperus procumbens*/ *Juniperus sabina*/ *Juniperus scopulorum*
 Call Number: S51.R22
Abstract: The following *Juniperus* spp. cultivars are better adapted for the Georgia Piedmont: *Juniperus* Blue Pfitzer, *Juniperus conferta* (Shore Juniper), *Juniperus chinensis* Sargenti, *Juniperus chinensis pfitzeriana aurea* (Golden tip Pfitzer), *Juniperus davurica* (Squamata expansa) *parsoni*, *Juniperus horizontalis andorra*, *Juniperus horizontalis andorra* compacts, *Juniperus horizontalis andorra*, (Aunt Jamina), *Juniperus horizontalis plumosa*, (Andorra juniper), *Juniperus horizontalis* 'Douglasi' (Waukegan), *Juniperus japonica* (San Jose), *Juniperus procumbens*, *Juniperus sabina* 'Arcadia', and *Juniperus scopulorum*, (White Silver King). These species are very hardy plants, able to withstand extremes in temperature, and provide excellent ground cover for landscaping around the home, in parks, and in highway beautification programs.

***Juniperus convallium* (2)**

1. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. Acta Horticulturae. 2003; 61291-106.
Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.
Abstract: Several cases involving apparent discordance in morphological, chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var. *microsperma*, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var. *squamata*, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.
2. ---. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). USABiochemical Systematics & Ecology. 2000; 28(6):529-543.
Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus pseudosabina*/ *Juniperus recurva*/ *Juniperus saltuaria*/ *Juniperus squamata*/ *Juniperus tibetica*/ *Juniperus wallichiana*/ RAPD/ DNA/ essential oils
Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallichiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

Juniperus coreana (1)

1. Man Kyu Huh and Hong Wook Huh . Genetic diversity and population structure of *Juniperus rigida* (*Cupressaceae*) and *Juniperus coreana*. *Evolutionary Ecology*. 2000; 14(2):87-98.

Keywords: *Juniperus rigida*/ *Juniperus coreana*/ Korea/ genetic diversity/ population structure/ alleles

Abstract: Enzyme electrophoresis was used to estimate genetic diversity and population structure of *Juniperus rigida* (*Cupressaceae*) and *Juniperus coreana* in Korea. In *J. rigida*, 16 of the 22 loci (72.7%) showed detectable polymorphism. Genetic diversity (0.224) was higher than average values for species with similar life history traits. The endemic species (*J. coreana*) was found to have fewer alleles per locus (1.39 vs. 1.61), fewer alleles per polymorphic locus (2.42 vs. 2.63), lower percent polymorphic locus (54.6 vs. 72.7%), and lower diversity (0.199 vs. 0.224) than *J. rigida*. These genetic diversity parameters indicated that *J. coreana* was genetically depauperate relative to its presumptive progenitor, *J. rigida*. Analysis of fixation indices showed a substantial deficiency of heterozygotes relative to Hardy-Weinberg expectations suggesting inbreeding in *J. coreana*. The G_{ST} values of *J. rigida* and *J. coreana* were 0.173 and 0.118 respectively. The indirect estimate of gene flow based on mean G_{ST} was moderate ($N_m = 1.19$ for *J. rigida* and 1.86 for *J. coreana*).

Juniperus dahurica (2)

1. Kozhevnikova, Z. V. Anatomical structure of the stem of Far Eastern species of juniper in relation to the features of root formation in cuttings. *Byulleten' Glavnogo Botanicheskogo Sada*. 1991; 16034-41.

Keywords: *Juniperus rigida*/ *Juniperus sibirica*/ *Juniperus conferta*/ *Juniperus dahurica*/ *Juniperus sargentii*/ vegetative propagation/ roots/ adventitious roots.

Abstract: Anatomical studies were made of the stems (often trailing or prostrate) of *Juniperus rigida*, *J. sibirica*, *J. conferta*, *J. dahurica* and *J. sargentii*, with special reference to the bark and the initiation of roots. All five species are capable of propagation by cuttings, and all of them produce a few or numerous root primordia on the stems in the crown, except for *J. rigida*. In lignified cuttings of *J. sibirica*, *J. conferta* and *J. sargentii* the root system is formed by adventitious roots all along the part of the stem in the soil and also from wound callus at the cut surface. *J. dahurica* forms roots mainly along the stem in the soil, and *J. rigida* mainly from the wound callus. In green cuttings in all five species the roots are formed only from the wound meristems.

2. ---. Vegetative propagation of Far Eastern junipers in the southern Maritime Province. *Byulleten' Glavnogo Botanicheskogo Sada*. 1991; 16190-98.

Keywords: *Juniperus rigida*/ *Juniperus conferta*/ *Juniperus sibirica*/ *Juniperus dahurica*/ *Juniperus sargentii* / cuttings/ propagation/ rooting

Abstract: An account is given of experience in propagating *Juniperus rigida*, *J. conferta*, *J. sibirica*, *J. dahurica* and *J. sargentii* by cuttings. It is best to use lignified cuttings taken from the terminal part of stout shoots containing two complete annual extensions. Green cuttings are only feasible with *J. dahurica* and *J. sargentii*. Cuttings should be rooted at the beginning or in the first half of the growing season; summer/autumn rooting is preferable only for *J. rigida*. The cuttings should be inserted at an angle - greatest for cuttings of prostrate species and least (i.e. nearly upright) for arborescent species. *J. dahurica*, *J. sibirica* and *J. conferta* root easily, mainly from the rudiments of adventitious roots and also from wound meristems, in one growing season; *J. rigida* and *J. sargentii* are more difficult to root, forming only wound callus in the first growing season and rooting in the second year.

***Juniperus davurica* (5)**

1. Adams R. P.; Shatar S., and Dembitsky A. D. Comparison of the volatile leaf oils of *Juniperus davurica* Pall. from Mongolia, with plants cultivated in Kazakhstan, Russia and Scotland. *Journal of Essential Oil Research*. 1994; 6(3):217-221.

Keywords: *Juniperus davurica*/ chemical composition/ plant genetic resources.

Abstract: The composition of the volatile oils, steam-distilled from leaves of *J. davurica* (collected from Mongolia), putative *J. davurica* plants (cultivated in Alma Ata Botanic Gardens, Kazakhstan, and Moscow, Russia), and *J. davurica* cv. *Expansa Variegata* (cultivated in the Royal Botanic Garden, Edinburgh, Scotland), were analyzed by GC-MS and compared with the essential oil of *J. chinensis* (from Gansu, China). Ninety-nine compounds were identified. The major constituents of *J. davurica* (Mongolia) were sabinene (28.6%), cedrol (11.5%), methyl citronellate (7.4%), citronellol (6.5%), terpinen-4-ol (5.8%) and alpha-pinene (4.1%). In contrast, the major compounds of *J. davurica* cv. *Expansa Variegata* were bornyl acetate (23.5%), sabinene (13.1%), terpinen-4-ol (7.7%), manool (6.3%) and myrcene (6.0%). The main constituents from the putative *J. davurica* plants from Kazakhstan and Russia were alpha-pinene (15.5 and 12.8%, respectively), sabinene (11.4 and 9.2%), limonene (18.4 and 15.0%), abieta-7,13-diene-3-one (9.0 and 9.3%) and elemol (6.9 and 5.2%). The main constituents of the *J. chinensis* volatile oil were cedrol (20.1%), sabinene (17.8%), alpha-pinene (16.7%) and limonene (15.1%). The large number and high concentrations of diterpenes in the putative *J. davurica* plants from Kazakhstan and Moscow indicate that they may represent a divergent variety of *J. chinensis* or some other taxon.

2. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus*

cultivars at the Secret Arboretum. Special Circular Ohio Agricultural Research and Development Center. 1992; 14032-34.

Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus virginiana*/ *Juniperus scopulorum*/ *Juniperus squamata*/ growth habit

Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate or convergent. All plants were also evaluated for growth characteristics of open or closed outline.

3. Kozhevnikova, Z. V. Seed anatomy and some peculiarities of germination in Soviet Far Eastern species of juniper. Byulleten' Glavnogo Botanicheskogo Sada. 1986; 14199-107; ISSN: 0366-502X.

Keywords: *Juniperus conferta*/ *Juniperus rigida*/ *Juniperus davurica*/ *Juniperus sargentii*/ *Juniperus sibirica*/ seeds/ morphology/ germination/ seed anatomy/ conifers

Abstract: Seeds of *Juniperus conferta*, *J. davurica*, *J. rigida*, *J. sargentii* and *J. sibirica* were collected in the Far East and examined by light microscopy and SEM. Data are tabulated on the max., min. and mean seed dimensions, spermoderm thickness and size of resin capsules, and the mean cell sizes in the tissues of the seed coat. In *J. davurica* and *J. sargentii*, the spermoderm was differentiated into 3 layers with a fleshy outer layer (sarcotesta). Observations are reported on seasonal reproductive behaviour, and anatomical development of the seed and ripening of the fruits are described. The resin capsules of the seed were derived from fruit tissue. Seeds from ripe fruits were in a state of deep rest. For rapid germination, seed extraction is recommended 1.5-2 months before the ripening of the fruits.

4. Ruth, J.; Klekowski, E. J. Jr., and Stein, O. L. Impermanent initials of the shoot apex and diplontic selection in a juniper chimera. American Journal of Botany. 1985; 72(7): 1127-1135.

Keywords: *Juniperus davurica*/ shoot apex/ meristems/ cells/ albino

Abstract: Shoot meristems of *Juniperus davurica* cv. *Expansa variegata* possess an apical zonation pattern similar to that found in some angiosperms. Anticlinal divisions predominate in the outer layer, the tunica. The underlying core of cells, the corpus, has cell divisions oriented in all directions. Typically, this variety exists as a periclinal chimaera, the outer layer genotypically albino and the inner core composed of normal, chlorophyll-producing cells. In this condition a shoot appears green. Occasionally a tunica cell divides periclinally and displaces an initial in the apical region of the corpus. This event is subsequently expressed during

ontogeny as an albino sector on the stem and leaves. Frequent variation in the width of an albino sector throughout ontogeny suggests a temporary nature of cells in the position of apical initials. A correlation was documented between the position of axillary bud release and a subsequent increase or decrease in the width of an albino sector. A model based upon stochastic processes and diplontic selection is proposed to account for the dynamic nature of chimaeric patterns observed in this plant.

5. Tereshkovich, George. *Juniperus* species: evergreen ground covers . Research Report. University of Georgia, College of Agriculture Experiment Stations. 1969; 3610 .

Keywords: *Juniperus conferta*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus horizontalis*/ *Juniperus japonica*/ *Juniperus procumbens*/ *Juniperus sabina*/ *Juniperus scopulorum*

Call Number: S51.R22

Abstract: The following *Juniperus* spp. cultivars are better adapted for the Georgia Piedmont: *Juniperus* Blue Pfitzer, *Juniperus conferta* (Shore Juniper), *Juniperus chinensis* Sargentii, *Juniperus chinensis pfitzeriana aurea* (Golden tip Pfitzer), *Juniperus davurica* (Squamata expansa) *parsoni*, *Juniperus horizontalis andorra*, *Juniperus horizontalis andorra* compacta, *Juniperus horizontalis andorra*, (Aunt Jamina), *Juniperus horizontal plumosa*, (Andorra juniper), *Juniperus horizontalis* 'Douglasi' (Waukegan), *Juniperus japonica* (San Jose), *Juniperus procumbens*, *Juniperus sabina* 'Arcadia', and *Juniperus scopulorum*, (White Silver King). These species are very hardy plants, able to withstand extremes in temperature, and provide excellent ground cover for landscaping around the home, in parks, and in highway beautification programs.

Juniperus deltoides (1)

1. Adams R. P.; Morris J. A.; Pandey R. N., and Schwarzbach A. E. Cryptic speciation between *Juniperus deltoides* and *Juniperus oxycedrus* (*Cupressaceae*) in the Mediterranean. Biochemical Systematics and Ecology. 2005; 33(8):771-787.

Keywords: *Juniperus deltoides*/ *Juniperus oxycedrus*/ *Juniperus navicularis*/ *Juniperus macrocarpa*/ DNA sequencing/ genetic markers/ Europe/ Morocco/ Turkey

Abstract: Analyses of individuals classically treated as *Juniperus oxycedrus* L. var. *oxycedrus* from Morocco, Portugal, Spain, France, Italy, Greece and Turkey, using DNA sequencing of nrDNA (ITS 1, 5.8S, ITS 2) plus RAPDs, leaf terpenoids and morphology revealed that two cryptic, genetically distinct but morphologically almost identical species are present. These species, *J. oxycedrus* L. var. *oxycedrus* and *Juniperus deltoides* R.P. Adams, are about as different from each other as *Juniperus navicularis* and *Juniperus macrocarpa* are from *J. oxycedrus* var. *oxycedrus*. Examination of herbarium specimens revealed that the two species are largely allopatric with *J. deltoides* occurring from Italy

eastward through Turkey into the Caucasus Mts. and Iran. *J. oxycedrus* var. *oxycedrus* appears to be largely concentrated west of Italy (France, Spain, Portugal, Morocco). Cryptic speciation is discussed.

Juniperus deppeana (14)

1. Adams, R. P. Reevaluation of the biological status of *Juniperus deppeana* var. *sperryi* Correll. *Brittonia*. 1973; 25(3):284-289.

Keywords: *Juniperus deppeana*/ *Juniperus pinchotii*/ *Juniperus flaccida*/ hybridization/ morphology/ terpenoids

Abstract: Gives the results of an examination of the terpenoids and morphological characters of foliage and bark from the type tree of *J. deppeana* var. *sperryi* and from trees of natural populations of *J. d.* var. *deppeana*, *J. pinchotii* and *J. flaccida*. The terpenoid data suggest that the variety is most closely related to *J. d.* var. *deppeana*, and no evidence was found of hybridization with *J. flaccida*. In some morphological characters, however, the variety is intermediate between the two last, and the probability of a hybrid origin is discussed. The new combination *J. deppeana* f. *sperryi* is proposed.

2. ---. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana*/ *Juniperus ashei*/ *Juniperus californica*/ *Juniperus coahuilensis*/ *Juniperus comitana*/ *Juniperus deppeana*/ *Juniperus durangensis*/ *Juniperus flaccida*/ *Juniperus gamboana*/ *Juniperus jaliscana*/ *Juniperus monosperma*/ *Juniperus monticola*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Juniperus pinchotii*/ *Juniperus saltillensis*/ *Juniperus standleyi*/ essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

3. Aldon E. F. and Loring T. J. Ecology, uses, and management of pinyon-juniper

woodlands. Proceedings of the workshop, March 24-25, 1977, Albuquerque, New Mexico. USDA Forest Service General Technical Report, Rocky Mountain Forest and Range Experiment Station. (RM-39). 1977; RM-39(III):48.

Keywords: *Juniperus osteosperma*/ *Juniperus scopulorum*/ *Juniperus monosperma*/ *Juniperus deppeana*/ *Pinus edulis*/ *Pinus monophylla*/ *Pinus cembroides*/ *Pinus quadrifolia* / ecology/ pinyon-juniper woodlands

Abstract: Pinyon (*Pinus edulis*, *P. monophylla*, *P. cembroides*, and *P. quadrifolia*)/juniper (*Juniperus osteosperma*, *J. scopulorum*, *J. monosperma* and *J. deppeana*) woodlands occupy 33 million acres in W. USA. Twelve papers were presented on the type in 3 sections: Ecology of pinyon juniper woodlands: Pieper, R.D. The southwestern pinyon/juniper ecosystem. [16 ref.] Clendenen, G.W. Pinyon and juniper inventory procedures. Little, E.L., Jr. Research in the pinyon/juniper woodland. [16 ref., 1 pl., 4 maps] Smith, T, Insects and diseases of pinyon/juniper. Swenson, E. Pinyon/juniper wildlife habitats. Baxter, C. A comparison between grazed and ungrazed juniper woodland. Uses and potential of the woodland zone: Ffolliott, P.F. Product potential of pinyon/juniper woodlands. [8 ref.] Voorhies, G. What is known and not known about pinyon/juniper utilization. [23 ref.] Fisher, J.T.; Montano. J.M. Management of pinyon for ornamentals, Christmas trees, and nut production. [29 ref.] Management strategies for the woodland zone: Gallegos, R.R. Forest practices needed for the pinyon/juniper type. Hurst, W.D. Managing pinyon/juniper for multiple benefits. Anderson, G. Systems approach to pinyon/juniper management.

4. Chojnacky, C. Juniper, pinyon, oak and mesquite volume equations for Arizona. Research Paper Intermountain Research Station, USDA Forest Service. (INT-391). 1988; INT-39111 pp.
Keywords: *Juniperus osteosperma*/ *Juniperus monosperma*/ *Juniperus deppeana*/ *Pinus*/ *Prosopis*/ *Acacia*/ *Olneya*/ *Quercus*/ broadleaves/ volume tables.
Abstract: Measurements made on *Juniperus* spp. (juniper species group - mainly *J. osteosperma*, *J. monosperma*, *J. deppeana*); *Pinus* spp. (pinyon species group - *P. edulis*, *P. cembroides*, *P. edulis* var. *fallax*); *Prosopis velutina*, *Acacia greggii* and *Olneya tesota* (mesquite species group); and *Quercus* spp. (oak species group - mainly *Q. emoryi*, *Q. arizonica*) from 291 plots were used to derive equations predicting volume from height and diameter near the root collar. Volume equations were constructed for single-stem and multiple-stem trees in each species group except pinyon, where only single-stem trees were considered. Results are presented in the form of graphs and volume tables, and compared with some of the results of other studies.
5. Chojnacky, D. C. Modeling diameter growth for pinyon and juniper trees in dryland forests. *Forest Ecology and Management*. 1997; 93(1/2):21-31.

Keywords: *Juniperus monosperma/ Juniperus scopulorum/ Juniperus deppeana/ Juniperus osteosperma/ Pinus edulis/ diameter*

Abstract: An individual-tree model has been developed to estimate diameter growth of pinyon pine (*Pinus edulis*) and juniper (*Juniperus monosperma, J. scopulorum, J. deppeana, J. osteosperma*) trees in pinyon-juniper dryland forests throughout New Mexico, USA. The model was built from radial growth data on 917 trees sampled from 82 plots. Individual tree growth can be predicted from measurements of tree diameter at the root collar, the number of basal stems per tree, and past 10-yr diameter growth of the median-sized stem in the stand of interest. Model development is patterned after growth and yield models for temperate forests in the western USA.

6. Ernst, R. and Pieper, R. D. Changes in pinon-juniper vegetation: a brief history. *Rangelands*. 1996; 18(1):14-16.

Keywords: *Juniperus monosperma/ Juniperus deppeana/ Juniperus osteosperma/ Pinus monophylla/ Pinus edulis/ human activity/ vegetation types/ palaeoclimatology.*

Abstract: The pinyon-juniper region of the southwestern USA and Mexico is comprised of morphologically different ecosystems across a heterogeneous landscape with a history of natural and induced disturbance regimes. Two pinyons (*Pinus monophylla* and *P. edulis*) and 3 junipers (*Juniperus deppeana, J. monosperma* and *J. osteosperma*) occur in these communities. This paper discusses how past climate, natural and induced fire, uses by prehistoric and historic humans, and recent large-scale clearing to increase forage for livestock have affected the structure and distribution of the pinyon-juniper complex.
7. Evans, R. A. Management of pinyon-juniper woodlands. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-249). 1988; INT-249(II):34 pp.

Keywords: *Juniperus deppeana/ Juniperus monosperma/ Juniperus scopulorum/ Juniperus osteosperma/ Juniperus occidentalis/ Pinus/ management/ woodlands*

Abstract: The pinyon/juniper woodlands are extensive in the western USA and are a valuable renewable resource for many uses. The occurrence and dominance of pinyon (*Pinus cembroides, P. monophylla* and *P. edulis*), juniper (*Juniperus deppeana, J. monosperma, J. scopulorum, J. osteosperma* and *J. occidentalis*), shrubs and herbs vary over the spectrum of the woodlands which occur on many soil types and topographies with different climates. The manual describes the ecosystem and gives basic guidelines for management for forest products (mostly fuelwood, poles and posts, and pinyon nuts), forage and browse production, wildlife, recreation and watershed values.
8. Everett, R. L. Proceedings - Pinyon-juniper conference: Reno, NV, January 13-16, 1986. General Technical Report Intermountain Research Station, USDA

Forest Service. (INT-215). 1987; INT-215(VII):581 pp.

Keywords: *Juniperus osteosperma*/ *Juniperus deppeana*/ *Juniperus scopulorum*/ *Juniperus erythrocarpa*/ *Pinus*/ vegetation types/ management.

Abstract: More than 90 papers are presented on the ecology and management of pinyon/juniper ecosystems which occur over large areas of the western USA. The major pine species are *Pinus edulis*, *P. monophylla* and *P. cembroides*; the most important juniper associates are *Juniperus monosperma*, *J. osteosperma*, *J. deppeana*, *J. scopulorum* and *J. erythrocarpa*. Topics discussed include the woodlands in general, palaeobotany, inventory and classification, synecology, silvics and silviculture, fire response, economics, plant water relations, woodland conversion, range management, wildlife, woodland hydrology and nutrient cycling.

9. Johnsen, T. N. Longevity of stored juniper seeds. *Ecology*. 1959; 40:487-488.

Keywords: *Juniperus deppeana*/ *Juniperus monosperma*/ seeds/ germination/ longevity

Abstract: Germination tests were done with various-age stored seeds of alligator juniper (*Juniperus deppeana* Steud.) and one-seed juniper (*J. monosperma* [Torr.] Little) in an attempt to determine the longevity of their seeds. Seeds 9 to 45 years old had 16 to 54 % germination. Data shows that seeds of these junipers can survive extended periods of dry storage and that they might be relatively unaffected by drought following seed dispersal.

10. Park, Andrew David E-mail andrew.park@utoronto.ca. Environmental influences on post-harvest natural regeneration in Mexican pine-oak forests. *Forest Ecology & Management*. 2001 Apr; 144(1-3):213-228.

Keywords: *Juniperus deppeana*/ regeneration/ Mexico/ *Pinus*

Abstract: Pine-oak forests in Mexico's Sierra Madre Occidental are increasingly harvested for industrial wood production, but few studies have investigated post-harvest stand dynamics or natural regeneration. The influence of environment, harvest year and stand location on natural regeneration was studied in 27 post-harvest and two undisturbed stands in the Madrean pine-oak forest of Durango state. Multivariate analyses showed that local environmental factors, including surface fires, continue to structure tree seedling communities more strongly than harvesting. Environmental factors explained 50% of the species variance while year of harvest and the spatial distribution of stands explained 13 and 7%, respectively. Regeneration of *Pinus durangensis*, *P. teocote* and *Quercus crassifolia* was more abundant on sloping sites with stony soils and low vegetation cover that had experienced recent surface fires. *Quercus sideroxylla*, *Juniperus deppeana*, *P. leiophylla* and *P. cooperi* were favored on valley bottom sites with deeper, fine-textured soils. Although stand spatial distribution had a minor role in structuring seedling communities, spatial autocorrelation in the distributions of single height

classes of *P. durangensis* and *P. teocote* may account for some of the species variance that was explained by harvest year. The topographic and soil factors that influence the species composition of natural regeneration in stands may also modify fire frequency and intensity, and thus affect seedling establishment. Thus, while current logging practices in the Sierra Madre allow natural regeneration to continue, Mexican foresters should consider incorporating natural disturbance regimes into their management practices.

11. Salazar R *Juniperus deppeana* Steud. Nota Tecnica Sobre Manejo De Semillas Forestales CATIE. 2000; 1122.
Keywords: *Juniperus deppeana*/ seed germination/ storage/ forest nurseries/ geographical distribution
Abstract: Information is given on synonyms, common names, botany, distribution and habitat, flowering and fruiting phenology, collection and yield of fruits, processing of fruits and seeds, seed quality, germination and storage, nursery management, and phytosanitary problems of *Juniperus deppeana*.
12. Schott, M. R. and Pieper, R. D. Succession of pinyon-juniper communities after mechanical disturbance in south central New Mexico. Journal of Range Management. 1987; 40(1):88-94.
Keywords: *Juniperus deppeana*/ *Pinus edulis*/ *Juniperus monosperma*/ secondary succession/ mechanical disturbance/ New Mexico
Abstract: Principal component analysis was used to interpret secondary succession, recorded in summer 1982-83 on sites in *Pinus edulis*/*Juniperus monosperma* and *P. edulis*/*J. deppeana* stands that had been cabled during 1950-75. Soil types were used to separate 93 sample units into 3 groups. Grasses on the deeper soils usually increased after cabling, but after 25 yr had declined to near pretreatment cover. *Quercus undulata* increased after cabling and, on older cablings, equaled or exceeded coverage on undisturbed sites. After approx. 28 yr, pinyons and junipers started suppressing the oak and became dominant. If the stand was near climax before cabling, pinyons rapidly became dominant. If the stand was seral, there would be more junipers, but their slow growth and maturation increased the time before they dominated the site. The successional pattern following cabling on relatively deep soils was similar to, but faster than, that after fire. Cover of grasses and shrubs increased more on soils without rocks. The ordinations indicated that succession in pinyon/juniper communities is directional and leads towards climax with a decrease in variability between sites.
13. Severson K E [Reprint author]. Woody plant reestablishment in modified pinyon-juniper woodlands New Mexico USA. Journal of Range Management. 1986; 39(5):438-442.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ *Juniperus deppeana*/ pinyon-juniper woodlands/ *Quercus*/ *Cercocarpus*/ New Mexico

Abstract: Pinyon (*Pinus edulis* Engelm.), one-seed juniper (*Juniperus monosperma* (Engelm.) Sarg.), and alligator juniper (*J. deppeana* Steud.) woodlands in southwestern New Mexico were thinned, were pushed with bulldozers leaving slash in place, and were pushed and then slash piled and burned. There were no significant differences ($P > 0.05$) in densities of these trees 13 and 18 years later between untreated (379 trees/ha) and thinned (489 trees/ha) plots or between pushed/left (67 trees/ha) and pushed/piled/burned plots (49 trees/ha). Differences between bulldozed treatments and untreated/thinned treatments were significant ($P < 0.05$). Total shrubs, 75% of which were gray oak (*Quercus grisea* Liebm.) and hairy mountain mahogany (*Cercocarpus breviflorus* Gray), were significantly more abundant in untreated areas (672 shrubs/ha), than in any of the treatments. No differences were noted among treatments (493, 393, 329 shrubs/ha for thinned, pushed/left, and pushed/piled/burned, respectively). Rates of pinyon reestablishment increased slowly up to the mid-1960's (from 1.1 to 1.3 trees/ha/year) then accelerated to 10 to 13 trees/ha/year. Pinyon and juniper densities were about 120 trees/ha when reestablishment rates increased.

14. Zandoni, T. A. and Adams, R. P. The genus *Juniperus* in Mexico and Guatemala: numerical and chemosystematic analysis. *Biochemical Systematics and Ecology*. 1976; 4(3):147-158.

Keywords: *Juniperus patoniana*/ *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus blancoi*/ *Juniperus scopulorum*/ plant composition/ terpenoids.

Abstract: The leaf constituents, mainly terpenoids, of each of the taxa of *Juniperus* in Mexico and Guatemala were analyzed by numerical taxonomic methods and the results compared with those of a previous study utilizing morphological characters. The two sets of data were generally in agreement on the major groups. Differences between more closely related species were more apparent with the chemical data. Four major groups were detected. The study confirmed the morphological data indicating that *J. patoniana* should be reduced to a variety of *J. deppeana*. No samples typical of *J. monosperma* were found in Mexico, and *J. monosperma* var. *gracilis* was not closely allied with *J. monosperma* from the USA, but had some uncertain affinities with species of the one-seeded complex. *J. blancoi* appears to be closely related to *J. scopulorum*.

***Juniperus deppeana* (1)**

1. Chojnacky, D. C. Estimating diameter growth for pinyon and juniper trees in Arizona and New Mexico. Research Note Intermountain Research Station, USDA Forest Service. (INT-GTR-429). 1996; INT-GTR- 4296.
Keywords: *Juniperus monosperma*/ *Juniperus deppeana*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Pinus*/ diameter growth/ Arizona/ New Mexico
Abstract: Diameter growth measurement is difficult for pinyon and

juniper trees because they are slow-growing, multiple-stemmed, and poorly suited to measurement methods used for other temperate tree species. A model designed to estimate diameter growth for individual pinyon (*Pinus edulis*) and juniper (*Juniperus* spp.) trees from a small subsample of growth measurements is described. Data for model construction include 10-year radial growth sampled from 1,536 trees on 176 plots spread throughout Arizona and New Mexico. Species include *Pinus edulis*, *Juniperus monosperma*, *J. deppeana*, *J. scopulorum*, and *J. osteosperma*. The model predicts past 10-year diameter growth from stand-level growth-index measurement, tree diameter, and number of basal stems in a tree.

***Juniperus drupacea* (5)**

1. Akinci I.; Ozdemir F.; Topuz A.; Kabas O., and Canakci M. Some physical and nutritional properties of *Juniperus drupacea* fruits. *Journal of Food Engineering*. 2004; 65(3):325-331.

Keywords: *Juniperus drupacea* / fruits/ Turkey

Abstract: Knowledge of the physical and nutritional properties of *Juniperus drupacea* fruit, which is used to produce pekmez (a traditional Turkish fruit concentrate), is necessary for the design of equipment for harvesting, transporting, sorting, cleaning, separating, smashing, extracting and processing it into different food. In this research, the nutritional properties of *J. drupacea* fruit and its concentrate were determined, and the effects of different moisture contents on the physical properties of the fruit were investigated. *J. drupacea* fruit pekmez is rich in some nutritional constituents, such as sugar (34.97 g/100 g), ash (3.79 g/100 g), Ca (1499 mg/kg), P (1445 mg/kg) and Zn (12.79 mg/kg). The average dimensions of the fruits were found to be 25.18 mm in length, and 23.09 mm in diameter, with a geometric mean diameter of 23.70 mm, a volume of 6422 mm³, a sphericity of 0.947, a surface area of 1776 mm², a projected area of 480 mm², a mass of 5.98 g, and a thousand fruit mass of 6015 g at an initial moisture of 18.9% d.b. At moisture contents from 8.9% to 41.2% d.b., the bulk density, fruit density and porosity varied from 488.1 to 465.6 kg/m³, from 989.3 to 991.5 kg/m³, and from 0.507 to 0.520, respectively. The terminal velocity increased from 5.07 to 6.14 m/s with an increase in the moisture content of the fruit. The static and dynamic coefficients of friction were measured at the different moisture contents on three different surfaces, and results varied between 0.235-0.637 and 0.197-0.540, respectively. The rupture strength decreased from 692.4 to 481.4 N with an increase in the moisture content of the fruit. The average values of extraction rate and extraction yield varied from 0.75 to 1.82°Bx/h, and from 5.5 to 14.7°Bx/100 g, respectively. The highest values of the extraction were obtained at an initial moisture content of 18.9% d.b.

2. Alpacar, G. Studies on overcoming germination difficulties for *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus* and *J. drupacea* seeds, and determination of morphological characters of cones and seeds. *Teknik Bulten Serisi Ormanlık Araştırma Enstitüsü Yayınları*. 1988; 197(7):21-38.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ *Juniperus drupacea*/ *Pinopsida*/ seeds/ seed morphology/ cones/ morphology/ seed treatment/ germination/ scarification/ stratification/ soaking
Abstract: Various stratification, soaking and scarification methods were tested for improving seed germination of *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus* and *J. drupacea*. Cone and seed morphology is also given for each species.

3. Boratynski, A. and Browicz, K. *Juniperus drupacea* Labill. in Greece. *Arboretum Kornickie*. 1983; 273-16.
Keywords: *Juniperus drupacea*/ Greece/ distribution
Abstract: A description of the distribution of *J. drupacea* on the Peloponnisos peninsular, its only European locality. It is found mainly on the Parnon massif and attains its altitudinal min. here with a range of 350-1250 m compared with 600-2050 m in the main Asiatic part of its range in Turkey, Syria and Lebanon.

4. Gultekin, H C and Ozturk, H. Advances in research on the propagation of prickly juniper (*Juniperus oxycedrus* L.) and Syrian juniper (*Arceuthos drupacea* Ant. et Kotschy.) using nursery techniques, and grey juniper (*Juniperus excelsa* Bieb.) under natural conditions. *Orman-Mühendisliği*. 2003; 40(11/12):6-16.
Keywords: *Juniperus oxycedrus*/ *Juniperus drupacea*/ *Juniperus excelsa*/ propagation/ Turkey/ seed/ germination
Abstract: Research on the propagation of 3 juniper species (*Juniperus oxycedrus*, *Arceuthos drupacea* [*J. drupacea*] and *J. excelsa*) in Turkey is reviewed. The methods used to propagate these species from seed are described, with reference to techniques specific to the *Cupressaceae*, the availability of seed, and the propagation techniques used for the 3 species under consideration. The results of trials conducted in 2002-2003 are tabulated and show the percentage of seed germination obtained: 46-72% for *J. drupacea* and 0-69% for *J. oxycedrus* under nursery conditions, compared with about 33% for *J. excelsa* under natural conditions.

5. Tan K.; Sfikas G., and Vold G. *Juniperus drupacea* (*Cupressaceae*) in the Southern Peloponnese. *Acta Botanica Fennica*. 1999; 162:133-135.
Keywords: *Juniperus drupacea* / Greece/ distribution
Abstract: The distribution of *Juniperus drupacea* Labill. in Europe was previously known only from the Parnon range in the Peloponnese, southern Greece. This is ca. 800 km from the nearest stands in southern Anatolia. The recent discovery in 1997 of the species in the foothills of the Taigetos range gives this taxon a second locality in Europe. This is all the

more unexpected because Taigetos is a mountain range thought to be botanically well known.

Juniperus durangensis (1)

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/* essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana, J. ashei, J. californica, J. coahuilensis, J. comitana, J. deppeana, J. durangensis, J. flaccida, J. gamboana, J. jaliscana, J. monosperma, J. monticola, J. osteosperma, J. occidentalis, J. pinchotii, J. saltillensis,* and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

Juniperus erythrocarpa (4)

1. Adams R. P. and Zanoni T. A. The distribution, synonymy, and taxonomy of three junipers of southwestern United States and northern Mexico. *Southwestern Naturalist*. 1979; 24(2):323-329.

Keywords: *Juniperus erythrocarpa/ Juniperus monosperma/ Juniperus pinchotii/* distribution/ taxonomy/ synonymy

Abstract: Revised distribution maps, new keys, and updated synonymy are presented for *Juniperus erythrocarpa, J. monosperma,* and *J. pinchotii*. These revisions reflect evidence from the past several years and are presented to aid field workers in the identification of these difficult taxa.

2. Adams, R P; Zanoni, T A; Rudloff, E von, and Hogge, L. The south-western USA and northern Mexico one-seeded junipers: their volatile oils and evolution. *Biochemical Systematics and Ecology*. 1981;

Keywords: *Juniperus erythrocarpa*/ *Juniperus monosperma*/
Juniperus pinchotii/ biochemistry/ taxonomy/ evolution/ arid regions

Abstract: The composition of the volatile oils of *Juniperus erythrocarpa*,
Juniperus

monosperma var. *gracilis* and *Juniperus pinchotii* are reported from analysis by capillary GC MS-computer search. *Juniperus erythrocarpa* appears to have two chemical types or races, one from southern Arizona-south-west New Mexico, USA, and the other from Mexico and trans-Pecos Texas, USA. *Juniperus monosperma* var. *gracilis* contained aromatics from the phenyl propanoid pathway marking the first report of these type compounds from the denticulate leaf junipers. *Juniperus monosperma* var. *monosperma* was not found to be similar to *J. monosperma* var. *gracilis*, suggesting a nomenclatural change is needed for the latter taxon. The evolution within this complex has apparently been discordant between the morphology and the terpenoids.

3. Ansley R. J.; Pinchak W. E., and Ueckert D. N. Changes in redberry juniper distribution in northwest Texas (1948 to 1982). *Rangelands*. 1995; 17(2):49-52.

Keywords: *Juniperus erythrocarpa*/ *Prosopis glandulosa*/ woody weeds/ geographical distribution/ plant colonization/ plant succession

Abstract: Planimeter measurements of distribution maps for 1948 and 1982, with no on-site verification suggested that distribution of redberry juniper [*Juniperus erythrocarpa*] has increased substantially in northwest Texas since 1948. The juniper has spread on to grasslands from adjacent mature stands and within honey mesquite [*Prosopis glandulosa*] communities. Reasons and pathways for the encroachment of juniper on to range sites are discussed.

4. Everett, R. L. Proceedings - Pinyon-juniper conference: Reno, NV, January 13-16, 1986. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-215). 1987; INT-215(VII):581 pp.

Keywords: *Juniperus osteosperma*/ *Juniperus deppeana*/ *Juniperus scopulorum*/ *Juniperus erythrocarpa*/ *Pinus*/ vegetation types/ management.

Abstract: More than 90 papers are presented on the ecology and management of pinyon/juniper ecosystems which occur over large areas of the western USA. The major pine species are *Pinus edulis*, *P. monophylla* and *P. cembroides*; the most important juniper associates are *Juniperus monosperma*, *J. osteosperma*, *J. deppeana*, *J. scopulorum* and *J. erythrocarpa*. Topics discussed include the woodlands in general, palaeobotany, inventory and classification, synecology, silvics and silviculture, fire response, economics, plant water relations, woodland conversion, range management, wildlife, woodland hydrology and nutrient cycling.

Juniperus excelsa (62)

1. Abdullah-Al-Refai; El-Kateb, H; Stimm, B, and Mosandl, R. Quality and germination of seeds of *Juniperus excelsa* M.-Bieb. in the Kalamoun mountains, Syria. Forstliche Forschungsberichte Munchen. 2003; 192164-175; ISSN: 0174-1810.

Keywords: *Juniperus excelsa*/ forests/ germination/ mountain/ forests/ seed quality/ stratification

Abstract: *Juniperus excelsa* is the main tree species of forest stands in the upper elevations of the Kalamoun mountains in Syria. In this preliminary experiment seeds of juniper from four stands in different elevations (1900, 2100, 2200, 2250 m) were subjected to two pre-treatments with different duration period: warm stratification for three-months followed by 45 days warm stratification followed by 45 days cold stratification, and six months with 90 days warm followed by 90 days cold stratification. In comparison to the other three stands, the stand 2100 above sea level had more vigorous trees from which the seeds were collected. After stratification, seed samples were subjected to a standard germination test according to ISTA regulations. Juniper seeds originating from the Kalamoun mountains showed with 92.5% a high percentage of empty seeds. The better quality of seeds with less empty seeds (87%) were found in the stand which included the more vigorous juniper trees in 2100 m above sea level. Germination of seeds was significantly dependant on the duration period of the warm and cold stratification. The six months pre-treatment with 90 days cold followed by 90 days warm stratification led to germination of all sound viable seeds. Germinated seeds yielded of the shorter stratification period was only 17%. The results indicated that there is a real lack of knowledge about the reproductive biology and activity of the Kalamoun populations of *J. excelsa*.

2. Abido M. S. and Kurbaisa M. S. The present status of the Syrian juniper forests on the East Lebanon mountain chain. Arab Gulf Journal of Scientific Research . 2003; 21(1):64-70.

Keywords: *Juniperus excelsa*/ autecology/ environmental degradation/ nature conservation

Abstract: A study was conducted to determine the current status of juniper forests in Assal Al-Ward ranges of the Anti-Lebanon Mountains, Syria, and to characterize the autecology and synecology of *Juniperus*. Species parameters were assessed in 42 sites of various aspects and altitudes using the distance method and line transect techniques. Results showed significant differences in juniper density among the sites with different aspects. The lowest level of species distribution was observed at 1880 m altitude. Average stand density, importance value and coverage were 28.76 trees/ha, 32.5 and 10.8%, respectively. *Juniperus excelsa* dominated the community; the most important associated deciduous species were *Amygdalus orientalis*, *A. korschynskii*, *Crataegus azarolus*, *Prunus* sp., *Pyrus syriaca*, *Cotoneaster nummularia*, *Acer hermoneum*,

Berberis cretica and *Rhamnus palaestina*. Less important species included *Astragalus* sp., *Artemisia* sp., *Salvia* sp., *Acantholimon* sp. Signs of environmental stress were apparent on juniper trees and were reflected mostly in the decline in increment of annual growth rings. Juniper trees attained a height of 6.5 m and averaged 80 cm in diameter. Age of trees was estimated at 225 years. The results indicated that the juniper trees have been neglected, misused, over felled, overgrazed and deliberately set on fire. This reduced the extent of the juniper ecosystem and demoted its ecological value. It is suggested that a management plan be put in effect to ensure the ecosystem sustainability and juniper conservation.

3. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. *Acta Horticulturae*. 2003; 61291-106.

Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.

Abstract: Several cases involving apparent discordance in morphological, chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var. *microsperma*, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var. *squamata*, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.

4. Ahmed M [Reprint author]; Nagi E E [Author], and Wang E L M [Author]. Present state of juniper in Rodhmallazai forest of Balochistan, Pakistan. *Pakistan Journal of Forestry*. 1990; 40(3):227-236.

Keywords: *Juniperus excelsa*/ Pakistan/ density/ basal area/ seeds/ regeneration

Abstract: A quantitative Survey was conducted in 32 stands of juniper (*Juniperus excelsa* M. Bieb) in four adjacent districts of Balochistan. No other tree species was recorded in the study area. Vegetation composition of the juniper was described. Mean density of juniper was 105 individual ha⁻¹ with a basal area of 18.4 m² ha⁻¹. Juniper density and basal area were significantly correlated ($r = .35$, $P < .05$). Density of female trees was higher than male. Healthy trees produced only 21% of heavy (embryonic) seeds. Trees were slow growing (18 years/cm radial growth rate). Leaves and soil analysis were also performed. Sandy clay loam with a

calcareous nature was the dominant soil of the area. No correlation was observed between tree density; basal area and soil characteristics. Regeneration was absent. It is concluded that these forests are rapidly degrading due to human disturbance.

5. Al-Refai A.; Mohadjer R. M., and Stimm B. Distribution, ecology, use and propagation: *Juniperus excelsa* Verbreitung, Ökologie, Nutzung und Vermehrung: der Baumwacholder. AFZ/Der Wald, Allgemeine Forst Zeitschrift Für Waldwirtschaft Und Umweltvorsorge. 2002; 57(16):868-871.
Keywords: *Juniperus excelsa*/ ecology/ propagation
6. Alpacar, G. Studies on overcoming germination difficulties for *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus* and *J. drupacea* seeds, and determination of morphological characters of cones and seeds. Teknik Bulten Serisi Ormanlık Araştırma Enstitüsü Yayınları. 1988; 197(7):21-38.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ *Juniperus drupacea*/ *Pinopsida*/ seeds/ seed morphology/ cones/ morphology/ seed treatment/ germination/ scarification/ stratification/ soaking
Abstract: Various stratification, soaking and scarification methods were tested for improving seed germination of *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus* and *J. drupacea*. Cone and seed morphology is also given for each species.
7. Avsar, Mahmut D. Author Reprint Author; E-mail: mdavsar@ksu.edu.tr], and Tonguc, Fatih Author. Evaluation of growth potential of Crimean juniper (*Juniperus excelsa* Bieb.) seedlings for the first growing season under Tekir forest nursery conditions in Kahramanmaraş, Turkey. Journal of Environmental Biology. 2003 Apr; 24(2):155-159.
Keywords: *Juniperus excelsa*/ Crimean juniper/ seedlings/ Turkey/ nursery
Abstract: In this study, growth potential of Crimean juniper (*Juniperus excelsa* Bieb.) seedlings for the first growing season under Tekir Forest Nursery conditions in Kahramanmaraş was evaluated. The height growth of Crimean juniper seedlings was relatively close to that of Lebanon cedar (*Cedrus libani* A. Rich.) seedlings produced in the same nursery, but their root collar diameters were fairly lower than that of Lebanon cedar seedlings. According to coniferous seedling standards of Turkish Standards Institute, the height growth of Crimean juniper seedlings was fairly good, but their root collar diameters were slightly small. In this respect, that 2+0 or 1+1 Crimean juniper seedlings are used in reforestation activities in the region would be more useful than 1+0 seedlings
8. Ayaz, M. Anatomy of juniper (*Juniperus excelsa*) seed. Pakistan Journal of Forestry. 1980; 30(2):99-101.
Keywords: *Juniperus excelsa*/ seeds

9. Bangash, S. H. and Sheikh, M. I. Effect of Greenzit nutrient solution of growth of different forest tree species . The Pakistan Journal of Forestry. 1981; 31(2):75-76.
Keywords: *Juniperus excelsa/ Eucalyptus camaldulensis/ Pinus roxburghii/* Pakistan/ nutrient solution/ seedling/ fertilizer
Abstract: To test the effect of Greenzit nutrient solution on different forest tree species at seeding stage, a study was conducted in Pakistan Forest Institute, Peshawar during 1980. Data indicate that the Greenzit nutrient solution significantly increases the height growth of *Eucalyptus camaldulensis, Juniperus excelsa* and *Pinus roxburghii* seeding. However, there seems to be no positive response of the nutrient on diameter of species under study.
10. Basturk, M. A. Suitability of Crimean juniper (*Juniperus excelsa*) for particleboard.
Boylu ardic (*Juniperus excelsa* Bieb.) odununun yongalevha uretimine uygunlaugu uzerine arastrmalar. Istanbul Universitesi Orman Fakultesi Derisi Seri A. 1996; 43(2):155-168.
Keywords: *Juniperus excelsa/ Populus nigra/ Fagus orientalis/* physical properties; mechanical properties.
Abstract: Experimental 3-layer particleboards were produced with Turkish samples of *Juniperus excelsa* in both the middle and surface layers, with juniper in the middle layer and poplar (*Populus nigra*) on the surface layers, and with juniper on the surface layers and beech (*Fagus orientalis*) in the middle layer. The boards were bonded with urea formaldehyde. Density, thickness swelling, bending strength, tensile strength, and screw holding properties parallel and perpendicular are reported.
11. Bektas, I.; Alma, M. H.; Goker, Y.; As, N., and Erdas, O. Effect of 180 years of service on various physical and mechanical properties of salvaged Crimean juniper wood. Forest Products Journal. 2004; 54(12):217-219.
Keywords: *Juniperus excelsa/* wood properties/ Turkey
Abstract: In this study, various physical and mechanical properties of Crimean juniper (*Juniperus excelsa* L.) wood, salvaged from the roof of a demolished warehouse used for 180 years, were determined and compared with those of wood from freshly cut trees. The results indicate that while the physical properties of the salvaged juniper wood were significantly affected by the 180-year service life, the mechanical properties, with the exception of impact and shear strength, were only slightly affected.
12. Beskaravainyi, M. M. Role of carpophagous vertebrates in *Juniperus excelsa* stands of the Crimea. Lesovedenie. 1993; 0(1):67-74.
Keywords: *Juniperus excelsa/* carpophagous vertebrates/ Crimea/ regeneration
Abstract: Cones of *Juniperus excelsa* are the fodder for 5 species of carpophagous vertebrates. Four species are from the group of seed-eaters

(*Chloris chloris*, *Sciurus vulgaris*, *Apodemus sylvaticus*, *A. flavicollis*); one species eats cone's flesh (*Turdus viscivorus*). Seed-eaters take seeds off not regularly every year and not in great amounts without influencing the forest regeneration. Squirrel promotes distributing seeds under crowns, but conditions for developing the undergrowth are unfavorable there. Seeds are brought to the places, where undergrowth can develop and dispersion of the *Juniperus species* takes place due to the trophic activity of Mistle-trush.

13. Carus. S. Increment and growth in Crimean juniper (*Juniperus excelsa* Bieb.) stands in Isparta-Sutculer Region of Turkey. *Journal of Biological Sciences*. 2004; 4(2):173-179.
Keywords: *Juniperus excelsa*/ Turkey/ Cedrus/ growth
Abstract: A study was conducted to determine the increment and growth of Crimean juniper (*Juniperus excelsa*) in undisturbed, normal canopy, pure, even-aged and naturally grown stands in Turkey depending on the age and site quality. The increment and growth properties of Crimean pine (*Pinus nigra*) and Lebanon cedar (*Cedrus libani*) were compared. Results showed that the stand structure of a large portion of the Crimean juniper have been deteriorated by factors such as prolonged resource mismanagement, overgrazing and silvicultural problems. Statistical analyses on the distribution of sample plots of the number of trees per hectare showed that Crimean juniper stands need more light as it grows old. The relationship between the diameter and diameter increment have shown big distribution in Crimean juniper young stands due to the variability in crown structure of the trees and social classes. In an old stand, the relationship between diameter and diameter increment values were in balance since competition between trees tend to be in minimum levels. A comparison of the top height, basal area, total volume and current annual increment among Crimean juniper, Lebanon cedar and Crimean pine was carried out using values of site quality classes. Crimean juniper was observed to grow slower than Crimean pine and Lebanon cedar. The basal area of Crimean juniper was quite close to Lebanon cedar but its total volume per hectare was low due to slower height growth. The low volume fertility in Crimean juniper stands was due to harsh environmental conditions and genetic properties.
14. Chaturvedi M. Studies on the pollen grains of *Juniperus* L. *Current Science*. 50(12). 1981. 548-549.
Palynol. Lab., National Bot. Res. Inst., Lucknow 226 001, India. 1981; 50(12):548-549.
Keywords: *Juniperus excelsa*/ *Juniperus macropoda*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus wallichiana*/ Himalayas/ pollen
Abstract: Light microscopic and SEM studies of 5 species (*J. excelsa*, *J. macropoda*, *J. pseudosabina*, *J. squamata* and *J. wallichiana*) from the Himalayas.

15. Chaudhry M. I. and Wali ur Rehman. Insect pests of juniper, their parasites and predators. *Pakistan Journal of Forestry*. 1979; 29(1):21-24.
Keywords: *Juniperus excelsa*/ Pakistan/ insects/ predators/ parasites/ *Semanotus*/ *Anthaxia*/ *Phloeosinus*/ *Arceuthobium*/ *Trichodes*/ *Teretrius*/ *Heterospilus*/ *Agathis*/ fruit/ seed
Abstract: Juniper forests of Baluchistan, Pakistan were surveyed and insect pests attacking *Juniperus excelsa* were studied in three localities. *Semanotus semenovi*, *Anthaxia* sp., *Phloeosinus jubatus* and *Phloeosinus* sp. were recorded feeding on bark and sapwood of dead and dying trees to various extent. Infestation of these borers was mostly restricted to Sasnamana where the trees were first weakened by dwarf mistletoe (*Arceuthobium oxycedri*). Healthy trees in Sasnamana, Ziarat and Chautair were found free from the attack of these borers. *Trichodes* sp. and *Teretrius* sp. were recorded as predators and *Heterospilus* sp. and *Agathis* sp. as parasites on these borers mostly in Sasnamana area. Fruit berries were heavily infested by fruit moth larvae in all the localities. Insect pests were surveyed in *Juniperus excelsa* forests in the Ziarat, Sasnamana and Chautair districts of Baluchistan in Oct./Nov. 1976. The borers *Semanotus semenovi*, *Anthaxia* sp., *Phloeosinus* sp. and *P. jubatus* were found feeding on the bark and sapwood of dead and dying trees (mostly those affected by dwarf mistletoe, *Arceuthobium oxycedri*). *Trichodes* sp. and *Teretrius* sp. were found as predators, on *S. semenovi* and *Phloeosinus* sp., respectively, and *Agathis* sp. and *Heterospilus* sp. as parasites, on *Phloeosinus* sp. and *Anthaxia* sp., respectively. The fruit berries were heavily infested by fruit moth larvae at all the sites. A brief review of literature references to pests of various juniper species is included.
16. Ciesla W. M.; Ghulam M., and Buzdar A. H. Balochistan's ancient junipers: bringing sustainable management to dry-zone forests. *Journal of Forestry*. 1998; 96(4):34-37.
Keywords: *Juniperus excelsa*/ *Arceuthobium*/ Pakistan/ degraded forests/ mistletoes
Abstract: The Ziarat forest in southwestern Pakistan is a fragile ecosystem. Forest health is poor because of harsh growing conditions and dwarf mistletoe (*Arceuthobium oxycedri*) infestations, and natural regeneration of the native juniper (*Juniperus excelsa*) is sparse. Human use of the forest, especially fuelwood harvesting and grazing, has caused severe degradation. Because of its location, advanced age and range of goods and services it provides, the Ziarat forest is a unique resource. The local people are aware of the tenuous condition of their forest, and attempts to manage this forest in a sustainable manner have begun.
17. Ciesla W. M.; Mohammed G., and Buzdar A. H. Juniper dwarf mistletoe, *Arceuthobium oxycedri* (DC.) M. Bieb, in Balochistan Province, Pakistan. *Forestry Chronicle*. 1998; 74(4):549-553.
Keywords: *Juniperus excelsa*/ mistletoe/ *Arceuthobium oxycedri* /

Pakistan

Abstract: In Pakistan, *A. oxycedri* is presently known from a single location, the Ziarat Forest, an 88 000 ha forest of *Juniperus excelsa* in northern Balochistan Province, where it occurs on a more or less contiguous area of approximately 3500 ha, or about 4% of the total forest area. *A. oxycedri* is found over much of the upper headwaters of the Chasnak and the Sasnamana Valleys of the Ziarat Forest. In the infested portions of the Chasnak Valley, an estimated 31.76% of the host trees are infected with a mean area dwarf mistletoe rating (DMR) of 1.53 and an estimated 2.03% annual mortality rate. Nearly 50% of the infected trees have a DMR of 6. An estimated 22% of the trees in the Sasnamana Valley are infested with a mean area DMR of 0.52. No recent tree mortality, directly attributable to *A. oxycedri*, was detected in the Sasnamana Valley and nearly 50% of the infected trees have a DMR of 1. *A. oxycedri* was also detected in portions of four adjoining drainages. It is estimated that these infestations have been present for at least 25-30 years. In two of the drainages, the host tree is widely scattered and there is only a limited potential for tree-to-tree spread. In the remaining two valleys, infestations occur in relatively well-stocked forests and there is a high potential for tree-to-tree spread.

18. El-Karemy, Z. A. R. and Zayed, K. M. A contribution to the vegetation and habitat types of Bahía plateau (Saudi Arabia). Feddes Repertorium. 1996; 107(1-2):135-144.

Keywords: *Juniperus excelsa*/ *Acacia*/ *Olea*/ *Dodonaea*/ *Pulicaria*/ *Rumex*/ *Astragalus*/ *Hyparrhenia*/ *Cardaria*/ *Achillea*/ Saudi Arabia/ habitat types/ plant communities

Abstract: The present study deals with the vegetation of Bahía plateau (19° degrees 50'-20°18' N, 41°38'-42°10' E), with elevation ranging between 1700 and 2400 m. Ten plant communities are recorded : communities dominated by trees (*Acacia negrii* and *Juniperus excelsa*); communities dominated by shrubs and undershrubs (*Acacia tortilis*, *Olea europaea*, *Dodonaea viscosa*, *Pulicaria crispa*, *Rumex limoniastrum* and *Astragalus atropilosus*); communities dominated by grasses (*Hyparrhenia hirta*) and a community dominated by ephemerals (*Achillea biebersteinii* - *Cardaria draba*). 167 species of vascular plants are recorded. Relations between communities and their habitat types as well as the human impact in the area are briefly discussed.

19. Eler, U. Yield studies for Crimean juniper (*Juniperus excelsa*) in Turkey. Turkiye'de boylu arde (*Juniperus excelsa* Bieb.) ormanlarında haslat araştırmaları. Teknik Bülten Serisi Ormanlık Araştırma Enstitüsü Yayınları. XXXII. 1988; 192(7):40 pp.

Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Cedrus libani*/ *Abies cilicica*/ *Pinus nigra*/ volume tables/ increment.

Abstract: A 2-way volume table, site class table and yield table were

developed for pure natural, even-aged, undisturbed stands of *Juniperus excelsa* in Turkey. Growth of *J. excelsa* was compared with that of *J. foetidissima*, Lebanon cedar [*Cedrus libani*], Cilician fir [*Abies cilicica*] and Austrian pine [*Pinus nigra*].

20. Esper, J. Long-term tree-ring variations in *Juniperus* at the upper timber-line in the Karakorum (Pakistan). *Holocene*. 2000; 10(2):253-260.
Keywords: *Juniperus excelsa*/ *Juniperus turkestanica*/ climate/ dendrochronology/ Pakistan
Abstract: Ring-width series of *Juniperus excelsa* and *Juniperus turkestanica* from six different sites, in the Hunza-Karakorum, were used in reconstructing modes of regional climate over the past 500 years. All reconstructions were derived from trees growing close to the upper timber-line (approx. 4000 m a.s.l.). Standardized site chronologies, derived from ring-width measurements, display common low- and high-frequency variation that is synchronous between all sites. Since the documented increase in atmospheric CO₂ loading, roughly 150 years ago, Hunza-Karakorum trees are not growing as well as they were previously. From the mid-nineteenth century to the present, these trees appear to be alternating between states of more extreme favourable and unfavorable growth periods of different amplitude and duration. Maximum (favourable) variations occurred between AD 1579 and 1603, whereas minimum (unfavourable) variations occurred between AD 1825 and 1850.
21. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. *Sabina*) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). *Edinburgh Journal of Botany*. 1992; 49(3):251-283.
Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpos*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia
Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpos* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpos*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.
22. Fisher, Martin and Gardner, Andrew S. The status and ecology of a *Juniperus excelsa* subsp. *polycarpos* woodland in the northern mountains of Oman. *Vegetatio*. 1995; 119(1):33-51.
Keywords: *Juniperus excelsa*/ Oman/ ecology/ wadis/ regeneration/

germination/ cone production

Abstract: *Juniperus excelsa* subsp. *polycarpus* (K. Koch) Takhtajan is found in mountain areas from Turkey through to India and as an isolated population on Jebel Akhdar in the northern mountains of Oman.

Juniperus is one of the dominant plant species in these mountains and a major landscape feature of several proposed National Nature and Scenic Reserves and of Hayl Juwari, a wooded valley at 2250 m altitude proposed as a Botanical Site of Special Interest. Above 2400 m altitude the *Juniperus* woodlands generally appear to be regenerating and in good condition, both on exposed slopes and in wadis and sheltered gullies, whereas below 2400 m most stands are in poor condition and exhibit few signs of regeneration. If the apparently poor condition of the lower altitude woodlands is due to any long term change in climatic conditions, both tree status and regeneration would be poorer in relatively more xeric habitats. To test this prediction we have carried out a detailed survey of the status and ecology of a 32 ha area of Hayl Juwari, and analyzed differences in tree status and regeneration between wadis (relatively more mesic sites) and non-wadi areas (relatively more xeric). Approximately one third of the trees are dead, and an analysis of the height, condition, regeneration, female cone production, preferred germination sites and spatial distribution of trees indicates the importance of topography, hydrology and microclimate for growth. However, although there are relatively greater numbers of dead and poor-condition trees in the more xeric non-wadi habitat, there is no unequivocal evidence that the present distribution of small, sexually immature trees in both habitats could not form a pattern of larger, sexually mature trees similar to that seen today. We speculate, however, that the climate at this altitude may be marginal for the survival of a *J. excelsa* subsp. *polycarpus* woodland and that even small increases in climatic stress could imperil the woodland's present status.

23. Gardner, A. S. and Fisher, M. The distribution and status of the montane juniper woodlands of Oman. *Journal of Biogeography*. 1996; 23(6):791-803.

Keywords: *Juniperus excelsa*/ *Olea*/ Oman/ woodlands

Abstract: The distribution, condition and reproductive status of *Juniperus excelsa* subsp. *polycarpus* were determined in the Hajar mountains of N Oman. Juniper is restricted to the highest areas, (the central massif of Jebel Akhdar and the outlying mountains of Jebel Qubal and Jebel Kawr), where it generally forms open woodlands. On exposed slopes juniper is distributed from an altitude of 2100 m to the highest summit at 3009 m, with no upper tree line, while on well-shaded north-facing slopes juniper trees grow as low as 1375 m. Above 2300 m, juniper is the dominant woody species, while below this altitude it is often co-dominant with *Olea europea*. The woodlands are generally in poor condition on exposed slopes below 2400 m. Above 2400 m and in shaded sites, there are markedly higher proportions of reproductively active trees on exposed slopes. Altitude, shade and habitat account for 30.8% of the

variation in a tree condition index, with slope being unimportant. The absence of juniper from lower and more outlying mountains is likely to have resulted from the alternation of pluvial and arid periods over the last 40 000 years. The current dieback of juniper at lower altitudes may be due to climatic change.

24. Gardner, Andrew S. and Fisher, Martin. How the forest lost its trees: Just so storytelling about *Juniperus excelsa* in Arabia. Journal of Arid Environments. 1994; 26(3):299-301.
Keywords: *Juniperus excelsa*/ *Strepsicrates*/ Saudi Arabia/ cones/ regeneration
Abstract: It has been suggested that the major cause of the poor regeneration of *Juniperus excelsa* in Saudi Arabia is the infestation of an average of 64.5% of the female cones with a tortricid moth, *Strepsicrates cryptosema*. We repudiate this hypothesis, since, in a long-lived species bearing several thousand cones annually, sufficient seeds will remain viable for regeneration. Human disturbance, grazing pressure or climatic change could be responsible for lack of seedling survival. We present evidence for *J. excelsa* in Oman which indicates that climatic change could be an important factor in the poor regeneration of the tree in Arabia.
25. Georgiev G.; Tsankov G., and Mirchev P. Utilization of diflubenzuron to control *Gelechia senticetella* (Stgr.) (*Lepidoptera: Gelechiidae*), a dangerous pest of *Juniperus excelsa* M. B. (*Cupressaceae*) in Bulgaria. Anzeiger Fur Schadlingskunde. 2000; 73(4):107-109.
Keywords: *Juniperus excelsa*/ *Gelechia*/ diflubenzuron/ Bulgaria
Abstract: In 1992, experiments were carried out in Bulgaria to control *Gelechia senticetella* (Stgr.) (*Lepidoptera: Gelechiidae*), a mining pest on the needles and young shoots of *Juniperus excelsa* M. B. by commercial products Dimilin ODC-45 and Dimilin WP-25 based on the insect growth regulator diflubenzuron. Two Ultra Low Volume (ULV) treatments were performed on 12 March and 16 April during the emergence of pest larvae from the infested shoots. Dimilin ODC-45 was applied at 60-120 ml/ha (27-54 g a.i./ha), dissolved in 5 liters of diesel oil, and Dimilin WP-25 at 200 g/ha (50 g a.i./ha) dissolved in 5 liters of water. The effect of Dimilin ODC-45 was very high - 92.5-95.0% control. The effect of Dimilin WP-25 was unsatisfactory - 70.0% control, which was most probably due to the fact that the oil emulsions adhered to the treated plants better than the water solutions, thus ensuring a longer period of action.
26. Goluber V. N. A bio-ecological study of the structure of plant communities with special reference to the oak/juniper forests of the southern Crimean coast. Botanicheskii-Zhurnal. 1989; 74(8):1140-1153.
Keywords: *Juniperus excelsa*/ *Quercus*/ developed countries/ Central Europe/ synecology/ gymnosperms
Abstract: *Quercus pubescens*/ *Juniperus excelsa* forest at 350-450 m altitude near Yalta.

27. Gultekin, H C and Ozturk, H. Advances in research on the propagation of prickly juniper (*Juniperus oxycedrus* L.) and Syrian juniper (*Arceuthos drupacea* Ant. et Kotschy.) using nursery techniques, and grey juniper (*Juniperus excelsa* Bieb.) under natural conditions. Orman-Muhendisligi. 2003; 40(11/12):6-16.
Keywords: *Juniperus oxycedrus/ Juniperus drupacea/ Juniperus excelsa/* propagation/ Turkey/ seed/ germination
Abstract: Research on the propagation of 3 juniper species (*Juniperus oxycedrus*, *Arceuthos drupacea* [*J. drupacea*] and *J. excelsa*) in Turkey is reviewed. The methods used to propagate these species from seed are described, with reference to techniques specific to the *Cupressaceae*, the availability of seed, and the propagation techniques used for the 3 species under consideration. The results of trials conducted in 2002-2003 are tabulated and show the percentage of seed germination obtained: 46-72% for *J. drupacea* and 0-69% for *J. oxycedrus* under nursery conditions, compared with about 33% for *J. excelsa* under natural conditions.
28. Gultekin, H. C. and Ozturk, H. Autumn germination of grey juniper (*Juniperus excelsa* Bieb.) seeds. Orman Muhendisligi. 2003; 40(1/2):13-18; ISSN: 1301-3572.
Keywords: *Juniperus excelsa/* germination/ seeds/ germination/ seedlings
Abstract: The germination of *Juniperus excelsa* seeds is briefly reviewed. A series of germination trials was carried out in Turkey, both in open forest clearings and in polyethylene tunnels, to determine the optimum time of sowing for autumn germination. The results showed that the tallest seedlings were obtained in October following a sowing date between 1 and 15 September. A higher percentage of germination was obtained in polyethylene tunnels (74 and 68% following sowing on 1 and 15 September, respectively) than in open clearings (60 and 56%, respectively).
29. Hajar, A. S. Germination studies of *Juniperus excelsa* from southwestern Saudi Arabia. Indian Botanical Contactor. 1991; 8(1):41-44.
Keywords: *Juniperus excelsa/* Saudi Arabia/ germination/ seedlings
Abstract: An extensive belt of *Juniperus excelsa* M Bieb at above 1800 masl in the south-western region of Saudi Arabia is threatened with extinction due to the scarcity of seedlings and germination difficulties. The present work emphasizes the important role of seed germination in the population dynamics of this species. The germination was dramatically improved when the cotyledons were partially exposed. Hormone treatment could also be useful in this context.
30. Hajara, A. S.; Faragalla, A. A. A, and Al-Ghamdi, K. M. Impact of biological stress on *Juniperus excelsa* M. Bieb. in south-western Saudi Arabia insect stress. Journal of Arid Environments. 1991; 21(3):327-330.
Keywords: *Juniperus excelsa/* Saudi Arabia/ insect/ seed production/

infestation/ *Strepsicrates cryptosema*

Abstract: *Juniperus excelsa* M. Bieb. is considered to be the most important tree in the south-western region of Saudi Arabia at altitudes above 1500 m.a.s.l. The present work reports for the first time the devastation on seed production caused by larvae belonging to the family Tortricidae. This insect has been identified as *Strepsicrates cryptosema* Diakonoff. The level of infestation was found to be about 64%.

31. Hall, J. B. *Juniperus excelsa* in Africa: a biogeographical study of an Afromontane tree. *Journal of Biogeography*. 1984; 11(1):47-61.
Keywords: *Juniperus excelsa*/ rainfall/ Africa/ pollen
Abstract: Occurrence within the continent is limited to the area between latitudes 22°N and 19°S and east of longitude 24°E. Within this area the species is naturally present on areas of land with mean annual temperature <19°C. Low (<1200 mm) mean annual rainfall associated with marked year-to-year rainfall variability is also characteristic of localities where it occurs. There is wide tolerance of parent rock type and soil types provided drainage is free and exposed sites subject to frequent mist and low cloud are typical. Reports of presence in pollen deposits are summarized. The present status of *J. excelsa* is discussed in relation to the ecology and the distribution. Conservation is urged.
32. Isikov, V. P. The diseases of Greek juniper in the Crimea Ukrainian SSR USSR. *Mikologiya i Fitopatologiya*. 1986; 20(5):413-416.
Keywords: *Juniperus excelsa*/ diseases/ USSR/ *Gymnosporangium*/ *Pyrofomes*/ *Antrodia*/ *Phellinus*
Abstract: The effect of *Gymnosporangium dobrozrakovae*, *Pyrofomes demidoffii*, *Antrodia juniperina* and *Phellinus torulosa* on the growth, productivity and preservation of *Juniperus excelsa* forests was studied. The role of meteorological conditions, recreational load and economic activity in the development of fungal diseases in the juniper was shown. Recommendations were made regarding the protection of these valuable relict planting.
33. ---. Diseases of *Juniperus excelsa* in the Crimea. *Mikologiya i Fitopatologiya*. 1986; 20(5):413-416.
Keywords: *Juniperus excelsa*/ diseases/ *Gymnosporangium*/ *Pyrofomes*/ *Antrodia*/ *Phellinus*
Abstract: Symptoms induced by *Gymnosporangium dobrozrakovae*, *Pyrofomes demidoffii*, *Antrodia juniperina* and *Phellinus torulosus* are described.
34. Jain, K. K. A taxonomic revision of the Himalayan Junipers. *Indian Forester*. 1976; 102(2):109-188.
Keywords: *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ *Juniperus communis*/ *Juniperus pseudosabina*/ taxonomy/ Himalayas
Abstract: Discusses the taxonomy of *Juniperus* in the Himalayas. On the

basis of morphological and anatomical studies (including studies of wood anatomy) eight taxa were identified. Of the species that are trees, *J. wallichiana*, *J. recurva* and *J. fargesii* [*J. squamata* var. *fargesii*] are restricted to the eastern Himalayas and *J. macropoda* and *J. excelsa* to the western Himalayas. Of the shrubs, *J. communis* subsp. *nana* occurs only in the western Himalayas, but *J. pseudosabina* and *J. squamata* occur throughout the area. Each species is briefly described.

35. Jones, S. The influence of stratification, scarification, hot water, and maternal plant on the germination of *Juniperus excelsa* seeds from Eritrea. *International Tree Crops Journal*. 1989; 5(4):221-236.
Keywords: *Juniperus excelsa*/ Eritrea/ stratification/ scarification/ hot water/ germination/ seeds
Abstract: Stratification for 60 days at 5.degree.C was found to increase the germination percentage of *Juniperus excelsa* seeds from Eritrea (63%) over untreated controls grown in a greenhouse (53%) and a growth chamber (47%). Scarification with H₂SO₄ for 15 min did not significantly improve germination percentage over untreated controls. Treatment with hot water resulted in zero germination after 240 days, while scarification in H₂SO₄ for 60 min significantly reduced germination percentage (7% and 8%). There were significant differences in germination percentage between seeds from different maternal plants (18 to 60%). Results presented in this study differ from those reported for *J. excelsa* seeds from Tanzania, possibly due to differences in provenance and duration of seed storage.
36. Kaushal, P. S. Studies in the Western Himalayan junipers: I. distribution pattern and taxonomic considerations. *Research Bulletin of the Panjab University, Science*. 1994; 44(1/4):53-62.
Keywords: *Juniperus communis*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ taxonomy/ India
Abstract: Five taxa of *Juniperus*, of which two with tree habit, are recorded from Western Himalaya in the States of Himachal Pradesh and Jammu and Kashmir, India and are studied for their morphological variation and distribution. The genus is represented by two distinct tree species (*J. macropoda* and *J. excelsa*) and three with shrubby forms (*J. communis*, *J. squamata* and *J. pseudosabina*). Several variants are observed in the polymorphic *J. squamata*. *Juniperus communis* and *J. pseudosabina* are morphologically conservative. A putative hybrid, intermediate in characters between *J. squamata* and *J. pseudosabina*, has also been recorded.
37. Kerfoot, O. and Lavranos, J. J. Studies in the flora of Arabia X. *Juniperus phoenicea* L. and *Juniperus excelsa* M. Bieb. *Notes RBG Edinb.* 1984; 41(3):483-489.
Keywords: *Juniperus phoenicea*/ *Juniperus excelsa*/ distribution/ Saudi Arabia

Abstract: A preliminary account of *Juniperus phoenicea* L. in the Arabian peninsula includes its distribution and phytosociology. Its geographical relation ship to the only other juniper occurring in Arabia, *J. excelsa* M. Bieb., is discussed and it is confirmed that the overall southern limit of *J. phoenicea* and the northern W Arabian limit of *J. excelsa* meet in SW Saudi Arabia.

38. Keskin, S. Studies on rooting cuttings of *Juniperus foetidissima* and *J. excelsa*. Kokulu ardc (*Juniperus foetidissima* Willd.) ve boylu ardc (*Juniperus excelsa* Bieb.) 'in celikle uretilmesi. Teknik Bulten Serisi Ormanclk Arastrma Enstitusu Yaynlar. 1992; 23330.
Keywords: *Juniperus foetidissima*/ *Juniperus excelsa*/ cuttings/ rooting
39. Keskin, S. S. Rooting of cuttings of *Juniperus foetidissima* and *Juniperus excelsa*. Kokulu ardc (*Juniperus foetidissima* Willd.) ve Boylu ardc (*Juniperus excelsa* Bieb.) celiklerinin koklendirilmesi uzerine calismalar. Teknik Raporlar Serisi Ormanclk Arastrma Enstitusu. 1989; 36-3935-48.
Keywords: *Juniperus foetidissima*/ *Juniperus excelsa*/ vegetative propagation/ shoot cuttings/ rooting
40. Khalique, A. Heterotrophic growth during seed germination in *Juniperus excelsa* M. Bieb. Pakistan Journal of Forestry. 1977; 27(4):177-181.
Keywords: *Juniperus excelsa*/ seed/ germination/ growth/ seedlings/ stratification
Abstract: Data are presented on the growth in length of the radicle, hypocotyl and cotyledons of seedlings incubated in a greenhouse with diffused light for 24 days after the emergence of the radicles. The growth rates of seedlings from stratified and unstratified seed were similar.
41. Khalique, A. and Perveen, S. Reproductive physiology of *Juniperus excelsa* M. Bieb. 1-pollen migration rate. The Pakistan Journal of Forestry . 1997; 27(2):81-85.
Keywords: *Juniperus excelsa*/ pollen/ migration
Abstract: The pollen dispersal of *Juniperus excelsa* M. Bieb. Was studied on a single isolated tree. The pollen specimens were collected at the following distances from the source tree: 3, 6, 12, 24, 48, 96 meters. The results showed that the pollen frequency at a distance of 96 meters is 0.5% of the source frequency. The standard deviation (σ_D) of the pollen dispersion distance was calculated from pollen counts as a measure of pollen dispersion. It was calculated according to SEWALL WRIGHT's formula (Wright, 1962). The value of σ_D is 16.1 meters.
42. Khan, M. H. Plant communities of the juniper forests in Khalifat, Ziarat (Baluchistan). Pakistan Journal of Forestry. 1980; 30(4):167-175.
Keywords: *Juniperus excelsa*/ *Caragana ambigua*/ *Thymus serpyllum*/ natural regeneration/ synecology.
Abstract: Vegetation was surveyed in 1977 by the Braun-Blanquet method to characterize to habitat of the markhor [*Capra falconerfi*]. Four

communities were recognized, a *Caragana ambigua/Thymus serpyllum* type giving best food and shelter. Regeneration of juniper (*Juniperus excelsa*) in the different communities is discussed.

43. Khattak, G. M. and Sheikh, M. I. Dry-zone afforestation in the juniper forests of Baluchistan. *Pakistan Journal of Forestry*. 1981; 31(3):89-94.
Keywords: *Juniperus excelsa/* natural regeneration/ germination/ seeds/ nursery/ artificial regeneration.
Abstract: After a brief description of the juniper (*Juniperus excelsa*) forests and their poor natural regeneration, an outline is given of current methods for increasing the germination of juniper seeds, and of nursery management and planting practices. Other species are also being tested in the area.
44. Larina, T. G. Structure of phytocenoses of *Juniperata [Junipereta] excelsae* association units in Crimean mountains. *Soviet Journal of Ecology*. 1981; 11(4):224-228.
Keywords: *Juniperus excelsa/ Quercus pubescens/ Arbutus andrachne/* Crimean mountains/ phytocenoses
Abstract: This relict community (with *Arbutus andrachne* and *Quercus pubescens*) on the S. coast consists of a mosaic of units (microcoenoses) ranging from trees with tall shrubs to grass with dwarf shrubs. Such communities, typical of environments unfavorable to woody plants, may be described as complex or (preferably) combined associations.
45. Mahmood, A.; Khalida, A., and Khan, N. H. Bud multiplication in juniper. *Hamdard Medicus*. 1992; 35(4):51-56.
Keywords: *Juniperus polycarpus/ Juniperus excelsa/* Pakistan/ tissue culture/ bud culture/ genetic resources.
Abstract: Natural regeneration of juniper (*Juniperus polycarpus*, syn. *J. excelsa*) in the Baluchistan (Pakistan) forests is very poor, so studies were undertaken on the possible propagation of the species by bud culture. Actively growing buds were excised from 2-yr-old plants growing in the Silviculture Garden of the Pakistan Forest Institute and their multiplication tested in various media. Successful multiplication was achieved in 2 wk by first treating the buds with 0.7% polyvinyl pyrrolidone (PVP) and 2% sucrose, and then culturing for 2 wk in basal MS (Murashige and Skoog) or WRC (White's Root Culture) media containing 0.5 mg/litre BAP (benzylaminopurine [benzyladenine]) or 1.0 mg/litre BAP or kinetin, respectively. On WRC medium 100% multiplication was achieved, with a maximum number of new buds of 9 per treated original bud.
46. Moinuddin-Ahmed; Imtiaz-Ahmed, and Anjum P. I. A study of natural regeneration of *Juniperus excelsa* M. Bieb. in Baluchistan, Pakistan. *Pakistan Journal of Botany*. 1989; 21(1):118-127.
Keywords: *Juniperus excelsa/* natural regeneration/ seedlings/ site factors
Abstract: Regenerating seedlings in 60 mature stands (not recently

logged) were sampled in May-November 1986. Counts ranged from zero to 219/ha with a mean of 52/ha. Seedling density and basal area ($P < .001$) and tree basal area and seedling density ($P < .05$) were significantly correlated, indicating that seedlings are shade loving. The highest average seedling density and basal area were recorded from west facing slopes. The size frequency distribution of seedlings showed recent recruitment in many stands (more seedlings in smaller size classes, with a gradual decrease in larger classes) suggesting that *J. excelsa* forests are not deteriorating in Baluchistan. Past disturbances in the stands could also be identified, as indicated by the absence of particular seedling size classes. For about 50% of the stands, the most destructive period (as indicated by lack of regeneration) appeared to have been in 1975-79, probably due to population increase associated with felling and overgrazing.

47. Mughal, M. S. Spotlight species on: *Juniperus excelsa*, M. Bieb. Pakistan Journal of Forestry. 1993; 43(3):170-172.
Keywords: *Juniperus excelsa*/ ecology/ silviculture/ management/ diseases/ pests
Abstract: Brief details are given of the ecology, silvicultural characters, silviculture, pests and diseases, management and uses of this species, which is found in Pakistan, India, Nepal, Afghanistan, Iran, and [Saudi] Arabia.
48. Muhammad I.; Mossa J. S., and El-Feraly F. S. Antibacterial diterpenes from the leaves and seeds of *Juniperus excelsa* M. Bieb. Phytotherapy Research. 1992; 6(5):261-264.
Keywords: *Juniperus excelsa*/ seeds/ diterpenes/ plant composition/ medicinal plants/ Saudi Arabia
Abstract: *J. excelsa*, known as Are-Are in Arabic, is used in traditional medicine to treat tuberculosis and jaundice. Two diterpenes from leaves and seeds (collected from Abha, Saudi Arabia), obtained by a bioautography-guided isolation technique, were found to possess significant antibacterial activity in a 2-fold serial dilution assay. (+)-Ferruginol (abieta-8,11,13-triene-12-ol) and (-)-sandaracopimeric acid (isopimara-8(14),15-diene-18-oic acid) were active against *Bacillus subtilis*, *Staphylococcus aureus* and *Streptococcus durans*, while their corresponding 3 beta -hydroxy derivatives hinokiol and 3 beta -hydroxysandaracopimeric acid, also isolated from *J. excelsa*, were found to be inactive. (+)-Ferruginol also demonstrated strong activity against *Mycobacterium smegmatis*, *M. intracellulare*, *M. xenopi* and *M. chelonae* [*M. chelonae*] (MIC value of 5.0 micro g/ml, compared with 10.0 micro g/ml for the antibiotic, streptomycin sulphate).
49. Negussie, A. In vitro induction of multiple buds in tissue culture of *Juniperus excelsa*. Forest Ecology & Management. 1997 Nov 3; 98(2):115-123.
Keywords: *Juniperus excelsa*/ excised cotyledon/ embryo/ explants/ NAA/ BAP

Abstract: In the present experiment adventitious buds were induced on excised cotyledon segments and embryo explants of *Juniperus excelsa* on both Eriksson (1965) and Murashige and Skoog (1962) basal media containing either 0.5 or 1 mg l⁻¹ BAP (6-benzylaminopurine) with or without NAA. When 0.02 mg l⁻¹ NAA was added to Eriksson basal medium containing 0.5 mg l⁻¹ BAP as many as 92 adventitious shoots were formed per cotyledon segment. Embryo explants showed the best response when the same concentration of NAA was added to Murashige and Skoog medium containing 1 mg l⁻¹ BAP. The presence of NAA in Murashige and Skoog basal medium suppressed the morphogenetic response of cotyledon explants and successive growth of the buds. When the proliferated explants with numerous scale-like organs were transferred to respective basal media containing neither BAP nor NAA and when all explants with overcrowded propagules were divided into two or more sections, the growth of the propagules was further stimulated. Better rooting of adventitious shoots was achieved when shoots were pre-treated with IBA (1 mg l⁻¹) and NAA (0.5 mg l⁻¹) or activated charcoal (1% w/v) for three weeks and incubated in a covered seed tray filled with non-sterile compost for four months. Untreated shoots also rooted after four months when maintained on the same basal medium. These aseptically rooted shoots needed more careful acclimatization.

50. Negussie, A.; Good, J. E., and Mayhead, G. J. The effect of pre-treatments and diurnal temperature variations on the germination of *Juniperus excelsa*. *International Tree Crops Journal*. 1991; 7(1-2):57-66.
Keywords: *Juniperus excelsa*/ germination/ seeds/ Kenya
Abstract: One-year old seed of *Juniperus excelsa* M. Bieb. from western Kenya was screened, pretreated and sown and germination percentage assessed after 18 weeks. Germination percentage was low at a maximum of 21%. Treatments included soaking in gibberillic acid, hydrogen peroxide, and sulphuric acid; stratification for 60 days; hot water treatments; and abrasion. All pre-treatments failed to significantly increase germination percentages. All hot water treatments produced no germination. A diurnal variation in temperature (20/30° C) produced significantly higher germination percentages than a constant 25° C.
51. Pontecorvo, G. and Bokhari, M. Hedge-like habit of *Juniperus excelsa* at high altitude on the Southern Zagros Mountains in Iran. *Proceedings of the Royal Society of London, B*. 1975; 188(1093):507-508.
Keywords: *Juniperus excelsa*/ Iran/ hedge-like habit/ windward/ leeward/ wind
Abstract: Briefly describes and illustrates with photos this example of the hedge-like habit occasionally adopted by conifers under very special conditions. *J. excelsa* grows at up to ca. 3300 m alt. in the Southern Zagros Mountains, normally in tree form. Below a col at ca. 3250 m, however, where wind is channeled uphill and winter snow cover is heavy, it grows in hedge-like form, rooting from the branches and dying at the windward end

while advancing at the leeward end.

52. Quraishi, M. A.; Khaliq, A.; Perveen, S., and Akhtar, P. Diurnal fluctuations in water balance of *Juniperus excelsa* M. Bieb. under natural conditions at Ziarat (Baluchistan). *Pakistan Journal of Forestry*. 1977; 27(3):114-122a.
Keywords: *Juniperus excelsa*/ adaptation/ plant water relations/ arid regions.
Abstract: A 14-h study was made on a single tree on 15 Sept. 1976, following a week of heavy rain. Measurements were made at 3-h intervals of transpiration rate, stomatal aperture, water content, water deficit, water potential and osmotic potential. The results (shown in graphs) suggested that *J. excelsa* is adapted to a habitat with a permanent water deficit.
53. ---. Eco-physiological investigations on the water balance of three important species of juniper forest tract at Ziarat (Baluchistan). *Pakistan Journal of Forestry*. 1978; 28(1):35-42.
Keywords: *Juniperus excelsa*/ *Caranga ambigua*/ *Perovskia abrotanoides*/ water content/ transpiration rate/ stomata
Abstract: Transpiration rate, stomatal behaviour, plant water content and water deficit were studied for one day on single plants of *Juniperus excelsa* and two of the shrubs most often associated with it, *Caranga ambigua* and *Perovskia abrotanoides*. All four parameters suggested that *J. excelsa* is better adapted to this habitat (cool, but very dry) than the two shrubs.
54. Ruguzov, I. A. [Author]; Sklonnaya, L. U. [Author]; Kostina, and V. P. [Author]. Cytoembryological principles of conservation of threatened species of genus *Juniperus* L. in the Crimea. *Ukrayins'Kyj Botanichnyi Zhurnal*. 1994; 51(2-3):211-217.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ Crimea/ cytoembryological/ seed
Abstract: The paper contains information on distribution of *Juniperus excelsa* Bieb., *J. foetidissima* Willd. and *J. oxycedrus* L. in the Crimea. It is emphasized that these woody species are on the brink of death in the natural area. Results of studying sporo- and gametogenesis, pollination and fertilization, embryogenesis and endosperm formation as a united and continuous process of viable seed formation are presented. Development cycles of reproductive structures of each species in the Crimea are shown on diagrams. A comparison of calendar dates and duration of certain formation stages of embryonal structures of the species under allowed to reveal a fluctuating modification process at seed formation. Disturbances and deviations leading to seed-emptiness and disappearance of these species in situ are discussed. Formation of non-viable seeds is stipulated by the fact that optimum ratio of female and male individuals in the population fragments of given species; unfavorable ecological conditions for microsporogenesis and pollination. Self-pollination of ovules and undevelopment of female gametophyte, degeneration of male gametophyte

for embryos death at one of embryogenesis stages - all these are the result of this. By the authors' opinion, only organization of seed-production of the *Juniperus* L. species will make it possible to produce necessary amount of viable seeds and to conserve these species.

55. Ruguzov, I. A.; Sklonnaya, L. U., and Chobotar, A. A. Pollination drop in conifers. *Botanicheskii Zhurnal* (Leningrad). 1992; 77(12):40-52.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ *Sequoia sempervirens*/ *Sequoiadendron giganteum*/ *Taxodium distichum*/ *Libocedrus decurrens*/ *Cephalotaxus drupacea*/ *Taxus baccata*/ *Torreya grandis*/ pollination/ pollen grains/ ovule nucellus
Abstract: Pollination mechanism was studied in *Sequoia sempervirens*, *Sequoiadendron giganteum*, *Taxodium distichum*, *Libocedrus decurrens*, *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus*, *Cephalotaxus drupacea*, *Taxus baccata*, and *Torreya grandis* of the family *Cupressaceae*. In all species, the contact of pollen grains with ovule nucellus is carried out with the aid of a pollination drop. The latter is developed only under definite hydrothermal conditions. The capacity of the ovule of perceiving pollen grains does not change during 4-14 days depending on the species. The functions of a pollination drop vary during phylogenesis.
56. Scott, J. The influence of stratification, scarification, hot water and maternal plant on the germination of *Juniperus excelsa* seeds from Eritrea. *International Tree Crops Journal*. 1989; 5(4):221-235.
Keywords: *Juniperus excelsa*/ seed germination/ seed treatment./ stratification/ greenhous/ scarification/ hot water/ sulfuric acid/ seeds/ Eritrea
Abstract: Stratification for 60 days at 5 ° C increased the germination percentage of *J. excelsa* seeds from Eritrea (63%) over untreated controls grown in a greenhouse (53%) and a growth chamber (47%). Scarification with conc. sulfuric acid for 15 min (followed by stratification) did not significantly improve germination percentage over untreated controls. Treatment with hot water (80 ° C) resulted in zero germination after 240 days, while scarification in concn. sulfuric acid for 60 min (followed by stratification) significantly reduced germination percentage (7-8%). There were significant differences in germination percentage between seeds from different maternal plants (18-60%), but not between seeds of different sizes and weights. Data are included on seed width, length, weight before and after imbibition, and viability (by the tetrazolium test). The results presented in this study differ from those reported for *J. excelsa* seeds from Tanzania, possibly due to differences in provenance and duration of seed storage.
57. Shanjani P. S. Callus induction and plant regeneration of *Juniperus excelsa* using in vitro technique. *Iranian Journal of Forest and Poplar Research*. 2003;

11(2):247-263, 320.

Keywords: *Juniperus excelsa*/ propagation/ in vitro/ callus/ regeneration/ roots

Abstract: In this paper, callus induction and regeneration of *Juniperus excelsa* using in vitro was explored. Small pieces of stem of 8-10 years old trees (10-15 mm long) containing shoot tips with needle fascicles were used as explants. Samples were cultured on a Murashige and Skoog (MS) medium and 6 revised MS medium supplemented with different concentrations of BAP, Kin, IBA, NAA and 2,4-D. Then, these cultures were incubated in a climate chamber at temperatures of 25 degrees C (day) and 15 degrees C (night) and 12 h light at 200-2500 Lux with 75% humidity. Results indicated that callusgenesis and callus growth were restricted by both nitrate and hormonal source. The best simulation of callus growth occurred on cultures without KNO₃, with glutamin (100 ml/litre) and an amount of 2,4-D/BAP (more than 1 ratio). Although adventitious buds were formed on juvenile stages of parent plants, root induction did not occur. In addition, the season of sampling can also restrict the callusgenesis, it is higher in autumn than during spring. No shoot proliferation was observed on MS medium, however, by eliminating ammonium nitrate from MS medium, bud appeared from callus as well as in leaf blade.

58. Sheikh, M. I. Afforestation in juniper forests of Baluchistan. Afforestation in Juniper Forests of Baluchistan. 1985; 2(46):8.

Keywords: *Juniperus excelsa*/ afforestation/ seed collection/ germination/ propagation/ survival/ silviculture/ Pakistan/ Baluchistan

Abstract: The introduction to this account of work done during a juniper (*Juniperus excelsa*) afforestation project in Baluchistan (started in 1975) describes the characteristics and importance of the juniper tract, and its ecology, geology and soils, climate, and use for grazing. Major afforestation work was required in order to arrest the decline of the juniper forests which was first brought to the attention of the government in 1974. Research is described on propagation from seed (including seed collection and germination), vegetative propagation, establishment in the field (shade and survival, mulching), and the use of other species (both indigenous and exotic). Integrated research work on range management, watershed management, pests and diseases, and the physiology and water relations of *J. excelsa* is also described. A summary is given of general recommendations made and of recommendations on nursery practices and field planting.

59. Sheikh, M I and Rafique, M. Effect of light, shade and age on survival of transplanted seedlings of *Juniperus excelsa*, M. Bieb. Pakistan Journal of Forestry. 1982; 32(1):28-29; ISSN: 0030-9818.

Keywords: *Juniperus excelsa*/ nurseries/ transplanting/ conifers

Abstract: Seedlings grown in nursery beds and transplanted to experimental plots in

the open showed better growth and form than those planted under overhead shade. Survival of seedlings was no different in the shade or open, and did not differ with age of seedlings (5, 10, 20 or 30 days), although older seedlings were easier to prick out.

60. Shelyag-Sosonko, Yu. R. and Didukh, Ya. P. Open forests of the *Junipereta excelsae* in the Crimea and an analysis of their flora. Ukrain's Kii Botanichnii Zhurnal. 1975; 32(6):753-762.
Keywords: *Juniperus excelsa*/ Crimea/ flora/ succession/ composition/ human disturbance
Abstract: The main associations of this formation are described, in which the tree layer is dominated by *Juniperus excelsa* up to 5-8 m high. The floristic and physiognomic composition and successional relations are analyzed, emphasizing the floristic richness of the vegetation type (238 species) and its sensitivity to human disturbance. [Cf. FA 32, 443].
61. von Wissmann, H. The *Juniperus* mountain forests in Arabia: their position between the boreal and tropical African floral kingdoms. Geocology of the High Mountain Regions of Eurasia. 1972; 157-176.
Keywords: *Juniperus excelsa*/ *Juniperus macropoda*/ *Juniperus procera*/ distribution/ vegetation types/ Africa
Abstract: Reviews the distribution and altitudinal range of *Juniperus* spp. (section Sabina); these represent one of the few genera of trees that range from Eurasia into Africa across the tropics; a map shows the range of individual species. Many of the sources are books of travel. Some associated plant species are noted. evidence is presented for regarding *J. excelsa* (the commonest species in Arabia), *J. macropoda* and *J. procera* as one and the same species, and for identifying them with the Almug or Algom trees of the Bible, and the Biblical land of Ophir with the province of Asir in Saudi Arabia, where *J. excelsa* stands are still plentiful.
62. Zakaullah . Decay in the Ziarat juniper forests of Baluchistan. Pakistan Journal of Forestry. 1978; 28(1):28-34.
Keywords: *Juniperus excelsa*/ Pakistan/ decay/ *Pyrofomes demidoffii*/ diseases/ assessment/ arid regions.
Abstract: A study of 137 juniper trees (*Juniperus excelsa*) located in the Baluchistan Province of Pakistan, indicated that the incidence of decay was 83% and the extent of volume loss 32% among the sample trees. The amount of decay increased with the diameter of the tree, rising markedly above 23 cm dbh. *Pyrofomes demidoffii*, the heart rot fungus, accounted for over 96% of the total decay volume. Dead branch stubs and root-connections were the important means of entry for decay fungi.
Juniperus excelsa forms about 31 400 ha of mature and over-mature dry juniper forest in the Ziarat forests. Decay was surveyed in 137 trees in 16 sample plots at 8 localities. Attack by decay-causing fungi was found in 114 of the trees; the vol. of decayed wood amounted to 32% of the vol. of the sample trees. Heart rot due to *Pyrofomes demidoffii* accounted for 96% of

the decay vol. Dead branch stubs and root connections were the main infection courts.

Juniperus faetida (1)

1. Mohr and Charles Theodore. Notes on the Red Cedar. 1901; 3137.
Keywords: *Juniperus virginiana*/ eastern red cedar/ *Juniperus caroliana*/ *Juniperus arborescens*/ *Juniperus barbadensis*/ *Juniperus faetida*/ *Juniperus australis*/ *Juniperus sabina*/ juniper/ cedar/ savin
Call Number: 1
Abstract: Botanical analysis and distribution of eastern red cedar in the early 1900's

Juniperus fargesii (1)

1. Mehra, P. N. and Jain, K. K. *Abies* and *Juniperus* complexes in the E. Himalayas with observations on *Larix griffithii* Hook. f. and *Tsuga dumosa* Eichler. *Abies* and *Juniperus* Complexes in the E. Himalayas With Observations on *Larix Griffithii* Hook. F. and *Tsuga Dumosa* Eichler. 1976; 143.
Keywords: *Juniperus pseudosabina*/ *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus fargesii*/ *Juniperus squamata*/ *Abies forrestii*/ *Abies spectabilis*/ anatomy/ morphology/ taxonomy/ classification.
Abstract: The main part of the book describes in detail the morphology and anatomy of leaves, young shoots, wood, bark and female cones of *Abies* and *Juniperus*, with 77 photographs and line drawings. Evolutionary trends in *Juniperus* and the *Pinaceae* are discussed and a short bibliography is included. It is concluded that *A. forrestii* is distinct from *A. spectabilis* and that the sabinoid group of *Juniperus* includes *J. pseudosabina* and *J. wallichiana* and the oxycedroid group *J. recurva*, *J. fargesii* and *J. squamata* var. *wilsonii*.

Juniperus flaccida (3)

1. Adams, R. P. Reevaluation of the biological status of *Juniperus deppeana* var. *sperryi* Correll. Brittonia. 1973; 25(3):284-289.
Keywords: *Juniperus deppeana*/ *Juniperus pinchotii*/ *Juniperus flaccida*/ hybridization/ morphology/ terpenoids
Abstract: Gives the results of an examination of the terpenoids and morphological characters of foliage and bark from the type tree of *J. deppeana* var. *sperryi* and from trees of natural populations of *J. d.* var. *deppeana*, *J. pinchotii* and *J. flaccida*. The terpenoid data suggest that the variety is most closely related to *J. d.* var. *deppeana*, and no evidence was found of hybridization with *J. flaccida*. In some morphological characters, however, the variety is intermediate between the two last, and the probability of a hybrid origin is discussed. The new combination *J. deppeana* f. *sperryi* is proposed.
2. ---. The serrate leaf margined *Juniperus* (section *Sabina*) of the western

hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/* essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. *Sabina*) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

3. Jimenez, J.; Aguirre, O., and Kramer, H. Stand structure analysis of an uneven-aged mixed pine-juniper-oak forest in northeastern Mexico. *Bestandesstrukturanalyse im ungleichaltrigen Kiefern-Wacholder-Eichen-Mischwald Nordostmexikos*. *Forstarchiv*. 1998; 69(6):227-234.
Keywords: *Juniperus flaccida/ Quercus/ Pinus/* diameter/ height/ analysis
Abstract: A stand structure investigation was carried out in 2.18-ha uneven-aged mixed pine-juniper-oak stand (*Pinus pseudostrabus*, *Juniperus flaccida*, *Quercus rysophylla*, *Q. canbyi*, *Q. laceyi*, with *Arbutus xalapensis* and other broadleaved shrubs), situated in the training forest of the Forestry Faculty of the Universidad Autonoma de Nuevo Leon, in the Sierra Madre Oriental, Nuevo Leon, Mexico. The stand structure analysis attempted to describe the complex conditions of a natural, uneven-aged mixed conifer/broadleaved forest in Mexico with a high tree species diversity. Inventory data from a complete enumeration survey were used to determine the abundance (number/ha) and dominance (basal area/tree species) of the individual tree species, as well as certain homogeneity indicators for the total stand and the different tree species. The representative sample trees were used to estimate tree species frequency, diameter differentiation and height differentiation, as well as the mingling for the total stand and the different tree species. Height of all sampled trees, the tree species were distributed into three height zones

(based on number and basal area of the trees). The investigation emphasized the importance of a detailed, horizontal and vertical stand structure analysis, arranged according to the tree species.

Juniperus foetidissima (15)

1. Adams R. P.; Mumba L. E.; James S. A.; Pandey R. N.; Gauquelin T., and Badri W. Geographic variation in the leaf oils and DNA fingerprints (RAPDs) of *Juniperus thurifera* L. from Morocco and Europe. *Journal of Essential Oil Research*. 2003; 15(3):148-154.
Keywords: *Juniperus thurifera*/ *Juniperus foetidissima*/ *Juniperus africana*/ Morocco/ Europe/ leaf oils/ populations/ seeds/ cones
Abstract: Samples of *J. thurifera* were collected from the Atlas Mountains, Morocco, northern and southern Spain, the Pyrenees, France, French Alps and Corse Island, France. The leaf oils were analyzed and were found to be polymorphic for several major compounds (sabinene, limonene, linalool, piperitone, linalyl acetate and sesquiterpenes). In general, the Moroccan trees were higher in sabinene, gamma -terpinene, cis-sabinene hydrate and terpinen-4-ol, but lower in limonene, delta -2-carene, and piperitone than trees from Europe. Analysis based on random amplified polymorphic DNAs (RAPDs) for the aforementioned population plus *J. foetidissima* (as an outgroup), revealed that the Moroccan *J. thurifera* populations were most similar to plants from southern Spain, then to populations from France. Although the trees generally clustered by populations, there appear to be some differentiation in the RAPDs between the European *J. thurifera* populations and the Moroccan populations. Combining previous studies on seeds per cone, proanthocyanidins, and the current report on the leaf essential oils and RAPDs, there is some support for the continued recognition of *J. thurifera* vat. *africana* syn. *J. africana*; *J. thurifera* subsp. *africana* in Algeria and Morocco.
2. Alpacar, G. Studies on overcoming germination difficulties for *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus* and *J. drupacea* seeds, and determination of morphological characters of cones and seeds. *Teknik Bulten Serisi Ormanlık Araştırma Enstitüsü Yayınları*. 1988; 197(7):21-38.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ *Juniperus drupacea*/ *Pinopsida*/ seeds/ seed morphology/ cones/ morphology/ seed treatment/ germination/ scarification/ stratification/ soaking
Abstract: Various stratification, soaking and scarification methods were tested for improving seed germination of *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus* and *J. drupacea*. Cone and seed morphology is also given for each species.
3. Balaban, M; Atik, C, and Ucar, G. Fungal growth inhibition by wood extracts from *Juniperus foetidissima* and *J. oxycedrus*. *Holz Als Roh Und Werkstoff*.

2003; 61(3):231-232.

Keywords: *Juniperus foetidissima*/ *Juniperus oxycedrus*/ fungus/ wood extracts/ *Coriolus versicolor*/ *Gloephyllum trabeum*/ *Chaetomium globosum*/ *Coniophora puteana*

Abstract: The fungal growth inhibition of two juniperus species (*Juniperus foetidissima* and *J. oxycedrus*) were investigated, which produce wood extractives in considerable amounts and are widespread in Anatolia, Turkey. Disks were cut from trees and after debarking, sapwood and heartwood were separated first. Mycelial plugs from the following fungal species were tested: *Coriolus versicolor*, *Gloephyllum trabeum*, *Chaetomium globosum* and *Coniophora puteana*. The antifungal activity was expressed as the percentage of growth diameter calculated and based on the diameter growth of controls. The results showed very high content of extractives in the heartwood of *J. foetidissima*. Furthermore, the compounds of polar character (soluble in ethanol and water) make up more than half of the extractives in sapwoods, whereas the nonpolar extracts (cyclohexane and chloroform soluble) were predominant in the case of heartwoods. The antifungal activities differ depending on the extract fraction and fungi species. In the average, the growth of *Chaetomium globosum* was inhibited to the highest extent.

4. Boydak, M. Recently discovered monumental forest and trees of *Cedrus libani*, *Juniperus foetidissima* and *Pinus brutia* in Turkey. Turkiye'de sedir, ardc ve kzlcamda yeni saptanan ant orman ve agaclar. Istanbul Universitesi Orman Fakultesi Derisi Seri A. 1988; 38(2):54-68.
Keywords: *Juniperus foetidissima*/ *Cedrus libani*/ *Pinus brutia*/ Turkey
5. Brullo S.; Galdo G. G. del, and Guarino R. The orophilous communities of the Pino-Juniperetea class in the Central and Eastern Mediterranean area. Feddes Repertorium. 2001; 112(3/4):261-308.
Keywords: *Juniperus foetidissima*/ orophilous plant communities/ Mediterranean
Abstract: Orophilous plant communities of the *Pino-Juniperetea* class, occurring in the Central and Eastern Mediterranean area, are examined. This vegetation is characterized by the dominance of trees and shrubs, mostly represented by conifers belonging to the genera *Juniperus*, *Abies* and *Pinus*. These communities are nowadays relegated to the supra- and oromediterranean belt, and show a fragmentary distribution, which is an evident proof of their relict connotation. The comparison among these communities, based on original and literature data, has highlighted a remarkable floristic and structural homogeneity, together with a series of geographical vicariances. From the phytosociological point of view, this justifies the arrangement of the aforesaid communities in the class *Pino-Juniperetea*, whose range is therefore extended to the whole Mediterranean basin. In the Central and Eastern Mediterranean area, the class is represented by the order *Juniperetalia hemisphaericae*, which comprises two new alliances: *Berberidion aetnensis*, restricted to the

Central Mediterranean area, and *Berberido creticae-Juniperion foetidissimae*, distributed in the Eastern Mediterranean area. Both of them have been on its turn split up in some suballiances, to emphasize the floristic autonomy of some well-defined phytogeographical districts. The identified associations, many of them new to science, are examined from the nomenclatural, floristical, ecological, structural and chorological point of view.

6. Eler, U. Yield studies for Crimean juniper (*Juniperus excelsa*) in Turkey. Turkiye'de boylu ardc (*Juniperus excelsa* Bieb.) ormanlarında haslat arastrmalar. Teknik Bulten Serisi Ormanclk Arastrma Enstitusu Yaynlar. XXXII. 1988; 192(7):40 pp.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Cedrus libani*/ *Abies cilicica*/ *Pinus nigra*/ volume tables/ increment.
Abstract: A 2-way volume table, site class table and yield table were developed for pure natural, even-aged, undisturbed stands of *Juniperus excelsa* in Turkey. Growth of *J. excelsa* was compared with that of *J. foetidissima*, Lebanon cedar [*Cedrus libani*], Cilician fir [*Abies cilicica*] and Austrian pine [*Pinus nigra*].
7. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. *Sabina*) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). Edinburgh Journal of Botany. 1992; 49(3):251-283.
Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia
Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpus* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpus*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.
8. Jolfaii, H. K. and Abbasi, M. First report of the telial state of *Gymnosporangium confusum* on *Juniperus foetidissima* in Iran. Rostaniha. En62-En63, Pe59. 2003; 4(1/2):59 pp.
Keywords: *Juniperus foetidissima*/ *Gymnosporangium*/ Iran/ fungus
Abstract: In northern Iran, *Juniperus foetidissima* trees were infected by a *Gymnosporangium* species with the following features: pulvinate to short conic, dark red-brown telia on small swellings on the branches; ellipsoid to fusiform teliospores, scarcely constricted or not constricted at

either of two septum types ((1) with 2-3 micro m thick, brown walls, or (2) with thin hyaline walls, slightly longer and narrower than 1); two pores per cell at the septum; hyaline pedicels, longer than the spore. The specimen was identified as *Gymnosporangium confusum*. This is thought to be the first report of the telial state of *G. confusum* on *J. foetidissima* in Iran.

9. Keskin, S. Studies on rooting cuttings of *Juniperus foetidissima* and *J. excelsa*. Kokulu ardc (*Juniperus foetidissima* Willd.) ve boylu ardc (*Juniperus excelsa* Bieb.) 'in celikle uretilmesi. Teknik Bulten Serisi Ormanclık Araştırma Enstitüsü Yayınları. 1992; 23330.
Keywords: *Juniperus foetidissima*/ *Juniperus excelsa*/ cuttings/ rooting
10. Keskin, S. S. Rooting of cuttings of *Juniperus foetidissima* and *Juniperus excelsa*. Kokulu ardc (*Juniperus foetidissima* Willd.) ve Boylu ardc (*Juniperus excelsa* Bieb.) celiklerinin koklendirilmesi uzerine calismalar. Teknik Raporlar Serisi Ormanclık Araştırma Enstitüsü. 1989; 36-3935-48.
Keywords: *Juniperus foetidissima*/ *Juniperus excelsa*/ vegetative propagation/ shoot cuttings/ rooting
11. Muradyan, V M. Growing tree junipers in Armenia. Lesnoe-Khozyaistvo. 1982; 762-63.
Keywords: *Juniperus polycarpos*/ *Juniperus foetidissima*/ Armenia/ planting stock/ nursery/ berries/ seeds/ stratification/ germination
Abstract: A summary account is given of experience in the production of planting stock of *Juniperus polycarpos* and *J. foetidissima*, xerophilous species suitable for planting in the dry conditions of the Caucasus (Soviet Armenia). The 'berries' should be harvested in the stage of waxy ripeness, wetted with water, stored in a layer 20-25 cm deep for 5 months in a cool place, then placed in sacks and dipped 5-6 times in boiling water for 3 min, each time followed by cold water, and finally stored for 2 days in a layer in a ventilated room; the seeds are then separated from the flesh in water, and stratified at 18-20 deg C and then 1-2 deg C. Seedlings can be raised in paper pots filled with a mix of soil, peat and mycorrhizal earth, or in manure/clay-loam blocks. Good survival rates have been obtained with these potted seedlings.
12. ---. Increasing the seed production of juniper stands in Armenia. Lesnoe Khozyaistvo. 1980; 1233-34; ISSN: 0024-1113.
Keywords: *Juniperus polycarpos*/ *Juniperus foetidissima*/ seed production/ broadleaves
Abstract: Investigations were made on 38 sample plots and 5385 sample trees in Soviet Armenia in order to determine the seed production of two species of juniper, viz. *Juniperus polycarpos* and 'heavy-scented juniper' [*J. foetidissima*?]. Data are tabulated on the fruiting of these two species in stands of coppice and seedling origin in various regions and on various soil types. The effect of site alt., winds and temp. on pollination is discussed, and practical recommendations are made for mineral

fertilizing and underplanting to rehabilitate these stands and thus improve their fruiting.

13. Muradyan, V. M. Propagation of juniper in Armenia. *Lesnoe Khozyaistvo*. 1982; 662-63.
Keywords: *Juniperus polycarpus*/ *Juniperus foetidissima*/ nurseries/ sowing/ seeds/ treatment/ germination.
Abstract: A summary account is given of investigations on the failure of junipers (*Juniperus polycarpus* and *J. foetidissima*) to regenerate naturally in Soviet Armenia, and of measures to propagate them successfully. As soon as the 'berries' are harvested they should be wetted with water at room temp., and held for 5 months in a cold place in a layer 20-25 cm thick; then bags of the berries should be dipped alternately in boiling water and cold water 5-6 times, washed in water at 60 ° C, and then left in a well-ventilated room for 2 days before separating the flesh from the seeds in water; before sowing, the seeds are stratified at 18-20 ° C and then at 1-2 ° C. The seedlings can be raised in nursery beds (details listed) or in paper pots in the open or in a greenhouse.

14. Ruguzov; I. A. [Author]; Sklonnaya; L. U. [Author]; Kostina, and V. P. [Author]. Cytoembryological principles of conservation of threatened species of genus *Juniperus* L. in the Crimea. *Ukrayins'Ky Botanični Zhurnal*. 1994; 51(2-3):211-217.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ Crimea/ cytoembryological/ seed
Abstract: The paper contains information on distribution of *Juniperus excelsa* Bieb., *J. foetidissima* Willd. and *J. oxycedrus* L. in the Crimea. It is emphasized that these woody species are on the brink of death in the natural area. Results of studying sporo- and gametogenesis, pollination and fertilization, embryogenesis and endosperm formation as a united and continuous process of viable seed formation are presented. Development cycles of reproductive structures of each species in the Crimea are shown on diagrams. A comparison of calendar dates and duration of certain formation stages of embryonal structures of the species under allowed to reveal a fluctuating modification process at seed formation. Disturbances and deviations leading to seed-emptiness and disappearance of these species in situ are discussed. Formation of non-viable seeds is stipulated by the fact that optimum ratio of female and male individuals in the population fragments of given species; unfavorable ecological conditions for microsporogenesis and pollination. Self-pollination of ovules and undevelopment of female gametophyte, degeneration of male gametophyte for embryos death at one of embryogenesis stages - all these are the result of this. By the authors' opinion, only organization of seed-production of the *Juniperus* L. species will make it possible to produce necessary amount of viable seeds and to conserve these species.

15. Ruguzov, I. A.; Sklonnaya, L. U., and Chobotar, A. A. Pollination drop in conifers. *Botanicheskii Zhurnal* (Leningrad). 1992; 77(12):40-52.

Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ *Sequoia sempervirens*/ *Sequoiadendron giganteum*/ *Taxodium distichum*/ *Libocedrus decurrens*/ *Cephalotaxus drupacea*/ *Taxus baccata*/ *Torreya grandis*/ pollination/ pollen grains/ ovule nucellus

Abstract: Pollination mechanism was studied in *Sequoia sempervirens*, *Sequoiadendron giganteum*, *Taxodium distichum*, *Libocedrus decurrens*, *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus*, *Cephalotaxus drupacea*, *Taxus baccata*, and *Torreya grandis* of the family *Cupressaceae*. In all species, the contact of pollen grains with ovule nucellus is carried out with the aid of a pollination drop. The latter is developed only under definite hydrothermal conditions. The capacity of the ovule of perceiving pollen grains does not change during 4-14 days depending on the species. The functions of a pollination drop vary during phylogenesis.

***Juniperus formosana* (1)**

1. Adams, Robert P.; Hsieh, Chang-Fu; Murata, Jim, and Pandey, Ram Nanresh. Systematics of *Juniperus* from eastern Asia based on Random Amplified Polymorphic DNA's (RAPDs) . *Biochemical Systematics and Ecology* . 2002 Mar; 30(3):231-241; ISSN: 0305-1978.

Keywords: *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus conferta*/ *Juniperus formosana*/ *Juniperus procumbens*/ *Juniperus rigida*/ *Juniperus taxifolia*/ RAPS's/ DNA/ Taiwan/ China
Call Number: QD415.A1B5

Abstract: DNA was examined by RAPD banding for *Juniperus chinensis*, *J. c.* var. *sargentii*, *J. c.* var. *tsukusiensis*, *J. communis*, *J. c.* var. *nipponica*, *J. c.* var. *saxatilis*, *J. conferta*, *J. formosana*, *J. procumbens*, *J. rigida*, *J. taxifolia*, and *J. t.* var. *lutchuensis*. The DNA data readily separated junipers of section *Sabina* from section *Juniperus*. *J. c.* var. *tsukusiensis* from Taiwan was found to be sufficiently different from *J. c.* var. *tsukusiensis* (Yakushima) to warrant the recognition of a new variety: *J. chinensis* var. *taiwanensis* R.P. Adams and C-F. Hsieh *nov. var.* *Juniperus formosana* from mainland China was found to be different from *J. formosana* from Taiwan and a new variety is recognized: *J. formosana* var. *mairei* (Lemee and Lev.) R.P. Adams and C-F. Hsieh *comb. nov.* *Juniperus communis* var. *nipponica* was found to be distinct from *J. communis* and this supports its recognition as a variety. The recognition of *J. conferta* as a variety of *J. rigida* [*J. rigida* var. *conferta* (Parl.) Patschke] is supported by the data. The data also supports the recognition of *J. lutchuensis* Koidz. [= *J. taxifolia* var. *lutchuensis* (Koldz.) Satake] and *J. morrisonicola* Hayata [= *J. squamata* var. *morrisonicola* (Hayata) H.L. Li and H. Keng] at the specific levels.

***Juniperus gamboana* (1)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/ essential oils/ DNA/ RAPD*

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana, J. ashei, J. californica, J. coahuilensis, J. comitana, J. deppeana, J. durangensis, J. flaccida, J. gamboana, J. jaliscana, J. monosperma, J. monticola, J. osteosperma, J. occidentalis, J. pinchotii, J. saltillensis, and J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

***Juniperus hemisperica* (1)**

1. Costa, M; Perez Badia, R, and Soriano, P. The *Juniperus thurifera* forests of Valencia. *Acta Botanica Malacitana*. 1990; 15:297-301.

Keywords: *Juniperus phoenicea/ Juniperus thurifera/ Quercus rotundifolia/ Juniperus hemisperica/ Spain/ distribution*

Abstract: The distribution and main features are described of the Junipereto phoeniceae-thuriferae, Junipereto thuriferae-Querceto rotundifoliae and Junipereto hemisphaerico-thuriferae communities in the Valencia region of Spain.

***Juniperus horizontalis* (32)**

1. Akers, M S Reprint author; Carpenter, P L Author, and Weller, S C Author. Herbicide systems for nursery plantings. *Hortscience*. 1984; 19(4):502-504.

Keywords: *Juniperus horizontalis/ Acer rubrum/ Acer platanoides/ Pachysandra terminalis/ herbicides/ nursery*

Abstract: Field studies conducted for 2 yr showed that glyphosate [N-(phosphonomethyl)glycine] or mixtures of glyphosate and preemergence

herbicides applied as preplant and directed postplant sprays were effective in providing season-long weed control in commercial nurseries. Oryzalin [3,5-dinitro-N₄,N₄-dipropylsulfanilamide] at 2.2 or 4.5 kg ai[active ingredient]/ha, and mixtures of simazine [2-chloro-4,6-bis(ethylamino)-s-triazine] at 1.1 kg/ha with diphenamid [N,N-dimethyl-2,2-diphenylacetamide] at 6.7 kg ai/ha, napropamide [2-(.alpha.-naphthoxyl)-N,N-diethylpropionamide] at 2.2 kg ai/ha, alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide] at 2.2 kg/ha or oryzalin at 4.5 kg ai/ha were effective treatments when used after preplant application of glyphosate (2.2 ai/ha) or when combined with glyphosate (2.2 kg ai/ha). None of the herbicide treatments reduced growth of red maple (*Acer rubrum* L.), Norway maple (*A. platanoides* L.), or creeping juniper (*Juniperus horizontalis* Moench). Japanese spurge (*Pachysandra terminalis* Sieb. and Zucc.) survival was reduced by treatments containing oryzalin.

2. Bandici, Gh. and Vlad I. Study on the use of some growth biostimulant substances for rooting of *Juniperus horizontalis* cuttings. Cercetari privind utilizarea unor substante biostimulatoare de crestere asupra inradacinarii butasilor de Junipertus horizontalis. Agricultura Revista De Stinta Si Practica Agricola. 2000; 9(1/4):48-51.
Keywords: *Juniperus horizontalis*/ growth/ rooting/ cuttings/ biostimulant

3. Calkins, James B. Author; Jarvis, Beth R. Author, and Swanson, Bert T. Author. Compost and rubber tire chips as peat substitutes in nursery container media: Growth effects. Journal of Environmental Horticulture. 1997; 15(2):88-94.
Keywords: *Juniperus chinensis*/ *Juniperus sabina*/ *Juniperus horizontalis*/ *Physocarpus*/ *Lamiastrum gakobdolon*/ container/ nursery/ rubber tire chips/ growth/ compost
Abstract: This research investigated the feasibility of using composted yard wastes, composted municipal solid waste and shredded rubber tire chips in nursery container media. Containerized *Physocarpus opulifolius* 'Dart's Gold', Forsythia times 'Meadowlark', *Spiraea* times 'billiardii', *Juniperus chinensis* 'Seagreen', *J. sabina* 'Mini Arcade', *J. horizontalis* 'Hughes', and *Lamiastrum gakobdolon* were grown in media amended with five recycled waste materials used as peat substitutes in a standard container medium of composted woodchips, peat, and sand (3:2:1 by vol). Waste materials used included three yard waste composts, one municipal solid waste compost and shredded rubber tire chips. Fifty or 100% of the peat in the standard growing medium was replaced with each amendment. Ten treatments (five amendments, each at 50% and 100% peat replacement) and a control (standard medium) were used for all seven plant species. Visual ratings, height and width measurements (crown volume), number of growing points and plant dry weights indicated that media in which 50% of the peat was replaced by an amendment produced

larger plants of superior quality compared to the control. Rubber tire chips were acceptable as a 50% peat substitute for plants that prefer well-drained conditions, while 100% peat substitution with tire chips was detrimental to plant growth and performance. Use of immature compost in container media negatively influenced plant growth.

4. Casini E.; Omodei Zorini L., and Conticini L. Scientific, technical and economic problems in the propagation of ornamental plants from cuttings. Observations and studies on *Cryptomeria japonica elegans*, *Juniperus horizontalis glauca* and *Chamaecyparis lawsoniana Ellwoodii*, propagated from cuttings using mist and rooting substances. Problemi scientifici, tecnici ed economici nella propagazione per talea delle piante ornamentali. Osservazioni e ricerche su: *Cryptomeria jap. el.*, *Juniperus hor. gl.*, *Chamaecyparis law. ell.*, propagate per talea mediante nebulizzazione ed impiego di sostanze rizogene. La Nuova AOPI. (Giugno 1976). 14. 1976; 14.

Keywords: *Juniperus horizontalis*/ cuttings/ propagation/ rooting

Abstract: Cuttings were dipped in IBA solution, packed in a box with their ends in sand and treated with mist. When cuttings were taken in winter rooting percentage in cryptomeria was 96.6% with 6000 p.p.m. IBA, 93.3% without IBA and 88.3% with 10 000 p.p.m. IBA.

Corresponding percentages for juniper were 83.3, 66.6 and 65.0 and for chamaecyparis 31.7, 0.00 and 38.3. Poorer results were obtained in 2 summer trials. The number of roots/cutting was increased by IBA treatment but root length was not.

5. Chhin, Sophan Author and Wang, G. Geoff Reprint author. Spatial and temporal pattern of white spruce regeneration within mixed-grass prairie in the Spruce Woods Provincial Park of Manitoba. Journal of Biogeography. 2002 Jul; 29(7):903-912.

Keywords: *Juniperus horizontalis*/ creeping juniper/ regeneration/ Canada/ *Picea glauca*

Abstract: Thirty white spruce (*Picea glauca* (Moench) Voss) islands were sampled to study the temporal and spatial pattern of white spruce regeneration at its southern limit of distribution. Location: The study was conducted within three mixed-grass prairies in the Spruce Woods Provincial Park (SWPP) of south-western Manitoba. Methods: White spruce seedlings, saplings and trees were mapped and measured in relation to eight sectors and five zones delimited by four transect lines extending through the center of each island oriented north to south, west to east, north-west to south-east and north-east to south-west. Results: Temporal patterns of regeneration were negatively correlated with July temperature at the time of establishment and up to 30 years after establishment. Height growth of seedlings and saplings were also negatively correlated with July temperature. Seedlings, saplings and trees were concentrated on the north vs. south aspect and within 4-12 m from the island center. Seedlings grew almost exclusively in association with

creeping juniper (*Juniperus horizontalis* Moench). Main conclusions: Results of the study suggest that white spruce recruitment and growth reflect past climatic variation, and microclimatic and microsite conditions promoting soil moisture retention and/or fire risk reduction facilitate white spruce germination and establishment.

6. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secret Arboretum. Special Circular Ohio Agricultural Research and Development Center. 1992; 14032-34.
Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus virginiana*/ *Juniperus scopulorum*/ *Juniperus squamata*/ growth habit
Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigate or convergent. All plants were also evaluated for growth characteristics of open or closed outline.
7. Derr, J. F. Pretransplant application of goal oxyfluorfen for weed control in container-grown nursery crops. Journal of Environmental Horticulture. 1989; 7(1):26-29.
Keywords: *Juniperus horizontalis*/ *Rhododendron obtusum*/ *Buxus microphylla*/ *Senecio vulgaris*/ Goal/ oxyfluorfen/ containers/ nursery/ pretransplant
Abstract: No injury was observed to 'Hershey Red', 'Pleasant White' and 'Scarlet Rose' azalea (*Rhododendron obtusum* Planch.), 'Prince of Wales' juniper (*Juniperus horizontalis* Moench), 'Helleri' holly (*Ilex crenata* Thunb.) or 'Green beauty' boxwood (*Buxus microphylla* Siebold and Zucc.) following pretransplant applications of Goal (oxyfluorfen) at rates ranging from 0.6 to 4.5 kg ai/ha (0.5 to 4.0 lb/A). Acceptable control of common groundsel (*Senecio vulgaris* L.) (less than one weed per pot) lasted approximately 1 month at 0.6 kg/ha (0.5 lb/A), 2 to 3 months at 1.1 kg/ha (1.0 lb/A), 3 to 4 months at 2.2 kg/ha (2.0 lb/A) and 4 months at 4.5 kg/ha (4.0 lb/A) with sprayed applications of Goal. Sprayed applications of Goal at 1.1 kg/ha (1.0 lb/A) gave equivalent weed control to a post-transplant application of Ornamental Herbicide 2, a granular formulation containing 2% oxyfluorfen and 1% pendimethalin, at 3.3 kg ai/ha (3.0 lb ai/A).
8. Evans, G. E. and Rasmussen, H. P. Anatomical changes in developing graft unions of *Juniperus* L. Journal of the American Society for Horticultural Science. 1972; 97(2):228-232.
Keywords: *Juniperus chinensis*/ *Juniperus horizontalis*/ vegetative

propagation/ grafting

Abstract: A study was made on three ornamental cultivars, one of *J. horizontalis* and two of *J. chinensis*, to determine the anatomical sequence of graft-union formation in the nine possible rootstock/scion combinations, and the origin of callus tissue in the union. Histological studies over 60 days showed differences only in the time, delayed with increasing ploidy of the tissue, at which each stage occurred; there was no difference in developmental sequence. Callus-tissue formation, from both rootstock and scion, began 10-20 days after grafting. Soon afterwards, isodiametric cells from uninjured cambia began to grow across the injured graft surfaces by an alternating series of radial and tangential divisions. By 40-50 days this new xylem had produced, by radial divisions, organized cells that filled gaps between the graft partners, crushing the intervening callus, and subsequently forming 'xylem bridges' of mixed origin. Tracheids with abnormally numerous pits developed in the 'bridges'. Up to the 50th day after grafting most new tissue arose from the rootstock, but after 60 days the contributions from rootstock and scion were equivalent.

9. Hicklenton, P. R. Growth analysis of 'Plumosa Compacta' juniper and 'Coral Beauty' cotoneaster subjected to different nitrogen fertilizer regimes. *Journal of Environmental Horticulture*. 1990; 8(4):192-196.

Keywords: *Juniperus horizontalis/ Cotoneaster dammeri/* growth/ nitrogen

Abstract: Rooted cuttings of *Juniperus horizontalis* cv. Plumosa Compacta and *Cotoneaster dammeri* cv. Coral Beauty were planted on 15 May in 3.8-litre containers filled with a 2:1:1 by volume mixture of pine bark, sphagnum peat and sand. Plants received weekly applications of N at 70, 140, 280 or 420 mg in a nutrient solution containing ammonium nitrate and potassium sulphate (providing 280 mg K/plant weekly). Growth was assessed in plants harvested from each treatment on 22 May and thereafter at monthly intervals until 16 Sep. Juniper plants supplied with 140 mg N weekly were larger at the end of the season than those in the other treatments. In plants of cotoneaster, growth increased as N rates increased from 70 to 420 mg/week. Path analysis was used to quantify the effect of plant relative growth rate (RGR) during each month on RGR in subsequent months, and on total seasonal relative dry weight gain (TRWG). RGR during each month significantly influenced TRWG; RGR in the periods 21 June-20 July and 21 July-18 Aug. had the greatest influence in cotoneaster. With juniper, the influence of RGR in each month on TRWG was the same for each of the successive 30-day periods. For both cotoneaster and juniper, increasing RGR during one month tended to have a negative influence on RGR during subsequent months.

10. ---. Growth of capillary-irrigated Andorra juniper and Sarcoxie euonymus as affected by controlled release fertilizer type and placement. *Journal of Environmental Horticulture*. 1990; 8(2):92-95.

Keywords: *Juniperus horizontalis/ Euonymus fortunei/* capillary-

irrigated/ controlled release fertilizer

Abstract: *Juniperus horizontalis* cv. Plumosa compacta and *Euonymus fortunei* cv. Sarcocoe were grown in a peat, perlite and sand medium in containers placed on a sand capillary bed. The plants were fertilized either with a 3:1 mixture of Type 100 and Type 40 Nutricote (16 N:4.4 P:8.1 K) or with Osmocote (18 N:2.6 P:9.7 K) incorporated into the growing medium, applied to its surface or dibbled below the roots. Throughout the growing season, leaf area, root or shoot dry weight of *E. fortunei* were not affected by fertilizer type or placement. Branch length and dry weight of *J. horizontalis* were not affected by fertilizer type when applied to the surface or incorporated in the growing medium. Dibbled Nutricote resulted in poor root and shoot development throughout the season. Growing medium soluble salt concentration (determined on container leachate) was 2800 dS/m in the dibbled Nutricote treatment in June (approximately 2.5 times higher than that in other treatments). Soluble salt concentration decreased between 21 June and 16 Aug. in all treatments and then remained constant until the end of the season (13 Sep.).

11. ---. Nitrogen and potassium nutrition in relation to growth of Andorra juniper in a sawdust-sphagnum peat medium. HortScience. 1982; 17(3):355-358.

Keywords: *Juniperus horizontalis*/ sawdust/ sphagnum peat/ growth/ nitrogen/ potassium

Abstract: Plants of *Juniperus horizontalis* cv. Plumosa Compacta were grown in 10-litre containers of a 3:1 mixture of sawdust and sphagnum peat with base fertilizers supplying Ca, Mg, P₂O₅ and trace elements. Slow-release or liquid N and K were applied at various rates. Brickett (granule size about 10 X 20 X 5 mm) isobutylidene diurea at 3.4 kg N/m³, in combination with either KCl or fritted K at 0.4 or 0.8 kg K/m³, produced growth and visual quality equal to those of plants grown with weekly liquid fertilization (2.7 g N and 2.2 g K/plant each week). Smaller granules (about 0.75 mm diameter) at either 1.7 or 3.4 kg N/m³ produced poor quality plants with a low growth rate. Tissue N levels remained fairly constant throughout the season in treatments with 3.4 kg N supplied by Brickett isobutylidene diurea, but decreased steadily in treatments with fine granules at either N rate. Tissue K levels were lower throughout the season with fritted K than with either 0.4 or 0.8 kg K/m³ supplied by KCl. Neither K rate nor source had a consistent effect on plant growth or quality over all sources and rates of isobutylidene diurea.

12. Hummel, R L; Kuo, S; Privett, D W, and Jellum, E J. Effect of nitrogen on blueberry and juniper grown in a fish waste compost:fir bark medium. The International Plant Propagators' Society: Combined Proceedings. 1994; 43201-204.

Keywords: *Juniperus horizontalis*/ *Vaccinium corymbosum*

Abstract: Rooted liners of *Juniperus horizontalis* cv. Bar Harbor and *Vaccinium corymbosum* cv. Bluecrop were grown in a bottomfish waste and hemlock/fir sawdust compost : Douglas fir bark (1:3, respectively)

medium. N was applied as a liquid at concentrations of 0, 150, 300, 450 or 600 p.p.m. every 2 weeks. DW and shoot growth index (SGI) increased with increasing N concentration up to 450 p.p.m. but decreased at the highest concentration. The quality of the Bluecrop plants also increased with increasing N but the quality of the Bar Harbor plants was unaffected.

13. Ingram, D. L. and Werken, H. van de. Distribution of *Ilex* and *Juniperus* roots in three container-media. *Scientia Horticulturae*. 1982; 16(2):191-195.
Keywords: *Juniperus horizontalis*/ *Ilex crenata*/ planting/ production/ container/ media
Abstract: *Ilex crenata*, cv. Green Luster, and *Juniperus horizontalis*, cv. Plumosa, were grown in 3 container-media for 13 months. The container media were sliced with 2 horizontal cuts to yield 3 depth zones, and 3 equal concentric areas were outlined on the lower surface of each depth zone. A greater number of *Ilex* roots were in the 2 inside concentric areas of the bottom two-thirds of the peat:perlite medium than in the same divisions of soil:peat:sand and pine bark:sand media. *Juniperus* roots were more evenly distributed through the depth zones of pine bark:sand than soil:peat:sand or peat:perlite media.
14. Klett, J E. Nitrogen nutrition of junipers. Combined Proceedings of the International Plant Propagators Society. 1977; 27377-382.
Keywords: *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus sabina*/ *Juniperus horizontalis*/ nitrogen/ nutrition/ ornamental plants/ ornamental conifers
Abstract: Five dwarf juniper cultivars (*Juniperus procumbens* cv. Nana, *J. chinensis* cv. Pfitzeriana, *J. communis* cv. Repanda, *J. sabina* cv. Broadmoor and *J. horizontalis* cv. Wiltonii) responded differently when they were supplied with ammonium sulphate, ammonium nitrate or potassium nitrate each at 200 or 400 p.p.m., as N sources in the glasshouse and outdoors. At a given rate potassium nitrate caused more toxicity than the ammonium fertilizers. The cvs Repanda and Broadmoor, which showed the least dry weight increment, were the first to develop symptoms of N toxicity. Potassium nitrate had a greater effect than other compounds on nitrate concentrations in the tissue. Repanda had the highest nitrate concentration, whereas Wiltonii had the lowest and showed very little toxicity. Plants treated with potassium nitrate or ammonium nitrate suffered more winter damage than those treated with ammonium sulphate. Plants treated with nitrate N were the slowest to break dormancy.
15. Klett, J. E. Superior ground cover junipers for the Great Plains region. *American Nurseryman*. 1978; 147(11):9, 52-55, 58.
Keywords: *Juniperus sabina*/ *Juniperus horizontalis*/ *Juniperus communis*/ *Juniperus procumbens*/ hardiness/ disease resistance/ Great Plains
Abstract: The characteristics are described of several prostrate junipers,

evaluated from trials with about 70 cvs. *Juniperus sabina*, cvs Arcadia, Broadmoor and Skandia have been selected for their hardiness, distinctive green foliage and resistance to juniper blight. *J. horizontalis*, cvs Glauca (blue creeping juniper), Blue Rug (Wiltonii) and Plumosa (Andorra juniper); *J. communis* var. repanda (creeping common juniper) and *J. procumbens* var. nana (dwarf Japanese juniper) are also briefly described.

16. Leonard, R. E.; Conkling, P. W., and McMahon, J. L. The response of plant species to low-level trampling stress on Hurrigan Island, Maine USA. U S Forest Service Research Note Ne. 1985; 3571-6.
Keywords: *Juniperus horizontalis/ Myrica/ Empetrum/ Solidago/ Aralia/ Picea/ Cladina/* trampling/ Hurrigan Island/ Maine/ survival/ resistance
Abstract: In 1981, a study was initiated to measure the effects of low-level trampling (100 to 200 trambles) on selected vegetation on Hurricane Island, Maine. Low levels of trampling are representative of general recreational use patterns on most Maine islands. The study was designed to compare percent survival of common island species when subjected to low-level trampling, to observe treadway formation, and to monitor recovery. The quadropod photographic technique was used to monitor changes in area coverage of species. Climatic conditions on Hurricane Island appear to favor rapid plant recovery. Most species were able to withstand low levels of trampling stress if allowed a recovery period of 1 year. The most resistant species were *Picea rubens* and *Cladina* spp. The woody shrubs *Empetrum nigrum*, *Myrica pensylvanica*, and *Juniperus horizontalis* and the tall herbaceous species *Solidago rugosa* and *Aralia nudicaulis* were the least resistant to trampling stress. Recovery of these species was relatively slow.
17. Major, J. E. and Grossnickle, S. C. Chilling units used to determine rooting of stem cuttings of junipers. Journal of Environmental Horticulture. 1990; 8(1):32*35.
Keywords: *Juniperus horizontalis/ Juniperus procumbens/ Juniperus sabina/ Juniperus scopulorum/* chilling units/ cuttings/ rooting/ propagation
Abstract: Stem cuttings of *Juniperus chinensis* cv. Pfitzer Aurea, *J. horizontalis* cultivars Bar Harbor, Prince of Wales, Wiltoni and Youngstown, *J. procumbens* cv. Green Mound, *J. sabina* cultivars Broadmoor, Buffalo and Tamariscifolia and *J. scopulorum* [*J. scopulorum*] cv. Wichita Blue, collected twice monthly from 15 Oct. 1986 to 28 Feb. 1987, were dipped in an IBA or NAA rooting dip (concentrations given) and inserted in rooting beds with bottom heat at 18 ° C and misting as required. The air temperature 1 m above the stock plants was monitored continuously and the seasonal chilling units (the number of hours when the temperature was <less or =>5 °) were determined. The chilling units experienced by stock plants affected the rooting response of cuttings taken from them. Cultivar variations in percentage rooting and rooting pattern

were marked. It is concluded that rooting success is related to the physiological status of the donor plant. Calendar dates can be used successfully as a guideline for cultivars known to root effectively over a large number of chilling units (such as Youngstown, Bar Harbor and Price of Wales). However, the chilling unit concept may be more appropriate for determining the optimum period for successful rooting of cultivars that have a more precise response to chilling units experienced (such as *Tamariscifolia*, Broadmoor and Green Mound).

18. Maronek, D. M.; Hendrix, J. W., and Kiernan, J. Differential growth response to the mycorrhizal fungus *Glomus fasciculatus* of southern magnolia and Bar Harbor juniper grown in containers in composted hardwood bark-shale. *Journal of the American Society for Horticultural Science*. 1980; 105(2):206-208.
Keywords: *Juniperus horizontalis*/ *Magnolia grandiflora*/ *Glomus fasciculatus*/ osmocote/ mycorrhizal fungus/ fertilization
Abstract: *Magnolia grandiflora* and *Juniperus horizontalis* cv. Bar Harbor were grown in a composted hardwood bark + expanded shale medium in containers in a greenhouse. All plants received either a low rate (1.1 kg/m³) or the manufacturer's recommended rate (4.5 kg/m³) of 18N-6P-12K slow-release fertilizer (Osmocote) and half the plants were inoculated with *Glomus fasciculatus*. After 6 months, the height of inoculated magnolia plants was nearly twice that of uninoculated plants, and the height difference increased with time. The juniper plants showed little or no growth response to infection with the mycorrhizal fungus. Fertilization of magnolia plants at the recommended rate compared with a quarter of the rate did not inhibit the degree of mycorrhizal infection of roots. Roots of inoculated juniper plants were heavily infected at both fertilizer rates, but the degree of infection was significantly greater at the lower fertilizer rate.
19. Miller, J. G. An ecological study of creeping juniper (*Juniperus horizontalis* Moench) in Montana. Bozeman, Montana: Montana State University Thesis . 1978; 154 pp.
Keywords: *Juniperus horizontalis*/ ecology/ Montana
20. Neal, Joseph C. and Senesac, Andrew F. Cultivar differences in postemergence graminicide phytotoxicity to *Juniperus* . *HortScience* . 1989 Feb; 24(1):96-98; ISSN: 0018-5345.
Keywords: *Juniperus horizontalis*/ *Juniperus chinensis*/ *Juniperus conferta*/ herbicides/ phytotoxicity
Call Number: SB1.H6
Abstract: Several juniper species and cultivars were compared by sensitivity to labeled and experimental postemergence graminicides. The junipers treated were: *Juniperus horizontalis* Moench. 'Wiltonii' (blue rug), *J. h.* 'Bar Harbor', *J. h.* 'Youngstown' (Youngstown Andorra), *J. chinensis* L. ;'Pfitzeriana' (Pfitzer), *J. c.* 'Parsonii' (Parson's), *J. c.*

'Sargentii' (Sargent's), and *J. conferta* Parl. (shore). The herbicide treatments were fluazifop-p, sethoxydim, haloxyfop, quizalofop, cycloxydim, and fenoxaprop at recommended rates for annual grassy weed control, with recommended spray adjuvants. 'Bar Harbor' juniper was injured, in decreasing order of severity, by haloxyfop, fenoxaprop, quizalofop, and fluazifop. Sethoxydim and cycloxydim produced no reduction in plant fresh weight for the juniper cultivars tested. However, sethoxydim plus adjuvants did reduce 'Bar Harbor' juniper visual quality ratings in 1986. Pfitzer juniper was slightly injured by haloxyfop in 1985 and by fenoxaprop in 1986. The other junipers were unaffected by herbicide treatments. Chemical names used: (R) -2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoic acid (fluazifop), (±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy] propanoic acid (fenoxaprop), 2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoic acid (haloxyfop), (±) -2-[4-[(6-chloro-2-quinoxalinyloxy]phenoxy] propanoic acid (quizalofop), 2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one (sethoxydim), and 2-[1-(ethoxyimino)butyl]-3-hydroxy-5-(2H-tetrahydrothiopyran-3-yl)-2-cyclohexen-1-one (cycloxydim).

21. Normandy, Philip M. *Juniperus conferta*. Public Gardens Journal, American Association of Botanical Garden Arboretums. 1991 Oct; 6(4):36-37; ISSN: 0885-3894.
Keywords: *Juniperus conferta*/ shore juniper/ *Juniperus horizontalis*/ cultivar
 Call Number: QK71.P83
Abstract: *Juniperus conferta* 'Silver Mist' was selected in Japan for its bright silver-blue needles and sent to Brookside Gardens in 1982. The importance of this cultivar is that it provides useful color, habit, and texture variations from both the standard "blue rug" types of *Juniperus horizontalis* and existing forms of *Juniperus conferta*.

22. Palma-Otal, M.; Moore, W. S.; Adams, R. P., and Joswiak, G. R. Morphological, chemical and biogeographical analyses of a hybrid zone involving *Juniperus virginiana* and *J. horizontalis* in Wisconsin. Canadian Journal of Botany. 1983; 61(10):2733-2746.
Keywords: *Juniperus virginiana*/ hybridization/ *Juniperus horizontalis*/ Wisconsin
Abstract: Analysis of morphological, terpene, and electrophoretic data is consistent with the hypothesis that hybridization is occurring beyond the F"SUB 1" generation. The biogeography of hybridization resembles an archipelago of hybrid populations arrayed along the Drift less boundary. The situation is unusual in that while most hybrid populations are in contact with extensive *J. virginiana* populations, none appear to be in contact with *J. horizontalis*. The one-sided structure of the hybrid zone suggests that hybrids are favored by selection along the eastern boundary of the Drift less Area.

23. Parent, J. and Richard, P. J. H. Pollen morphology of *Cupressaceae* from eastern Canada and northeastern United States applied to the study of Quaternary sediments. *Canadian Journal of Botany*. 1990; 68(1):79-89; ISSN: 0008-4026.
Keywords: *Juniperus communis*/ *Juniperus horizontalis*/ *Juniperus virginiana*/ *Chamaecyparis thyoides*/ *Thuja occidentalis*/ *Taxodium distichum*/ *Cupressaceae*/ *Pinopsida*/ pollen/ morphology/ identification/ palaeoecology
Abstract: Light microscopy was used to study pollen morphology of *Chamaecyparis thyoides*, *Juniperus communis* var. *depressa* and var. *montana*, *J. horizontalis*, *J. horizontalis* f. *alpina*, *J. virginiana* and *Thuja occidentalis*. Pollen of *Taxodium distichum* (*Taxodiaceae*), which is present in the study area, was also studied. Four pollen types were identified: *J. communis*/ *Thuja occidentalis*, *C. thyoides*, *J. horizontalis*/ *J. virginiana* and *Taxodium distichum*. Five shapes of pollen grains, representing different stages of hydration, were found in all species and could not be used for identification. A key is included for identifying pollen in fossil sediments.
24. Rathier, T M Reprint author and Frink, C R Author. Nitrate in runoff water from container grown juniper and Alberta spruce under different irrigation and nitrogen fertilization regimes. *Journal of Environmental Horticulture*. 1989; 7(1):32-35.
Keywords: *Juniperus horizontalis*/ *Picea glauca*/ nitrogen/ fertilizer/ irrigation/ nitrate
Abstract: *Juniperus horizontalis* Moench 'Plumosa Compacta Youngstown' (compact Andorra juniper) and *Picea glauca* Moench (Voss) 'Conica' (dwarf Alberta spruce) were grown for one season in 2.2 l (N1) nursery containers in a potting medium containing composted hardwood bark, sphagnum peat moss and sand (1:1:1 by vol). The containers were placed over lysimeters permitting continuous collection and measurement of water passing through and around the containers. Slow release or soluble N was applied at an annual rate of 1.6 g of N per pot. Containers were irrigated by either trickle or overhead methods and water volumes were recorded. Subsamples of leachate were collected and analyzed for nitrate. Much less nitrate was leached by the trickle than by the overhead irrigation. Although slow release N sources lost considerably less nitrate in runoff water, there is still sufficient nitrate lost by these sources to pollute ground water unless annual fertilizer needs are supplied by split applications. Depending on sources, 58-80% of the N applied as slow release fertilizers was not recovered in either the plant or runoff water.
25. Rioux, J A.; Richer, C., and Lamy, M P. Tolerance evaluation of eleven junipers (*Juniperus* sp.) under north-eastern Canadian climatic conditions. *Canadian Journal of Plant Science*. 2004; 84(4):1135-1153.
Keywords: *Juniperus communis*/ *Juniperus sabina*/ *Juniperus*

squamata/ Juniperus horizontalis/ Canada/ winter hardiness/ growth

Abstract: Young plants of 11 species and cultivars of junipers were planted between 1987 and 1994 in six or eight sites distributed in northeastern Canadian climatic zones 2a to 5b (the most populated zones of Quebec). These plants were evaluated over a 5-yr period to provide more detailed information about the winter hardiness and growth under these climatic conditions. *Juniperus sabina* 'Blue Danube', the control, was established five times and compared to the 10 other junipers. These plants were observed for a 5-yr period in order to determine their winter hardiness and growth under these climatic conditions. Survival and usage potentials of *J. sabina* and its cultivars Blue Danube and Broadmoor, *J. horizontalis* 'Douglasii', *J. communis* 'Rependa' and 'Depressa Aurea' and *J. squamata* 'Blue Carpet' were established in zone 2a. These potentials could be extended to zone 1b for *J. sabina*, *J. s.* 'Blue Danube' and 'Douglasii' and 'Rependa' cultivars, no mortality was observed in the coldest zone (2a). *J. squamata* 'Blue Star' is the less hardy cultivar, and its survival and usage potentials were fixed to zone 4. Furthermore, *J. sabina* 'Wapiti' can survive and be used in zone 2b. *J. x media* 'Pfitzeriana' and *J. squamata* 'Meyeri' can survive in zone 2b, but can be used in zone 4. The three *J. squamata* cultivars and *J. x media* 'Pfitzeriana' are often affected by foliage desiccation in their respective usage zones. The full ornamental potential was observed in zone 2a for *J. horizontalis* 'Douglasii', in zone 2b for *J. sabina*, its 'Blue Danube' and 'Broadmoor' cultivars and *J. communis* 'Rependa', and in zone 5b for *J. x media* 'Pfitzeriana', *J. squamata* 'Blue Carpet' and 'Blue Star'. This potential has been observed only in zone 4a for *J. communis* 'Depressa Aurea', *J. sabina* 'Wapiti' and *J. squamata* 'Meyeri', snow cover being an important factor.

26. Rudloff, E. von. Chemosystematic studies of the volatile oils of *Juniperus horizontalis*, *J. scopulorum* and *J. virginiana*. *Phytochemistry*. 1975; 14(5/6):1319-1329.

Keywords: *Juniperus horizontalis/ Juniperus scopulorum/ Juniperus virginiana/* plant composition/ terpenoids / taxonomy

Abstract: The volatile oil from the foliage of individual plants from different populations of *Juniperus horizontalis*, *J. scopulorum* and *J. virginiana* has been analyzed qualitatively and quantitatively. Some analytical problems are discussed and several new constituents have been identified. *J. horizontalis* can be differentiated from the other two species by the presence of relatively large percentages of cadinane-type sesquiterpenes and less of the elemol-eudesmol type. The ratio of methyl citronellate to citronellol may also have diagnostic value, as may be the virtual absence of aromatic ethers of the safrole-type. The oil of *J. scopulorum* is virtually devoid of the cadinol type sesquiterpenes but differentiation from that of *J. virginiana* is difficult. A useful measure of clinal variation within different populations of each species is the ratio of sabinene and limonene percentages. The occurrence of aromatic ethers in *J. scopulorum* and *J. virginiana* is erratic; in *J. horizontalis* they are

present in trace amounts only. Provided an adequate foliage sample size is taken during the dormant season, population studies based on the means of the percentages of the foliage oil components are feasible. Two hybrid swarms of *J. horizontalis* and *J. scopulorum* were sampled and all plants had intermediate foliage oil compositions".

27. Sawwan J. S. and Shraim F. M. Improving rooting efficiency of creeping juniper (*Juniperus horizontalis* Moench.) stem cuttings. Dirasat Agricultural Sciences. 1999; 26(3):371-376.
Keywords: *Juniperus horizontalis*/ plant growth regulators/ seasonal variation/ rooting
Abstract: The best rooting percentage (65%) was obtained when shoot cuttings were collected during February and treated with 4000 ppm IBA. Cuttings collected during June and August failed to root. The highest number of roots per rooted cutting (10.5) was obtained when the cuttings were collected during April and treated with 6000 ppm IBA. Average root length was greatest when the cuttings were collected during April, and treated with 4000 ppm IBA. All the cuttings not treated with IBA failed to root.
28. Sheppard, W. J.; Gilliam, C. H., and Fretz, T. A. Macronutrient stability during overwintering of Royal Beauty cotoneaster and Andorra juniper. HortScience. 1979; 14(6):751-753.
Keywords: *Juniperus horizontalis*/ *Cotoneaster dammeri*/ macronutrients/ overwintering/ composition/ seasonal variation.
Abstract: Fluctuations of macronutrient levels in the leaves, stems and roots were analyzed in *Cotoneaster dammeri* cv. Royal Beauty and *Juniperus horizontalis* cv. Plumosa during the overwintering period. K, Mg and Ca levels in both spp. were relatively stable. P levels remained stable in all tissues, while N in leaves, stems and roots of both spp. fluctuated significantly throughout the sampling period.
29. Smith, E M. Juniper growth in hardwood and pine bark mixtures. American Nurseryman. 1978; 148(1):27, 232-234.
Keywords: *Juniperus horizontalis*/ container/ hardwood bark/ pine bark/ growth media
Abstract: Plants of *Juniperus horizontalis* cv. *Plumosa* (Youngstown selection) were potted-on into 2-gal containers with hardwood bark either alone or in various proportions with sand, or soil/peat/sand, or pine bark/vermiculite mixtures (analyses given). Growth after 2 growing seasons was greatest in pine bark/vermiculite and soil/peat/sand, and differed little between the hardwood bark/sand mixtures.
30. Smith, E M and Treaster, S A. Growth response of euonymus, juniper and azalea treated with differing rates of Osmocote 18-6-12. Special Circular, Ohio Agricultural Research and Development Center. 1988; 1154-5.
Keywords: *Juniperus horizontalis*/ *Rhododendron*/ *Euonymus*/ Osmocote/ fertilizer/ cuttings

Abstract: Studies are reported with *Euonymus fortunei* cv. Emerald 'N Gaiety', *Rhododendron obtusum* cv. Hershey Red and *Juniperus horizontalis* cv. Wiltoni. Rooted cuttings from the previous summer and plants one year older, all growing in a 6:3:1 mixture of pine bark + peat + sand in 1-gal containers were supplied on 24 Apr. with the NPK fertilizer Osmocote at 3.0, 6.0, 8.5, 11.0 or 14.0 lb/yd³, equivalent to 0.5, 1.0, 1.5, 2.0 or 2.5 lb N/ yd³. Controls received none. Plant height and width were evaluated on 4 Sep. With rooted cuttings, euonymus grew best at 2.0 and 2.5 lb/ yd³, juniper grew well at all rates and azalea grew equally well at rates between 1.0 and 2.5 lb/ yd³. With established plants, euonymus growth was greatest at 1.0-2.5 lb, while azalea and juniper grew equally well at rates between 0.5 and 2.5 lb.

31. Spangler, Ronald Lee. Graft success as influenced by environmental conditions affecting physiological changes in *Juniperus* L. PhD. Thesis, Michigan State University . 1971; 139 pp.

Keywords: *Juniperus horizontalis*/ *Juniperus chinensis*/ Andorra/ Hetzi/ Pfitzer/ scion/ graft survival/ rootstock/ temperature/ cold storage

Abstract: *Juniperus horizontalis* 'Andorra', *J. chinensis* 'Hetzi' and *J. chinensis* 'Pfitzer' were self-grafted following varying temperature storage treatments to the scion and understock. Treatments consisted of two temperatures, greenhouse stored (18 ° C) and cold dark storage (2° C). Storage periods for the cold treatment were four, nine or twelve weeks.

Graft survival data indicated decreasing order of clonal survival was Andorra, Hetzi, Pfitzer. Decreasing order of graft survival for temperature-storage treatments was nine, four, and twelve weeks of cold storage. Data from the scion/stock treatments indicated whenever greenhouse (18° C) scion or stock was involved in the graft treatment, graft survival was greater than if (2° C) scion or stock material was involved regardless of the length of cold treatment. Application of different concentrations of auxin: gibberellin: kinetin solutions resulted in equally poor graft survival.

In Andorra, four weeks of cold storage did not affect total growth when compared to greenhouse natural day length plants. Nine and twelve weeks of cold caused the growth rate of Andorra to be greatly reduced when compared to growth of natural day length. In comparison, Hetzi and Pfitzer shoot growth rate was accelerated by increasing the cold storage period to nine or twelve weeks.

Changes in growth promoters were determined by the mung bean bioassay. By partitioning the crude methanol extract into its acidic, basic and neutral ether fractions only R_f 0.80-0.93 was found to be active from the mung bean bioassay. This region was designated cofactor 4 which was found to be present in the shoots and roots of all clones.

In Andorra, the pattern of change in relative concentration of cofactor 4 for greenhouse plants from October through May was found to be very similar to the pattern of change of Andorra outdoor plants from April through November. When these curves were superimposed on each

other a shift of six months by the greenhouse plants was noted. A shift of one month and two months was noted for Hetzi and Pfitzer, respectively. All clones exposed to four weeks of cold showed a decline in cofactor 4 concentration after being moved into the greenhouse for one month. Plants exposed to nine weeks of cold increased in cofactor 4 concentration after one month in the greenhouse.

32. Tereshkovich, George. *Juniperus* species: evergreen ground covers . Research Report. University of Georgia, College of Agriculture Experiment Stations. 1969; 3610 .

Keywords: *Juniperus conferta*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus horizontalis*/ *Juniperus japonica*/ *Juniperus procumbens*/ *Juniperus sabina*/ *Juniperus scopulorum*

Call Number: S51.R22

Abstract: The following *Juniperus* spp. cultivars are better adapted for the Georgia Piedmont: *Juniperus* Blue Pfitzer, *Juniperus conferta* (Shore Juniper), *Juniperus chinensis* Sargenti, *Juniperus chinensis pfitzeriana aurea* (Golden tip Pfitzer), *Juniperus davurica* (Squamata expansa) *parsoni*, *Juniperus horizontalis andorra*, *Juniperus horizontalis andorra* compacts, *Juniperus horizontalis andorra*, (Aunt Jamina), *Juniperus horizontalis plumosa*, (Andorra juniper), *Juniperus horizontalis 'Douglasi'* (Waukegan), *Juniperus japonica* (San Jose), *Juniperus procumbens*, *Juniperus sabina 'Arcadia'*, and *Juniperus scopulorum*, (White Silver King). These species are very hardy plants, able to withstand extremes in temperature, and provide excellent ground cover for landscaping around the home, in parks, and in highway beautification programs.

***Juniperus indica* (3)**

1. Adams, R. P. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). USABiochemical Systematics & Ecology. 2000; 28(6):529-543.

Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus pseudosabina*/ *Juniperus recurva*/ *Juniperus saltuaria*/ *Juniperus squamata*/ *Juniperus tibetica*/ *Juniperus wallichiana*/ RAPD/ DNA/ essential oils

Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallichiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K.

Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

2. Adams R. P. and Turuspekov Y. Taxonomic reassessment of some Central Asian and Himalayan scale-leaved taxa of *Juniperus* (*Cupressaceae*) supported by random amplification of polymorphic DNA. *Taxon*. 1998; 47(1):75-83.

Keywords: *Juniperus centrasiatrica*/ *Juniperus turkestanica*/ *Juniperus pseudosabina*/ *Juniperus indica*/ RAPD/ DNA/ taxonomy

Abstract: Analysis of central Asian *Juniperus* using RAPD revealed that *J. centrasiatrica*, *J. turkestanica*, and *J. pseudosabina* appear to belong to a single species, to be named *J. pseudosabina*. This conclusion is also supported by previous work on terpenoids. Putative *J. indica* from Nepal (shrub form) was found to be distinct from *J. pseudosabina*. It appears that the common scale-leaved shrub or tree juniper of the Himalayas should be called *J. indica* not *J. pseudosabina*.

3. Farjon, A. and Garcia, S. O. Towards the minimal conifer cone: Ontogeny and trends in *Cupressus*, *Juniperus* and *Microbiota* (*Cupressaceae* s. str.). *Botanische Jahrbuecher Fuer Systematik Pflanzengeschichte Und Pflanzengeographie*. 2002; 124(2):129-147.

Keywords: *Juniperus virginiana*/ *Cupressus goveniana*/ *Juniperus phoenicea*/ *Juniperus indica*/ *Microbiota decussata*/ ontogeny/ cone / seeds

Abstract: Morphology and early development of seed cones of *Cupressus goveniana* Gordon, *Juniperus phoenicea* L., *J. virginiana* L., *J. indica* Bertol. and *Microbiota decussata* Kom. (*Cupressaceae*) have been studied under the Scanning Electron Microscope (SEM). The basic process of cone ontogeny is similar in all species observed. Their differences are due to differences in numbers of bracts (= cone scales) associated with ovules, differences in number of ovules produced, and the modifications in the bracts leading to mature cone scales. A tendency towards a reduction of these numbers, observable in the species studied, is interpreted as a probable evolutionary development. This hypothesis is supported by the probable phylogeny of the taxa. The selection pressures that possibly have led to this minimal cone are discussed. It would appear that this evolution to a minimal cone has occurred twice independently within *Cupressaceae*: once from a *Cupressus*-like cone to a 'monoseed' cone in *Juniperus*, and independently from *Platycladus* to *Microbiota* (Jagel & Stutzel 2001b), both these taxa not being closely related to the former.

***Juniperus jaliscana* (1)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section *Sabina*) of the western hemisphere: Systematics and evolution based on leaf essential oils and

Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/ essential oils/ DNA/ RAPD*

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. *Sabina*) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

***Juniperus japonica* (1)**

1. Tereshkovich, George. *Juniperus* species: evergreen ground covers . Research Report. University of Georgia, College of Agriculture Experiment Stations. 1969; 3610 .

Keywords: *Juniperus conferta/ Juniperus chinensis/ Juniperus davurica/ Juniperus horizontalis/ Juniperus japonica/ Juniperus procumbens/ Juniperus sabina/ Juniperus scopulorum*
Call Number: S51.R22

Abstract: The following *Juniperus* spp. cultivars are better adapted for the Georgia Piedmont: *Juniperus* Blue Pfitzer, *Juniperus conferta* (Shore Juniper), *Juniperus chinensis* Sargentii, *Juniperus chinensis pfitzeriana aurea* (Golden tip Pfitzer), *Juniperus davurica* (Squamata expansa) *parsoni*, *Juniperus horizontalis andorra*, *Juniperus horizontalis andorra* compacta, *Juniperus horizontalis andorra*, (Aunt Jamina), *Juniperus horizontalis plumosa*, (Andorra juniper), *Juniperus horizontalis 'Douglasi'* (Waukegan), *Juniperus japonica* (San Jose), *Juniperus procumbens*, *Juniperus sabina 'Arcadia'*, and *Juniperus scopulorum*, (White Silver King). These species are very hardy plants, able to withstand extremes in temperature, and provide excellent ground cover for landscaping around the home, in parks, and in highway beautification programs.

***Juniperus komarovii* (1)**

1. Adams, R. P. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). *USABiochemical Systematics & Ecology*. 2000; 28(6):529-543.
Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus pseudosabina*/ *Juniperus recurva*/ *Juniperus saltuaria*/ *Juniperus squamata*/ *Juniperus tibetica*/ *Juniperus wallichiana*/ RAPD/ DNA/ essential oils
Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxi*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallachiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxi* A.B. Jacks. (Syn.: *J. recurva* var. *coxi*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

***Juniperus macrocarpa* (2)**

1. Adams R. P.; Morris J. A.; Pandey R. N., and Schwarzbach A. E. Cryptic speciation between *Juniperus deltoides* and *Juniperus oxycedrus* (*Cupressaceae*) in the Mediterranean. *Biochemical Systematics and Ecology*. 2005; 33(8):771-787.
Keywords: *Juniperus deltoides*/ *Juniperus oxycedrus*/ *Juniperus navicularis*/ *Juniperus macrocarpa*/ DNA sequencing/ genetic markers/ Europe/ Morocco/ Turkey
Abstract: Analyses of individuals classically treated as *Juniperus oxycedrus* L. var. *oxycedrus* from Morocco, Portugal, Spain, France, Italy, Greece and Turkey, using DNA sequencing of nrDNA (ITS 1, 5.8S, ITS 2) plus RAPDs, leaf terpenoids and morphology revealed that two cryptic, genetically distinct but morphologically almost identical species are present. These species, *J. oxycedrus* L. var. *oxycedrus* and *Juniperus deltoides* R.P. Adams, are about as different from each other as *Juniperus navicularis* and *Juniperus macrocarpa* are from *J. oxycedrus* var. *oxycedrus*. Examination of herbarium specimens revealed that the two species are largely allopatric with *J. deltoides* occurring from Italy eastward through Turkey into the Caucasus Mts. and Iran. *J. oxycedrus* var. *oxycedrus* appears to be largely concentrated west of Italy (France, Spain, Portugal, Morocco). Cryptic speciation is discussed.

2. Lebreton, Philippe; Perez De Paz; Pedro Luis , and Barbero, Marcel. Systematic study of the subgenus *Oxycedrus* (oxycedroides section) of the genus *Juniperus* (*Cupressaceae*). *Ecologia Mediterranea*. 1998; 24(1):53-61.
Keywords: *Juniperus oxycedrus*/ *Juniperus cedrus*/ *Juniperus brevifolia*/ prodelphinidin content/ proanthocyanic/ seed/ galbulus/ *Juniperus macrocarpa*
Abstract: Some biochemical (foliar proanthocyanidins) and morphometric (seeds and galbulus) parameters of the taxa *Juniperus oxycedrus* L. sensu lato (Mediterranean area), *Juniperus cedrus* Webb. and Berth. (endemic of the Canary Islands and Madeira) and *Juniperus brevifolia* (Seub.) Antoine (endemic of the Azores Islands), section oxycedroides, subgenus *Oxycedrus*, genus *Juniperus* (*Cupressaceae*, Conifers), have been studied. Due to their low prodelphinidin content, *Oxycedrus* junipers from Turkey and Cyprus can be considered as the extreme representatives to the subspecies oxycedrus. Reversibly, the Cretan population studied, with high prodelphinidin content, appears to be the maximum homozygotic expression of the proanthocyanic biosynthesis (subspecies *macrocarpa*). Proanthocyanic content and the number of the seeds unquestionably link *J. brevifolia* to the *J. oxycedrus* complex; however, we propose to maintain this taxon as a species in view of the small size of its needles. *J. cedrus* generally contains one seed only by galbulus; moreover, there is a contradiction between the absolute proanthocyanic content (low) and the relative prodelphinidin content (fairly high). This confers it an unquestionable specific originality. In the end, we propose to consider all the representatives of the Mediterranean-atlantic group of the oxycedroides section (*J. oxycedrus*, *J. macrocarpa*, *J. cedrus*, *J. brevifolia*) as diversely related taxa within a *Juniperus* aggr. *oxycedrus* complex, with a good chemical and morphogenetical consistency. A parallel has been established with *J. aggr. communis*, an other representative of the same sub-genus *Oxycedrus*.

***Juniperus macropoda* (8)**

1. Chaturvedi M. Studies on the pollen grains of *Juniperus* L. *Current Science*. 50(12). 1981. 548-549.
 Palynol. Lab., National Bot. Res. Inst., Lucknow 226 001, India. 1981; 50(12):548-549.
Keywords: *Juniperus excelsa*/ *Juniperus macropoda*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus wallichiana*/ Himalayas/ pollen
Abstract: Light microscopic and SEM studies of 5 species (*J. excelsa*, *J. macropoda*, *J. pseudosabina*, *J. squamata* and *J. wallichiana*) from the Himalayas.
2. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. Sabina) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). *Edinburgh Journal of Botany*. 1992; 49(3):251-283.

Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia

Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpus* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpus*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.

3. Jain, K. K. A taxonomic revision of the Himalayan Junipers. Indian Forester. 1976; 102(2):109-188.

Keywords: *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ *Juniperus communis*/ *Juniperus pseudosabina*/ taxonomy/ Himalayas

Abstract: Discusses the taxonomy of *Juniperus* in the Himalayas. On the basis of morphological and anatomical studies (including studies of wood anatomy) eight taxa were identified. Of the species that are trees, *J. wallichiana*, *J. recurva* and *J. fargesii* [*J. squamata* var. *fargesii*] are restricted to the eastern Himalayas and *J. macropoda* and *J. excelsa* to the western Himalayas. Of the shrubs, *J. communis* subsp. *nana* occurs only in the western Himalayas, but *J. pseudosabina* and *J. squamata* occur throughout the area. Each species is briefly described.

4. Kaushal, P. S. Studies in the Western Himalayan junipers: I. distribution pattern and taxonomic considerations. Research Bulletin of the Panjab University, Science. 1994; 44(1/4):53-62.

Keywords: *Juniperus communis*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ taxonomy/ India

Abstract: Five taxa of *Juniperus*, of which two with tree habit, are recorded from Western Himalaya in the States of Himachal Pradesh and Jammu and Kashmir, India and are studied for their morphological variation and distribution. The genus is represented by two distinct tree species (*J. macropoda* and *J. excelsa*) and three with shrubby forms (*J. communis*, *J. squamata* and *J. pseudosabina*). Several variants are observed in the polymorphic *J. squamata*. *Juniperus communis* and *J. pseudosabina* are morphologically conservative. A putative hybrid, intermediate in characters between *J. squamata* and *J. pseudosabina*, has also been recorded.

5. Sharma B. M. and Anup Raj. Status of natural regeneration of *Juniperus*

macropoda Boiss. in Ladakh, the cold arid region of Western Trans-Himalayas. Indian Journal of Forestry. 2004; 27(3):237-240.

Keywords: *Juniperus macropoda*/ natural regeneration/ Ladakh

Abstract: The study was conducted to appraise the status of natural regeneration of *Juniperus macropoda* at three different sites located in Ladakh, the high altitude cold desert of Jammu and Kashmir. Presence of middle diameter class trees at sites I and II indicated that there was potential for natural regeneration at these sites. However, presence of few or no seedlings and saplings at all, at these sites alluded to some forces operating there to nullify this potential. At site III very uneven size class distribution of stems gave an impression of completely irregular stand. Preponderance of mature and over-mature trees at all the three sites and biotic pressures in the form of over-grazing and lopping of twigs, leaves and cones for burning as incense were identified as major factors responsible for very poor natural regeneration of *J. macropoda* on these sites.

6. von Wissmann, H. The *Juniperus* mountain forests in Arabia: their position between the boreal and tropical African floral kingdoms. Geocology of the High Mountain Regions of Eurasia. 1972; 157-176.

Keywords: *Juniperus excelsa*/ *Juniperus macropoda*/ *Juniperus procera*/ distribution/ vegetation types/ Africa

Abstract: Reviews the distribution and altitudinal range of *Juniperus* spp. (section Sabina); these represent one of the few genera of trees that range from Eurasia into Africa across the tropics; a map shows the range of individual species. Many of the sources are books of travel. Some associated plant species are noted. Evidence is presented for regarding *J. excelsa* (the commonest species in Arabia), *J. macropoda* and *J. procera* as one and the same species, and for identifying them with the Almug or Algom trees of the Bible, and the Biblical land of Ophir with the province of Asir in Saudi Arabia, where *J. excelsa* stands are still plentiful.

7. Zakaullah (Zaka Ullah) . Juniper dwarf mistletoe and steepness of slope. Pakistan Journal of Forestry. 1979; 29(1):51-52.

Keywords: *Juniperus macropoda*/ Pakistan/ *Arceuthobium oxycedri*

Abstract: A survey of 479 juniper [*Juniperus macropoda*] trees in 72 sample plots in the Sasnamana Forest, Pakistan, showed that the incidence of dwarf mistletoe [*Arceuthobium oxycedri*] was highest in trees growing on gentle slopes, decreasing as the steepness of slope increased.

8. Zakaullah (Zaka-Ullah). Survey of juniper dwarf mistletoe in the adjacent areas of Sasnamana State Forest of Baluchistan. Pakistan Journal of Forestry. 1977; 27(3):143-146.

Keywords: *Juniperus macropoda*/ *Arceuthobium oxycedri*/ Pakistan

Abstract: The incidence of the mistletoe [*Arceuthobium oxycedri*] was assessed in plots along lines extending 1.6 km to the N., S. and E. of the forest boundary. Infected trees [*Juniperus macropoda*] were only found to

the N., along the northern ridge of Sasnamana and in the contiguous Chasnak forest.

Juniperus monophylla (1)

1. Harper, K. T.; Sanderson, S. C., and McArthur, E. D. Pinyon-juniper woodlands in Zion National Park, Utah. *Western North American Naturalist*. 2003; 63(2):189-202.

Keywords: *Juniperus osteosperma/ Juniperus monophylla/ Pinus edulis/* nature conservation/ plant communities.

Abstract: *Juniperus osteosperma-Pinus monophylla* or *P. edulis* (P-J) woodlands are the most widespread plant community in Zion National Park (ZNP), southwestern Utah, USA. These woodlands dominate nearly half of the park's land area. Our study of this vegetational complex is based on a sample consisting of 115 macroplots (each 0.01 ha in area) objectively distributed across the entire area of ZNP. We recognize 3 subtypes within the P-J complex: *J. osteosperma* (Utah juniper) alone, juniper with *P. monophylla* (single-leaf pinyon), and juniper with *P. edulis* (two-leaf pinyon). The 2 pinyon pines rarely occur together, and thus the foregoing subtypes do not overlap geographically to a significant extent. The first 2 subtypes occur primarily below 1800 m elevation, while the latter is most commonly found above that elevation. Because of the scarcity of sizable expanses (over ~10 ha) of well-developed soils in ZNP, the P-J complex occurs primarily on sites where exposed bedrock covers a large portion of the habitat. As a result, over 90% of stands assigned to the P-J complex support less than 50% tree canopy cover (64% have less than 25% tree cover). Shrub cover increases along the woodland successional gradient. Pinyon cover increases faster than juniper cover. Microbiotic soil crust cover is consistently greater in *J. osteosperma-P. monophylla* woodlands than in *J. osteosperma-P. edulis* woodlands, but total living cover increases significantly along the successional gradient in both communities. To enhance plant and animal biodiversity, we recommend that pinyon-juniper woodlands of Zion National Park be managed so that late seral stages do not dominate large tracts.

Juniperus monosperma (54)

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/* essential oils/

DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. *Sabina*) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

2. Adams R. P. and Zanoni T. A. The distribution, synonymy, and taxonomy of three junipers of southwestern United States and northern Mexico. *Southwestern Naturalist*. 1979; 24(2):323-329.

Keywords: *Juniperus erythrocarpa*/ *Juniperus monosperma*/
Juniperus pinchotii/ distribution/ taxonomy/ synonymy

Abstract: Revised distribution maps, new keys, and updated synonymy are presented for *Juniperus erythrocarpa*, *J. monosperma*, and *J. pinchotii*. These revisions reflect evidence from the past several years and are presented to aid field workers in the identification of these difficult taxa.

3. Adams, R P; Zanoni, T A; Rudloff, E von, and Hogge, L. The south-western USA and northern Mexico one-seeded junipers: their volatile oils and evolution. *Biochemical Systematics and Ecology*. 1981; 9(2/3):93-96; ISSN: 0305-1978

Keywords: *Juniperus erythrocarpa*/ *Juniperus monosperma*/
Juniperus pinchotii/ biochemistry/ taxonomy/ evolution/ arid regions

Abstract: The composition of the volatile oils of *Juniperus erythrocarpa*, *Juniperus*

monosperma var. *gracilis* and *Juniperus pinchotii* are reported from analysis by capillary GC MS-computer search. *Juniperus erythrocarpa* appears to have two chemical types or races, one from southern Arizona-south-west New Mexico, USA, and the other from Mexico and trans-Pecos Texas, USA. *Juniperus monosperma* var. *gracilis* contained aromatics from the phenyl propanoid pathway marking the first report of these type compounds from the denticulate leaf junipers. *Juniperus monosperma* var. *monosperma* was not found to be similar to *J. monosperma* var. *gracilis*, suggesting a nomenclatural change is needed for the latter taxon. The evolution within this complex has apparently been discordant between the morphology and the terpenoids.

4. Aldon E. F. and Loring T. J. Ecology, uses, and management of pinyon-juniper woodlands. Proceedings of the workshop, March 24-25, 1977, Albuquerque, New Mexico. USDA Forest Service General Technical Report, Rocky Mountain Forest and Range Experiment Station. (RM-39). 1977; RM-39(III):48.

Keywords: *Juniperus osteosperma*/ *Juniperus scopulorum*/ *Juniperus monosperma*/ *Juniperus deppeana*/ *Pinus edulis*/ *Pinus monophylla*/ *Pinus cembroides*/ *Pinus quadrifolia* / ecology/ pinyon-juniper woodlands

Abstract: Pinyon (*Pinus edulis*, *P. monophylla*, *P. cembroides*, and *P. quadrifolia*)/juniper (*Juniperus osteosperma*, *J. scopulorum*, *J. monosperma* and *J. deppeana*) woodlands occupy 33 million acres in W. USA. Twelve papers were presented on the type in 3 sections: Ecology of pinyon juniper woodlands: Pieper, R.D. The southwestern pinyon/juniper ecosystem. [16 ref.] Clendenen, G.W. Pinyon and juniper inventory procedures. Little, E.L., Jr. Research in the pinyon/juniper woodland. [16 ref., 1 pl., 4 maps] Smith, T, Insects and diseases of pinyon/juniper. Swenson, E. Pinyon/juniper wildlife habitats. Baxter, C. A comparison between grazed and ungrazed juniper woodland. Uses and potential of the woodland zone: Ffolliott, P.F. Product potential of pinyon/juniper woodlands. [8 ref.] Voorhies, G. What is known and not known about pinyon/juniper utilization. [23 ref.] Fisher, J.T.; Montano. J.M. Management of pinyon for ornamentals, Christmas trees, and nut production. [29 ref.] Management strategies for the woodland zone: Gallegos, R.R. Forest practices needed for the pinyon/juniper type. Hurst, W.D. Managing pinyon/juniper for multiple benefits. Anderson, G. Systems approach to pinyon/juniper management.

5. Armentrout S M [Reprint author] and Piper R D [Author]. Plant distribution surrounding Rocky Mountain pinyon pine and one-seed juniper in south-central New Mexico USA. Journal of Range Management. 1988; 41(2):139-143.

Keywords: *Juniperus monosperma* / New Mexico/ pinyon pine/ one-seed juniper/ *Pinus edulis*

Abstract: Within the pinyon-juniper type, trees and understory vegetation are interspersed with open areas forming a mosaic of vegetational patterns. The objective of this research was to define and describe vegetational zones surrounding Rocky Mountain pinyon (*Pinus edulis* Engelm.) and oneseed juniper (*Juniperus monosperma* [Engelm.] Sarg.). Transects consisting of contiguous frames were laid out from the base of the tree and continued into the interspace area (outside the canopy) for each cardinal direction. Potential zone boundaries were located by calculating a squared Euclidean distance utilizing basal cover estimates of each frame. Zone boundaries were verified by discriminant analysis. Vegetation associated with both pinyon pine and oneseed juniper exhibited 3 zones. Zone 1 consisted of vegetation associated with the tree bole. Zone 2 was, for the most part, located beneath the tree canopy. Zone

3, consisting primarily of interspace, contained mostly perennial grasses and forbs. Mean basal cover of vegetation surrounding oneseed juniper increased from <1% in zone 1, to approximately 7% in zone 2, to about 12% in zone 3. Mean basal cover estimates of vegetation associated with pinyon pine increased from approximately 4% in zone 1, to 10 and 11% in zones 2 and 3, respectively. Differences in species composition among zones between tree species were apparent.

6. Barnes, F. J. Carbon gain and water relations in pinyon-juniper habitat types. Dissertation Abstracts International B, Sciences and Engineering. 47(8). 1987. 3217-B. Thesis. 1984; 47(8):195 pp.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ metabolism/ plant water relations/ distribution.
Abstract: Pinyon (*Pinus edulis*) and juniper (*Juniperus monosperma*) have overlapping distributions in northern New Mexico, but relative dominance of the 2 species varies with altitude along a complex environmental gradient. Photosynthetic responses to important variables along this gradient were studied to determine the ecophysiological parameters contributing to the dominance pattern. Three habitat types were defined and seasonal changes in predawn leaf water potentials of dominant species were determined at 2 sites in each type. Photosynthetic responses of pinyon and juniper to light, temp. and water status were studied under controlled conditions. Carbon gain by leaves was estimated for each species at each site. Results showed that pinyon is limited at lower, more xeric sites by its lack of tolerance for water stress; juniper dominates the overstorey on such sites. Environmental limitations to the distribution of juniper were not found at higher sites where pinyon is dominant. With increasing soil moisture, however, pinyon has a steep increase in leaf carbon gain so that juniper may be subjected to increasing competitive stress. Pinyon has higher photosynthetic capacity than juniper and individuals from mesic sites have higher rates of carbon gain than those from xeric sites. Juniper is more drought tolerant than pinyon. There was n.s.d. between the species in the temp. peak of carbon gain, but juniper had a wider temp. opt. than pinyon, with the additional range being at higher temp.
7. Breshears, D. D.; Myers, O. B.; Johnson, S. R.; Meyer, C. W., and Martens, S. N. Differential use of spatially heterogeneous soil moisture by two semiarid woody species: *Pinus edulis* and *Juniperus monosperma*. *Journal of Ecology Oxford* . 1997; 85(3):289-299.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ semiarid zones/ plant water relations
Abstract: Soil moisture in semiarid woodlands varies both vertically with depth and horizontally between canopy patches beneath woody plants and the intercanopy patches that separate them, such that shallow soil layers in intercanopy locations are wettest, yet few studies have considered both dimensions of spatial variability in testing for acquisition of resources by

plants. Three hypotheses were tested relative to the use of shallow water in intercanopy locations by 2 coexisting semiarid woodland tree species, *Pinus edulis* (pinon) and *Juniperus monosperma* (juniper), in high-altitude (2140 m) pinon-juniper woodland in northern New Mexico: that (i) both species can use shallow water from intercanopy locations, (ii) *J. monosperma* is able to obtain more shallow water from intercanopy locations than *P. edulis*, and (iii) the spatial arrangement of the trees influences the amount of water they obtain. Soil moisture and plant water potential (i.e. plant water stress) were measured before and after the addition of water to shallow depths (0-30 cm) of intercanopy locations for trees of both species in 2 spatial arrangements: isolated and paired with a contiguous tree of the other species. Both species responded to the addition of shallow water in intercanopy locations, as measured by plant water potential. The response of *J. monosperma* was significantly greater than that of *P. edulis*, as measured by depletion of shallow soil moisture in intercanopy locations and by change in plant water potential per unit change in soil water potential (the difference was not detectable on the basis of plant water potential alone); in addition, the amount of depletion was correlated with basal area of *J. monosperma* but not of *P. edulis*. The responses were not influenced by spatial arrangement. The results of this study are consistent with differences in the relative abundances of the 2 species across locations, suggesting that species differences in ability to use shallow water in intercanopy locations is important in structuring semiarid woodlands. Further, the results suggest that current theoretical concepts for semiarid ecosystems, which ignore either vertical or horizontal variability in soil moisture, may be inadequate for predicting changes in the ratio of woody to herbaceous plant biomass, particularly for plant communities with codominant woody species that differ in ability to acquire spatially heterogeneous resources.

8. Breshears, David D.; Nyhan, John W.; Heil, Christopher E., and Wilcox, Bradford P. Effects of woody plants on microclimate in a semiarid woodland: Soil temperature and evaporation in canopy and intercanopy patches. *International Journal of Plant Sciences*. 1998 Nov; 159(6):1010-1017.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ New Mexico/ canopy/ temperature
Abstract: The canopies of woody plants in semiarid ecosystems modify the microclimate beneath and around them, with canopy patches usually having lower soil temperatures than intercanopy patches. However, lacking are studies that have evaluated how heterogeneity in soil temperature, induced by woody plant canopies, influences soil evaporation rates and the consequent effects on plant-available water. Soil temperatures were measured and soil evaporation rates were estimated for canopy and intercanopy patches in a semiarid pinon-juniper woodland (*Pinus edulis* and *Juniperus monosperma*) in northern New Mexico. Soil temperature was measured at 2-cm-depths in four canopy and four intercanopy locations during 1994. Maximum soil temperature in

intercanopy patches was greater than in canopy patches between May and September, by as much as 10°C, while soil temperatures in intercanopy patches were lower than in canopy patches during colder parts of the day in the fall and winter months. Equations for soil drying rates for sandy loam soil samples were determined in laboratory experiments over a range of temperatures and soil water contents. Drying rates were disproportionately greater at high soil moisture and high soil temperature. Intercanopy patches were predicted to dry more than canopy patches for days in April through September by as much as 2% volumetric soil water content per day. The difference between patches was amplified at lower soil water contents when expressed as soil water potential, which more directly determines plant-available water. Our results quantify the effects of woody plants on the microclimate with respect to soil temperature and evaporation, which in turn affect herbaceous and woody plants by modifying factors such as germination, the potential for facilitation, and the amount of plant-available water.

9. Brockway D. G.; Gatewood R. G., and Paris R. B. Restoring grassland savannas from degraded pinyon-juniper woodlands: effects of mechanical overstorey reduction and slash treatment alternatives. *Journal of Environmental Management*. 2002; 64(2):179-197.

Keywords: *Juniperus monosperma*/ *Pinus edulis*/ biomass/ controlled burning/ erosion

Abstract: Although the distribution and structure of pinyon-juniper woodlands in southwestern USA are thought to be the result of historic fluctuations in regional climatic conditions, more recent increases in the areal extent, tree density, soil erosion rates and loss of understorey plant diversity are attributed to heavy grazing by domestic livestock and interruption of the natural fire regime. Prior to 1850, many areas currently occupied by high-density pinyon-juniper woodlands, with their degraded soils and depauperate understoreys, were very likely savannas dominated by native grasses and forbs and containing sparse tree cover scattered across the landscape. The purpose of this study was to evaluate the effectiveness of mechanical overstorey reduction and three slash treatment alternatives (removal, clustering and scattering) followed by prescribed fire as techniques for restoring grassland savannas from degraded woodlands. Plant cover, diversity, biomass and nutrient status, litter cover and soil chemistry and erosion rates were measured prior to and for two years following experimental treatment in a degraded pinyon-juniper (*Pinus edulis-Juniperus monosperma*) woodland in central New Mexico, USA. Treatment resulted in a significant increase in the cover of native grasses (including *Bouteloua gracilis*) and, to a lesser degree, forbs and shrubs. Plant species richness and diversity increased most on sites where slash was either completely removed or scattered to serve as a mulch. Although no changes in soil chemistry or plant nutrient status were observed, understorey biomass increased over 200% for all harvest treatments and was significantly greater than controls. While treatment

increased litter cover and decreased soil exposure, this improvement did not significantly affect soil loss rates. Even though all slash treatment alternatives increased the cover and biomass of native grasses, scattering slash across the site to serve as a mulch appears most beneficial to improving plant species diversity and conserving site resources.

10. Chojnacky, C. Juniper, pinyon, oak and mesquite volume equations for Arizona. Research Paper Intermountain Research Station, USDA Forest Service. (INT-391). 1988; INT-39111 pp.
Keywords: *Juniperus osteosperma*/ *Juniperus monosperma*/ *Juniperus deppeana*/ *Pinus*/ *Prosopis*/ *Acacia*/ *Olneya*/ *Quercus*/ broadleaves/ volume tables.
Abstract: Measurements made on *Juniperus* spp. (juniper species group - mainly *J. osteosperma*, *J. monosperma*, *J. deppeana*); *Pinus* spp. (pinyon species group - *P. edulis*, *P. cembroides*, *P. edulis* var. fallax); *Prosopis velutina*, *Acacia greggii* and *Olneya tesota* (mesquite species group); and *Quercus* spp. (oak species group - mainly *Q. emoryi*, *Q. arizonica*) from 291 plots were used to derive equations predicting volume from height and diameter near the root collar. Volume equations were constructed for single-stem and multiple-stem trees in each species group except pinyon, where only single-stem trees were considered. Results are presented in the form of graphs and volume tables, and compared with some of the results of other studies.
11. Chojnacky, D. C. Estimating diameter growth for pinyon and juniper trees in Arizona and New Mexico. Research Note Intermountain Research Station, USDA Forest Service. (INT-GTR-429). 1996; INT-GTR- 4296.
Keywords: *Juniperus monosperma*/ *Juniperus deppeana*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Pinus*/ diameter growth/ Arizona/ New Mexico
Abstract: Diameter growth measurement is difficult for pinyon and juniper trees because they are slow-growing, multiple-stemmed, and poorly suited to measurement methods used for other temperate tree species. A model designed to estimate diameter growth for individual pinyon (*Pinus edulis*) and juniper (*Juniperus* spp.) trees from a small subsample of growth measurements is described. Data for model construction include 10-year radial growth sampled from 1,536 trees on 176 plots spread throughout Arizona and New Mexico. Species include *Pinus edulis*, *Juniperus monosperma*, *J. deppeana*, *J. scopulorum*, and *J. osteosperma*. The model predicts past 10-year diameter growth from stand-level growth-index measurement, tree diameter, and number of basal stems in a tree.
12. ---. Modeling diameter growth for pinyon and juniper trees in dryland forests. Forest Ecology and Management. 1997; 93(1/2):21-31.
Keywords: *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus deppeana*/ *Juniperus osteosperma*/ *Pinus edulis*/ diameter

Abstract: An individual-tree model has been developed to estimate diameter growth of pinyon pine (*Pinus edulis*) and juniper (*Juniperus monosperma*, *J. scopulorum*, *J. deppeana*, *J. osteosperma*) trees in pinyon-juniper dryland forests throughout New Mexico, USA. The model was built from radial growth data on 917 trees sampled from 82 plots. Individual tree growth can be predicted from measurements of tree diameter at the root collar, the number of basal stems per tree, and past 10-yr diameter growth of the median-sized stem in the stand of interest. Model development is patterned after growth and yield models for temperate forests in the western USA.

13. ---. Pinyon-juniper volume equations for the central Rocky Mountain states. Research Paper, Intermountain Forest and Range Experiment Station, USDA Forest-Service. (INT-339). 1985; INT-339(I):27 pp.
Keywords: *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Pinus edulis*/ *Pinus monophylla*/ *Quercus*/ *Cercocarpus*/ woodland/ volume tables
Abstract: Equations and volume tables are presented for *Juniperus monosperma*, *J. scopulorum*, *J. osteosperma*, *J. occidentalis*, *Pinus edulis*, *P. monophylla*, *Quercus macrocarpa*, *Q. gambelii*, *Cercocarpus* spp. and a group of broadleaved species in pinyon/juniper woodland in Nevada, Idaho, Utah, Colorado, Wyoming and South Dakota.
14. Covington W. W.; DeBano L. F., and Huntsberger T. G. Soil nitrogen changes associated with slash pile burning in pinyon-juniper woodlands. Forest Science. 1991; 37(1):347-355.
Keywords: *Juniperus monosperma*/ *Juniperus osteosperma*/ *Pinus edulis*/ soil nitrogen/ slash pile burning
Abstract: The effects of slash pile burning in a pinyon pine (*Pinus edulis*)/juniper (*Juniperus monosperma*, *J. osteosperma*) woodland that had been harvested for fuelwood were investigated using a time sequence study and experimental studies (both with repeated measurements) in the Coconino National Forest, Arizona. The results showed that burning caused immediate increases (approximately 50-fold) in soil ammonium concentrations. Nitrate concentrations were not immediately affected; however, by one year after burning, nitrate concentrations were approximately 20 times higher where piles had been burned than in unburned controls. These increases in inorganic nitrogen disappeared by year 5 after burning.
15. Daugherty, C. M. and Mathiasen, R. L. Adult sex ratio of *Phoradendron juniperinum* in ten severely infected *Juniperus monosperma* in northern Arizona. Madrono. 1999; 46(4):169-176.
Keywords: *Juniperus monosperma*/ *Phoradendron juniperinum*/ mistletoes/ parasitic weeds/ sex ratio/ spatial distribution
Abstract: The adult sex ratio of *Phoradendron juniperinum* (juniper mistletoe) was determined on 10 severely infected *Juniperus monosperma*

(one-seeded juniper) trees near Flagstaff, Arizona. The adult sex ratio of *P. juniperinum* has previously been reported to be male-biased. Although two trees did have a male-biased sex ratio, two trees had a female-biased sex ratio, and the overall sex ratio of this population of *P. juniperinum* was essentially 1:1. The sex ratio of adult *P. juniperinum* was also examined on the south, east, west, and north sides (quadrants) of each tree. There was a large amount of variation in the sex ratio by quadrant among individual trees. However, the overall sex ratio was not significantly different from a 1:1 ratio in the south, east, and north quadrant, while the west quadrant had a female-biased sex ratio. The sex ratio of adult *P. juniperinum* also varied by height when the data were pooled for all trees. The results also indicate that the total number of *P. juniperinum* (adults and non-reproductive plants combined) was usually greater on the south sides of trees with fewer on the north sides. The reasons for the distribution of *P. juniperinum* within the crowns of host trees are discussed in relation to how this parasitic plant is disseminated.

16. Davenport, D. W.; Wilcox, B. P., and Breshears, D. D. Soil morphology of canopy and intercanopy sites in a pinon-juniper woodland. *Soil Science Society of America Journal*. 1996; 60(6):1881-1887.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ soil morphology/ canopy/ New Mexico
Abstract: Pinon-juniper woodlands in the semiarid western USA have expanded as much as fivefold during the last 150 yr, often accompanied by losses of understory vegetation and increasing soil erosion. A study was conducted to determine the differences in soil morphology between canopy and intercanopy locations within a pinon (*Pinus edulis*)-juniper (*Juniperus monosperma*) woodland with uniform parent material, topography, and climate. The woodland studied, located near Los Alamos, New Mexico, has a mean tree age of 135 yr. Soil morphology was examined by augering 135 profiles in a square grid pattern and comparing soils under pinon and juniper canopies with intercanopy soils. Only two of the 17 morphological properties compared showed significant differences. The B horizons make up a slightly greater proportion of total profile thickness in intercanopy soils, and there are higher percentages of coarse fragments in the lower portions of canopy soil profiles. Canopy soils have lower mean pH and higher mean organic C than intercanopy soils. Regression analysis showed that most soil properties did not closely correspond with tree size, but total soil thickness and B horizon thickness are significantly greater under the largest pinon trees, and soil reaction is lower under the largest juniper trees. The findings suggest that during the period in which pinon-juniper woodlands have been expanding, the trees have had only minor effects on soil morphology.
17. Dearing, M. D.; McLister, J. D., and Sorensen, J. S. Woodrat (*Neotoma*) herbivores maintain nitrogen balance on a low-nitrogen, high-phenolic forage, *Juniperus monosperma*. *Journal of Comparative Physiology B*,

Biochemical, Systemic, and Environmental Physiology. 2005; 175(5):349-355.

Keywords: *Juniperus monosperma*/ *Neotoma stephensi*/ metabolic detoxification; wild animals.

Abstract: The acquisition of adequate quantities of nitrogen is a challenge for herbivorous vertebrates because many plants are in low nitrogen and contain secondary metabolites that reduce nitrogen digestibility. To investigate whether herbivores maintain nitrogen balance on plant diets low in nitrogen and high in secondary compounds, we studied the effect of juniper (*Juniperus monosperma*) ingestion on the nitrogen balance of two species of herbivorous woodrats (*Neotoma stephensi* and *N. albigula*). These woodrat species feed on the foliage of juniper: *N. stephensi* is a juniper specialist, whereas *N. albigula* is a generalist that incorporates some juniper in its diet. Based on the nitrogen contents of the natural diets of these woodrats, we predicted that the generalist would be in negative nitrogen balance on a juniper diet whereas the specialist would not be affected. We found that both species of woodrat had low-nitrogen requirements (334.2 mg N/kg^{0.75}/day) and that a diet of 50% juniper did not result in negative nitrogen balance for either species. However, excretion patterns of nitrogen were altered; on the 50% juniper diet, fecal nitrogen losses increased ~38% and urinary nitrogen losses were half that of the control diet. The results suggest that absorption and detoxification of juniper secondary compounds may be more important for restricting juniper intake by the generalist than nitrogen imbalance.

18. Ernst, R. and Pieper, R. D. Changes in pinon-juniper vegetation: a brief history. Rangelands. 1996; 18(1):14-16.

Keywords: *Juniperus monosperma*/ *Juniperus deppeana*/ *Juniperus osteosperma*/ *Pinus monophylla*/ *Pinus edulis*/ human activity/ vegetation types/ palaeoclimatology.

Abstract: The pinyon-juniper region of the southwestern USA and Mexico is comprised of morphologically different ecosystems across a heterogeneous landscape with a history of natural and induced disturbance regimes. Two pinyons (*Pinus monophylla* and *P. edulis*) and 3 junipers (*Juniperus deppeana*, *J. monosperma* and *J. osteosperma*) occur in these communities. This paper discusses how past climate, natural and induced fire, uses by prehistoric and historic humans, and recent large-scale clearing to increase forage for livestock have affected the structure and distribution of the pinyon-juniper complex.

19. Evans, R. A. Management of pinyon-juniper woodlands. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-249). 1988; INT-249(II):34 pp.

Keywords: *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Pinus*/ management/ woodlands

Abstract: The pinyon/juniper woodlands are extensive in the western USA and are a valuable renewable resource for many uses. The occurrence and dominance of pinyon (*Pinus cembroides*, *P. monophylla* and *P. edulis*), juniper (*Juniperus deppeana*, *J. monosperma*, *J. scopulorum*, *J. osteosperma* and *J. occidentalis*), shrubs and herbs vary over the spectrum of the woodlands which occur on many soil types and topographies with different climates. The manual describes the ecosystem and gives basic guidelines for management for forest products (mostly fuelwood, poles and posts, and pinyon nuts), forage and browse production, wildlife, recreation and watershed values.

20. Fernandes, G. W. and Whitham, T. G. Selective fruit abscission by *Juniperus monosperma* as an induced defense against predators. *American Midland Naturalist*. 1989; 121(2):389-392.

Keywords: *Juniperus monosperma*/ predators/ larvae/ fruits/ abscission/ damage

Abstract: Abscised fruits were more likely to contain predator larvae than were undamaged fruits. Larvae in abscised fruits were more likely to die than larvae in fruits still attached to the tree. Selective abscission of damaged fruits is viewed as an adaptive plant defense since 1) abscission reduces the plant's losses by terminating any further investment into a doomed propagule; 2) abscission may reduce the number of fruit predators that mature to attack future fruit crops.

21. Fisher, J T; Fancher, G A, and Aldon, EF. Factors affecting establishment of one-seed juniper (*Juniperus monosperma*) on surface-mined lands in New Mexico. *Canadian Journal of Forest Research*. 1990; 20(7):880-886; ISSN: 0045-5067.

Keywords: *Juniperus monosperma*/ mine-spoil/ fertilizers/ weeds/ planting season/ mulching/ seedlings/ seedling growth

Abstract: Containerized *Juniperus monosperma* were planted on 2 N. New Mexico mine spoils in 1982 and 1983, to evaluate effects of establishment methods and postplanting site conditions on seedling survival and growth, as measured about 5 yr after planting. Establishment factors included planting date, mulch, fertilizer regimes and seedling protection. Wood chip mulch and animal protection provided by rigid plastic mesh tubes or plastic netting improved juniper survival, growth, or both. The forms and rates of fertilizers tested provided no benefits and sometimes decreased survival. Fertilizer treatment at planting stimulated the growth of reseeded grass and resulted in greater competition. Perennial weeds that invaded a mechanically cleared planting site also reduced juniper growth and survival. The results suggest the need to consider the adverse effects associated with fertilization, time of planting and order of grass and juniper establishment.

22. Fisher, J T; Fancher, G A, and Neumann, R W. Survival and growth of containerized native juniper (*Juniperus monosperma*) on surface-mined

lands in New Mexico. *Forest Ecology and Management*. 1986; 16(1-4):291-299.

Keywords: *Juniperus monosperma*/ mine spoils/ containers/ New Mexico/ survival/ seedlings

Abstract: Two years after planting on 3 northern mine spoils to evaluate cultural treatments (including planting date, mulch, drip irrigation, fertilizer regimes and seedling protection) survival rates of 72%, 70% and 99% were observed for the best treatments at each site. July was the best planting date for the high altitude site and Aug. for the low altitude site. Drip irrigation was better than mulching and triple superphosphate better than slow-release NPK fertilizer. Plastic mesh was essential and more effective for rodent protection than animal repellent.

23. Fisher, James T.; Fancher, Gregory A., and Neumann, Robert W. Germination and field establishment of juniper in the southwest. New Mexico Agricultural Experiment Station, Scientific Paper No. 253. 1987 Jan; 215293-299; ISSN: 0748-1209.

Keywords: *Juniperus monosperma*/ germination/ stratification/ survival/ seedling/ New Mexico

Call Number: aSD11. A48

Abstract: Studies were conducted to determine reliable methods for germination and establishing *Juniperus monosperma*. Poor germination is caused by a germination inhibitor in the seed coat and physiological dormancy. Germination rate and value were significantly improved when seeds were leached 48 hours with H₂O or treated with ethephon or H₂O₂ plus GA₃ before stratification at 4° C.

Establishment studies at three New Mexico sites evaluated the effects of planting date, mulch, drip irrigation, fertilizer and rodent protection on juniper seedling survival. Two years after planting, survival rates for the best treatment combinations ranged from 70 to 99% among sites. July was the superior planting date for the site near Raton, New Mexico. Drip irrigation proved superior to mulch. Plastic mesh was essential and was more effective than animal repellent for rodent protection.

24. Gehring, C. A. and Whitham, T. G. Reduced mycorrhizae on *Juniperus monosperma* with mistletoe: the influence of environmental stress and tree gender on a plant parasite and a plant-fungal mutualism. *Oecologia*. 1992; 89(2):298-303.

Keywords: *Juniperus monosperma*/ *Phoradendron juniperinum*/ mistletoe/ parasitic plants/ parasite relationships/ stress.

Abstract: The interactions between mycorrhizas and a xylem-tapping mistletoe (*Phoradendron juniperinum*) growing on *J. monosperma* were investigated. High levels of mistletoe parasitism were correlated with low levels of mycorrhizas in both male and female trees. The level of mistletoe parasitism on trees growing in a stressful environment was 3-fold higher on female trees than on males, and the negative association between mistletoe and mycorrhizas was slightly, but significantly stronger in female

trees. No differences in mistletoe infestation were observed between male and female trees growing in the more favourable soils.

25. Goguen C. B. and Mathews N. E. Songbird community composition and nesting success in grazed and ungrazed pinyon-juniper woodlands. *Journal of Wildlife Management*. 1998; 62(2):474-484.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ songbirds/ silvopastoral systems/ wild birds
Abstract: The effects of livestock grazing on breeding bird communities in pinyon-juniper (*Pinus edulis*-*Juniperus monosperma*) habitats in the western United States were studied. Habitat structure, songbird abundance, and nesting productivity were compared within pinyon-juniper woodlands on an actively grazed site and a site experiencing long-term relief from livestock (cattle) grazing in northeastern New Mexico. From 1992 to 1995, vegetation sampling and songbird point counts were conducted, and nests were located and monitored on 8 35-ha study plots. Four of these plots experienced moderate cattle grazing and 4 were ungrazed since 1973. There were no differences in habitat or vegetation features between grazed and ungrazed plots. Bird communities were similar, with only 1 of the 11 species tested more abundant on the ungrazed treatment (western scrub-jay; *Aphelocoma californicus*). No differences in nesting success or cause-specific rates of nest failure for 7 common bird species ($P < 0.05$), and no differences in brown-headed cowbird (*Molothrus ater*) parasitism rates for the major hosts, were detected between grazed and ungrazed areas. Greater than 75% of the nests of the solitary vireo (*Vireo solitarius*), western tanager (*Piranga ludoviciana*), and blue-gray gnatcatcher (*Polioptila caerulea*) were parasitized on both treatments. These high parasitism rates may be the result of high densities of local cowbirds because of abundant feeding sites (i.e., livestock), the high mobility of cowbirds, and the close proximity of ungrazed plots to grazed areas (all <4 km). It is concluded that 20 years of relief from grazing had little influence on the habitat structure or bird species composition of the pinyon-juniper woodlands on the study site. However, livestock grazing has indirectly affected the nesting success of some songbird species via the influence of grazing on cowbird abundance.
26. Grier, C. C.; Elliott, K. J., and McCullough, D. G. Biomass distribution and productivity of *Pinus edulis*-*Juniperus monosperma* woodlands of north-central Arizona. *Forest Ecology and Management*. 1992; 50(3-4):331-350.
Keywords: *Juniperus monosperma* / *Pinus edulis*/ Arizona/ biomass/ productivity
Abstract: Above-ground biomass distribution, leaf area, above-ground net primary productivity and foliage characteristics were determined for 90- and 350-year-old *Pinus edulis*/*Juniperus monosperma* ecosystems on the Colorado Plateau. Biomass of the 350-year-old pinyon/juniper stand examined in this study was 54.1 t/ha, that of the 90-year-old stand was

23.7 t/ha. Annual above-ground net primary production averaged 2.12 t/ha for the young and 2.88 t/ha for the mature stand; tree production was about 80% of these values for both stands. Projected ecosystem leaf area (LAI) of the stands was 1.72 and 1.85 m²/m², respectively. Annual production efficiency (dry matter production per unit leaf area) was 0.129 kg/m² for the young, and 0.160 kg/m² for the mature stand (which is lower than the 0.188 kg/m² reported for xeric, pure juniper stands in the northern Great Basin). Biomass of pinyon/juniper ecosystems of northern Arizona is generally below the 60 to 121 mg/ha reported for pinyon/juniper stands of the western Great Basin in Nevada. A climatic gradient with summer precipitation decreasing between southeast Arizona and northwest Nevada occurs in the pinyon/juniper region. Great Basin pinyon/juniper ecosystems lie at the dry-summer end of this gradient while pinyon/juniper ecosystems of the Colorado Plateau lie at about the middle of this gradient. In spite of wetter summers, pinyon/juniper ecosystems of northern Arizona are less productive than those of the Great Basin.

27. Hastings, B. K.; Smith, F. M., and Jacobs, B. F. Rapidly eroding pinon-juniper woodlands in New Mexico: response to slash treatment. *Journal of Environmental Quality*. 2003; 32(4):1290-1298.

Keywords: *Juniperus monosperma*/ *Pinus edulis*/ degraded forests/ erosion control.

Abstract: The pinon (*Pinus edulis* Engelm.)-juniper [*Juniperus monosperma* (Engelm.) Sarg.] woodlands of Bandelier National Monument are experiencing accelerated erosion. Earlier studies suggest that causes of these rapidly eroding woodlands are related to an unprecedented rapid transition of ponderosa pine (*Pinus ponderosa* C. Lawson) savanna to pinon-juniper woodlands as a result of cumulative historical effects of overgrazing, fire suppression, and severe drought. To study the effectiveness of slash treatment in reducing accelerated erosion, we used sediment check dams to quantify sediment yield from twelve paired microwatersheds (300-1100 m²) within an existing paired watershed study. Six of the twelve microwatersheds were located in a 41-ha (treatment) watershed with scattered slash treatment, whereas six microwatersheds were located in an adjacent 35-ha untreated (control) watershed. The primary purpose of our research was to quantify the rates of sediment yield between the treated and control microwatersheds. Sediment yield was measured from 15 individual storms during the months of June-September (2000 and 2001). In response to slash treatment, mean seasonal sediment yield for 2000 equaled 2.99 Mg/ha in the control vs. 0.03 Mg/ha in the treatment and 2.07 Mg/ha in the control vs. 0.07 Mg/ha in the treatment in 2001. The practice of slash treatment demonstrates efficacy in reducing erosion in degraded pinon-juniper woodlands by encouraging herbaceous recovery. Our data show that slash treatment increases total ground cover (slash and herbaceous growth) beyond a potential erosion threshold. Restored pinon-juniper woodlands,

as the result of slash treatment, provide a forest structure similar to pre-grazing and pre-fire suppression conditions and decrease catastrophic fire hazard.

28. Itami, J. K. and Craig, G. T. P. Life history of *Styloxus bicolor* Coleoptera Cerambycidae on *Juniperus monosperma* in northern Arizona USA. Annals of the Entomological Society of America. 1989; 82(5):582-587.
Keywords: *Juniperus monosperma*/ *Styloxus bicolor*/ Arizona/ one-seed juniper/ life history
Abstract: Life history and mortality factors of *Styloxus bicolor* (Champlain and Knull) were studied on its host, one-seed juniper, *Juniperus monosperma* (Englemann) Sarg., in northern Arizona from 1982 to 1986. Adults emerged from juniper branches in early August. Larval development was completed over a 3-yr period. Each year the larva created a circumferential gallery (a flattened spiral cut severing the xylem) at the nearest branching point. This is a previously undescribed life history strategy for a cerambycid with a multiple-year life cycle. Mating and oviposition behavior of the adults and larval gallery construction are described. A survivorship curve showed that 10.8% of the 1983 cohort survived to adults, 15.7% died from natural enemies, 34.3% died from branch breakage at the circumferential gallery, 16.0% died from resinosis, 3.8% died in long travel galleries, and 19.1% died of

29. Johnsen, T. N. Longevity of stored juniper seeds. Ecology. 1959; 40:487-488.
Keywords: *Juniperus deppeana*/ *Juniperus monosperma*/ seeds/ germination/ longevity
Abstract: Germination tests were done with various-age stored seeds of alligator juniper (*Juniperus deppeana* Steud.) and one-seed juniper (*J. monosperma* [Torr.] Little) in an attempt to determine the longevity of their seeds. Seeds 9 to 45 years old had 16 to 54 % germination. Data shows that seeds of these junipers can survive extended periods of dry storage and that they might be relatively unaffected by drought following seed dispersal.

30. Kleintjes, P. K.; Jacobs, B. F., and Fettig, S. M. Initial response of butterflies to an overstory reduction and slash mulching treatment of a degraded pinon-juniper woodland. Restoration Ecology. 2004; 12(2):231-238.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ degraded forests/ mechanical methods.
Abstract: Overstory reduction and slash mulching (ORSM) has been shown to be an effective means for increasing herbaceous cover and diversity in degraded pinon (*Pinus edulis*) and juniper (*Juniperus monosperma*) woodlands of north-central New Mexico. Local fire history, tree age-class structure, and grazing records suggest that many areas now occupied by dense pinon-juniper woodlands were formerly more open, with grassy understories that supported well-developed soils and a fire regime. At Bandelier National Monument, studies are evaluating the use of

ORSM treatments as a restoration management tool. In 1999 and 2001, we evaluated the effects of an ORSM treatment implemented in 1997 upon butterfly abundance and species richness between a pair of treated and control watersheds. Butterfly abundance and species richness were significantly greater on the treated watershed in both years, and these measures were correlated with significant increases in forb and grass cover in the treated watershed. Five of the 10 most common nectar and larval host plants had significantly greater cover in the treated watershed, including the legume *Lotus wrightii*. Our results suggest that the increased herbaceous cover resulting from an ORSM treatment of a single watershed induced a positive, initial response by butterflies. Using butterflies as indicators of site productivity and species richness, our results suggest ORSM is a promising technique for restoring biodiversity in degraded pinon-juniper woodlands.

31. Kramer S. and Green D. M. Phosphorus pools in tree and intercanopy microsites of a juniper-grass ecosystem. *Soil Science Society of America Journal*. 1999; 63(6):1901-1905.
Keywords: *Juniperus monosperma/ Hilaria/ aridisols/ phosphorus*
Abstract: Gradients of soil-nutrient distribution between trees and intercanopy areas are common in many semiarid woodland ecosystems. To test if microsites under and between canopies influenced P pool distribution in a semiarid woodland dominated by one-seed juniper (*Juniperus monosperma* (Engelm.) Sarg.) and galleta grass (*Hilaria jamesii* (Torr.) Benth.), we compared inorganic, organic, and microbial P pools under trees and intercanopy areas of two Aridisols. Soils collected (5-15 cm depth) under eight tree canopies and in eight intercanopy areas from a Calciorthid and a Camborthid were subjected to a sequential P fractionation scheme. Soils and microsites were significant independent factors determining total soil P, which ranged from 814 mug P g⁻¹ soil (SE = 25) to 1123 mug P g⁻¹ soil (SE = 21). Resin P was significantly influenced by the interaction of soils with microsite. Organic hydroxide P was the largest organic P fraction and exceeded or equaled the amount of resin P. It differed significantly between the Calciorthid at 10.1 mug P g⁻¹ soil (SE = 1.0) and the Camborthid at 22.1 mug P g⁻¹ soil (SE = 1.6). Microsite and soil did not significantly affect microbial P, which ranged from 12.9 mug P g⁻¹ soil (SE = 2.1) to 17.0 mug P g⁻¹ soil (SE = 0.7). Nutrients and microbial activity are usually concentrated under canopies in semiarid and arid ecosystems. This research shows that P pools distribution in the studied ecosystem did not follow this general pattern, and that soils may be more important in determining P pool distribution than microsites.
32. Ludwig, J. A.; Whitford, W. G.; Rodney, A. B., and Grieve, R. E. An evaluation of transmission line construction on Pinon-Juniper woodland and grassland communities in New Mexico. *Journal of Environmental Management*. 1977; 5(2):127-137.
Keywords: *Juniperus monosperma/ Pinus edulis/ plant communities/*

woodlands.

Abstract: Species diversity and cover were measured in corridors of different ages created by the construction of transmission lines in 1951-69 in *Pinus edulis*/*Juniperus monosperma* woodland. The tree canopy was reduced in corridors, but tree density was not affected since felling practices did not always kill the trees and re-establishment was rapid. On sites cleared for pylons the first stage of recovery was characterized by annuals; trees re-established within 5 years.

33. Martens, Scott N.; Breshears, David D., and Barnes, Fairley J. E-mail daveb@lanl.gov. Development of species dominance along an elevational gradient: Population dynamics of *Pinus edulis* and *Juniperus monosperma*. International Journal of Plant Sciences. 2001 Jul; 162(4):777-783.

Keywords: *Juniperus monosperma*/ *Pinus edulis*/ pinyon-juniper woodlands/ species

Abstract: We evaluated species-environment relationships within pinyon-juniper woodlands in northern New Mexico (United States) using canonical correspondence analysis (CCA). The first CCA axis was associated primarily with elevation. Our results showed separation between pinyon and juniper along the elevation gradient, as expected: pinyon is relatively more dominant at higher sites, whereas juniper is relatively more dominant at lower sites. To examine how this pattern of dominance might emerge with time, we plotted the position of centroids for three pinyon and juniper size classes along the first CCA axis. We found that small pinions and junipers were distributed relatively uniformly across the gradient, whereas large pinions and junipers were strongly segregated along the gradient, with intermediate-sized pinions and junipers intermediate on the CCA axis between small and large. This produced a pattern of increased divergence between the two species that increased with size. We suggest that this pattern emerges as a result of differential mortality between the species rather than as a result of differences in seedling establishment along the gradient. These differences between the species could result from differences in resource use (i.e., physiology) and resource acquisition (i.e., rooting patterns relative to plant available water). We present a conceptual model of how differences between the species in resource acquisition increase with size (age). We suggest that differences in resource acquisition between species, which increase as individuals mature, may play a greater role in determining species dominance along resource gradients than has been previously appreciated.

34. McDaniel, Kirk C. Juniper control with soil-applied herbicides . New Mexico State University Agricultural Experiment Station Bulletin 772. 1995; 77219.

Keywords: *Juniperus monosperma*/ tebuthiuron/ herbicides/ New Mexico/ picloram/ hexazione

Call Number: 100 N465 (1) no. 772

Abstract: Various herbicides active through the soil and plant roots were applied on juniper woodlands in New Mexico to determine effects on the trees and associated shrubs. Tebuthiuron pellets applied by an airplane at a 0.8 lb active ingredient (a.i. /ac) rate killed about 76 % of one-seed juniper (*Juniperus monosperma*) growing on sand or loamy sand, whereas 1.5 lb a.i./ac was needed to control the trees on loam or clay soils. Picloram pellets controlled one-seed juniper at a 2.0 lb a.i./ac rate on sandy and loam soils, but did not kill a high percentage of the trees on clay loam soils.. Where pinyon (*Pinyon edulis*) grew with juniper, more than 50% of the trees were killed with 1.0 lb a.i./ac of tebuthiuron and 0.8 lb a.i./ ac of picloram. Wavyleaf oak (*Quercus undulata*), sand sagebrush (*Artemisia filifolia*), skunkbush (*Rhus trilobata*), and algerita (*Berberis* spp.) were controlled by tebuthiuron at 0.8 a.i./ac, but were not controlled by picloram. Higher rates of tebuthiuron and picloram applied as a broadcast or individual plant treatment were needed to control trees and shrubs on deep, fine-textured soils than on shallow, coarse-textured soils. Trees less than 10 ft tall were usually more readily controlled than larger trees. Hexazone applied at 4 ml per 3 ft of height or canopy diameter was more effective than tebuthiuron or picloram for individual plant control, but because the herbicide damages grasses it should not be used as a broadcast treatment.

35. Meagher, G. S. Reaction of pinyon and juniper seedlings to artificial shade and supplemental water. *Journal of Forestry*. 1941; 41:480-482.
Keywords: *Juniperus monosperma/ Juniperus idahoensis/ Pinus edulis/* seeds/ germination/ drought/ artificial shade
Abstract: Pinyon and juniper seeds were planted in four locations for each species and received supplemental watering, artificial shade, and a combination of these treatments. Total germination for the four treatments was normal for the species. Shading, watering, and both treatments together speeded up germination as much as a month for *Pinus edulis* and *Juniperus monosperma*. Seedling mortality was caused by frost heaving and drought. Watering and shade reduced these effects on pinyon and one-seed juniper. Utah juniper (*Juniperus idahoensis*) was not killed by frost but was affected by drought. Greatest survival and growth of all species was under combined water and shade treatments. There was no survival on the control plots.
36. Nunez-Hernandez, G.; Holechek, J. L.; Wallace, J. D.; Galyean, M. L.; Tembo, A.; Valdez, R., and Cardenas, M. Influence of native shrubs on nutritional status of goats nitrogen retention . *Journal of Range Management*. 1989; 42(3):28-232.
Keywords: *Juniperus monosperma/* one-seed juniper/ goats/ nitrogen/ *Artemisia tridentata/ Ceratoides lanata/ Atriplex canescens/ Quercus*
Abstract: In vivo digestibility trials were conducted to evaluate the influence of shrubs containing low and high levels of soluble

phenolic/tannins on digestibility and nitrogen retention by Angora goats. Each of 6 shrubs and alfalfa hay (*Medicago sativa* L.) were fed to goats at 30% (dry matter basis) of the diet in a barley straw-prairie hay mixture. The mixture was regulated so that all diets contained about 8% crude protein. High soluble phenolic shrubs used included big sagebrush (*Artemisia tridentata* Nutt. ssp. *tridentata*), gray oak (*Quercus grisea* Liebm.), true mountain mahogany (*Cercocarpus montanus* Raf.), and one-seed juniper (*Juniperus monosperma* [Engelm.] Sarg). Low-soluble phenolic species included common winterfat (*Ceratoides lanata* [Pursh.], J.T. Howell), fourwing saltbrush (*Atriplex canescens* [Pursh.], Nutt.), and alfalfa. Nitrogen digestibilities of winterfat, gray oak, mountain mahogany and one-seed juniper diets were less ($P < .05$) than the alfalfa control, but big sagebrush did not differ ($P > .05$) compared with the alfalfa control. Retained nitrogen (g/d) differed ($P < .05$) only among alfalfa, juniper, and mountain mahogany diets. Goats fed juniper had greater ($P < 0.05$) retained nitrogen than the alfalfa control. Shrubs high in soluble phenolics, with the exception of big sagebrush, had elevated fecal nitrogen losses, but reduced urinary nitrogen losses compared with the alfalfa control. Forage organic matter intake (% body weight) and nitrogen intake (g/d) were correlated more highly with nitrogen retention than dietary crude protein (%) or digestible protein (%). Present data indicate that protein found in palatable native shrubs is assimilated with similar efficiency to that in alfalfa hay if these shrubs are consumed at moderate levels.

37. O'Brien, J. V. and Fisher, J. T. Seed handling and germination of New Mexico native junipers. HortScience. 1980; 15(3, II):396-397; ISSN: 0018-5345.
Keywords: *Juniperus osteosperma*/ *Juniperus monosperma*/ seeds/ growth regulators
Abstract: Seed of *Juniperus monosperma* and *J. osteosperma*, harvested in 1978 and 1979, was used to determine optimal harvest dates and criteria for seed maturity. Seeds were imbibed, stratified and germinated using different time, temp. and light treatments in the laboratory. They were also soaked in solutions of GA₃, kinetin, H₂O₂ and ethephon to increase germination and reduce stratification requirements. Results showed that germination can be increased by carefully chosen harvest and pre-germination practices.
38. Reid K. D.; Wilcox B. P.; Breshears D. D., and MacDonald L. Runoff and erosion in a pinon-juniper woodland: influence of vegetation patches. Soil Science Society of America Journal. 1999; 63(6):1869-1879.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ New Mexico/ erosion/ vegetation
Abstract: In many semiarid regions, runoff and erosion differ according to vegetation patch type. These differences, although hypothesized to fundamentally affect ecological processes, have been poorly quantified. In a semiarid pinon-juniper woodland (*Pinus edulis* and *Juniperus*

monosperma) in northern New Mexico, USA, we measured runoff and erosion from the three patch types that compose these woodlands: canopy patches (those beneath woody plants), vegetated patches in intercanopy areas, and bare patches in intercanopy areas. The bare intercanopy patches exhibited the highest rates, followed by vegetated intercanopy patches and then by canopy patches. Large convective summer storms, though relatively infrequent, generated much of the runoff and most of the sediment; prolonged frontal storms were capable of generating considerable runoff but little sediment. A portion of the runoff and most of the sediment generated from bare intercanopy patches was redistributed downslope, probably to adjacent vegetated intercanopy patches, demonstrating connectivity between these two patch types. Our results indicate that there are significant and important differences in runoff and sediment production from the three patch types; that bare intercanopy patches act as sources of both water and sediment for the vegetated intercanopy patches; and that the transfer of water and sediment at small scales is both frequent enough and substantial enough to be considered ecologically significant.

39. Riffle, J W. Effect of certain nematodes on the growth of *Pinus edulis* and *Juniperus monosperma* seedlings. *Journal of Nematology*. 1972; 4(2):91-94; ISSN: 0022-300X.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ nematodes/ *Rotylenchus*/ *Tylenchus*/ *Xiphinema*/ *Hoplolaimus*/ *Tylenchorhynchus*/ *Aphelenchoides*/ *Criconemoides*
Abstract: Seedlings of *P. edulis* and *J. monosperma* were inoculated separately with each of 7 nematode species and grown for 9 months. Soil temperature was maintained at 20 deg C. *Rotylenchus pumilis*, *Tylenchus exiguus*, *Xiphinema americanum* and *Hoplolaimus galeatus* parasitized *P. edulis* seedlings but did not significantly reduce plant growth. *P. edulis* was not a host for *Tylenchorhynchus cylindricus*, *Aphelenchoides cibolensis* or *Criconemoides humilis*. Root weights and root-collar diameters of *J. monosperma* seedlings were reduced by *X. americanum* and *R. pumilis* but were not affected by *A. cibolensis* and *T. exiguus*. The relation between *J. monosperma* and *T. cylindricus* and *C. humilis* was uncertain.
40. Rosenstock S. S. and Riper C. III van. Breeding bird responses to juniper woodland expansion. *Journal of Range Management*. 2001; 54(3):226-232.
Keywords: *Juniperus monosperma* / *Pinus*/ habitat selection/ plant colonization/ woodlands/ birds
Abstract: In recent times, pinyon (*Pinus* spp.)-juniper (*Juniperus* spp.) woodlands have expanded into large portions of the southwest historically occupied by grassland vegetation. From 1997-1998, we studied responses of breeding birds to one-seed juniper (*J. monosperma*) woodland expansion at 2 grassland study areas in northern Arizona, USA. We

sampled breeding birds in 3 successional stages along a grassland-woodland gradient: un-invaded grassland, grassland undergoing early stages of juniper establishment, and developing woodland. Species composition varied greatly among successional stages and was most different between endpoints of the gradient. Ground-nesting grassland species predominated in uninvaded grassland but declined dramatically as tree density increased. Tree- and cavity-nesting species increased with tree density and were most abundant in developing woodland. Restoration of juniper-invaded grasslands will benefit grassland-obligate birds and other wildlife.

41. Salomonson and Michael. Adaptations for Animal Dispersal of One-Seed Juniper Seeds . *Oecologia*. 1978; 32(3):333-339; ISSN: 0029-8549.
Keywords: *Juniperus monosperma*/ juniper/ one-seed/ seeds/ dispersal patterns/ germination/ zoochory/ pinon-juniper woodlands/ birds/ Townsend's Solitaires
Call Number: QL750.03
Abstract: Distributional patterns of one-seed juniper seeds and seedlings show that most seeds are found directly beneath source trees but most seedlings are found away from the source sites. Thus, seeds dispersed away from source trees seem to have a better chance of germination and growth than seeds beneath source trees. Seed distributions patterns indicate haphazard animal dispersal rather than directional dispersal by water runoff or gravity. One-seed juniper appears to have adaptations favoring zoochory over other types of dispersal methods. Seeds are not well protected from animals but are presented in an attractive, abundant, easily accessible and nutritious fruit. Fruit ripening occurs just before the arrival of avian winter residents in the pinon-juniper woodlands. Several of these species are potential dispersal agents. Seeds passed through the intestines of Townsend's Solitaires showed lowered germination compared to untreated seeds but these birds are probably good dispersers.
42. Samuels, M. L. and Betancourt, J. L. Modeling the long-term effects of fuelwood harvests on pinyon-juniper woodlands. *Environmental Management*. 1982; 6(6):505-515.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ fuel harvesting/ cords/ woodlands
Abstract: A computer program (FORMAN I), written in FORTRAN IV is described, which models prolonged fuel harvesting and its effects, with particular reference to the southeastern USA. The technique is suitable for historical analyses. As an example, the effects are simulated of prehistoric people on a marginal *Pinus edulis*/ *Juniperus monosperma* woodland in Chaco Canyon, New Mexico. Results showed that a low density woodland (less than 14.8 cords/ha) would have been completely depleted within 200 yr when subjected to 10-12th century estimates of human demography for the canyon. The lack of pinyon/juniper recovery over the last thousand years is remarked and traditional assumptions about the pristine state of

vegetation before Anglo-European settlement and subsequent invasion of marginal grasslands by pinyon and juniper are questioned.

43. Schott, M. R. and Pieper, R. D. Influence of canopy characteristics of one-seed juniper on understory grasses. *Journal of Range Management*. 1985; 38(4):328-331.
Keywords: *Juniperus monosperma*/ *Piptochaetium fimbriatum*/ understory/ New Mexico/ grass/ basal area/ canopy cover/ litter depth.
Abstract: The influence of *Juniperus monosperma* canopy on understory vegetation was determined in the Sacramento mountains, New Mexico. The basal area of grass spp. was estimated at 6 sites beneath each of 50 *J. monosperma* trees. Litter depth, canopy height, cover and closure, tree height, trunk diam. and, N.-S. and E.-W. crown diam. were measured. Sites adjacent to the trunk had greatest canopy cover and litter depth and lowest height to canopy. Sites at the canopy edge had least crown cover and litter depth, and greatest height to canopy. Most grass spp. had the greatest basal areas at edge sites and the least at interior sites beneath the canopy. *Piptochaetium fimbriatum* was never found at exterior sites. Regression models indicated that shading influenced the basal areas of most grass spp. Litter depth was negatively correlated with grass basal cover in 4 models and positively correlated in one model. Basal area of *P. fimbriatum* was positively correlated with *J. monosperma* trunk diam. and canopy cover.
44. ---. Succession of pinyon-juniper communities after mechanical disturbance in south-central New Mexico. *Journal of Range Management*. 1987; 40(1):88-94.
Keywords: *Juniperus deppeana*/ *Pinus edulis*/ *Juniperus monosperma*/ secondary succession/ mechanical disturbance/ New Mexico
Abstract: Principal component analysis was used to interpret secondary succession, recorded in summer 1982-83 on sites in *Pinus edulis*/*Juniperus monosperma* and *P. edulis*/*J. deppeana* stands that had been cabled during 1950-75. Soil types were used to separate 93 sample units into 3 groups. Grasses on the deeper soils usually increased after cabling, but after 25 yr had declined to near pretreatment cover. *Quercus undulata* increased after cabling and, on older cablings, equaled or exceeded coverage on undisturbed sites. After approx. 28 yr, pinyons and junipers started suppressing the oak and became dominant. If the stand was near climax before cabling, pinyons rapidly became dominant. If the stand was seral, there would be more junipers, but their slow growth and maturation increased the time before they dominated the site. The successional pattern following cabling on relatively deep soils was similar to, but faster than, that after fire. Cover of grasses and shrubs increased more on soils without rocks. The ordinations indicated that succession in pinyon/juniper communities is directional and leads towards climax with a decrease in variability between sites.

45. Severson K E [Reprint author]. Woody plant reestablishment in modified pinyon-juniper woodlands New Mexico USA. *Journal of Range Management*. 1986; 39(5):438-442.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ *Juniperus deppeana*/ pinyon-juniper woodlands/ *Quercus*/ *Cercocarpus*/ New Mexico
Abstract: Pinyon (*Pinus edulis* Engelm.), one-seed juniper (*Juniperus monosperma* (Engelm.) Sarg.), and alligator juniper (*J. deppeana* Steud.) woodlands in southwestern New Mexico were thinned, were pushed with bulldozers leaving slash in place, and were pushed and then slash piled and burned. There were no significant differences ($P > 0.05$) in densities of these trees 13 and 18 years later between untreated (379 trees/ha) and thinned (489 trees/ha) plots or between pushed/left (67 trees/ha) and pushed/piled/burned plots (49 trees/ha). Differences between bulldozed treatments and untreated/thinned treatments were significant ($P < 0.05$). Total shrubs, 75% of which were gray oak (*Quercus grisea* Liebm.) and hairy mountain mahogany (*Cercocarpus breviflorus* Gray), were significantly more abundant in untreated areas (672 shrubs/ha), than in any of the treatments. No differences were noted among treatments (493, 393, 329 shrubs/ha for thinned, pushed/left, and pushed/piled/burned, respectively). Rates of pinyon reestablishment increased slowly up to the mid-1969's (from 1.1 to 1.3 trees/ha/year) then accelerated to 10 to 13 trees/ha/year. Pinyon and juniper densities were about 120 trees/ha when reestablishment rates increased.
46. Severson K E [Reprint author] and Hayward B J [Author]. Rodent weights in modified pinyon-juniper woodlands of southwestern New Mexico USA. *Great Basin Naturalist*. 1988; 48(4):554-557.
Keywords: *Juniperus monosperma*/ New Mexico/ pinyon-juniper woodlands/ rodents/ *Pinus edulis*
Abstract: Changing habitat structure in pinyon (*Pinus edulis*)-one-seed juniper (*Juniperus monosperma*) stands by (1) pushing trees down with a bulldozer and leaving them in place, (2) pushing, then piling and burning slash, or (3) thinning to a spacing of 6.1 m and leaving slash did not affect weights of individuals of nine rodent species. Previous studies have shown that habitat modifications influence kinds of species and numbers of individuals, but changes in total rodent biomass are a function of sizes of different species occupying different habitats, not changes in weights of individuals.
47. Smith, F. W. and Schuler, T. Yields of southwestern pinyon-juniper woodlands. *Western Journal of Applied Forestry*. 1988; 3(3):70-74.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ *Juniperus osteosperma*/ growth/ density/ site index/ site class assessment/ increment.
Abstract: Measurements of site quality, growth/growing stock relations, and estimations of yields were made in plots in 129 woodlands at 1400-2300 m alt. (each variable-sized plot with 30-40 live and dead trees >2.5

cm diam. at stump height) throughout the southwestern forests of pinyon pine (*Pinus edulis*), one-seed juniper (*Juniperus monosperma*) and Utah juniper (*J. osteosperma*). Pinyon and juniper p.a.i., taken separately, were highly correlated with stand density and pinyon site index; pinyon was twice as productive as juniper at similar stand densities. Average yields for woodlands of average density and site index were 0.29 and 0.15 m³/ha per yr, respectively, for pinyon and juniper; at high densities yields increased to 0.61 and 0.31 m³/ha per yr. Maximum yield of dense mixed species woodland was 0.78 m³/ha per yr, where pinyon made up 65%.

48. Stimson H. C.; Breshears D. D.; Ustin S. L., and Kefauver S. C. Spectral sensing of foliar water conditions in two co-occurring conifer species: *Pinus edulis* and *Juniperus monosperma*. Remote Sensing of Environment. 2005; 96(1):108-118.

Keywords: *Juniperus monosperma*/ *Pinus edulis*/ image analysis/ leaf water potential.

Abstract: Many fundamental ecosystem properties and dynamics are determined by plant water stress, particularly in dryland ecosystems where water is usually limiting. Indeed, under severe drought, plant water stress and associated insect infestations can produce landscape-scale mortality. Despite the fundamental importance of plant water stress in determining properties and dynamics at ecosystem and landscape scales, approaches for remote sensing plant water stress are largely lacking, particularly for conifers. We evaluated the remotely sensed detection of foliar drought stress in two conifer species, *Pinus edulis* and *Juniperus monosperma*, which are co-dominants of extensive-juniper woodlands in northern New Mexico, USA, the first of which experienced extensive mortality in association with a recent drought. Needle spectra were made on these species in the field using an integrating sphere and portable spectrometer. Two indices of foliar water condition, plant water content (% of dry mass) and plant water potential, were compared to five spectral analyses: continuum removal of the 970 and 1200 nm water absorption features, the Normalized Difference Water Index (NDWI), the Normalized Difference Vegetation Index (NDVI), and the red edge wavelength position. For *P. edulis*, plant water content was significantly correlated with four of the five indices: NDVI (R²=0.71) and NDWI (R²=0.68) which exhibited stronger relationships than 970 nm continuum removal (R²=0.57) or red edge position (R²=0.45). All five indices were significantly correlated with *P. edulis* water content when trees undergoing mortality were included in analyses (R²=0.60-0.93). Although the correlations were weaker than for plant water content, plant water potential was significantly correlated with NDWI (R²=0.49), 970 nm (R²=0.44), NDVI (R²=0.35), and red edge (R²=0.34); again all five indices had significant relationships when trees undergoing mortality were included (R²=0.51-0.86). The relationships were weaker for *J. monosperma*: water content was significantly related to 970 nm (R²=0.50) and 1200 nm (R²=0.37) continuums and NDVI (R²=0.33),

while water potential was related only to 1200 nm ($R^2=0.40$). Our results demonstrate a critical link between plant physiological characteristics tied to water stress and associated spectral signatures for two extensive co-occurring conifer species.

49. Tonnesen, Alex S. Author and Ebersole, James J. Reprint author. Human trampling effects on regeneration and age structures of *Pinus edulis* and *Juniperus monosperma*. Great Basin Naturalist. 1997; 57(1):50-56.
Keywords: *Juniperus monosperma*/ *Pinus edulis*/ seedlings/ one-seed juniper/ reproduction/ Colorado
Abstract: We examined effects of human foot traffic on age structures and densities of seedlings and saplings of *Pinus edulis* (Colorado pinyon) and *Juniperus monosperma* (one-seed juniper) in a heavily used urban park, Garden of the Gods, Colorado. Age structures show no stand-destroying disturbances, but they do contain small peaks 85-95 yr ago (minimum age), which have been interpreted as responses to heavy grazing. For *Pinus edulis* reverse J-shaped age structures indicate a strongly reproducing population, while flat age structures of *J. monosperma* show low present reproduction. Young trees showed strong preferences for establishing under existing trees and shrubs and not among herbs or on blue soil. *Pinus edulis* seedling density was reduced by 73% in heavily trampled areas compared to lightly trampled areas. However, there were no differences in density when only the area protected by rocks, shrubs, or trees was considered. This indicates that direct effects such as physical damage and soil erosion kill young trees, and indirect effects, such as lower seed production, do not cause the lower densities in heavily trampled areas. *Pinus edulis* saplings and *J. monosperma* seedlings and saplings showed no differences in density across trampling intensities. In heavily trampled areas of Garden of the Gods Park, recent increases in use have apparently reduced *Pinus edulis* seedling establishment enough that long-term regeneration is threatened. Managers of all pinyon-juniper woodlands must recognize that in areas strongly impacted by foot traffic, and also presumably by similar disturbances such as vehicle traffic, sufficient regeneration likely does not occur to replace trees. The areal extent of severely disturbed areas should be limited, and managers should seek to avoid further degradation of less damaged areas.
50. van Ommen, R. J. and Whitham, T. G. Changes in interactions between juniper and mistletoe mediated by shared avian frugivores: parasitism to potential mutualism. *Oecologia*. 2002; 130(2):281-288.
Keywords: *Juniperus monosperma*/ *Phoradendron juniperinum*/ seed dispersal/ mutualism/ parasitism.
Abstract: Although mistletoe is typically viewed as a parasite of juniper in a two-way interaction, its role may become neutral or even mutualistic when their common avian seed dispersing agents are considered as a three-way interaction. In the study area, in Arizona, USA, wintering avian

frugivores forage on both one-seed juniper (*Juniperus monosperma*) berries and on the fruit of its associated mistletoe (*Phoradendron juniperinum*). Three major findings emerged from our studies that support a three-way interaction and the hypothesis of conditional interactions. First, mistletoes provide a stable resource for shared avian seed dispersers; junipers do not. Whereas juniper berry production varied 10- to 15-fold over the 3 years of our study, mistletoe fruit abundance did not vary significantly. Second, the abundance of avian seed dispersal agents, such as Townsend's solitaires (*Myadestes townsendi*), is strongly tied to the abundance of juniper berries in most years and mistletoe fruits in all years. In fact, the best overall predictor of their common avian seed dispersal agents was the abundance of mistletoe; stands with mistletoe attracted up to 3 times more avian frugivores than stands with little or no mistletoe. Thus, mistletoe berries can serve as the main attractor for birds that disperse juniper berries. Third, in agreement with the hypothesis that mistletoe can benefit junipers by attracting and supporting greater populations of avian seed dispersal agents, the number of juniper seedlings was more than 2-fold greater in stands with high mistletoe density compared with stands that had little or no mistletoe. Results suggest that the occurrence of a three-way interaction, in the presence of environmental variation (in this case, annual variation in juniper berry crops), may change the ecological roles of associated species. A conceptual model is presented to illustrate how the role of mistletoe may range from parasitic to mutualistic, while the role of avian seed dispersers may conversely range from mutualistic to parasitic, the latter by acting as vectors for the spread of mistletoe.

51. Wilcox B. P.; Breshears D. D., and Turin H. J. Hydraulic conductivity in a pinon-juniper woodland: influence of vegetation. Soil Science Society of America Journal. 2003; 67(4):1243-1249.

Keywords: *Juniperus monosperma*/ *Pinus edulis*/ hydraulic conductivity/ vegetation

Abstract: In semiarid environments, vegetation affects surface runoff either by altering surface characteristics (e.g., surface roughness, litter absorption) or subsurface characteristics (e.g., hydraulic conductivity). Previous observations of runoff within a pinon-juniper [*Pinus edulis* Englem. and *Juniperus monosperma* (Englem.) Sarg.] woodland led us to hypothesize that hydraulic conductivity differs between vegetation types. Using ponded and tension infiltrometers, we measured saturated (K_s) and unsaturated [$K(h)$] hydraulic conductivity at three levels of a nested hierarchy: the patch (canopy and intercanopy), the unit (juniper canopy, pinon canopy, vegetated intercanopy, and bare intercanopy), and the intercanopy locus (grass, biological soil crust, bare spot). Differences were smaller than expected and generally not significant. Canopy and intercanopy K_s values were comparable with the exception of a small number of exceedingly high readings under the juniper canopy - a difference we attribute to higher surface macroporosity beneath juniper

canopies. The unsaturated hydraulic conductivity, $K(h)$, values were higher for canopy soils than for intercanopy soils, although differences were small. At the unit level, the only significant differences were for $K(h)$ between juniper or pinon canopies vs. bare interspaces. Median K values for vegetated intercanopy areas were intermediate between but not significantly different from those for canopies and bare areas. There were no significant differences between grass, biological soil crust, and bare spots within the herbaceous intercanopy area. Overall, the observed differences in K between canopy and intercanopy patches do not account for differences in runoff observed previously.

52. Wilcox B. P.; Pitlick J.; Allen C. D., and Davenport D. W. Runoff and erosion from a rapidly eroding pinyon [*Pinus ponderosa*]-juniper [*Juniperus monosperma*] hill slope. *Advances in Hill slope Processes*. 1996; 161-77.
Keywords: *Juniperus monosperma*/ *Pinus ponderosa*/ runoff/ erosion/ New Mexico
Abstract: Results from 3 years investigations on water and sediment budgets in rapidly eroding semiarid woodlands, effects of present vegetation on changes in erosion processes, assessment of quantitative (and conceptual) relationship between runoff and erosion, and the scale of erosion in a catchment located in northern New Mexico, USA, are discussed.
53. With, K. A. and Morrison, M. L. Flock formation of two parids in relation to cyclical seed production in a pinyon-juniper woodland. *Auk*. 1990; 107(3):522-532.
Keywords: *Juniperus monosperma*/ pinyon-juniper woodland/ seed production/ parids/ seeds/ birds
Abstract: Cyclical production of seeds in a pinyon-juniper (*Pinus edulis*-*Juniperus monosperma*) woodland enabled us to assess the effects of resource abundance on the winter foraging ecology and flock formation of two avian seed predators, the Mountain Chickadee (*Parus gambeli*) and the Plain Titmouse (*P. inornatus*). During the low seed abundance (1986/1987), chickadees and titmice converged in microhabitat use. Chickadees exhibited a coarse-grain response by selectively foraging in areas with greater ponderosa pine (*Pinus ponderosa*) density during the winter of high seed production, but shifted to a fine-grained use of microhabitat during the following year by randomly foraging in different tree species. Titmice displayed a fine-grained response in microhabitat use irrespective of seed abundance, but foraged significantly more in ponderosa pine during the winter of low seed production (becoming more like chickadees in use of tree species). Conversely, foraging behavior was consistent between years, and the two species were separable based upon the use of juniper substrates (e.g. chickadees foraged more on juniper needles than titmice, titmice foraged more on the ground beneath juniper). The convergence in microhabitat use by chickadee and titmice during the winter of low seed abundance may be attributed to the

prevalence of mixed-species flocks. During the year of a mast seed crop, chickadees and titmice foraged singly or in pairs 80% of the time and were never observed together. Half of all individuals were observed in flocks the following year, and two thirds of flocking chickadees and nearly all (88%) gregarious titmice participated in mixed flocks. Monospecific flocks of chickadees used less juniper and foraged distinctly from titmice (e.g. probed more, pecked less, gleaned from an inverted position), but converged in these characteristics in the presence of titmice. Only two titmice ever occurred in mixed-species flocks, yet up to six chickadees formed these mixed-species flocks. Chickadees apparently join titmice, as substantiated by the observed shifts in foraging ecology by chickadees in the presence of titmice, and perhaps gain knowledge of resource locations from resident titmice (chickadees are potentially altitudinal migrants within our study areas). We observed an increase in sociality during periods of low seed abundance, which supports the proximate role of resource levels in promoting flock formation, but does not preclude the possibility that other factors that are a consequence of low resource abundance (e.g., decreased time available for vigilance) provide the primary impetus for flocking behavior.

54. Zanoni. T. A. and Adams. R. P. The genus *Juniperus* in Mexico and Guatemala: numerical and chemosystematic analysis. *Biochemical Systematics and Ecology*. 1976; 4(3):147-158.

Keywords: *Juniperus patoniana*/ *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus blancoi*/ *Juniperus scopulorum*/ plant composition/ terpenoids.

Abstract: The leaf constituents, mainly terpenoids, of each of the taxa of *Juniperus* in Mexico and Guatemala were analyzed by numerical taxonomic methods and the results compared with those of a previous study utilizing morphological characters. The two sets of data were generally in agreement on the major groups. Differences between more closely related species were more apparent with the chemical data. Four major groups were detected. The study confirmed the morphological data indicating that *J. patoniana* should be reduced to a variety of *J. deppeana*. No samples typical of *J. monosperma* were found in Mexico, and *J. monosperma* var. *gracilis* was not closely allied with *J. monosperma* from the USA, but had some uncertain affinities with species of the one-seeded complex. *J. blancoi* appears to be closely related to *J. scopulorum*.

***Juniperus monticola* (3)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section *Sabina*) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana*/ *Juniperus ashei*/ *Juniperus californica*/ *Juniperus coahuilensis*/ *Juniperus comitana*/ *Juniperus*

depeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/ essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. *Sabina*) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. depeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

2. Adams R. P. and Zanoni T. A. *Juniperus monticola* (*Cupressaceae*) revisited. *Taxon*. 1993; 42(1):85-86.

Keywords: *Juniperus monticola/ Juniperus sabinoides/ nomenclature*

Abstract: Following a reexamination of nomenclature, the correct name for the alpine *Juniperus* species of Mexico is *J. monticola* and not *J. sabinoides* (which is an illegitimate later homonym).

3. Azcarate J.G. and Escamilla M. The edaphic-xerophyllous community (junipers and bunchgrassland) in the mountains and Central Mexico. *Phytocoenologia*. 1999; 29(4):449-468.

Keywords: *Juniperus monticola/ Mexico/ Pinus hartwegii/ plant communities/ succession/ edaphic-xerophyllous*

Abstract: *Juniperus monticola* Mart. f. *compacta* and its human-induced bunchgrassland ('zacatonal') are distributed at the contact zone between *Pinus hartwegii* Lindl. forest and zonal bunchgrassland. These are found on rock outcrops. This azonal vegetation is dominated in physiognomy by prostrate *Juniperus* shrubs. In order to describe these plant communities, 74 relevés were surveyed in mountains located at the central zone of 'Eje Neovolcanico Transmexicano' namely: Nevado de Toluca, Sierra de las Cruces, Sierra Chichinautzin, Sierra Nevada and Malinche. The plant species classification analysis was carried out with the aid of TWINSPLAN. This classification showed significant differences between two relevé clusters. The first group is described under the Echeverio secundae-Juniperetum monticolae association; the second group is typified under the name, Gnaphalio lavandulaceae-Calamagrostietum tolocensis. The first association is dominated by *Juniperus monticola* and the second by tussock grasses and some chamaephytes. The present paper discusses the

following topics of each association: physiognomy, floristic composition, ecology, dynamics, syntaxonomy, variability and conservation. The floristic composition and successional stages were related to establish the vegetation series edaphic-xerophyllous in the orotropical *Juniperus* shrubs.

***Juniperus mucronata* (1)**

1. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. Acta Horticulturae. 2003; 61291-106.

Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.

Abstract: Several cases involving apparent discordance in morphological, chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var. *microsperma*, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var. *squamata*, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.

***Juniperus nana* (2)**

1. Rivas Martinez, S.; Navarro, G.; Mendiola, A., and Tarazona, T. Oromediterranean creeping juniper scrubs of the Iberico-Soriano sector, Spain). Lazaroa. 1985; 7535-547.
Keywords: *Juniperus nana*/ Spain/ conservation/ ecology
Abstract: Some ecological and conservation data are included regarding *Juniperus nana* communities.
2. Tinner, Willy Reprint author; Ammann, Brigitta Reprint author, and Germann, Peter Author. Treeline fluctuations recorded for 12,500 years by soil profiles, pollen, and plant macrofossils in the Central Swiss Alps. Arctic & Alpine Research. 1996; 28(2):131-147.
Keywords: *Juniperus nana*/ *Alnus viridis*/ *Picea abies*/ *Pinus cembra*/ pollen/ macrofossils/ Swiss Alps
Abstract: Past treelines can rarely be recorded by pollen percentages alone, but pollen concentration, pollen influx, and plant macrofossils

(including stomata of conifers) are more reliable indicators. In addition, ancient forest soils above today's treeline may trace the maximum upper expansion of the forest since the last glaciation. Charcoal in such soil profiles may be radiocarbon dated. Our example from the Central Swiss Alps at the Alps d'Essertse consists of a plant-macrofossil diagram and pollen diagrams of the pond Gouille Rion at 2343 m a.s.l. and a sequence of soil profiles from 1780 m to 2600 m a.s.l. The area around the pond was forested with *Larix decidua* and *Pinus cembra* between 9500 and 3600 BP. After 4700 BP the forest became more open and *Juniperus nana* and *Alnus viridis* expanded (together with *Picea abies* in the subalpine forest). Between 1700 and 900 BP the *Juniperus nana* and *Alnus viridis* scrubs declined while meadows and pastures took over, so that the pond Gouille Rion was definitively above timberline. The highest Holocene treeline was at 2400 to 2450 m a.s.l. (i.e. 50 to 100 m higher than the uppermost single specimen of *Pinus cembra* today) between 9000 and 4700 BP, but it is not yet dated in more detail. The highest charcoal of *Pinus cembra* at 2380 m a.s.l. has a radiocarbon date of 6010 ± 70 BR. Around 6900 BP a strong climatic deterioration caused an opening of timberline forest. First indicators of anthropogenic influence occurred at 4700 BP, when the forest limit started to move down. The lowering of timberline after 4700 BP was probably due to combined effects of human and climatic impact.

***Juniperus navicularis* (2)**

1. Adams R. P.; Morris J. A.; Pandey R. N., and Schwarzbach A. E. Cryptic speciation between *Juniperus deltoides* and *Juniperus oxycedrus* (*Cupressaceae*) in the Mediterranean. *Biochemical Systematics and Ecology*. 2005; 33(8):771-787.
Keywords: *Juniperus deltoides*/ *Juniperus oxycedrus*/ *Juniperus navicularis*/ *Juniperus macrocarpa*/ DNA sequencing/ genetic markers/ Europe/ Morocco/ Turkey
Abstract: Analyses of individuals classically treated as *Juniperus oxycedrus* L. var. *oxycedrus* from Morocco, Portugal, Spain, France, Italy, Greece and Turkey, using DNA sequencing of nrDNA (ITS 1, 5.8S, ITS 2) plus RAPDs, leaf terpenoids and morphology revealed that two cryptic, genetically distinct but morphologically almost identical species are present. These species, *J. oxycedrus* L. var. *oxycedrus* and *Juniperus deltoides* R.P. Adams, are about as different from each other as *Juniperus navicularis* and *Juniperus macrocarpa* are from *J. oxycedrus* var. *oxycedrus*. Examination of herbarium specimens revealed that the two species are largely allopatric with *J. deltoides* occurring from Italy eastward through Turkey into the Caucasus Mts. and Iran. *J. oxycedrus* var. *oxycedrus* appears to be largely concentrated west of Italy (France, Spain, Portugal, Morocco). Cryptic speciation is discussed.
2. Velasco-Negueruela A.; Perez-Alonso M. J.; Pala-Paul J.; In-igo A., and Lopez G. Leaf essential oils analysis of *Juniperus navicularis* Gandoger. *Botanica*

Complutensis. 2002; 2685-91.

Keywords: *Juniperus navicularis*/ Portugal/ essential oil

Abstract: The steam distilled oil obtained from the leaves of *Juniperus navicularis* Gand., gathered in SW Portugal was analyzed by CG and GC/MS in combination with retention indices. The oil was shown to contain α -pinene (30,8%), α -phellandrene (11,1%) and limonene + β -phellandrene (27,2%) as major constituents. Other characteristic compounds were cadinanes + muurolanes (2,7%). In addition to these components, (E)-nerolidol (4.8%) and α -epi-bisabolol (0,6%) were also present.

***Juniperus occidentalis* (58)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana*/ *Juniperus ashei*/ *Juniperus californica*/ *Juniperus coahuilensis*/ *Juniperus comitana*/ *Juniperus deppeana*/ *Juniperus durangensis*/ *Juniperus flaccida*/ *Juniperus gamboana*/ *Juniperus jaliscana*/ *Juniperus monosperma*/ *Juniperus monticola*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Juniperus pinchotii*/ *Juniperus saltillensis*/ *Juniperus standleyi*/ essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

2. Anthoni P. M.; Law B. E.; Unsworth M. H., and Vong R. J. Variation of net radiation over heterogeneous surfaces: measurements and simulation in a juniper-sagebrush ecosystem. *Agricultural and Forest Meteorology*. 2000; 102(4):275-286.

Keywords: *Juniperus occidentalis*/ *Artemisia*/ measurement/ carbon dioxide/ energy exchange

Abstract: As part of a larger study of carbon dioxide and energy exchange, energy components in an open-canopied juniper-sagebrush

(*Juniperus occidentalis*-*Artemisia tridentata*) ecosystem located in the semi-arid region of Eastern Oregon were measured with the eddy covariance technique. Daytime net radiation averaged 20-30% greater than the sum of sensible, latent and soil heat fluxes. On cloudless days several days after a rain event the imbalance was $\sim 200-250 \text{ W m}^{-2}$. At such times, differences between the surface radiation temperatures of soil and foliage were large, and we investigated whether such differences may generate systematic errors in the measurement of net radiation. A point measurement of net radiation above an open-canopied forest ecosystem is uncertain, because vegetation structure around the measurement location can be highly variable. Depending on location, various fractions of the upwelling radiation from the soil are intercepted by vegetation and do not reach the radiometer. To determine the magnitude of this uncertainty, we measured tree locations and dimensions, and surface radiation temperature (T_r) and short-wave reflection coefficients (α) of soils and vegetation in a 100 by 100 m area. Geometrical models generated by ray tracing and rendering software were used to calculate the upwelling radiation that would reach radiometers placed at random locations above the surface. In summer, under cloudless skies the measured radiative surface temperatures of soil and vegetation varied considerably, from a mean of 56° C for sunlit soil to 25° for shaded soil, and $27-29^\circ \text{ C}$ for sunlit and shaded vegetation (trees and shrubs). The mean short-wave reflection coefficient varied little between components (with $\alpha_v=0.10$ for vegetation and $\alpha_s=0.13$ for soil). Spatial variability in upwelling radiation (R_u) arises mainly from component variability at viewing angles from $\sim 30^\circ$ to $\sim 60^\circ$, where contributions to R_u are large and variation in fractional cover between radiometer locations is large. Our measurements and modeling suggest that a radiometer deployed from a tower in a small clearing will only be affected slightly by the clearing since only about 10% of R_u arises from viewing angles less than 15° (directly below the radiometer). The spatial variation in the upwelling radiation reaching a sensor above the canopy increases with increasing differences between the radiation temperatures and reflection coefficients of the various ecosystem components. For the radiative properties found at our site, where the radiative temperature of sunlit soil was $\sim 30^\circ \text{ C}$ larger than the temperature of vegetation and shaded components, the spatial variability in the longwave upwelling radiation (R_{lu}) was less than 20 W m^{-2} . The spatial variation in the short-wave upwelling radiation (R_{su}) for the small differences in the reflection coefficient of the ecosystem components was less than 10 W m^{-2} . Consequently, the uncertainty associated with estimating the available energy from a single point measurement of net radiation is not enough to explain the lack of energy closure ($200-250 \text{ W m}^{-2}$) in this complex open-canopy ecosystem.

3. Azuma, David L. Reprint author and Bednar, Larry Author. A method for evaluating fixed-radius plot size when sampling western juniper seedlings and saplings. *Western Journal of Applied Forestry*. 2002 Oct; 17(4):207-

208.

Keywords: *Juniperus occidentalis*/ western juniper/ Oregon/ seedlings/ sampling

Abstract: This note outlines a method for evaluating plot size selection for an inventory of western **juniper** woodlands in eastern Oregon. The Forest Inventory and Analysis (FIA) program of the USDA Forest Service in Portland, Oregon, used this method to evaluate several plot sizes to measure **seedlings** and saplings in the 1998 inventory of eastern Oregon. By choosing a 5 m radius plot, the probability of tallying no **seedlings** or saplings on four subplots is less than 10% for the three sample densities (0.01, 0.02, and 0.03 trees/m²) used.

4. Bates, J. D.; Miller, R. F., and Svejcar, T. Long-term successional trends following western juniper cutting. *Rangeland Ecology & Management*. 2005; 58(5):533-541.

Keywords: *Juniperus occidentalis*/ succession/ cutting

Abstract: Western juniper (*Juniperus occidentalis* spp. *occidentalis* Hook.) expansion into sagebrush steppe plant communities in the northern Great Basin has diminished shrub-steppe productivity and diversity. Chainsaw cutting of western juniper woodlands is a commonly applied practice for removing tree interference and restoring understory composition. Studies reporting understory response following juniper cutting have been limited to early successional stages. This study assessed successional dynamics spanning 13 years following tree cutting. Total herbaceous standing crop and cover increased significantly in the CUT. Total standing crop was 10 times greater in the CUT vs. WOODLAND. Herbaceous standing crop and cover, and densities of perennial grasses in the CUT did not change between 1996 and 2004 indicating that by the 5th year after cutting, remaining open areas had been occupied. In the early successional stages, perennial bunchgrasses and Sandberg's bluegrass were dominant. By the 5th year after treatment, cheatgrass had supplanted Sandberg's bluegrass and was codominant with perennial bunchgrasses. In 2003 and 2004, perennial bunchgrasses dominated herbaceous productivity in the CUT, representing nearly 90% of total herbaceous standing crop. A pretreatment density of 2-3 perennial bunchgrasses m² appeared to be sufficient to permit natural recovery after juniper control. Perennial bunchgrass density peaked in the 6th year after treatment and the results suggested that 10-12 plants m² were sufficient to fully occupy the site and dominate herbaceous composition in subsequent years. In the CUT, juniper rapidly reestablished from seed and from the presence of seedlings not controlled in the initial treatment. The shifts in herbaceous composition across years suggests that long term monitoring is important for evaluating plant community response to juniper control and to develop appropriate post treatment management to promote continued site improvement.

5. ---. Understory patterns in cut western juniper (*Juniperus occidentalis* spp.

occidentalis Hook.) woodlands. Great Basin Naturalist. 1998; 58(4):363-374.

Keywords: *Juniperus occidentalis*/ cutting/ understory/ shrub steppe/ woodlands

Abstract: Western juniper (*Juniperus occidentalis* subsp. *occidentalis*) has rapidly expanded into shrub steppe communities in the Intermountain Northwest (USA) during the past 120 years. Cutting juniper is a management tool used to restore shrub steppe communities. This study assessed distribution patterns of understory plants over 2 growing seasons after tree cutting in a western juniper woodland in SE Oregon, USA. Cover, density, and diversity of understory species were compared among 3 locations: interspaces, duff zones (previously under tree canopies), and debris zones (beneath cut trees). Plant cover and density increased in all zones following tree cutting. Understory vegetation in cut woodlands exhibited strong zonal distribution. Cover and density of *Poa sandbergii* and *Sitanion hystrix* [*Elymus elymoides*] and canopy cover of annual forbs were greatest in duff zones ($P < 0.05$). Density and cover of other perennial grasses and total densities of perennial forbs and annual forbs were greatest in interspaces ($P < 0.05$). Debris zones tended to have the lowest overall understory cover and plant density values. Under juniper debris, many species common to interspaces were reduced in density, although plants that survived or established beneath debris grew larger than their counterparts in interspaces. Species that increased in density and cover under debris were plants characteristic of duff zones and whose seeds are typically wind dispersed.

6. Bates, J. D.; Miller, R. F., and Svejcar, T. J. Understory dynamics in cut and uncut western juniper woodlands. Journal of Range Management. 2000; 53(1):119-126.

Keywords: *Juniperus occidentalis*/ plant succession/ cutting/ understory

Abstract: Expansion of western juniper (*Juniperus occidentalis* spp. *occidentalis*) woodlands in the sagebrush steppe has the potential to change composition, structure, and productivity of understorey vegetation. Cutting of western juniper woodland can potentially restore understory productivity and diversity. Understory responses were assessed after cutting a juniper woodland in southeastern Oregon in 1991. The experimental design was a randomized complete block with eight, 0.8 ha sized blocks and 2 treatments, cut and uncut woodland. Understory cover, density, diversity, biomass, and nitrogen (N) status were compared between treatments after cutting. Plants were separated into 5 functional groups: bluegrass (*Poa scabrella* and *P. sandbergii*), perennial bunchgrass (*Elymus spicatus*, *E. cinereus*, *Koeleria cristata*, *Oryzopsis hymenoides*, *Sitanion hystrix* [*Elymus elymoides*], *Stipa thurberiana*), perennial forb, annual forb, and annual grass (*Bromus japonicus* and *B. tectorum*). Cutting of juniper reduced belowground interference for soil water and N. Leaf water potentials were less negative and understorey N concentration

and biomass N were greater in the cut versus woodland treatment. Cutting of juniper trees was effective in increasing total understorey biomass, cover, and diversity. In the second year post-cutting total understorey biomass and N uptake were nearly 9 times greater in cut versus woodland treatments. Perennial plant basal cover was 3 times greater and plant diversity was 1.6 times greater in the cut versus woodland treatments. In the cut, perennial bunchgrass density increased by 1 plant/ m² in both duff and interspace zones and bluegrass increased by 3 plants/ m² in interspaces. Plant succession was dominated by plants present on the site prior to juniper cutting suggesting that pre-treatment floristics may be useful in predicting early successional understorey response. Early plant dynamics on this site supports the multiple entrance point model of succession as perennial grasses and bluegrass made up the majority of total herbaceous biomass and cover.

7. Belsky, A. J. Viewpoint: western juniper expansion: is it a threat to arid northwestern ecosystems? *Journal of Range Management*. 1996; 49(1):53-59.
Keywords: *Juniperus occidentalis/ Pinus edulis/* expansion/ geographical distribution/ wildlife
Abstract: Many ranchers, rangeland managers and range scientists in the Pacific Northwest consider western juniper (*Juniperus occidentalis*) to be an invading weed that reduces water infiltration, dries up springs and streams, increases erosion, reduces biodiversity and reduces the quality and quantity of forage for livestock and wildlife species. Although there is little scientific evidence supporting most of these beliefs, they are currently being used as rationales for controlling juniper on public and private lands. Similar views were held about pinyon-juniper [*Pinus edulis-Juniperus*] woodlands in the Southwest and Great Basin from the 1940s to the 1960s, when efforts were also made to control woodland expansion. Pressures to control the further spread of western juniper and reduce its density to woodlands are increasing. Because of the paucity of information on the environmental effects of western juniper expansion in the Northwest, this paper primarily reviews evidence from earlier studies of pinyon-juniper woodlands in the Southwest and Great Basin. These studies rejected similar assumptions about the deleterious effects of pinyon-juniper expansion on ecosystem properties and call into question current rationales for controlling western juniper in the Northwest. These studies also suggest that while the expansion of juniper might alter species composition and decrease herbaceous biomass in grasslands and shrublands, they have few detrimental effects on stream flow, aquatic organisms, soil properties or wildlife habitat.
8. ---. Western juniper expansion: is it a threat to arid northwestern ecosystems? *Journal of Range Management*. 49/1. 1996. 53-59. 1996; 49(1):53-59.
Keywords: *Juniperus occidentalis/* woodlands/ Great Basin/ pinyon-juniper

Abstract: Many ranchers, rangeland managers, and range scientists in the Pacific Northwest consider western juniper (*Juniperus occidentalis*) to be an invading weed. Pressures to control the further spread of western juniper and reduce its density in woodlands are increasing. Because of the paucity of information on the environmental effects of western juniper expansion in the Northwest, this paper primarily reviews evidence from earlier studies of pinyon-juniper woodlands in the SW and Great Basin. These studies rejected assumptions about the deleterious effects of pinyon-juniper expansion on ecosystem properties and call into question current rationales for controlling western juniper in the NW. These studies also suggest that while the expansion of juniper might alter species composition and decrease herbaceous biomass in grasslands and shrublands, they have few detrimental effects on streamflow, aquatic organisms, soil properties, or wildlife habitat.

9. Bolsinger, C. L. California's western juniper and pinyon-juniper woodlands: area, stand characteristics, wood volume, and fence posts. Resource Bulletin Pacific Northwest Research Station, USDA Forest Service. (PNW-RB-166). 1989; PNW-RB-166:37 pp.

Keywords: *Juniperus occidentalis*/ *Pinus*/ vegetation types/ forest inventories

Abstract: Results are given of an inventory of western juniper (*Juniperus occidentalis*) and pinyon/juniper (*Pinus* spp./ *Juniperus* spp.) woodlands, including: area of woodland (with <more or =>10% tree cover) by type and owner; area of rangeland with scattered juniper and pinyon trees; wood volume by owner, species and tree size; juniper fence posts; tree and stand age distribution; and stand characteristics, including overstory and understory. Most trees were 50-100 yr old and in most areas there was a scarcity of trees <50 yr old. The total woody biomass is a sizable potential resource for many uses other than fuelwood and fence posts, although the economics of harvesting do not favor its use. About 143 million fence posts could be cut from juniper trees, sufficient for 400 000 miles of fence. The high cost of cutting posts from limby juniper trees makes commercial post operations marginal without a slight increase in the price of steel and pressure-treated wooden posts.

10. Britton C. M. and Sneva F. A. Effects of tebuthiuron on western juniper. Journal of Range Management. 1981; 34(1):30-32.

Keywords: *Juniperus occidentalis*/ *Artemisia*/ *Chrysothamnus*/ management/ environmental impact/ control.

Abstract: Plots in uniform stands of *Juniperus occidentalis occidentalis* in Oregon, with a sagebrush (mainly *Artemisia arbuscula*) shrub layer, were treated with aerial applications of 2 or 4 kg/ha a.i. tebuthiuron pellets in Oct. 1975. After 3 yr, only 22% of the juniper was killed by the 4 kg/ha treatment; forb species were significantly damaged. Individual applications to 160 trees at 20 or 40 g/tree a.i. tebuthiuron in 1976 killed 80-85% of the juniper less than 2 m tall. In eastern Oregon, a sagebrush-

bunchgrass community supporting western juniper was treated with aerial applications of 2 or 4 kg/ha (active ingredient) of tebuthiuron pellets. The treatments did not effectively control western juniper and caused appreciable damage to herbaceous vegetation. Individual tree applications of tebuthiuron at rates of 20 or 40 g a.i./tree killed most of the western juniper less than 2 m tall. A sagebrush-bunchgrass community supporting western juniper received aerial applications of tebuthiuron pellets at 2 or 4 kg a.i./ha. Western juniper (*Juniperus occidentalis* ssp. *occidentalis*) was not effectively controlled and appreciable damage was inflicted on the herbaceous vegetation. Green rabbitbrush (*Chrysothamnus viscidiflorus*) was virtually eliminated by the higher rate of tebuthiuron. Individual applications of tebuthiuron at 20 or 40 g a.i./tree killed most of the western juniper less than 2 m tall.

11. Burkhardt J. W. and Tisdale E. W. Causes of juniper invasion in south-western Idaho. *Ecology*. 1976; 57(3):472-484.
Keywords: *Juniperus occidentalis*/ *Artemisia tridentata*/ *Agropyron*/ *Festuca*/ synecology/ seeds/ succession/ fire.
Abstract: Invasion of western juniper (*Juniperus occidentalis*) into vegetation dominated by mountain big sage brush (*Artemisia tridentata*) and perennial bunchgrass (*Agropyron spicatum* and/or *Festuca idahoensis*) on the Owyhee Plateau of S.W. Idaho appears to be directly related to cessation of periodic fires. Evidence from adjacent climax juniper stands indicates that fires were frequent for at least several hundred years preceding white settlement. Fires have been much less frequent during the past century due to active fire control, development of roads and other fire barriers, and reduced fuel because of heavy grazing and a shift towards decreased precipitation. Physical and biotic factors affecting the establishment of juniper, seed dispersal mechanisms, and the fire history of the study area were investigated. Results indicated that range condition as such had a negligible effect on juniper establishment.
12. Calvin, C. L.; Wilson, C. A., and Varughese, G. Growth of longitudinal strands of *Phoradendron juniperinum* *Viscaceae* in shoots of *Juniperus occidentalis*. *Annals of Botany* (London). 1991; 67(2):153-162.
Keywords: *Juniperus occidentalis*/ western juniper/ *Phoradendron juniperinum*/ mistletoe
Abstract: To quantify the development of the mistletoe *Phoradendron juniperinum* within the branches of its host, *Juniperus occidentalis*, the growth of longitudinal (cortical) strands was measured. To begin, infections were classified positionally as either lateral (attached along sides of branches) or pseudoterminal (secondarily occurring at ends of branches). For both infection types five shoot dry weight classes were established, allowing comparisons of growth of longitudinal trends to shoot dry weight. For lateral infections of all weight classes longitudinal strands showed greater basipetal than acropetal growth. In early stages of seedling establishment endophytic system spread is emphasized over

shoot growth while in older plants shoot growth is emphasized; this feature is reflected in the dramatic decrease in spread/weight values over time. Comparisons between lateral and pseudoterminal infections of all weight classes revealed that lateral infections extend greater distances within host bark. The significantly lesser growth shown by the endophytic system of pseudoterminal infections suggests that they occupy positions providing better access to host water and minerals. Absorptive efficiency values were calculated by dividing shoot mass by the length and number of longitudinal strands. Viewed in this manner, the absorptive units (longitudinal strands with sinkers) of pseudoterminal infections are nearly three times as efficient as those of lateral infections. The determination of spread/weight and absorptive efficiency values represents a novel approach to endophytic system study that has applicability in physiological and ecological studies as well as in mistletoe-control methods.

13. Chojnacky, D. C. Pinyon-juniper volume equations for the central Rocky Mountain states. Research Paper, Intermountain Forest and Range Experiment Station, USDA Forest-Service. (INT-339). 1985; INT-339(I):27 pp.
Keywords: *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Pinus edulis*/ *Pinus monophylla*/ *Quercus*/ *Cercocarpus*/ woodland/ volume tables
Abstract: Equations and volume tables are presented for *Juniperus monosperma*, *J. scopulorum*, *J. osteosperma*, *J. occidentalis*, *Pinus edulis*, *P. monophylla*, *Quercus macrocarpa*, *Q. gambelii*, *Cercocarpus* spp. and a group of broadleaved species in pinyon/juniper woodland in Nevada, Idaho, Utah, Colorado, Wyoming and South Dakota.

14. Craig A. M.; Karchesy J. J.; Blythe L. L.; Gonzalez-Hernandez M. del P., and Swan L. R. Toxicity studies on western juniper oil (*Juniperus occidentalis*) and Port-Orford-cedar oil (*Chamaecyparis lawsoniana*) extracts utilizing local lymph node and acute dermal irritation assays. Toxicology Letters. 2004; 154(3):217-224.
Keywords: *Juniperus occidentalis*/ *Chamaecyparis lawsoniana*/ chemical composition/ essential oils/ human diseases.
Abstract: The essential oil extracts of western juniper oil (*Juniperus occidentalis*) and Port-Orford-cedar oil (*Chamaecyparis lawsoniana*) were evaluated for possible dermal toxic effects on mice and rabbits. Mice were tested for their response to both extracts utilizing a local lymph node assay. Western juniper oil extract at 0.5% and 5% concentrations did not show a stimulation index (SI) greater than normal (3.0); however, a 50% concentration did show a positive response at 3.3. Port-Orford-cedar oil extract did not show a positive response at concentrations of 0.5%, 5% or 50%. An acute dermal irritation study using rabbits had a primary irritation index (PII) of 3.3 with 100% Port-Orford-cedar oil extract. This was reduced to a PII of 0.625 when diluted 1:1 with olive oil. Undiluted

western juniper oil extract had a PII score of 2.7. While a 5.0% solution had a PII score of 0.3, a 0.5% solution of western juniper oil was a non-irritant. It would appear that animals bedded on wood shavings have contact with essential oils at concentrations far less than the 2% maximum by weight obtained by steam distillation extraction. These concentrations did not elicit a hypersensitivity response.

15. Dealy J. E.; Geist J. M., and Driscoll R. S. Western juniper communities on rangelands of the Pacific Northwest. Proceedings of the First International Rangeland Congress, Denver, Colorado, USA, August 14-18, 1978 [Hyder, DN Editor]. 1978; 201-204.
Keywords: *Juniperus occidentalis*/ fire suppression/ litter reduction/ grazing
Abstract: Aspects of the climate, soil and site characteristics and communities of *Juniperus occidentalis* var. *occidentalis* in central and SE Oregon and SW Idaho are summarized. Fire suppression and reduction of litter through heavy grazing have contributed to an increase in its distribution, and heavy grazing has probably contributed to its increased density. It is suggested that controlled burning of juniper-dominated ranges may be an effective way of diversifying habitats and increasing forage.
16. Doescher P S [Reprint author]; Eddleman L E [Author], and Vaitkus M R [Author]. Evaluation of soil nutrients pH and organic matter in rangelands dominated by western juniper. Northwest Science. 1987; 61(2):97-102.
Keywords: *Juniperus occidentalis*/ Oregon/ pH/ organic matter
Abstract: Establishment of western juniper (*Juniperus occidentalis* Hook) in sagebrush-steppe of central Oregon appears to have affected the distribution of total N, organic matter, Ca, K, and pH . Compared to interspace soils and soils under juvenile trees, soil Ca, K, and pH were significantly higher under mature trees. Highest concentrations of total N and organic matter were found in upper soil layers under juvenile canopies. Thus, invasion of western juniper changes mineral cycling in microenvironments beneath the canopy. Further, these changes occur in such a way as to apparently enhance the competitiveness of western juniper with other herbaceous vegetation.
17. Evans, R. A. Management of pinyon-juniper woodlands. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-249). 1988; INT-249(II):34 pp.
Keywords: *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Pinus*/ management/ woodlands
Abstract: The pinyon/juniper woodlands are extensive in the western USA and are a valuable renewable resource for many uses. The occurrence and dominance of pinyon (*Pinus cembroides*, *P. monophylla* and *P.*

edulis), juniper (*Juniperus deppeana*, *J. monosperma*, *J. scopulorum*, *J. osteosperma* and *J. occidentalis*), shrubs and herbs vary over the spectrum of the woodlands which occur on many soil types and topographies with different climates. The manual describes the ecosystem and gives basic guidelines for management for forest products (mostly fuelwood, poles and posts, and pinyon nuts), forage and browse production, wildlife, recreation and watershed values.

18. Evans, R. A. and Young, J. A. Plant succession following control of western juniper (*Juniperus occidentalis*) with picloram. *Weed Science*. 1985; 33(1):63-68.
Keywords: *Juniperus occidentalis*/ *Bromus tectorum*/ *Taeniatherum asperum*/ succession/ picloram/ herbicides
Abstract: A 7-year study was conducted to investigate successional dynamics of herbaceous vegetation after control of *J. occidentalis* trees with picloram pellets. *Bromus tectorum* rapidly dominated areas under dead tree canopies with an accompanying yield increase from almost none to about 1400 kg/ha within 4 years after treatment. In the interstitial zone between tree canopies, a dramatic shift in herbaceous spp. occurred with tree control. Annual broadleaved spp. decreased, *B. tectorum* increased and *Taeniatherum asperum* gradually became dominant. Total yield of herbaceous vegetation in the interstitial zone increased dramatically after picloram treatment, especially where few shrubs occurred. Available soil moisture, litter accumulation and decay after picloram treatment, and N in the surface layer of the soil affected responses of herbaceous vegetation, especially under dead tree canopies. Responses of annual weedy spp. to *J. occidentalis* control emphasize the need for comprehensive manipulation of all components of vegetation when range improvement is attempted.
19. Gedney, D. R.; Azuma, D. L.; Bolsinger, C. L., and McKay, N. Western juniper in eastern Oregon. General Technical Reports of the US Department of Agriculture Forest Service. (PNW-GTR-464). 1999; PNW-GTR -4641-53.
Keywords: *Juniperus occidentalis*/ Oregon/ inventory
Abstract: This report analyzes and summarizes a 1988 inventory of western juniper (*Juniperus occidentalis* Hook.) in eastern Oregon. This inventory, conducted by the Pacific Northwest Research Station of the USDA Forest Service, was intensified to meet increased need for more information about the juniper resource than was available in previous inventories. A primary sample, using aerial photos, recorded crown cover and ownership on all juniper forest and savanna lands in eastern Oregon. The inventory sampled all private and public lands in eastern Oregon, except some lands classified as reserved and some National Forest land. A secondary sample of field plots was established in juniper forests. Detailed statistics were developed of the area, volume, and ownership of juniper forests. The report includes data on juniper in transitional stands where juniper grows in association with ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) and other commercial timberland species. Estimates of the area

of juniper savanna also are presented. Data on juniper forest and savanna are presented by crown cover class and for juniper forest by site index. Maps and statistics of change during the past half century are shown based on past inventories and historical records. Large-scale maps of the past and present range of juniper and their occurrence in relation to ownership, elevation, precipitation, and soils are included.

20. Geist J. M.; Driscoll R. S.; Hall F. C.; Maser C.; Gashwiler J. S.; Jeppesen D. J.; Bright L.; Meeuwig R. O.; Nurray R. B.; Winegar H.; Elmore W.; Leckenby D. A.; Bedell T. E.; Bunch T. R., and Herbst J. R. Proceedings of the Western Juniper Ecology and Management Workshop. Bend, Oregon, January 1977. General Technical Report, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service. (PNW-74). 1978; PNW-74177 pp.
Keywords: *Juniperus occidentalis*/ ecology/ management/ Oregon
Abstract: The 12 papers presented at this conference on *Juniperus occidentalis* ssp. *occidentalis*, an important invader of rangelands in central and eastern Oregon, are given below. The conference was jointly sponsored by the Pacific Northwest Forest and Range Experiment Station, Crooked River National Grasslands (Ochoco National Forest) and the Central Oregon Chapter of the Society for Range management. Caraher, D.L. The spread of western juniper in central Oregon. 3-7. Dealy, J.E.; Geist, J.M.; Driscoll, R.S. Communities of western juniper in the Intermountain Northwest. 11-29 [21 ref., 1 pl.] Hall, F.C. Western juniper in association with other tree species. 31-36 [4 ref.] Maser, C.; Gashwiler, J.S. Interrelationships of wildlife and western juniper. 37-82 [60 ref., 11 pl.] Jeppesen, D.J. Competitive moisture consumption by the western juniper (*Juniperus occidentalis*). 83-90 [7 ref.] Bright, L. Weather stress difference between two levels of juniper canopy cover. 91-95 [5 ref.] Meeuwig, R.O.; Murray, R.B. Current research on pinyon-juniper in the Great Basin. 97-103 [6 ref.] Winegar, H.; Elmore, W. Mechanical manipulation of western juniper - some methods and results. 107-119 [6 ref.] Martin, R.E. Fire manipulation and effects in western juniper (*Juniperus occidentalis* Hook.) 121-136 [12 ref.] Leckenby, D.A. Western juniper management for mule deer. 137-161 [48 ref.] Bedell, T.E.; Bunch, T.R. Effects of western juniper on forage production and livestock grazing management. 163-167 [9 ref.] Herbst, J.R. Physical properties and commercial uses of western juniper. 169-177 [9 ref.].
21. Gholz, H. L. Structure and productivity of *Juniperus occidentalis* in central Oregon. American Midland Naturalist . Article Available at the Fire Research Institute, Number 26796. 1980; 103(2):251-261.
Keywords: *Juniperus occidentalis*/ structure/ productivity/ Oregon
22. Herbst, J. R. Physical properties and commercial uses of western juniper. General Technical Report, Pacific Northwest Forest and Range Experiment Station, USDA Forest-Service. (PNW-74). 1978; PNW-74169-

177.

Keywords: *Juniperus occidentalis*/ wood uses/ essential oils

Abstract: A review of the current and potential uses of *Juniperus occidentalis*, which has a history of use for fence posts and firewood. Essential oils from foliage, terminal branches and timber have a wide potential market as scenting and flavoring agents but may need some refining to compete with other juniper oils. The wood has been successfully dried and cured and made (commercially) into furniture and paneling with an attractive smooth finish; veneer, hardboard and particleboard have all been successfully produced. Management implications for the production of lumber or oils are discussed.

23. Klemmedson, J. O. and Tiedemann, A. R. Influence of western juniper development on distribution of soil and organic layer nutrients. Northwest Science. 2000; 74(1):1-11.
Keywords: *Juniperus occidentalis*/ *Artemisia*/ *Pseudoroegneria*/ Oregon/ soil/ organic nutrients
Abstract: This study determined the effects of invading western juniper (*Juniperus occidentalis*) into big sagebrush (*Artemisia tridentata*)/bluebunch wheatgrass (*Agropyron spicatum* [now *Pseudoroegneria spicata*]) ecosystems of central Oregon, USA, on the spatial distribution of nutrients in the organic and mineral soil layers. The organic layer and mineral soil from four layers (0-5, 5-15, 15-30, and 30+ cm), were collected beneath juniper trees of five size classes, and one area devoid of juniper on five replicated sites. Samples were taken at five distances (0 to 4 canopy radii) from tree boles into intercanopy areas. The organic layer and mineral soil were analyzed for organic carbon (Corg), total nitrogen (N), total phosphorus (P) and total sulfur (S); mineral soil was analyzed for exchangeable calcium (Caex), magnesium (Mgex) and potassium (Kex). Mass of the organic layer and amounts of organic layer nutrients increased with juniper size, and were higher under canopies than in intercanopy and no juniper areas. Concentrations of organic layer N, P, and S declined with distance from tree boles. Tree size, distance and soil layer interacted to affect concentrations of soil Corg, Kex, Caex and Mgex. Concentrations of soil N and S increased with tree size. Amounts of soil nutrients, except Corg, were not significantly influenced by tree size, but amounts of all soil nutrients, except S and Caex, were greater under juniper trees than intercanopy areas. Only Caex and Mgex were lost from intercanopy soils compared to no juniper soils.
24. Knapp P. A. and Soule P. T. Impacts of an extreme early-season freeze event in the interior Pacific Northwest (30 October-3 November 2002) on Western Juniper Woodlands. Journal of Applied Meteorology. 2005; 44(7):1152-1158.
Keywords: *Juniperus occidentalis*/ freezing/ temperature/ Pacific Northwest/ cold
Abstract: In mid-autumn 2002, an exceptional 5-day cold spell affected

much of the interior Pacific Northwest, with minimum temperatures averaging 13< degrees >C below long-term means (1953-2002). On 31 October, minimum temperature records occurred at 98 of the 106 recording stations, with records lowered in some locations by 9< degrees >C. Calculation of recurrence intervals of minimum temperatures shows that 50% of the stations experienced a >500-yr event. The synoptic conditions responsible were the development of a pronounced high pressure ridge over western Canada and an intense low pressure area centered in the Intermountain West that promoted strong northeasterly winds. The cold spell occurred near the end of the growing season for an ecologically critical and dominant tree species of the interior Pacific Northwest - western juniper - and followed an extended period of severe drought. In spring 2003, it became apparent that the cold had caused high rates of tree mortality and canopy dieback in a species that is remarkable for its longevity and resistance to climatic stress. The cold event altered western juniper dominance in some areas, and this alteration may have long-term impacts on water budgets, fire intensities and frequencies, animal species interrelationships, and interspecific competition among plant species.

25. Knapp P. A. and Soule P. T. Recent *Juniperus occidentalis* (western juniper) expansion on a protected site in central Oregon. *Global Change Biology*. 1998; 4(3):347-357.

Keywords: *Juniperus occidentalis*/ Oregon/ expansion

Abstract: The expansion of *Juniperus occidentalis* (western juniper) has been extensive in the last century, and increases in density and cover have been linked with the indirect effects of domestic livestock grazing (i.e. cessation of periodic fires, increases of nurse-plant sites), and more favourable climatic conditions. In this study, we document changes in vegetation (including *J. occidentalis*) in central Oregon over a 23-year period and relate these changes to their probable causes. In June 1995 we returned to the Horse Ridge Research Natural Area (HRRNA), a site that has a history of minimal anthropogenic impacts, to replicate a 1972 vegetation survey. Using the canopy-intercept method, line intercept method, and aerial photography analysis to measure herbaceous cover, shrub cover and tree cover, respectively, we found significant changes had occurred in the 23-year period between studies. Relative changes of tree, shrub, and perennial herbaceous cover were 59%, 7%, and - 38%, respectively. Relative increases in *J. occidentalis* density, as measured by the number of clumps and the number of stems, were 37% and 53%, respectively. Mean maximum height of *J. occidentalis* had increased by 10%. We examined the role of potentially confounding influences (e.g. fire, grazing, pathogens, climatic variability) and found that none of the traditional mechanisms implicated in *J. occidentalis* expansion adequately explained the observed changes. We suggest that the role of biological inertia of both anthropogenic and natural means may have had a profound effect on the *J. occidentalis* ecology of HRRNA.

26. Knapp, P. A.; Soule, P. T., and Grissino Mayer, H. D. Post-drought growth responses of western juniper (*Juniperus occidentalis* var. *occidentalis*) in central Oregon. *Geophysical Research Letters*. 2001; 28(13):2657-2660.
Keywords: *Juniperus occidentalis*/ drought/ air pollution/ atmosphere.
Abstract: Increased atmospheric CO₂ may affect the physiological response of natural trees to drought. Radial growth rates developed from five western juniper chronologies were examined to determine if post-drought growth responses have changed. Using prior year October to current year June precipitation from 1896 to 1998, drought recovery years were identified as having standardized scores (z-scores) >0 and by being preceded by a year with a z-score <-0.6. The analysis was defined by an early period, 1896-1930, when atmospheric CO₂ concentrations were close to preindustrial levels, and by a late period, 1964-98, when concentrations were substantially higher. Mean growth index values of recovery years between early and late periods were significantly greater ($2 < 0.05$) for four of the five sites, and for all sites combined. These results are consistent with the drought-ameliorating effects of CO₂ shown by controlled laboratory studies and suggest that rising levels of atmospheric CO₂ may impact western juniper growth rates.
27. Kramer, S.; Miller, P. M., and Eddleman, L. E. Root system morphology and development of seedling and juvenile *Juniperus occidentalis*. *Forest Ecology & Management*. 1996; 86(1-3):229-240.
Keywords: *Juniperus occidentalis*/ root system morphology/ seedling/ biomass/ Oregon/ tap root
Abstract: Root systems of 55 *Juniperus occidentalis* Hook. ssp. *occidentalis* (4-65 cm tall, 3-28 years old) were excavated at two sites in central Oregon. Above- and below-ground tree components were measured, and root system morphology was delineated into three phases of development. The prominence of tap root length and biomass declined as trees grew. In the tallest trees, excavated tap roots penetrated to 130 cm; lateral roots 1-5 mm diameter accounted for most of lateral root biomass, but lateral root length was dominated by roots of less than 1 mm diameter. Total root length for the tallest trees was 152 m; lateral roots extended 5.7 m from the trunk, occupied 102 m² of soil, and were concentrated in the upper 25 cm of the profile. Tree height was a good predictor of root parameters of biomass, length, tap root penetration, and lateral root extension with r² values of 0.82-0.96. The period of major changes in foliage morphology and root system structure coincide with a significant decrease in fine root/foliage biomass ratio.
28. Leavengood, S. and Swan, L. Proceedings, Western Juniper Forum '97. General Technical Reports of the US Department of Agriculture Forest Service. (PNW-GTR-432). 1998; PNW-GTR-4321-97.
Keywords: *Juniperus occidentalis*/ management/ commercialization
Abstract: This proceedings is a compilation of 30 articles on various aspects of the management and commercialization of western juniper. The

topics are split between commercial and industrial topics, and science and management topics. Presenters were asked to provide abstracts, not full papers, and to include who to contact for more information or a copy of the complete paper, or when and where the information or study was expected to be published.

29. ---. Western juniper drying project summaries, 1993-96. General Technical Report Pacific Northwest Research Station, USDA Forest Service. (PNW-GTR-475). 1999; PNW-GTR-475 8 pp.
Keywords: *Juniperus occidentalis*/ drying/ *Pinus ponderosa*/ splitting/ warping/ temperature
Abstract: Drying tests and trials for western juniper (*Juniperus occidentalis*) grown in the Pacific Northwest, were conducted between 1993 and 1996 to (1) test and refine existing dry kiln schedules; (2) develop moisture meter correction factors; (3) test dry western juniper in different types of kilns, both by itself and with ponderosa pine (*Pinus ponderosa*); (4) explore alternative drying techniques to minimize splitting and warping caused by inherent growth stresses; and (5) test a "saw-dry-rip" program currently used in the hardwood industry to reduce splitting and cracking. Test results over a 3-year period revealed that checking and splitting in juniper can be reduced by (a) careful selection of logs to minimize large knots, spiral grain, and excessive taper; (b) careful treatment of logs after harvest, such as end-coating and sawing logs as soon as possible after felling; (c) minimizing material with large knots (over one-half inch) and pith; (d) drying thinner and shorter boards; (e) using moderate kiln schedules (lower initial temperatures, higher initial relative humidities, and longer times); and (f) finger jointing and emphasizing products that require shorter and thinner lumber than that commonly produced in the Pacific Northwest.
30. Long, J. N.; Schreiner, E. G., and Manuwal, N. J. The role of actively moving sand dunes in the maintenance of an azonal, juniper-dominated community. Northwest Science. 1979; 53(3):170-179.
Keywords: *Juniperus occidentalis*/ sand dune/ azonal vegetation/ Washington
Abstract: An edaphically controlled pattern of cyclic community development is described for azonal vegetation dominated by a disjunct population of *Juniperus occidentalis* on a sand dune complex within the Pasco basin, E. Washington. The mobility of the habitat is responsible for the apparent movement of the plant community. It is suggested that, in the absence of sand dunes, the environment would be unsuitable for some of the species, notably *J. occidentalis*.
31. Miller; Richard F. [Author]; Rose, and Jeffery A. [Author]. Historic expansion of *Juniperus occidentalis* (western Juniper) in southeastern Oregon. Great Basin Naturalist. 1995; 55(1):37-45.
Keywords: *Juniperus occidentalis*/ western juniper/ Oregon/ seedling

Abstract: The chronology of *Juniperus occidentalis* (western juniper) expansion in eastern Oregon, the effect of plant canopy and interspace on *J. occidentalis* seedling establishment and growth rates, and the age of *J. occidentalis* maximum reproductive potential were determined. Measurements were recorded in twenty-two 0.4-ha plots established in sagebrush-grassland communities and six 0.1-ha plots in *Populus tremuloides* (quaking aspen) communities. *J. occidentalis* began increasing during the 1880s in stands containing trees > 130 yr old. Relatively steady establishment ensued into the 1950s and then began to progress at a geometric rate in the 1960s. *J. occidentalis* encroachment into aspen stands began between 1910 and 1920. The largest proportion of juvenile trees established beneath *Artemisia* species in sagebrush-grassland communities. *J. occidentalis* trees appeared to reach full reproductive potential at > 50 yr of age. The ratio of male:female trees increased from 1.7 in scattered *J. occidentalis* stands to 3.8 in closed stands. The initiation of *J. occidentalis* encroachment during the late 1800s coincides with optimal climatic conditions for *Juniperus* berry production and establishment, reduced fire-return intervals, and heavy livestock grazing. The accelerated increase in *J. occidentalis* expansion since 1960 may be due to the continued absence of fire, abundant woody plant cover, and the large increase in *J. occidentalis* seed production.

32. Miller P. M.; Eddleman L. E., and Kramer S. Allocation patterns of carbon and minerals in juvenile and small-adult *Juniperus occidentalis*. Forest Science . 1990; 36(3):734-747.

Keywords: *Juniperus occidentalis*/ Oregon/ plant nutrition/ nutrient allocation.

Abstract: Allocation patterns in western juniper (*Juniperus occidentalis* subsp. *occidentalis*) collected from central Oregon, in August and September 1987, were studied to understand how a successful, invasive, indigenous species balances the allocation of resources between above-ground tissue (to optimize photosynthetic capacity) and below-ground tissue (to maintain itself in a semi-arid environment). Above- and below-ground biomass, gross heat of combustion, concentrations of macro- and micronutrient elements, and 'construction' costs were measured on 7 trees with 100% juvenile foliage (juveniles) and 7 others with both juvenile and adult foliage (small adults). Adult foliage had the greatest heat of combustion, N concentrations and construction cost. Allocation patterns indicated a larger investment in resources to above-ground than below-ground tissue in both juvenile and small-adult *J. occidentalis*. The proportions by weight of nutrient elements in juniper foliage were 1.3 to 29 times greater than the optimum proportions required for maximum growth of *Pinus sylvestris*. Compared with similar-aged species for which data are available, juvenile and small adult *J. occidentalis* allocate larger proportions of dry mass to foliage (to optimize photosynthetic capacity) and to roots (to optimize water and nutrient acquisition); the larger

allocation to foliage and roots was accomplished through reduction of allocation to branch/bole components.

33. Miller, P. M.; Eddleman, L. E., and Miller, J. M. *Juniperus occidentalis* juvenile foliage: advantages and disadvantages for a stress-tolerant, invasive conifer. *Canadian Journal of Forest Research*. 1995; 25(3):470-479.
Keywords: *Juniperus occidentalis*/ foliage/ gas exchange/ water relation/ foliar nutrition/ root biomass/ stress factors
Abstract: Physiological processes for juvenile and adult foliage of *Juniperus occidentalis* were compared to evaluate the advantages and disadvantages of juvenile foliage for a stress-tolerant, invasive conifer. Above- and below-ground biomass allocation and monthly measurements (April through October) of gas exchange, water relations, foliar nitrogen concentrations, and growth were made for juvenile and small-adult trees in the field in central Oregon. Compared with small adults, juveniles have greater allocations to foliage and fine-root biomass, higher rates of CO₂ assimilation, leaf conductance, and transpiration, and lower investments of biomass and nitrogen per unit of foliar area. Juvenile foliage is less costly to produce than adult foliage. The suite of physiological processes associated with juvenile awl-like foliage should enhance establishment and early growth of *J. occidentalis*. However, high rates of water loss, which are associated with high rates of CO₂ assimilation of juvenile foliage, appear to be a liability for large trees in the semi-arid environment of eastern Oregon. Once established, the transition to a more conservative use of resources associated with adult scale-like foliage is consistent with the stress-tolerant strategy of long-lived evergreen trees.
34. Miller, P. M.; Eddleman, L. E., and Miller, J. M. The response of juvenile and small adult western juniper (*Juniperus occidentalis*) to nitrate and ammonium fertilization. *Canadian Journal of Botany*. 1991; 69(11):2344-2352.
Keywords: *Juniperus occidentalis*/ fertilizers/ plant nutrition/ plant physiology.
Abstract: Calcium nitrate or ammonium + dicyandiamide were applied in April 1988 around naturally-regenerated juveniles and small adults (<1.75 m tall with adult foliage) of *Juniperus occidentalis* in central Oregon on a site where ammonium-N was the dominant form of soil nitrogen. Foliar nitrogen concentrations, carbon dioxide assimilation, leaf conductance, transpiration, intercellular carbon dioxide, xylem pressure potentials, specific leaf mass, and growth were measured in mid-May, mid-July and 30-31 August to 1 September. Both forms of nitrogen increased foliar nitrogen concentrations in juveniles and small adults in May; concentrations in small adult foliage from the nitrate treatment were still higher than controls in September. Both forms of nitrogen reduced carbon dioxide assimilation and potential photosynthetic nitrogen-use efficiency. The negative relation between nitrogen addition and carbon dioxide assimilation was more apparent in juveniles than in small adults,

and was more pronounced in the ammonium treatment. Leaf conductance and transpiration were also reduced, but reductions in water loss were greater than the negative effects of fertilizer on carbon gain; thus water-use efficiency increased in May and July. The depression in gas exchange processes was detectable for longer during summer in juveniles than in small adults. Branchlet elongation was increased with both fertilizers, but variability reduced significance levels. *J. occidentalis* appears to be adapted to utilize low, ambient levels of soil nitrate at the research site and did not preferentially utilize ammonium.

35. Miller, P. M.; Eddleman, L. E., and Miller, J. M. The response of western juniper (*Juniperus occidentalis*) to reductions in above- and below-ground tissue. *Canadian Journal of Forest Research*. 1991; 21(2):207-216.
Keywords: *Juniperus occidentalis*/ foliage/ roots/ leaf conductance/ foliar nutrition/ photosynthesis
Abstract: Foliage removal increased rates of CO "SUB 2" assimilation and photosynthetic N-use efficiency, but neither increased growth nor improved water status or N concentration of remaining foliage. Cutting lateral roots reduced assimilation, leaf conductance, foliage N concentration, branchlet elongation, water-use efficiency, and photosynthetic N-use efficiency. By late August, juvenile and small-adult *J. occidentalis* in the cut-top treatment had compensated for foliage removal by reestablishing patterns of water-use efficiencies similar to those of control plants, which may indicate that an overall metabolic control was functioning to regulate the balance between CO "SUB 2" assimilation and water loss. Cutting lateral roots had a more lasting effect on efficiencies; by late August, juveniles and small adults still had significantly lower water-use efficiencies than controls.
36. Miller, R. F.; Eddleman, L. E., and Angell, R. F. Relationship of western juniper stem conducting tissue and basal circumference to leaf area and biomass. *Great Basin Naturalist*. 1987; 47(3):349-354.
Keywords: *Juniperus occidentalis*/ leaf area/ biomass
Abstract: Estimates of leaf area and biomass are required when studying the effects of western juniper (*Juniperus occidentalis*) woodlands on nutrient resources and the hydrologic cycle. In order to develop a non-destructive method for estimating leaf area and biomass, the relations between the leaf parameters and sapwood area and basal girth were studied by destructively sampling 19 trees, 9-263 cm girth, in SE and central Oregon. The entire leaf biomass was harvested and measured, and regression equations were developed. Both sapwood area and basal girth were significantly correlated with projected leaf area and leaf biomass.
37. Miller R. F. and Rose J. A. Fire history and western juniper encroachment in sagebrush steppe. *Journal of Range Management*. 1999; 52(6):550-559.
Keywords: *Juniperus occidentalis*/ *Artemisia*/ *Pinus*/ encroachment/ fire

Abstract: The recent expansion of juniper into sagebrush steppe communities throughout the semiarid Intermountain West of the USA is most frequently attributed to the reduced role of fire, introduction and overstocking of domestic livestock in the late 1800s, and mild and wet climate around the turn of the century. This study was undertaken to test the hypothesis that the post-settlement expansion of juniper was synchronous with the introduction of domestic livestock, reduction in fire frequency, and optimal climate conditions for plant growth. We documented the fire history and western juniper (*Juniperus occidentalis*) woodland chronology for a sagebrush steppe in a 5000-ha watershed in south central Oregon. Regional tree ring data were used as proxy data for presettlement climatic conditions. Western juniper age distribution was determined by coring trees across the study area. Fire history was constructed from several small clusters of presettlement ponderosa pine (*Pinus ponderosa*) scattered across the study area. Samples were cross-dated to determine fire occurrence to the calendar year. Mean fire intervals were computed for each cluster based on cumulative fire history of each tree sampled within the cluster. Fire events in low sagebrush (*Artemisia arbuscula*) were documented by determining death dates of fire-killed western juniper trees. Records dating the introduction and buildup of livestock during the late 1800s and dates of initial fire suppression were summarized. Western juniper expansion began between 1875 and 1885, with peak expansion rates occurring between 1905 and 1925. The fire record spans 1601 to 1996. Before 1897, mean fire intervals within individual clusters ranged from 12 to 15 years with years between fires varying between 3 and 28. Nearly one-third of the fires in the basin were large and were usually preceded by one year of above-average tree ring growth. Two fire events were recorded in the sparsely vegetated low sagebrush site, 1717 and 1855. The last large fire occurred in the study area in 1870 and the last small fire in 1897. The time sequence of wet climatic conditions between 1870 and 1915, introduction of livestock, and the reduced role of fire support the hypothesis that these factors contributed to the post-settlement expansion of western juniper.

38. Miller R. F.; Svejcar T. J., and Rose J. A. Impacts of western juniper on plant community composition and structure. *Journal of Range Management*. 2000; 53(6):574-585.

Keywords: *Juniperus occidentalis*/ *Artemisia*/ *Purshia*/ *Stipa*/ *Festuca*/
plant community structure

Abstract: Western juniper (*Juniperus occidentalis*) has been actively invading shrub steppe communities during the past 120 years. The majority of these stands are still in transition, from early open juniper shrub steppe communities to closed juniper woodlands. In addition, juniper expansion has been occurring across a broad array of soils and topographic positions. Despite the high degree of spatial and developmental heterogeneity, juniper woodlands are frequently treated generically in resource inventories, management, and wildlife habitat

assessments. Our goal was to evaluate the impact of western juniper encroachment and dominance on plant community composition and structure across several plant associations. This study was conducted in southeastern Oregon and northeastern California on low sagebrush (*Artemisia arbuscula*), mountain big sagebrush (*A. tridentata* subsp. *vaseyana*), and aspen (*Populus tremuloides*) alliances. Stages of woodland development across plant associations were categorized into 1 of 4 successional phases (early, mid, late, and closed) based on tree growth and stand structural characteristics. Plant cover by species group, species diversity and richness, bare ground, soil characteristics, altitude, aspect, and slope were measured in one hundred and eight 60x46 m macroplots. Twinspan was used to sort plant communities. Regression analysis was used to evaluate the relationship of tree canopy cover to shrub and herbaceous cover. Vegetative cover and bare ground were compared between early and closed stands within plant communities. Woodland structure at stand closure was different among associations varying from 19% cover and 64 trees ha⁻¹ in a low sagebrush community to 90% cover and 1731 trees ha⁻¹ in an aspen community. Increase in juniper dominance had little impact on low sagebrush and an inconsistent effect on bitterbrush (*Purshia tridentata*). In the mountain big sagebrush alliance, sagebrush cover declined to approximately 80% of maximum potential as juniper increased to about 50% of maximum canopy cover. Aspen also declined as juniper dominance increased. Herbaceous cover and species diversity declined and bare ground increased with increasing juniper dominance in the mountain big sagebrush/Thurber needlegrass (*Stipa thurberiana*) association. However, herbaceous cover on the deeper soils characterized by Idaho fescue (*Festuca idahoensis*) did not decrease with increasing juniper dominance. To determine the effect of juniper dominance or woodland management on community composition and structure, plant community and stage of stand development should be identified.

39. Poddar, S. and Lederer, R. J. Juniper berries as an exclusive winter forage for Townsend's solitaires. *American Midland Naturalist*. 1982; 108(1):34-40.
Keywords: *Juniperus occidentalis*/ *Myadestes townsendi*/ berries/ fruit/ nutrition
Abstract: Berries of *Juniperus occidentalis* constitute the sole winter diet of *Myadestes townsendi*. Nutrient content of juniper berries is similar to that of other temperate zone berry-like fruits, but, because moisture is low, energy and nutritional content are concentrated and the berries offer more value per unit. Ripe berries contain an average of 4% protein, 16% lipid, 46% carbohydrate and 34% fiber and ash by dry weight; their calorific content is c.5 kcal per g.
40. Roberts C. and Jones J. A. Soil patchiness in juniper-sagebrush-grass communities of central Oregon. *Plant and Soil*. 2000; 223(1/2):45-61.
Keywords: *Juniperus occidentalis*/ *Artemisia*/ *Elymus*/ *Poa*/ *Festuca*/

soil patches

Abstract: The sizes, spacings and properties (soil moisture, pH, nitrogen, soil arthropods and VAM) of soil resource islands and bare patches in sagebrush (*Artemisia tridentata*)-grass communities (*Elymus spicatus*, *Poa secunda*, and *Festuca idahoensis*) invaded by western juniper (*Juniperus occidentalis*) were compared to those without juniper. A total of 1000 surface soil samples were taken from nine 50-m radius circular plots sampled in December 1991 and May 1992 on 'The Island', an undisturbed area of sagebrush-grass shrubland in Oregon, USA. Spatial structure was interpreted from correlograms (Moran's I) and standardized semivariograms. The presence of juniper was associated with increased bare area and smaller, more widely spaced grass and sagebrush plants. Soil arthropod numbers and biomass in plots with juniper were only approx. one-fifth of those in sagebrush-grass plots in December. The dominant soil pattern in both sagebrush-grass and juniper-sagebrush-grass plots was regularly-distributed patches spanning a range of sizes and spacings. Plots with juniper had greater patchiness at shorter lags (<3 m), and patchiness was more developed for soil moisture, net nitrification, and net N mineralization, whereas sagebrush-grass plots had greater patchiness at longer lags (3-9 m) and patchiness was more developed for NO₃-N, arthropod numbers and biomass. These differences in soil patterns with and without juniper indicate that juniper responds to, or causes, changes in the size of resource islands under sage and grass when it invades sage-grass communities.

41. Rose, J. A. and Eddleman, L. E. Ponderosa pine and understory growth following western juniper removal. Northwest Science. 1994; 68(2):79-85.
Keywords: *Juniperus occidentalis*/ *Pinus ponderosa*/ plant colonization/ weed control/ Oregon
Abstract: A study was conducted on 2 sites in the ponderosa pine-western juniper (*Pinus ponderosa*-*Juniperus occidentalis*) ecotone of central Oregon to determine the effects of ponderosa pine thinning and removal of western juniper on basal area growth of ponderosa pine and on understory vegetation. Encroachment of western juniper is of concern to land managers in this area. Total understory plant biomass and cover increased in response to removal of western juniper. However, thinning ponderosa pine and leaving western juniper reduced biomass and cover of understory groups in comparison with control plots. Ponderosa pines <5 cm d.b.h. grew more on control plots than on plots where competing trees were removed. Removal of western juniper appeared to benefit understory vegetation, but may reduce growth of small ponderosa pines for the first few years after treatment.
42. Schupp; Eugene W. [Reprint author]; Gomez; Jose M. [Author]; Jimenez; Jaime E. [Author]; Fuentes, and Marcelino [Author]. Dispersal of *Juniperus occidentalis* (western juniper) seeds by frugivorous mammals on Juniper Mountain, southeastern Oregon. Great Basin Naturalist. 1997; 57(1):74-78.

Keywords: *Juniperus occidentalis*/ western juniper/ seeds/ Oregon

43. Soule P. T. and Knapp P. A. *Juniperus occidentalis* (western juniper) establishment history on two minimally disturbed research natural areas in central Oregon. *Western North American Naturalist*. 2000; 60(1):26-33.
Keywords: *Juniperus occidentalis*/ *Artemisia*/ spread/ natural regeneration.
Abstract: While a trend toward western juniper (*Juniperus occidentalis* subsp. *occidentalis*) super-dominance in big sagebrush (*Artemisia tridentata*) communities of the Pacific Northwest since the late 1800s has been well documented, establishment dates of western juniper in less disturbed environments have not. In this paper we document the establishment history of western juniper on 2 minimally disturbed research natural areas in central Oregon that have substantial differences in their physical characteristics. On each site we randomly established twenty 0.05-ha plots to obtain per hectare counts of mature and juvenile western juniper and to obtain a sample of 100 trees closest to the plot center. These trees were then dated using standard dendrochronological techniques. The lower-elevation, more xeric site has an establishment history that suggests it is an emerging western juniper woodland, with the majority of trees sampled establishing since 1978. The higher-elevation site is an older, well-established woodland with a more even temporal distribution of trees. These results suggest that suitable establishment sites may switch from canopy dependence in emerging woodlands to open sites in mature woodlands and that neither domestic livestock grazing nor active fire suppression is a required mechanism for establishment.
44. Soule P. T. and Knapp P. A. Western juniper expansion on adjacent disturbed and near-relict sites. *Journal of Range Management*. 1999; 52(5):525-533.
Keywords: *Juniperus occidentalis*/ plant colonization/ nature reserves/ semiarid zones.
Abstract: Rates of western juniper (*Juniperus occidentalis* subsp. *occidentalis*) density and cover change were investigated from 1951 to 1994 at 3 adjacent sites with nearly identical altitude, slope, aspect, soils, plant communities, and climate, but different land-use histories. The 3 sites are located in central Oregon at the confluence of the Deschutes and Crooked Rivers. Two of the sites were typical of central Oregon rangelands in that they have a history of anthropogenic disturbance including active fire suppression and domestic livestock grazing. The third site is a relict mesa that is a protected Research Natural Area and has experienced minimal anthropogenic impacts. Large scale aerial photography was used to determine cover and density of western juniper in 1951, 1956, 1961, 1972, 1982, and 1994. Western juniper density and cover during the last 4 decades had increased at all sites, with changes on the relict site similar to those on one of the disturbed sites. It is suggested that even though 2 of

the traditionally cited causes of western juniper expansion since the late 1800s (altered fire regimes, domestic livestock grazing) may have contributed to expansion on the disturbed sites, these mechanisms could not explain expansion on the near-relict mesa. Climatic changes since 1900 were examined for the region and it is concluded that the data did not fully support a climate-driven mechanism for the expansion.

45. Soule P. T.; Knapp P. A., and Grissino-Mayer H. D. Comparative rates of western juniper afforestation in south-central Oregon and the role of anthropogenic disturbance. *Professional Geographer*. 2003; 55(1):43-55.
Keywords: *Juniperus occidentalis*/ canopy cover/ Oregon/ rangelands
Abstract: We examine changes in canopy cover for adult western juniper from the 1960s to 1994 in central Oregon using repeat aerial photography. We compare changes at four sites with a land-use history of minimal anthropogenic disturbance to changes on adjacent sites that have a disturbance history more typical of central Oregon rangelands. Canopy cover increased at all sites, but afforestation on sites with domestic livestock grazing was greater. The potential driving forces common to all sites include a long fire-free interval, early twentieth-century favorable climatic conditions, biological inertia, and atmospheric.
46. Soule, Peter T.; Knapp, Paul A., and Grissino-Mayer, Henry D. Human agency, environmental drivers, and western juniper establishment during the late Holocene. *Ecological Applications*. 2004; 14(1):96-112.
Keywords: *Juniperus occidentalis*/ livestock grazing/ fire suppression/ expansion
Abstract: Western juniper (*Juniperus occidentalis* var. *occidentalis*) is undergoing rapid rates of expansion, and human activities (domestic livestock grazing, fire suppression) are typically presented as the primary agents of change. To determine the importance of active disturbance as a vehicle for these major ecosystem changes (e.g., a near doubling of western juniper cover at some locales over a recent 30-yr period), we conducted a comparative study of western juniper establishment at matched disturbed and less-disturbed sites in Oregon (USA). We used dendroecological techniques to randomly sample and cross-date 160-200 trees per site from five Research Natural Areas (RNAs) or proposed RNAs, and from areas adjacent to these RNAs that are actively disturbed. For each location we determined the density of adult and juvenile western juniper and created a timeline of tree establishment. We discuss the probable causes of these establishment pattern changes. Recent increases in establishment could best be described as geometric on the disturbed sites. While trees on the less disturbed sites are generally older and have a more consistent establishment history, they also are experiencing increasing rates of establishment. Disturbance does appear to accelerate rates of establishment of western juniper, especially with domestic livestock grazing on sites that are downslope from established woodlands. Climatic changes, a lack of high-severity fires, an increasing seed rain, and

atmospheric carbon dioxide enrichment are more recent causal mechanisms contributing to establishment. The driving forces proffered to explain the late 1800s to early 1900s pulse of establishment for western juniper (e.g., favorable climatic conditions, domestic livestock grazing) appear to be operative at the majority of our study sites. Conversely, a second pulse of establishment (post 1940s) occurred during a period that was not characterized by climatic conditions favorable for above-average radial growth of western juniper. Because our results show that rates of establishment are generally accelerating regardless of the disturbance regime, we suggest that active human disturbance is not a required element for these ecosystem changes to occur, and that other agents of change have either appeared or become more dominant in recent decades.

47. Southworth, D Reprint author. Isolation of exines from gymnosperm pollen. *American Journal of Botany*. 1988; 75(1):15-21.
Keywords: *Juniperus occidentalis/ Sequoia/ Chamaecyparis/ Calocedrus/ Pseudotsuga/ pollen/ exines*
Abstract: Exines of certain Gymnosperms spontaneously separate from the intine during the process of hydration preceding pollen germination. Exines of pollen of *Calocedrus decurrens*, *Chamaecyparis lawsoniana*, *Juniperus occidentalis*, *Sequoia sempervirens*, and *Pseudotsuga menziesii* were isolated from hydrated, autoclaved pollen. Free exines were purified by centrifugation on a discontinuous sucrose gradient of densities 1.14 to 1.27 g/ml. The outer intine dissolved on autoclaving. This method may be applicable to a wide range of genera. Purified exines are of potential use in chemical analyses of sporopollenin and in production of antibodies to exine.

48. Tiedemann A. R. and Klemmedson J. O. Biomass and nutrient distribution and system nutrient budget for western juniper in central Oregon. *Northwest Science*. 2000; 74(1):12-24.
Keywords: *Juniperus occidentalis/ Artemisia tridentata/ nutrients/ community ecology/ plant succession*
Abstract: Invasion of western juniper (*Juniperus occidentalis* Hook.) into big sagebrush (*Artemisia tridentata* Nutt.) communities of eastern Oregon implies redistribution of nutrients among ecosystem components, with management implications as stands mature. To assess these effects, we measured biomass and nutrients in juniper trees of five size classes ranging in average age from 36 to 161 yr, and in understory vegetation. Understory was measured at 0.0, 0.5, 1, 2, and 4 canopy radii from the bole and in areas devoid of juniper ("no juniper"). Tree size and distance from boles had no effect on biomass or concentrations and amounts of nutrients in understory vegetation. Above-ground tree biomass increased with maturity from 18.4 kg for size class 1 to 741.4 g for class 5. Biomass accumulated rapidly (22.3 kg/tree/yr) between classes 2 and 3. Foliage comprised 41% of tree biomass in class 1 trees, but decreased to 15% for class 5 trees. Concomitantly, percentage of tree biomass in boles and live

branches increased from 29 to 47%. From class 1 to class 5, amounts of nutrients increased as follows: nitrogen (N) from 89 to 2117 kg/tree; phosphorus (P) from 12 to 283 g/tree; and sulfur (S) from 10 to 294 g/tree. In open systems (intercanopy and "no juniper" areas), soil contained 89.9 to 99.8% of the organic carbon (Corg), N, P, and S of entire systems. For tree systems (areas occupied by juniper canopies), Corg, N, and S in aboveground biomass increased with increasing tree maturity, while P did not change. For the most mature trees, proportions of total system N, S and P allocated to the organic layer and trees was 30, 78, and 5%, respectively. Considering the N and S limited nature of these sites, a conservative harvest management approach that emphasizes retention of organic layers and tree foliage appears prudent.

49. Tiedemann, A. R. and Klemmedson, J. O. The influence of western juniper development on soil nutrient availability. Northwest Science. 1995; 69(1):1-8.
Keywords: *Juniperus occidentalis*/ nutrient availability/ development/ plant colonization/ Oregon
Abstract: The effect of western juniper (*Juniperus occidentalis*) invasion and tree ageing on soil nutrient availability was assessed in sagebrush/grass ecosystems of central Oregon. Barley was used as a bioassay test plant to determine availabilities of N, P, K, and S. The surface 15 cm of soil from beneath juniper canopies (canopy soil) and intercanopy areas (intercanopy soil) was collected for five age classes of trees ranging from 36 to 160 yr. Nutrient availability determined by bioassay in these soils was compared with an area where juniper had not invaded. Phosphorus availability of intercanopy soils was significantly reduced for the two oldest tree classes, suggesting that lateral root systems of the junipers may have transported P from open areas to the tree and canopy area. Availability of N and K in soil beneath juniper canopies was not greatly enhanced. Advancing juniper maturity was associated with increasing then decreasing P availability with the oldest tree class. The most striking effect of juniper was increased S availability in canopy soils with advancing juniper maturity. Differential responses of N and S availability in canopy soils may reflect the fact that N mineralization is chiefly a biological process whereas S mineralization is both biological and biochemical. Low inherent availabilities of N and S suggest the productivity enhancement measures should include fertilization with these elements.
50. Vaitkus, M. R. and Eddleman, L. E. Tree size and understory phytomass production in a western juniper woodland. Great Basin Naturalist. 1991; 51(3):236-243.
Keywords: *Juniperus occidentalis*/ Oregon/ understory/ phytomass/ tree size
Abstract: Understory phytomass production in a western juniper (*Juniperus occidentalis*) woodland was examined relative to tree size in

central Oregon [USA] in 1983 and 1984. Vegetation was sampled in two zones, the canopy zone (beneath the canopy) and the intercanopy zone (the space between canopies), on two adjacent sites—a lower slope site with shallow soil and an upper slope site with deeper soil. Sampling was stratified into three tree size classes. Individual species production was significantly affected by tree size and location relative to tree canopy. Production of bottlebrush squirreltail, bluebunch wheatgrass, cheatgrass, miscellaneous annual grasses, perennial forbs, and annual forbs increased with increasing tree size. Sandberg bluegrass production was greater in the intercanopy than the canopy zone, while production of bottlebrush squirreltail, bluebunch wheatgrass, miscellaneous annual grasses, and both perennial and annual forbs was greater in the canopy zone. Production of cheatgrass was determined by the interaction of tree size and zone. Phytomass relationships were expressed to a greater degree on the upper slope site, where total production exceeded that of the lower slope site by approximately 50% the second year of the study. Individual trees appear to exert a great influence on associated vegetation as western juniper woodlands progress from the seedling (tree establishment) phase to closed stands of mature trees. Original community dominants appear to be spatially segregated beneath tree canopies and associated with large trees, while formerly less common species, such as cheatgrass, come to dominate the entire site.

51. Waichler, W. S.; Miller, R. F., and Doescher, P. S. Community characteristics of old-growth western juniper woodlands. *Journal of Range Management*. 2001; 54(5):518-527.

Keywords: *Juniperus occidentalis*/ aeolian soils/ botanical composition/ forbs.

Abstract: While considerable attention has been given to the areal expansion of juniper (*Juniperus* sp.) in western USA, the presence and ecological significance of old-growth juniper communities has gone largely unnoted. Increased recognition of these communities has prompted questions about how to recognize old-growth, community structure, ecological importance, and appropriate management. As an initial analysis of old-growth western juniper woodlands (*Juniperus occidentalis* var. *occidentalis*) in central Oregon, USA, this study investigated old-growth community structure on aeolian-sand derived soils. These woodlands represent the most extensive old-growth western juniper woodlands throughout its range. Nine study plots were established at 7 sites. Within each plot, densities and physical attributes of all live trees and large standing and fallen woody detritus were recorded. Additional measurements for live trees included canopy cover, apparent age class (pre- or postsettlement), and a sampling of tree ages. Aging of trees older than 250 years was complicated by extensive heartwood rot. Shrub density and cover were measured by species. Understorey cover was measured by species and functional type. Bare ground, rock, juniper litter, other litter, moss, and cryptogamic crust cover were also measured. Plant cover ranged

from 11 to 33% for trees, 0 to 10% for shrubs, 3 to 12% for perennial grasses, 1 to 2% for forbs, and from 0 to 0.1% for annual grasses. The woodlands contained at least 80 trees ha⁻¹ aged over 200 years. Correlations between tree parameters and understory structure and composition were generally poor. Differences in plant composition among these stands was primarily attributed to elevation, slope, and percent sand content. Structural characteristics that distinguished old-growth stands from younger stands included tree growth form, presence of standing and dead large woody debris, lichen on dead branches, and a relatively open canopy. Results provide a preliminary basis for identifying old-growth *Juniperus occidentalis* stands, as a prelude to the development of management plans and further research into the functional characteristics of the systems. A definition of old-growth juniper woodlands is presented.

52. Wall T. G.; Miller R. F., and Svejcar T. J. Juniper encroachment into aspen in the Northwest Great Basin. *Journal of Range Management*. 2001; 54(6):691-698.

Keywords: *Juniperus occidentalis/ Populus tremuloides/* ecological disturbance/ nutrient content/ nature conservation/ plant succession.

Abstract: In the northwest Great Basin, western juniper (*Juniperus occidentalis* subsp. *occidentalis*) is encroaching into aspen (*Populus tremuloides*) communities. There is a concern that aspen communities in this region are in a state of decline, but their status has not been documented. This study (conducted in the High Desert and Klamath Ecological Provinces in southeast Oregon, northeast California, and northwest Nevada, USA) determined the timing, extent, and some of the effects of this expansion. Ninety-one aspen stands were sampled for density, canopy cover, age, stand structure, and recruitment of western juniper and aspen. Soils and tree litter beneath aspen and western juniper were collected to analyze the effects of western juniper on soils. Additionally, 2 large aspen complexes in southeast Oregon, USA, were intensively aged to determine disturbance (fire) frequencies. Western juniper encroachment peaked between 1900 and 1939 with 77% of all juniper trees sampled having been established during this period. Three-fourths of aspen stands sampled have established populations of western juniper. Twelve percent of aspen stands sampled were completely replaced by western juniper and another 23% dominated by western juniper. Average density of western juniper in aspen sites was 1573 trees ha⁻¹. Seventy percent of aspen stands sampled had zero recruitment of new aspen. Aspen stands averaged 98 years old. There was an inverse correlation between aspen canopy cover and western juniper canopy cover. Soils influenced by western juniper had a higher C : N ratio, pH, salts, lime, and sulfate, and lower amounts of magnesium, iron, copper, and manganese. Aspen litter had a lower C : N ratio than western juniper litter. Two major aspen complexes sampled had even-age, 2-tiered even-age, and multiple-age aspen trees. The absence of presettlement juniper within all sampled aspen stands suggests fire was the primary stand-replacing

disturbance in these northwest Great Basin aspen communities. The lack of fire coupled with aspen stand decadence and low recruitment levels will allow for the continued encroachment and replacement of aspen communities by western juniper in the northwest Great Basin.

53. Young, J. A. and Evans, R. A. Alternatives for control of juvenile western juniper (*Juniperus occidentalis* Hook.) trees. Abstracts of 1979 Meeting of the Weed Science Society of America. 1979; 58.
Keywords: *Juniperus occidentalis*/ picloram/ crops/ rangelands/ weed control/ cultural control.
Abstract: Economical control of *Juniperus occidentalis* on rangeland is obtained by applying picloram granules to the base of the crowns of juvenile trees (<2m high) at a rate of 1.4 g/m of tree height. Alternative treatments are bulldozing, hand cutting and prescribed burning.
54. Young, J. A. and Evans, R. A. Litter as a factor in western juniper competition and control . Western Society of Weed Science, Proceedings. 1977; 3074.
Keywords: *Juniperus occidentalis*/ *Artemisia*/ litter/ seed bed/ germination/ growth
Abstract: Western juniper (*Juniperus occidentalis*) has invaded sagebrush (*Artemisia*) grasslands in the USA and increased in density during the last 100 years. Competition from the established junipers has reduced stands of desirable browse and forage plants. In the semiarid environments where western juniper grows, competition for moisture is usually of vital importance in determining survival of plant species. Preliminary studies indicate that western junipers are highly competitive users of available soil moisture. In any woodland situation light is usually an important competition factor. In western juniper woodlands the relatively open aspect of tree spacing apparently limits the importance of competition for light. The annual litter fall, which for western juniper is composed of leaf and bark scales plus some small twigs, greatly exceeds the annual rate of decay. This results in huge accumulations of litter beneath the tree canopies. This accumulation of litter influences competition within the juniper woodlands both by providing a seed bed unsuitable for germination and growth of herbaceous vegetation and by accumulating large amounts of nutrients that are unavailable for plant growth. The nutrient aspect of competition is further complicated by the excessive amounts of nitrogen necessary for decomposition of the litter. The litter accumulations interact with control measures by possibly interfering with the activity of soil-applied herbicides and because the recycling of the litter nutrient sinks must be accounted for in any conversion of western juniper woodlands.
55. ---. Soil moisture availability and canopy interception in western juniper (*Juniperus occidentalis* Hook.) woodlands. Abstracts of 1979 Meeting of the Weed Science Society of America. 1979; 87-88.
Keywords: *Juniperus occidentalis*/ soil moisture/ canopy/ stem flow

Abstract: Successful competition for moisture appears to be an important cause of the invasion of shrub and grass communities by *Juniperus occidentalis*. Stem flow (movement of moisture down the stem following collection of precipitation by the foliage and stems of the tree) concentrates moisture round the base of the trees where litter accumulation reduces evaporation and provides favourable conditions for nitrification.

56. Young, J. A.; Evans, R. A.; Budy, J. D., and Palmquist, D. E. Stratification of seeds of western and Utah juniper. *Forest Science*. 1988; 34(4):1059-1066.

Keywords: *Juniperus occidentalis*/ Utah juniper/ western juniper/ *Juniperus osteosperma*/ seed/ stratification/ germination

Abstract: Seeds of western juniper (*Juniperus occidentalis* subsp. *occidentalis* Hook.) and Utah juniper [*J. osteosperma* (Torr.) Little] are highly dormant when freshly harvested. Cool-moist stratification at 5° C for 14 weeks in vermiculite enhanced subsequent emergence of seedlings of both species, but total emergence was still low. The year of seed production greatly influences the viability of seedlots. Dry storage for 1 to 4 years at room temperatures did not enhance germination. Outdoor stratification, over winter, in sand, enhances subsequent emergence depending on the environment of the stratification site. The year of seed production also interacts with outdoor situations. Repeat stratification treatments, interrupted by 8-week continuously wet-emergence-assay periods in the greenhouse and dry storage during the summer were cumulative for increased seed germination of both species. Interrupted treatments were more effective than continuous stratification in excess of the optimum duration to enhance germination. Stratification in aqueous solutions with near saturation of the solution with oxygen increased subsequent emergence of seedlings of western and Utah juniper to about 50%. Similar treatments using aqueous solutions of 0.289 m mol L⁻¹ gibberellin (GA₃) enhanced subsequent emergence of seedlings of western juniper to better than 80%.

57. Young, J. A.; Evans, R. A., and Cluff, G. Cost of controlling maturing western juniper trees. *Proceedings of the Western Society of Weed Science*. 1980; 33:118.

Keywords: *Juniperus occidentalis*/ picloram/ wood harvesting/ slash disposal/ costs

Abstract: The costs of 4 alternatives for the management of *Juniperus occidentalis* woodland were as follows: (1) the application of picloram to kill the trees with no further treatment \$31/acre, (2) picloram followed by sufficient limbing and/or felling to allow passage of a rangeland drill, \$179/acre, (3) mechanical clearance and burning \$237/acre and (4) wood harvesting and slash disposal \$832/acre. Treatment (3) required a high capital investment while (4) required a large amount of labor. All the treatments resulted in mechanically drillable sites but of very different quality. It is suggested that, for a specific woodland, a combination of

treatments would be cost-effective.

58. Young, J. A.; Evans, R. A., and Rimbey, C. Weed control and revegetation following western juniper (*Juniperus occidentalis*) control. *Weed Science*. 1985; 33(4):513-517.

Keywords: *Juniperus occidentalis*/ weed control/ revegetation/ tree control/ crops/ mechanical methods.

Abstract: The control of *J. occidentalis* released shrub and herbaceous vegetation from dominance of the tree overstory. Revegetation of the woodland with desirable browse and forage spp. required control of both shrub and herbaceous spp. The method of tree control (herbicidal, mechanical, or wood harvesting) influenced subsequent weed control-revegetation in the understory. Standing dead trees resulting from the use of picloram hindered weed control and sowing. Accumulation of litter interfered with the use of atrazine for annual grass control on both the picloram and wood harvest plots. Establishment of forage spp. was most successful on the mechanically cleared plots. Attempts to revegetate with browse spp. were largely foiled by native herbivores, and selective predation occurred on herbaceous spp.

***Juniperus occidentalis* (subsp. *australis* and subsp. *occidentalis*) (1)**

1. Terry R. G.¹; Nowak R. S.¹, and Tausch R.J.². Genetic variation in chloroplast and nuclear ribosomal DNA in Utah juniper (*Juniperus osteosperma*, *Cupressaceae*): evidence for interspecific gene flow. *American Journal of Botany*. 2000; 87(2):250-258.

Keywords: *Juniperus occidentalis* (subsp. *australis* and subsp. *occidentalis*)/ *Juniperus osteosperma*/ chloroplast DNA/ *Cupressaceae*/ hybridization/ nuclear ribosomal DNA/ restriction fragment length polymorphism (RFLP).

Abstract: Geographic patterns of genetic variation in chloroplast (cpDNA) and nuclear ribosomal (nrDNA) DNA were examined to test the hypothesis of hybridization between *Juniperus osteosperma* and *Juniperus occidentalis* in the Great Basin of western Nevada. Noncoding DNA from the *trnL-trnF* intergenic spacer and the *trnL* intron of the chloroplast genome was sequenced from seven population of *J. osteosperma* and four populations of *J. occidentalis* sampled over a large proportion of their respective ranges. An adenine nucleotide at position 436 in the aligned sequence and within a *Tru 91* restriction site was found to be present in individuals of *J. osteosperma* sampled from western Colorado and central Utah, but absent in sequences of *J. osteosperma* sampled from central and western Nevada all sequences of *J. occidentalis*. Two hundred fourteen individuals from 34 populations of *J. osteosperma* and *J. occidentalis* were then screened for cpDNA haplotype by *Tru 91* digestion of the *trnL-trnF* polymerase chain reaction (PCR) product. Two cpDNA haplotypes were evident, each consisting of restriction fragment profiles that differed solely with respect to the presence or absence of the

Tru 91 site encompassing the adenine nucleotide at position 436. One of these haplotypes was monomorphic in *J. occidentalis* and exhibited a decreasing frequency in *J. osteosperma* with increasing geographic distance from *J. occidentalis* in west-central Nevada. Geographic patterns in nuclear ribosomal DNA (nrDNA) variation were examined by restriction fragment analysis and, although spatially more restricted, exhibited patterns of clinal variation similar to those observed in cpDNA haplotype. Genetic relationship based on DNA sequences and geographic patterns of genetic variation in chloroplast and nuclear ribosomal DNA are consistent with morphology in suggesting interspecific gene flow between *J. occidentalis* and *J. osteosperma*.

***Juniperus osteosperma* (70)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana/ Juniperus ashei/ Juniperus californica/ Juniperus coahuilensis/ Juniperus comitana/ Juniperus deppeana/ Juniperus durangensis/ Juniperus flaccida/ Juniperus gamboana/ Juniperus jaliscana/ Juniperus monosperma/ Juniperus monticola/ Juniperus osteosperma/ Juniperus occidentalis/ Juniperus pinchotii/ Juniperus saltillensis/ Juniperus standleyi/ essential oils/ DNA/ RAPD*

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

2. Aldon E. F. and Loring T. J. Ecology, uses, and management of pinyon-juniper woodlands. Proceedings of the workshop, March 24-25, 1977, Albuquerque, New Mexico. USDA Forest Service General Technical Report, Rocky Mountain Forest and Range Experiment Station. (RM-39). 1977; RM-39(III):48.

Keywords: *Juniperus osteosperma/ Juniperus scopulorum/ Juniperus monosperma/ Juniperus deppeana/ Pinus edulis/ Pinus monophylla/*

Pinus cembroides/ Pinus quadrifolia / ecology/ pinyon-juniper woodlands

Abstract: Pinyon (*Pinus edulis*, *P. monophylla*, *P. cembroides*, and *P. quadrifolia*)/juniper (*Juniperus osteosperma*, *J. scopulorum*, *J. monosperma* and *J. deppeana*) woodlands occupy 33 million acres in W. USA. Twelve papers were presented on the type in 3 sections: Ecology of pinyon juniper woodlands: Pieper, R.D. The southwestern pinyon/juniper ecosystem. [16 ref.] Clendenen, G.W. Pinyon and juniper inventory procedures. Little, E.L., Jr. Research in the pinyon/juniper woodland. [16 ref., 1 pl., 4 maps] Smith, T, Insects and diseases of pinyon/juniper. Swenson, E. Pinyon/juniper wildlife habitats. Baxter, C. A comparison between grazed and ungrazed juniper woodland. Uses and potential of the woodland zone: Ffolliott, P.F. Product potential of pinyon/juniper woodlands. [8 ref.] Voorhies, G. What is known and not known about pinyon/juniper utilization. [23 ref.] Fisher, J.T.; Montano. J.M. Management of pinyon for ornamentals, Christmas trees, and nut production. [29 ref.] Management strategies for the woodland zone: Gallegos, R.R. Forest practices needed for the pinyon/juniper type. Hurst, W.D. Managing pinyon/juniper for multiple benefits. Anderson, G. Systems approach to pinyon/juniper management.

3. Brotherson J. D. and Osayande S. T. Mineral concentrations in true mountain mahogany and Utah juniper, and in associated soils. *Journal of Range Management*. 1980; 33(3):182-185.
Keywords: *Juniperus osteosperma/ Cercocarpus montanus/ minerals*
Abstract: Concentrations of minerals in soils and plants were measured in two plant communities in northeast Utah, USA. Zinc, copper, magnesium, phosphorus, and nitrogen showed significantly greater concentration in true mountain mahogany (*Cercocarpus montanus*) than in Utah juniper (*Juniperus osteosperma*). Soils beneath plant canopies had significantly higher nitrogen than soils in open areas between plants. Concentrations of zinc, manganese, and phosphorus were significantly higher in the soils of the juniper community, while calcium and magnesium concentrations were significantly higher in soils of the mountain mahogany community. True mountain mahogany showed copper concentration (x=28.9 ppm) high enough to approach toxic levels for some herbivores. Except for copper, mineral concentrations indicated good forage value for these two species.
4. Bunderson E. D.; Weber D. J., and Davis J. N. Soil mineral composition and nutrient uptake in *Juniperus osteosperma* in 17 Utah sites. *Soil Science*. 1985; 139(2):139-148.
Keywords: *Juniperus osteosperma/ plant composition/ autecology*
Abstract: This report details the basic physiology and autecology of *Juniperus osteosperma*, as measured in 17 pinyon-juniper sites throughout Utah. Foliage samples were collected from 255 trees and soil samples from each of the 17 sites and analyzed for mineral content. The

concentrations of mineral nutrients, total soluble carbohydrates, and total chlorophyll content in the *J. osteosperma* foliage were then compared with mineral concentrations and other soil properties, noting also the effects of temperature and precipitation on mineral uptake in junipers. Foliage variables were factor-analyzed, and production functions were calculated to explore the interactions between soil and environmental variables as predictors of mineral concentration in the foliage. An analysis of the production functions suggested that phosphorus and potassium, in addition to nitrogen, were growth-limiting factors in pinyon-juniper soils. Temperature and moisture gradients were also distinct growth-limiting factors in this ecosystem.

5. Bunderson E. D.; Weber D. J., and Nelson D. L. Diseases associated with *Juniperus osteosperma* and a model for predicting their occurrence with environmental site factors. *Great Basin Naturalist*. 1986; 46(3):427-440.
Keywords: *Juniperus osteosperma/ Gymnosporangium/ Phoradendron/ Utah/ diseases*
Abstract: On 17 Utah juniper sites studied in Utah, *Gymnosporangium inconspicuum* was the most common rust fungus, followed in frequency and severity by *G. nelsoni*, *G. kernianum* and *G. speciosum*. The incidence of *G. kernianum* was correlated with moderate temp. and greater than av. precipitation. True mistletoe, *Phoradendron juniperinum*, was present on 7 sites. Incidence of mildew-type foliage diseases was low on sites with low spring and summer temp. and high on sites with high summer and autumn precipitation. Wood rot was common, and incidence seemed to be correlated with low winter temp. and low soil nitrate but not with annual precipitation. Needle blight, shoot dieback and needle cast symptoms were common and considered of abiotic origin. A nonparametric model was developed that accurately predicted the frequency of the mildew-type diseases based on measured environmental site factors.

6. Chambers, Jeanne C. *Pinus monophylla* establishment in an expanding *Pinus-Juniperus* woodland: Environmental conditions, facilitation and interacting factors. *Journal of Vegetation Science*. 2001 Feb; 12(1):27-40.
Keywords: *Juniperus osteosperma/ Pinus monophylla/ seed/ seedling*
Abstract: The tree species comprising *Pinus-Juniperus* woodlands are rapidly expanding into shrub-grasslands throughout their range. Observational studies indicate that establishment is facilitated by nurse plants, but little information exists on the mechanisms involved. I examined both abiotic and biotic factors influencing *Pinus monophylla* establishment in *Artemisia tridentata* steppe with expanding populations of *P. monophylla* and *Juniperus osteosperma*. I also examined the effects of seed burial and predation on seedling establishment. Microhabitats under trees and shrubs had higher extractable P and K, higher organic matter, total nitrogen and cation exchange capacity than interspace microhabitats. Soil water contents (0-15 cm) were lower in interspaces than under shrubs or trees due to dry surface (0-5 cm) soils. Soil

temperatures (at 1 and 15 cm) were lowest under trees, intermediate under shrubs, and highest in interspaces. Timing and rate of seedling emergence were temperature dependent with the order of emergence paralleling mean growing season temperatures: tree interspace = shrub interspace > under shrub > under *Juniperus* gtoREQ under *Pinus*. Seed burial was required for rooting and the highest emergence occurred from depths of 1 and 3 cm indicating that caching by birds and rodents is essential and that animals bury seeds at adequate if not optimal depths for emergence. Seedlings required micro-environmental modification for survival; all seedlings, including those that emerged from seeds and transplants, died within the first year in interspace microhabitats. Survival in under-tree or under-shrub microhabitats depended on soil water availability and corresponded closely to soil water contents over the 3-yr study. Under-shrub microhabitats had more favorable soil and micro-environmental characteristics than under-tree microhabitats and had the highest seedling life spans for the first-year seedling cohort. Predation of *Pinus* seedlings by rodents was a significant cause of mortality with caged transplants exhibiting life spans that were 74 % longer overall than uncaged transplants. Emergence and survival of *P. monophylla* within the expanding woodland were dependent upon a complex set of interacting factors including growing season conditions, microhabitat characteristics, and animal species.

7. Chojnacky, C. Juniper, pinyon, oak and mesquite volume equations for Arizona. Research Paper Intermountain Research Station, USDA Forest Service. (INT-391). 1988; INT-39111 pp.
Keywords: *Juniperus osteosperma/ Juniperus monosperma/ Juniperus deppeana/ Pinus/ Prosopis/ Acacia/ Olneya/ Quercus/ broadleaves/* volume tables.
Abstract: Measurements made on *Juniperus* spp. (juniper species group - mainly *J. osteosperma*, *J. monosperma*, *J. deppeana*); *Pinus* spp. (pinyon species group - *P. edulis*, *P. cembroides*, *P. edulis* var. *fallax*); *Prosopis velutina*, *Acacia greggii* and *Olneya tesota* (mesquite species group); and *Quercus* spp. (oak species group - mainly *Q. emoryi*, *Q. arizonica*) from 291 plots were used to derive equations predicting volume from height and diameter near the root collar. Volume equations were constructed for single-stem and multiple-stem trees in each species group except pinyon, where only single-stem trees were considered. Results are presented in the form of graphs and volume tables, and compared with some of the results of other studies.

8. Chojnacky, D. C. Estimating diameter growth for pinyon and juniper trees in Arizona and New Mexico. Research Note Intermountain Research Station, USDA Forest Service. (INT-GTR-429). 1996; INT-GTR- 4296.
Keywords: *Juniperus monosperma/ Juniperus deppeana/ Juniperus scopulorum/ Juniperus osteosperma/ Pinus/* diameter growth/ Arizona/ New Mexico

Abstract: Diameter growth measurement is difficult for pinyon and juniper trees because they are slow-growing, multiple-stemmed, and poorly suited to measurement methods used for other temperate tree species. A model designed to estimate diameter growth for individual pinyon (*Pinus edulis*) and juniper (*Juniperus* spp.) trees from a small subsample of growth measurements is described. Data for model construction include 10-year radial growth sampled from 1,536 trees on 176 plots spread throughout Arizona and New Mexico. Species include *Pinus edulis*, *Juniperus monosperma*, *J. deppeana*, *J. scopulorum*, and *J. osteosperma*. The model predicts past 10-year diameter growth from stand-level growth-index measurement, tree diameter, and number of basal stems in a tree.

9. ---. Modeling diameter growth for pinyon and juniper trees in dryland forests. *Forest Ecology and Management*. 1997; 93(1/2):21-31.

Keywords: *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus deppeana*/ *Juniperus osteosperma*/ *Pinus edulis*/ diameter

Abstract: An individual-tree model has been developed to estimate diameter growth of pinyon pine (*Pinus edulis*) and juniper (*Juniperus monosperma*, *J. scopulorum*, *J. deppeana*, *J. osteosperma*) trees in pinyon-juniper dryland forests throughout New Mexico, USA. The model was built from radial growth data on 917 trees sampled from 82 plots. Individual tree growth can be predicted from measurements of tree diameter at the root collar, the number of basal stems per tree, and past 10-yr diameter growth of the median-sized stem in the stand of interest. Model development is patterned after growth and yield models for temperate forests in the western USA.

10. ---. Pinyon-juniper volume equations for the central Rocky Mountain states. Research Paper, Intermountain Forest and Range Experiment Station, USDA Forest-Service. (INT-339). 1985; INT-339(I):27 pp.

Keywords: *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Pinus edulis*/ *Pinus monophylla*/ *Quercus*/ *Cercocarpus*/ woodland/ volume tables

Abstract: Equations and volume tables are presented for *Juniperus monosperma*, *J. scopulorum*, *J. osteosperma*, *J. occidentalis*, *Pinus edulis*, *P. monophylla*, *Quercus macrocarpa*, *Q. gambelii*, *Cercocarpus* spp. and a group of broadleaved species in pinyon/juniper woodland in Nevada, Idaho, Utah, Colorado, Wyoming and South Dakota.

11. Chojnacky D. C. and Moisen G. G. Converting wood volume to biomass for pinyon and juniper. Research Note, US Department of Agriculture, Forest Service. INT-411. . 1993; INT-4115 pp.

Keywords: *Juniperus osteosperma*/ pinyon/ weight/ specific gravity/ Arizona/ Nevada

Abstract: The method uses specific gravity and biomass conversion equations to obtain foliage weight and total wood weight of all stems,

branches, and bark. Specific gravity data are given for several Arizona singleleaf pinyon Utah juniper species. Biomass conversion equations are constructed from *Juniperus osteosperma* - *Pinus monophylla* data collected in Nevada.

12. Covington W. W.; DeBano L. F., and Huntsberger T. G. Soil nitrogen changes associated with slash pile burning in pinyon-juniper woodlands. *Forest Science*. 1991; 37(1):347-355.
Keywords: *Juniperus monosperma*/ *Juniperus osteosperma*/ *Pinus edulis*/ soil nitrogen/ slash pile burning
Abstract: The effects of slash pile burning in a pinyon pine (*Pinus edulis*)/juniper (*Juniperus monosperma*, *J. osteosperma*) woodland that had been harvested for fuelwood were investigated using a time sequence study and experimental studies (both with repeated measurements) in the Coconino National Forest, Arizona. The results showed that burning caused immediate increases (approximately 50-fold) in soil ammonium concentrations. Nitrate concentrations were not immediately affected; however, by one year after burning, nitrate concentrations were approximately 20 times higher where piles had been burned than in unburned controls. These increases in inorganic nitrogen disappeared by year 5 after burning.
13. Davis, J. N. and Harper, K. T. Weedy annuals and establishment of seeded species on a chained juniper-pinyon woodland in central Utah. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-276). 1990; INT-27672-79.
Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ Utah/ *Bromus*/ *Ranunculus*/ weedy annuals/ seeded species
Abstract: A 300-ha juniper-pinyon (*Juniperus osteosperma*-*Pinus edulis*) site 4 km NE of Ephraim, Utah, that supported high densities of 2 weedy annuals, cheatgrass (*Bromus tectorum*) and bur buttercup (*Ranunculus testiculatus*), was chained to juniper + pinyon densities of 186 + 62 trees/ha in Nov. 1982 and was studied over the following 3 years following sowing with 9 species of grass, 7 forbs and 10 shrubs. Only 9 of the herbaceous species planted appeared in any of the 520 sample quadrats. Significant plot-to-plot variation in the density of 7 of the seeded species was explained by the initial densities of either bur buttercup or cheatgrass. The level of precipitation was not thought to be responsible for the poor establishment of seeded species, as it was 160% of the av. value in 1982. Almost without exception, the native and seeded perennial grass species increased over the period of observation. It was concluded that, although annual weeds interfered with the initial establishment of the seeded perennials, these species gradually became highly competitive with and strongly reduced the density of both bur buttercup and cheatgrass in time.
14. DeBano, L. F. and Klopatek, J. M. Phosphorus dynamics of pinyon-juniper soils

following simulated burning. Soil Science Society of America Journal. 1988; 52(1):271-277.

Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ phosphorus/ burning/ Arizona

Abstract: The objective of this study was to determine the effect of a simulated prescribed fire on P compounds in a Lithic Ustochrept soil supporting a pinyon-juniper woodland in Arizona. Soil, litter and duff collected from beneath pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) and adjacent interspaces were used to reconstruct laboratory microcosms in clay pipes that were burned when soils were wet or dry. Soil temperatures were monitored continuously throughout the microcosms during burning. Total, bicarbonate-extractable (BEP), microbial and organic P, phosphatase activity and organic C were measured in the soil, litter and duff before and immediately after burning and 45 and 90 d later. Soil texture, pH and CaCO₃ equivalents were also determined on unburned soils. Organic P and phosphatase activity were significantly higher in unburned juniper soils than under pinyon and interspaces. Total P and BEP were higher in unburned juniper litter than in pinyon litter. Organic P made up <35%, and BEP <5%, of the total soil P. About 50% of the total P was lost from the litter during burning. Burning significantly increased BEP in pinyon and juniper soils, but the increases were short-lived and became statistically insignificant after 45 d. Phosphatase activity was significantly reduced in pinyon pine and juniper soils when burned dry. Burning over wet soils did not affect phosphatase activity or the concentration of P compounds.

15. Ernst, R. and Pieper, R. D. Changes in pinon-juniper vegetation: a brief history. Rangelands. 1996; 18(1):14-16.

Keywords: *Juniperus monosperma*/ *Juniperus deppeana*/ *Juniperus osteosperma*/ *Pinus monophylla*/ *Pinus edulis*/ human activity/ vegetation types/ palaeoclimatology.

Abstract: The pinyon-juniper region of the southwestern USA and Mexico is comprised of morphologically different ecosystems across a heterogeneous landscape with a history of natural and induced disturbance regimes. Two pinyons (*Pinus monophylla* and *P. edulis*) and 3 junipers (*Juniperus deppeana*, *J. monosperma* and *J. osteosperma*) occur in these communities. This paper discusses how past climate, natural and induced fire, uses by prehistoric and historic humans, and recent large-scale clearing to increase forage for livestock have affected the structure and distribution of the pinyon-juniper complex.

16. Estola, J. D. Preliminary pinon-juniper volume tables. Resource Inventory-Notes. (BLM 18). 1979; BLM 18 6-8.

Keywords: *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Pinus edulis*/ volume tables

Abstract: Some 392 pinon pine trees (*Pinus edulis*) and 206 Rocky Mountain and Utah junipers (*Juniperus scopulorum* and *J. osteosperma*)

from New Mexico and Colorado were randomly selected and measured. From these data, tables were constructed from which cubic vol. can be determined from estimates of total ht., crown diam., and diam. at 1-ft stump ht. Though the tables may not provide accurate estimates of individual tree volumes, acceptable estimates can be obtained for groups of trees.

17. Evangelista, P; Stohlgren, T J; Guenther, D, and Stewart, S. Vegetation response to fire and postburn seeding treatments in juniper woodlands of the Grand Staircase-Escalante National Monument, Utah. *Western North American Naturalist*. 2004; 64(3):293-305; ISSN: 1527-0904.
Keywords: *Juniperus-osteosperma*/ botanical composition/ crusts/ fire effects/ forest fires/ ground cover/ natural regeneration/ plant communities/ population density/ sowing/ species richness
Abstract: We compared 3 naturally ignited burns with unburned sites in the Grand Staircase-Escalante National Monument, Utah, USA. Each burn site was restored with native and non-native seed mixes, restored with native seeds only, or regenerated naturally. In general, burned sites had significantly lower native species richness (1.8 vs. 2.9 species), native species cover (11% vs. 22.5%), and soil crust cover (4.1% vs. 15%) than unburned sites. Most burned plots, seeded or not, had significantly higher average nonnative species richness and cover and lower average native species richness and cover than unburned sites. Regression tree analyses suggest site variation was equally important to rehabilitation results as seeding treatments. Low native species richness and cover, high soil C, and low cover of biological soil crusts may facilitate increased nonnative species richness and cover. Our study also found that unburned sites in the region had equally high cover of nonnative species compared with the rest of the Monument. Cheatgrass (*Bromus tectorum*) dominated both burned and unburned sites. Despite the invasion of cheatgrass, unburned sites still maintain higher native species richness; however, the high cover of cheatgrass may increase fire frequency, further reduce native species richness and cover, and ultimately change vegetation composition in juniper woodlands
18. Evans, R. A. Management of pinyon-juniper woodlands. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-249). 1988; INT-249(II):34 pp.
Keywords: *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Pinus*/ management/ woodlands
Abstract: The pinyon/juniper woodlands are extensive in the western USA and are a valuable renewable resource for many uses. The occurrence and dominance of pinyon (*Pinus cembroides*, *P. monophylla* and *P. edulis*), juniper (*Juniperus deppeana*, *J. monosperma*, *J. scopulorum*, *J. osteosperma* and *J. occidentalis*), shrubs and herbs vary over the

spectrum of the woodlands which occur on many soil types and topographies with different climates. The manual describes the ecosystem and gives basic guidelines for management for forest products (mostly fuelwood, poles and posts, and pinyon nuts), forage and browse production, wildlife, recreation and watershed values.

19. Everett, R. L. Proceedings - Pinyon-juniper conference: Reno, NV, January 13-16, 1986. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-215). 1987; INT-215(VII):581 pp.
Keywords: *Juniperus osteosperma*/ *Juniperus deppeana*/ *Juniperus scopulorum*/ *Juniperus erythrocarpa*/ *Pinus*/ vegetation types/ management.
Abstract: More than 90 papers are presented on the ecology and management of pinyon/juniper ecosystems which occur over large areas of the western USA. The major pine species are *Pinus edulis*, *P. monophylla* and *P. cembroides*; the most important juniper associates are *Juniperus monosperma*, *J. osteosperma*, *J. deppeana*, *J. scopulorum* and *J. erythrocarpa*. Topics discussed include the woodlands in general, palaeobotany, inventory and classification, synecology, silvics and silviculture, fire response, economics, plant water relations, woodland conversion, range management, wildlife, woodland hydrology and nutrient cycling.
20. Everett R. L. and Sharrow S. H. Response of grass species to tree harvesting in single leaf pinyon-Utah juniper stands. Research Paper, Intermountain Forest and Range Experiment Station, USDA Forest Service. (INT-334). 1985; INT-3347 pp.
Keywords: *Juniperus osteosperma*/ *Pinus*/ *Poa sandbergii*/ *Festuca idahoensis*/ *Elymus*/ *Koeleria* / harvesting/ yield/ cover
Abstract: Cover, yield and nutrient content of *Poa sandbergii*, *Festuca idahoensis*, *Sitanion hystrix* [*Elymus elymoides*] and *Koeleria cristata* [*K. macrantha*] were sampled on N.-, W.- and S.- facing plots of a *Pinus monophylla*/*Juniperus osteosperma* stand, with or without removal of all trees >1 m high. Grass cover increased rapidly for the first 2 years after clearing, but the rate of increase declined over the following 32 years. Grass yield varied among aspects and soil microsites on harvested plots, but tree competition masked the effect on non-cleared sites. Grass spp. in cleared plots had greater yield and N and P content than on non-cleared plots. In cleared plots, tree-associated microsites had higher yield/unit area than microsites between trees. Clearing decreased the area required/animal unit from 11 to 3 and from 17 to 2 ha on N.- and W.- facing sites, resp., but had no effect on the S.- facing site. Protein content was adequate for livestock on cleared plots (N. and W.), but were below recommendations for deer.
21. Everett, R. L. and Sharrow, S. H. Understory seed rain on tree-harvested and unharvested pinyon-juniper sites. Journal of Environmental

Management. 1983; 17(4):349-358.

Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ seeds/
harvesting

Abstract: Number of filled seeds reaching the soil surface was measured for 2 yr in adjacent harvested/unharvested plots in *Pinus monophylla*/*Juniperus osteosperma* woodlands on N., W. and S. aspects of the Shoshone Mtns. in central Nevada. Quantity and species composition varied between years but total seed rain was greater on harvested than unharvested plots and on mesic than xeric sites. Seed rain continued to increase from the first to second year after tree harvest.

22. Everett, R. L. and Ward, K. Early plant succession on pinyon-juniper controlled burns. Northwest Science. 1984; 58(1):57-68.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ succession/
prescribed burning
Abstract: Cover of ground vegetation and understory species was recorded before burning and at the end of the growing season for 4-5 yr after controlled burns in 1975-76 on 6 sites in *Pinus monophylla*/*Juniperus osteosperma* woodland on the E. slope of the White River Mts., E. Nevada. Results suggested that succession was site-specific and started from a continuum of preburn assemblages with multiple entrance points into the successional model. Qualitative, but not quantitative, predictions could be made of plant response after the fire.
23. Everett, Richard L. Understory seed rain in harvested pinyon-juniper woodlands . Great Basin Naturalist . 1986 Oct 31; 46(4):706-710; ISSN: 0017-3614.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ seed rain/
microsites/ pinyon-juniper woodlands/ singleleaf pinyon/ Utah juniper
Call Number: 410 G79
Abstract: Seed rain was collected on six paired tree harvest and undisturbed plots in singleleaf pinyon(*Pinus monophylla*) - Utah juniper(*Juniper osteosperma*) stands. Approximately 14,600 seeds were collected during four years. Seed rain in undisturbed plots was similar to levels in mixed forest communities. Seed rain on harvest plots was similar to disturbed sites and grasslands. Seed rain levels reflect the current successional stage rather than the climax community type for the site. Seed rain increased in numbers and seed production per unit of plant cover following tree removal and especially on transition soil microsites. Only three to four of the plant species present on a site contributed greater than 10% of the total seed rain. Seed rain composition was similar on harvest and undisturbed plots(Jacard Similarity Index Values = 47% to 67%) and explains in part the rapid establishment of predisturbance understory communities.
24. Floyd, M. L.; Hanna, D. D., and Romme, W. H. Historical and recent fire regimes in Pinon-Juniper woodlands on Mesa Verde, Colorado, USA. Forest Ecology and Management. 2004; 198(1/3):269-289.

Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ woodlands/ Colorado/ fire

Abstract: The fire history of Pinon-Juniper (*Pinus edulis* - *Juniperus osteosperma*) woodlands in much of the southwestern United States is poorly understood, and as a result, fire management decisions are being made without a rigorous ecological underpinning. We investigated the historic fire regimes in Pinon-Juniper woodlands on the Mesa Verde cuesta utilizing stand and age structures. All Pinon trees in eight stands were aged and stand age was extrapolated to the surrounding landscapes using digital imagery, creating a time-since-fire map of the 1995 landscape. Six sampled stands were over 400 years, while two were between 200 and 300 years. Stand-replacing fire with a rotation of 400 years or longer characterized this Pinon-Juniper landscape before 1995; low-severity surface fires apparently have never been an important component of the fire regime in Mesa Verde. Superposed epoch analysis revealed that large fires occur following significantly low precipitation in May or in the winter (October-March) preceding a summer fire season. Since the mid-1990's, a severe drought has characterized climate in this region, but the recent drought is similar to previous drought periods since 1950. A combination of canopy fuel build-up during two wet decades before 1995 and the current drought conditions has resulted in unprecedented fire activity (six large wildfires between 1996 and 2003) when compared with the reference period 1700-1900. We may be witnessing a unique period in the ecological history of the southwest, a period when vegetation patterns are being altered over extensive areas within a very short time. If the current drought continues, we ultimately may lose much of the old-growth Pinon-Juniper woodland in the southwest. We emphasize however, that these changes are not due to fire suppression or other direct human intervention but rather result from natural ecological responses to climatic variability. Therefore, our data provide no ecological justification for aggressive management activities such as mechanical fuel reduction or prescribed burning, except in the immediate vicinity of vulnerable cultural resources.

25. Fuentes; Marcelino; Schupp, and Eugene W. Empty seeds reduce seed predation by birds in *Juniperus osteosperma*. *Evolutionary Ecology*. 1998 Oct; 12(7):823-827.

Keywords: *Juniperus osteosperma*/ Utah juniper/ seed/ parthenocarpic/ *Parus inornatus*. empty seed

Abstract: Utah juniper (*Juniperus osteosperma*) is one of many plant species that produce large numbers of fruits containing parthenocarpic or otherwise empty or unviable seeds. We tested the hypothesis that production of empty fruits in this species results in reduced levels of predation on fertile seeds. In a population in west-central Utah, we estimated the proportion of fruits with filled seeds in trees suffering high levels of fruit destruction by the seed-eating bird *Parus inornatus* and in neighboring trees similar in crown and fruit-crop size but suffering

negligible predation. We found that the heavily attacked trees had higher proportions of filled seeds. Thus, juniper may benefit from producing fruits that contain no offspring. This is the first study to demonstrate that empty seeds may reduce predation by vertebrate seed eaters and the first to demonstrate discrimination based on seed filling at the level of whole plants.

26. Gifford, G. F. Impact of burning and grazing on soil water patterns in the pinyon-juniper type. *Journal of Range Management*. 1982; 35(6):697-699.
Keywords: *Juniperus osteosperma/ Pinus edulis/ Agropyron cristatum/* soil moisture/ burning
Abstract: Soil moisture was recorded from June 1973 to Feb. 1977 in Utah on: (a) *Pinus edulis/ Juniperus osteosperma* woodland; (b) woodland chained, windrowed and grazed from March 1974; (c) as (b) but not grazed; (d) woodland chained with debris in place, and burned in 1974; and (e) as (d) but left unburned. Areas (b) to (e) were first chained in 1967, and drill- or broadcast-sown with *Agropyron cristatum*. Untreated control woodland (a) always had the least soil water. Grazing did not affect soil water. There was significantly more water on the burned area (d) than on the unburned area (e) at the beginning of the second year. Up to Aug. 1974 treatment (e) produced more soil water than (c), but after that soil moisture readings were n.s.d.
27. Greenwood, L. R. and Brotherson, J. D. Ecological relationships between pinyon-juniper and true mountain mahogany stands in the Uintah Basin, Utah. *Journal of Range Management*. 1978; 31(3):164-167.
Keywords: *Juniperus osteosperma/ Pinus edulis/ Cercocarpus montanus/* Utah/ ecology
Abstract: Discrimination analysis of 15 variables used in the classification of mountain mahogany (*Cercocarpus montanus*) and *Pinus edulis/ Juniperus osteosperma* stands selected percentage rock cover and soil depth, pH and salt content beneath and between plants as those factors contributing most to the process of discrimination. *C. montanus* communities were dominated by grasses and shrubs and included large areas of soil-free sandstone. Av. plant cover was 12.8% and soil beneath and between plants had a pH of 7.9 and 7.7 and a salt content of 157 and 256 p.p.m., resp. *P. edulis/ J. osteosperma* vegetation consisted mainly of trees and annuals. Av. plant cover was 26.8% and soil beneath and between plants had a pH of 7.7 and 7.6 and a salt content of 482 and 157, resp. Differences in soil characteristics were ascribed mainly to the dispersal of shed leaves from mountain mahogany sites and their accumulation under pinyon/juniper vegetation.
28. Harper, K. T.; Sanderson, S. C., and McArthur, E. D. Pinyon-juniper woodlands in Zion National Park, Utah. *Western North American Naturalist*. 2003; 63(2):189-202.
Keywords: *Juniperus osteosperma/ Juniperus monophylla/ Pinus*

edulis/ nature conservation/ plant communities.

Abstract: *Juniperus osteosperma*-*Pinus monophylla* or *P. edulis* (P-J) woodlands are the most widespread plant community in Zion National Park (ZNP), southwestern Utah, USA. These woodlands dominate nearly half of the park's land area. Our study of this vegetational complex is based on a sample consisting of 115 macroplots (each 0.01 ha in area) objectively distributed across the entire area of ZNP. We recognize 3 subtypes within the P-J complex: *J. osteosperma* (Utah juniper) alone, juniper with *P. monophylla* (single-leaf pinyon), and juniper with *P. edulis* (two-leaf pinyon). The 2 pinyon pines rarely occur together, and thus the foregoing subtypes do not overlap geographically to a significant extent. The first 2 subtypes occur primarily below 1800 m elevation, while the latter is most commonly found above that elevation. Because of the scarcity of sizable expanses (over ~10 ha) of well-developed soils in ZNP, the P-J complex occurs primarily on sites where exposed bedrock covers a large portion of the habitat. As a result, over 90% of stands assigned to the P-J complex support less than 50% tree canopy cover (64% have less than 25% tree cover). Shrub cover increases along the woodland successional gradient. Pinyon cover increases faster than juniper cover. Microbiotic soil crust cover is consistently greater in *J. osteosperma*-*P. monophylla* woodlands than in *J. osteosperma*-*P. edulis* woodlands, but total living cover increases significantly along the successional gradient in both communities. To enhance plant and animal biodiversity, we recommend that pinyon-juniper woodlands of Zion National Park be managed so that late seral stages do not dominate large tracts.

29. Horman, C. S. and Anderson, V. J. Understory species response to Utah juniper litter. *Journal of Range Management* . 2003; 56(1):68-71.

Keywords: *Juniperus osteosperma*/ *Pseudoregnaria*/ *Elymus*/ *Bromus*/ *Dactylis*/ *Linum*/ *Sanguisorba*/ *Purshia*/ *Artemisia*/ litter/ understory

Abstract: A greenhouse study was conducted to determine the effects of litter leachate and litter depth of Utah juniper (*Juniperus osteosperma*) on seedling emergence and emergence rate of 8 common herbaceous understory species. Species tested were: 'Secar' bluebunch wheatgrass (*Pseudoroegneria spicata* [*Elymus spicatus*]), bottlebrush squirreltail (*Elymus elymoides*), cheatgrass (*Bromus tectorum*), 'Paiute' orchardgrass (*Dactylis glomerata*), 'Appar' Lewis flax (*Linum lewisii*), 'Delar' small burnet (*Sanguisorba minor*), antelope bitterbrush (*Purshia tridentata*), and mountain big sagebrush (*Artemisia tridentata*). Three water treatments (distilled water, 1%, and 10% litter leachates) and 3 litter depths (0, 3, and 5 cm) were tested. Leachates decreased seedling emergence of orchardgrass and small burnet. Emergence rate was unaffected by leachate treatments. Seedling emergence of all species tested decreased significantly with increasing litter depth. Emergence rate was initially slower in pots with litter, but after 2 weeks no differences were found.

30. Johnsen, T. N. Jr. Picloram in water and soil from a semiarid pinyon-juniper watershed. *Journal of Environmental Quality*. 1980; 9(4):601-605.
Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ plant communities/ herbicides.
Abstract: A mixture of picloram (4-amino-3,5,6-trichloropicolinic acid) at 2.8 kg acid equivalent (ae)/ha and 2,4-D [(2,4-dichlorophenoxy) acetic acid] at 5.6 kg acid equivalent/ha was aerially applied onto 113 ha of a 146-ha pinyon-juniper watershed [*Juniperus osteosperma* (Torr.) Little and *Pinus edulis* Engelm., respectively] in north-central Arizona. Picloram residues in runoff water and soil were monitored. Picloram was detected in runoff water leaving the treated area for 30.5 months after application. The highest concentration, 320 ppbw, was in the initial runoff after treatment. A total of 1.1% of the picloram applied left the treated area in runoff water. Picloram was not detected farther than 5.6 km downstream. The picloram concentration was relatively constant during runoff events unless water from snow melt or from an untreated area mixed with the runoff from the treated area. Less picloram came from an area with individually treated trees than from an area with broadcast application. Dip (grab), single-stage flood, or splitter-box water samples all gave comparable picloram contents from the same location with the same runoff event. Picloram was detected in the soils for 44 months, mainly below the 45-cm depth down to bedrock at 122 cm.
31. Johnsen, T. N. Jr. and Elson, J. W. Sixty Years of Change on a Central Arizona Grassland-Juniper Woodland Ecotone. US Department of Agriculture, Agricultural Review and Manuals. (ARM-W-7). 1979; ARM-W-728.
Keywords: *Juniperus osteosperma*/ *Quercus turbinella*/ *Cowania mexicana*/ *Cercocarpus betuloides*/ *Fallugia paradoxa*/ grazing/ rangeland/ species composition
Abstract: 20 pairs of photographs taken in 1916 and 1977 at 14 grassland/juniper sites in central Arizona are presented. Grazing markedly affected understory spp. composition, especially near reliable water before 1916 and with repeated summer grazing later. Junipers greatly increased in numbers and size on hillsides and rocky ridges, but not on low ground. *Juniperus osteosperma* was rapidly becoming re-established on areas cleared in 1959-60, but its open growth habit suggested that conditions approached the limit for the sp. *Shrub* spp. such as *Quercus turbinella*, *Cowania mexicana*, *Cercocarpus betuloides* and *Fallugia paradoxa* did not spread, but cover in the stands increased greatly in the 60-yr period.
32. Johnson, A. E.; James, L. F., and Spillet, J. The abortifacient and toxic effects of big sagebrush (*Artemisia tridentata*) and juniper (*Juniperus osteosperma*) on domestic sheep. *Journal of Range Management*. 1976; 29(4):278-280.
Keywords: *Juniperus osteosperma*/ *Artemisia tridentata*/ sheep/ pregnancy/ abortion

Abstract: *Artemisia tridentata* fed to sheep by stomach pump during the second trimester of pregnancy produced no reproductive difficulties. However, ewes died when 0.75 lb was fed by this method daily for 1, 2 or 3 days. Sagebrush fed at 0.25 lb per day and slowly increased to 0.75 lb per day was not toxic. Juniper fed to sheep at 1 lb/day in an interrupted series of feedings totaling 30 days in the second and early third trimester of pregnancy caused abortion in two sheep and birth of a weak lamb from a third sheep, but attempts to confirm these findings by feeding juniper to other sheep between the 60th and 90th days of gestation were not successful. The principal acute lesion in sagebrush poisoning was a severe necrotic rumenitis which developed rapidly and produced systemic shock.

33. Klopatek C. C. and Klopatek J. M. Nitrifiers and mycorrhizae in pristine and grazed pinyon-juniper ecosystems. *Arid Soil Research and Rehabilitation*. 1997; 11(4):331-342.

Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ mycorrhiza/ nitrifiers/ bacteria

Abstract: Soils from grazed and pristine pinyon [*Pinus edulis*]-juniper [*Juniperus osteosperma*] ecosystems in Arizona, USA, were compared for the numbers of chemoautotrophic nitrifying bacteria, and the distribution of vesicular-arbuscular mycorrhizas (VAM) and ectomycorrhizae (EM) was determined. Additionally, the presence of allelopathic substances in organic horizons was studied. Ammonium (NH₄⁺)-oxidizing bacteria were in greater numbers in the interspaces between the trees, ranging from 9.60 x 10⁴ to 2.13 x 10⁵ bacteria/g soil, than under the canopies (3.5 x 10⁴ to 4.8 x 10⁴ bacteria/g soil). Grazed interspace soils had over twice the number of NH₄⁺ oxidizing bacteria than any other location. There were no differences in the numbers of nitrite-oxidizing bacteria between either vegetative covers or sites. The rate of nitrate production did not correlate with the number of nitrifiers. However, there was a significant correlation between mineralization coefficients of total N and the total number of nitrifiers. Fourteen known and ten unknown monoterpenes were found in soils under pinyon pine and juniper canopies. VAM spore numbers were significantly greater under canopies than in interspace soils at both sites, with the lowest number recorded in grazed interspace soils. No differences were found in the degree of colonization of either EM or VAM on pinyon pine or juniper, respectively, between each site. The differences in the spatial distribution of nitrifiers and mycorrhizas emphasized the complexities of the below ground ecosystem in these woodlands despite their apparent aboveground structural simplicity.

34. Klopatek, J. M. Nitrogen mineralization and nitrification in mineral soils of pinyon-juniper ecosystems. *Soil Science Society of America Journal*. 1987; 51(2):453-457.

Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ nitrification/ mineralization

Abstract: The mineral soils in the interspaces and under canopy of three

pinyon (*Pinus edulis*)-juniper (*Juniperus osteosperma*) woodland communities were analyzed to determine their nutrient status and potential N mineralization and nitrification. A > 400-yr-old ungrazed, a 300-yr-old grazed, and a 35-yr-old burned and grazed site were represented. Significant differences were noted in soil pH, texture, bulk density, total N, organic C, and NaHCO₃ extractable P between the canopies and the respective interspaces of the mature sites. No differences were noted between the canopy soils of the ungrazed and grazed mature sites. The 35-yr-old canopy soils showed significantly less total N and organic C than the mature sites. Interspaces exhibited relatively few differences between sites. Both canopy and interspace soils exhibited linear rates of mineralization and nitrification over the 60-d incubation. On all sampling dates there were significant differences in mineralization and nitrification rates between the canopy and interspace soils. The proportion of total N mineralized was highest for the most disturbed (burned, grazed) canopy soils and lowest for the least disturbed (ungrazed). The results obtained indicate that nitrification is not inhibited in mature pinyon-juniper woodlands, but suggest that the rate of N mineralization and nitrification may be enhanced by disturbance.

35. Klopatek, J. M.; Klopatek, C. C., and DeBano, L. F. Potential variation of nitrogen transformations in pinyon-juniper ecosystems resulting from burning. *Biology and Fertility of Soils*. 1990; 10(1):35-44.
Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ nitrogen transformations/ burning/ bacteria
Abstract: Forest floor litter, duff, and underlying soils were assembled in laboratory microcosms representing pinyon (*Pinus edulis*), juniper (*Juniperus osteosperma*), and interspace field conditions. Burning removed more than 95% of both N and C from the litter, with losses from the duff dependent on soil moisture conditions. No significant changes in total N or C were noted in the soil. Immediate increases were observed in soil NH₄⁺, decreasing with depth and related to soil heating. The greatest increases were noted in both the pinyon and juniper soils that were dry at the time of the burn, with interspace soils exhibiting the least changes. Soil NH₄⁺ closely approximated the controls on day 90 after the burns in all treatments. Ninety days after the burn, microbial biomass N was highest in the controls, followed by the wet- and then the dry-burned soils, in both the pinyon and juniper microcosms. This was inversely related to the levels of accumulated NO₃⁻. Nitrifying bacteria populations were indirectly correlated with soil temperatures during the burn. Population levels 90 days after the burn showed increases in both the wet- and the dry-burn treatments, with those in the pinyon treatments exceeding those found in the initial controls of pinyon soils.
36. Koniak, S. Succession in pinyon-juniper woodlands following wildfire in the Great Basin. *Great Basin Naturalist*. 1985; 45(3):556-566.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ wildfire/ Great

Basin

Abstract: Data on occurrence and canopy cover of individual plant species were collected from 21 areas in pinyon/juniper (*Pinus monophylla*/*Juniperus osteosperma*) woodlands that had been burned by wildfire 1-60 yr earlier and in adjacent unburned mature stands in Nevada and California. One yr after burning, all late successional woodland species were present except trees. Tree species began to re-establish 20-30 yr after fire, but cover was minimal even 60 yr after burning.

37. ---. Tree densities on pinyon-juniper woodland sites in Nevada and California. *Great Basin Naturalist*. 1986; 46(1):178-184.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ tree density/ woodlands/ Nevada/ California
Abstract: Densities of pinyon (*Pinus monophylla*) and juniper (*Juniperus osteosperma*) in four diam. classes were measured on 522 plots (each 0.1 ha) in 20 areas in Nevada and California. One-way and 2-way analyses of variance were used to compare number of trees per plot and % of the total tree density in each diam. class on eastern and western Great Basin sites, on N., S., E. and W. aspects and at high and low alt. The point used to differentiate between high and low alt. was 2160 m in eastern areas and 2040 m in western areas. At most sites, N. and (to a lesser extent) W. slopes supported higher densities of pinyon than S. and E. slopes, with more small trees on N. slopes and large trees on W. slopes. Pinyon densities were higher on eastern sites and at higher alt. Juniper densities were higher on eastern sites and at lower alt. On low alt. sites, juniper densities in the western area were greater on S. and W. aspects while in the eastern area densities were greater on N. and W. slopes.
38. Lavin, F.; Jameson, D. A., and Gomm, F. B. *Juniperus* extract and deficient aeration effects on germination of sex range species. *Journal of Range Management*. 1968; 21:262-263.
Keywords: *Juniperus osteosperma*/ germination/ foliage/ extract/ *Agropyron*/ *Atriplex*/ *Bouteloua*/ *Eragrostis*
Abstract: *Juniperus* foliage extract significantly decreased seed germination for three of six range species tested. Deficient aeration severely decreased germination for two species and completely inhibited germination of the other four. *Juniper* foliage extract was from *Juniperus osteosperma* (Torr.) Little. Range species tested were *Agropyron desertorum*, *A. trichophorum*, *Atriplex canescens*, *Bouteloua curtipendula*, *B. gracilis* and *Eragrostis curvula*.
39. Leffler, A. J. and Caldwell, M. M. Shifts in depth of water extraction and photosynthetic capacity inferred from stable isotope proxies across an ecotone of *Juniperus osteosperma* (Utah juniper) and *Artemisia tridentata* (big sagebrush). *Journal of Ecology Oxford*. 2005; 93(4):783-793.
Keywords: *Juniperus osteosperma*/ *Artemisia tridentata*/ ecotone/

water extraction/ photosynthetic capacity

Abstract: In western North America, juniper trees (*Juniperus* spp.) are apparently encroaching into numerous communities including sagebrush-dominated (*Artemisia tridentata*) valleys, where, as density of juniper increases, the density and condition of sagebrush decline but juniper condition appears unaffected. We examined stable isotope proxies of plant gas exchange and relative depth of soil water extraction of *Juniperus osteosperma* and *Artemisia tridentata* as their relative densities changed across a transition zone in northern Utah, USA. Measurement of ^{13}C and ^{18}O of foliage allowed separation of the contributions of stomatal and biochemical factors to differences in mean intercellular CO_2 concentration, while deuterium composition of stem water served as an indicator of the relative depth of water extraction. Leaf $\delta^{13}\text{C}$ of juniper and, to a lesser extent, of sagebrush increased with decreasing density of juniper. Foliage ^{18}O did not vary significantly with juniper density, indicating that this was primarily caused by an increase in photosynthetic capacity rather than decreased supply of CO_2 . Increased foliage nitrogen concentration of both species with decreasing juniper density is also consistent with increased photosynthetic capacity. The much greater mean age of juniper trees in the high juniper density plots may explain their lower photosynthetic capacity. Averaged across densities, juniper always extracted water deeper in the profile than did sagebrush, but in June and August, only the high juniper density plots showed an effect. Sagebrush is either restricted from using water at greater depth in the presence of juniper at high density or was in such poor condition that deep-water sources were not necessary to maintain their reduced function. Ecotones can serve as useful, spatially constrained stages for examining resource partitioning and relationships among plant species. We observed spatial and temporal variation in resource use and partitioning of limited resources that will enable better design of manipulative experiments to explicitly examine competition.

40. Leffler, A. J.; Ryel, R. J.; Hipps, L.; Ivans, S., and Caldwell, M. M. Carbon acquisition and water use in a northern Utah *Juniperus osteosperma* (Utah juniper) population. *Tree Physiology*. 2002; 22(17):1221-1230.

Keywords: *Juniperus osteosperma*/ Utah/ water use/ carbon acquisition/ plant water potential

Abstract: Water use and carbon acquisition were examined in a northern Utah population of *Juniperus osteosperma* (Torr.) Little. Leaf-level carbon assimilation, which was greatest in the spring and autumn, was limited by soil water availability. Gas exchange, plant water potential and tissue hydrogen stable isotopic ratio (δD) data suggested that plants responded rapidly to summer rain events. Based on a leaf area index of 1.4, leaf-level water use and carbon acquisition scaled to canopy-level means of 0.59 mm day⁻¹ and 0.13 mol m⁻² ground surface day⁻¹, respectively. Patterns of soil water potential indicated that *J. osteosperma* dries the soil from the surface downward to a depth of about 1 m. Hydraulic

redistribution is a significant process in soil water dynamics. Eddy covariance data indicated a mean evapotranspiration rate of 0.85 mm day⁻¹ from March to October 2001, during which period the juniper population at the eddy flux site was a net source of CO₂ (3.9 mol m⁻² ground area). We discuss these results in relation to the rapid range expansion of juniper species during the past century.

41. Lei S. A. Combined effects of drought and *Phoradendron juniperinum* infestation severity on fruit characteristics of *P. juniperinum* and its *Juniperus osteosperma* hosts. Bulletin Southern California Academy of Sciences. 2001; 100(2):86-95.

Keywords: *Juniperus osteosperma*/ *Phoradendron juniperinum*/ fruit/ drought/ parasite/ seed

Abstract: The interactive effects of severe drought and severity of *Phoradendron juniperinum* (juniper mistletoe) infestation on fruit characteristics of parasitic *P. juniperinum* and its *Juniperus osteosperma* (Utah juniper) host trees were examined in Pine Creek of the Red Rock Canyon National Conservation Area in southern Nevada. A severe drought, characterized by extremely low precipitation and above average air temperatures, started in January and persisted through mid-July 1997. Significant interactions were detected between drought and parasite severity for fruit production, fruit water content, diameter, thickness, dry mass as well as seed length and seed dry mass of *P. juniperinum*. Similarly, significant interactions were found between drought and parasite severity for fruit and seed characteristics of *J. osteosperma* hosts. There was also evidence for significant correlations between the drought parasite severity combination and all of the fruit traits measured in both hosts and parasites, and evidence for more positive correlations with parasites as the severity of drought increased in Pine Creek.

42. Lei S. A. Variation in germination response to temperature and water availability in blackbrush (*Coleogyne ramosissima*) and its ecological significance. Great Basin Naturalist. 1997; 57(2):172-177.

Keywords: *Juniperus osteosperma*/ seeds/ germination/ blackbrush/ *Coleogyne ramosissima*/ Utah juniper

Abstract: Blackbrush (*Coleogyne ramosissima* Torr.) is a dominant desert shrub in a distinct mid-elevational vegetation belt between creosote bush-bursage (*Larrea tridentata*-*Ambrosia dumosa*) shrubland below and big sagebrush-pinyon pine-Utah juniper (*Artemisia tridentata*-*Pinus monophylla*-*Juniperus osteosperma*) woodland above in the Mojave Desert. Seed germination patterns of blackbrush seeds collected from 2 elevations (1200 and 1550 m) in 5 mountain ranges within the blackbrush shrublands were investigated. Morphological features of blackbrush seeds, including weight, length, and width, were not significantly different ($P > 0.05$) among elevations and mountain ranges in the Mojave Desert. Germination of blackbrush seeds was optimal when preceded by a prechill period of 4-6 wk. Seeds incubated at room temperature germinated poorly

Seeds collected at warm, low-elevation sites appeared to be less dormant (required less prechill time), germinated faster, and showed a higher overall germination response at low temperature relative to cold, high-elevation sites. Frequencies of watering also determined the germination response; watering at 2-wk intervals revealed the greatest germination. Some ecotypic variation among populations establishing at different elevations was evident with regard to dormancy duration and germination response at certain constant temperatures.

43. Linton, M. J.; Sperry, J. S., and Williams, D. G. Limits to water transport in *Juniperus osteosperma* and *Pinus edulis*: Implications for drought tolerance and regulation of transpiration. *Functional Ecology*. 1998; 12(6):906-911.
Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ drought/ water transport/ transpiration
Abstract: An air-injection method was used to study loss of water transport capacity caused by xylem cavitation in roots and branches of *Pinus edulis* (Colorado Pinyon) and *Juniperus osteosperma* (Utah Juniper). These two species characterize the Pinyon-Juniper communities of the high deserts of the western United States. *Juniperus osteosperma* can grow in drier sites than *P. edulis* and is considered the more drought tolerant. 2. *Juniperus osteosperma* was more resistant to xylem cavitation than *P. edulis* in both branches and roots. Within a species, branches were more resistant to cavitation than roots for *P. edulis* but no difference was seen between the two organs for *J. osteosperma*. There was also no difference between juveniles and adults in *J. osteosperma*; this comparison was not made for *P. edulis*. 3. Tracheid diameter was positively correlated with xylem cavitation pressure across roots and stems of both species. This relation suggests a trade-off between xylem conductance and resistance to xylem cavitation in these species. 4. During summer drought, *P. edulis* maintained higher predawn xylem pressures and showed much greater stomatal restriction of transpiration, consistent with its greater vulnerability to cavitation, than *J. osteosperma*. 5. These results suggest that the relative drought tolerance of *P. edulis* and *J. osteosperma* results in part from difference in their vulnerability to xylem cavitation.
44. Meeuwig, R. O. and Budy, J. D. Point and line-intersect sampling in pinyon-juniper woodlands. General Technical Report, Intermountain Forest and Range Experiment Station, USDA Forest Service. (INT-104). 1981; INT-10438.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ forest inventories/ sampling.
Abstract: Methods are given for point sampling of predominantly *Pinus monophylla* stands, using a method based on stem angle, and for line-intersect sampling of *P. monophylla* and/or *Juniperus osteosperma* [see FA 40, 3396]. For each method, equations are given for estimating:

cordwood and slash volumes; above ground biomass; foliage and fine fuels; canopy cover; trees/unit area; stand b.a.; and growth rates.

45. Meeuwig, R. O. and Cooper, S. V. Site quality and growth of pinyon-juniper stands in Nevada. *Forest Science*. 1981; 27(3):593-601.
Keywords: *Juniperus osteosperma/ Pinus monophylla/* growth/ topography
Abstract: Potential b.a. growth (in ft²/acre per decade) is suggested as a site quality index for *Pinus monophylla/ Juniperus osteosperma* woodlands in Nevada. Graphs of b.a. development are given for stands in 13 stem analysis plots (4 in California); b.a. increases gradually at first becoming constant when the stand is fully stocked. Relations between b.a. growth and site factors were investigated in 103 other stands (including some in California and Utah) using line sampling. Data from the 2 studies were pooled and analyzed using regression techniques to give an equation for estimating site index. The index can be estimated for any site using the regression model, which includes slope gradient, aspect, land form and parent material. Potential biomass production is proportional to the site index.
46. ---. Stand estimates of biomass and growth in pinyon [*Pinus monophylla*]-juniper [*Juniperus osteosperma*] woodlands in Nevada. Research Note, Intermountain Forest and Range Experiment Station, USDA Forest Service. (INT-311). 1981; INT-3113.
Keywords: *Juniperus osteosperma/ Pinus monophylla/* biomass/ growth/ Nevada
47. O'Brien, J. V. and Fisher, J. T. Seed handling and germination of New Mexico native junipers. *HortScience*. 1980; 15(3, II):396-397; ISSN: 0018-5345.
Keywords: *Juniperus osteosperma/ Juniperus monosperma/* seeds/ growth regulators
Abstract: Seed of *Juniperus monosperma* and *J. osteosperma*, harvested in 1978 and 1979, was used to determine optimal harvest dates and criteria for seed maturity. Seeds were imbibed, stratified and germinated using different time, temp. and light treatments in the laboratory. They were also soaked in solutions of GA₃, kinetin, H₂O₂ and ethephon to increase germination and reduce stratification requirements. Results showed that germination can be increased by carefully chosen harvest and pre-germination practices.
48. Pavlacky, David C. Jr. and Anderson, Stanley H. Comparative habitat use in a juniper woodland bird community. *Western North American Naturalist*. 2004 Aug; 64(3):376-384.
Keywords: *Juniperus osteosperma/* bird/ Utah juniper/ habitat
Abstract: We compared vegetation structure used by 14 bird species during the 1998 and 1999 breeding seasons to determine what habitat features best accounted for habitat division and community organization

in Utah juniper (*Juniperus osteosperma*) woodlands of southwestern Wyoming. Habitat use was quantified by measuring 24 habitat variables in 461 bird-centered quadrats, each 0.04 ha in size. Using discriminant function analysis, we differentiated between habitat used by 14 bird species along 3 habitat dimensions: (1) variation in shrub cover, overstory juniper cover, mature tree density, understory height, and decadent tree density; (2) a gradient composed of elevation and forb cover; and (3) variation in grass cover, tree height, seedling/sapling cover, and bare ground/rock cover. Of 14 species considered, 9 exhibited substantial habitat partitioning: Mourning Dove (*Zenaida macroura*), Bewick's Wren (*Thryomanes bewickii*), Blue-gray Gnatcatcher (*Polioptila caerulea*), Mountain Bluebird (*Sialia currucoides*), Plumbeous Vireo (*Vireo plumbeus*), Green-tailed Towhee (*Pipilo chlorurus*), Brewer's Sparrow (*Spizella breweri*), Dark-eyed Junco (*Junco hyemalis*), and Cassin's Finch (*Carpodacus cassinii*). Our results indicate juniper bird communities of southwestern Wyoming are organized along a 3-dimensional habitat gradient composed of woodland maturity, elevation, and juniper recruitment. Because juniper birds partition habitat along successional and altitudinal gradients, indiscriminate woodland clearing as well as continued fire suppression will alter species composition. Restoration efforts should ensure that all successional stages of juniper woodland are present on the landscape.

49. Reinsvold, R J Reprint author and Reeves, F B Author. The mycorrhizae of *Juniperus osteosperma* identity of the vesicular- arbuscular mycorrhizal symbiont and resynthesis of vesicular- arbuscular mycorrhizae. Mycologia. 1986; 78(1):108-113.
Keywords: *Juniperus osteosperma*/ *Glomus fasciculatum*/ mycorrhizae/ ectomycorrhizae
Abstract: In Utah juniper, *Juniperus osteosperma*, an important tree of the western United States, both vesicular-arbuscular (VA) and ectomycorrhizae occur on excavated roots collected from natural, undisturbed sites in Colorado. Based on the "inoculated pot culture" technique, *Glomus fasciculatum* is the native VAM fungal symbiont. By means of rooted stem cuttings, resynthesis of VA mycorrhizae with two isolated of *G. fasciculatum* and one of *G. mosseae* was achieved. The reported mycorrhizal status of additional *Juniperus* species is given.
50. Rhea, H T. and McGlothlin, J. W. Measurement techniques in the pinyon [*Pinus monophylla*] juniper [*Juniperus osteosperma*] woodlands of Nevada. General Technical Report, USDA Forest Service, Washington. (WO-28). 1981. 1981; WO-28485-486.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ Nevada/ woodlands
51. Schupp; Eugene W. [Reprint author]; Heaton; Hoyt J. [Author]; Gomez, and Jose M. [Author]. Lagomorphs and the dispersal of seeds into communities

dominated by exotic annual weeds. Great Basin Naturalist. 1997; 57(3):253-258.

Keywords: *Juniperus osteosperma*/ Lagomorphs/ cheatgrass/ *Bromus tectorum*/ seed/ Utah juniper

Abstract: Large areas of western rangeland are presently dominated by alien annual weeds such as *Bromus tectorum* (cheatgrass). These communities resist succession to perennial communities primarily because the annuals are competitively superior to establishing perennial seedlings and they promote fires that favor weeds over perennials. Succession may be further slowed, however, by low rates of seed dispersal into annual grasslands. We investigated the role of lagomorphs (*Sylvilagus nuttallii*, Nuttall's cottontail; *S. audubonii*, desert cottontail; and *Lepus californicus*, black-tailed jackrabbit) in seed dispersal across an ecotone between an open juniper woodland and an annual grassland. We collected pellets along five 100 times 2-m transects parallel to the ecotone: 50 m into woodland, border, and 20 m, 50 m, and 100 m into grassland. We searched pellets for juniper seeds visually and for any other species through germination from trend with respect to position of transect. *Juniperus osteosperma* (Utah juniper) was the most abundant seed. Both the crushed pellets after cold, moist stratification. Pellets were not evenly distributed across transects, but there was no trend with respect to position of transect. *Juniperus osteosperma* (Utah juniper) was the most abundant seed. Both the number of juniper seeds and the proportion of pellets with juniper seeds decreased steadily from a high in woodland to absence at 100 m into grassland. Only 2 dicot seedlings emerged from pellets, 1 *Salsola pestifer* and 1 unknown that died prior to identification. Consequently, there was little seed movement into the grassland; 72% of all seeds were collected from either woodland or border transects. Lagomorphs apparently do not effectively replenish the native perennial seed pool of cheatgrass-dominated disturbances at Dugway.

52. Schupp, E W; Fuentes, M, and Gomez, J M. Dispersal of Utah juniper (*Juniperus osteosperma*) seeds by lagomorphs. Rangelands in a Sustainable Biosphere Proceedings of the Fifth International Rangeland Congress, Salt Lake City, Utah, USA 23-28 July, 1995 Volume 1 Contributed Presentations. 1996; 1496-497.

Keywords: *Juniperus osteosperma*/ *Lepus californicus*/ *Sylvilagus nuttallii*/ *Sylvilagus audubonii*/ seeds/ seed dispersal/ seed-predation/ wild animals/ forest trees

Abstract: Dispersal of Utah juniper (*Juniperus osteosperma*) in three west-central Utah populations of pinyon-juniper woodland was primarily by lagomorphs (rabbits, *Sylvilagus nuttallii*, *S. audubonii*, and hares, *Lepus californicus*). While 91-96% of lagomorph pellets were empty, the remainder contained 1-4 seeds, yielding 864 to 2255 seeds/ha dispersed within a population over 9 months. Of those seeds dispersed, only 0-3% were deposited

beneath shrubs, the microsite generally considered necessary for successful establishment of juniper.

53. Shaw, C. B. and Gifford, G. F. Sap velocity studies in natural stands of Pinyon and Juniper trees. *Journal of Range Management*. 1975; 28(5):377-379.
Keywords: *Juniperus osteosperma/ Pinus edulis/* transpiration/ plant water relations/ sap velocity
Abstract: In further studies at the two sites already described [cf. FA 37, 2091] in Pinyon/Juniper (*Pinus edulis/ Juniperus osteosperma*) woodland in Utah, sap velocity was measured by the heat-pulse technique (see FA 37, 3460] on 5 trees of each species over a 1-year period (1970-71). Measurements of sap velocity and micrometeorological factors were made hourly on 15 selected days. Diurnal variations were strongly correlated with the local environment especially in Pinyon which also showed higher maximum sap velocities (15-20 cm/h). Dalton's equation for evaporation from a water surface (as modified by Rohwer) accounted for a large part of these variations. Sap velocity was independent of biomass in both species. A linear regression of green biomass on diameter at 30 cm height was calculated, the same equation being valid for both species. The study suggests that transpirational water loss can occur in both species throughout the year.
54. Smith, F. W. and Schuler, T. Yields of southwestern pinyon-juniper woodlands. *Western Journal of Applied Forestry*. 1988; 3(3):70-74.
Keywords: *Juniperus monosperma/ Pinus edulis/ Juniperus osteosperma/* growth/ density/ site index/ site class assessment/ increment.
Abstract: Measurements of site quality, growth/growing stock relations, and estimations of yields were made in plots in 129 woodlands at 1400-2300 m alt. (each variable-sized plot with 30-40 live and dead trees >2.5 cm diam. at stump height) throughout the southwestern forests of pinyon pine (*Pinus edulis*), one-seed juniper (*Juniperus monosperma*) and Utah juniper (*J. osteosperma*). Pinyon and juniper p.a.i., taken separately, were highly correlated with stand density and pinyon site index; pinyon was twice as productive as juniper at similar stand densities. Average yields for woodlands of average density and site index were 0.29 and 0.15 m³/ha per yr, respectively, for pinyon and juniper; at high densities yields increased to 0.61 and 0.31 m³/ha per yr. Maximum yield of dense mixed species woodland was 0.78 m³/ha per yr, where pinyon made up 65%.
55. Stevens, R.; Giunta, B. C., and Plummer, A. P. Some aspects in the biological control of juniper and pinyon. [Proceedings] *The Pinyon-Juniper Ecosystem: a-Symposium*, May 1975. 1975 May; 77-82.
Keywords: *Juniperus osteosperma/ Pinus edulis/ Pinus monophylla/* browsing damage/ biological control.
Abstract: Experiments in Utah suggest that sowing competitive grasses, forbs and shrubs and browsing pressure from deer, rabbits and livestock

prevents juniper (*Juniperus osteosperma*) and pinyon pines (*Pinus edulis* and *P. monophylla*) from regaining dominance on chained areas.

56. Tausch R. J.; Chambers J. C.; Blank R. R., and Nowak R. S. Differential establishment of perennial grass and cheatgrass following fire on an ungrazed sagebrush-juniper site. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-GTR-315). 1995; INT-GTR-315252-257.
Keywords: *Juniperus osteosperma* / *Artemisia*/ *Pseudoroegneria*/ *Bromus*/ establishment/ population-dynamics
Abstract: At 2 sites on an ungrazed burnt *Artemisia tridentata* subsp. *wyomingensis*/*Juniperus osteosperma* woodland with an understory dominated by *Pseudoroegneria spicata* [*Elymus spicatus*] it was found that *Bromus tectorum* became dominant under the remnant crowns of burned *J. osteosperma* but *P. spicata* still dominated the spaces in between *J. osteosperma* plants after the 1st burn. After the 2nd burn, species crown cover, average perennial plant size and perennial plant and *B. tectorum* densities were the same in the area under *J. osteosperma*. Several soil surface variables and total organic C and N contents differed between the areas under and between *J. osteosperma* before but not after the burns.
57. Tausch R. J. and West N. E. Differential establishment of pinyon and juniper following fire. American Midland Naturalist. 1988; 119(1):174-184.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ fire/ establishment / Utah
Abstract: Reestablishment patterns of *Pinus monophylla* and *Juniperus osteosperma* following a mid-19th century fire were investigated on a SW Utah site; ages were estimated on 12 plots from growth ring counts. Thirty-eight percent of the juniper, but only 0.6% of the pinyon alive at sampling were older than the fire. Juniper seedlings initially reestablished at higher densities than pinyon. Pinyon density exceeded that for juniper by about 60 yr after the fire and was nearly six times that of juniper 145 yr afterward. Patterns of establishment were also more variable for juniper than pinyon. Reestablishment levels for pinyon and juniper after the fire were lower on plots with higher densities of juniper that survived the fire.
58. Tausch, R. J.; West, N. E., and Nabi, A. A. Tree age and dominance patterns in Great Basin pinyon-juniper woodlands. Journal of Range Management. 1981; 34(4):259-264.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ plant communities/ environmental factors/ Great Basin/ dominance/ tree age
Abstract: Prior studies of pinyon-juniper woodlands at a few locations have indicated considerable historical expansion of the trees and loss of understory. Whether these changes are a widespread phenomenon and related to pervasive, rather than local, influences was the question asked by this research. An objective sampling of 18 randomly selected mountain

ranges in the Great Basin (USA) was undertaken. Tree age and dominance in the pinyon-juniper woodlands showed definite geographical, elevational, and historical trends. The oldest, most tree-dominated woodlands were located in areas of intermediate topography where disturbances may have been less frequent. Populations of both tree species (*Pinus monophylla* (Torr.) and *Juniperus osteosperma* (Torr. and Frem.) were progressively younger and less dominant in both upslope and downslope directions from the intermediate elevations. Tree densities have also historically increased within the oldest woodlands. Pinyon density has increased faster than that of juniper. Approximately 40 percent of the sampled plots had their trees establishing during the last 150 years. These changes generally coincide with introduction of heavy livestock grazing, tree utilization by the mining industry, and fire suppression that followed settlement of the region. Associated climatic trends were also investigated. The relative importance of these influences on the changes in tree age and dominance cannot be determined without further research. The loss of understory, coincident with increasing tree dominance, has reduced forage production and made the woodlands progressively less susceptible to fire. Barring some major environmental change or management action, this forage reduction and decreased frequency of burning will continue until trees dominate much more area. Samples of previously published data showed trends in tree age and dominance with geography, altitude and history. The oldest, most tree-dominated woodlands were found at intermediate altitude, where disturbances may have been less frequent. Populations of both *Pinus monophylla* and *Juniperus osteosperma* were younger and less dominant upslope and downslope from the intermediate altitudes. A historical increase in tree density began almost simultaneously over the Great Basin with pinyon density increasing faster than juniper. In 59% of plots the overstory cover was dominated by trees less than 150 yr old and in 40% of plots the oldest tree was also this age. These changes coincided with the introduction of heavy livestock grazing, the use of trees for the mining industry, and fire suppression following settlement. The loss of understory and increasing tree dominance has reduced forage production and susceptibility to fire.

59. Terry R. G.¹; Nowak R. S.¹, and Tausch R.J.². Genetic variation in chloroplast and nuclear ribosomal DNA in Utah juniper (*Juniperus osteosperma*, *Cupressaceae*): evidence for interspecific gene flow. *American Journal of Botany* . 2000; 87(2):250-258.

Keywords: *Juniperus occidentalis* (subsp. *australis* and subsp. *occidentalis*)/ *Juniperus osteosperma*/ chloroplast DNA/ *Cupressaceae*/ hybridization/ nuclear ribosomal DNA/ restriction fragment length polymorphism (RFLP).

Abstract: Geographic patterns of genetic variation in chloroplast (cpDNA) and nuclear ribosomal (nrDNA) DNA were examined to test the hypothesis of hybridization between *Juniperus osteosperma* and

Juniperus occidentalis in the Great Basin of western Nevada. Noncoding DNA from the *trnL-trnF* intergenic spacer and the *trnL* intron of the chloroplast genome was sequenced from seven population of *J. osteosperma* and four populations of *J. occidentalis* sampled over a large proportion of their respective ranges. An adenine nucleotide at position 436 in the aligned sequence and within a *Tru 91* restriction site was found to be present in individuals of *J. osteosperma* sampled from western Colorado and central Utah, but absent in sequences of *J. osteosperma* sampled from central and western Nevada all sequences of *J. occidentalis*. Two hundred fourteen individuals from 34 populations of *J. osteosperma* and *J. occidentalis* were then screened for cpDNA haplotype by *Tru 91* digestion of the *trnL-trnF* polymerase chain reaction (PCR) product. Two cpDNA haplotypes were evident, each consisting of restriction fragment profiles that differed solely with respect to the presence or absence of the *Tru 91* site encompassing the adenine nucleotide at position 436. One of these haplotypes was monomorphic in *J. occidentalis* and exhibited a decreasing frequency in *J. osteosperma* with increasing geographic distance from *J. occidentalis* in west-central Nevada. Geographic patterns in nuclear ribosomal DNA (nrDNA) variation were examined by restriction fragment analysis and, although spatially more restricted, exhibited patterns of clinal variation similar to those observed in cpDNA haplotype. Genetic relationship based on DNA sequences and geographic patterns of genetic variation in chloroplast and nuclear ribosomal DNA are consistent with morphology in suggesting interspecific gene flow between *J. occidentalis* and *J. osteosperma*.

60. Tueller. P. T.; Beeson. C. D.; Tausch. R. J.; West. N. E., and Rea. K. H. Pinyon-juniper woodlands of the Great Basin: distribution, flora, vegetal cover. Research Paper, Intermountain Forest and Range Experiment Station, USDA Forest Service. (INT-229). 1979; INT-22922.
Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ *Pinus edulis*/ Great Basin/ grid analysis/ species composition/ vegetative cover/ altitude
Abstract: Dot grid analysis of maps from LANDSAT-1 photographs showed that approx. 7.1 million ha of pinyon-juniper are found in the Great Basin. A list is given of 240 plant species identified in the area (5 trees and 67 shrubs). Total vegetative cover increased with altitude. *Juniperus osteosperma* was more frequent at lower, drier sites, whereas *Pinus monophylla* and *P. edulis* were more frequent at higher altitudes.
61. van Pelt, N S; Stevens, R, and West, N E. Survival and growth of immature *Juniperus osteosperma* and *Pinus edulis* following woodland chaining in central Utah. Southwestern Naturalist. 1990; 35(3):322-328.
Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ Utah/ seedling/ survival/ growth/ woodlands
Abstract: Post-disturbance survival, seedling recruitment and height growth rates of 331 mapped Utah juniper (*Juniperus osteosperma*) and Rocky Mountain pinyon (*Pinus edulis*) were studied during 1962-88

within chained woodlands of central Utah. Size-specific attrition occurred primarily in the 4 years after chaining. *J. osteosperma* was subsequently twice as prolific but showed a 10% loss in numbers between 1962 and 1988. *P. edulis* grew faster and more uniformly, but suffered a 27% loss of density. Growth and survival of the two species were least similar in the seedling stage.

62. van Pelt, N. S. and West, N. E. Interactions of pinyon and juniper trees with tebuthiuron applications at 2 matched reinvaded sites in Utah. *Journal of Range Management*. 1993; 46(1):76-81.

Keywords: *Juniperus osteosperma/ Pinus monophylla/ Pinus edulis/* tebuthiuron/ defoliation/ Utah

Abstract: Immature noncommercial woodlands are steadily reoccupying sites cleared for forage production [in the western USA]. Two balanced factorial experiments were conducted at well-separated sites in the Great Basin and Colorado Plateau, Utah, in order to compare the amount of defoliation from various doses and placements of tebuthiuron applied to different tree sizes. Four rates of tebuthiuron (0.12, 0.25, 0.50 and 0.75 g/130 dm³ of crown volume) were applied to the stem bases, mid-crown or dripline of 4 size classes (crown volume of 12-99, 100-299, 300-599 or 600-1099 dm³) of juniper (*Juniperus osteosperma*) and pinyon (*Pinus monophylla* or *P. edulis*). The trees were treated in September 1985 and defoliation and mortality were estimated after 24 and 36 months. Both sites received similar amounts of herbicide and precipitation. Analysis of variance showed that the presence and strength of main effects and first order interactions were largely site-specific. Pinyon was more susceptible than juniper at both sites. Medium and large saplings were apparently more easily defoliated than seedlings or small saplings. Dose effects were generally nonlinear for both species. Application of tebuthiuron at stem bases gave the highest, fastest and most uniform defoliation and mortality.

63. Walker, S C; Stevens, R; Monsen, S B, and Jorgensen, K R. Interaction between native and seeded introduced grasses for 23 years following chaining of juniper-pinyon woodlands. General Technical Report Intermountain Research Station, USDA Forest Service.(INT-GTR-315) . 1995; 315372-380.

Keywords: *Juniperus osteosperma/ Pinus edulis/* rabbits/ deer/ *Agropyron cristatum/ Agropyron desertorum/ Elymus smithii/ Elymus hispidus/ Dactylis glomerata/* grasses/ *Medicago sativa/ Melilotus officinalis*

Abstract: In 1959, 3 *Juniperus osteosperma-Pinus edulis* sites in Sanpete County, central Utah were cleared of trees and shrubs and in 1962 sown with grass species including *Agropyron cristatum*, *A. desertorum* cv. Potomac, *A. smithii* [*Elymus smithii*], *A. intermedium* [*Elymus hispidus*] and *Dactylis glomerata* and legume species including *Medicago sativa* cv. Ladak and Rambler and *Melilotus officinalis* and/or native forage species mixtures. The sites were enclosed so that rabbits, deer and livestock were all

excluded, to give rabbit only access, rabbit and deer access or access to all three species. Over 23 years the communities, though changing in density and percentage cover, had not stabilized in terms of plant dominance. The introduced exotic grass species were increasing in density, cover and production at a greater rate than the native species. Native grass species showed less fluctuation in density, cover and production than did the introduced species. The characteristics that allowed introduced species to dominate native species were reduced with grazing by livestock, big game and rabbits.

64. Waugh, W. J. Verification, distribution, demography and causality of *Juniperus osteosperma* encroachment at a Big Horn basin, Wyoming site. Dissertation Abstracts International B, Sciences and Engineering. 1987; 47(9):3610-B.
Keywords: *Juniperus osteosperma*/ *Artemisia nova*/ Wyoming/ encroachment
Abstract: Encroachment of Utah juniper (*J. osteosperma*) into a community dominated by black sagebrush (*Artemisia nova*) during 1890-1940 was inferred from the age structure of a lower treeline stand. Many apparently multi-stemmed junipers were intimate clumps of individuals all the same age, but the anomaly was not peculiar to the expansion episode. The onset of stand expansion may have been related to livestock-induced increases in sagebrush. More than 90% of juniper seedlings established beneath sagebrush or older junipers; this nurse effect was more pronounced in the seral stand where junipers grew taller and broader. The onset of the expansion corresponded to the first major wet period following the close of the Little Ice Age. Causes of the abrupt cessation of expansion may have included inadequate recharge of underlying limestone fractures and frost damage to foliage by temp. inversions.
65. Weber, D. J.; Gang, D.; Halls, S., and Nelson, D. L. Juniper decline in Natural Bridges National Monument and Canyonlands National Park. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-GTR-315). 1995; INT-GTR-315258-262.
Keywords: *Juniperus osteosperma*/ *Styloxus bicolor*/ plant pests/ forest decline/ Utah
Abstract: Extensive foliar damage, with chlorosis and death of distal foliage, has been observed on Utah juniper (*Juniperus osteosperma*) in southern Utah. No pathogenic agents or soil minerals have been identified as the cause of the decline. Twig cutters (*Styloxus bicolor*) contributed significantly to chlorotic branches but the symptoms differed from those of the decline. It is suggested that the decline could be a combination of drought and temperature stress.
66. Welden C W [Reprint author]; Slauson W L [Author], and Ward R T [Author]. Spatial pattern and interference in pinyon juniper woodlands of northwest

Colorado USA. Great Basin Naturalist. 1990; 50(4):313-320.

Keywords: *Juniperus osteosperma*/ Colorado/ pinyon-juniper woodlands/ *Pinus edulis*

Abstract: The local spatial arrangement of the coniferous trees *Pinus edulis* and *Juniperus osteosperma* was mapped in two woodland stands and measured in two shrub-dominated stands in the semiarid Piceance Basin of northwest Colorado. In the woodlands, small trees were often clumped, while medium and large trees were either randomly or uniformly dispersed. Significant regressions were obtained between a tree's basal area or canopy area and the area of its Dirichlet domain (the region closer to it than to any other tree). Both findings from the woodland stands accord with results obtained by other workers in other vegetation. Like earlier workers, we interpret these patterns to indicate density-dependent mortality and density-dependent depression of growth rates among the trees in the woodland. In contrast, the trees in the shrub-dominated stands are located at random with respect to each other. However, they are strongly associated with shrub cover. Apparently, tree seeds arrive in these stands primarily by long-distance dispersal, and the establishment of seedlings is more likely in the shade of shrubs.

67. West N. E.; Tausch R. J., and Tueller P.T. A management-oriented classification of pinyon-juniper woodlands of the Great Basin. General-Technical-Report-Rocky-Mountain-Research-Station,-USDA-Forest-Service. (RMRS-GTR-12). 1998; RMRS -GTR-12 (III):42 pp.

Keywords: *Juniperus osteosperma*/ *Pinus monophylla*/ *Pinus edulis*/ mountain-areas/ synecology/ shrubs.

Abstract: A hierarchical framework for the classification of Great Basin (Utah, Nevada and California) pinyon-juniper (*Pinus monophylla* or *P. edulis* with *Juniperus osteosperma*) woodlands was based on a systematic sample of 426 stands from a random selection of 66 of the 110 mountain ranges in the region. The National Hierarchical Framework of Ecological Units (ECOMAP) was used for the highest levels of classification, subdividing the Great Basin into 9 relatively environmentally homogeneous sections, based on bioclimate, geomorphology and topography. The remaining levels are vegetation-based, focusing on the relative composition and dominance of pinyon and juniper, and the dominant shrub and perennial grass species present.

68. Williams D. G. and Ehleringer J. R. Intra- and interspecific variation for summer precipitation use in pinyon-juniper woodlands. Ecological Monographs. 2000; 70(4):517-537.

Keywords: *Juniperus osteosperma* / *Pinus edulis*/ gas exchange/ groundwater/ leaf water potential/ precipitation

Abstract: In the arid southwest of North America, winter precipitation penetrates to deep soil layers, whereas summer "monsoon" precipitation generally wets only surface layers. Use of these spatially separated water sources was determined for three dominant tree species of the pinyon-

juniper ecosystem at six sites along a gradient of increasing summer precipitation in Utah and Arizona. Mean summer precipitation ranged from 79 to 286 mm, or from 18% to 60% of the annual total across the gradient. We predicted that, along this summer rainfall gradient, populations of dominant tree species would exhibit a clinal off-on response for use of water from upper soil layers, responding at particular threshold levels of summer precipitation input. This prediction was largely supported by our observations of tree water source use over a two-year period and from irrigation experiments. Hydrogen and oxygen stable isotope ratios (δD and $\delta^{18}O$) of tree xylem water were compared to that of precipitation, groundwater, and deep and shallow soil water to distinguish among possible tree water sources. δD - $\delta^{18}O$ relationships and seasonal xylem water potential changes revealed that trees of this ecosystem used a mixture of soil water and recent precipitation, but not groundwater. During the monsoon period, a large proportion of xylem water in *Pinus edulis* and *Juniperus osteosperma* was from monsoon precipitation, but use of this precipitation declined sharply with decreasing summer rain input at sites near the regional monsoon boundary in Utah. *Quercus gambelii* at most sites along the gradient used only deep soil water even following substantial inputs of summer rain. Populations of *Quercus* at sites with the highest average summer precipitation input, however, predominantly used water in upper soil layers from recent summer rain events. Soil temperature correlated with patterns of summer precipitation use across the gradient; high soil temperatures north of the monsoon boundary may have inhibited surface root activity for some or all of the three tree species. Irrigation experiments with deuterium-labeled water revealed that *Quercus gambelii* in northern Arizona and southern Utah did not use water from surface layers. In contrast, *Juniperus osteosperma* at these sites responded significantly to the irrigations: between 37% and 41% of xylem water originated from irrigations that wetted only the top 30 cm of soil. Responses by *Pinus edulis* to these irrigations were variable; uptake of labeled water by this species was greater in September at the end of the summer than during the hot midsummer period. Inactivity of *Pinus* roots in midsummer supports the hypothesis that root activity in this species is sensitive to soil temperature. Seasonal patterns of leaf gas exchange and plant water potential corresponded to the seasonality of rainfall at different sites. However, no correlation between a species' ability to use summer rainfall and its tolerance to water deficits at the leaf level was found. Midday stomatal conductance (g_s) for *Pinus* needles approached zero at predawn water potentials near -2 MPa, whereas g_s in *Quercus* and *Juniperus* declined to zero at -2.8 and -3.7 MPa, respectively. The relationship between photosynthesis (A) and g_s was similar among the three species, although *Quercus* maintained higher overall rates of gas exchange and tended to operate higher on the A/g_s curve than the two conifers. At sites in eastern Arizona where *Quercus* fully used moisture from summer rains, leaf gas exchange characteristics were similar to those

of *Pinus* and *Juniperus*.

69. Yorks, T. P.; West, N. E., and Capels, K. M. Changes in pinyon-juniper woodlands in western Utah's Pine Valley between 1933-1989. *Journal of Range Management*. 1994; 47(5):359-364.

Keywords: *Juniperus osteosperma*/ *Pinus edulis*/ Utah/ pinyon-juniper woodlands

Abstract: In 1933, vegetation along a 37-km transect which had been heavily grazed since about 1890 in southern Pine Valley, Utah, was described from circular 19-m² plots located every 42 m. The major intermediate management treatment has been reduction of grazing pressure by introduced animals, although a fraction of the area was chained and burned in 1977. During a period climatically and phenologically similar to the original study, representative segments of this transect were re-examined by a more detailed updating of the original 'square-foot-density' method. Significantly greater shrub and perennial grass covers (more than threefold increases) were found in 1989, even where overall dominance is still by pinyon/juniper (*Pinus edulis*/*Juniperus osteosperma*). This change was more obvious on steeper slopes away from roads and water, where both human and livestock disturbances would be expected to be minimized. Except in the chained portion, the observed shifts in dominance/diversity are contrary to widely accepted expectations.

70. Young, J. A.; Evans, R. A.; Budy, J. D., and Palmquist, D. E. Stratification of seeds of western and Utah juniper. *Forest Science*. 1988; 34(4):1059-1066.

Keywords: *Juniperus occidentalis*/ Utah juniper/ western juniper/ *Juniperus osteosperma*/ seed/ stratification/ germination

Abstract: Seeds of western juniper (*Juniperus occidentalis* subsp. *occidentalis* Hook.) and Utah juniper [*J. osteosperma* (Torr.) Little] are highly dormant when freshly harvested. Cool-moist stratification at 5° C for 14 weeks in vermiculite enhanced subsequent emergence of seedlings of both species, but total emergence was still low. The year of seed production greatly influences the viability of seedlots. Dry storage for 1 to 4 years at room temperatures did not enhance germination. Outdoor stratification, over winter, in sand, enhances subsequent emergence depending on the environment of the stratification site. The year of seed production also interacts with outdoor situations. Repeat stratification treatments, interrupted by 8-week continuously wet-emergence-assay periods in the greenhouse and dry storage during the summer were cumulative for increased seed germination of both species. Interrupted treatments were more effective than continuous stratification in excess of the optimum duration to enhance germination. Stratification in aqueous solutions with near saturation of the solution with oxygen increased subsequent emergence of seedlings of western and Utah juniper to about 50%. Similar treatments using aqueous solutions of 0.289 m mol L⁻¹ gibberellin (GA₃) enhanced subsequent emergence of seedlings of western

juniper to better than 80%.

Juniperus oxycedrus (35)

1. Adams R. P.; Morris J. A.; Pandey R. N., and Schwarzbach A. E. Cryptic speciation between *Juniperus deltooides* and *Juniperus oxycedrus* (*Cupressaceae*) in the Mediterranean. *Biochemical Systematics and Ecology*. 2005; 33(8):771-787.
Keywords: *Juniperus deltooides/ Juniperus oxycedrus/ Juniperus navicularis/ Juniperus macrocarpa/* DNA sequencing/ genetic markers/ Europe/ Morocco/ Turkey
Abstract: Analyses of individuals classically treated as *Juniperus oxycedrus* L. var. *oxycedrus* from Morocco, Portugal, Spain, France, Italy, Greece and Turkey, using DNA sequencing of nrDNA (ITS 1, 5.8S, ITS 2) plus RAPDs, leaf terpenoids and morphology revealed that two cryptic, genetically distinct but morphologically almost identical species are present. These species, *J. oxycedrus* L. var. *oxycedrus* and *Juniperus deltooides* R.P. Adams, are about as different from each other as *Juniperus navicularis* and *Juniperus macrocarpa* are from *J. oxycedrus* var. *oxycedrus*. Examination of herbarium specimens revealed that the two species are largely allopatric with *J. deltooides* occurring from Italy eastward through Turkey into the Caucasus Mts. and Iran. *J. oxycedrus* var. *oxycedrus* appears to be largely concentrated west of Italy (France, Spain, Portugal, Morocco). Cryptic speciation is discussed.
2. Aleksandrov A. Kh.; Yurukov S., and Peev G. A new find of *Juniperus oxycedrus* in the Western Rhodope mountains. *Nauka-Za-Gorata*. 1993; 30(3):79-83.
Keywords: *Juniperus oxycedrus/* vegetation types/ understory/ height
Abstract: A note is given on the location and characteristics of a community of *Juniperus oxycedrus* at an altitude of 1300-1350 m in Bulgaria. The juniper occurs as an underwood in pure and mixed stands of *Pinus nigra*, *P. sylvestris*, *Fagus sylvatica* and *Quercus petraea*. Some of the junipers are 7-8 m tall and 9-10 cm diameter at 90 years old. This community of juniper occupies an area about 1000 m long and 500-550 m wide.
3. Alpacar, G. Studies on overcoming germination difficulties for *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus* and *J. drupacea* seeds, and determination of morphological characters of cones and seeds. *Teknik Bulten Serisi Ormanclk Arastrma Enstitusu Yaynlar*. 1988; 197(7):21-38.
Keywords: *Juniperus excelsa/ Juniperus foetidissima/ Juniperus oxycedrus/ Juniperus drupacea/ Pinopsida/* seeds/ seed morphology/ cones/ morphology/ seed treatment/ germination/ scarification/ stratification/ soaking
Abstract: Various stratification, soaking and scarification methods were tested for improving seed germination of *Juniperus excelsa*, *J.*

foetidissima, *J. oxycedrus* and *J. drupacea*. Cone and seed morphology is also given for each species.

4. Aragon G.; Sarrion F. J., and Martinez I. Epiphytic lichens on *Juniperus oxycedrus* L. in the Iberian Peninsula. *Nova Hedwigia*. 2004; 78(1/2):45-56.
Keywords: *Juniperus oxycedrus*/ Spain/ *Ramboldia*/ *Rhizocarpon*/ *Rinodina*/ *Rimularia*/ *Adpicilia*/ *Bacidia*/ *Calicium*/ flora/ lichen / epiphytic
Abstract: The epiphytic lichen flora on *Juniperus oxycedrus* in southern Spain is investigated. The main studied areas are 'Sierra de Segura' (Jaen prov.), 'Montes de Toledo' (Ciudad Real and Toledo provs.) and 'Sierra Madrona' (Ciudad Real prov.). A total number of 111 species are reported. *Ramboldia insidiosa*, *Rhizocarpon schedomices* and *Rinodina excrecens* are new to the Iberian Peninsula, while *Rimularia gyrizans* is new to Spain. Other taxa (*Aspicilia lignicola*, *Bacidia absistens*, *Calicium montanum*, *Rinodina furfuracea* and *Xyloschistes platytropa* var. *pyrenaica*) are specially considered due to their chorological and ecological value for Europe.
5. Arista, Montserrat Reprint author; Ortiz, Pedro L. Reprint author, and Talavera, Salvador Reprint author. Reproductive cycles of two allopatric subspecies of *Juniperus oxycedrus* (*Cupressaceae*). *Flora (Jena)*. 2001; 196(2):114-120.
Keywords: *Juniperus oxycedrus* / pollen/ cones/ ovule/ gametophyte/ megaspore/ fertilization
Abstract: Reproductive cycles of *Juniperus oxycedrus* subsp. *oxycedrus* and subsp. *macrocarpa* were studied during three consecutive years in southwestern Spain. The two subspecies showed two-year reproductive cycles in which all the events were similar and synchronous. Pollen was dispersed in late October to early November. Seed cones began to secrete pollination drops in late October; unpollinated ovules secreted until February. Cones in which no ovule was pollinated aborted. Pollen grains germinated in early February. Fertilization took place at the end of May or beginning of June, and seventeen months later, the embryo was completely mature. Unpollinated ovules failed to mature. Some pollinated ovules aborted in late January, probably as a consequence of a failure in megaspore development. Many others aborted at the mature gametophyte stage, just at fertilization time. Results are discussed in relation to deficient pollination and low pollen viability or vigor.
6. Balaban, M; Atik, C, and Ucar, G. Fungal growth inhibition by wood extracts from *Juniperus foetidissima* and *J. oxycedrus*. *Holz Als Roh Und Werkstoff*. 2003; 61(3):231-232.
Keywords: *Juniperus foetidissima*/ *Juniperus oxycedrus*/ fungus/ wood extracts/ *Coriolus versicolor*/ *Gloephyllum trabeum*/ *Chaetomium globosum*/ *Coniphora puteana*

Abstract: The fungal growth inhibition of two juniperus species (*Juniperus foetidissima* and *J. oxycedrus*) were investigated, which produce wood extractives in considerable amounts and are widespread in Anatolia, Turkey. Disks were cut from trees and after debarking, sapwood and heartwood were separated first. Mycelial plugs from the following fungal species were tested: *Coriolus versicolor*, *Gloephyllum trabeum*, *Chaetomium globosum* and *Coniophora puteana*. The antifungal activity was expressed as the percentage of growth diameter calculated and based on the diameter growth of controls. The results showed very high content of extractives in the heartwood of *J. foetidissima*. Furthermore, the compounds of polar character (soluble in ethanol and water) make up more than half of the extractives in sapwoods, whereas the nonpolar extracts (cyclohexane and chloroform soluble) were predominant in the case of heartwoods. The antifungal activities differ depending on the extract fraction and fungi species. In the average, the growth of *Chaetomium globosum* was inhibited to the highest extent.

7. Baldoni, M.; Biondi, E.; E-mail: biondi@univpm.it], and Ferrante, L. Demographic and spatial analysis of a population of *Juniperus oxycedrus* L. in an abandoned grassland. *Plant Biosystems*. 2004 Jul; 138(2):89-100.
Keywords: *Juniperus oxycedrus*/ *Pinus nigra*/ *Ostrya carpinifolia*/ Italy/ population/ spatial analysis/ germination/ fruit/ seedlings
Abstract: A study of the structural, dynamic, and space occupancy characteristics of a prickly juniper (*Juniperus oxycedrus*) population developed on an abandoned secondary grassland of the Central Apennines (Italy), is presented here. The data were collected from a permanent plot, limited by mixed deciduous woods dominated by *Ostrya carpinifolia* Scop. by a plantation of *Pinus nigra* Arnold, and by a forest road, and consisting of 1744 prickly juniper individuals, as well as other pre-forest and forest species. The age and sex distributions of this population were assessed. With these data, the age pyramid was constructed, within which three developmental phases of the population became apparent, as confirmed by a study of the logistic curve of development of the population. Based on an estimate of the intensity function of the spatial distribution of the prickly juniper individuals, the hypothesis of complete randomness has to be rejected. On the other hand, the correlation between sex and population density was significant. The mode of space occupancy of the prickly juniper population was investigated also with respect to the other populations of shrubs and forest species. It was shown to spread out in all directions, following lines of diffusion that could be randomly determined. Finally, the presence, within the plot, of some pasture areas not occupied by prickly juniper may be derived from lack of germination of the fruits, or development of the seedlings owing to unfavorable micro-environmental conditions.
8. Cantos, Manuel Reprint author; Cuerva, Juan Author; Zarate, Rafael Author, and Troncoso, Antonio Author. Embryo rescue and development of *Juniperus*

oxycedrus subsp. *oxycedrus* and *macrocarpa*. Seed Science & Technology. 1998; 26(1):193-198.

Keywords: *Juniperus oxycedrus*/ germination/ seed/ embryos/ in vitro/ greenhouse

Abstract: Germination of intact seeds, seeds without testa and isolated embryos of two subspecies of *Juniperus oxycedrus* (*oxycedrus* and *macrocarpa*) was compared both in vitro and under greenhouse conditions (for intact and seeds without testa). Intact seeds did not germinate in the greenhouse or in vitro. Seeds without testa did not germinate under greenhouse conditions, although these showed a low response in vitro (12%) on 1/3 strength of Murashige and Skoog medium with 3% sucrose with and without 0.5 g l⁻¹ of GA₃. However, isolated embryos in vitro reached germination levels of about 50% on the same media, providing a promising method for improving germination and propagation of *Juniperus oxycedrus*. Acclimatization of plantlets in soil under greenhouse conditions was very successful. The survival rate was 80% and the average plant height after one year was 20 cm.

9. Cerro-Barja A. del and Lopez-Serrano F. R. Structural, mensurational and silvicultural aspects of a mixed stand [*Quercus ilex*, *Q. rotundifolia*, *Q. faginea*, *Q. coccifera*, *Juniperus thurifera* and *J. oxycedrus*] in the south east of Spain. Mixed Stands: Research Plots, Measurements and Results, Models Proceedings From the Symposium of the IUFRO Working Groups S401, April -25-29, 1994 in Lousa/Coimbra, Portugal. 1994; 159-177.

Keywords: *Juniperus thurifera*/ *Juniperus oxycedrus*/ *Quercus ilex*/ *Q. rotundifolia*/ *Q. faginea*/ *Q. coccifera*/ Spain/ stands/ models/ mixed forests

10. Gehu, J. M.; Costa, M., and Biondi, E. The *Junipereta macrocarpae* communities on sand.

Les *Junipereta macrocarpae* sur sable. Acta Botanica Malacitana. 1990; 15303-309.

Keywords: *Juniperus oxycedrus*/ Mediterranean/ communities

Abstract: Surveys were made of communities of *Juniperus oxycedrus* subsp. *macrocarpa* on sand dunes in the Mediterranean region (Spain, Corsica, Sardinia, Italy). Four territorial associations of the *Junipereta macrocarpae* grp. ass. nov. are distinguished.

11. Gomez M. P. and Segua J. Morphogenesis in leaf and single-cell cultures of mature *Juniperus oxycedrus*. Tree Physiology . 1996; 16(8):681-686.

Keywords: *Juniperus oxycedrus*/ adventitious budding/ mature explants/ somatic embryogenesis

Abstract: Single cell were mechanically isolated from leaf-derived callus of mature *Juniperus oxycedrus* L. These cells divided and gave rise to callus when planted medium containing growth regulators. Best plating efficiency was obtained on a modified Schenk and Hildebrandt medium supplemented with 0.6 μM 2,4-dichlorophenoxyacetic acid and 100 mg l⁻¹

casein hydrolyzate. Although single-cell-derived callus showed poor morphogenic potential, both adventitious shoots and embryogenic tissues differentiated from callus. We also achieved induction of somatic embryogenesis in leaf explants of mature *J. oxycedrus* tree cultured in presence of 0.0 or 10.0 μ M 2,4-dichlorophenoxyacetic acid or picloram. Frequency of embryogenic callus ranged from 6 to 18%; however, under the culture conditions tested, isolated embryos failed to develop into plants.

12. Gomez M. P. and Segura J. Axillary shoot proliferation in cultures of explants from mature *Juniperus oxycedrus* trees. *Tree Physiology*. 1995; 15(9):625-628.
Keywords: *Juniperus oxycedrus*/ tissue culture/ plant growth regulators/ rooting/ auxins/ benzyladenine/ cytokines/ indoleacetic acid/ indolebutyric acid/ kinetin/ naphthaleneacetic acid/ tissue culture.
Abstract: Procedures were developed for the micropropagation of *Juniperus oxycedrus* using apices or nodal segments from mature plants. Terminal shoots were taken from lateral branches of 30-yr-old trees growing in a natural habitat near Valencia, Spain. Of the media and explants examined, the best culture establishment was obtained with shoot apices cultured on modified Schenk and Hildebrandt medium (SH medium) without growth regulators; however, shoot multiplication was only achieved when shoot apices isolated from shoots grown in SH medium without growth regulators were subcultured on SH medium containing 0.5 μ M benzyladenine. None of the auxins and methods tested for root induction provided satisfactory results.
13. Gomez, M. P. and Segura, J. Factors controlling adventitious bud induction and plant regeneration in mature *Juniperus oxycedrus* leaves cultured *in vitro*. *In Vitro Cell Developmental Biology*. 1994 Oct; 30P(4):210-218; ISSN: 1054-5476.
Keywords: *Juniperus oxycedrus*/ in vitro/ explant/ differentiation/ leaves/ charcoal/ roots
Call Number: QK725. I43
Abstract: The morphogenetic capacity of mature *Juniperus oxycedrus* L. leaves cultured in vitro has been studied, noting nutritive, hormonal, and environmental factors inducing differentiation and development of adventitious shoots. Bud promordia formed directly from the leaves. Highest bud differentiation rates were obtained when the explants were cultured for at least 21 days on a modified Schenk and Hildebrandt solidified medium containing 0.5 μ M benzyladenine under a 16-h photoperiod. Maximum bud development and elongation was achieved on cytokinin-free medium containing 4% (wt/vol) sucrose and 0.05% (wt/vol) activated charcoal. Regenerated shoots were excised and induced to root on media with auxin. Rooting percentages up to 100% were obtained in the presence of 2.5 μ M naphthaleneacetic acid and 4% (wt/vol) sucrose. The inclusion of activated charcoal in the root induction

medium dramatically reduced the number of rooted shoots. Following conventional procedures, plantlets were ultimately established in soil.

14. Gultekin, H C and Ozturk, H. Advances in research on the propagation of prickly juniper (*Juniperus oxycedrus* L.) and Syrian juniper (*Arceuthos drupacea* Ant. et Kotschy.) using nursery techniques, and grey juniper (*Juniperus excelsa* Bieb.) under natural conditions. Orman-Muhendisligi. 2003; 40(11/12):6-16.
Keywords: *Juniperus oxycedrus*/ *Juniperus drupacea*/ *Juniperus excelsa*/ propagation/ Turkey/ seed/ germination
Abstract: Research on the propagation of 3 juniper species (*Juniperus oxycedrus*, *Arceuthos drupacea* [*J. drupacea*] and *J. excelsa*) in Turkey is reviewed. The methods used to propagate these species from seed are described, with reference to techniques specific to the *Cupressaceae*, the availability of seed, and the propagation techniques used for the 3 species under consideration. The results of trials conducted in 2002-2003 are tabulated and show the percentage of seed germination obtained: 46-72% for *J. drupacea* and 0-69% for *J. oxycedrus* under nursery conditions, compared with about 33% for *J. excelsa* under natural conditions.
15. Iglesias, M. T.; Walter, I., and Trabaud, L. Evolution au cours de deux annees des teneurs en nutriments d'un sol incendie d'un bois de *Juniperus oxycedrus*. In: International Workshop: Fire, Landscape And Dynamics In The Mediterranean Area, Banyuls-Sur-Mer, France, 15-19 September, 1997. 1997.
Keywords: *Juniperus oxycedrus*/ evolution/ nutrients
16. Juan, R.; Pastor, J.; Fernandez, I., and Diosdado, J. C. Relationships between mature cone traits and seed viability in *Juniperus oxycedrus* L. subsp. *macrocarpa* (SM.) ball (*Cupressaceae*). Acta Biologica Cracoviensia Series Botanica. 2003; 45(2):69-78.
Keywords: *Juniperus oxycedrus*/ cones/ seeds/ weight/ length/ diameter
Abstract: The study addressed different biological aspects of *Juniperus oxycedrus* subsp. *macrocarpa*, including female cone production, biometric analysis of mature cones and seeds, and their viability. The results indicate that the proportion of aborted female cones was very high. In the four populations studied, cone diameter and weight and seed length and weight were closely related. The distribution of numbers of seeds with and without embryos in mature cones was examined, as well as the frequency of numbers of seeds with embryos. The general trend in all populations was three seeds per mature cone, of which only one or two showed embryos. Tetrazolium tests showed the percentage of viable seeds to be lower.
17. Klimko, M.; Boratynska, K.; Boratynski, A., and Marcysiak, K. Morphological variation of *Juniperus oxycedrus* subsp. *macrocarpa* (*Cupressaceae*) in three Italian localities. Acta Societatis Botanicorum Poloniae. 2004;

73(2):113-119.

Keywords: *Juniperus oxycedrus*/ Italy/ biometry/ plant morphology/ seeds

Abstract: The intra- and interpopulational geographic variation of three distant populations of *J. oxycedrus* subsp. *macrocarpa* in Italy (Orbetello, Tuscany; Sabaudia; and Vendicari, Sicily) was examined biometrically on the basis of morphological key-characters of needles, seeds and cones. The shortest Euclidean distances were used in the agglomerative grouping of closest neighborhood and discrimination analysis with principal component analysis was performed to verify the south-north differentiation of the taxon in Italy. Most of the cone and seed dimensional characters were correlated. No significant correlations were found between cone and needle characters. The sampled populations differed only insignificantly from one another, while the intrapopulational variation was slightly higher. Cone length as well as seed number, width and thickness were significantly correlated with geographic latitude, while the other four characters were not. Differences in cone shape were observed between individuals, so that several morphotypes can be distinguished.

18. Kose, H. Studies on the germination of some woody ornamental plants existing in Turkish flora. III. *Juniperus oxycedrus* L. (prickly juniper). Anadolu. 2000; 10(2):88-100; ISSN: 1300-0225.

Keywords: *Juniperus oxycedrus*/ seed/ germination/ seed/ treatment/ stratification

Abstract: The objective of this study was to determine the optimum method for germinating seeds of *Juniperus oxycedrus* which is indigenous to the Aegean region of Turkey. Viability tests were made using 2,3,5-triphenyl tetrazolium chloride. The seed morphology was examined to identify the applications for germination tests. Germination rates were measured for 28 methods. Best germination rate (62%) was maintained for *J. oxycedrus* seeds at 15 degrees C for 103 days with warm stratification at 20 degrees C for 60 days followed by cold stratification at 4 degrees C for 60 days.

19. Koukos, P. K.; Papadopoulou, K. I.; Papagiannopoulos, A. D., and Patiaka, D. T. Variation in the chemical composition of the berry oil of *Juniperus oxycedrus* L grown in North and West Greece. Holz Als Roh Und Werkstoff. 2002; 60(2):152-153.

Keywords: *Juniperus oxycedrus*/ berries/ oil/ myrcene/ citronellol/ alpha-pinene

Abstract: Essential oil from berries of *Juniperus oxycedrus* L. from two different locations (Mt. Holomontas and Mt. Pindos) was analyzed by GC/MS. Quantitative differences in yield and oil components were found between the two locations. The major components of the berry oil were myrcene (23.4-24.3%), citronellol (16.3-26.8%) and alpha-pinene (14.4-16.7%).

20. Lacovacci, P.; Afferni, C.; Barletta, B.; Tinghino, R.; Di Felice, G.; Pini, C., and Mari, A. *Juniperus oxycedrus*: A new allergenic pollen from the *Cupressaceae* family. *Journal of Allergy and Clinical Immunology*. 1998; 101(6I):755-761.
Keywords: *Juniperus oxycedrus*/ *Cupressus*/ *Juniperus ashei*/ pollen/ allergy/ Italy
Abstract: Cupressaceae allergy is a worldwide pollinosis caused by several species. Some species in limited geographic areas pollinate in fall and winter. *Juniperus oxycedrus* matches these features. Objective: We sought to define the immunochemical, allergologic, and environmental aspects of *J. oxycedrus* pollen. Methods: Pollen extract from *J. oxycedrus* was prepared and characterized by biochemical analysis and human specific IgE binding by means of ELISA and immunoblotting. A 3-year phenological study was conducted to define the pollinating period of *J. oxycedrus*. Forty consecutive patients allergic to cypress were recruited in two areas and divided into two groups according to their exposure to *J. oxycedrus* pollen. Clinical evaluation, skin prick tests, and specific IgE determination with *J. oxycedrus*, *J. ashei*, and *Cupressus arizonica* extracts were carried out on both groups. Results: *J. oxycedrus* pollen extract was obtained, and it showed specific IgE binding and wide cross-reactivity with other Cupressaceae species. The extract caused a positive skin test response in all the patients tested, with about 80% of them having detectable specific IgE. Symptoms related to *J. oxycedrus* pollen exposure were recorded in 72% of the directly exposed patients and occasionally in 9% of the nonexposed patients. In the Mediterranean coastal area considered, *J. oxycedrus* was the first *Cupressaceae* species that started to pollinate at the beginning of November and ended in the first part of December. Conclusions: *J. oxycedrus* represents a newly characterized pollen species of the *Cupressaceae* family that cross-reacts with other members of the same family. Subjects with cypress allergy have in vivo and in vitro positive test responses for *J. oxycedrus* and can show symptoms when exposed to its pollen. Finally, the most important feature of *J. oxycedrus* is its early pollinating period in southern Europe (Italy), causing a further extension of the cypress pollen season in areas where other *Cupressaceae* species are present.
21. Lebreton, Philippe; Perez De Paz; Pedro Luis , and Barbero, Marcel. Systematic study of the subgenus *Oxycedrus* (oxycedroides section) of the genus *Juniperus* (*Cupressaceae*). *Ecologia Mediterranea*. 1998; 24(1):53-61.
Keywords: *Juniperus oxycedrus*/ *Juniperus cedrus*/ *Juniperus brevifolia*/ prodelphinidin content/ proanthocyanic/ seed/ galbulus/ *Juniperus macrocarpa*
Abstract: Some biochemical (foliar proanthocyanidins) and morphometric (seeds and galbulus) parameters of the taxa *Juniperus oxycedrus* L. sensu lato (Mediterranean area), *Juniperus cedrus* Webb. and Berth. (endemic of the Canary Islands and Madeira) and *Juniperus brevifolia* (Seub.) Antoine (endemic of the Azores Islands), section

oxycedroides, subgenus *Oxycedrus*, genus *Juniperus* (*Cupressaceae*, Conifers), have been studied. Due to their low prodelphinidin content, *Oxycedrus* junipers from Turkey and Cyprus can be considered as the extreme representatives to the subspecies *oxycedrus*. Reversibly, the Cretan population studied, with high prodelphinidin content, appears to be the maximum homozygotic expression of the proanthocyanic biosynthesis (subspecies *macrocarpa*). Proanthocyanic content and the number of the seeds unquestionably link *J. brevifolia* to the *J. oxycedrus* complex; however, we propose to maintain this taxon as a species in view of the small size of its needles. *J. cedrus* generally contains one seed only by galbulus; moreover, there is a contradiction between the absolute proanthocyanic content (low) and the relative prodelphinidin content (fairly high). This confers it an unquestionable specific originality. In the end, we propose to consider all the representatives of the Mediterraneo-atlantic group of the oxycedroides section (*J. oxycedrus*, *J. macrocarpa*, *J. cedrus*, *J. brevifolia*) as diversely related taxa within a *Juniperus* aggr. *oxycedrus* complex, with a good chemical and morphogenetical consistency. A parallel has been established with *J. aggr. communis*, an other representative of the same sub-genus *Oxycedrus*.

22. Madar, Z. and Kimchi, M. Branch dieback of brown-berried juniper in Israel caused by *Phomopsis occulta*. *Phytoparasitica*. 1998; 26(2):127-128.
Keywords: *Juniperus oxycedrus*/ *Phomopsis occulta*/ Israel/ dieback/ shoots/ branches
Abstract: During 1996, a new disease of *Juniperus oxycedrus* occurred in Meron, Israel, and caused dieback of shoots and branches. Many affected shoots turned reddish-brown and died, and stem cankers with resinous exudates were observed. The causal agent was identified as *P. occulta*, and pathogenicity was confirmed.
23. Maugeri, G. and Leonardi, S. An example of *Juniperus [oxycedrus]/Pistacia lentiscus* macchia in southern Sicily. *Archivio Botanico*. 1974; 50:51-60.
Keywords: *Juniperus oxycedrus*/ *Pistacia lentiscus* / vegetation types/ maquis.
Abstract: The occurrence of *P. lentiscus* of tree habit on the landward side of the coastal strip described is thought to indicate that this species may once have formed part of the climax forest (which has now disappeared) of the Sicilian *Oleo-Ceratonion*.
24. Monero R, R; Ocio T, E; Sanchez Vizcaino, E, and Moreno R, M D. Natural pastures of south-east Spain: II. Chemical composition and evaluation, in vitro digestibility and nutritive value of rosemary (*Rosmarinus officinalis* L.), thyme (*Thymus vulgaris* L.), *Cistus clusii* Dunal in DC, wormwood (*Artemisia campestris* L.), *Fumana thymifolia* L., fennel (*Foeniculum vulgare* Miller), *Lygeum spartum* L. and juniper (*Juniperus oxycedrus* L.). *Pastos* . 1981; 11(1):205-216.
Keywords: *Juniperus oxycedrus*/ Spain/ nutrition/ digestibility/

woodland pasture/ *Rosmarinus*/ *Thymus*/ *Cistus*/ *Artemisia*/ *Fumana*/ *Foeniculum*/ *Lygeum*

Abstract: Samples of *R. officinalis*, *T. vulgaris*, *C. clusii*, *A. campestris*, *F. thymifolia*, *F. vulgare*, *L. spartum* and *J. oxycedrus* were collected on the same day in a woodland pasture in Murcia. Data are given on ash contents, main OM fractions, DM and OM digestibility, FU/kg DM and kg fresh matter/kg DM and kg fresh matter/FU. A description of each sp. with notes on their phytosociology, ecology, phenology and use by livestock is given.

25. Munoz-Reinoso. J. C. Diversity of maritime juniper woodlands. *Forest Ecology and Management*. 2004; 192(2/3):267-276.

Keywords: *Juniperus oxycedrus*/ *Pinus pinea*/ diversity/ plant composition/ Spain

Abstract: Plant composition and diversity of *Juniperus oxycedrus* subsp. *macrocarpa* woodlands were studied along the southwestern coast of Spain, including juniper communities on sand dunes, cliffs, and as understorey of pine plantations. Cliffs showed significantly higher richness and diversity values than dunes and pine plantations, while those in dunes and pine plantations were the same. Juniper woodlands on dune systems have a lower diversity of woody species due to the harsher environmental factors such as salt spray and sand mobility, showing their dominance-diversity curves geometric patterns. On the cliffs, the environmental stress promoted by the salt spray is reduced by the elevation of the coast, and plant species composition is mainly controlled by lithology and climate. Juniper communities on cliffs had higher diversity values, and dominance-diversity curves followed log normal patterns. Coastal *Pinus pinea* plantations tend to attenuate the effect of the harsh maritime physical environmental factors, causing the disappearance of endemic juniper woodland vegetation and by promoting the establishment of landward species, which change the structure and composition of these plant communities. Diversity values correlated with the management of both, the pine trees and the understorey. Where pine trees are managed and maritime juniper is favored over other woody species as understorey, the diversity was high and the dominance-diversity curve showed a log normal distribution. However, removal of the understorey by management for wood production and a later abandonment of the exploitation has resulted in higher densities of small pine trees which produce low diversity and geometric distributions in dominance-diversity curves. Given that *J. oxycedrus* subsp. *macrocarpa* woodlands is an endangered community, its conservation in southwest Spain is a priority. For the conservation of this community to be successful it would be necessary to restore this locally endemic community from abandoned coastal pine plantations. Results of this study show that juniper woodlands on the coastal dunes represent natural reference communities for planning the restoration of the original vegetation found in abandoned coastal pine plantations.

26. Munoz-Reinoso, J. C. *Juniperus oxycedrus* ssp. *macrocarpa* in SW Spain: Ecology and conservation problems. *Journal of Coastal Conservation*. 2003; 9(2):113-122.
Keywords: *Juniperus oxycedrus*/ Spain/ ecology/ plant composition/ woodlands
Abstract: Woodlands of the Mediterranean species *Juniperus oxycedrus* ssp. *macrocarpa* (maritime juniper) are both vulnerable and ecologically important. Their ecology and biological status along the SW coast of Spain are not well known; this, the first major study of these juniper populations is a basis for future research and restoration policies. These communities are subject to harsh conditions, the plant composition being controlled by several factors at different scales. On a large scale, climate and soil texture play an important role in controlling the soil water availability to plants, and in separating xerophytic from mesic communities. On a small scale, coastal physiography, and substrate composition are related to differences in the floristic composition. Coastal plantations modify environmental conditions, such as sand mobility and salt spray deposition, inducing important changes in plant communities. The population of maritime juniper on this coast was estimated in ca. 25000 individuals, of which 93.6% are concentrated in three locations. Large proportions of young individuals were found in extensive and protected populations. However, adult individuals dominated the smaller populations located under pine plantations. This limitation of recruitment may be imposed by several factors. A male biased ratio was detected on the southern coast of Cadiz, which I hypothesize is due to the lower cost of pollen production in a stressful habitat. Preservation of suitable habitats, the recovery of abandoned pine plantations, and the connection between juniper populations, seem to be important requisites for the conservation of maritime juniper in the southwestern coast of Spain.
27. Ortiz, Pedro L.; Arista, Montserrat, and Talavera, Salvador. Low reproductive success in two subspecies of *Juniperus oxycedrus* L. *International Journal of Plant Sciences*. 1998 Sep; 159(5):843-847.
Keywords: *Juniperus oxycedrus*/ seed cone abortion/ seed/ cone/ seed viability/ seed efficiency
Abstract: Mature seed cone and seed production were studied in six populations of *Juniperus oxycedrus* (three of subspecies *oxycedrus* and three of subspecies *macrocarpa*). In both subspecies, seed cone abortion took place mainly just after the pollination period, and most of the remaining seed cones reached full size. Percentage of mature cones was significantly higher in subspecies *oxycedrus* than in *macrocarpa*. In both taxa, seed cones developed fully in the absence of filled seeds. Both the number of full-sized seeds per cone and the seed viability were low, and they were similar in both subspecies. However, seed potential was markedly higher in subsp. *macrocarpa* (mean 4.1 ovules/cone) than in subspecies *oxycedrus* (mean 2.8 ovules/cone), indicating a lower seed efficiency in subspecies *macrocarpa*. Results indicate that deficient

pollination and site quality can be causes of low seed cone production and low seed viability in both subspecies of *J. oxycedrus*.

28. Pardos, J. A. and Lazaro, G. Aspects of the germination of *Juniperus oxycedrus*. *Anales Del Instituto Nacional De Investigaciones Agrarias, Forestal, Spain*. 1983; 7155-163.
Keywords: *Juniperus oxycedrus*/ seeds/ germination
29. Quezel, P. and Barbero, M. Pre-steppe juniper associations in Morocco. Contribution a l'etude des formations pre-steppiques a Genevriers au Maroc. *Boletim Da Sociedade Broteriana*, 2. 1981; 53(2):1137-1160; 6 tab.
Keywords: *Juniperus phoenicea*/ *Juniperus oxycedrus*/ *Juniperus thurifera*/ High Atlas/ phytosociology
Abstract: A phytosociological study of associations dominated by arborescent *Juniperus* spp. (*J. phoenicea*, *J. oxycedrus*, *J. thurifera*), with special reference to vegetation of the High Atlas.
30. Roques, A.; Raimbault, J. P., and Goussard, F. The colonization of mediterranean juniper cones and galbuli by insects and acarids and its effect on possibilities of natural regeneration of these species. *Ecologia Mediterranea*. 1984; 10(1-2):147-170.
Keywords: *Juniperus oxycedrus*/ *Juniperus phoenicea*/ *Juniperus thurifera*/ seed/ berries/ seed pests.
Abstract: Pests of the female reproductive forms of Mediterranean juniper seem to be confined to *Cupressaceae* and in majority strictly to genus *Juniperus*. The fauna appears to be climate-linked. *J. oxycedrus* L. and *J. phoenicea* L., characteristic of the mediterranean vegetation, present in their whole French distribution area the same fauna, very different from *J. thurifera* L. species distributed in the supra Mediterranean level. High attack rates of berries are frequently observed for the 3 spp., with some differences between continental and Corsican stands. But the low number of seed pests and the number of sound seeds/berry limits (excepted for *J. thurifera* L.) the reduction of the regeneration possibilities of natural juniper stands by insect or mite action.
31. Ruguzov; I. A. [Author]; Sklonnaya; L. U. [Author]; Kostina, and V. P. [Author]. Cytoembryological principles of conservation of threatened species of genus *Juniperus* L. in the Crimea. *Ukrayins'Kyj Botanichnyi Zhurnal*. 1994; 51(2-3):211-217.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ Crimea/ cytoembryological/ seed
Abstract: The paper contains information on distribution of *Juniperus excelsa* Bieb., *J. foetidissima* Willd. and *J. oxycedrus* L. in the Crimea. It is emphasized that these woody species are on the brink of death in the natural area. Results of studying sporo- and gametogenesis, pollination and fertilization, embryogenesis and endosperm formation as a united and continuous process of viable seed formation are presented. Development

cycles of reproductive structures of each species in the Crimea are shown on diagrams. A comparison of calendar dates and duration of certain formation stages of embryonal structures of the species under allowed to reveal a fluctuating modification process at seed formation. Disturbances and deviations leading to seed-emptiness and disappearance of these species in situ are discussed. Formation of non-viable seeds is stipulated by the fact that optimum ratio of female and male individuals in the population fragments of given species; unfavorable ecological conditions for microsporogenesis and pollination. Self-pollination of ovules and undevelopment of female gametophyte, degeneration of male gametophyte for embryos death at one of embryogenesis stages - all these are the result of this. By the authors' opinion, only organization of seed-production of the *Juniperus* L. species will make it possible to produce necessary amount of viable seeds and to conserve these species.

32. Ruguzov, I. A.; Sklonnaya, L. U., and Chobotar, A. A. Pollination drop in conifers. *Botanicheskii Zhurnal* (Leningrad). 1992; 77(12):40-52.
Keywords: *Juniperus excelsa*/ *Juniperus foetidissima*/ *Juniperus oxycedrus*/ *Sequoia sempervirens*/ *Sequoiadendron giganteum*/ *Taxodium distichum*/ *Libocedrus decurrens*/ *Cephalotaxus drupacea*/ *Taxus baccata*/ *Torreya grandis*/ pollination/ pollen grains/ ovule nucellus
Abstract: Pollination mechanism was studied in *Sequoia sempervirens*, *Sequoiadendron giganteum*, *Taxodium distichum*, *Libocedrus decurrens*, *Juniperus excelsa*, *J. foetidissima*, *J. oxycedrus*, *Cephalotaxus drupacea*, *Taxus baccata*, and *Torreya grandis* of the family *Cupressaceae*. In all species, the contact of pollen grains with ovule nucellus is carried out with the aid of a pollination drop. The latter is developed only under definite hydrothermal conditions. The capacity of the ovule of perceiving pollen grains does not change during 4-14 days depending on the species. The functions of a pollination drop vary during phylogenesis.
33. Van den Berghen C. The thicket with *Juniperus oxycedrus* subsp. *macrocarpa* in the dunes of the Gulf of Tunis.
 Le fourre a *Juniperus oxycedrus* subsp. *macrocarpa* dans les dunes du Golfe de Tunis. *Belgian Journal of Botany*. 1990; 123(1-2):5-13.
Keywords: *Juniperus oxycedrus*/ Tunisia/ coastal sand dunes
Abstract: The vegetation of coastal sand dunes of the Gulf of Tunis between Soliman and Sidi Rais, Tunisia, was surveyed in 1987 and 1989. Floristic composition and dynamics were analyzed of the thickets of *Juniperus oxycedrus* subsp. *macrocarpa*, which form a natural and relatively undisturbed vegetation. On the landward side, the invasion of peripheral dunes by *Retama raetam* was also analyzed.
34. Velasco-Negueruela A.; Perez-Alonso M. J.; Pala-Paul J.; In~igo A.; Cervera M., and Lopez G. Essential oil analyses of the leaves and berries of *Juniperus*

oxycedrus L. subsp. *badia* (H. Gay) Debeaux. Botanica Complutensis. 2003; 27147-154.

Keywords: *Juniperus oxycedrus*/ essential oil/ berries/ leaves

Abstract: The steam distilled oil obtained from the leaves and berries of *Juniperus oxycedrus* L. subsp. *badia* (H. Gay) Debeaux, gathered in Embalse del Quiebrajano (Jaen) was analyzed by GC and GC/MS. The oil from the berries was found to contain as major constituents α -pinene (59,8-61,5%) and myrcene (18,5-18,6%). Other characteristic compounds were germacrene D (3,6-1,8%), cadinanes (1,6-1,3%), muurolanes (0,7-0,5%) and manoyl oxide (0,1%). The oil from the female leaves contained α -pinene (85.2-86.9%) as main constituent and other characteristic components were germacrene D (0,8-2,2%), manoyl oxide (0,1%), cadinanes (0,8-0,9%) and muurolanes (0,3-0,4%). The oil from the male leaves had as mayor compounds α -pinene (70,6-75,5%) and delta-3-carene (8,4-13,1%) and moderate amounts of beta-phellandrene (6,7%) together with small quantities of germacrene D (0,8-0,4%), manoyl oxide (0,5-0,2%), cadinanes (0,4-0,4%) and muurolanes (0,1-0,1%).

35. Vilagrosa, A. Author Reprint Author; Cortina, J. Author; Gil-Pelegrin, E. Author, and Bellot, J. Author. Suitability of drought-preconditioning techniques in Mediterranean climate. *Restoration Ecology*. 2003 Jun; 11(2):208-216.

Keywords: *Juniperus oxycedrus*/ drought/ *Quercus*/ *Pistacia*/ preconditioning

Abstract: Revegetation with native well-adapted evergreen shrubs is desirable, but techniques for successful establishment of these species are not fully developed. Transplant shock is a key hurdle to plantation success. The application of a drought-preconditioning treatment during the last months of nursery culture is a potential technique for reducing transplant shock. This technique has been widely applied in boreal habitats and humid temperate areas. Three representative Mediterranean species (*Pistacia lentiscus*, *Quercus coccifera*, and *Juniperus oxycedrus* seedlings) were exposed to classic drought-preconditioning treatment consisting of reductions in the watering regime. The effects of preconditioning on seedling quality were assessed by cell water relationships (pressure-volume curves), minimal transpiration, leaf capacitance, chlorophyll fluorescence, and gas exchange. Moreover, seedlings were exposed to transplant shock (intense drought period) during which water potential (predawn and midday) and maximal photochemical efficiency were evaluated to establish seedling performance. Results showed that preconditioning did not affect cell water relationships and minimal transpiration in any of the three species. Preconditioned seedlings of *P. lentiscus* maintained higher water content during desiccating conditions as a consequence of an increase in leaf water content at full turgor. These changes allowed plants to maintain higher net CO₂ assimilation rates and an elevated photosystem II status, facilitating an increase in drought survival. Preconditioning improved the performance of *Q. coccifera* and *J. oxycedrus* seedlings, but these two species were much less responsive than

P. lentiscus seedlings. Finally, results suggest that sensitivity to drought preconditioning may be related to drought tolerance or avoidance strategy of each species. Drought-related strategies should be considered to optimize management scale preconditioning.

Juniperus patoniana (1)

1. Zaroni, T. A. and Adams, R. P. The genus *Juniperus* in Mexico and Guatemala: numerical and chemosystematic analysis. *Biochemical Systematics and Ecology*. 1976; 4(3):147-158.

Keywords: *Juniperus patoniana*/ *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus blancoi*/ *Juniperus scopulorum*/ plant composition/ terpenoids.

Abstract: The leaf constituents, mainly terpenoids, of each of the taxa of *Juniperus* in Mexico and Guatemala were analyzed by numerical taxonomic methods and the results compared with those of a previous study utilizing morphological characters. The two sets of data were generally in agreement on the major groups. Differences between more closely related species were more apparent with the chemical data. Four major groups were detected. The study confirmed the morphological data indicating that *J. patoniana* should be reduced to a variety of *J. deppeana*. No samples typical of *J. monosperma* were found in Mexico, and *J. monosperma* var. *gracilis* was not closely allied with *J. monosperma* from the USA, but had some uncertain affinities with species of the one-seeded complex. *J. blancoi* appears to be closely related to *J. scopulorum*.

Juniperus pauli (1)

1. Kvacek, Z. A new juniper from the Palaeogene of Central Europe. *Feddes Repertorium*. 113; 7-8492-502.

Keywords: *Juniperus pauli*/ seeds/ pollen/ Palaeogene/ Bohemia/ fossil

Abstract: The earliest fossil record of *Juniperus* L. (*Cupressaceae*) is reported. *Juniperus pauli* Z. Kvacek, sp. nova is based on foliage shoots, pollen cones, seed cones and seeds, and belongs to the multiseed series of "entire"-leafed species of sect. *Sabina*. It occurs in association with the humid warm-temperate mixed-mesophytic forest vegetation in the volcanogenic diatomaceous shale at Roudniky and Vetruse in the Palaeogene of the Ceske stredohori Mountains, north Bohemia. The former site is radiometrically dated near the Eocene/Oligocene boundary. The relationship to extant taxa is discussed together with a review of fossil junipers.

Juniperus phoenicea (24)

1. Adams, Robert P.; Pandey, Naresh; Rezzi, Serge, and Casonova, Joseph. Geographic variation in the Random Amplified Polymorphic DNAs

(RAPDs) of *Juniperus phoenicea*, *J.p.* var *canariensis*, *J.p.* subsp. *eu-mediterranea* and *J.p.* var *turbinata*. *Biochemical Systematics and Ecology*. 2002 Mar; 30(3):223-229; ISSN: 0305-1978.

Keywords: *Juniperus phoenicea*/ *Cupressaceae*/ Geographic variation/ RAPDs

Call Number: QD415.A4B5

Abstract: Random Amplified Polymorphic DNAs (RAPDs) were analyzed for *J. phoenicea* var. *phoenicea* from Spain. *J.p.* var *canariensis* from the Canary Islands, and *J.p.* subsp. *eu-mediterranea* from Portugal and *J.p.* var *turbinata* from Corsica, Greece and Spain. *Juniperus phoenicea* was clearly divided into *J.p.* var *phoenicea* and *J.p.* var *turbinata* and affiliated populations. *J.p.* subsp. *mediterranea* Lebr. and Thiv. from Portugal was confirmed to be conspecific with *J.p.* var *turbinata* (Guss.) Parl.

2. Arista; M. [Reprint author]; Ortiz; P. L. [Author]; Talavera, and S. [Author]. Reproductive isolation of two sympatric subspecies of *Juniperus phoenicea* (*Cupressaceae*) in southern Spain. *Plant Systematics & Evolution*. 1997; 208(3-4):225-237.

Keywords: *Juniperus phoenicea*/ Spain/ phenology/ reproduction/ flowering/ pollen

Abstract: The phenology, reproductive cycle and cone crop of two sympatric subspecies of *Juniperus phoenicea* (*Cupressaceae*) were studied during three consecutive years in southern Spain. The flowering pattern of each subspecies was constant during this period: in *J. phoenicea* subsp. *turbinata* flowering was always in October-November, while *J. phoenicea* subsp. *phoenicea* flowered in February-March. There was no overlap between the flowering periods of the two taxa. The reproductive cycle of the two subspecies was similar, though there were some important differences because of their flowering times. Male cone development in both subspecies occurred in autumn, but the male cones of *J. phoenicea* subsp. *phoenicea* did not shed pollen until the end of February. In *J. phoenicea* subsp. *turbinata*, the gap between pollination and fertilization was seven months while in *J. phoenicea* subsp. *phoenicea* it was only three months, fertilization taking place at the same time in the two taxa. Post-fertilization events were similar in the two subspecies, leading to a cycle of two years in *J. phoenicea* subsp. *turbinata* and a shorter one of about 20 months in *J. phoenicea* subsp. *phoenicea*. Alternating good and slight seed cone crops were found in both taxa during the three years studied, the good crops of one subspecies coinciding with the slight crops of the other one. Although the proximity of the two subspecies and method of pollination could make hybridization between the taxa possible, the different flowering seasons prevent hybridization isolating them reproductively.

3. Barrero A. F.; Quilez Del Moral J. F.; Herrador M. M.; Akssira M.; Bennamara A.; Akkad S., and Aitigri M. Oxygenated diterpenes and other constituents

from Moroccan *Juniperus phoenicea* and *Juniperus thurifera* var. *africana*. *Phytochemistry*. 2004; 65(17):2507-2515.

Keywords: *Juniperus thurifera*/ *Juniperus phoenicea*/ Morocco/ diterpenes

Abstract: Six new diterpenic acids isolated as their methyl ester together the isovalerate derivatives of p-methoxycinnamyl alcohol and 8-hydroxylinalool, were isolated from the leaves of *Juniperus thurifera* and *Juniperus phoenicea*, grown in Morocco. The cytotoxicity of the abietane diterpenoids was tested against five cell lines. Six new diterpenic acids isolated as their methyl ester derivatives, i.e., methyl 12-oxo-8a,15-dihydroxyabiet-13-en-19-oate, methyl 12-oxo-8a-hydroxyabiet-13-en-19-oate, methyl 15-hydroperoxy-8a,12a-epidioxiabiet-13-en-19-oate, methyl 15-hydroxy-8a,12a-epidioxiabiet-13-en-19-oate, methyl 15-hydroperoxy-8a,14a,12a,13a-diepoxiabietan-13-en-19-oate, and methyl 7a,12a-dihydroxysandaracopimarate, together with two new isovalerate derivatives of p-methoxycinnamyl alcohol and linalool, were isolated from the leaves of *Juniperus thurifera* var. *africana* and *Juniperus phoenicea*, grown in Morocco. The structures of these compounds were established by using spectroscopic techniques, including 2D NMR spectra. The cytotoxicity of the abietane diterpenoids was tested against five cell lines.

4. Berger, A. and Heurteaux, P. Response of *Juniperus phoenicea* on sandy dunes in the Camargue (France) to water and saline constraint in summer. *Vegetatio*. 1985; 62(1-3):327-333.
Keywords: *Juniperus phoenicea*/ sand dunes/ France/ water potential/ transpiration
Abstract: The water relationships in the soil-plant system have been studied along a transect between the top and the borders of a dune surrounded by saline lands. Using simultaneous water potential measurements of the sunny and shady sides of *Juniperus* trees daily and seasonal transpiration regulations were studied. Trees on the border of the dune as well as on tops are absorbing water from the same freshwater lens in the middle of the dune.
5. Costa, M; Perez Badia, R, and Soriano, P. The *Juniperus thurifera* forests of Valencia. *Acta Botanica Malacitana*. 1990; 15:297-301.
Keywords: *Juniperus phoenicea*/ *Juniperus thurifera*/ *Quercus rotundifolia*/ *Juniperus hemispherica*/ Spain/ distribution
Abstract: The distribution and main features are described of the Junipereto phoeniceae-thuriferae, Junipereto thuriferae-Querceto rotundifoliae and Junipereto hemisphaerico-thuriferae communities in the Valencia region of Spain.
6. Davies, Caroline P. and Fall, Patricia L. E-mail fall@asu.edu. Modern pollen precipitation from an elevational transect in central Jordan and its relationship to vegetation. *Journal of Biogeography*. 2001 Oct; 28(10):1195-1210.

Keywords: *Juniperus phoenicea*/ *Quercus*/ *Hammada*/ *Tamarix*/
Artemisia/ *Chopodiaceae*/ Jordan/ pollen

Abstract: To explore the relationship between modern pollen precipitation and vegetation patterns in an and region of the Middle East. Location: Data come from the central Jordan Rift from 1700 m elevation in the highlands to 300 m below sea level in the Dead Sea basin. Methods: Modern pollen samples and descriptive vegetation data were collected from twenty-one locations at 100 m elevational intervals from the highest elevations on the eastern side of the rift valley, where woodlands grow, to the lowest elevation desert on earth, characterized by drought and salt tolerant plants. Pollen percentage data from each vegetation zone are compared descriptively and numerically using cluster and Principal Components Analyses (PCA). Results: Three major vegetation zones: woodland, shrub steppe, and desert scrub, are identified by their dominant plant species. The widely spaced tree, *Quercus calliprinos* Webb, defines the *Quercus* L. woodland that grows above 1500 m elevation. The shrub steppe can be divided into two subzones found between about 1500 and 900 m elevation: *Artemisia herba-alba* Asso shrub steppe and *Artemisia* L. shrub steppe with *Juniperus phoenicea* L. Desert scrub dominates the lower elevation landscape with *Hammada salicornia* (Moq.) Iljin the dominant shrub between 900 and 200 m and *Haloxylon persicum* Bge. found below 200 m elevation. Pollen spectra reflect the elevational vegetation zones. In particular, *Quercus* L., *Juniperus* L. and *Tamarix* L. pollen are abundant where the trees grow. Highly variable amounts of non-arboreal pollen taxa - primarily *Artemisia* L. and *Chenopodiaceae* Vent. - differentiate shrub steppe from desert scrub vegetation. Cluster and PCA of pollen data support the qualitative vegetation zonation. Main conclusions: The main vegetation zones along the Jordan Rift from 1700 to -300 m elevation can be distinguished by their modern pollen precipitation. Open vegetation types, in particular, can be recognized by their pollen spectra. High amounts of *Artemisia* L. pollen distinguish the moister upper elevations where *Artemisia* L. steppe grows. In contrast, greater amounts of *Chenopodiaceae* Vent. pollen characterize the drier, lower elevation deserts.

7. Diez-Garretas B.; Asensi A., and Martin-Osorio V.E. Phytosociological behaviour of *Juniperus phoenicea* L. s.l. in southern Iberian Peninsula. Comportamiento fitosociológico de *Juniperus phoenicea* L. s.l. en el sur de la Peninsula Iberica. Lazaroa. 1995; 16:159-167.

Keywords: *Juniperus phoenicea*/ *Juniperus turbinata*/ plant communities/ Spain

Abstract: The plant communities dominated by *J. phoenicea* in S Spain (Rondeno sector) were studied pointing out a new record of *J. turbinata* subsp. *turbinata* in Rondeno sector. Two new syntaxa are described: *Asparago horridi-Juniperetum turbinatae* and *Rhamno myrtifoliae-Juniperetum phoeniceae* subass. *rhamnetosum oleoidis*.

8. El-Abidine, A. Z.; Zaidi, A., and Niass, M. F. Seed germination of *Juniperus phoenicea*. *Annales De La Recherche Forestiere Au Maroc*. 1996; 291-23; ISSN: 0483-8009.
Keywords: *Juniperus phoenicea*/ forest/ trees/ temperature/ provenance/ seeds/ germination/ techniques
Abstract: The effect of temperature, provenance (Essaouira and Mehdia, Morocco) and different seed pretreatments (sulfuric acid, stratification) were studied, in an evaluation of techniques to aid *Juniperus phoenicea* germination
9. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. *Sabina*) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). *Edinburgh Journal of Botany*. 1992; 49(3):251-283.
Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia
Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpus* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpus*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.
10. Farjon, A. and Garcia, S. O. Towards the minimal conifer cone: Ontogeny and trends in *Cupressus*, *Juniperus* and *Microbiota* (*Cupressaceae* s. str.). *Botanische Jahrbuecher Fuer Systematik Pflanzengeschichte Und Pflanzengeographie*. 2002; 124(2):129-147.
Keywords: *Juniperus virginiana*/ *Cupressus goveniana*/ *Juniperus phoenicea*/ *Juniperus indica*/ *Microbiota decussata*/ ontogeny/ cone / seeds
Abstract: Morphology and early development of seed cones of *Cupressus goveniana* Gordon, *Juniperus phoenicea* L., *J. virginiana* L., *J. indica* Bertol. and *Microbiota decussata* Kom. (*Cupressaceae*) have been studied under the Scanning Electron Microscope (SEM). The basic process of cone ontogeny is similar in all species observed. Their differences are due to differences in numbers of bracts (= cone scales) associated with ovules, differences in number of ovules produced, and the modifications in the bracts leading to mature cone scales. A tendency towards a reduction of these numbers, observable in the species studied, is interpreted as a probable evolutionary development. This hypothesis is supported by the probable phylogeny of the taxa. The selection pressures that possibly have

led to this minimal cone are discussed. It would appear that this evolution to a minimal cone has occurred twice independently within *Cupressaceae*: once from a *Cupressus*-like cone to a 'monoseed' cone in *Juniperus*, and independently from *Platycladus* to *Microbiota* (Jagel & Stutzel 2001b), both these taxa not being closely related to the former.

11. Guido, M. and Roques, A. Impact of the phytophagous insect and mite complex associated with cones on junipers (*Juniperus phoenicea* L. and *J. Cedrus* Webb and Berth.) in the Canary Islands. *Ecologia Mediterranea*. 1996; 22(1-2):1-10.
Keywords: *Juniperus phoenicea*/ *Juniperus cedrus* / Canary Islands/ Phoenician juniper
Abstract: Five stands of the Phoenician juniper, *Juniperus phoenicea*, and 2 of the endemic *J. cedrus* were surveyed in 4 islands of the Canarian archipelago for cone and seed pest damage. A total of 4 phytophagous species, 3 insects and 1 mite, were observed in cones of the Phoenician juniper while those of *J. cedrus* hosted the same species except a cone moth. A cone weevil was the dominant pest in both junipers but differences in cone colonization were observed among the surveyed islands. The Canarian entomofauna was not endemic and seemed comparatively poor with respect to that observed in southern Europe and North Africa. Pests significantly decreased the mean number of seeds and the mean number of filled seeds per cone in both juniper species. Because the two junipers differed by the number of seeds per cone, pest damage resulted in a different impact on the potential of juniper regeneration. The consequences of pest attack on the survival of *J. cedrus*, a species under protection that usually produces only 1 filled seed per cone, are discussed.
12. Jordano, P. Gender variation and expression of monoecy in *Juniperus phoenicea* L. *Cupressaceae*. *Botanical Gazette*. 1991; 152(4):476-485.
Keywords: *Juniperus phoenicea*/ Spain/ gender variation/ monoecy/ cone/ seed
Abstract: Variation of gender expression and cone production is described quantitatively for *Juniperus phoenicea* L. populations in southern Spain and Morocco. The species is monoecious, but most populations showed a dichotomy of gender expression at flowering, with predominantly "male" and predominantly "female" plants and few "monoecious" individuals, a functionally subdioecious breeding system. The proportion of female plants in the Spanish populations ranged from 31% (R. B. Donana) to 40% (Cda. Sabinas, 1988) and did not exceed 10% in Morocco. Most plants with femaleness values < .40 failed to set full-sized seed cones or produced very small crops. Individual plants showed a significant constancy of gender expression in consecutive years. Most inconsistencies in sexual behavior involved transitions between the male and female expressions and their respective "inconstant" conditions. Between-year variations in seed-bearing cone production largely reflected changes in female flowering gender of the individual plants; years with

large crop production were characterized by increases in average female gender expression for a given gender category and, as a result, a greater percentage of the population producing female cones. Plants differing in gender expression showed no significant differences in size. Male plants always produced fewer than 10 female cones per crop, and inconstant males rarely exceeded 200 female cones; female plants usually had crop sizes above 100 cones, except in the seasons of cone crop failure. Individual plants also differed in annual shoot growth, but these differences were unrelated to both gender expression and cone production in the previous season. Differences among populations accounted for 52% of total variance in female cone size, while the effect of the individual plant accounted for 26%; only 22% was attributable to within-plant variation. A nested model with gender category as the main effect and plant as a nested effect accounted for 88% of total variation in five cone characteristics, but gender effect accounted for .1toreq. 2%.

13. Jordano, P. Geographical ecology and variation of plant-seed disperser interactions: southern Spanish junipers and frugivorous thrushes. *Vegetatio*. 1993; 107-10885-104; ISSN: 0042-3106.
Keywords: *Juniperus communis*/ birds/ *Juniperus phoenicea*/ *Juniperus sabina*/ *Turdus merula*/ *Turdus pilaris*/ seed dispersal/ seeds/ Wildlife
Abstract: Results are presented from a study of interaction patterns between 6 species of strongly frugivorous thrushes (*Turdus iliacus*, *T. merula*, *T. viscivorus*, *T. philomelos*, *T. pilaris*, *T. torquatus*) and their major winter food plants (*Juniperus communis*, *J. phoenicea*, *J. sabina*) in 1985-89 at 6 localities in the highlands of southern Spain. Data are presented on feeding records of thrushes on juniper and other fruits, geographical variation in local thrush/juniper assemblages on regional and local scales, temporal variation in local assemblages, and mutual congruency of distribution patterns and interaction strengths. In the context of seed dispersal, it is concluded that the strong uncoupling of biogeographical attributes of plants and frugivores makes taxon-specific coevolved interactions unlikely, and restricts interactions between two species to particular subsets of their respective populations with extremely variable outcomes in space and time.

14. Kerfoot, O. and Lavranos, J. J. Studies in the flora of Arabia X. *Juniperus phoenicea* L. and *Juniperus excelsa* M. Bieb. *Notes RBG Edinb.* 1984; 41(3):483-489.
Keywords: *Juniperus phoenicea*/ *Juniperus excelsa*/ distribution/ Saudi Arabia
Abstract: A preliminary account of *Juniperus phoenicea* L. in the Arabian peninsula includes its distribution and phytosociology. Its geographical relation ship to the only other juniper occurring in Arabia, *J.*

excelsa M. Bieb., is discussed and it is confirmed that the overall southern limit of *J. phoenicea* and the northern W Arabian limit of *J. excelsa* meet in SW Saudi Arabia.

15. Kovacic, S.; Jasprica, N., and Ruscic, M. Floristic characteristics of Phoenician juniper macchia (ass. *Pistacio lentisci* - *Juniperetum phoeniceae* Trinajstić 1987) in Central and Southern Dalmatia (Croatia). *Natura Croatica*. 2001; 10(2):73-81.
Keywords: *Juniperus phoenicea*/ species richness/ botanical composition.
Abstract: The results of the analysis on the floristic characteristics of the *Pistacio lentisci*-*Juniperetum phoeniceae* association in the islands of Ciovo, Solta, Brac, Hvar, Korcula and Lopud, including the peninsula of Peljesac and the Dubrovnik coastal regions in Croatia are discussed. A total of 11 species characteristic of the *Oleo-Ceratonion* alliance and 18 for the order and class of *Quercetalia ilicis* were found. Seven species showed the greatest percentage of presence (appearance in 100% relevés). The average number of species for all phytocoenological relevés is 23. A total of 15 new species for this community was noted, while 7 of the previously noted species were absent. While association of *P. lentisci*-*J. phoeniceae* in the southern localities is still in the initial phase of development, these results indicate a succession of this vegetation towards the development of the *Quercus ilicis*-*Pinetum halepensis* forest community.
16. Kutbay, H. G.; Ok, T.; Bilgin, A., and Yalcin, E. Seasonal nutrient levels and foliar resorption in *Juniperus phoenicea*. *Belgian Journal of Botany*. 2005; 138(1):67-75.
Keywords: *Juniperus phoenicea*/ Turkey/ nutrients/ foliar resorption
Abstract: *Juniperus phoenicea* L. occurs in the Mediterranean region in the southern part of Turkey and has been widely used in landscape planning to stabilize coastal dunes. In this study, seasonal nitrogen (N), phosphorus (P), potassium (K) and calcium (Ca) concentrations and foliar resorption were investigated in *J. phoenicea*. The concentrations of N, P and K declined in senescent leaves, while that of Ca increased. N, P and K were subject to high remobilization, whereas Ca was accumulated in senescent leaves. N, P, K and Ca concentrations in young and fallen leaves were significantly different.
17. Liphshitz, Nili; Waisel, Y., and Lev-Yaden, S. (Department of Botany, Tel Aviv University, Tel Aviv, Israel). Dendrochronological investigations in the east Mediterranean Basin. editor, Syoji Sudo. *Proceedings of Pacific Regional Wood Anatomy Conference*. 1984 Oct 1-1984 Oct 7; 70-72.
Keywords: *Juniperus phoenicea*/ *Juniperus polycarpos*/ ring production/ ring width/ favorable conditions/ narrow rings
Call Number: QK647. 32
Abstract: In Sinai, *Juniperus phoenicea* produced a wide ring production during 1670-1712, and 1790-1820. Narrow rings produced during 1715-

1740, and 1830-1860. In Iran, *Juniperus polycarpus* produced better ring width growth during 1675-1690, and 1790-1810 while less favorable conditions prevailed during 1700-1735, and 1855-1865.

18. Mazur, M.; Boratynska, K.; Marcysiak, K.; Gomez, D.; Tomaszewski, D.; Didukh, J., and Boratynski, A. Morphological variability of *Juniperus phoenicea* (*Cupressaceae*) from three distant localities on Iberian Peninsula. *Acta Societatis Botanicorum Poloniae*. 2003; 72(1):71-78.
Keywords: *Juniperus phoenicea*/ Iberian peninsula/ cones/ seeds/ subspecies
Abstract: The aim of the present study was biometrical comparison of three Iberian populations of *Juniperus phoenicea*, represented by the subsp. *turbinata* and subsp. *phoenicea*. Eight features of the cones and seeds, two of the shoots and leaves were studied. The biometrical analysis of three distant populations of *J. phoenicea* shows great taxonomic distances among them. Two of them, representatives of *J. phoenicea* subsp. *turbinata*, are closer related each other than to the third, which represents *J. phoenicea* subsp. *phoenicea*. These results confirm the genetic differentiation of the taxons and also the biochemical and morphologic division of them. Nevertheless, the distances between particular populations are so great that more resemble the distances between species than between subspecies.
19. Molero Mesa, J. and Perez Raya, F. Phytosociological study of the juniper scrubs of *Juniperus phoenicea* L. in Malacitano-Almijarense sector, Betica chorological province, Spain). *Lazaroa*. 1985; 7301-306.
Keywords: *Juniperus phoenicea*/ Spain/ phytosociology
Abstract: A new association belonging to All. Rhamno-Quercion cocciferae, is proposed: Rhamno myrtifoli-Juniperetum phoeniceae
20. Quezel, P. and Barbero, M. Pre-steppe juniper associations in Morocco. Contribution a l'etude des formations pre-steppiques a Genevriers au Maroc. *Boletim Da Sociedade Broteriana*, 2. 1981; 53(2):1137-1160; 6 tab.
Keywords: *Juniperus phoenicea*/ *Juniperus oxycedrus*/ *Juniperus thurifera*/ High Atlas/ phytosociology
Abstract: A phytosociological study of associations dominated by arborescent *Juniperus* spp. (*J. phoenicea*, *J. oxycedrus*, *J. thurifera*), with special reference to vegetation of the High Atlas.
21. Roques, A.; Raimbault, J. P., and Goussard, F. The colonization of mediterranean juniper cones and galbuli by insects and acarids and its effect on possibilities of natural regeneration of these species. *Ecologia Mediterranea*. 1984; 10(1-2):147-170.
Keywords: *Juniperus oxycedrus*/ *Juniperus phoenicea*/ *Juniperus thurifera*/ seed/ berries/ seed pests.
Abstract: Pests of the female reproductive forms of Mediterranean juniper seem to be confined to *Cupressaceae* and in majority strictly to genus *Juniperus*. The fauna appears to be climate-linked. *J. oxycedrus* L.

and *J. phoenicea* L., characteristic of the mediterranean vegetation, present in their whole French distribution area the same fauna, very different from *J. thurifera* L. species distributed in the supra Mediterranean level. High attack rates of berries are frequently observed for the 3 spp., with some differences between continental and Corsican stands. But the low number of seed pests and the number of sound seeds/berry limits (excepted for *J. thurifera* L.) the reduction of the regeneration possibilities of natural juniper stands by insect or mite action.

22. Rossi F. ; Facini O. ; Rotondi A. ; Loreti S., and Georgiadis T. Optical properties of juniper and lentisk canopies in a coastal Mediterranean macchia shrubland. *Trees Structure & Function*. 2001; 15(8):462-471.
Keywords: *Juniperus phoenicea*/ *Pistacia*/ canopy/ light absorbance / Italy
Abstract: Light absorbance and reflectance were measured on representative shrubs of two dominant shrub species (*Pistacia lentiscus* and *Juniperus phoenicea*) of coastal Mediterranean macchia ecosystems in Sardinia (Italy). An array of 64 calibrated photodiodes was adopted for both calculations of leaf area index (LAI) and canopy transmittance of photosynthetic active radiation (PAR). PAR and NIR reflectance of canopies having similar LAI allowed us to establish the particular optical properties of each species. Lentisk reflected twice as much as juniper in the 700-1,100 spectral region. Water indexes of the two species were also different in relation to leaf water content and red edge amplitude appeared to be related to chlorophyll content. Epidermis and mesophyll structures of both species are shown.
23. Traveset, A. and Sans, A. Insect frugivory in *Juniperus phoenicea* (L.) (*Cupressaceae*) in Cabrera island (Balearic Archipelago). *Bolleti De La Societat D' Historia Natural De Les Balears*. 1994; 37143-149.
Keywords: *Juniperus phoenicea*/ Balearic Islands/ seeds/ plant pests/ agricultural entomology/ frugivory/ cones/ larva/ infestation
Abstract: The variation between individuals of *Juniperus phoenicea* in the incidence of frugivorous insects was examined on Cabrera island, Balearic Islands, during 1992-93. The proportion of seeds damaged was determined and the relationship between the number of cones infested by insects and cone size (diameter) was examined. A great variability in the proportion of cones infested was found, representing 3-50% of the crop. The larva of an unidentified gelechiid fed upon on the pulp of the fruit and rarely (<3%) damaged the seeds. Cone diameter did not influence the intensity of attack. Larger fruits did not have more seeds and were not more infested than small fruits. In 1993, fruit infestation was greater than in 1992, possibly because cones take 2 years to mature and those collected in 1993 had been exposed to infestation for longer.
24. Trinajstić I. Plant sociological features of macchia *Pistacio-Juniperetum*

phoeniceae Trinajstić 1987 (Oleo-Ceratonion Br.-Bl.) on the coasts of Malostonski zaljev (Croatia).

Fitocenološke značajke makije somine - *Pistacio-Juniperetum phoeniceae* Trinajstić 1987 (Oleo-Ceratonion Br.-Bl.) na obalama Malostonskog zaljeva. Radovi Sumarski Institut Jastrebarsko. 2000; 35(1):5-12.

Keywords: *Juniperus phoenicea*/ Croatia/ floristic composition

Abstract: Data collected during 1999 were used in floristic analysis of the macchia association *Pistacio-Juniperetum phoeniceae* in Malostonski zaljev, southern Croatia. Parts of the area were not studied because the land was mined during 1991-93 war. This association has relatively poor floristic composition, with 12-20 species per releve, and a total of 38 species on 6 releves. The dominant, characteristic species is *Juniperus phoenicea*. The stands of this association are indicators of a climate with mean minimum values of 6-8 ° C.

***Juniperus pinchotii* (26)**

1. Adams, R. P. Reevaluation of the biological status of *Juniperus deppeana* var. *sperryi* Correll. Brittonia. 1973; 25(3):284-289.

Keywords: *Juniperus deppeana*/ *Juniperus pinchotii*/ *Juniperus flaccida*/ hybridization/ morphology/ terpenoids

Abstract: Gives the results of an examination of the terpenoids and morphological characters of foliage and bark from the type tree of *J. deppeana* var. *sperryi* and from trees of natural populations of *J. d.* var. *deppeana*, *J. pinchotii* and *J. flaccida*. The terpenoid data suggest that the variety is most closely related to *J. d.* var. *deppeana*, and no evidence was found of hybridization with *J. flaccida*. In some morphological characters, however, the variety is intermediate between the two last, and the probability of a hybrid origin is discussed. The new combination *J. deppeana* f. *sperryi* is proposed.

2. ---. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). Biochemical Systematics and Ecology. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana*/ *Juniperus ashei*/ *Juniperus californica*/ *Juniperus coahuilensis*/ *Juniperus comitana*/ *Juniperus deppeana*/ *Juniperus durangensis*/ *Juniperus flaccida*/ *Juniperus gamboana*/ *Juniperus jaliscana*/ *Juniperus monosperma*/ *Juniperus monticola*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Juniperus pinchotii*/ *Juniperus saltillensis*/ *Juniperus standleyi*/ essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J.*

osteosperma, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

3. Adams R. P. and Zanoni T. A. The distribution, synonymy, and taxonomy of three junipers of southwestern United States and northern Mexico. *Southwestern Naturalist*. 1979; 24(2):323-329.

Keywords: *Juniperus erythrocarpa*/ *Juniperus monosperma*/
Juniperus pinchotii/ distribution/ taxonomy/ synonymy

Abstract: Revised distribution maps, new keys, and updated synonymy are presented for *Juniperus erythrocarpa*, *J. monosperma*, and *J. pinchotii*. These revisions reflect evidence from the past several years and are presented to aid field workers in the identification of these difficult taxa.

4. Adams, R P; Zanoni, T A; Rudloff, E von, and Hogge, L. The south-western USA and northern Mexico one-seeded junipers: their volatile oils and evolution. *Biochemical Systematics and Ecology*. 1981; 9(2/3):93-96; ISSN: 0305-1978

Keywords: *Juniperus erythrocarpa*/ *Juniperus monosperma*/
Juniperus pinchotii/ biochemistry/ taxonomy/ evolution/ arid regions

Abstract: The composition of the volatile oils of *Juniperus erythrocarpa*, *Juniperus monosperma* var. *gracilis* and *Juniperus pinchotii* are reported from analysis by capillary GC MS-computer search. *Juniperus erythrocarpa* appears to have two chemical types or races, one from southern Arizona-south-west New Mexico, USA, and the other from Mexico and trans-Pecos Texas, USA. *Juniperus monosperma* var. *gracilis* contained aromatics from the phenyl propanoid pathway marking the first report of these type compounds from the denticulate leaf junipers. *Juniperus monosperma* var. *monosperma* was not found to be similar to *J. monosperma* var. *gracilis*, suggesting a nomenclatural change is needed for the latter taxon. The evolution within this complex has apparently been discordant between the morphology and the terpenoids.

5. Alexander H. Controlling juniper: fire and goats, a combination? *Rangelands*. 1993; 15(6):257-259.

Keywords: *Juniperus pinchotii*/ *Juniperus ashei*/ *Juniperus virginiana*
/ fire/ goats

Abstract: Control of *Juniperus pinchotii*, *J. ashei* and *J. virginiana* in

Texas rangelands using fire and goats, and the ecological impact of these methods, are discussed.

6. Bunting S. C. and Wright H. A. Seasonal flammability of redberry juniper. Noxious Brush and Weed Control Research Highlights. 1976; 740-41.
Keywords: *Juniperus pinchotii*/ flammability/ Texas/ ignition
Abstract: A study was carried out near Post, Texas to examine the causes of the seasonal change in the flammability of *Juniperus pinchotii*. The length of pre-heating time required for ignition, the moisture content and volatile oil content of the foliage and the weather conditions were recorded at monthly intervals from June 1973 to April 1975. Analysis of the data indicated that, in relatively dry years, the moisture content of the foliage and the average temp. for the preceding month were the most significant variables for predicting *J. pinchotii* ignition. During wet years, however, the prediction of flammability was difficult using the variables chosen.
7. Dye, K. L. II; Ueckert, D. N., and Whisenant, S. G. Redberry juniper-herbaceous understory interactions. Journal of Range Management. 1995; 48(2):100-107.
Keywords: *Juniperus pinchotii*/ plant succession/ plant competition/ understory
Abstract: Basal cover, density, biomass and species richness of the understory were measured in concentric zones from the stem bases of large redberry juniper (*Juniperus pinchotii*) trees to 6 m beyond their canopy edges on a shallow, rocky soil and 2 deep soils in the northern Edwards Plateau of Texas. The juniper-driven successional processes of tree dominance, debilitation of understory dominants, influx of subsidiary species, and the general reduction in diversity, density and biomass of the herbaceous species were evident on all 3 sites. Juniper interference intensified with increasing proximity to the stem bases. Biomass and basal cover of the herbaceous understory responded to a greater extent than did density and species richness 2 years after large redberry junipers were killed with soil injections of picloram. Herbaceous biomass responses after junipers were killed indicated that the sphere of influence of large junipers was more extensive on the shallow soil than on the deep soils. Herbaceous biomass in the presence of interference by large junipers on the Kimbrough, Angelo clay loam (both Mollisols) and Tulia loam (an Alfisol) soils was 1300, 1780 and 1290 kg/ha, respectively, compared with 2140, 2140 and 1560 kg/ha 2 years after the junipers were killed on the 3 sites, respectively. Projected herbaceous biomass when juniper populations on the sites develop into closed-canopy woodlands was 320, 880 and 270 kg/ha for the Kimbrough, Angelo clay loam and Tulia loam soils, respectively.
8. Everitt, J. H.; Yang, C.; Racher, B. J.; Britton, C. M., and Davis, M. R. Remote sensing of redberry juniper in the Texas rolling plains. Journal of Range Management. 2001; 54(3):254-259.

Keywords: *Juniperus pinchotii*/ Texas/ image analysis/ range management.

Abstract: Redberry juniper (*Juniperus pinchotii*) is a noxious shrub or small tree that invades rangelands in northwest Texas, USA. Field reflectance measurements showed that redberry juniper had lower visible and higher near-infrared (NIR) reflectance than associated species and mixtures of species in February. The low visible reflectance of redberry juniper was due to its darker green foliage than associated species, whereas its high NIR reflectance was attributed to its greater vegetative density than associated vegetation. Redberry juniper had a distinct reddish-brown image tonal response on color-infrared aerial photographs obtained in February. Computer analysis of a color-infrared photographic transparency showed that redberry juniper infestations could be quantified. An accuracy assessment performed on the classified image had a user's accuracy of 100% and a producer's accuracy of 94% for redberry juniper.

9. Herndon, E. B. Granular picloram controls redberry juniper. Noxious Brush and Weed Control Research Highlights. 1973; 433.

Keywords: *Juniperus pinchotii*/ picloram/ herbicide/ control

Abstract: Spring application of 10% picloram granules effectively controlled *Juniperus pinchotii* in the Rolling Plains. A rate of 2 lb/acre gave 89% canopy reduction and the cost compared favorably with mechanical control provided there were <300 plants/acre. Chemical suppression of forage under the treated plants was only temporary. In another study, Tandex (karbutilate) at 10 lb/acre was ineffective.

10. Johnson, P.; Gerbolini, A.; Ethridge, D.; Britton, C., and Ueckert, D. Economics of redberry juniper control in the Texas Rolling Plains. Journal of Range Management. 1999; 52(6):569-574.

Keywords: *Juniperus pinchotii*/ controlled burning/ productivity

Abstract: Redberry juniper (*Juniperus pinchotii*) is a common invasive brush species that reduces rangeland productivity over vast areas in the Rolling Plains and Edwards Plateau regions of Texas, USA. The objectives of this study were to evaluate the economic feasibility of redberry juniper control and determine the optimum treatment cycle for maintenance burning. A response equation was used to estimate the relationship between herbage production and redberry juniper canopy. Data to estimate the relationship was obtained for a site in the Texas Rolling Plains. The analysis used chaining as the initial treatment and periodic prescribed burns as maintenance treatments. Additional livestock production resulting from brush treatments and the costs of treatments were estimated and used to calculate net present values of the investment in brush control over a 30-year period. Net present values indicated that juniper control was economically feasible across a wide range of economic and environmental conditions. Prescribed burn intervals were found to be optimal at 7-year intervals under most conditions.

11. McPherson, G. R.; Masters, R. A., and Rasmussen, G. A. Prescribed burning of a chained redberry juniper community with a helitorch. Fire Management Notes. 1986; 46(4):7-10.
Keywords: *Juniperus pinchotii*/ Texas/ management/ controlled burning
Abstract: A 4015-ha unit dominated by redberry juniper (*Juniperus pinchotii*)/mixed grass, NE of Paducah, Texas, was chained 2 yr before prescribed burning. Headfires were lit with a helitorch on 25 Feb. and 6 Mar. 1985. The objectives were to remove 80% of woody debris, reduce juniper canopy cover by 70%, remove dead material from 70% of grass plants and kill 70% of young encroaching juniper and honey mesquite, thus improving livestock handling and forage availability and accessibility. Near opt. conditions on 25 Feb. resulted in achievement of burning objectives, but cooler weather and an increase in green fine fuel caused a failure to meet the objectives on 6 Mar. It is concluded, however, that large units can be burned safely and quickly with a helitorch at far less expense than hand ignition.
12. McPherson, G. R.; Rasmussen, G. A.; Wester, D. B., and Masters, R. A. Vegetation and soil zonation associated with *Juniperus pinchotii* Sudw. trees. Great Basin Naturalist. 1991; 51(4):316-324.
Keywords: *Juniperus pinchotii*/ Texas/ forest influences/ soil chemistry/ synecology.
Abstract: Herbaceous vegetation pattern and soil chemical properties around individual *Juniperus pinchotii* trees were studied on a grazed and a relict grassland in western Texas. Samples were collected under the canopy, at the edge of the canopy and beyond the canopy in July and October, 1984-85. Herbaceous standing crop was lowest midway between the bole and the canopy edge. Soil organic matter was greatest under juniper canopies on both sites. Soil pH and P were not related to distance from the bole. Herbaceous patterns under the canopy apparently depended on tree size, but trees had little affect on herbaceous vegetation 3-5 m beyond the canopy edge.
13. McPherson, G. R. and Wright, H. A. Direct effects of competition on individual juniper plants: a field study. Journal of Applied Ecology. 1989; 26(3):979-988.
Keywords: *Juniperus pinchotii*/ Texas/ competition
Abstract: On each of two sites in western Texas, 240 *Juniperus pinchotii* plants were harvested. The competitive influence of herbs and shrubs associated with each juniper plant was quantified in an attempt to explain variability in survival and regrowth of individual coppiced plants. Survival and regrowth were greater on the deep-soiled Rolling Plains site than on the shallow-soiled High Plains site. Pre-harvest age or size largely controlled survival and subsequent regrowth of coppiced *J. pinchotii* plants. Competition from neighboring shrubs, though significant, explained little of the observed variation in survival or growth.

Competition was most common during periods of active juniper growth. Competitive influence decreased with increasing distance, but not in a linear manner. Competition from herbaceous plants was not detected.

14. ---. Establishment of *Juniperus pinchotii* in western Texas USA environmental effects. *Journal of Arid Environments*. 1990; 19(3):283-288.
Keywords: *Juniperus pinchotii*/ Texas/ pinyon-juniper woodlands
Abstract: Identification of causal factors in the encroachment of woody assemblages onto grasslands is of fundamental importance in understanding these systems. In particular, displacement of grasslands by pinyon-juniper woodlands in North America has received considerable attention. This study compared monthly, seasonal, and yearly precipitation to the annual establishment rate of *Juniperus pinchotii* over a 30-year period (1950-79) on two sites in western Texas. Establishment was approximately twice as high in the second year of a 2-year period of above-average precipitation (5.0 to 5.6%) as during other periods (2.0 to 2.6%). Above-average precipitation in successive years (the first for seed production, the second for establishment) apparently acted as an environmental trigger for juniper establishment onto western Texas grasslands.
15. Schuster, J. L. Redberry juniper control with picloram. *Journal of Range Management*. 1976; 29(6):490-491.
Keywords: *Juniperus pinchotii*/ picloram/ pellets/ foliage/ herbicide
Abstract: Individual plant treatments with picloram at 0.5 lb in 100 gal of an oil: water carrier controlled redberry juniper (*Juniperus pinchotii*) when applied to foliage between April and September. Picloram pellets, as an individual plant treatment, effectively controlled *J. pinchotii* at rates equivalent to 2 and 4 lb/acre.
16. Schuster, J. L. and George, J. Redberry Juniper response to top removal. *Journal of Range Management*. 1976; 29(3):258-259.
Keywords: *Juniperus pinchotii*/ Texas/ top removal/ regrowth
Abstract: Trees of Redberry Juniper (*Juniperus pinchotii*) - a noxious brush species - growing in the Texas High Plains, were cut off at ground level at monthly intervals throughout 1968. After one year, regrowth was lowest for trees cut from May to Aug. A linear relationship was found between regrowth production and basal stem circumference.
17. Schuster, J. L.; Herndon, E. B., and Graves, R. G. Redberry juniper control and resulting forage responses in the High and Rolling plains of Texas. *Proceedings 25th Annual Meeting Southern Weed Science Society*. 1972; 296-301.
Keywords: *Juniperus pinchotii*/ crops/ growth stages/ roots/ herbicides/ Texas
Abstract: Redberry juniper (*Juniperus pinchotii*) has spread to grassland in many areas of the High and Rolling Red Plains. It is particularly difficult to control because of its ability to resprout from roots and crown after top

removal, but foliage application of picloram potassium at 0.5 lb/100 gal diesel oil:water solution can be expected to give >90% reduction in growth throughout the growing season. Optimum time of application is late spring or early autumn. Individual tree treatments of Tordon 10K [picloram potassium 11.6% granules] were effective and economical, costing per 1% cover from \$0.07 for 0.5 lb/acre to \$0.54 for 4 lb. Juniper control can increase forage yields by up to 88%, giving a possible 8.1 lb additional annual beef production/acre.

18. Smith, M. A.; Wright, H. A., and Schuster, J. L. Reproductive characteristics of redberry juniper. *Journal of Range Management*. 1975; 28(2):126-128.
Keywords: *Juniperus pinchotii*/ seed germination/ plant competition/ seeds
Abstract: In laboratory experiments, germination of *Juniperus pinchotii* seeds tested at 10 °, 18 ° or 27 °C and 0-16 bars osmotic potential was highest at 18 ° and 0-4 bars. Differences in emergence from seeds placed 0-2 cm deep were not significant but no seedlings emerged from depths of >2 cm. Germination was not affected by passage through animals. Removal of the epicotyl 1 mm above the axil of the cotyledon resulted in 58% mortality compared with 20% mortality in intact seedlings. In a field test, sprouting occurred in 30 and 14% of 8- and 12-year-old plants cut to ground level and always originated in stems and above root crowns. Moderate and heavy competition with blue grama markedly reduced shoot and root length, the number of shoot and root branches and plant dry weight. It was concluded that good grass cover combined with fires at intervals of 8-12 years would suppress juniper establishment.
19. Steuter, A. A. Ecological role and potential use of fire in redberry juniper-mixed grass habitats. *Dissertation Abstracts International, B*. 1982; 43(4):934.
Keywords: *Juniperus pinchotii*/ *Aristida*/ *Xanthocephalum dracunculoides*/ fire/ mortality
Abstract: Within a range of mixed grass fuel loadings more than 70% of *Juniperus pinchotii* plants with the bud zone above the soil surface were killed by fires. When the bud zone was partially covered by soil, plant mortality was 3%. Spring fires were also ineffective in controlling *Aristida* spp. and *Xanthocephalum dracunculoides*.
20. Steuter, A. A. and Britton, C. M. Fire-induced mortality of redberry juniper [*Juniperus pinchotii* Sudw.]. *Journal of Range Management*. 1983; 36(3):343-345.
Keywords: *Juniperus pinchotii*/ fire/ mortality/ burning
Abstract: Mortality of *J. pinchotii* was 1-100% following spring broadcast burning in 1979 and 1980, and individual plant burning with 3 heat treatments in 1981. Bud zone location, plant size, site and growing conditions all affected mortality. In yr with above av. precipitation, mortality averaged 70% for plants with bud zones above the soil and 3% for those with buds partially below the soil. Mortality was also significantly

higher when burning took place under hotter conditions or was followed by a dry growing season.

21. Steuter, A. A. and Wright, H. A. Redberry juniper mortality following prescribed burning. Research Highlights 1979, Noxious Brush and Weed Control; Range and Wildlife Management. 1979; 1014.
Keywords: *Juniperus pinchotii*/ weed control/ cultural control.
Abstract: Young *Juniperus pinchotii* 7 to 70 cm high and adult plants that had been chained in 1975 were burned in March 1979 using fine fuel at 2600 kg/ha. Mortality of young *J. pinchotii* 6 months later averaged 42% and depended on the size of individual plants and the amount of fine fuel adjacent to them. Only 1% of adult *J. pinchotii* plants was killed by burning. Adult plants resprouted after chaining to form a compact bush which was largely insulated from the heat of the fire.
22. ---. Spring burning effects on redberry juniper mixed grass habitats. Journal of Range Management. 1983; 36(2):161-164.
Keywords: *Juniperus pinchotii*/ *Aristida wrightii*/ *Aristida purpurea*/ *Aristida longiseta*/ *Xanthocephalum dracunculoides*/ burning/ fire/ spring/ Texas
Abstract: In 1979-81, redberry juniper (*Juniperus pinchotii*) mixed grass rangelands in the Rolling Plains area of Texas were (a) chained in 2 directions, (b) chained/burned, (c) burned/chained/burned, (d) burned/chained, or (e) burned. Treatment (b) decreased shrub and debris cover but increased the percentage of bare ground. Treatment (e) increased perennial grass yields in high rainfall yr, but yields were reduced to 50% of (a) in dry yr. Percentage cover of forbs in (e) was similar to the untreated control. March burning was most effective in controlling redberry juniper, perennial threeawn (*Aristida wrightii* *A. purpurea* and *A. longiseta*) and common broomweed (*Xanthocephalum dracunculoides*).
23. Straka E.; Scott C. B.; Taylor C. A.; , Jr, and Bailey E. M. Jr. Biological control of the toxic shrub juniper. Poisonous Plants and Related Toxins. 2004; 436-442.
Keywords: *Juniperus ashei*/ *Juniperus pinchotii*/ biological control
Abstract: This chapter presents an overview of the biological control of juniper (*Juniperus ashei* and *J. pinchotii*) using goats, briefly discussing the toxicological effects of juniper and methods for increasing juniper consumption.
24. Teague, W R; Dowhower, S L; Whisenant, S G, and Flores-Ancira, E. Mesquite and grass interference with establishing redberry juniper seedlings. Journal of Range Management. 2001; 54(6):680-684; ISSN: 0022-409X.
Keywords: *Juniperus pinchotii*/ establishment/ nutrient availability/ plant competition/ rangelands/ roots/ seedlings/ *Bouteloua curtipendula*/ *Buchloe dactyloides*/ grasses/ *Hilaria mutica*/ *Poaceae*/ *Prosopis*

glandulosa

Abstract: Excessive cover of juniper (*Juniperus pinchotii*) reduces forage production, interferes with livestock management, and diminishes the watershed and wildlife habitat values of rangelands. We studied whether juniper seedlings in Texas, USA, were differentially suppressed in the presence of different grass species, and to what extent established mesquite (*Prosopis glandulosa*) trees facilitated or competed with establishing juniper seedlings. Seedlings growing with any of the grasses (relative growth rate (RGR)=0.23 to 0.43 cm cm⁻¹) grew significantly ($P<0.01$) less than those with no grass competition (RGR=0.72 cm cm⁻¹). Juniper seedlings grew significantly less ($P<0.01$) in the presence of buffalograss (*Buchloe dactyloides*) (RGR=0.23 cm cm⁻¹) than with either sideoats grama (*Bouteloua curtipendula*) (RGR=0.43 cm cm⁻¹) or tobosagrass (*Hilaria mutica*) (RGR=0.43 cm cm⁻¹). In contrast, juniper seedlings grew larger under intact canopies of mesquite (RGR=0.99 cm cm⁻¹) than in open grassland (RGR=0.65 cm cm⁻¹) ($P<0.05$) due in part to the greater nutrient availability ($P<0.05$) under mesquite canopies. Juniper growing in sub-canopy positions with mesquite trees removed grew less (RGR=0.84 cm cm⁻¹) than those growing under mesquite canopies with root competition (RGR=0.99 cm cm⁻¹) ($P<0.05$). Juniper growing under intact mesquite canopies but without mesquite root competition, grew no better or worse (RGR=0.93 cm cm⁻¹) than those with mesquite root competition (RGR=0.99 cm cm⁻¹) ($P>0.05$), indicating that mesquite root competition with juniper is probably inconsequential. Since junipers grow mainly in fall, winter and spring when mesquite trees are dormant and leafless, the lack of competition may largely be due to these 2 species using resources at different times of the year. Greater nutrient availability beneath mesquite canopies, reduction of summer temperatures, and temporal separation of resource use clearly benefit juniper seedlings growing in the presence of mesquite. Managing for a vigorous grass component with low densities and cover of mesquite is the best way to limit the rate of invasion by juniper.

25. Ueckert D. N.; Phillips R. A.; Petersen J. L.; Wu X. B., and Waldron D. F. Redberry juniper canopy cover dynamics on western Texas rangelands. *Journal of Range Management*. 2001; 54(5):603-610.
Keywords: *Juniperus pinchotii*/ canopy/ cultural control/ grubbing.
Abstract: Knowledge of the rate woody plant canopy cover increases is essential for understanding the ecology of rangeland plant communities, determining the economic feasibility of brush management practices, and for scheduling initial and maintenance control practices. We determined rates of change in redberry juniper (*Juniperus pinchotii*) canopy cover from the mid 1950s through the late 1990s at 5 locations (Coke, Crockett, Irion, Nolan and Reagan County) in western Texas, USA on rangeland that had been chained or grubbed for juniper control and on adjacent untreated areas. Juniper cover was estimated from aerial photographs by

the line intercept method using a 10-X monocular lens with a vernier. Juniper cover increased at 0.35+or-0.06 percentage units/year on untreated sites and at 1.01+or-0.07 percentage units/year following chaining or grubbing. Juniper cover returned to pre-treatment levels in an average of 20 years (range 11 to 25) following chaining or grubbing. Herbage production on untreated rangeland was predicted to decline slowly (2.4 to 5.0 kg/ha/year) as juniper cover increased from 6 to 14%, and rapidly (>8 kg/ha/year) as juniper cover increased from 30 to 38%. Herbage production was predicted to decline at a constantly increasing rate following mechanical control of juniper, from <2 kg/ha/year in year 1 to 23 kg/ha/year in year 29. Potential additional livestock carrying capacity due to juniper control would be under estimated by more than 40%, assuming forage production without treatment remained constant during the entire planning horizon of an economic analysis. To avoid significant reductions in livestock carrying capacity, redberry juniper control should be implemented before its canopy cover exceeds about 20%.

26. Ueckert, D. N. and Whisenant, S. G. Individual plant treatments for controlling redberry juniper seedlings. *Journal of Range Management*. 1982; 35(4):419-423.
Keywords: *Juniperus pinchotii*/ manual weed control/ chemical treatment/ bromacil/ hexazinone/ picloram/ dicamba/ thebuthiuron
Abstract: Seventeen treatments were applied in autumn 1977 and spring 1978 to *Juniperus pinchotii* seedlings on a valley range site in Texas and mortality was recorded 3-25 months later. Cutting at the soil surface or hand grubbing to a depth of 5-15 cm gave complete control. Foliar sprays (0.5% a.i.) of bromacil, hexazinone, 2,4,5-T plus picloram (1:1), and picloram (in water or in diesel fuel/water emulsion) also produced complete control; dicamba gave complete control in a wet spring, and 76% control in a dry autumn. Pelleted or granular applications of dicamba, tebuthiuron and picloram (at 2.2-4.5 kg/ha a.i.) did not produce satisfactory control. Cutting or hand grubbing were the cheapest methods (\$23.14/ha), based on 1979 prices for controlling stands with over 2000 plants/ha. The cheapest foliar spray was dicamba (\$28.24/ha), followed by bromacil (\$29.28).

Juniperus pingii (3)

1. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. *Acta Horticulturae*. 2003; 61291-106.
Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.
Abstract: Several cases involving apparent discordance in morphological,

chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var. *microsperma*, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var. *squamata*, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.

2. ---. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). *USABiochemical Systematics & Ecology*. 2000; 28(6):529-543.

Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus pseudosabina*/ *Juniperus recurva*/ *Juniperus saltuaria*/ *Juniperus squamata*/ *Juniperus tibetica*/ *Juniperus wallichiana*/ RAPD/ DNA/ essential oils

Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallichiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

3. Yu Y. F. and Fu L. K. Notes on Gymnosperms II. New taxa and combinations in *Juniperus* (*Cupressaceae*) and *Ephedra* (*Ephedraceae*) from China. *Novon*. 1997; 7(4):443-444.

Keywords: *Juniperus chengii*/ *Juniperus baimashanensis*/ *Juniperus pingii*/ *Juniperus squamata*/ *Ephedra*/ China/ varieties

Abstract: Two new species, *Juniperus chengii* L. K. Fu and Y. F. Yu and *J. baimashanensis* Y. F. Yu and L. K. Fu, and three new varieties, *J. pingii* Cheng ex Ferre var. *carinata* Y. F. Yu and L. K. Fu, *J. squamata* Buchanan-Hamilton ex D. Don var. *parvifolia* Y. F. Yu and L. K. Fu, and *J. squamata* var. *hongxiensis* Y. F. Yu and L. K. Fu, are described. Two new

combinations in *Juniperus* and one in *Ephedra* are proposed.

Juniperus polycarpus (10)

1. Dar, G. H. and Christensen, K. I. Gymnosperms of the Western Himalaya. 1. The genus *Juniperus* (*Cupressaceae*). Pakistan Journal of Botany. 2003; 35(3):283-311.

Keywords: *Juniperus communis*/ *Juniperus squamata* / *Juniperus recurva*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus wallichiana*/ *Juniperus pseudosabina*/ Himalaya

Abstract: A thorough study of an extensive collection of herbarium specimens and literature of *Juniperus* (*Cupressaceae*) from the Western Himalaya, during our work on gymnosperms of this region, has revealed that the taxonomy of West Himalayan Junipers has been confusing. A total of up to 6 taxa have been reported from this region by various earlier workers under a large number of specific and infraspecific names, most of which are synonyms. Seven taxa are recognized from the Western Himalaya in the present study: one belonging to *Juniperus* Sect. *Juniperus*, *J. communis* var. *saxatilis*, and the other six to *Juniperus* Sect. *Sabina*. The latter section includes two acicular-leaved species, *J. squamata* and *J. recurva*, and four scale-leaved species: two multiseed, *J. semiglobosa* and *J. polycarpus*, and two monoseed, *J. wallichiana* and *J. pseudosabina*.

2. Diavanshir, K. Problems of regeneration of *Juniperus polycarpus* C. Koch in the Forests of Iran. Silvae Genet. 1974; 23(4):106-108.

Keywords: *Juniperus polycarpus* / artificial pollination/ Iran/ seed

Abstract: *Juniperus polycarpus* covers about 1.2 million hectares in the high mountains of Iran. Little or no regeneration occurs in these forest; hence they may eventually disappear. Our research showed that almost no filled seeds are produced naturally. Artificial pollination, on the other hand, is an effective in producing sound seeds. Damage by insect, especially *Megastigmus*, was not found to be an important factor causing empty seeds.

3. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. *Sabina*) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). Edinburgh Journal of Botany. 1992; 49(3):251-283.

Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia

Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were

previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpus* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpus*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.

4. Javeed, Q. N.; Perveen, R.; Imtiazul-Haq, and Ilahi, I. Propagation of *Juniperus polycarpus* C. Koch through tissue culture. I. Induction of callus. Pakistan Journal of Forestry. 1980; 30(2):72-77.
Keywords: *Juniperus polycarpus*/ callus/ vegetative propagation/ tissue culture.
Abstract: The effects were studied of various factors on the induction and growth of callus in shoot segments of *J. polycarpus* on Murashige and Skoog medium. A successful callus could only be raised in diffuse light with shoot segments that included an apical bud on medium supplemented with 1.0 mg/litre 2,4-D, 10% coconut milk and 2% sucrose. Addition of 1 mg/litre of benzylaminopurine further enhanced callus growth.
5. Liphschitz, Nili; Waisel, Y., and Lev-Yaden, S. (Department of Botany, Tel Aviv University, Tel Aviv, Israel). Dendrochronological investigations in the east Mediterranean Basin. editor, Syoji Sudo. Proceedings of Pacific Regional Wood Anatomy Conference . 1984 Oct 1-1984 Oct 7; 70-72.
Keywords: *Juniperus phoenicea*/ *Juniperus polycarpus*/ ring production/ ring width/ favorable conditions/ narrow rings
Call Number: QK647. 32
Abstract: In Sinai, *Juniperus phoenicea* produced a wide ring production during 1670-1712, and 1790-1820. Narrow rings produced during 1715-1740, and 1830-1860. In Iran, *Juniperus polycarpus* produced better ring width growth during 1675-1690, and 1790-1810 while less favorable conditions prevailed during 1700-1735, and 1855-1865.
6. Mahmood, A.; Khalida, A., and Khan, N. H. Bud multiplication in juniper. Hamdard Medicus. 1992; 35(4):51-56.
Keywords: *Juniperus polycarpus*/ *Juniperus excelsa*/ Pakistan/ tissue culture/ bud culture/ genetic resources.
Abstract: Natural regeneration of juniper (*Juniperus polycarpus*, syn. *J. excelsa*) in the Baluchistan (Pakistan) forests is very poor, so studies were undertaken on the possible propagation of the species by bud culture. Actively growing buds were excised from 2-yr-old plants growing in the Silviculture Garden of the Pakistan Forest Institute and their multiplication tested in various media. Successful multiplication was achieved in 2 wk by first treating the buds with 0.7% polyvinyl pyrrolidone (PVP) and 2% sucrose, and then culturing for 2 wk in basal MS (Murashige and Skoog) or WRC (White's Root Culture) media containing 0.5 mg/litre BAP (benzylaminopurine [benzyladenine]) or 1.0 mg/litre BAP or kinetin,

respectively. On WRC medium 100% multiplication was achieved, with a maximum number of new buds of 9 per treated original bud.

7. Muradyan, V M. Growing tree junipers in Armenia. Lesnoe-Khozyaistvo. 1982; 762-63.
Keywords: *Juniperus polycarpus*/ *Juniperus foetidissima*/ Armenia/ planting stock/ nursery/ berries/ seeds/ stratification/ germination
Abstract: A summary account is given of experience in the production of planting stock of *Juniperus polycarpus* and *J. foetidissima*, xerophilous species suitable for planting in the dry conditions of the Caucasus (Soviet Armenia). The 'berries' should be harvested in the stage of waxy ripeness, wetted with water, stored in a layer 20-25 cm deep for 5 months in a cool place, then placed in sacks and dipped 5-6 times in boiling water for 3 min, each time followed by cold water, and finally stored for 2 days in a layer in a ventilated room; the seeds are then separated from the flesh in water, and stratified at 18-20 deg C and then 1-2 deg C. Seedlings can be raised in paper pots filled with a mix of soil, peat and mycorrhizal earth, or in manure/clay-loam blocks. Good survival rates have been obtained with these potted seedlings.

8. ---. Increasing the seed production of juniper stands in Armenia. Lesnoe Khozyaistvo. 1980; 1233-34; ISSN: 0024-1113.
Keywords: *Juniperus polycarpus*/ *Juniperus foetidissima*/ seed production/ broadleaves
Abstract: Investigations were made on 38 sample plots and 5385 sample trees in Soviet Armenia in order to determine the seed production of two species of juniper, viz. *Juniperus polycarpus* and 'heavy-scented juniper' [*J. foetidissima*?]. Data are tabulated on the fruiting of these two species in stands of coppice and seedling origin in various regions and on various soil types. The effect of site alt., winds and temp. on pollination is discussed, and practical recommendations are made for mineral fertilizing and underplanting to rehabilitate these stands and thus improve their fruiting.

9. Muradyan, V. M. Propagation of juniper in Armenia. Lesnoe Khozyaistvo. 1982; 662-63.
Keywords: *Juniperus polycarpus*/ *Juniperus foetidissima*/ nurseries/ sowing/ seeds/ treatment/ germination.
Abstract: A summary account is given of investigations on the failure of junipers (*Juniperus polycarpus* and *J. foetidissima*) to regenerate naturally in Soviet Armenia, and of measures to propagate them successfully. As soon as the 'berries' are harvested they should be wetted with water at room temp., and held for 5 months in a cold place in a layer 20-25 cm thick; then bags of the berries should be dipped alternately in boiling water and cold water 5-6 times, washed in water at 60 ° C, and then left in a well-ventilated room for 2 days before separating the flesh from the seeds in water; before sowing, the seeds are stratified at 18-20 ° C

and then at 1-2 ° C. The seedlings can be raised in nursery beds (details listed) or in paper pots in the open or in a greenhouse.

10. Quraishi, M. A. and Mahmood, T. Diseases of *Juniperus polycarpos* C. Koch. Pakistan Journal of Forestry. 1971; 21(4):391-400.
Keywords: *Juniperus polycarpos*/ fungi/ ecology/ Pakistan
Abstract: A description of 8 spp. of pathogenic fungi and a brief ecological review of the host in Pakistan.

***Juniperus przewalskii* (1)**

1. Adams, R. P. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). USABiochemical Systematics & Ecology. 2000; 28(6):529-543.
Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus pseudosabina*/ *Juniperus recurva*/ *Juniperus saltuaria*/ *Juniperus squamata*/ *Juniperus tibetica*/ *Juniperus wallichiana*/ RAPD/ DNA/ essential oils
Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallachiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

***Juniperus procera* (34)**

1. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. Acta Horticulturae. 2003; 61291-106.
Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.
Abstract: Several cases involving apparent discordance in morphological, chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var.

microsperma, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var. *squamata*, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.

2. Berhe, D. ¹ and Negash, L. Asexual propagation of *Juniperus procera* from Ethiopia: a contribution to the conservation of African pencil cedar. *Forest Ecology and Management* . 1998; 112:179-190.
Keywords: *Juniperus procera*/ ageing/ auxins/ rooted cuttings/ stecklings/ vegetative propagation/ Ethiopia
Abstract: The rooting responses of branch cuttings of *Juniperus procera* Hochst. Ex Endl., obtained from young (Class I) and mature (Class II) source plants to four plant growth regulators (PGRs), namely, indole-3-acetic acid (IAA), indole-3-butyric acid (IBA), naphthaleneacetic acid (NAA), and 2,4-dichlorophenoxyacetic acid (2,4-D) applied at various concentrations (10^{-3} – 10^{-9} M) were examined in sand culture. Assessments on rooting, as well as on root number and root length, of the cuttings were conducted 16 and 32 weeks after treatment. Histological origin of root primordia was examined microscopically. Establishment and performance of stecklings were assessed on sample rooted cuttings. Only 2% of the cuttings obtained from young (Class I) source plants rooted 16 weeks after treatment; and 24% of this cuttings rooted cuttings rooted 32 weeks after treatment. Of the cuttings collected from mature (Class II) source plants, only a single cutting could root 32 weeks after treatment. The maximum attainable rooting percentage was 60, and was obtained from cutting of Class I stock plants when these were treated with IAA at 10^{-7} M. Cuttings treated with 10^{-6} M IAA and the control resulted in a relatively higher root number (17 ± 4.1 and 17 ± 1.7). Those that were treated with 10^{-3} M NAA yielded relatively longer roots (372 ± 51.5 mm). Mean root number of length of the control were significantly greater than most of the PGR treatments ($p < 0.05$). In this species, cells of callus tissue, cambium, cortex, as well as xylem cells, could give rise to root primordia. Stecklings with well developed root system were easily established and grew well indicating the suitability of the species for propagating through vegetative means.

3. Bussmann R. W. and Beck E. Regeneration and succession processes in the cedar forests (*Juniperion procerae*) of Mount Kenya. *Ecotropica*. 1995; 1(2):79-84.
Keywords: *Juniperus procera*/ plant succession/ seed germination/ deforestation.

Abstract: Approximately 2000 km² of the submontane and montane zone of Mount Kenya are covered with natural forests or woodland vegetation. The western and northern parts of that belt, at an altitudinal range of 2500-2950 m, carry several types of evergreen xeromorphic forest which are characterized by the East African Pencil Cedar (*Juniperus procera*). Due to the great physiognomic and floristic variety, the syntaxonomical rank of the alliance *Juniperion procerae*, was allotted to these forests. Typically, they occupy the drier parts of the montane zone, where deep humic Acrisols dominate. The regenerational and successional processes of these forests were studied. Fire seems to play an important role in regeneration, entailing rapid germination of the seeds of *Juniperus procera*. The young trees outgrow all other species and frequently monotonous forests arise within a short time. This regeneration cycle is typical of the forests of the higher altitudes. In lower areas, and if fire is absent for longer time periods, mainly broadleaved species contribute to the climax forests after breakdown of the over-aged cedars. Over-exploitation by logging and clear felling for plantations of exotic softwood species as well as for agricultural use have already destroyed large parts of the cedar forests, and the regeneration of the remaining stands seems to be impaired by the high population density of wildlife, especially elephant and buffalo.

4. Bussmann, Rainer W. Author Reprint Author and E-mail: Rainer.Bussmann@uni-bayreuth.de]. Succession and regeneration patterns of East African mountain forests: A review. *Systematics & Geography of Plants*. 2001; 71(2):959-974.
Keywords: *Juniperus procera*/ *Ocotea*/ *Camphor*/ *Olea*/ *Sinarundinaria*/ *Hagenia*/ *Sambucus*/ *Podocarpus*/ regeneration/ montane/ Kenya/ Ethiopia/ regeneration/ succession
Abstract: Regeneration and succession processes in montane forests of Kenya and parts of Ethiopia were investigated. The slowly growing camphor tree, *Ocotea usambarensis*, regenerates mainly by suckers from old root systems. Undamaged seeds were very rarely seen, and, apparently are viable only for a few days. After natural breakdown of an old tree, the gap is filled by fast growing species, mainly *Macaranga kilimandscharica* and *Neoboutonia macrocalyx*, in the shade of which the young *Ocotea* suckers can establish. After the death of the secondary species, whose germination requires full sunlight and is inhibited in the shade, the *Ocotea* forest recovers. Large scale logging of *Camphor* trees predominantly destroys the regeneration of *Ocotea* and leads to secondary forest types, which regenerate in own cycles. The high number of big game was found to be without impact on the natural regeneration of *Ocotea*. The *Cassipourea malosana* dominated forest regenerates as a mosaic-climax without a single species becoming dominant. Cedar forests dominated by *Juniperus procera* regenerate most efficiently after fire. Without recurrent burning, the forests of the lower and middle part of the montane zone, regenerate to climax associations dominated by broad-leaved trees as *Olea*

capensis ssp. *hochstetteri*, *Olea europaea* ssp. *cuspidata* and *Podocarpus latifolius*. On higher altitudes *Juniperus procera* always remains dominant even if fire does not occur for a longer time period. The high population density especially of buffaloes seems to inhibit successful regeneration in many parts of the Juniperion, due to intensive browsing and in particular trampling. The African Bamboo, *Sinarundinaria alpina*, shows a distinct growth cycle and can grow for extremely long periods in the vegetative state before flowering, especially so at the borders of its area. After flowering and dying of the bamboo, in most areas a dense *Sambucus africana* shrub is formed into which bamboo is invading from old rhizomes again. In Ethiopia, regeneration occurs directly, without an interspersed *Sambucus* stage. The uniform age of the *Hagenia* stands suggests that regeneration in these forests occurs suddenly after a disturbing event. Germination tests yielded, that *Hagenia* seeds are not germinating unless the competing undergrowth is removed. As fire is the only natural factor able to clear the grass layer of larger areas, it is assumed, that the reproduction of the subalpine forests depends on occasional burning.

5. Couralet C.; Sass-Klaassen U.; Sterck F.; Bekele T., and Zuidema PA. Combining dendrochronology and matrix modelling in demographic studies: An evaluation for *Juniperus procera* in Ethiopia. *Forest Ecology & Management*. 2005; 216(1-3):317-330.
Keywords: *Juniperus procera*/ Ethiopia/ dendrochronology
Abstract: Tree demography was analyzed by applying dendrochronological techniques and matrix modelling on a static data set of *Juniperus procera* populations of Ethiopian dry highland forests. Six permanent sample plots were established for an inventory of diameters and 11 stem discs were collected for dendrochronological analysis. *J. procera* was proved to form concentric annual growth layers in response to seasonal changes in precipitation. Uncertainty analysis for the matrix model revealed its robustness to variations in parameter estimates. The major outcome was that the population growth rate is very sensitive to changes in growth or survival of trees between 10 and 40 cm DBH. For forest management this implies that these intermediate sized individuals should be protected and less used for harvest. This study documents that interesting results can be achieved using a relatively simple approach that can easily be adopted for other areas or with other species. However, the matrix modelling requires more precise knowledge about the trees' fecundity and survival (especially for the smaller individuals) and more consistent inventories. For tree-ring analysis it can be concluded that *J. procera* from Ethiopia has potential to investigate the relationship between tree growth and precipitation with a high temporal resolution.
6. El Naggar, M. R. Inhibition of nitrification in soil under *Juniperus procera* woods in Asir region, Saudi Arabia. *Journal College of Science King Saud University*. 1982; 13(2):193-203.

Keywords: *Juniperus procera*/ nitrification/ *Nitrosomonas*/
Nitrobacter

Abstract: Counts of *Nitrosomonas* and *Nitrobacter* were lower in soil samples collected from *J. procera* dominated areas than from those lacking this plant. Amount of nitrate-N was lowest in plots with juniper. The amount of ammonium-N was highest in plots with juniper. Depletion in counts of *Nitrobacter* and in amount of nitrate-N in plots with juniper indicates an inhibitory effect exerted by this plant on nitrifiers.

7. Eshetu, Y. ¹ and Kari, Leinonen². Seed germination responses of four afro-montane tree species to red/far-red ratio and temperature. *Forest Ecology and Management* . 2002; 168:53-61.

Keywords: *Juniperus procera*/ *Cordia*/ *Faidherbia*/ *Acacia*/
temperature/ far-red light/ germination/ seeds/ dormancy

Abstract: The germination response of *Cordia africana*, *Juniperus procera*, *Acacia abyssinica*, and *Faidherbia albida* seeds to continuous exposure of various red to red-far ratios (R/FR) and constant-temperatures of 15, 20, 25 and 30°C were studied. Germination of *C. africana* seeds was strongly inhibited at low R/FR and it appears that this species has evolved a light quality sensing mechanism that prevents seeds germination beneath leaf canopies. The germination probability of *C. africana* increased as temperature increased from 15 to 30°C. R/FR, temperature, and their interaction significantly affected germination of *J. procera*. Seeds of this species displayed a complex dormancy mechanism and germinated only in a narrow range of temperatures and R/FR. The effects of R/FR on germination of *J. procera* was most pronounced and the highest germination probability was recorded at 20°C. The germination probability of *F. albida* seeds increased with rising temperature (from 15 to 30°C), but there was no significant effect of light. At high temperatures, mean germination time in this species decreased with increasing R/FR, but increased with rising R/FR at low temperatures. Neither R/FR, temperature, nor their interaction had a significant effect on the germination of *A. abyssinica* seeds. The result suggests that deep sowing of *J. procera* and especially *C. africana* seeds, as well as covering and shading of their seed beds with leaf litter in nurseries, should be avoided. By proper regulation of light and temperature conditions, prolonged nursery germination of *J. procera* seeds can be reduced.

8. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. *Sabina*) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). *Edinburgh Journal of Botany*. 1992; 49(3):251-283.

Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia

Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and

E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpus* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpus*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.

9. Fetene, Masresha and Feleke, Yonas. Growth and photosynthesis of seedlings of four tree species from a dry tropical Afromontane forest. *Journal of Tropical Ecology*. 2001 Mar; 17(2):269-283.

Keywords: *Juniperus procera*/ Afromontane/ growth/ *Podocarpus falcatus*/ *Olea euopea*/ *Hagenia abyssinica*

Abstract: Growth, photosynthesis and carbon allocation pattern were studied in four dry Afromontane forest tree species (*Olea euopea* subspecies *cuspidata*, *Podocarpus falcatus*, *Hagenia abyssinica* and *Juniperus procera*) under varied light regimes in a greenhouse. The objective of the study was to assess the potential of the species for growth under forest canopies and to identify their habitat preferences. The light regimes were created using shade cloth and they corresponded with deep forest understoreys (2% of the light in the open gap); moderate shade (10%), slight shade as is found in edges of forest gaps (20%) and 100% representing open gaps. Seedling biomass was significantly influenced by light regimes for all species as were total leaf area and relative growth rate. *H. abyssinica* had the highest growth rate but the lowest survival rate in shade. There was a consistent trend for higher specific leaf area (SLA) and leaf area ratio (LAR) at lower growth light regimes in *O. euopea* and *P. falcatus*. *O. euopea* and *P. falcatus* had similar allocation patterns whereby between 20-40% of the total biomass was allocated to stem, 20-30% to roots and 50-60% to leaves. In *H. abyssinica* up to 80% was allocated to leaves and only a small percentage to stem and to roots. Within species there were significant differences in the light saturated rate of photosynthesis (A_{max}) per unit area among the plants grown at the lowest light level and in the open. For plants grown in the open there were very little among species differences in A_{max} per unit area. However, there were significant differences in the A_{max} of the different species grown at the lowest light level. Chlorophyll fluorescence measurements indicated that open-grown *P. falcatus* and *O. euopea* experienced moderate photoinhibition. From the growth and photosynthesis results *P. falcatus* and *O. euopea* appeared to be non-pioneer, shade-tolerant species, while *J. procera* and to a larger extent *H. abyssinica* showed pioneer, light-demanding characteristics. The results are discussed in terms of the occurrence of the species in the mosaic climax of Afromontane forests.

10. Hall, J. B. Data sheets on species undergoing genetic impoverishment; *Juniperus procera* Hochst. ex Endl. Forest Genetic Resources Information, FAO. 1981; 1025-29.
Keywords: *Juniperus procera*/ genetic impoverishment
11. Hilu sharew; Legg, C J, and Grace, J. Effects of ground preparation and microenvironment on germination and natural regeneration of *Juniperus procera* and *Afrocarpus gracilior* in Ethiopia. Forest Ecology and Management. 1997; 93(3):215-225; ISSN: 0378-1127.
Keywords: *Juniperus procera*/ *Afrocarpus gracilior*/ seed/ germination/ seedlings/ stand establishment/ seedbeds/ site preparation/ light/ burning/ scarification/ mechanical methods/ silvicultural systems/ clear felling/ pioneer species/ natural regeneration/ germination
Abstract: The seedling establishment of *Juniperus procera* and *Afrocarpus gracilior* was assessed in the Afromontane forests of Ethiopia. Percentage light transmission, litter depth and percentage cover of vegetation were assessed for seedling microsites in 5 sites with different levels and history of disturbance. The response of natural and artificial regeneration to burning, mechanical scarification (removal of all logging waste and ground vegetation) and cultivation following clear felling and timber extraction was assessed 19 months after treatment. There was no evidence that regeneration was correlated with light intensity. Despite the presence of a viable seed bank in the undisturbed forest floor, removal of the overstorey vegetation by clear felling did not encourage natural regeneration of *J. procera*. This suggests that light may not be the main factor limiting regeneration of *J. procera*. Natural regeneration of *J. procera* can withstand exposure and is compatible with management by clear felling with seeding from adjacent stands, together with ground treatment, particularly controlled burning which exposes the mineral soil and releases nutrients. In contrast, both clear felling and surface disturbance will discourage the natural (or artificial) regeneration of *A. gracilior* suggesting that *J. procera* is a pioneer species which is more exposure-tolerant, whilst *A. gracilior* is more shade-tolerant and exposure-intolerant.
12. Kebrom, T.; Backeus, I.; Skoglund, J., and Woldu, Z. Vegetation on bill slopes in southern Wello, Ethiopia: Degradation and regeneration. Nordic Journal of Botany. 1997; 17(5):483-493.
Keywords: *Juniperus procera*/ *Olea*/ *Podocarpus*/ *Euclea*/ *Dodonaea*/ Ethiopia/ degradation/ regeneration
Abstract: A study was made of the vegetation in southern Wello (Ethiopia) in relation to human impact and the environment. 65 sample plots were laid out and analyzed with respect to the cover value of vascular plant species. Altitude, slope, aspect and estimates of grazing pressure for each plot were also recorded along with physical and chemical soil properties analyzed for samples taken from each plot. The following environmental factors, isolated by forward selection, show correlation with

the axes of Canonical Correspondence Analysis (CCA): altitude, grazing, pH, K, Ca, Mg, slope and aspect. Through hierarchical and non-hierarchical clustering methods the vegetation was divided into eight types, from which one was secondary forest characterized by patch dominance of *Juniperus procera* and *Olea europaea* ssp. *cuspidata*. These forest patches are found at high altitude sites and because of their inaccessibility are usually characterized by low livestock density and consequently low grazing pressure. The presence of large boulders and stones in *Podocarpus falcatus* forest decreases accessibility and creates natural protection for the trees. The other vegetation types, most of which are found at lower altitude and associated with varying intensities of grazing, include grasslands (grazed and protected), regenerating sites dominated by *Euclea racemosa* and *Dodonaea angustifolia*, dense and open shrublands and *Olea europaea* ssp. *cuspidata* woodlands. Human interference has a major impact on the vegetation of the study area and its recovery will depend on the degree of participation of the local people.

13. Kigomo, B. N. Crown-bole diameter relationship of *Juniperus procera* (cedar) and its application to stand density control and production survey in natural stands. East African Agricultural and Forestry Journal. 1985; 46(1/4):27-37.
Keywords: *Juniperus procera*/ Kenya/ stand characteristics/ diameter.
Abstract: Measurements of crown and bole diam. of *J. procera* were taken at 5 sites in Kenya covering a wide range of altitudes and climatic conditions. Regression analysis of the data showed that 87% of variation of crown diam. was explained by corresponding bole diam. The linear regression equation obtained was used to estimate a stand density control parameter (basal area), and a thinning schedule for *J. procera* stands was developed. A bole/crown diam. regression equation was also calculated, and 88% of the variation of bole diam. was explained by crown diam. This relationship would be useful to estimate bole diam. from aerial photographs, from which productivity could be estimated.

14. Kigomo, B N. Growth characteristics of natural regenerates of African pencil cedar (*Juniperus procera*). East African Agricultural and Forestry Journal. 1984; 50(1-4):54-60.
Keywords: *Juniperus procera*/ Kenya/ growth/ mean annual rainfall
Abstract: An assessment was made of diam. and ht. growth of naturally-regenerated *J. procera* in Timboroa, Kenya, between the ages of 15 and 50 yr. The site was at 2700 m alt. with a mean annual temp. of 13.6 ° C and a mean annual rainfall of 1300 mm. M.a.i. for diam. and ht. were 1.06 cm and 0.63 m respectively for the first 27 yr. Growth in later years declined slowly with increase in b.a., but m.a.i. remained reasonably high at 0.77 cm and 0.47 m at age 50 yr. Increment rate was better than at 2 sites of lower alt. and mean rainfall. At Timboroa, *J. procera* may be expected to reach 60 cm d.b.h. o.b. and about 35 m ht. by age 100 yr.

15. Kinyanjui, T.; Gitu, P. M., and Kamau, G. N. Potential antitermite compounds from *Juniperus procera* extracts. *Chemosphere*. 2000; 41(7):1071-1074.
Keywords: *Juniperus procera*/ *Croton*/ chromatography/ termite
Abstract: Thin layer chromatography (TLC) analysis revealed that destructive distillation of *Juniperus procera* tree gave ten major components, whereas *Croton megalocarpus* tree yielded five components. This was confirmed by gas chromatography (GC). The components were isolated by column chromatography and analyzed using infrared, ultra-violet, visible and mass spectroscopy (MS) techniques. The whole extract was about 30.3% of the starting material (sawdust) and consisted of 77.5% water and 22.5% oily reddish-brown layer. The extracts had alcoholic and phenolic compounds together with acids. Cedrol, a tertiary tricyclic alcohol, was found to be in the greatest proportion in the oily layer. IR spectra with a peak beyond 3000 cm^{-1} , UV- VIS absorption maxima at 230 nm and mass spectra with m/e 204 suggested the presence of cedrene in the extract.
16. Kurschner, H. Epiphytic bryophyte communities of southwestern Arabia - Phytosociology, ecology and life strategies. *Nova Hedwigia*. 2003; 77(1-2):55-71.
Keywords: *Juniperus procera*/ epiphyte/ bryophyte/ Arabia/ ecology
Abstract: Based on a phytosociological analysis, the epiphytic *Leptodonto- Leucodontetum schweinfurthii* and *Orthotricho- Fabronietum socotranae* were described from southwestern Arabia (Asir Mts. of Saudi Arabia, Yemen escarpment mountains). Both are typical of the monsoon-affected *Juniperus procera*, respectively *Acacia origena* woodland and form one of the most striking vegetation units on the Arabian Peninsula. Character species mainly are drought-tolerant Afromontane mosses. Higher-ranked character species, such as *Orthotrichum diaphanum* and *Syntrichia laevipila* allow to classify the new communities within the *Syntrichion laevipilae* alliance that reach a southern outpost in the southwestern Arabian border mountains. In addition to the syntaxonomic and ecological descriptions of the communities, a life form and life strategy analysis has been carried out. The analysis indicates that life forms and life strategies clearly correlate with the ecological site conditions. The drought-tolerant, photo- and xerophytic *Orthotricho- Fabronietum socotranae* is dominated by cushion, short-turf and mat forming perennial stayers with regular sporophyte formation. By contrast, tail or fan forming pleurocarpous perennial shuttle species with large spores indicating short-range dispersal and a 'passive' (e. g., moderately low reproduction) or 'generative' reproduction, as well as liverworts, concentrate in the sciophytic, subhumid *Leptodonto- Leucodontetum schweinfurthii*. In addition, the latter association shows a much higher diversity in life forms and life strategies.
17. Lange, Sigrun; Bussmann, R. W., and Beck, E. Stand structure and regeneration of the subalpine *Hagenia abyssinica* forests of Mt. Kenya. *Botanica Acta*.

1997 Dec; 110(6):473-480.

Keywords: *Juniperus procera*/ *Hagenia abyssinicae*/ Kenya/ germination/ seeds/ fire/ regeneration/ phytosociology/ ecology

Abstract: The uppermost forest belt on Mt. Kenya (Kenya, East Africa), ranges from 2900 to 3400 m a.s.l. and is dominated by the evergreen "Kosso" tree, *Hagenia abyssinica* (Bruce) J.F. Gmel. (Rosaceae). The ecology of this tree, with emphasis on regeneration, was investigated. Twenty-five phytosociological relevés, representing several types of *Hagenia* forests were produced, and attributed to various associations of the alliances *Hagenia abyssinicae* - *Hypericium revoluti* Bussmann 1994 and *Hagenia abyssinicae* - *Juniperion procerae* Bussmann 1994 (Bussmann and Beck 1995a). Biometric data of young and adult *Hagenia* trees were collected. Kosso trees of the individual relevés were either of almost equal size, and presumably age, or could be grouped into only two size categories. This uniformity of the *Hagenia* populations suggests simultaneous regeneration after major disturbance. Charcoal horizons were found in soil profiles at various sites in the *Hagenia* zone of Mt. Kenya, indicating former burning of these forests. Therefore, fire is thought to be the disturbing factor, which triggers the regeneration of the *Hagenia* forests. Germination of *Hagenia* seeds was investigated under various ecological conditions at Mt. Kenya and in greenhouses. Crucial factors for successful germination were high temperatures and bare soil. Light intensity or potentially allelopathic decomposition compounds, leaching from the abundantly shed leaves, had no significant effect on the germination rates. Fire apparently promotes germination by clearing and heating the prospective seed bed. In areas suffering from a high activity of herbivores, the regeneration capability of *Hagenia* is greatly decreased or abolished. A fire-requiring regeneration cycle of the *Hagenia* forests of Mt. Kenya is concluded from the phytosociological and ecological data.

18. Laurent, N and Chamshama, S A O. Studies on the germination of *Erythrina abyssinica* and *Juniperus procera*. International Tree Crops Journal. 1987; 4(4):291-298; ISSN: 0143-5698.
Keywords: *Juniperus procera*/ *Erythrina abyssinica*/ seeds/ germination/ treatment
Abstract: Pretreatment with either hot water or conc. H₂SO₄ gave 80-84% germination for *E. abyssinica* and 68-78% germination for *J. procera* when measured 14 days after sowing. Without treatment there was no germination. Fire scorching of *J. procera* gave 50-60% germination after 18 days.
19. Lisanework, N. and Michelsen, A. Litterfall and nutrient release by decomposition in three plantations compared with a natural forest in the Ethiopian highland. Forest Ecology & Management. 1994; 65(2-3):149-164.
Keywords: *Juniperus procera*/ *Cupressus*/ *Eucalyptus*/ litterfall/ nutrient/ Ethiopia

Call Number:

Abstract: The pattern of litterfall, its nutrient element content, rate of weight loss and release of nutrient elements were investigated in 28-40 year old plantations of two exotic species, *Cupressus lusitanica* and *Eucalyptus globulus* and one indigenous species, *Juniperus procera*, and compared with that of an adjacent *Juniperus-Olea-Podocarpus* montane forest in the Ethiopian highland. The total annual fine litterfall was 501 g m⁻² year⁻¹, 583 g m⁻² year⁻¹, 583 g m⁻² year⁻¹, 653 g m⁻¹ year⁻¹ and 1087 g m⁻² year⁻¹ in the *C. lusitanica*, *Eucalyptus globulus*, *J. procera* plantations and the natural forest, respectively: of this litterfall, leaves constituted 57.6%, 77.2%, 71.9% and 65.5%. Litterfall was higher in the natural forest than in any of the plantations in 18 of 24 months studied. It was generally high during the dry months and low during wetter months and varied between the 2 years of study. The concentration of nutrient elements in the litterfall to some extent showed a seasonal pattern, most pronounced for K. The four sites could be arranged in this sequence with respect to the rate of nutrient release from decomposing litter after 12 months: *J. procera* = *C. lusitanica* > *Eucalyptus globulus* = natural forest. Nutrient elements and dry weight (DW) followed the release pattern: K gt Mg gt Ca gt DW gt N = P. After 24 months, the weight loss was less in the natural forest and *C. lusitanica* site than in the *Eucalyptus globulus* and *J. procera* sites, with 11.8%, 10.6%, 7.2% and 4.6% remaining DW, respectively. The high N to P ratio in litter in the first phase and at the end of decomposition, or during the whole period in the case of *Eucalyptus globulus*, indicates that P was generally limiting for the decomposition. Owing to the lower amount of litter and its lower nutritional quality, the annual nutrient input by litter of the two exotics generally was much lower than that of *J. procera* and, in particular, that of the natural forest. A consequence of the less efficient within-stand cycling in the *J. procera* and natural forest sites may be that the herbs, shrubs and tree seedlings here may benefit more from nutrient elements released from litterfall than plants in the *C. lusitanica* and *Eucalyptus globulus* sites.

20. Negash, L. Successful vegetative propagation techniques for the threatened African pencil cedar (*Juniperus procera* Hoechst. ex Endl.). Forest Ecology and Management. 2002; 16(1/3):53-64.
Keywords: *Juniperus procera*/ planting stock/ root cuttings.
Abstract: Rooting efficiencies of cuttings derived from three age class stock plants of African pencil cedar (*Juniperus procera* Hoechst. ex Endl.), were studied using eight different concentrations of indolebutyric acid (IBA), viz. 0.00, 0.05, 0.10, 0.20, 0.40, 0.80, 1.60 and 3.20%. The number of cuttings used in anyone treatment ranged from 60 to 70. IBA applied at either 20 micro g per cutting (for cuttings derived from 5-month-old stock plants) or at 40 micro g per cutting (for cuttings derived from 10- and 15-month-old stock plants) resulted in significantly higher rooting responses compared to the control (P<0.001). Whereas callusing in cuttings derived

from the 5-month-old stock plants declined with increasing IBA level ($r = -0.78$, $P < 0.05$), rooting increased up to only 0.2% IBA. There were significant differences ($P < 0.001$) among the rooting responses of cuttings derived from 5- and 15-month-old stock plants, as well as among those derived from 10- and 15-month-old stock plants. The number of rooted cuttings and the corresponding root number declined rapidly when cuttings were treated with IBA beyond the 0.4% level. None of the cuttings derived from any of the age classes survived the lethal effects of IBA when this was applied at a concentration of 160 and 320 micro g per cutting. By far the most significant effect of IBA was on the total root number. Mean root number increased by over three-fold in cuttings derived from all the three categories of stock plants when these were treated with 40 micro g of IBA per cutting. The effectiveness of applied IBA in inducing rooting and in increasing the total root number increased with the age of stock plants from which cuttings were derived. Cuttings derived from 15-month-old stock plants needed higher IBA concentration, and the magnitude of the response (relative to the control, and in terms of rooting ability) was higher compared to those derived from 5-month-old stock plants. Interestingly, a significant number of cuttings derived from the more mature stock plants tended to produce roots without undergoing tissue dedifferentiation. Conversely, more than 95% of the control cuttings derived from 5-month-old seedlings produced calli, hence developing the majority of their roots after tissue differentiation had taken place. Growth of stecklings was proportional to the number of roots and (provided that growing conditions are optimal) planting size stecklings could be produced within about 10 months after transplanting rooted cuttings from the rooting medium to potted soils. With an overall rooting success of 60-80%, and with a reasonably good growth rate of stecklings, production of planting material from juvenile stock plants of *J. procera* through vegetative means, and through use of low-cost propagators, offers opportunities for a cheaper, practically sound and technically less demanding alternative means of propagation.

21. Pohjonen, V. and Pukkala, T. *Juniperus procera* Hocht.ex.Endl. in Ethiopian forestry. Forest Ecology and Management. 1992; 49(1-2):75-85.
Keywords: *Juniperus procera*/ Ethiopia/ volume/ choice of species/ plant genetic resources.
Abstract: Distribution, importance and growth potential of *J. procera*, an indigenous coniferous tree in the Ethiopian highlands, were analyzed. A termite- and fungi-resistant local timber, *J. procera* has been highly valued for the construction of houses and larger buildings such as churches. Reduction of natural forests by >90% over the past 100 years, which is continuing, has halted utilization of *J. procera*. Analysis was made of 22 *J. procera* stands, 21 aged 10-39 years and one aged 200 years. Growth potential was calculated as a maximum mean annual increment of 7.5 m³/ha at age 55 years. Most rapid volume growth occurred at ages 15-50 years. Dominant height (about 45 m) was reached at ages of

between 100 and 150 years. It is recommended that *J. procera* be used for planting instead of *Cupressus lusitanica*, as it would provide a superior, durable timber. There is good potential for natural regeneration of *J. procera* provided seed trees are nearby. However, the relatively low yield potential of *J. procera*, compared with exotic tree species, would necessitate some national or international help in plantation establishment.

22. Pohjonen, V. M. Volume equations and volume tables of *Juniperus procera* Hocht. ex. Endl. *Forest Ecology and Management*. 1991; 44(2-4):185-200.
Keywords: *Juniperus procera*/ volume/ height/ diameter/ Ethiopia/ altitude/ rainfall
Abstract: Logarithmic stem volume equations based on tree height, diameter at breast height (d.b.h.), and on both variables were determined for *J. procera*. Data were measured in Menagesha National Park (20 km W. of Addis Ababa, altitude 2500 m, annual rainfall 1100 mm), a remnant of the indigenous Ethiopian highland forest, on 75 sample trees which varied between 5 and 125 cm d.b.h. and 4 and 50 m height. The relative standard error of the volume estimate was lowest (10 to 12%) with the two-variable model.
23. Senbeta, Feyera Author and Teketay, Demel Reprint author. Regeneration of indigenous woody species under the canopies of tree plantations in Central Ethiopia. *Tropical Ecology*. 2001 Winter; 42(2):175-185.
Keywords: *Juniperus procera*/ regeneration/ canopy/ Ethiopia/ *Cupressus lusitanica*/ *Pinus patula*/ *Eucalyptus globulus*
Abstract: The hypothesis that tree plantations may foster the regeneration of native woody species, was tested through studies of understory floristic composition, height-class distribution of naturally regenerated seedlings and saplings of indigenous woody species, and soil seed banks in the native and exotic tree plantations in Central Ethiopia. A total of 70 plots, having 10X10 m area each, were studied in six monoculture plantation stands of four exotic species, i.e. *Cupressus lusitanica* (2 stands of different age), *Eucalyptus globulus*, *Pinus patula*, *P. radiata* and *Juniperus procera*, an indigenous coniferous species. Ages of the plantations ranged between 14 and 42 years. Soil seed bank analysis was also undertaken from soil samples collected in each of the 70 plots to examine the similarity between the soil seed flora and aboveground vegetation. Vegetation diversity was assessed through analyses of floristic composition, species richness and abundance. A total of 37 naturally regenerated indigenous woody species were recorded beneath all plantation stands, with densities ranging between 1630 and 18270 individuals ha⁻¹. There was considerable variation among plantation stands/species with respect to the density of naturally regenerated native woody species. Generally, seedling populations were the most abundant components of the regeneration in most of the plantation stands, forming

85% of the total regeneration count. A total of 68 plant species represented by 53 herbs, eight woody species and seven grasses were recorded in the soil seed bank from all stands. Similarity between the soil seed banks and aboveground flora (both seedlings and larger plants) was very low implying that the role of soil seed banks in the regeneration is low and dispersal of seeds from the adjacent natural forest plays an important role in the process. These results support the concept that forest plantations can foster the regeneration of native woody species and increase biodiversity in the plantation stands, if seed sources are available in the vicinity of the plantations.

24. Sharew, Hailu Author; Legg, Colin J. Reprint author, and Grace, John Author. Effects of ground preparation and microenvironment on germination and natural regeneration of *Juniperus procera* and *Afrocarpus gracilior* in Ethiopia. *Forest Ecology & Management*. 1997; 93(3):215-225.
Keywords: *Juniperus procera*/ *Afrocarpus gracilior*/ Afromontane/ Ethiopia/ germination/ seed/ regeneration
Abstract: The seedling establishment of *Juniperus procera* Hochst. ex Endl. and *Afrocarpus gracilior* (Pilger) C. N. Page was assessed in the Afromontane forests of Ethiopia. Percent light transmission, litter depth and percentage cover of vegetation were assessed for seedling microsites in five sites with different levels and history of disturbance. The response of natural and artificial regeneration to burning, mechanical scarification (removal of all logging waste and ground vegetation) and cultivation following clear felling and timber extraction was assessed 19 months after treatment. There was no evidence that regeneration was correlated with light intensity. Despite the presence of a viable seed bank in the undisturbed forest floor, removal of the overstorey vegetation by clear felling did not encourage natural regeneration of *J. procera*. This suggests that light may not be the main factor limiting regeneration of *J. procera*. Natural regeneration of *J. procera* can withstand exposure and is compatible with management by 'clear cutting with seeding from adjacent stands' together with ground treatment, particularly controlled burning which exposes the mineral soil and releases nutrients. In contrast, both clear felling and surface disturbance will discourage the natural (or artificial) regeneration of *A. gracilior* suggesting that *J. procera* is a pioneer species which is more exposure-tolerant, whilst *A. gracilior* is more shade-tolerant and exposure-intolerant.
25. Teketay; Demel [Reprint author]; Granstrom, and Anders [Author]. Seed viability of Afromontane tree species in forest soils. *Journal of Tropical Ecology*. 1997; 13(1):81-85.
Keywords: *Juniperus procera*/ Ethiopia/ seeds/ *Bersama abyssinica*/ *Ekebergia capensis*/ germination/ seedlings
Abstract: The fate of seeds of eight tree species was followed during 4 y of storage in the soil of an Afromontane forest at Gara Ades in the eastern highlands of Ethiopia. Seeds were enclosed in nylon mesh bags and buried

at 5 cm soil depth. The bags were exhumed at intervals and the viability of the seeds was assessed by germination and cutting tests. Seeds of *Bersama abyssinica* and *Ekebergia capensis* germinated in the soil almost completely within a year after burial. The seeds of *Juniperus procera*, *Olea europaea* and *Podocarpus falcatus* also germinated to a substantial degree in the soil but with a distribution over several years, and some seeds of these species remained viable at the end of the 4-y period. Germination in the soil was very low in seeds of *Acacia abyssinica* and *Croton macrostachyus* throughout the whole burial period and the seeds kept their viability. In *C. macrostachyus* fresh seeds were highly dormant, but after 3 y or more in the soil they germinated readily in the laboratory suggesting an altered dormancy with time in the soil. Dormancy in seeds of *A. abyssinica* and *Indigofera rothii* was not altered throughout the study period as evidenced by marginal or no germination during incubation in the laboratory. The differential seed behaviour observed during storage in the soil can be an indicator of the regeneration strategy of the species studied. *B. abyssinica*, *E. capensis*, *J. procera*, *O. europaea* and *P. falcatus* form seedling banks on the forest floor and lack persistent soil seed reserves in contrast to *A. abyssinica*, *C. macrostachyus* and *I. rothii* which accumulate reserves of long-lived seeds in the soil. The generally high levels of dormancy and somewhat extended viability in the soil, even in several of the species producing seedlings in undisturbed forest, may have been selected for under a climate of seasonal drought and unreliable rainfall that characterizes this region.

26. Teketay, Demel Reprint author and Granstrom, Anders Author. Germination ecology of forest species from the highlands of Ethiopia. *Journal of Tropical Ecology*. 1997 Nov; 13(6):805-831.

Keywords: *Juniperus procera*/ *Bersama*/ *Ekebergia*/ germination/ ecology/ fire/ Afromontane/ Ethiopia

Abstract: A comparative study of seed germination was performed on 25 species of trees, shrubs, woody climbers and herbs from the dry Afromontane forest zone of Ethiopia. Despite the restricted geographical range of the species tested, the optimum constant temperature for germination varied considerably. For 17 of the species studied, it was between 20 and 25° C while for three, germination was highest at 30° C. Germination was virtually inhibited (<20%) for eight of the species at 10° C and eight of the species at 30° C. There was no clear division in temperature response between plants differing in habitat. For four out of 12 species tested, fluctuating temperatures (20/12° C) resulted in significantly higher germination than the constant temperature treatment (20° C), suggesting that field-germination would be favored by disturbance to the canopy or soil. Speed of germination was negatively correlated with the logarithm of seed size. Most species lay in the range 3-15 d to reach 50% of final germination at their optimum temperature for germination. Germination was significantly suppressed in darkness for a large number of species, particularly for those with seed size less than c. 3

mg. When these were incubated under leaf-filtered light, germination was in most cases even more effectively suppressed. Most of these species are known to have large soil seed banks. Mechanical scarification improved germination over the control in nine species. Five of these also responded to heat or sulphuric acid scarification. Circumstantial evidence suggests that the species showing heat-induced germination may be fire adapted, although fire is probably a rare natural phenomenon in the Afromontane forest proper. Only one species, *Bersama abyssinica*, showed a classic recalcitrant behaviour. Germination dropped from 88% when the seeds were fresh to less than 20% after 1 mo of dry storage and 0% after 3 mo. Germinability of seeds of *Ekebergia capensis* also declined significantly with increasing storage time, although less rapidly; after 24 mo of dry storage, germination was 4%. In contrast, germinability of *Juniperus procera* was not significantly altered during 54 mo of storage. The results indicate that dormancy plays a major role in regulating germination in dry Afromontane species. Out of the 25 species studied, 15 (60%) showed some degree of initial dormancy. In most of the species with initially non-dormant seeds, dormancy would evidently be induced if the seeds are dispersed under a closed forest canopy or buried in the soil. These patterns of dormancy may have evolved in response to a highly unpredictable climate and small-scale disturbances, and should make the Afromontane forest flora relatively resilient also to anthropogenic disturbances.

27. Uhlig, S. K.; Wagenfuhr, R., and Tenaw, W. A. Structural analyses on ring formation in juniper (*Juniperus procera*) in Ethiopia. Strukturanalysen zur Ringbildung beim Baumwacholder (*Juniperus procera* Hochst.) in Athiopien. Holz Als Roh Und Werkstoff. 1992; 50(6):257-260.
Keywords: *Juniperus procera*/ Ethiopia/ ring formation
Abstract: Stem disks were taken from 16-yr-old planted *J. procera* in Alemaya and from a devastated natural stand 30 km distant. Macro- and micro-scopic and X-ray densitometric investigations were made on the ring structure. The more or less distinct concentric zones are formed by narrow-lumen tracheids and/or parenchyma cells. These zones are irregularly formed and their clarity differs. Ring width varied greatly, and averaged 1.2 mm. With approximately equal cell-wall thicknesses of 4.3-4.5 micro m, the lumina of the tracheids in the initial ('earlywood') zones were 18.8 micro m and in the end ('latewood') zones only 8.4 micro m; the corresponding Runkel numbers were 0.4 and 1.1, respectively. The ring structure could not be related to external factors, or matched chronologically.
28. Uibrig H. Construction of a volume table and derivation of a form factor function and height curve for *Juniperus procera* in montane forest at Gara Ades, Ethiopia.
 Zur Konstruktion einer Volumentafel und Bestimmung von Formzahlfunktion und Hohenkurve fur die Baumart *Juniperus procera*

Hochst. im Bergwald am Gara Ades, Athiopien. Wissenschaftliche Zeitschrift Der Technischen Universität Dresden. 1986; 35(3):195-196.

Keywords: *Juniperus procera*/ volume/ height/ diameter/ form

Abstract: Ht. and d.b.h. measurements were made on approx. 50 trees (d.b.h. 7-68 cm) growing at 2300-2600 m alt. in Harerge province; a mirror relascope was used to determine form height. Equations were derived to estimate stemwood vol. ($r^2=0.95$), ht. ($r^2=0.75$), and stem form-factor based on d.b.h. Graphs show d.b.h. (10-65 cm) vs. stemwood vol., tree ht., and form factor. Data will be used to compile a local volume table for *J. procera*.

29. von Wissmann, H. The *Juniperus* mountain forests in Arabia: their position between the boreal and tropical African floral kingdoms. Geocology of the High Mountain Regions of Eurasia. 1972; 157-176.
Keywords: *Juniperus excelsa*/ *Juniperus macropoda*/ *Juniperus procera*/ distribution/ vegetation types/ Africa
Abstract: Reviews the distribution and altitudinal range of *Juniperus* spp. (section Sabina); these represent one of the few genera of trees that range from Eurasia into Africa across the tropics; a map shows the range of individual species. Many of the sources are books of travel. Some associated plant species are noted. Evidence is presented for regarding *J. excelsa* (the commonest species in Arabia), *J. macropoda* and *J. procera* as one and the same species, and for identifying them with the Almug or Algum trees of the Bible, and the Biblical land of Ophir with the province of Asir in Saudi Arabia, where *J. excelsa* stands are still plentiful.
30. Wubet, Tesfaye E-mail wubet mitiku@hotmail.com; Kottke, Ingrid; Teketay, Demel, and Oberwinkler, Franz. Mycorrhizal status of indigenous trees in dry Afromontane forests of Ethiopia. Forest Ecology & Management. 2003 Jul 3; 179(1-3):387-399.
Keywords: *Juniperus procera*/ mycorrhiza/ Ethiopia/ Afromontane
Abstract: The dry Afromontane forests in Ethiopia are composed of a number of indigenous tree species. Currently, indigenous trees are declining at an alarming rate in this ecosystem. The few reforestation programs, which have so far been undertaken, employ exotic tree species. This is mainly due to lack of knowledge on the environmental requirements of indigenous trees. Though there have been efforts to solve problems associated with the use of indigenous trees in the reforestation activities, information on the mycorrhizal symbiosis is still lacking. Investigation of roots of 11 indigenous trees, *Albizia gummifera*, *Albizia schimperiana*, *Aningeria adolfi-friedericii*, *Croton machrostachyus*, *Ekebergia capensis*, *Hagenia abyssinica*, *Juniperus procera*, *Podocarpus falcatus*, *Prunus africana*, *Olea europaea* ssp. *cuspidata*, and *Syzygium guineense*, revealed arbuscular mycorrhizal colonization. No evidence of ectomycorrhizal colonization was found. This is the first report on the mycorrhizal status of *A. gummifera*, *A. schimperiana*, *A. adolfi-friedericii*, *E. capensis*, *H. abyssinica*, *P. africana* and *S. guineense*. The mycorrhizas

are characterized by dominantly intercellular hyphal growth, formation of arbuscules on intracellular hyphal branches and low frequency of hyphal coils which can be classified as an Arum-type of AM. The Arum-type of AM is reported for the first time in *S. guineense* (Myrtaceae), *E. capensis* (Meliaceae), *A. adolfi-friedericii* (Sapotaceae) and the gymnosperms *J. procera* and *P. falcatus*. Results established that arbuscular mycorrhizas (AM) are predominant in the dry Afromontane forests of Ethiopia. Therefore, AM should receive special attention in indigenous tree seedling production and restoration activities of the dry Afromontane ecosystems of the country.

31. Yirdaw, Eshetu and Leinonen, Kari E-mail eshetu.yirdaw@helsinki.fi kari.a.leinonen@helsinki.fi. Seed germination responses of four afromontane tree species to red/far-red ratio and temperature. *Forest Ecology & Management*. 2002 Sep; 168(1-3):53-61.
Keywords: *Juniperus procera/ Cordia/ Faidherbia/ Acacia/ far-red light/ red light/ germination/ temperature*
Abstract: The germination response of *Cordia africana*, *Juniperus procera*, *Acacia abyssinica*, and *Faidherbia albida* seeds to continuous exposure of various red to far-red ratios (R/FR) and constant-temperatures of 15, 20, 25 and 30°C were studied. Germination of *C. africana* seeds was strongly inhibited at low R/FR and it appears that this species has evolved a light quality sensing mechanism that prevents seed germination beneath leaf canopies. The germination probability of *C. africana* increased as temperature increased from 15 to 30° C. R/FR, temperature, and their interaction significantly affected germination of *J. procera*. Seeds of this species displayed a complex dormancy mechanism and germinated only in a narrow range of temperatures and R/FR. The effect of R/FR on germination of *J. procera* was most pronounced and the highest germination probability was recorded at 20° C. The germination probability of *F. albida* seeds increased with rising temperature (from 15 to 30° C), but there was no significant effect of light. At high temperatures, mean germination time in this species decreased with increasing R/FR, but increased with rising R/FR at low temperatures. Neither R/FR, temperature, nor their interaction had a significant effect on the germination of *A. abyssinica* seeds. The results suggest that deep sowing of *J. procera* and especially *C. africana* seeds, as well as covering and shading of their seed beds with leaf litter in nurseries, should be avoided. By proper regulation of light and temperature conditions, prolonged nursery germination of *J. procera* seeds can be reduced.
32. Yirdaw, Eshetu and Luukkanen, Olavi. Photosynthetically active radiation transmittance of forest plantation canopies in the Ethiopian highlands. *Forest Ecology and Management* . 2004 Feb; 188(1-3):17-24; ISSN: 0378-1127.
Keywords: *Juniperus procera / Eucalyptus globulus/ Cupressus lusitanica/ Grevillea robusta/ red light/ far-red light/ photon flux*

density/ plantations/ Ethiopia

Call Number: SD1.F73

Abstract: Hemispherical photographs and a quantum sensor were used to study the canopy photosynthetic photon flux density (PPFD) transmittance of five forest plantation species in Ethiopia. Red/far-red (R/FR) ratios and temperatures beneath the forest plantations were also measured. The species studied were: *Eucalyptus globulus*, *Pinus patula*, *Cupressus lusitanica*, *Grevillea robusta*, and *Juniperus procera*. The canopies of *E. globulus*, *P. patula*, and *G. robusta* transmitted about three times as much PPFD as *J. procera* or *C. lusitanica* plantations. Furthermore, plantations of *G. robusta* and *E. globulus* had the highest, while *J. procera* had the lowest R/FR ratio. In contrast to *J. procera*, *C. lusitanica*, *E. globulus*, and *G. robusta* had relatively open crowns, higher crown-bases and lower leaf area indices, and as a result, their canopies had higher PPFD transmittance percentages as well as higher below-canopy R-FR ratios and temperatures. From the perspective of understory light regime, plantations of *E. globulus* and *G. robusta* are best suited for promoting the natural regeneration of native species. In general, opening of gaps in plantations of heavy-shading tree species may increase the herbaceous layer ground cover, enhance the colonization and growth of native woody species and consequently may also increase the floristic diversity of mono-specific plantations.

33. Yirday, E. Diversity of naturally-regenerated native woody species in forest plantations in Ethiopian highlands. *New Forests* . 2001; 22:159-177.
- Keywords:** *Juniperus procera*/ *Pinus patula*/ *Cupressus lusitanica*/ *Grevillea robusta*/ Ethiopia/ afro-montane forests/ biodiversity/ degraded lands/ natural regeneration/ plantation/ restoration.
- Abstract:** Woody species diversity and ground layer vegetation cover were studied in plantations of *Pinus patula*, *Cupressus lusitanica*, *Grevillea robusta*, and *Juniperus procera*, and in surrounding natural forests in Wondo Genet, Ethiopia. In the understory of the plantations, a total of 53 naturally regenerated tree and shrub species belonging to 31 families were recorded. Important indigenous timber species were also represented. Trees accounted for 72% of all naturally-regenerated woody species richness among plantations, *C. lusitanica* plantations had a significantly higher abundance of woody species than those of *P. patula*, but the difference was not significant in relation to *J. procera*, *G. robusta* and the adjacent natural forest. The herbaceous ground cover percentage in *G. robusta* and *P. patula* stands was considerably higher than in *C. lusitanica* and *J. procera* stands. Relative to plantations of other species, plantations of the native tree species *J. procera* had higher understory species richness, medium woody species abundance and low ground cover. Although there was a marked variation in understory plantation density, its effect on understory species richness and abundance was not significant. The density of naturally-regenerated woody species in plantations was over three times the usual planting density in Ethiopia,

indicating a high potential of forest plantations for restoring the natural forest ecosystems on degraded lands at a comparatively low cost.

34. Yoshikawa, K. and Yamamoto, F. *Juniperus procera* forest in Saudi Arabia. Tropical Forestry. 1995; 3414-23.
Keywords: *Juniperus procera*/ Saudi Arabia/ forests

Juniperus procumbens (10)

1. Adams, Robert P.; Hsieh, Chang-Fu; Murata, Jim, and Pandey, Ram Nanresh. Systematics of *Juniperus* from eastern Asia based on Random Amplified Polymorphic DNA's (RAPDs) . Biochemical Systematics and Ecology . 2002 Mar; 30(3):231-241; ISSN: 0305-1978.
Keywords: *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus conferta*/ *Juniperus formosana*/ *Juniperus procumbens*/ *Juniperus rigida*/ *Juniperus taxifolia*/ RAPS's/ DNA/ Taiwan/ China
Call Number: QD415.A1B5
Abstract: DNA was examined by RAPD banding for *Juniperus chinensis*, *J. c.* var. *sargentii*, *J. c.* var. *tsukusiensis*, *J. communis*, *J. c.* var. *nipponica*, *J. c.* var. *saxatilis*, *J. conferta*, *J. formosana*, *J. procumbens*, *J. rigida*, *J. taxifolia*, and *J. t.* var. *lutchuensis*. The DNA data readily separated junipers of section *Sabina* from section *Juniperus*. *J. c.* var. *tsukusiensis* from Taiwan was found to be sufficiently different from *J. c.* var. *tsukusiensis* (Yakushima) to warrant the recognition of a new variety: *J. chinensis* var. *taiwanensis* R.P. Adams and C-F. Hsieh *nov. var.* *Juniperus formosana* from mainland China was found to be different from *J. formosana* from Taiwan and a new variety is recognized: *J. formosana* var. *mairi* (Lemee and Lev.) R.P. Adams and C-F. Hsieh *comb. nov.* *Juniperus communis* var. *nipponica* was found to be distinct from *J. communis* and this supports its recognition as a variety. The recognition of *J. conferta* as a variety of *J. rigida* [*J. rigida* var. *conferta* (Parl.) Patschke] is supported by the data. The data also supports the recognition of *J. lutchuensis* Koidz. [= *J. taxifolia* var. *lutchuensis* (Koldz.) Satake] and *J. morrisonicola* Hayata [= *J. squamata* var. *morrisonicola* (Hayata) H.L. Li and H. Keng] at the specific levels.
2. Arnold M. A.; Lesikar B. J.; Kenimer A. L., and Wilkerson D. C. Spring recovery of constructed wetland plants affects nutrient removal from nursery runoff. Journal of Environmental Horticulture. 1999; 17(1):5-10.
Keywords: *Juniperus procumbens*/ runoff/ wetland plants/ nursery/ greenhouse/ nutrients
Abstract: The nursery/greenhouse industry is the fastest growing segment of United States agriculture. Consumer demand for excellent product quality requires luxury applications of water and agricultural chemicals. These cultural practices tend to yield significant volumes of runoff rich in nutrients and pesticides. A capture and recycle system at the Nursery/Floral Crops Research and Education Center at the Texas A&M

University was fitted with 12 sub-surface flow (SSF) and 12 free-surface flow (FSF) wetland cells. A single pass of runoff through constructed wetland cells provided substantial reduction of runoff nutrient concentrations, particularly NO₃-N, without increasing electrical conductivity (EC), an indicator of salinity. Nitrate-N concentration reductions were greater in the FSF cells than SSF cells, while the greatest reductions in ammonium and nitrites were obtained with SSF cells. Growth of *Iris pseudacorus* L. and *Canna x generalis* L.H. Bailey during spring growth was greater in the FSF wetland cells, while that of *Colocasia* sp. Fabr. was greater in the SSF wetland cells. *Equisetum hyemale* L. grew equally well in both cell types. Interactions among irrigation water sources and container media types for growth indices occurred for *Juniperus procumbens* (Endl.) Miq. 'Green Mound' and *Ilex vomitoria* Ait. 'Nana', but not for *Raphiolepis indica* L. 'Carmelita'.

3. Bean, R. R. and Whitcomb, C. E. Effects of multiple cuttings per container and fertilizer levels on visual appearance, production time, and landscape performance of *Juniperus procumbens*. Research Report, Oklahoma Agricultural Experiment Station. 1974; P-70416-18.
Keywords: *Juniperus procumbens*/ cuttings/ fertilizer/ Osmocote
Abstract: One, 2 or 3 rooted cuttings of *J. procumbens* were planted in a 3-gal container of 1:1 peat and sand, and supplied with 2000, 3000 or 4000 lb N/acre annually in the form of 2 dressings of 18-6-12 Osmocote. Plant appearance improved with increasing plant number/container, but was adversely affected by rising N levels. The 2 dressings of Osmocote probably resulted in an excessively high soluble salts level.
4. Blythe, G. Cutting propagation of *Juniperus procumbens* 'Nana'. International Plant Propagators' Society: Combined Proceedings. 1995; 44409-413.
Keywords: *Juniperus procumbens*/ IBA/ cuttings/ propagation
Abstract: In a series of trials comparing the effects of IBA and other growth regulator treatments, viz. NAA (alone or in combination with IBA) or KIB (a potassium salt of IBA), on the rooting of *J. procumbens* cv. Nana cuttings, 8000 p.p.m. IBA resulted in the highest rooting percentages (>50%). Extending the duration of this treatment from a quick dip to one lasting 15 seconds slightly, but not significantly, increased rooting percentage. In the final trial, rooted cuttings (originally treated with 8000 p.p.m. IBA) were potted after 15 weeks while any callused, unrooted cuttings were retreated with IBA and restuck in the flats for an additional 12 weeks. This practice resulted in an overall rooting percentage equivalent to that normally obtained when rooted cuttings are potted after ~6 months (standard practice) while reducing the production time for the majority of the crop and reducing the transplant losses sometimes experienced with rooted cuttings kept in the cutting flats for a long time.
5. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secrest Arboretum. Special Circular Ohio Agricultural

Research and Development Center. 1992; 14032-34.

Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus virginiana*/ *Juniperus scopulorum*/ *Juniperus squamata*/ growth habit

Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate or convergent. All plants were also evaluated for growth characteristics of open or closed outline.

6. Diver, S and Whitcomb, C E. The effect of dolomite, Micromax and propagation media on the rooting and subsequent growth of *Pyracantha coccinea* and *Juniperus procumbens*. Research Report, Agricultural Experiment Station, Oklahoma State University. 1981; P-81821-23.

Keywords: *Juniperus procumbens*/ *Pyracantha coccinea*/ rooting/ micronutrients/ dolomite/ cuttings

Abstract: Cuttings of both species were taken in November and rooted in 50% peat + 50% perlite or 100% peat with dolomite added at 0, 4, 8 or 16 lb/yd³ and/or Micromax (micronutrients) at 0 or 1 lb/yd³. *P. coccinea* cuttings showed no differences in rooting. *J. procumbens* cuttings rooted better without dolomite in the medium; they also rooted better in 100% peat than in the mixture. Plants which rooted better also grew better and had more branches after 5 months

7. Klett, J E. Nitrogen nutrition of junipers. Combined Proceedings of the International Plant Propagators Society. 1977; 27377-382.

Keywords: *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus sabina*/ *Juniperus horizontalis*/ nitrogen/ nutrition/ ornamental plants/ ornamental conifers

Abstract: Five dwarf juniper cultivars (*Juniperus procumbens* cv. Nana, *J. chinensis* cv. Pfitzeriana, *J. communis* cv. Repanda, *J. sabina* cv. Broadmoor and *J. horizontalis* cv. Wiltonii) responded differently when they were supplied with ammonium sulphate, ammonium nitrate or potassium nitrate each at 200 or 400 p.p.m., as N sources in the glasshouse and outdoors. At a given rate potassium nitrate caused more toxicity than the ammonium fertilizers. The cvs Repanda and Broadmoor, which showed the least dry weight increment, were the first to develop symptoms of N toxicity. Potassium nitrate had a greater effect than other compounds on nitrate concentrations in the tissue. Repanda had the highest nitrate concentration, whereas Wiltonii had the lowest and showed very little toxicity. Plants treated with potassium nitrate or ammonium nitrate suffered more winter damage than those treated with ammonium sulphate. Plants treated with nitrate N were the slowest to break

dormancy.

8. Klett, J. E. Superior ground cover junipers for the Great Plains region. American Nurseryman. 1978; 147(11):9, 52-55, 58.
Keywords: *Juniperus sabina*/ *Juniperus horizontalis*/ *Juniperus communis*/ *Juniperus procumbens*/ hardiness/ disease resistance/ Great Plains
Abstract: The characteristics are described of several prostrate junipers, evaluated from trials with about 70 cvs. *Juniperus sabina*, cvs Arcadia, Broadmoor and Skandia have been selected for their hardiness, distinctive green foliage and resistance to juniper blight. *J. horizontalis*, cvs Glauca (blue creeping juniper), Blue Rug (Wiltonii) and Plumosa (Andorra juniper); *J. communis* var. repanda (creeping common juniper) and *J. procumbens* var. nana (dwarf Japanese juniper) are also briefly described.
9. Major, J. E. and Grossnickle, S. C. Chilling units used to determine rooting of stem cuttings of junipers. Journal of Environmental Horticulture. 1990; 8(1):32*35.
Keywords: *Juniperus horizontalis*/ *Juniperus procumbens*/ *Juniperus sabina*/ *Juniperus scopulorum*/ chilling units/ cuttings/ rooting/ propagation
Abstract: Stem cuttings of *Juniperus chinensis* cv. Pfitzer Aurea, *J. horizontalis* cultivars Bar Harbor, Prince of Wales, Wiltoni and Youngstown, *J. procumbens* cv. Green Mound, *J. sabina* cultivars Broadmoor, Buffalo and Tamariscifolia and *J. scopulorum* [*J. scopulorum*] cv. Wichita Blue, collected twice monthly from 15 Oct. 1986 to 28 Feb. 1987, were dipped in an IBA or NAA rooting dip (concentrations given) and inserted in rooting beds with bottom heat at 18 ° C and misting as required. The air temperature 1 m above the stock plants was monitored continuously and the seasonal chilling units (the number of hours when the temperature was <less or =>5 °) were determined. The chilling units experienced by stock plants affected the rooting response of cuttings taken from them. Cultivar variations in percentage rooting and rooting pattern were marked. It is concluded that rooting success is related to the physiological status of the donor plant. Calendar dates can be used successfully as a guideline for cultivars known to root effectively over a large number of chilling units (such as Youngstown, Bar Harbor and Price of Wales). However, the chilling unit concept may be more appropriate for determining the optimum period for successful rooting of cultivars that have a more precise response to chilling units experienced (such as Tamariscifolia, Broadmoor and Green Mound).
10. Tereshkovich, George. *Juniperus* species: evergreen ground covers . Research Report. University of Georgia, College of Agriculture Experiment Stations. 1969; 3610 .
Keywords: *Juniperus conferta*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus horizontalis*/ *Juniperus japonica*/ *Juniperus*

procumbens/ Juniperus sabina/ Juniperus scopulorum

Call Number: S51.R22

Abstract: The following *Juniperus* spp. cultivars are better adapted for the Georgia Piedmont: *Juniperus* Blue Pfitzer, *Juniperus conferta* (Shore Juniper), *Juniperus chinensis* Sargenti, *Juniperus chinensis pfitzeriana aurea* (Golden tip Pfitzer), *Juniperus davurica* (Squamata expansa) *parsoni*, *Juniperus horizontalis andorra*, *Juniperus horizontalis andorra* compacts, *Juniperus horizontalis andorra*, (Aunt Jamina), *Juniperus horizontalis plumosa*, (Andorra juniper), *Juniperus horizontalis 'Douglasi'* (Waukegan), *Juniperus japonica* (San Jose), *Juniperus procumbens*, *Juniperus sabina 'Arcadia'*, and *Juniperus scopulorum*, (White Silver King). These species are very hardy plants, able to withstand extremes in temperature, and provide excellent ground cover for landscaping around the home, in parks, and in highway beautification programs.

***Juniperus prostrata* (1)**

1. Pack, D. A. After-ripening and germination of *Juniperus* seeds. Botanical Gazette. 1921; 7132-60.

Keywords: *Juniperus communis/ Juniperus virginiana/ Juniperus prostrata/ germination/ after-ripening/ temperatures*

Abstract: Seed biology from *Juniperus communis*, *Juniperus virginiana*, *Juniperus prostrata*, were examined with after-ripening treatments. Freezing and thawing has no forcing action on the germination of juniper seeds, nor did it hasten after-ripening. Freezing causes injury to after-ripened seeds. After-ripening occurred at temperatures between 0 ° C to 10 ° C , although fastest at about 5 ° C. When after-ripened seeds were transferred from 5 ° C to temperatures above 15 ° C , seeds were thrown into a state of secondary dormancy. Seeds that have not split open and developed a short hypocotyl should not be transferred to a germinator above 5° C. Inhibitors were found in the endosperm and embryo but not in the seedcoat.

***Juniperus pseudosabina* (8)**

1. Adams, R. P. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). USABiochemical Systematics & Ecology. 2000; 28(6):529-543.

Keywords: *Juniperus convallium/ Juniperus indica/ Juniperus komarovii/ Juniperus pingii/ Juniperus przewalskii/ Juniperus pseudosabina/ Juniperus recurva/ Juniperus saltuaria/ Juniperus squamata/ Juniperus tibetica/ Juniperus wallichiana/ RAPD/ DNA/ essential oils*

Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var.

microsperma, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxi*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallachiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxi* A.B. Jacks. (Syn.: *J. recurva* var. *coxi*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

2. Adams R. P. and Turuspekov Y. Taxonomic reassessment of some Central Asian and Himalayan scale-leaved taxa of *Juniperus* (*Cupressaceae*) supported by random amplification of polymorphic DNA. *Taxon*. 1998; 47(1):75-83.
Keywords: *Juniperus centrasiatica*/ *Juniperus turkestanica*/ *Juniperus pseudosabina*/ *Juniperus indica*/ RAPD/ DNA/ taxonomy
Abstract: Analysis of central Asian *Juniperus* using RAPD revealed that *J. centrasiatica*, *J. turkestanica*, and *J. pseudosabina* appear to belong to a single species, to be named *J. pseudosabina*. This conclusion is also supported by previous work on terpenoids. Putative *J. indica* from Nepal (shrub form) was found to be distinct from *J. pseudosabina*. It appears that the common scale-leaved shrub or tree juniper of the Himalayas should be called *J. indica* not *J. pseudosabina*.
3. Chaturvedi M. Studies on the pollen grains of *Juniperus* L. *Current Science*. 50(12). 1981. 548-549.
 Palynol. Lab., National Bot. Res. Inst., Lucknow 226 001, India. 1981; 50(12):548-549.
Keywords: *Juniperus excelsa*/ *Juniperus macropoda*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus wallichiana*/ Himalayas/ pollen
Abstract: Light microscopic and SEM studies of 5 species (*J. excelsa*, *J. macropoda*, *J. pseudosabina*, *J. squamata* and *J. wallichiana*) from the Himalayas.
4. Chaturvedi, Mithilesh. A report on the pollen morphology of *Juniperus pseudosabina* Fisch. et Mey. *Journal of Palymology*. 1979; 15(1):46-48.
Keywords: *Juniperus pseudosabina*/ pollen/ morphology
 Call Number: QK658. A1J6
Abstract: Three morphotypes of the pollen grains of one of the population of *Juniperus pseudosabina* are described. Various stages of amalgamation of orbicules have been observed.
5. Dar, G. H. and Christensen, K. I. Gymnosperms of the Western Himalaya. 1. The genus *Juniperus* (*Cupressaceae*). *Pakistan Journal of Botany*. 2003; 35(3):283-311.

Keywords: *Juniperus communis*/ *Juniperus squamata* / *Juniperus recurva*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus wallichiana*/ *Juniperus pseudosabina*/ Himalaya

Abstract: A thorough study of an extensive collection of herbarium specimens and literature of *Juniperus* (*Cupressaceae*) from the Western Himalaya, during our work on gymnosperms of this region, has revealed that the taxonomy of West Himalayan Junipers has been confusing. A total of up to 6 taxa have been reported from this region by various earlier workers under a large number of specific and infraspecific names, most of which are synonyms. Seven taxa are recognized from the Western Himalaya in the present study: one belonging to *Juniperus* Sect. *Juniperus*, *J. communis* var. *saxatilis*, and the other six to *Juniperus* Sect. *Sabina*. The latter section includes two acicular-leaved species, *J. squamata* and *J. recurva*, and four scale-leaved species: two multiseed, *J. semiglobosa* and *J. polycarpus*, and two monoseed, *J. wallichiana* and *J. pseudosabina*.

6. Jain, K. K. A taxonomic revision of the Himalayan Junipers. Indian Forester. 1976; 102(2):109-188.

Keywords: *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ *Juniperus communis*/ *Juniperus pseudosabina*/ taxonomy/ Himalayas

Abstract: Discusses the taxonomy of *Juniperus* in the Himalayas. On the basis of morphological and anatomical studies (including studies of wood anatomy) eight taxa were identified. Of the species that are trees, *J. wallichiana*, *J. recurva* and *J. fargesii* [*J. squamata* var. *fargesii*] are restricted to the eastern Himalayas and *J. macropoda* and *J. excelsa* to the western Himalayas. Of the shrubs, *J. communis* subsp. *nana* occurs only in the western Himalayas, but *J. pseudosabina* and *J. squamata* occur throughout the area. Each species is briefly described.

7. Kaushal, P. S. Studies in the Western Himalayan junipers: I. distribution pattern and taxonomic considerations. Research Bulletin of the Panjab University, Science. 1994; 44(1/4):53-62.

Keywords: *Juniperus communis*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ taxonomy/ India

Abstract: Five taxa of *Juniperus*, of which two with tree habit, are recorded from Western Himalaya in the States of Himachal Pradesh and Jammu and Kashmir, India and are studied for their morphological variation and distribution. The genus is represented by two distinct tree species (*J. macropoda* and *J. excelsa*) and three with shrubby forms (*J. communis*, *J. squamata* and *J. pseudosabina*). Several variants are observed in the polymorphic *J. squamata*. *Juniperus communis* and *J. pseudosabina* are morphologically conservative. A putative hybrid, intermediate in characters between *J. squamata* and *J. pseudosabina*, has also been recorded.

8. Mehra, P. N. and Jain, K. K. *Abies* and *Juniperus* complexes in the E. Himalayas with observations on *Larix griffithii* Hook. f. and *Tsuga dumosa* Eichler. *Abies* and *Juniperus* Complexes in the E. Himalayas With Observations on *Larix Griffithii* Hook. F. and *Tsuga Dumosa* Eichler. 1976; 143.
Keywords: *Juniperus pseudosabina*/ *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus fargesii*/ *Juniperus squamata*/ *Abies forrestii*/ *Abies spectabilis*/ anatomy/ morphology/ taxonomy/ classification.
Abstract: The main part of the book describes in detail the morphology and anatomy of leaves, young shoots, wood, bark and female cones of *Abies* and *Juniperus*, with 77 photographs and line drawings. Evolutionary trends in *Juniperus* and the *Pinaceae* are discussed and a short bibliography is included. It is concluded that *A. forrestii* is distinct from *A. spectabilis* and that the sabinoid group of *Juniperus* includes *J. pseudosabina* and *J. wallichiana* and the oxycedroid group *J. recurva*, *J. fargesii* and *J. squamata* var. *wilsonii*.

***Juniperus recurva* (6)**

1. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. *Acta Horticulturae*. 2003; 61291-106.
Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.
Abstract: Several cases involving apparent discordance in morphological, chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var. *microsperma*, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var. *squamata*, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.
2. ---. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). *USABiochemical Systematics & Ecology*. 2000; 28(6):529-543.
Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus pseudosabina*/ *Juniperus recurva*/ *Juniperus saltuaria*/ *Juniperus squamata*/ *Juniperus tibetica*/ *Juniperus wallichiana*/ RAPD/ DNA/

essential oils

Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallachiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

3. Adams R. P.; Thappa R. K.; Agarwal S. G.; Kapahi B. K.; Srivastava T. N., and Chaudhary R. P. The leaf essential oil of *Juniperus recurva* Buch.-Ham. ex D. Don from India and Nepal compared with *J. recurva* var. *squamata* (D. Don) Parl. *Journal of Essential Oil Research*. 1998; 10(1):21-24.
Keywords: *Juniperus recurva*/ non wood forest products/ chemical composition/ essential oils

Abstract: The composition of the leaf oils of *J. recurva* from India (Sikkim) and Nepal were analyzed and compared with the composition of *J. recurva* var. *squamata* from western India. The major components of the essential oils were alpha -pinene (0.5-6.9%), sabinene (0.4-13.4%), delta -3-carene (13.6-23.7%), limonene (0.2-18.4%), terpinen-4-ol (0.2-3.7%), gamma -cadinene (0.4-3.9%), delta -cadinene (0.8-10.2%), elemol (3.9-5.1%), cubenol (0-3.7%), epi- alpha -cadinol (0.3-5.5%), epi- alpha -muurolol (0.5-5.5%), alpha -cadinol (0.8-13.1%) and 4-epi-abietal (trace-3.75%).

4. Dar, G. H. and Christensen, K. I. Gymnosperms of the Western Himalaya. 1. The genus *Juniperus* (*Cupressaceae*). *Pakistan Journal of Botany*. 2003; 35(3):283-311.

Keywords: *Juniperus communis*/ *Juniperus squamata* / *Juniperus recurva*/ *Juniperus semiglobosa*/ *Juniperus polycarpos*/ *Juniperus wallichiana*/ *Juniperus pseudosabina*/ Himalaya

Abstract: A thorough study of an extensive collection of herbarium specimens and literature of *Juniperus* (*Cupressaceae*) from the Western Himalaya, during our work on gymnosperms of this region, has revealed that the taxonomy of West Himalayan Junipers has been confusing. A total of up to 6 taxa have been reported from this region by various earlier workers under a large number of specific and infraspecific names, most of which are synonyms. Seven taxa are recognized from the Western Himalaya in the present study: one belonging to *Juniperus* Sect. *Juniperus*, *J. communis* var. *saxatilis*, and the other six to *Juniperus* Sect.

Sabina. The latter section includes two acicular-leaved species, *J. squamata* and *J. recurva*, and four scale-leaved species: two multiseed, *J. semiglobosa* and *J. polycarpus*, and two monoseed, *J. wallichiana* and *J. pseudosabina*.

5. Jain, K. K. A taxonomic revision of the Himalayan Junipers. *Indian Forester*. 1976; 102(2):109-188.

Keywords: *Juniperus wallichiana/ Juniperus recurva/ Juniperus squamata/ Juniperus macropoda/ Juniperus excelsa/ Juniperus communis/ Juniperus pseudosabina/ taxonomy/ Himalayas*

Abstract: Discusses the taxonomy of *Juniperus* in the Himalayas. On the basis of morphological and anatomical studies (including studies of wood anatomy) eight taxa were identified. Of the species that are trees, *J. wallichiana*, *J. recurva* and *J. fargesii* [*J. squamata* var. *fargesii*] are restricted to the eastern Himalayas and *J. macropoda* and *J. excelsa* to the western Himalayas. Of the shrubs, *J. communis* subsp. *nana* occurs only in the western Himalayas, but *J. pseudosabina* and *J. squamata* occur throughout the area. Each species is briefly described.

6. Mehra, P. N. and Jain, K. K. *Abies* and *Juniperus* complexes in the E. Himalayas with observations on *Larix griffithii* Hook. f. and *Tsuga dumosa* Eichler. *Abies* and *Juniperus* Complexes in the E. Himalayas With Observations on *Larix Griffithii* Hook. F. and *Tsuga Dumosa* Eichler. 1976; 143.

Keywords: *Juniperus pseudosabina/ Juniperus wallichiana/ Juniperus recurva/ Juniperus fargesii/ Juniperus squamata/ Abies forrestii/ Abies spectabilis/ anatomy/ morphology/ taxonomy/ classification.*

Abstract: The main part of the book describes in detail the morphology and anatomy of leaves, young shoots, wood, bark and female cones of *Abies* and *Juniperus*, with 77 photographs and line drawings. Evolutionary trends in *Juniperus* and the *Pinaceae* are discussed and a short bibliography is included. It is concluded that *A. forrestii* is distinct from *A. spectabilis* and that the sabinoid group of *Juniperus* includes *J. pseudosabina* and *J. wallichiana* and the oxycedroid group *J. recurva*, *J. fargesii* and *J. squamata* var. *wilsonii*.

***Juniperus rigida* (8)**

1. Adams, Robert P.; Hsieh, Chang-Fu; Murata, Jim, and Pandey, Ram Nanresh. Systematics of *Juniperus* from eastern Asia based on Random Amplified Polymorphic DNA's (RAPDs) . *Biochemical Systematics and Ecology* . 2002 Mar; 30(3):231-241; ISSN: 0305-1978.

Keywords: *Juniperus chinensis/ Juniperus communis/ Juniperus conferta/ Juniperus formosana/ Juniperus procumbens/ Juniperus rigida/ Juniperus taxifolia/ RAPS's/ DNA/ Taiwan/ China*

Call Number: QD415.A1B5

Abstract: DNA was examined by RAPD banding for *Juniperus chinensis*, *J. c.* var. *sargentii*, *J. c.* var. *tsukusiensis*, *J. communis*, *J. c.* var.

nipponica, *J. c.* var. *saxatilis*, *J. conferta*, *J. formosana*, *J. procumbens*, *J. rigida*, *J. taxifolia*, and *J. t.* var. *lutchuensis*. The DNA data readily separated junipers of section *Sabina* from section *Juniperus*. *J. c.* var. *tsukusiensis* from Taiwan was found to be sufficiently different from *J. c.* var. *tsukusiensis* (Yakushima) to warrant the recognition of a new variety: *J. chinensis* var. *taiwanensis* R.P. Adams and C-F. Hsieh *nov. var.* *Juniperus formosana* from mainland China was found to be different from *J. formosana* from Taiwan and a new variety is recognized: *J. formosana* var. *mairei* (Lemee and Lev.) R.P. Adams and C-F. Hsieh *comb. nov.* *Juniperus communis* var. *nipponica* was found to be distinct from *J. communis* and this supports its recognition as a variety. The recognition of *J. conferta* as a variety of *J. rigida* [*J. rigida* var. *conferta* (Parl.) Patschke] is supported by the data. The data also supports the recognition of *J. lutchuensis* Koidz. [= *J. taxifolia* var. *lutchuensis* (Koidz.) Satake] and *J. morrisonicola* Hayata [= *J. squamata* var. *morrisonicola* (Hayata) H.L. Li and H. Keng] at the specific levels.

2. Garanovich, I. M. and Antonova, E. V. Features of propagating junipers by cuttings. *Lesnoe Khozyaistvo*. 1997; 239-40.
Keywords: *Juniperus communis*/ *Juniperus rigida*/ *Juniperus sabina*/ *Juniperus virginiana*/ vegetative propagation/ shoot cuttings/ rooting.
Abstract: Cuttings of junipers (including *Juniperus communis*, *J. rigida*, *J. sabina*, *J. virginiana*) were rooted in various substrates under mist, with the use of various growth regulators. Data are presented on rooting success and the development of the cuttings. The best substrate was a peat/sand mixture (1:1).
3. Kozhevnikova, Z. V. Anatomical structure of the stem of Far Eastern species of juniper in relation to the features of root formation in cuttings. *Byulleten' Glavnogo Botanicheskogo Sada*. 1991; 16034-41.
Keywords: *Juniperus rigida*/ *Juniperus sibirica*/ *Juniperus conferta*/ *Juniperus dahurica*/ *Juniperus sargentii*/ vegetative propagation/ roots/ adventitious roots.
Abstract: Anatomical studies were made of the stems (often trailing or prostrate) of *Juniperus rigida*, *J. sibirica*, *J. conferta*, *J. dahurica* and *J. sargentii*, with special reference to the bark and the initiation of roots. All five species are capable of propagation by cuttings, and all of them produce a few or numerous root primordia on the stems in the crown, except for *J. rigida*. In lignified cuttings of *J. sibirica*, *J. conferta* and *J. sargentii* the root system is formed by adventitious roots all along the part of the stem in the soil and also from wound callus at the cut surface. *J. dahurica* forms roots mainly along the stem in the soil, and *J. rigida* mainly from the wound callus. In green cuttings in all five species the roots are formed only from the wound meristems.
4. ---. Seed anatomy and some peculiarities of germination in Soviet Far Eastern species of juniper. *Byulleten' Glavnogo Botanicheskogo Sada*. 1986;

14199-107; ISSN: 0366-502X.

Keywords: *Juniperus conferta*/ *Juniperus rigida*/ *Juniperus davurica*/ *Juniperus sargentii*/ *Juniperus sibirica*/ seeds/ morphology/ germination/ seed anatomy/ conifers

Abstract: Seeds of *Juniperus conferta*, *J. davurica*, *J. rigida*, *J. sargentii* and *J. sibirica* were collected in the Far East and examined by light microscopy and SEM. Data are tabulated on the max., min. and mean seed dimensions, spermoderm thickness and size of resin capsules, and the mean cell sizes in the tissues of the seed coat. In *J. davurica* and *J. sargentii*, the spermoderm was differentiated into 3 layers with a fleshy outer layer (sarcotesta). Observations are reported on seasonal reproductive behaviour, and anatomical development of the seed and ripening of the fruits are described. The resin capsules of the seed were derived from fruit tissue. Seeds from ripe fruits were in a state of deep rest. For rapid germination, seed extraction is recommended 1.5-2 months before the ripening of the fruits.

5. ---. Vegetative propagation of Far Eastern junipers in the southern Maritime Province. Byulleten' Glavnogo Botanicheskogo Sada. 1991; 16190-98.
Keywords: *Juniperus rigida*/ *Juniperus conferta*/ *Juniperus sibirica*/ *Juniperus dahurica*/ *Juniperus sargentii* / cuttings/ propagation/ rooting
Abstract: An account is given of experience in propagating *Juniperus rigida*, *J. conferta*, *J. sibirica*, *J. dahurica* and *J. sargentii* by cuttings. It is best to use lignified cuttings taken from the terminal part of stout shoots containing two complete annual extensions. Green cuttings are only feasible with *J. dahurica* and *J. sargentii*. Cuttings should be rooted at the beginning or in the first half of the growing season; summer/autumn rooting is preferable only for *J. rigida*. The cuttings should be inserted at an angle - greatest for cuttings of prostrate species and least (i.e. nearly upright) for arborescent species. *J. dahurica*, *J. sibirica* and *J. conferta* root easily, mainly from the rudiments of adventitious roots and also from wound meristems, in one growing season; *J. rigida* and *J. sargentii* are more difficult to root, forming only wound callus in the first growing season and rooting in the second year.
6. Man Kyu Huh and Hong Wook Huh . Genetic diversity and population structure of *Juniperus rigida* (*Cupressaceae*) and *Juniperus coreana*. Evolutionary Ecology. 2000; 14(2):87-98.
Keywords: *Juniperus rigida*/ *Juniperus coreana*/ Korea/ genetic diversity/ population structure/ alleles
Abstract: Enzyme electrophoresis was used to estimate genetic diversity and population structure of *Juniperus rigida* (*Cupressaceae*) and *Juniperus coreana* in Korea. In *J. rigida*, 16 of the 22 loci (72.7%) showed detectable polymorphism. Genetic diversity (0.224) was higher than average values for species with similar life history traits. The endemic species (*J. coreana*) was found to have fewer alleles per locus (1.39 vs. 1.61), fewer alleles per polymorphic locus (2.42 vs. 2.63), lower percent

polymorphic locus (54.6 vs. 72.7%), and lower diversity (0.199 vs. 0.224) than *J. rigida*. These genetic diversity parameters indicated that *J. coreana* was genetically depauperate relative to its presumptive progenitor, *J. rigida*. Analysis of fixation indices showed a substantial deficiency of heterozygotes relative to Hardy-Weinberg expectations suggesting inbreeding in *J. coreana*. The G_{ST} values of *J. rigida* and *J. coreana* were 0.173 and 0.118 respectively. The indirect estimate of gene flow based on mean G_{ST} was moderate ($N_m = 1.19$ for *J. rigida* and 1.86 for *J. coreana*).

7. Ren Yi. Addenda on seed plants of Qinling Mountains: *Gymnospermae* and *monocotyledonae* of *Angiospermae*. Xibei Zhiwu Xuebao. 2000; 20(4):653-660.
Keywords: *Juniperus rigida*/ Qinling Mountains/ *Elymus*/ *Indocalamus*/ *Fargesia*/ *Hierochloe*/ *Allium*/ *Liriope*/ *Ophiopogon*/ *Listera*/ *Veratrum*/ *Amitostigma*/ *cyripedium*/ *Goodyera*/ *Liparis*
Abstract: This is the first paper that deals with addenda on seed plants of Qinling Mountains. *Juniperus rigida* Sieb. et Zucc. of *Gymnospermae*, *Elymus excelsus* Turcz., *Indocalamus bashanensis* (C. D. Chu et C. S. Chao) H. R. Zhao et Y. L. Yang, *Fargesia qinlingensis* Yi et J. X. Shao, *Hierochloe odorata* (Linn.) Beauv. var. *brevipes* Y. Ren of *Gramineae*, *Allium ramosum* Linn., *Liriope longipedicellata* Wang et Tang, *Ophiopogon bodinieri* Levl., and *Veratrum nigrum* Linn. var. *paniculatum* Y. Ren of *Liliaceae*, *Listera* R. Br., *Amitostigma gracile* (Bl.) Schltr., *Cyripedium guttatum* Smith, *Cyripedium macranthum* Sw., *Goodyera biflora* (Lindl.) Hook. f., *Liparis japonica* Maxim. var. *purpurea* Y. Ren, *Listera puberula* Maxim., and *Listera grandiflora* Rolfe of *Orchidaceae* of *Monocotyledons* of *Angiospermae* were included in the present paper. *Elymus excelsus* Turcz. is a new record of Qinling Mountains.
8. Song, J H. Study on accelerating germination of seed of needle juniper (*Juniperus rigida*). Journal of North East Forestry University, China. 1987; 15(6):103-110.
Keywords: *Juniperus rigida*/ seeds/ germination/ treatment/ stratification/ conifers
Abstract: In tests in 1982-86, soaking seeds in industrial conc. H₂SO₄ for 30-80 min (opt. 60 min) or laboratory conc. H₂SO₄ for 30-60 min (opt. 45 min), followed by 8-10 d stratification, increased germination by 17-25%.

***Juniperus sabina* (29)**

1. Alm, T. *Juniperus sabina* in Norwegian folk tradition. Blyttia. 2003; 61(4):186-189.
Keywords: *Juniperus sabina*/ Norway/ abortion

Abstract: Throughout Europe, *Juniperus sabina* (Cupressaceae) has been much used to provoke abortion, thus gaining an evil reputation. The plant does not occur in Fennoscandia, but may be cultivated here, though the use in Norway must have been based largely on imported plant material. The species is included in a few Norwegian black book recipes, mostly aimed at provoking abortion.

2. Antonyuk E. D. Growing plants of *Juniperus sabina* in containers. Lesnoe Khozyaistvo. 1991; 1224-26.
Keywords: *Juniperus sabina*/ cuttings/ containers/ media/ mulch/ irrigation
Abstract: Rooted cuttings of *Juniperus sabina* (30 cm long, roots 6 cm long) were grown in containers of capacity 1.5 or 3.5 liters, with three different substrates (fertilized peat, humus soil, or a 1:1 peat/soil mixture), with watering by overhead sprinkling and with a sawdust mulch, or watering from below and with a polythene mulch. Data are presented on the growth of the aerial parts and the roots. The best results were achieved with a fertilized-peat/humus-soil mix and sawdust or perlite mulch, in containers of 3.5 liters (for plants grown on for 2 years).
3. Bluhm, W. L. and Burt, J. Cutting propagation costs for Fraser photinia and Tam juniper. Combined Proceedings, International Plant Propagators' Society. 1984; 3383-87.
Keywords: *Juniperus sabina*/ Oregon/ *Photinia*/ planting stock/ production/ plant breeding.
Abstract: Data from a group of Oregon nurserymen showed that propagation costs for *Photinia X fraseri* and *Juniperus sabina* var. *tamariscifolia* (2 widely grown subjects) were 20.5 and 13.1 cents per salable rooted cutting, respectively. Sticking, rooting and growing cuttings amounted to 71.2 and 73.3% of the total cost. Labor was the principal cost factor (> 50% of total)
4. Burger D. W.; Hartz T. K., and Forister G. W. Composted green waste as a container medium amendment for the production of ornamental plants. Hortscience. 1997; 32(1):57-60.
Keywords: *Juniperus sabina*/ *Catharanthus*/ *Dendranthema*/ *Pittosporum*/ *Photinia*/ seeds/ germination/ containers
Abstract: Seed germination and crop growth characteristics were determined for *Tagetes* spp. L. 'Lemondrop', marigold; *Catharanthus roseus* Don. 'Little Pinkie', vinca; *Petunia hybrida* Vilm. 'Royalty Cherry', petunia; *Dendranthema times grandiflorum* (Ramat.) *Kitamura* 'White Diamond', *chrysanthemum*; *Pittosporum tobira* Ait. 'Wheeleri', sweet mock orange; *Photinia times fraseri* Dress., *Photinia* and *Juniperus sabina* L. 'Moon Glow', juniper grown in various size containers containing blends of composted green waste (CGW) and UC Mix. Seed germination, plant height, and stem and root fresh and dry mass were lowest in unamended CGW. For most plants studied, a CGW: UC Mix

blend containing at least 25% UC Mix was required for adequate growth and development. Germinating seeds and young seedlings were most adversely affected by unamended CGW. As plants grew and were transplanted into larger containers (10- and 15-cm pots, 530 and 1800 mL), they were better able to grow in media with higher CGW content.

5. Calkins, James B. Author; Jarvis, Beth R. Author, and Swanson, Bert T. Author. Compost and rubber tire chips as peat substitutes in nursery container media: Growth effects. *Journal of Environmental Horticulture*. 1997; 15(2):88-94.
Keywords: *Juniperus chinensis*/ *Juniperus sabina*/ *Juniperus horizontalis*/ *Physocarpus*/ *Lamiastrum gakobdolon*/ container/ nursery/ rubber tire chips/ growth/ compost
Abstract: This research investigated the feasibility of using composted yard wastes, composted municipal solid waste and shredded rubber tire chips in nursery container media. Containerized *Physocarpus opulifolius* 'Dart's Gold', Forsythia times 'Meadowlark', *Spiraea* times billiardii, *Juniperus chinensis* 'Seagreen', *J. sabina* 'Mini Arcade', *J. horizontalis* 'Hughes', and *Lamiastrum gakobdolon* were grown in media amended with five recycled waste materials used as peat substitutes in a standard container medium of composted woodchips, peat, and sand (3:2:1 by vol). Waste materials used included three yard waste composts, one municipal solid waste compost and shredded rubber tire chips. Fifty or 100% of the peat in the standard growing medium was replaced with each amendment. Ten treatments (five amendments, each at 50% and 100% peat replacement) and a control (standard medium) were used for all seven plant species. Visual ratings, height and width measurements (crown volume), number of growing points and plant dry weights indicated that media in which 50% of the peat was replaced by an amendment produced larger plants of superior quality compared to the control. Rubber tire chips were acceptable as a 50% peat substitute for plants that prefer well-drained conditions, while 100% peat substitution with tire chips was detrimental to plant growth and performance. Use of immature compost in container media negatively influenced plant growth.
6. Chong C. Simultaneous grafting and rooting of juniper . *HortScience*. 1981; 16(4):561-562.
Keywords: *Juniperus virginiana*/ *Juniperus sabina*/ rootstock/ cuttings/ grafting
Abstract: Scion cuttings of *Juniperus virginiana* cv. Skyrocket were grafted on *J. sabina* cv. Blue Danube rootstock cuttings and rooted together under intermittent mist. Successful grafts and rooting were 46% by a paired-cutting procedure, 57% by conventional side grafting, and 75% by a new procedure in which side grafted cuttings are held together by a styrofoam block.
7. Chong, Calvin Author and Rinker, Danny L. Author. Use of spent mushroom

substrate for growing containerized woody ornamentals: An overview. *Compost Science & Utilization*. 1994; 2(3):45-53.

Keywords: *Juniperus sabina*/ *Weigela*/ *Rosa*/ *Ligustrum*/ *Potentilla*/ *Forsythia*/ *Deutzia*/ *Cornus*/ *Cotoneaster*/ *Physocarpus*/ nursery/ mushroom substrate/ container

Abstract: There are substantial environmental and economic benefits to be gained by recycling spent mushroom substrate (SMS). Researchers throughout the world have grown many types of crops with SMS but information with ornamental nursery crops is sparse. High salt levels in SMS is largely responsible for its restricted use in agriculture.

Investigations showed that many ornamental woody species grew well in 6-liter (2-gal) regular nursery containers amended with different proportions of SMS (33%, 67%, and 100% by volume) mixed with bark. Test species were: cotoneaster (*Cotoneaster dammeri* 'Coral Beauty'); deutzia (*Deutzia gracilis*); dogwood (*Cornus alba* and *C. alba* 'Argenteo-marginata'); forsythia (*Forsythia x intermedia* 'Lynwood'); juniper (*Juniperus sabina* 'Blue Danube' and *J. virginiana* 'Hetzii'); ninebark (*Physocarpus opulifolius*); potentilla (*Potentilla fruticosa* 'Red Ace'); privet (*Ligustrum vulgare*); rose (*Rosa* 'John Franklin'); and weigela (*Weigela* 'Bristol Ruby' and *W. florida* 'Variegata Nana'). Despite variable species response, there was little relationship of growth performance to: source of SMS (different farms, fresh or aged, leached or unleached); initial or subsequent salt levels in the media; chemical or physical characteristics of the media, including increasing shrinkage with increasing amounts of SMS; or contents of leaf nutrients. Plants of all species, except privet, achieved marketable size and quality at harvest. Time-course studies demonstrated that rapid leaching of undesirable high salt levels from the containers was the key to our successful results. In further studies which evaluated a wider range of amendment combinations (peat, bark, and sand) with SMS included in amounts (25% or 50%) more desirable in commercial container nursery practice, all SMS amended media promoted excellent growth of nursery crops. Minimal shrinkage was obtained with a medium consisting of 25% sand, 25% SMS, and 50% peat or bark.

8. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secret Arboretum. Special Circular Ohio Agricultural Research and Development Center. 1992; 14032-34.

Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus virginiana*/ *Juniperus scopulorum*/ *Juniperus squamata*/ growth habit

Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to

branching habit: procumbent, horizontal, arched, ascending, fastigiate or convergent. All plants were also evaluated for growth characteristics of open or closed outline.

9. Cummings, M J and Whitcomb, C E. Effects of nutrition on growth and quality of Tam juniper, *J. sabina* 'Tamariscifolia' and juniper blight, *Phomopsis juniperivora*. Research Report, Nursery Research Field Day. 1980; P-80334-35.
Keywords: *Juniperus sabina*/ *Phomopsis juniperivora*/ micronutrients/ Osmocote
Abstract: During a 1yr test only 4 of 128 junipers developed *P.* [*juniperivora*] blight. Affected plants had been grown without micronutrients and with low levels of Osmocote. Those junipers grown with high levels of Osmocote, Micromax micronutrients and once-yearly pruning were of excellent quality with 34% more growing terminals than unpruned plants without added nutrients.
10. Garanovich, I. M. and Antonova, E. V. Features of propagating junipers by cuttings. Lesnoe Khozyaistvo. 1997; 239-40.
Keywords: *Juniperus communis*/ *Juniperus rigida*/ *Juniperus sabina*/ *Juniperus virginiana*/ vegetative propagation/ shoot cuttings/ rooting.
Abstract: Cuttings of junipers (including *Juniperus communis*, *J. rigida*, *J. sabina*, *J. virginiana*) were rooted in various substrates under mist, with the use of various growth regulators. Data are presented on rooting success and the development of the cuttings. The best substrate was a peat/sand mixture (1:1).
11. Gomez Sal, A and Oliver, S. Pastures with *Juniperus sabina* in the Teruel mountains. Structure and ecological conditions. Pastos. 1981; 11(2):253-272.
Keywords: *Juniperus sabina*/ pastures/ Pyrenees/ ecology
Abstract: The botanical composition and ecology of pastures including *J. sabina* were investigated. The communities were found in the Teruel Iberian system at higher altitudes and in the Palencia-Leon mountains but only in very localized sites in the Pyrenees. They occurred at sites with extreme environments with degraded stony soils subject to heaving. Such pastures are considered locally to be of high quality. In the Teruel pastures *J. sabina* occurred in 32 localities in 5 different communities.
12. Gordienko, I I; Sapozhnikova, N F, and Derendovskaya, A I. Endogenous growth regulators and rooting of *Juniperus sabina* cuttings. Fiziologiya-Rastenii. 1976; 23(4):753-759.
Keywords: *Juniperus sabina*/ rooting/ growth regulators/ cuttings
Abstract: In studies with 1-year-old shoots during their 5 developmental phases a correlation was observed between the rate of accumulation of growth-promoting substances and the rooting of cuttings. The optimum time for rooting was between late March and mid April. The growth-stimulating substance, found in the shoots and roots of *J. sabina*, was

identified as IAA; several growth inhibitors of a phenolic nature and ABA were also found.

13. Jarvis, Beth R. Author; Calkins, James B. Author, and Swanson, Bert T. Author. Compost and rubber tire chips as peat substitutes in nursery container media: Effects on chemical and physical media properties. *Journal of Environmental Horticulture*. 1996; 14(3):122-129.
Keywords: *Juniperus chinensis*/ *Juniperus sabina*/ compost/ rubber tire chips/ nursery/ containers
Abstract: *Physocarpus opulifolius* 'Dart's Gold', *Forsythia* times 'Meadowlark', *Spiraea* times *billiardii*, *Juniperus chinensis* 'Seagreen', *J. sabina* 'Mini Arcade', *J. horizontalis* 'Hughes', and *Lamiaestrum galeobdolon* were grown in container media amended with three yard waste (YW) composts, one municipal solid waste (MSW) compost and shredded rubber tire chips. Each of the five amendments was used to replace 50% or 100% of the sphagnum peat in a standard container medium resulting in eleven media treatments. Effects of peat replacement with compost or tire chips were compared relative to chemical and physical media characteristics. Amendments evaluated had limited long term nutritional value. Initial pH was increased when peat was replaced with compost or rubber tire chips; the increase in pH was proportional to the amount of peat replaced (50 or 100%). Over time, pH of all media equilibrated with irrigation water pH. Soluble salts were reduced for media amended with rubber tire chips while peat replacement with compost had variable effects on soluble salt levels based on compost source. Media amended with compost exhibited increased bulk density and decreased porosity, water infiltration capacity and water holding capacity compared to the standard, peat-based control medium. Peat replacement with rubber tire chips increased bulk density and porosity and decreased water holding capacity compared to the standard control medium. Water infiltration capacity was greatly increased and water holding capacity decreased when peat was replaced 100% with rubber tire chips.
14. Jordano, P. Geographical ecology and variation of plant-seed disperser interactions: southern Spanish junipers and frugivorous thrushes. *Vegetatio*. 1993; 107-10885-104; ISSN: 0042-3106.
Keywords: *Juniperus communis*/ birds/ *Juniperus phoenicea*/ *Juniperus sabina*/ *Turdus merula*/ *Turdus pilaris*/ seed dispersal/ seeds/ Wildlife
Abstract: Results are presented from a study of interaction patterns between 6 species of strongly frugivorous thrushes (*Turdus iliacus*, *T. merula*, *T. viscivorus*, *T. philomelos*, *T. pilaris*, *T. torquatus*) and their major winter food plants (*Juniperus communis*, *J. phoenicea*, *J. sabina*) in 1985-89 at 6 localities in the highlands of southern Spain. Data are presented on feeding

records of thrushes on juniper and other fruits, geographical variation in local thrush/juniper assemblages on regional and local scales, temporal variation in local assemblages, and mutual congruency of distribution patterns and interaction strengths. In the context of seed dispersal, it is concluded that the strong uncoupling of biogeographical attributes of plants and frugivores makes taxon-specific coevolved interactions unlikely, and restricts interactions between two species to particular subsets of their respective populations with extremely variable outcomes in space and time.

15. Keuchel, D and Whitcomb, C E. Effects of Micromax micronutrients and gypsum on growth and incidence of juniper blight on *Juniperus sabina* Tamariscifolia'. Research Report, Nursery Research Field Day. 1980; P-80332-33.
Keywords: *Juniperus sabina* / *Phomopsis*/ micronutrients/ gypsum/ fertilization
Abstract: None of the juniper plants grown under simulated commercial conditions in the presence of infected nursery stock developed blight (*Phomopsis [juniperivora]*) during 3 test seasons when fertilized with Micromax (1-4 lb/yd³) or gypsum (5lb/yd³), although conditions were favourable for disease development.
16. Klett, J E. Nitrogen nutrition of junipers. Combined Proceedings of the International Plant Propagators Society. 1977; 27377-382.
Keywords: *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus sabina*/ *Juniperus horizontalis*/ nitrogen/ nutrition/ ornamental plants/ ornamental conifers
Abstract: Five dwarf juniper cultivars (*Juniperus procumbens* cv. Nana, *J. chinensis* cv. Pfitzeriana, *J. communis* cv. Repanda, *J. sabina* cv. Broadmoor and *J. horizontalis* cv. Wiltonii) responded differently when they were supplied with ammonium sulphate, ammonium nitrate or potassium nitrate each at 200 or 400 p.p.m., as N sources in the glasshouse and outdoors. At a given rate potassium nitrate caused more toxicity than the ammonium fertilizers. The cvs Repanda and Broadmoor, which showed the least dry weight increment, were the first to develop symptoms of N toxicity. Potassium nitrate had a greater effect than other compounds on nitrate concentrations in the tissue. Repanda had the highest nitrate concentration, whereas Wiltonii had the lowest and showed very little toxicity. Plants treated with potassium nitrate or ammonium nitrate suffered more winter damage than those treated with ammonium sulphate. Plants treated with nitrate N were the slowest to break dormancy.
17. Klett, J. E. Superior ground cover junipers for the Great Plains region. American Nurseryman. 1978; 147(11):9, 52-55, 58.
Keywords: *Juniperus sabina*/ *Juniperus horizontalis*/ *Juniperus communis*/ *Juniperus procumbens*/ hardiness/ disease resistance/ Great

Plains

Abstract: The characteristics are described of several prostrate junipers, evaluated from trials with about 70 cvs. *Juniperus sabina*, cvs Arcadia, Broadmoor and Skandia have been selected for their hardiness, distinctive green foliage and resistance to juniper blight. *J. horizontalis*, cvs Glauca (blue creeping juniper), Blue Rug (Wiltonii) and Plumosa (Andorra juniper); *J. communis* var. repanda (creeping common juniper) and *J. procumbens* var. nana (dwarf Japanese juniper) are also briefly described.

18. Major, J. E. and Grossnickle, S. C. Chilling units used to determine rooting of stem cuttings of junipers. *Journal of Environmental Horticulture*. 1990; 8(1):32*35.
Keywords: *Juniperus horizontalis/ Juniperus procumbens/ Juniperus sabina/ Juniperus scopulorum/* chilling units/ cuttings/ rooting/ propagation
Abstract: Stem cuttings of *Juniperus chinensis* cv. Pfitzer Aurea, *J. horizontalis* cultivars Bar Harbor, Prince of Wales, Wiltoni and Youngstown, *J. procumbens* cv. Green Mound, *J. sabina* cultivars Broadmoor, Buffalo and Tamariscifolia and *J. scopulorum* [*J. scopulorum*] cv. Wichita Blue, collected twice monthly from 15 Oct. 1986 to 28 Feb. 1987, were dipped in an IBA or NAA rooting dip (concentrations given) and inserted in rooting beds with bottom heat at 18 ° C and misting as required. The air temperature 1 m above the stock plants was monitored continuously and the seasonal chilling units (the number of hours when the temperature was <less or =>5 °) were determined. The chilling units experienced by stock plants affected the rooting response of cuttings taken from them. Cultivar variations in percentage rooting and rooting pattern were marked. It is concluded that rooting success is related to the physiological status of the donor plant. Calendar dates can be used successfully as a guideline for cultivars known to root effectively over a large number of chilling units (such as Youngstown, Bar Harbor and Price of Wales). However, the chilling unit concept may be more appropriate for determining the optimum period for successful rooting of cultivars that have a more precise response to chilling units experienced (such as Tamariscifolia, Broadmoor and Green Mound).
19. Mohr and Charles Theodore. Notes on the Red Cedar. 1901; 3137.
Keywords: *Juniperus virginiana/ eastern red cedar/ Juniperus caroliana/ Juniperus arborescens/ Juniperus barbadensis/ Juniperus faetida/ Juniperus australis/ Juniperus sabina/ juniper/ cedar/ savin*
Call Number: 1
Abstract: Botanical analysis and distribution of eastern red cedar in the early 1900's
20. Morrison, L S. Juniper blight of container grown tam junipers. Research Report, Oklahoma Agricultural Experiment Station. 1974; P-70449.
Keywords: *Juniperus sabina/ fungicide/ Phomopsis juniperovora/*

Benlate

Abstract: In preliminary fungicide trials for the control of *Phomopsis juniperovora* on container-grown *Juniperus sabina* var. *tamariscifolia*, Benlate (benomyl) at 1 lb/100 gal every 7 or 14 days was most effective.

21. Quezel, P. and Barbero, M. The juniper formations of Djurdjura (Algeria): their ecological, dynamic and syntaxonomic significance for the Kabylean cedar forests as a whole.
Les formations a genevriers rampants du Djurdjura (Algerie). Leur signification ecologique, dynamique et syntaxonomique dans une approche globale des cedraies kabyles. *Lazaroa*. 1989; 1185-99.
Keywords: *Juniperus communis*/ *Juniperus sabina*/ *Cedrus*/ Algeria/ ecology/ associations
Abstract: A new phytosociological interpretation is proposed for the *Juniperus communis* subsp. *hemisphaerica* and *J. sabina* scrub in this region. They form two associations belonging to a new alliance in the order *Quercu-Cedretalia atlanticae*. The floristic and phytosociological organization of the two associations is described. These associations form the pre-forest stage of the Kabylean cedar [*Cedrus atlantica*] forests, which belong to a new association, *Senecio perralderiani-Cedretum atlanticae*. Changes in these communities over the last 30 years are discussed.
22. Rioux, J A.; Richer, C., and Lamy, M P. Tolerance evaluation of eleven junipers (*Juniperus* sp.) under north-eastern Canadian climatic conditions. *Canadian Journal of Plant Science*. 2004; 84(4):1135-1153.
Keywords: *Juniperus communis*/ *Juniperus sabina*/ *Juniperus squamata*/ *Juniperus horizontalis*/ Canada/ winter hardiness/ growth
Abstract: Young plants of 11 species and cultivars of junipers were planted between 1987 and 1994 in six or eight sites distributed in northeastern Canadian climatic zones 2a to 5b (the most populated zones of Quebec). These plants were evaluated over a 5-yr period to provide more detailed information about the winter hardiness and growth under these climatic conditions. *Juniperus sabina* 'Blue Danube', the control, was established five times and compared to the 10 other junipers. These plants were observed for a 5-yr period in order to determine their winter hardiness and growth under these climatic conditions. Survival and usage potentials of *J. sabina* and its cultivars Blue Danube and Broadmoor, *J. horizontalis* 'Douglasii', *J. communis* 'Rependa' and 'Depressa Aurea' and *J. squamata* 'Blue Carpet' were established in zone 2a. These potentials could be extended to zone 1b for *J. sabina*, *J. s.* 'Blue Danube' and 'Douglasii' and 'Rependa' cultivars, no mortality was observed in the coldest zone (2a). *J. squamata* 'Blue Star' is the less hardy cultivar, and its survival and usage potentials were fixed to zone 4. Furthermore, *J. sabina* 'Wapiti' can survive and be used in zone 2b. *J. x media* 'Pfitzeriana' and *J. squamata* 'Meyeri' can survive in zone 2b, but can be used in zone 4. The three *J. squamata* cultivars and *J. x media* 'Pfitzeriana' are often affected by foliage desiccation in their respective usage zones. The full ornamental

potential was observed in zone 2a for *J. horizontalis* 'Douglasii', in zone 2b for *J. sabina*, his 'Blue Danube' and 'Broadmoor' cultivars and *J. communis* 'Rependa', and in zone 5b for *J. x media* 'Pfitzeriana', *J. squamata* 'Blue Carpet' and 'Blue Star'. This potential has been observed only in zone 4a for *J. communis* 'Depressa Aurea', *J. sabina* 'Wapiti' and *J. squamata* 'Meyeri', snow cover being an important factor.

23. Schmidt, G. New methods for propagation by summer cuttings of certain *Juniperus* spp. and [broadleaved] evergreens. *Kerteszet* Egyetem Közleményei. 1974; 37(5):71-75, 2 plates.
Keywords: *Juniperus chinensis*/ *Juniperus sabina*/ *Juniperus communis*/ vegetative propagation/ nurseries/ protected cultivation.
Abstract: Preliminary results are given of one year's trials with cuttings taken on 1-3 July and set in seed boxes in sand. *J. chinensis* 'Hetzii' (a), *J. sabina* 'Blaue Donau' (b) and *J. communis* 'Suecica' (c) rooted better in a plastic tunnel with mist than under a plastic sheet without mist. The results without mist were, however, satisfactory and less costly. The application of certain growth substances and fungicides improved rooting in (a) and (b) but not in (c).
24. Schuch, Ursula K. Reprint author and Burger, David W. Author. Water use and crop coefficients of woody ornamentals in containers. *Journal of the American Society for Horticultural Science*. 1997; 122(5):727-734.
Keywords: *Juniperus sabina*/ *Cercis occidentalis*/ *Pittosporum*/ *Rhamnus californica* / *Prunus ilicifolia*/ *Cercocarpus minutiflorus*/ *Buxus microphylla japonica*/ nursery/ crop coefficients/ evapotranspiration/ *Raphiolepis indica*
Abstract: Twelve species of woody ornamentals were grown in containers in Riverside and Davis, Calif., to determine plant water use and compare crop coefficients (K-c) calculated with reference evapotranspiration (ET) from local weather stations (ET-cim) or atmometers (ET-atm). Water use, Kc-atm, and Kc-cim differed by species, location, and month of the year. *Raphiolepis indica* (L.) Lindl., *Pittosporum tobira* (Thunb.) Ait., *Juniperus sabina* L., and *Photinia times fraseri* Dress. were the highest water users in Riverside and *Arctostaphylos densiflora* M.S. Bak., *Juniperus*, *Cercis occidentalis* Torr., and *Pittosporum* used the highest amount of water in Davis, when averaged over the 20-month study period. *Rhamnus californica* Eschsch., *Prunus ilicifolia* (Nutt.) Walp., and *Cercocarpus minutiflorus* Abrams. were among the lowest water users in both locations. Although plant water use fluctuated considerably between individual sampling dates, the relative ranking of species water use in each location changed very little over the study period. During periods of high winds, ET-cim may not provide an accurate reference for container crops. K-c values fluctuated seasonally from as much as 1 to 4.7 for high water users, while values were stable for low water users and also for *Buxus microphylla japonica* Rehd. and E.H. Wils., an intermediate water user. During periods of low ET, especially in fall and winter, K-c values were

artificially high and failed to correspond to the plants' low water use. K-c values for low water users seem to be useful to estimate water requirements over an extended period of time, whereas general K-c values seem to have limited value for plants with high water demand and need to be modified for different growth stages and growing locations.

25. Tereshkovich, George. *Juniperus* species: evergreen ground covers . Research Report. University of Georgia, College of Agriculture Experiment Stations. 1969; 3610 .

Keywords: *Juniperus conferta*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus horizontalis*/ *Juniperus japonica*/ *Juniperus procumbens*/ *Juniperus sabina*/ *Juniperus scopulorum*

Call Number: S51.R22

Abstract: The following *Juniperus* spp. cultivars are better adapted for the Georgia Piedmont: *Juniperus* Blue Pfitzer, *Juniperus conferta* (Shore Juniper), *Juniperus chinensis* Sargenti, *Juniperus chinensis pfitzeriana aurea* (Golden tip Pfitzer), *Juniperus davurica* (Squamata expansa) *parsoni*, *Juniperus horizontalis andorra*, *Juniperus horizontalis andorra* compacts, *Juniperus horizontalis andorra*, (Aunt Jamina), *Juniperus horizontal plumosa*, (Andorra juniper), *Juniperus horizontalis* 'Douglasi' (Waukegan), *Juniperus japonica* (San Jose), *Juniperus procumbens*, *Juniperus sabina* 'Arcadia', and *Juniperus scopulorum*, (White Silver King). These species are very hardy plants, able to withstand extremes in temperature, and provide excellent ground cover for landscaping around the home, in parks, and in highway beautification programs.

26. Verdu, M.; Villar-Salvador, P., and Garcia-Fayos, P. Gender effects on the post-facilitation performance of two dioecious *Juniperus* species. *Functional Ecology*. 2004; 18(1):87-93.

Keywords: *Juniperus sabina*/ *Juniperus communis*/ gender/ sex ratio/ Spain

Abstract: Plant facilitation usually changes to competition as plants age. In dioecious plants, females should be affected more negatively than males by stressful conditions because of the greater costs of female reproduction. We investigated the gender effects on the post-facilitation performance of adult plants of two dioecious *Juniperus* species from the high mountains of eastern Spain: *J. sabina* acts as a nurse plant for *J. communis*. We compared physiological (water potential, carbon isotope discrimination and nitrogen concentration), vegetative (shoot growth) and reproductive (number of male flowers, and number of fruits and seeds) characters of associated and non-associated plants of both species, to test the hypothesis that this association represents a more stressful condition for females than for males because of the greater costs of female reproduction. Despite their close phylogenetic relatedness, both species showed a distinct performance pattern after the facilitation phase. Association with the nurse plant reduced the growth and reproductive capacity of both genders in *J. communis*, the facilitated species. In contrast, the association with *J.*

communis did not affect the fitness of the nurse plant, *J. sabina*, although in accordance with our hypothesis a gender effect was found on several physiological parameters. Thus *J. sabina*-associated females had a more negative water potential and carbon isotope discrimination than the associated males, but there were no differences between genders when growing in isolation. The consequences of the post-facilitation interaction between the two long-lived woody Juniperus species are asymmetrical: harmful for the facilitated species, but harmless for the nurse. Gender had also asymmetrical consequences on some functional traits of the nurse - but not the facilitated species.

27. Verdu, M. E-mail miguel.verdu@uv.es and Garcia-Fayos, P. Frugivorous birds mediate sex-biased facilitation in a dioecious nurse plant. *Journal of Vegetation Science*. 2003 Feb; 14(1):35-42.
Keywords: *Juniperus sabina*/ *Juniperus communis*/ birds/ seed/ fruit
Abstract: Facilitation by dispersal occurs if the nurse plant acts as a focus which is actively selected by seed dispersers and enhances the fitness of the facilitated plant. Sex-biased facilitation may be produced if seed dispersers tend to concentrate the seeds under female, fruit-bearing plants of dioecious species more often than under conspecific males. *Juniperus sabina* is a dioecious shrub with a prostrate growth form from Mediterranean high mountains that modifies many microhabitat characteristics related to seedling establishment and survival. Soil water availability, maximum soil temperature in summer, organic matter and total nitrogen content, were different on open ground as compared with beneath *J. sabina* shrubs, irrespective of its sex. Other studied characteristics such as soil bulk density and soil compaction after rain did not differ between the microhabitats considered. Some species, such as *Juniperus communis*, *Pinus nigra*, *Helleborus foetidus* and *Euphorbia nicaeensis*, are spatially associated to *J. sabina* shrubs, strongly suggesting a facilitative role. The anemochorous *P. nigra* and myrmecochorous *H. foetidus* and *E. nicaeensis* did not associate preferentially to any sex of *J. sabina*. Only *J. communis*, an endozoochorous species sharing the same bird dispersers as *J. sabina*, presented a female-biased spatial association with the nurse plant. Seed dispersal mediated by birds attracted by the fruit-rewarding females of *J. sabina* explains the sex-biased spatial pattern of *Juniperus communis*.
28. Wesche K. and Ronnenberg K. Phytosociological affinities and habitat preferences of *Juniperus sabina* L. and *Artemisia santolinifolia* TURCZ. ex BESS. in mountain sites of the south-eastern Gobi Altay, Mongolia. *Feddes Repertorium*. 2004; 115(7-8):585-600.
Keywords: *Juniperus sabina*/ *Artemisia santolinifolia*/ Mongolia/ plant composition
Abstract: Plant community composition was analyzed for 145 relevés, randomly sampled on steep slopes in the Gobi Gurvan Sayhan National Park, southern Mongolia. Cluster analysis designated seven communities

into three main groups, namely mountain steppes, dominance stands of the dwarf shrub *Artemisia santolinifolia*, and scrub composed of *Juniperus sabina*. Multivariate classifications corresponded well to available phytosociological classification schemes. Dense mountain steppes on northern exposures, as well as juniper stands on south- and east-facing scree slopes, had high contents of organic matter and cations in the soil, while stands with disturbance-tolerant species such as *Carex stenophylla*, annuals, or *A. santolinifolia* grew on less favourable soils. Stands of the latter species showed some overlap with *J. sabina* with respect to species composition and site conditions, and specimens of *A. santolinifolia* were present in most releves of juniper stands. The complete absence of juniper seedlings suggested an apparent potential replacing of ageing specimens of *J. sabina* by *A. santolinifolia*. However, both species were distinct in cluster, ordination and correlation analyses, so this process seems to be still in its infancy.

29. Wesche K.; Ronnenberg K., and Hensen I. Lack of sexual reproduction within mountain steppe populations of the clonal shrub *Juniperus sabina* L. in semi-arid southern Mongolia. *Journal of Arid Environments*. 2005; 63(2):390-405.

Keywords: *Juniperus sabina*/ Mongolia/ reproduction/ germination

Abstract: The present study describes the reproductive ecology of the prostrate shrub *Juniperus sabina* in dry mountain steppes of southern Mongolia where stands are located at the drought-limit of the species' distributional range. Even though cones are produced in large numbers, the larger part of those collected for the study had incompletely developed embryos, and only 2.5% were viable. In germination experiments only 3 out of 2100 intact seeds germinated, suggesting that germination would be unlikely under field conditions. Correspondingly, nearly no seedlings or saplings were found in the field. Ample evidence was found for clonal growth. Patches of similar sexes of *J. sabina* were spatially associated in the field. RAPD-fingerprinting demonstrated that patches were constituted by a single genet. As mean current growth rates were between 1.8 and 6.8 cm year⁻¹, we estimated that the largest patches found in the study area had minimum ages of 770-2940 years. Thus, establishment of seedlings may have taken place in periods defined by more favourable climatic conditions, whereas dry phases have apparently been survived by clonal growth. This combination of rare sexual reproduction with extended periods of exclusively vegetative reproduction could be a widespread strategy in the harsh conditions of the central Asian drylands.

***Juniperus sabinoides* (2)**

1. Adams R. P. and Zanoni T. A. *Juniperus monticola* (Cupressaceae) revisited. *Taxon*. 1993; 42(1):85-86.

Keywords: *Juniperus monticola*/ *Juniperus sabinoides*/ nomenclature

Abstract: Following a reexamination of nomenclature, the correct name for the alpine *Juniperus* species of Mexico is *J. monticola* and not *J. sabinoides* (which is an illegitimate later homonym).

2. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. *Sabina*) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). *Edinburgh Journal of Botany*. 1992; 49(3):251-283.

Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia

Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpus* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpus*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.

***Juniperus saltillensis* (1)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section *Sabina*) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana*/ *Juniperus ashei*/ *Juniperus californica*/ *Juniperus coahuilensis*/ *Juniperus comitana*/ *Juniperus deppeana*/ *Juniperus durangensis*/ *Juniperus flaccida*/ *Juniperus gamboana*/ *Juniperus jaliscana*/ *Juniperus monosperma*/ *Juniperus monticola*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Juniperus pinchotii*/ *Juniperus saltillensis*/ *Juniperus standleyi*/ essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. *Sabina*) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These

data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

***Juniperus saltuaria* (2)**

1. Adams, R. P. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). USABiochemical Systematics & Ecology. 2000; 28(6):529-543.
Keywords: *Juniperus convallium/ Juniperus indica/ Juniperus komarovii/ Juniperus pingii/ Juniperus przewalskii/ Juniperus pseudosabina/ Juniperus recurva/ Juniperus saltuaria/ Juniperus squamata/ Juniperus tibetica/ Juniperus wallichiana/ RAPD/ DNA/ essential oils*
Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallachiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).
2. Adams R. P.¹; Shao-Zhen Z., and Ge-lin Z.². The Volatile Leaf Oil of *Juniperus saltuaria* Rehd. & Wils. from China. J. Essent. Oil Res. 1993; 5675-677.
Keywords: *Juniperus saltuaria/ Cupressaceae*, sabinene, monoterpenes, sesquiterpenes, diterpenes.
Abstract: The leaf essential oils of *Juniperus saltuaria* Rehd. & Wils. Were analyzed by GC and GC/MS. Major components are sabinene (38.2%), elemol (7.6%), 8- α -hydroxyisopimarene (5.3%), α -eudesmol (4.3%), terpinen-4-ol (3.9%) and cedrol (3.2%). Both cis- and tran-sabinol are also present, which is unusual.

***Juniperus sargentii* (3)**

1. Kozhevnikova, Z. V. Anatomical structure of the stem of Far Eastern species of juniper in relation to the features of root formation in cuttings. Byulleten' Glavnogo Botanicheskogo Sada. 1991; 16034-41.
Keywords: *Juniperus rigida/ Juniperus sibirica/ Juniperus conferta/ Juniperus dahurica/ Juniperus sargentii/ vegetative propagation/ roots/ adventitious roots.*

Abstract: Anatomical studies were made of the stems (often trailing or prostrate) of *Juniperus rigida*, *J. sibirica*, *J. conferta*, *J. dahurica* and *J. sargentii*, with special reference to the bark and the initiation of roots. All five species are capable of propagation by cuttings, and all of them produce a few or numerous root primordia on the stems in the crown, except for *J. rigida*. In lignified cuttings of *J. sibirica*, *J. conferta* and *J. sargentii* the root system is formed by adventitious roots all along the part of the stem in the soil and also from wound callus at the cut surface. *J. dahurica* forms roots mainly along the stem in the soil, and *J. rigida* mainly from the wound callus. In green cuttings in all five species the roots are formed only from the wound meristems.

2. ---. Seed anatomy and some peculiarities of germination in Soviet Far Eastern species of juniper. Byulleten' Glavnogo Botanicheskogo Sada. 1986; 14199-107; ISSN: 0366-502X.

Keywords: *Juniperus conferta*/ *Juniperus rigida*/ *Juniperus davurica*/ *Juniperus sargentii*/ *Juniperus sibirica*/ seeds/ morphology/ germination/ seed anatomy/ conifers

Abstract: Seeds of *Juniperus conferta*, *J. davurica*, *J. rigida*, *J. sargentii* and *J. sibirica* were collected in the Far East and examined by light microscopy and SEM. Data are tabulated on the max., min. and mean seed dimensions, spermoderm thickness and size of resin capsules, and the mean cell sizes in the tissues of the seed coat. In *J. davurica* and *J. sargentii*, the spermoderm was differentiated into 3 layers with a fleshy outer layer (sarcotesta). Observations are reported on seasonal reproductive behaviour, and anatomical development of the seed and ripening of the fruits are described. The resin capsules of the seed were derived from fruit tissue. Seeds from ripe fruits were in a state of deep rest. For rapid germination, seed extraction is recommended 1.5-2 months before the ripening of the fruits.

3. ---. Vegetative propagation of Far Eastern junipers in the southern Maritime Province. Byulleten' Glavnogo Botanicheskogo Sada. 1991; 16190-98.

Keywords: *Juniperus rigida*/ *Juniperus conferta*/ *Juniperus sibirica*/ *Juniperus dahurica*/ *Juniperus sargentii* / cuttings/ propagation/ rooting

Abstract: An account is given of experience in propagating *Juniperus rigida*, *J. conferta*, *J. sibirica*, *J. dahurica* and *J. sargentii* by cuttings. It is best to use lignified cuttings taken from the terminal part of stout shoots containing two complete annual extensions. Green cuttings are only feasible with *J. dahurica* and *J. sargentii*. Cuttings should be rooted at the beginning or in the first half of the growing season; summer/autumn rooting is preferable only for *J. rigida*. The cuttings should be inserted at an angle - greatest for cuttings of prostrate species and least (i.e. nearly upright) for arborescent species. *J. dahurica*, *J. sibirica* and *J. conferta* root easily, mainly from the rudiments of adventitious roots and also from wound meristems, in one growing season; *J. rigida* and *J. sargentii* are more difficult to root, forming only wound callus in the first growing

season and rooting in the second year.

***Juniperus schugnanica* (1)**

1. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. *Sabina*) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). Edinburgh Journal of Botany. 1992; 49(3):251-283.

Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia

Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpus* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpus*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.

***Juniperus scopulorum* (47)**

1. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. Acta Horticulturae. 2003; 61291-106.

Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.

Abstract: Several cases involving apparent discordance in morphological, chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var. *microsperma*, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var. *squamata*, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.

2. Aldon E. F. and Loring T. J. Ecology, uses, and management of pinyon-juniper woodlands. Proceedings of the workshop, March 24-25, 1977, Albuquerque, New Mexico. USDA Forest Service General Technical Report, Rocky Mountain Forest and Range Experiment Station. (RM-39). 1977; RM-39(III):48.
Keywords: *Juniperus osteosperma/ Juniperus scopulorum/ Juniperus monosperma/ Juniperus deppeana/ Pinus edulis/ Pinus monophylla/ Pinus cembroides/ Pinus quadrifolia* / ecology/ pinyon-juniper woodlands
Abstract: Pinyon (*Pinus edulis*, *P. monophylla*, *P. cembroides*, and *P. quadrifolia*)/juniper (*Juniperus osteosperma*, *J. scopulorum*, *J. monosperma* and *J. deppeana*) woodlands occupy 33 million acres in W. USA. Twelve papers were presented on the type in 3 sections: Ecology of pinyon juniper woodlands: Pieper, R.D. The southwestern pinyon/juniper ecosystem. [16 ref.] Clendenen, G.W. Pinyon and juniper inventory procedures. Little, E.L., Jr. Research in the pinyon/juniper woodland. [16 ref., 1 pl., 4 maps] Smith, T, Insects and diseases of pinyon/juniper. Swenson, E. Pinyon/juniper wildlife habitats. Baxter, C. A comparison between grazed and ungrazed juniper woodland. Uses and potential of the woodland zone: Ffolliott, P.F. Product potential of pinyon/juniper woodlands. [8 ref.] Voorhies, G. What is known and not known about pinyon/juniper utilization. [23 ref.] Fisher, J.T.; Montano. J.M. Management of pinyon for ornamentals, Christmas trees, and nut production. [29 ref.] Management strategies for the woodland zone: Gallegos, R.R. Forest practices needed for the pinyon/juniper type. Hurst, W.D. Managing pinyon/juniper for multiple benefits. Anderson, G. Systems approach to pinyon/juniper management.

3. Barbour, Jill. Rocky Mountain Juniper study: preliminary results. In: Dumroese, R.K., Riley, L.E., Landis, T.D., Technical Coordinators, National Proceedings: Forest and Conservation Nursery Associations - 1999, 2000, and 2001. Proceedings RMRS-P-24. Ogden, UT USDA Forest Service, Rocky Mountain Research Station. 2002; RMRS-P-2459-66.
Keywords: *Juniperus scopulorum/* Rocky Mountain Juniper/ stratification/ pretreatment/ germination/ seed/ sizing
Abstract: Twenty-one pretreatments were tried on a South Dakota seed source of *Juniperus scopulorum* after the seedlot was sized and run over a Oliver 30 gravity table. Percent viability by weight ranged from 80% for heavy weight seed to 53 % for trashy seed. Five seed samples, from various seed sizes that represented the seedlot, were run through the pretreatments. The best five pretreatments were also the best in other experiments and show promise to finding a reliable laboratory test for germination for this species.

4. Benson, Darrell A. Stratification of *Juniperus scopulorum*. USDA Forest Service Tree Planters' Notes. 1976; 27(2):11,23.

Keywords: *Juniperus scopulorum*/ Rocky Mountain Juniper/
stratification/ germination/ nursery

Abstract: Stratification of *J. scopulorum* seed in moist peat at 38-41 ° F. for 8 to 6 months prior to sowing in mid-July improved germination, resulting in more uniform seedbeds, and better seedlings with less cull percent.

5. Betancourt, Julio L.; Rylander, Kate Aasen; Penalba, Cristina, and McVickar, Janet L. E-mail jlbetanc@usgs.gov. Late Quaternary vegetation history of Rough Canyon, south-central New Mexico, USA. *Palaeogeography Palaeoclimatology Palaeoecology*. 2001 Jan; 165(1-2):71-95.

Keywords: *Juniperus scopulorum*/ *Pinus edulis*/ *Larrea tridentata*/
Choisya dumosa/ *Prosopis*/ pollen/ New Mexico/ macrofossil/ Holocene

Abstract: South-central New Mexico, USA, at the junction of the Rocky Mountains, High Plains and Chihuahuan Desert, is one of the better known regions in the late Quaternary of North America. Plant macrofossils and pollen from a packrat midden series in Rough Canyon, New Mexico allows refinement of plant distributions and paleoclimates in this transitional area since full glacial times. From 17 000 to 12 000 14Carbon yr BP, *Pinus edulis*-*Juniperus scopulorum* woodlands dominated limestone substrates between 1800 and 1490 m, with *Pseudotsuga menziesii* and other mixed-conifer species restricted to shady, north-facing slopes. *Juniperus deppeana*, the dominant juniper today above 2000 m in southern New Mexico, is conspicuously absent from glacial middens and must have been displaced south of the US-Mexico border. The minimum climatic conditions for *P. edulis*-*J. scopulorum* woodlands area ca 20% wetter and 3.5-5 °C cooler (July mean maximum temperatures) than the modern climate at Rough Canyon. Holocene warming/drying may have started as early as 12000 14Carbon yr BP with the extirpation of *J. scopulorum* from Rough Canyon, and was completed by at least 10540 14Carbon yr BP. The record for arrivals of some desert species is confounded by traces of pollen and macrofossils in some of the glacial middens, which could signify either earliest occurrence or temporal mixing (contamination) of assemblages. AMS 14C dating can discriminate between early arrival and contamination in midden macrofossils but not in pollen. AMS dates show that *Choisya dumosa*, presently near its northern (cold) limits at Rough Canyon, endured late glacial winters, possibly as clonal populations. Some *Larrea tridentata* leaves and pollen occur in middens dominated by conifers and oaks no longer at the site; an AMS date of 3205 14C yr BP on *Larrea* leaves from one midden indicates contamination. Evidence for some macrofossil contamination, however, does not rule out the possibility that pollen of desert elements (e.g. *Larrea*, *Prosopis*) in late glacial-early Holocene middens indicates their presence in the Tularosa Basin, well ahead of their local appearance in Rough Canyon. Finally, the increasing dominance of desert elements after 5000 14C yr BP in the Rough Canyon series and elsewhere in the northern Chihuahuan Desert could reflect slow, postglacial migration from the

south and/or progressive encroachment with gradual stripping of soils formed during the last glacial period.

6. Bielenin, M. Effect of red or blue supplementary light on rooting of cuttings and growth of young plants of *Juniperus scopulorum* 'Skyrocket' and *Thuja occidentalis* 'Smaragd'. Gartenbauwissenschaft. 2000; 65(5):195-198.
Keywords: *Juniperus scopulorum*/ *Thuja occidentalis*/ red light/ blue light/ cuttings/ irradiation
Abstract: In a greenhouse experiment with *Juniperus scopulorum* cv. Skyrocket and *Thuja occidentalis* cv. Smaragd, supplementary monochromatic red or blue light (20 micro mol/m/s) did not effect rooting of cuttings of either species either after irradiation of stock plants prior to cutting collection or after application of monochromatic light to cuttings during rooting. In contrast, red or blue light increased the root:shoot fresh weight ratio of both species and decreased the height and height:width ratio of *T. occidentalis*. Total fresh weight was not affected in either species.
7. Bjugstad, A J. Shrub and tree establishment on coal soils in northern high plains USA. Minerals and the Environment. 1984; 6(3):127-130.
Keywords: *Juniperus scopulorum*/ *Fraxinus*/ *Elaeagnus*/ *Shepherdia*/ *Caragana*/ *Prunus*/ *Pinus*/ irrigation/ survival/ coal mine spoil/ Wyoming
Abstract: Trickle irrigation during establishment increased survival 2 fold for 7 spp. of shrubs and trees planted on coal mine spoil in the semiarid area of northeastern Wyoming, USA. Increased survival of irrigated plants persisted for 5 yr after initiation of this study, which included 2 growing and winter seasons after cessation of irrigation. Species included green ash (*Fraxinus pennsylvanica*), Russian olive (*Elaeagnus angustifolia*), silver buffaloberry (*Shepherdia argentea*), Siberian peashrub (*Caragana arborescens*), American plum (*Prunus americana*), ponderosa pine (*Pinus ponderosa*) and Rocky Mountain juniper (*Juniperus scopulorum*).
8. Chojnacky, D. C. Estimating diameter growth for pinyon and juniper trees in Arizona and New Mexico. Research Note Intermountain Research Station, USDA Forest Service. (INT-GTR-429). 1996; INT-GTR- 4296.
Keywords: *Juniperus monosperma*/ *Juniperus deppeana*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Pinus*/ diameter growth/ Arizona/ New Mexico
Abstract: Diameter growth measurement is difficult for pinyon and juniper trees because they are slow-growing, multiple-stemmed, and poorly suited to measurement methods used for other temperate tree species. A model designed to estimate diameter growth for individual pinyon (*Pinus edulis*) and juniper (*Juniperus* spp.) trees from a small subsample of growth measurements is described. Data for model construction include 10-year radial growth sampled from 1,536 trees on

176 plots spread throughout Arizona and New Mexico. Species include *Pinus edulis*, *Juniperus monosperma*, *J. deppeana*, *J. scopulorum*, and *J. osteosperma*. The model predicts past 10-year diameter growth from stand-level growth-index measurement, tree diameter, and number of basal stems in a tree.

9. ---. Modeling diameter growth for pinyon and juniper trees in dryland forests. *Forest Ecology and Management*. 1997; 93(1/2):21-31.
Keywords: *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus deppeana*/ *Juniperus osteosperma*/ *Pinus edulis*/ diameter
Abstract: An individual-tree model has been developed to estimate diameter growth of pinyon pine (*Pinus edulis*) and juniper (*Juniperus monosperma*, *J. scopulorum*, *J. deppeana*, *J. osteosperma*) trees in pinyon-juniper dryland forests throughout New Mexico, USA. The model was built from radial growth data on 917 trees sampled from 82 plots. Individual tree growth can be predicted from measurements of tree diameter at the root collar, the number of basal stems per tree, and past 10-yr diameter growth of the median-sized stem in the stand of interest. Model development is patterned after growth and yield models for temperate forests in the western USA.
10. ---. Pinyon-juniper volume equations for the central Rocky Mountain states. Research Paper, Intermountain Forest and Range Experiment Station, USDA Forest-Service. (INT-339). 1985; INT-339(I):27 pp.
Keywords: *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Pinus edulis*/ *Pinus monophylla*/ *Quercus*/ *Cercocarpus*/ woodland/ volume tables
Abstract: Equations and volume tables are presented for *Juniperus monosperma*, *J. scopulorum*, *J. osteosperma*, *J. occidentalis*, *Pinus edulis*, *P. monophylla*, *Quercus macrocarpa*, *Q. gambelii*, *Cercocarpus* spp. and a group of broadleaved species in pinyon/juniper woodland in Nevada, Idaho, Utah, Colorado, Wyoming and South Dakota.
11. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secret Arboretum. Special Circular Ohio Agricultural Research and Development Center. 1992; 14032-34.
Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus virginiana*/ *Juniperus scopulorum*/ *Juniperus squamata*/ growth habit
Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate or convergent. All plants were also evaluated for growth characteristics of

open or closed outline.

12. Cregg, B. M. Leaf area estimation of mature foliage of *Juniperus*. Forest Science. 1992 Feb; 38(1):61-67; ISSN: 0015-749X.
Keywords: *Juniperus scopulorum*/ *Juniperus virginiana*/ specific leaf area/ surface volume ratio
Call Number: 99.8 F7632
Abstract: The ratio of total surface area to projected leaf area was determined from mature foliage samples collected at three canopy heights from *Juniperus virginiana* and *Juniperus scopulorum* from four seed sources grown in southeastern Nebraska. The relation of projected leaf area to leaf dry weight and volume was also determined. Total surface area was estimated to be 3.2 times the projected surface area. This relationship was independent of seed source or crown position. Projected leaf area can be satisfactorily estimated from weight or volume. However, these relationships differed by crown position or seed source. These results indicate that leaf area of mature juniper foliage may be rapidly estimated through measurement of projected surface area. Further, the leaf area of large samples may be estimated by determining the appropriate specific leaf area or surface-to-volume ratios.

13. Cunningham, R. A. and King, R. M. Juniper seed sources in the Great Plains. General Technical Report Rocky Mountain Research Station, USDA Forest Service. (RMRS-GTR-51): i + 19. 2000; 51(1):19.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ seeds/ geographical variation
Abstract: At age 10, 100% of eastern redcedar (*Juniperus virginiana*) and Rocky Mountain juniper (*Juniperus scopulorum*) trees from several seed sources throughout the Great Plains had survived. Seed sources from southeastern Texas had the poorest survival. Eastern redcedar trees from Kansas seed sources grew tallest, and trees from Montana and southeastern Texas seed sources were the shortest. Rocky Mountain juniper trees survived better, were shorter, had smaller crowns, exhibited greater damage from *Cercospora* blight ((Ellis and Everh.) Sutton and Hodges, formerly var.) and *Kabatina* tip blight (Schneider and V. Arx) and less damage from cedar-apple rust than did eastern redcedar trees. Eastern redcedar trees were larger, had more horizontal branching, and exhibited a greater incidence of cedar-apple rust and bagworm. In the northern Great Plains, trees from seed sources 1 to 4 degrees latitude south of each test site survived best and grew the tallest. In the central Great Plains, trees from seed sources from 1 to 4 degrees latitude north of each test site survived best, while those from 4 degrees latitude north and 6 degrees longitude east grew the tallest. Cluster analyses differentiated groups of seed sources that performed in a similar manner in terms of survival, height, and crown characteristics. Although most clusters were composed of seed sources from the same species and geographic area, one cluster contained

seed sources of both species and ranked near the median for most traits. Age/age correlations indicated that seed sources may be successfully selected for good survival and fast growth rate at age 5.

14. Djavanshir, K and Fechner, GH. Epicotyl and hypocotyl germination of Eastern Redcedar and Rocky Mountain Juniper. *Forest Science*. 1976; 22(3):261-266; ISSN: 0015-749X.
Keywords: *Juniperus virginiana/ Juniperus scopulorum/ seeds/ germination/ treatment/ seed treatment/ conifers*
Abstract: Seeds of (a) *Juniperus virginiana* and (b) *J. scopulorum* were subjected to various treatments and germinated at 18 deg /8 deg C on damp paper. The treatments included removal of the seed tip or the seed base (hilum), extraction of embryos followed by chilling at 5-6 deg C, soaking of all or part of the seed in concentrated H₂SO₄, and cold storage of seed at -20 deg C. Seeds of (a) were also soaked in lukewarm water, dilute growth regulator or acid solutions. Chilling of the seed was required for hypocotyl development, but not for epicotyl development. Softening of the seed coat by H₂SO₄ for 35 and 120 min for (a) and (b) respectively increased the rate of germination provided that the carbonized surface was removed. Prolonged soaking or seed-base excision, two methods that remove the hilum, caused some abnormal germination in which only epicotyl development occurred: these epicotyls developed into normal seedlings under artificial conditions. It is concluded that slow germination is due to a combination of dormancy and seed-coat impermeability, and it is suggested that artificially germinated seedlings be transferred to peat moss/vermiculite in the greenhouse.
15. Duer, R. A. Cutting propagation of *Juniperus scopulorum* cultivars. Combined Proceedings, International Plant Propagators' Society. 1982; 31141-144.
Keywords: *Juniperus scopulorum/ treatment/ growth regulators/ cuttings/ propagation*
Abstract: General cultural practices are outlined. Cuttings of cv. Cologreen treated with 3000 p.p.m. NAA gave 40% rooting and in one experiment 45 000 p.p.m. IBA in talc gave 74% rooting. IBA treatment of cuttings of cvs Gray Gleam at 6000 p.p.m., Pathfinder at 8000 p.p.m., Table Top at 16 000 p.p.m. and Wichita Blue at 8000 p.p.m., gave 52, 62, 63 and 57% rooting, respectively.
16. Dumroese, R. Kasten. Growth of *Juniperus* and *Potentilla* using liquid exponential and controlled-release fertilizers. *Hortscience*. 2003 Dec; 38(7):1378-1380.
Keywords: *Juniperus scopulorum/ Potentilla fruticosa/ fertilizer/ seedlings/ containers*
Abstract: *Juniperus scopulorum* Sarg. (Rocky Mountain juniper) and *Potentilla fruticosa* L. 'Gold Drop' (gold drop potentilla) plants grown in containers had similar or better morphology, higher nitrogen concentrations and contents, and higher N-use efficiency when grown with

liquid fertilizer applied at an exponentially increasing rate as compared to the same amount of N applied via controlled-release fertilizers. More importantly, plants grown with a half-exponential rate were similar to those grown with controlled-release fertilizer but with a higher N-use efficiency, indicating that this type of fertilization may be a method for reducing the amounts of applied nutrients in nurseries and subsequent nutrient discharge.

17. Edson J. L.; Wenny D. L.; Dumroese R. K., and Leege-Brusven A. Mass propagation of Rocky mountain juniper from shoot tip cuttings. *Tree Planters' Notes*. 1997; 47(3):94-99.
Keywords: *Juniperus scopulorum*/ micropropagation/ stecklings/ rooting.
Abstract: Demand has exceeded supply for conservation plantings of Rocky Mountain juniper (*Juniperus scopulorum*). Vegetative propagation could provide an alternative source of planting stock. Ortets from 2 to 40 years of age provided cuttings from leaders and first-rank branches. Ramets (12-cm-long) from 2-year-old ortets, rooted at rates of up to 82%. Treatment of cuttings with 1.6 or 3.0% IBA accelerated rooting by several months and increased overall rooting success by up to 36%. Stecklings survived at high rates (97%) and developed a normal seedling-like form.
18. Estola, J. D. Preliminary pinon-juniper volume tables. *Resource Inventory-Notes*. (BLM 18). 1979; BLM 18 6-8.
Keywords: *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Pinus edulis*/ volume tables
Abstract: Some 392 pinon pine trees (*Pinus edulis*) and 206 Rocky Mountain and Utah junipers (*Juniperus scopulorum* and *J. osteosperma*) from New Mexico and Colorado were randomly selected and measured. From these data, tables were constructed from which cubic vol. can be determined from estimates of total ht., crown diam., and diam. at 1-ft stump ht. Though the tables may not provide accurate estimates of individual tree volumes, acceptable estimates can be obtained for groups of trees.
19. Evans, R. A. Management of pinyon-juniper woodlands. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-249). 1988; INT-249(II):34 pp.
Keywords: *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus scopulorum*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Pinus*/ management/ woodlands
Abstract: The pinyon/juniper woodlands are extensive in the western USA and are a valuable renewable resource for many uses. The occurrence and dominance of pinyon (*Pinus cembroides*, *P. monophylla* and *P. edulis*), juniper (*Juniperus deppeana*, *J. monosperma*, *J. scopulorum*, *J. osteosperma* and *J. occidentalis*), shrubs and herbs vary over the spectrum of the woodlands which occur on many soil types and

topographies with different climates. The manual describes the ecosystem and gives basic guidelines for management for forest products (mostly fuelwood, poles and posts, and pinyon nuts), forage and browse production, wildlife, recreation and watershed values.

20. Everett, R. L. Proceedings - Pinyon-juniper conference: Reno, NV, January 13-16, 1986. General Technical Report Intermountain Research Station, USDA Forest Service. (INT-215). 1987; INT-215(VII):581 pp.
Keywords: *Juniperus osteosperma*/ *Juniperus deppeana*/ *Juniperus scopulorum*/ *Juniperus erythrocarpa*/ *Pinus*/ vegetation types/ management.
Abstract: More than 90 papers are presented on the ecology and management of pinyon/juniper ecosystems which occur over large areas of the western USA. The major pine species are *Pinus edulis*, *P. monophylla* and *P. cembroides*; the most important juniper associates are *Juniperus monosperma*, *J. osteosperma*, *J. deppeana*, *J. scopulorum* and *J. erythrocarpa*. Topics discussed include the woodlands in general, palaeobotany, inventory and classification, synecology, silvics and silviculture, fire response, economics, plant water relations, woodland conversion, range management, wildlife, woodland hydrology and nutrient cycling.
21. Fechner, G. H. Controlled pollination in eastern redcedar [*Juniperus virginiana*] and Rocky Mountain juniper [*J. scopulorum*]. USDA Forest Service General Technical Report, North Central Forest Experiment Station. (NC-26). 1976; NC-2624-34.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ control pollination
Abstract: Preliminary results from studies at Fort Collins, Colorado indicate that wind pollination is less reliable than controlled-pollination in obtaining sound seed set in *J. virginiana*. On the basis of fruit set, sound seed set, and 1st-yr gametophyte development, it appears that hybridization between the 2 species is possible.
22. Gal, T. and Szeoke, K. Appearance of *Argyresthia trifasciata* Staudinger, 1871 (*Lepidoptera*, *Yponomeutidae*) on *Juniperus* in Hungary. Az *Argyresthia trifasciata* Staudinger, 1871 (*Lepidoptera*, *Yponomeutidae*) megjelenése magyarországon *Juniperus* orokzoldon. *Novenyvedelem*. 2000; 36(6):301-304.
Keywords: *Juniperus scopulorum*/ *Argyresthia*/ geographical distribution/ new geographic records
Abstract: A severe infestation of *Argyresthia trifasciata* on *Juniperus scopulorum* cv. Skyrocket was observed in county Zala. This pest was previously unknown in Hungary. A symptom of larval damage is the presence of mines in the *J. scopulorum* shoot tips. The shoot tips turn brown, dry out and the physical appearance of the plants deteriorate. One generation of this species occurs per year in Hungary. Adults fly in May,

and larvae attack the host from mid-June to November. Recommendations are given for control of the pest and a Hungarian name for the pest is proposed.

23. Hall, G C and Whitcomb, C E. Rooting of *Juniperus scopulorum* utilizing antitranspirants as a replacement for mist and growth of resulting plants. Research Report, Oklahoma Agricultural Experiment Station. 1974; P-70444-46.
Keywords: *Juniperus scopulorum*/ *Juniperus chinensis*/ cuttings/ rooting/ IBA/ antitranspirants
Abstract: Hardwood cuttings of *J. scopulorum* 'Blue Heaven' and *J. chinensis* 'Hetzi' were treated with combinations of 5 levels of IBA, 3 levels of shading from nil to 62%, and 5 levels of transpiration control. The use of proprietary antitranspirants as a replacement for intermittent mist was unsatisfactory; the highest percentage (60%) of cuttings rooted under mist applied for 3 sec/min plus a basal treatment with 16 000 p.p.m. IBA in talc. In another trial cuttings of *J. chinensis* 'Hetzi' and *Ligustrum japonicum* were treated with 0, 10 or 20% levels of each of 3 antitranspirants (Folicote, Foli-Gard and Wilt-Pruf), allowed to dry and weighed at 48-h intervals to determine protection against water loss. All 3 antitranspirant coatings proved ineffective and were found to have ruptured..
24. Holmgren, Camille A. E-mail holmgren@geo.arizona.edu; Cristina Penalba, M.; Rylander, Kate Aasen, and Betancourt, Julio L. A 16,000 14C yr B.P. packrat midden series from the USA-Mexico Borderlands. Quaternary Research (Orlando). 2003 Nov; 60(3):319-329.
Keywords: *Juniperus scopulorum*/ *Pinus edulis*/ *Larrea tridentata*/ Holocene/ Mexico/ New Mexico/ packrat midden series
Abstract: A new packrat midden chronology from Playas Valley, southwestern New Mexico, is the first installment of an ongoing effort to reconstruct paleovegetation and paleoclimate in the U.S.A.-Mexico Borderlands. Playas Valley and neighboring basins supported pluvial lakes during full and/or late glacial times. Plant macrofossil and pollen assemblages from nine middens in the Playas Valley allow comparisons of two time intervals: 16,000-10,000 and 4000-0 14C yr B.P. Vegetation along pluvial lake margins consisted of open pinyon-juniper communities dominated by *Pinus edulis*, *Juniperus scopulorum*, *Juniperus cf. coahuilensis*, and a rich understory of C4 annuals and grasses. This summer-flowering understory is also characteristic of modern desert grassland in the Borderlands and indicates at least moderate summer precipitation. *P. edulis* and *J. scopulorum* disappeared or were rare in the midden record by 10,670 14C yr B.P. The late Holocene is marked by the arrival of Chihuahuan desert scrub elements and few departures as the vegetation gradually became modern in character. *Larrea tridentata* appears as late as 2190 14C yr B.P. based on macrofossils, but may have been present as early as 4095 14C yr B.P. based on pollen. *Fouquieria*

splendens, one of the dominant desert species present at the site today, makes its first appearance only in the last millennium. The midden pollen assemblages are difficult to interpret; they lack modern analogs in surface pollen assemblages from stock tanks at different elevations in the Borderlands.

25. Hsiang T. and Huang J. The use of RAPD markers to distinguish among juniper and cedar cultivars. *Canadian Journal Botany* . 2000; 78:655-659.
Keywords: *Juniperus scopulorum/ Chamaecyparis/ Juniperus chinensis/* DNA/ RAPD/ cultivars/ markers
Abstract: Two species of *Chamaecyparis* and six cultivars each of *Juniperus chinensis* L. and *Juniperus scopulorum* Sarg. (Cupressaceae) were subjected to random amplified polymorphic DNA (RAPD) analysis using seven primers. Un-weighted pair group method with averages (UPGMA) and principal component analyses of genetic distances between cultivars showed that 42 polymorphic RAPD bands could distinguish among all cultivars and properly group them by species and genera. Where the origin of a specific juniper cultivar is uncertain, analysis of genetic distance can pinpoint close relatives. For example, we were unable to trace the origin of *J. chinensis* 'Alps', and we initially thought it was a mislabeled *J. chinensis* 'Blue Alps'. However, we found 'Alps' to be closer to *J. chinensis* 'Fairview' and 'Mountbatten' than to 'Blue Alps'. Similarly, 'Wichita Blue' has an unknown origin, but it had the highest genetic similarity with 'Medora'.
26. Korszun S. and Zalewska J. The use of Osmocote Exact Lo-Start fertilizer in cultivation of Rocky Mountain juniper (*Juniperus scopulorum* Sarg.) 'Blue Arrow' variety in containers.
Zastosowanie nawozu Osmocote Exact Lo-Start w uprawie jaowca skalnego (*Juniperus scopulorum* Sarg.) odmiany 'Blue Arrow' w pojemnikach. *Folia Universitatis Agriculturae Stetinensis, Agricultura*. 2004; 94:81-86.
Keywords: *Juniperus scopulorum/* application rates/ fertilizers/ growth/ roots.
Abstract: Potted *J. scopulorum* cv. Blue Arrow plants were supplied with 2, 2.5, 3 or 3.5 g Osmocote Exact Lo-Start fertilizer (OELSF)/dm³. Plant height, length and number of lateral shoots and fresh weight of roots and aboveground parts were highest with the application of 3 g OELSF/dm³.
27. Lind E. M. In search of Rocky Mountain juniper. The characteristics and uses of a unique botanical extract. *Perfumer and Flavorist*. 2005; 30(1):52-58.
Keywords: *Juniperus scopulorum/* botanical extract/ essential oil
Abstract: The history and uses of juniper, particularly for medicinal, aromatic and spiritual purposes, are briefly discussed. The characteristics of Rocky Mountain juniper, *Juniperus scopulorum*, and the organoleptic notes and chemical composition of its essential oil are described. Safety issues concerning the therapeutic use of juniper oil are also considered.

28. Major, J. E. and Grossnickle, S. C. Chilling units used to determine rooting of stem cuttings of junipers. *Journal of Environmental Horticulture*. 1990; 8(1):32*35.
Keywords: *Juniperus horizontalis/ Juniperus procumbens/ Juniperus sabina/ Juniperus scopulorum/* chilling units/ cuttings/ rooting/ propagation
Abstract: Stem cuttings of *Juniperus chinensis* cv. Pfitzer Aurea, *J. horizontalis* cultivars Bar Harbor, Prince of Wales, Wiltoni and Youngstown, *J. procumbens* cv. Green Mound, *J. sabina* cultivars Broadmoor, Buffalo and Tamariscifolia and *J. scopulorum* [*J. scopulorum*] cv. Wichita Blue, collected twice monthly from 15 Oct. 1986 to 28 Feb. 1987, were dipped in an IBA or NAA rooting dip (concentrations given) and inserted in rooting beds with bottom heat at 18 ° C and misting as required. The air temperature 1 m above the stock plants was monitored continuously and the seasonal chilling units (the number of hours when the temperature was <less or =>5 °) were determined. The chilling units experienced by stock plants affected the rooting response of cuttings taken from them. Cultivar variations in percentage rooting and rooting pattern were marked. It is concluded that rooting success is related to the physiological status of the donor plant. Calendar dates can be used successfully as a guideline for cultivars known to root effectively over a large number of chilling units (such as Youngstown, Bar Harbor and Price of Wales). However, the chilling unit concept may be more appropriate for determining the optimum period for successful rooting of cultivars that have a more precise response to chilling units experienced (such as Tamariscifolia, Broadmoor and Green Mound).
29. Moench, R. D. Rocky Mountain juniper production at the Colorado State Forest Service. In: Landis, T. D., Cregg. B. Tech. Coords. National Proceedings: Forest and Conservation Nursery Associations, General Technical Report PNW-GTR-365; Portland Oregon, U. S. Department of Agriculture, Pacific Northwest Research Station. 1995; 52-53.
Keywords: *Juniperus scopulorum/* Rocky Mountain juniper/ stratification/ seed/ Colorado
Call Number: aSD11.A46 no. 365
Abstract: Seed dormancy limits Rocky Mountain juniper production. The Colorado State Forest Service has found summer sowing and "natural stratification" to be beneficial. Seed stratified in this way follows a "natural" soil temperature regime over a seven month period. Seventy percent or better germination is achieved using the method from Great Plains and Northern Colorado seed sources.
30. Mulligan, B. O. Pines and junipers in north-eastern Utah. *Year Book* 1975, International Dendrology Society, UK. 1976; 25-27.
Keywords: *Juniperus scopulorum/ Pinus flexilis/ Pinus edulis/* Utah/ seeds / collection
Abstract: A brief illustrated account of some large or old specimens of

Pinus flexilis, *P. edulis* and *Juniperus scopulorum* observed during a seed-collecting trip.

31. Murov, M.; Statler, S.; Tress, J. A., and Phillips III, A. M. Effects of pre-germination treatments on several seed sources of *Juniperus scopulorum*. Rocky Mountain Forest and Range Experiment Station, Forestry Sciences Laboratory, East Campus, University of Nebraska, Lincoln, NE 68583-0822 . 1989 Dec; 15 pp.
Keywords: *Juniperus scopulorum*/ scarification/ stratification/ seeds/ germination
Abstract: During two years of studies, scarification and stratification pre-treatments were performed on Rock Mountain juniper (*J. scopulorum*) seeds to develop a method for producing greater and more uniform germination in the shortest amount of time. The pre-treatment that produced the best results was 60 day moist-chill/ 60 day warm-moist/ 60 day moist-chill stratification. Although this treatment shortened germination time, germination percentages were not enhanced. Scarification paired with stratification did not improve germination or shorten germination time. Fresh seeds from different geographic sources responded differently to treatments. Further investigation into the causes and effects of after-ripening, and how this process may correlate with the germination process are suggested.
32. Panova, L. N. Propagation of junipers in southern steppe conditions in the Ukraine. Lesnoe Khozyaistvo. 1985; 1234.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ seeds/ treatment/ vegetative propagation/ techniques.
Abstract: In the Askaniya-Nova botanical park in the Ukraine, seeds of *J. virginiana* and *J. scopulorum* are scarified with sand and sown in autumn, or are stratified at 0-5° C and sown in spring. Other species, especially ornamental species and forms of *J. communis* and *J. sabina*, are propagated by cuttings in a cold frame under plastic; callus forms in 45-50 days, and roots form in 75-80 days. The best time for planting cuttings is late March, and the optimum length of cuttings is 8-15 cm. Some details are given of the growth rates of seedlings and rooted cuttings, and of the ages at which they can be planted out.
33. Peterson, G. B. Determination of the presence, location and allelopathic effects of substances produced by *Juniperus scopulorum* Sarg. Dissertation Abstracts International, B. 1972; 32(7):3811-3812.
Keywords: *Juniperus scopulorum*/ germination/ allelopathic effects
Abstract: Reports the presence in *J. scopulorum* of a water-soluble inhibitor which reduced the germination of several herbaceous species (including grasses) growing at the same altitude as the tree. Although present throughout the tree, the inhibitor occurred at highest concentrations in the branches. A volatile inhibitor was also identified in fresh branches, at varying concentrations according to season.

34. Peterson, G. W. Infection of *Juniperus virginiana* and *J. scopulorum* by *Phomopsis juniperovora*. *Phytopathology*. 1973; 63(2):246-251.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ *Phomopsis juniperovora*/ infection/ lesions/ leaves
Abstract: Young leaves of both *J. spp.* were highly susceptible to *P. juniperovora* but no lesions developed on old leaves. Infection occurred at 12-32 ° C, with greater intensity at 24-28 ° . Small, light colored lesions developed in 3-5 days. Disease was more severe when high (32 °) post-inoculation temps. prevailed. Infection took place in 7 h at 100% RH and 24 ° . Pycnidia with viable spores were present 3 weeks after inoculation. The opt. temp. for germination, germ-tube development and growth in culture was 24 ° , exposure to -22 and +43 ° did not prevent germination. Spores also germinated following hydration, desiccation and the return to favourable conditions. Light had no effect on germination, growth or infection.
35. Rietveld, W. J. Variable seed dormancy in rocky mountain juniper. General Technical Report Rocky Mountain Forest Experiment Station U.S. Department of Agriculture, Forest Service . 1989 Dec; 18460-64; ISSN: 0277-5786.
Keywords: *Juniperus scopulorum*/ Rocky mountain juniper/ seed/ germination/ stratification/ nursery
Call Number: aSD11.A42
Abstract: Rocky Mountain juniper is difficult to grow in the nursery due to variable seed dormancy that spreads germination over time. In two experiments, six seed sources, five seed treatments, and 15 stratification treatments were tested. Although there were some seed source and stratification treatment differences, none of the treatments effectively enhanced germination amount or timing enough to be useful in nursery culture.
36. Rudloff, E. von. Chemosystematic studies of the volatile oils of *Juniperus horizontalis*, *J. scopulorum* and *J. virginiana*. *Phytochemistry*. 1975; 14(5/6):1319-1329.
Keywords: *Juniperus horizontalis*/ *Juniperus scopulorum*/ *Juniperus virginiana*/ plant composition/ terpenoids / taxonomy
Abstract: The volatile oil from the foliage of individual plants from different populations of *Juniperus horizontalis*, *J. scopulorum* and *J. virginiana* has been analyzed qualitatively and quantitatively. Some analytical problems are discussed and several new constituents have been identified. *J. horizontalis* can be differentiated from the other two species by the presence of relatively large percentages of cadinane-type sesquiterpenes and less of the elemol-eudesmol type. The ratio of methyl citronellate to citronellol may also have diagnostic value, as may be the virtual absence of aromatic ethers of the safrole-type. The oil of *J. scopulorum* is virtually devoid of the cadinol type sesquiterpenes but differentiation from that of *J. virginiana* is difficult. A useful measure of

clinal variation within different populations of each species is the ratio of sabinene and limonene percentages. The occurrence of aromatic ethers in *J. scopulorum* and *J. virginiana* is erratic; in *J. horizontalis* they are present in trace amounts only. Provided an adequate foliage sample size is taken during the dormant season, population studies based on the means of the percentages of the foliage oil components are feasible. Two hybrid swarms of *J. horizontalis* and *J. scopulorum* were sampled and all plants had intermediate foliage oil compositions".

37. Schaefer, P. R. Ten-year results of an eastern redcedar and Rocky Mountain juniper provenance test in eastern South Dakota. Northern Journal of Applied Forestry. 1995; 12(1):30-35.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ South Dakota/ statistical analysis/ fungal diseases/ height crown width/ survival/ branch angle/ *Gymnosporangium*/ *Phomopsis*/ *Cercospora*
Abstract: Seedlings of 118 sources of eastern redcedar [*Juniperus virginiana*] and 26 sources of Rocky Mountain juniper [*J. scopulorum*] were established as a provenance test near Brooking, South Dakota, in 1980. Height, crown width, survival, branch angle, foliage density, number of terminal leaders, sex, flowering, and the incidence of 3 diseases (cedar-apple rust [*Gymnosporangium juniperi-virginianae*] galls, *Phomopsis [juniperivora]* blight, and *Cercospora [sequoiae]* blight) were recorded after 10 yr. ANOVA, Chi-square, simple and rank correlation, cluster analysis, and discriminant analysis methods were used to analyze the data. Eastern redcedar exhibited better overall performance than Rocky Mountain juniper for use as windbreaks. Eastern redcedar originating in central Nebraska showed the best combination of height, survival and crown characteristics. Results indicate that selection for fast growing sources may begin 2-3 yr after field planting, while the ability to select fast growing individuals within sources was only moderate after 5 yr. Correlations among traits after 10 yr were generally weak.
38. Schaefer P. R. and Baer N. B. An eastern redcedar and Rocky Mountain juniper provenance test for windbreak suitability in eastern South Dakota. Northern Journal of Applied Forestry. 1988; 5(2):129-132.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ provenances/ South Dakota
Abstract: A regional provenance test of 118 eastern redcedar [*Juniperus virginiana*] and 26 Rocky Mountain juniper [*J. scopulorum*] sources was established in Brookings, S. Dakota, USA, in 1980. Eastern redcedar exhibited better combinations of traits, with greater ht. growth, larger crown spread, a wider branch angle, and a stronger tendency toward producing a single terminal leader than Rocky Mountain juniper. Based on a windbreak suitability index, best performing seedlots collected from natural stands were all eastern redcedar from a large area of the central Great Plains. These results indicate that eastern redcedar should be favored over Rocky Mountain juniper for planting in eastern S. Dakota,

and sources of eastern redcedar south of central Kansas should be avoided.

39. Scianna, JD. Rocky Mountain juniper seed: collecting, processing, and germinating. *Native-Plants-Journal*. 2001; 2(2):73-78; ISSN: 1522-8339.
Keywords: *Juniperus scopulorum*/ cones/ crop-yield/ macerating/ scarification/ seed collection/ seed dormancy/ seed germination/ seed orchards/ seed/ quality/ seed treatment/ seed weight
Abstract: Propagating Rocky Mountain juniper (*Juniperus scopulorum*, *Cupressaceae*) from seeds is difficult, but proper collection, cleaning, storage, and dormancy treatment can improve success. Our best results were achieved by: (1) avoiding collection of immature and insect damaged cones; (2) minimizing cone storage or storing surface-dried cones under well-ventilated conditions at 1 to 3 degrees C and 80 to 90% humidity; (3) macerating cones in hand-cleaner-amended water; (4) separating light or unfilled seeds from viable seeds with flotation; and (5) treating seeds with a 120-day warm moist stratification in peat moss mix followed by a 150-day cold moist chilling. Establishment and management of cultivated orchards improves seed yield and quality.
40. Sieg, C. H. Rocky Mountain juniper woodlands: year-round avian habitat. Research Paper, US Department of Agriculture, Forest Service. 1992; RM-2967.
Keywords: *Juniperus scopulorum*/ birds/ food/ cover/ migratory corridors/ nesting/ perching sites
Abstract: Total bird numbers and species richness were consistently higher in every season in *Juniperus scopulorum* stands than on grasslands. Rocky Mountain juniper stands provide food and thermal cover in winter; migratory corridors in fall and spring; and feeding, nesting and perching sites in summer.
41. Stepanek, Laurie J. Reprint author and Harrell, Mark O. Reprint author. Mortality of seedling windbreak trees caused by a common sunflower insect *Isophrictis similiella* (Chambers) (*Lepidoptera: Gelechiidae*). *Journal of the Kansas Entomological Society*. 2000 Apr; 73(2):123-125.
Keywords: *Juniperus scopulorum*/ Rocky Mountain Juniper/ *Isophrictis similiella*
Abstract: A common pest of native sunflowers (*Helianthus* spp.) was found to cause mortality in seedling trees of newly planted windbreaks. *Isophrictis similiella* (Chambers) (*Lepidoptera: Gelechiidae*) tunnels into the main stem of recently planted trees, causing top dieback and often mortality. Rocky Mountain juniper (*Juniperus scopulorum* Sarg.) and eastern redcedar (*J. virginiana* L.) are commonly attacked. The insect has also been found in cotoneaster (*Cotoneaster* sp.) and potentially may attack a number of species of seedling trees and shrubs. *I. similiella* larvae normally inhabit the stems and heads of sunflower, but if disturbed, as from tree planting operations, the larvae may seek out alternative shelter. Newly planted seedlings are often the only vegetation available.

42. Tauer, C. G.; Harris, K. D., and VanHaverbeke, David F. Seed source influence juniper seedling survival under severe drought stress. Research Note RM-470, Rocky Mountain Research Forest and Range Experiment Station, USDA Forest Service . 1987 Jul; 4704 .
Keywords: *Juniperus scopulorum*/ *Juniperus virginiana*/ seed/ Great Plains/ Oklahoma/ seedling
 Call Number: A99.9 F7632US
Abstract: Thirty-nine sources of eastern redcedar (*Juniperus virginiana* L.) and 15 sources of Rocky Mountain juniper (*Juniperus scopulorum* Sarg.), representing collections from throughout the Great Plains, were planted in 1980 as 2 + 0 stock in south-central Oklahoma. Extremely droughty conditions during 1980 resulted in 77% first-year mortality. Percent survival of seedlings, by source, showed a low and negative, but statistically significant ($p=0.05$) correlation ($r=-0.21$) with mean nursery height. Survival of Rocky Mountain juniper was greater (32%) than survival eastern redcedar (20%). Analysis of covariance (with height as the covariate) of percent survival by species showed source differences in survival only for eastern redcedar. Selection of optimum species and seed sources should improve survival of junipers in windbreak plantings on severe sites in the Great Plains.
43. Tereshkovich, George. *Juniperus* species: evergreen ground covers . Research Report. University of Georgia, College of Agriculture Experiment Stations. 1969; 3610 .
Keywords: *Juniperus conferta*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus horizontalis*/ *Juniperus japonica*/ *Juniperus procumbens*/ *Juniperus sabina*/ *Juniperus scopulorum*
 Call Number: S51.R22
Abstract: The following *Juniperus* spp. cultivars are better adapted for the Georgia Piedmont: *Juniperus* Blue Pfitzer, *Juniperus conferta* (Shore Juniper), *Juniperus chinensis* Sargentii, *Juniperus chinensis pfitzeriana aurea* (Golden tip Pfitzer), *Juniperus davurica* (Squamata expansa) *parsoni*, *Juniperus horizontalis andorra*, *Juniperus horizontalis andorra* compacta, *Juniperus horizontalis andorra*, (Aunt Jamina), *Juniperus horizontal plumosa*, (Andorra juniper), *Juniperus horizontalis* 'Douglasi' (Waukegan), *Juniperus japonica* (San Jose), *Juniperus procumbens*, *Juniperus sabina* 'Arcadia', and *Juniperus scopulorum*, (White Silver King). These species are very hardy plants, able to withstand extremes in temperature, and provide excellent ground cover for landscaping around the home, in parks, and in highway beautification programs.
44. Tulloch, A. P. and Bergter, L. Epicuticular wax of *Juniperus scopulorum*. Phytochemistry. 1981; 20(12):2711-2716.
Keywords: *Juniperus scopulorum*/ epicuticular wax
45. Van Haverbeke, D. F. A population analysis of *Juniperus* in the Missouri River Basin. University of Nebraska Stud. New Ser. No. 38. 1968; 3882 pp.

Keywords: *Juniperus scopulorum*/ *Juniperus virginiana*/ taxonomy/ Missouri River Basin

Abstract: A taxonomic interrelationships between *Juniperus scopulorum* Sarg. and *J. virginiana* L. in the Missouri River Basin is described. An interpretation of the data is presented which proposes that the *Juniperus* have evolved through divergence from *J. scopulorum* rather than from introgression between *J. scopulorum* and *J. virginiana*.

46. Van Haverbeke, D. F. and Barnhart, M. R. A laboratory technique for depulping *Juniperus* cones. *Tree Planters' Notes* . 1978; 29(4):33-34.

Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ depulping/ berries/ cones/ seeds

Abstract: A technique for depulping small lots of *Juniperus virginiana* and *Juniperus scopulorum* uses a 3 speed commercial blender, variable speed rheostat, and timer. It saves time by eliminating presoaking the cones in water and soaking seed in lye solution after maceration to free seeds of residual resins.

47. Zanoni, T. A. and Adams, R. P. The genus *Juniperus* in Mexico and Guatemala: numerical and chemosystematic analysis. *Biochemical Systematics and Ecology*. 1976; 4(3):147-158.

Keywords: *Juniperus patoniana*/ *Juniperus deppeana*/ *Juniperus monosperma*/ *Juniperus blancoi*/ *Juniperus scopulorum*/ plant composition/ terpenoids.

Abstract: The leaf constituents, mainly terpenoids, of each of the taxa of *Juniperus* in Mexico and Guatemala were analyzed by numerical taxonomic methods and the results compared with those of a previous study utilizing morphological characters. The two sets of data were generally in agreement on the major groups. Differences between more closely related species were more apparent with the chemical data. Four major groups were detected. The study confirmed the morphological data indicating that *J. patoniana* should be reduced to a variety of *J. deppeana*. No samples typical of *J. monosperma* were found in Mexico, and *J. monosperma* var. *gracilis* was not closely allied with *J. monosperma* from the USA, but had some uncertain affinities with species of the one-seeded complex. *J. blancoi* appears to be closely related to *J. scopulorum*.

***Juniperus semiglobosa* (13)**

1. Abseitov, S Yu. Installation for extracting seeds from juniper berries. *Lesnoe Khozyaistvo*. 1983; 1064-66; ISSN: 0024-1113.

Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ seeds/ processing/ variation/ equipment/ seed size/ conifers

Abstract: Data are presented on the large variations in thickness, width and length of seeds and 'berries' of three species of Central Asian junipers, viz.

Juniperus semiglobosa, *J. seravschanica* and *J. turkestanica*. The seeds can be extracted from the flesh by rubbing the berries between two discs (one rotating, the other fixed). The biometric data on the berries and seeds can be used to determine the optimum gap between the discs so as to avoid damaging the seed. Data are also given on berry and seed weights, % flesh, and the crushing force of the berries and seeds. For *J. semiglobosa* the optimum gap is 5.5 mm (88% berries crushed, with only 1% seed damage); for *J. seravschanica* 6 mm (89%; 1.7%), and for *J. turkestanica* 10.5 mm (89%; 1.8%). With hand extraction seed damage amounts to 7.6-10.4%. The disc-type seed extractor has a throughput of berries of 127 kg/h.

2. Abseitov, S Yu and Osipov, Yu S. Basis of the process of extracting seeds from juniper 'berries'. *Lesnoi Zhurnal*. 1985; 326-30.
Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turcomanica*/ seeds/ processing/ machinery/ extraction/ conifers
Abstract: Data are presented on the physical and mechanical properties of the arils and seeds of four Central Asian junipers, viz. *Juniperus semiglobosa*, *J. turkestanica*, and (together) *J. seravschanica* and *J. turcomanica*. Permissible forces that can be used in extracting seeds from the flesh of arils are calculated, and details are given of the design and basic parameters of an appropriate mechanical extraction process. Arils are dried to 6-25% m.c., screened, rasped between two metal surfaces, and then screened with a set of three screens having openings of 1.2, 2.5 and 3.2 mm. Some data are given from trials with a prototype machine. Sound seed was undamaged, and cleaning was good, with a throughput of 87.6 kg/h of arils.
3. Azhibekov K. A. Forestry in the juniper forest zone of Kirgizia. *Lesnoe Khozyaistvo*. 1982; 764-66.
Keywords: *Juniperus semiglobosa*/ *Larix sibirica*/ *Betula pendula*/ *Picea schrenkiana*/ mountains/ plantations/ Kirgizia
Abstract: A review is given of experience in plantation forestry in the juniper forest zone in Kirgizia (Soviet Central Asia), i.e. on steep mountain slopes at high altitudes where these forests have an important role in soil and water conservation. The performance of *Larix sibirica*, *Betula pendula*, *Picea schrenkiana* and *Juniperus semiglobosa* is discussed, and it is concluded that these species are promising for planting at 2200-2600 m alt.
4. Chub A. V. Trial in growing Juniper seedlings by sowing freshly collected seeds. *Kul' Tura Lesnykh Porod v Kirgizii*. 1973; 52-57.
Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ seeds/ berries/ germination/ mulching/ seedlings
Abstract: Gives data on the germination of seeds of *Juniperus*

turkestanica and *J. semiglobosa* in nursery experiments at 2500 m alt. in Kirghizia. Seeds removed from the 'berries' germinated better than 'berries' sown complete, and mulching (with moss) improved germination. When seeds collected at various dates were removed from the 'berries' and sown within a few days of collection, germination differed according to date of sowing, results being best for *J. turkestanica* sown in late July and in August, and for *J. semiglobosa* a month later.

5. Dar, G. H. and Christensen, K. I. Gymnosperms of the Western Himalaya. 1. The genus *Juniperus* (*Cupressaceae*). Pakistan Journal of Botany. 2003; 35(3):283-311.
Keywords: *Juniperus communis*/ *Juniperus squamata* / *Juniperus recurva*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus wallichiana*/ *Juniperus pseudosabina*/ Himalaya
Abstract: A thorough study of an extensive collection of herbarium specimens and literature of *Juniperus* (*Cupressaceae*) from the Western Himalaya, during our work on gymnosperms of this region, has revealed that the taxonomy of West Himalayan Junipers has been confusing. A total of up to 6 taxa have been reported from this region by various earlier workers under a large number of specific and infraspecific names, most of which are synonyms. Seven taxa are recognized from the Western Himalaya in the present study: one belonging to *Juniperus* Sect. *Juniperus*, *J. communis* var. *saxatilis*, and the other six to *Juniperus* Sect. *Sabina*. The latter section includes two acicular-leaved species, *J. squamata* and *J. recurva*, and four scale-leaved species: two multiseed, *J. semiglobosa* and *J. polycarpus*, and two monoseed, *J. wallichiana* and *J. pseudosabina*.
6. DeMillo, A P. Life cycles of mites (Acariformes, Eriophyoidea) living in seeds and buds
of *Juniperus semiglobosa* Rgl. XIIIth International Congress of Entomology, Moscow, 2-9 August, 1968 Proceedings Volume 3: Rafes, P M. 1968 Aug 2-1968 Aug 9; 3.
Keywords: *Juniperus semiglobosa*/ mites/ seeds/ buds
7. Farjon, A. The taxonomy of multiseed junipers (*Juniperus* sect. *Sabina*) in southwest Asia and east Africa. (Taxonomic notes on *Cupressaceae* I). Edinburgh Journal of Botany. 1992; 49(3):251-283.
Keywords: *Juniperus foetidissima*/ *Juniperus macropoda*/ *Juniperus procera*/ *Juniperus sabinoides*/ *Juniperus schugnanica*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus excelsa*/ *Juniperus phoenicea*/ taxonomy/ Africa/ Asia
Abstract: An extensive study of herbarium specimens and literature of arborescent multiseed junipers (*Juniperus* sect. *Sabina*) from SW Asia and E. Africa, in preparation for a monographic volume 'Drawings and Descriptions of Cupressaceae', has led to a substantially revised concept of taxa and their distribution. A total of 18 species and 7 varieties were

previously recognized in this group; most turned out to be synonyms. *J. foetidissima* var. *pindicola*, *J. macropoda*, *J. procera*, *J. sabinoides*, *J. schugnanica* and *J. semiglobosa* were lectotypified; *J. polycarpus* was neotypified. The following taxa answering to the above circumscription are here recognized for the area: *J. excelsa*, *J. excelsa* subsp. *polycarpus*, *J. foetidissima*, *J. semiglobosa*, *J. phoenicea* and *J. procera*.

8. Golovina, R. D. Root systems of juniper in the forests of the Alai ridge. Lesovedenie. 1991; 371-74.
Keywords: *Juniperus semiglobosa*/ *Juniperus turkestanica*/ roots/ phytomass
Abstract: Details are given of the root systems of 4 sample trees of *Juniperus semiglobosa* in stands at 2560-2570 m altitude, and 4 trees of *J. turkestanica* in stands at 2650 and 33200 m altitude in Kirghizia. The trees ranged in age from 50 to 309 years, and the aerial phytomass was greater at the higher (moister) altitudes. In *J. semiglobosa* the root projection area was much greater than the crown projection, some of the large roots extending for up to 12 m. In *J. turkestanica*, at the tree line the root system is smaller, viz. only 0.21-0.23 t of roots per t of aerial phytomass. The importance of the juniper roots in protecting the soil from erosion is discussed.
9. Konnov, A. A. and Molotkovskii, Yu. I. Ecology of juniper stands in the Pamir-Alai. Soviet Journal of Ecology. Transl. From Ekologiya . 1981; 12(5):14-24.
Keywords: *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turkestanica*/ phytomass structure
Abstract: Diurnal and seasonal variations in transpiration intensity were measured in *Juniperus semiglobosa*, *J. seravschanica* and *J. turkestanica* in 2 vegetation types at 2450 m alt., and in *J. seravschanica* in 2 thermophilic vegetation types at 1850 and 1100 m alt. The vegetation is described. Data are also presented on seasonal needle water content and seasonal water use (mm) in 1969-71, and the phytomass structure of the vegetation types at 2450 and 1850 m. Results show that the water balance of junipers varies considerably in response to water supply.
10. Molotkovskii, Yu. I. and Konnov, A. A. Some characteristics of the growth and water exchange in juniper affected by a plant parasite, *Arceuthobium oxycedri* (DC.) M.B. Russian Journal of Ecology. 1995; 26(4):296-299.
Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ *Arceuthobium oxycedri*/ mistletoe/ infection/ Turkmenstan/ transpiration
Abstract: Studies on water relations of junipers (*Juniperus turkestanica* and *J. semiglobosa*) infected with the mistletoe *Arceuthobium oxycedri* were conducted on the northern slope of Turkmenstan Ridge [Tajikistan]. Diurnal and seasonal variation in transpiration rate and shoot growth were measured for the junipers and the mistletoe. Transpiration rate was

greater in *J. semiglobosa* than in *J. turkestanica*. Transpiration rate of the mistletoe was generally higher than that of its host and was greater on *J. semiglobosa* than on *J. turkestanica*.

11. Mukhamedshin, K. D. and Sartbaev, S. K. The increment cycle of Juniper in the high mountain conditions of the Tien Shan. *Izv AN KirgSSR*. 1972; 255-60.
Keywords: *Juniperus seravschanica/ Juniperus semiglobosa/ Juniperus turkestanica/* water relations/ growth rings.
Abstract: Describes studies on 1580 trees of *Juniperus* spp. It is shown that wood is laid down annually, even at the alpine forest limit, and therefore Junipers can be used for dendrochronological and dendroclimatic research. In the arid lower regions the growth of *J. seravschanica* and *J. semiglobosa* is determined mainly by moisture, and high temperatures in the growing season (especially in July) have an adverse effect. In the colder and moister higher regions the increment of *J. turkestanica* is determined mainly by the temperature in June/July.
12. Sakhatskii, V. M. The sowing qualities of seeds of junipers in Central Asia. *Posevnye kachestva semyan mozhzhevel'nikov v Srednei Azii*. *Lesnoe Khozyaistvo*. 1979; 1240-42.
Keywords: *Juniperus turcomanica/ Juniperus semiglobosa/ Juniperus seravschanica/ Juniperus turkestanica/* sowing rates/ nursery/ seed/ handling seed/ Central Asia
Abstract: On the basis of studies in Soviet Central Asia in 1963-70, data are tabulated on the physical characteristics and sowing qualities of seed of *Juniperus turcomanica*, *J. semiglobosa*, *J. seravschanica* and *J. turkestanica*. Standard sowing rates are calculated for each species; for 1 ha of nursery area this ranges from 400 kg clean seed of *J. semiglobosa* to 2970 kg clean seed of *J. turkestanica*. The treatment and handling of juniper seed are discussed, and sowing dates are given for various areas, depending on alt.
13. Sultanov, Yu and Padalko, V V. Growing plantations of junipers. *Lesnoe Khozyaistvo*. 1988; 1153-54.
Keywords: *Juniperus seravschanica/ Juniperus semiglobosa/ Juniperus turkestanica/* seed collection/ plantation/ root/ growth
Abstract: A note is given on the techniques of seed collection and treatment, and plantation establishment, used successfully in Tadzhikistan for growing *Juniperus seravschanica*, *J. semiglobosa* and *J. turkestanica*. Height growth is typically slow, but root growth is quite rapid, and the total length of roots in the third year is 54.57 m per plant, and the root penetration depth is 117 cm.

***Juniperus seravschanica* (8)**

1. Abseitov, S Yu. Installation for extracting seeds from juniper berries. *Lesnoe Khozyaistvo*. 1983; 1064-66; ISSN: 0024-1113.

Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ seeds/ processing/ variation/ equipment/ seed size/ conifers

Abstract: Data are presented on the large variations in thickness, width and length of seeds and 'berries' of three species of Central Asian junipers, viz. *Juniperus semiglobosa*, *J. seravschanica* and *J. turkestanica*. The seeds can be extracted from the flesh by rubbing the berries between two discs (one rotating, the other fixed). The biometric data on the berries and seeds can be used to determine the optimum gap between the discs so as to avoid damaging the seed. Data are also given on berry and seed weights, % flesh, and the crushing force of the berries and seeds. For *J. semiglobosa* the optimum gap is 5.5 mm (88% berries crushed, with only 1% seed damage); for *J. seravschanica* 6 mm (89%; 1.7%), and for *J. turkestanica* 10.5 mm (89%; 1.8%). With hand extraction seed damage amounts to 7.6-10.4%. The disc-type seed extractor has a throughput of berries of 127 kg/h.

2. Abseitov, S Yu and Osipov, Yu S. Basis of the process of extracting seeds from juniper 'berries'. *Lesnoi Zhurnal*. 1985; 326-30.

Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turcomanica*/ seeds/ processing/ machinery/ extraction/ conifers

Abstract: Data are presented on the physical and mechanical properties of the arils and seeds of four Central Asian junipers, viz. *Juniperus semiglobosa*, *J. turkestanica*, and (together) *J. seravschanica* and *J. turcomanica*. Permissible forces that can be used in extracting seeds from the flesh of arils are calculated, and details are given of the design and basic parameters of an appropriate mechanical extraction process. Arils are dried to 6-25% m.c., screened, rasped between two metal surfaces, and then screened with a set of three screens having openings of 1.2, 2.5 and 3.2 mm. Some data are given from trials with a prototype machine. Sound seed was undamaged, and cleaning was good, with a throughput of 87.6 kg/h of arils.

3. Konnov, A. A. and Molotkovskii, Yu. I. Ecology of juniper stands in the Pamir-Alai. *Soviet Journal of Ecology*. Transl. From *Ekologiya* . 1981; 12(5):14-24.

Keywords: *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turkestanica*/ phytomass structure

Abstract: Diurnal and seasonal variations in transpiration intensity were measured in *Juniperus semiglobosa*, *J. seravschanica* and *J. turkestanica* in 2 vegetation types at 2450 m alt., and in *J. seravschanica* in 2 thermophilic vegetation types at 1850 and 1100 m alt. The vegetation is described. Data are also presented on seasonal needle water content and seasonal water use (mm) in 1969-71, and the phytomass structure of the

vegetation types at 2450 and 1850 m. Results show that the water balance of junipers varies considerably in response to water supply.

4. Kul' bachnyi, I. A. Some results of studies on the growth of Juniper stands. Nauch Tr Tashkent S Kh In T. 1972; 25139-145.
Keywords: *Juniperus seravschanica*/ Uzbekistan/ growth
Abstract: Gives results of studies on *Juniperus seravschanica* in Uzbekistan, including tables of stem numbers and b.a. of fully stocked stands, a scale of site classes, and a provisional yield table for site class I.
5. Mukhamedshin, K. D. and Sartbaev, S. K. The increment cycle of Juniper in the high mountain conditions of the Tien Shan. Izv AN KirgSSR. 1972; 255-60.
Keywords: *Juniperus seravschanica*/ *Juniperus semiglobosa* / *Juniperus turkestanica*/ water relations/ growth rings.
Abstract: Describes studies on 1580 trees of *Juniperus* spp. It is shown that wood is laid down annually, even at the alpine forest limit, and therefore Junipers can be used for dendrochronological and dendroclimatic research. In the arid lower regions the growth of *J. seravschanica* and *J. semiglobosa* is determined mainly by moisture, and high temperatures in the growing season (especially in July) have an adverse effect. In the colder and moister higher regions the increment of *J. turkestanica* is determined mainly by the temperature in June/July.
6. Sakhatskii, V M. Effect of temperature on the field germination of seeds of *Juniperus seravschanica*. Tr-Chatkal' Sk Gorno Les Zapovedn. 1972; 3128-143.
Keywords: *Juniperus seravschanica*/ germination/ seeds/ temperature
Abstract: In experiments to determine the optimum time for sowing *J. seravschanica*, summer/autumn sowings gave the greatest field germination in the first spring. The seeds sown should receive a sum of 750 deg C in mean daily air temperatures above 5 deg during autumn. When stratified seeds are sown, the first phase of development is completed in Oct./Nov. when the mean daily air and soil temperatures go above and below 5 deg ; the second phase proceeds during winter. With increasing altitude the number of days needed for the first phase decreases, but the duration of the second phase increases.
7. Sakhatskii, V. M. The sowing qualities of seeds of junipers in Central Asia. Posevnye kachestva semyan mozhzhevel'nikov v Srednei Azii. Lesnoe Khozyaistvo. 1979; 1240-42.
Keywords: *Juniperus turcomanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turkestanica*/ sowing rates/ nursery/ seed/ handling seed/ Central Asia
Abstract: On the basis of studies in Soviet Central Asia in 1963-70, data are tabulated on the physical characteristics and sowing qualities of seed of *Juniperus turcomanica*, *J. semiglobosa*, *J. seravschanica* and *J. turkestanica*. Standard sowing rates are calculated for each species; for 1

ha of nursery area this ranges from 400 kg clean seed of *J. semiglobosa* to 2970 kg clean seed of *J. turkestanica*. The treatment and handling of juniper seed are discussed, and sowing dates are given for various areas, depending on alt.

8. Sultanov, Yu and Padalko, V V. Growing plantations of junipers. Lesnoe-Khozyaistvo. 1988; 1153-54.

Keywords: *Juniperus seravschanica*/ *Juniperus semiglobosa*/
Juniperus turkestanica/ seed collection/ plantation/ root/ growth

Abstract: A note is given on the techniques of seed collection and treatment, and plantation establishment, used successfully in Tadzhikistan for growing *Juniperus seravschanica*, *J. semiglobosa* and *J. turkestanica*. Height growth is typically slow, but root growth is quite rapid, and the total length of roots in the third year is 54.57 m per plant, and the root penetration depth is 117 cm.

***Juniperus sibirica* (6)**

1. Filipovich, L. A. Anthropogenic influence on the vegetation development on the high slopes of vitosa mountain Bulgaria during the late postglacial times. Fitologiya. 1988; 3525-34.

Keywords: *Juniperus sibirica*/ *Pinus*/ *Vaccinium*/ *Bruckenthalia*/
Bulgaria/ pollen/ anthropogenic influence

Abstract: The palynological studies carried out in the past years on peat bogs in Vitosa Mountain proved that human housing activities played a considerable part for the vegetation development during the late Postglacial times. The influence of human activity began probably in the Eneolithic and increased gradually. Due to the high-mountainous position of the peat bogs in Vitosa Mountain, the palynological-data go back to a later time, when the material culture of the population in Vitosa region allowed the use of the natural resources, including the plant cover, on the higher mountain slopes. Therefore, no traces of human activity are marked in the pollen diagrams during the first phase, so far established, of mixed deciduous forests and birch and hazelbush communities, and corresponding in a time sequence to the Eneolithic. Probably, human activities were confined within the foothills of the mountain. During the stage of the hornbeam and coniferous forests which extends over the Bronze Age and the beginning of the Iron Age, the pollen diagrams included grains of *Chenopodiaceae*, *Artemisia*, *Urtica*, *Rumex*, *R. alpinus* L., *Plantago lanceolata* L., and in some of them-of *Polygonum aviculare* L., *Avena*, *Triticum*, *Centaurea cyanus* L. Therefore, it can be assumed that part of the cattle grazed in summer on the grassy places on the mountain slopes. At the beginning of the stage of beech and coniferous forests (during the Iron Age) the quantity of anthropophytic elements from the herb vegetation strongly increased in all pollen diagrams, which undoubtedly proves the steady presence of man on the high slopes. Man's influence has been a main factor of vegetation changes since the Middle

Ages. It has turned part of the woods into shrubs; the mountain slopes, especially the southern ones have been strongly deforested; the upper limit of the forests has been secondarily lowered; *Pinus mugo* Turra has been destroyed; the communities of *Juniperus sibirica* Burgsd., *Vaccinium*, *Bruckenthalia*, and the herb communities have been expanded. Mountain stock-breeding has played the greatest part for the changes in the plant cover of Vitosa Mountain since the Bronze Age till the past decades. Second in duration, but not in harmfulness, has been the iron-production. Its intensity was highest in the 1386-1860 period. The least significant factor was agriculture, due to its limited spread over the mountain slopes. Certainly, the need for wood for heating, for building purposes, etc., have also had effect on the vegetation changes, along with the very presence of man and his fortifying constructions in different periods. The protection measures for the forests and the constant afforestation in the past decades, as well as the proclaiming of Vitosa as a National Park and formation of reserves within its area, have led to a gradual recreation of the natural resources of the mountain.

2. Khantemirov, R. M.; Shiyatov, S. G., and Gorlanova, L. A. The dendroclimatic potential of *Juniperus sibirica*. . Lesovedenie. 1999; 633-38.
Keywords: *Juniperus sibirica*/ *Juniperus communis*/ Russia/ *Picea*/ *Larix*/ dendroclimate
Abstract: Discs were taken from the best developed branches of 26 of the oldest bushes of *Juniperus sibirica* [*Juniperus communis* var. *montana*] growing in sparse larch forests in the Polar Urals. Discs were also taken from dead branches found near the living juniper bushes. Analysis of the discs allowed a 636-year ring-width chronology to be produced, revealing the mean May/June/July temperature of the current year to be the main climatic factor affecting radial increment. Comparison of the juniper chronology with the chronologies for *Larix sibirica* and *Picea obovata* revealed similarities and differences between the bushes and the trees. Constructing a combined chronology based on juniper and larch provided a much more reliable reconstruction of mean June/July temperatures than a chronology based on larch alone.
3. Kozhevnikova, Z. V. Anatomical structure of the stem of Far Eastern species of juniper in relation to the features of root formation in cuttings. Byulleten' Glavnogo Botanicheskogo Sada. 1991; 16034-41.
Keywords: *Juniperus rigida*/ *Juniperus sibirica*/ *Juniperus conferta*/ *Juniperus dahurica*/ *Juniperus sargentii*/ vegetative propagation/ roots/ adventitious roots.
Abstract: Anatomical studies were made of the stems (often trailing or prostrate) of *Juniperus rigida*, *J. sibirica*, *J. conferta*, *J. dahurica* and *J. sargentii*, with special reference to the bark and the initiation of roots. All five species are capable of propagation by cuttings, and all of them produce a few or numerous root primordia on the stems in the crown, except for *J. rigida*. In lignified cuttings of *J. sibirica*, *J. conferta* and *J.*

sargentii the root system is formed by adventitious roots all along the part of the stem in the soil and also from wound callus at the cut surface. *J. dahurica* forms roots mainly along the stem in the soil, and *J. rigida* mainly from the wound callus. In green cuttings in all five species the roots are formed only from the wound meristems.

4. ---. Seed anatomy and some peculiarities of germination in Soviet Far Eastern species of juniper. Byulleten' Glavnogo Botanicheskogo Sada. 1986; 14199-107; ISSN: 0366-502X.
Keywords: *Juniperus conferta*/ *Juniperus rigida*/ *Juniperus davurica*/ *Juniperus sargentii*/ *Juniperus sibirica*/ seeds/ morphology/ germination/ seed anatomy/ conifers
Abstract: Seeds of *Juniperus conferta*, *J. davurica*, *J. rigida*, *J. sargentii* and *J. sibirica* were collected in the Far East and examined by light microscopy and SEM. Data are tabulated on the max., min. and mean seed dimensions, spermoderm thickness and size of resin capsules, and the mean cell sizes in the tissues of the seed coat. In *J. davurica* and *J. sargentii*, the spermoderm was differentiated into 3 layers with a fleshy outer layer (sarcotesta). Observations are reported on seasonal reproductive behaviour, and anatomical development of the seed and ripening of the fruits are described. The resin capsules of the seed were derived from fruit tissue. Seeds from ripe fruits were in a state of deep rest. For rapid germination, seed extraction is recommended 1.5-2 months before the ripening of the fruits.
5. ---. Vegetative propagation of Far Eastern junipers in the southern Maritime Province. Byulleten' Glavnogo Botanicheskogo Sada. 1991; 16190-98.
Keywords: *Juniperus rigida*/ *Juniperus conferta*/ *Juniperus sibirica*/ *Juniperus dahurica*/ *Juniperus sargentii* / cuttings/ propagation/ rooting
Abstract: An account is given of experience in propagating *Juniperus rigida*, *J. conferta*, *J. sibirica*, *J. dahurica* and *J. sargentii* by cuttings. It is best to use lignified cuttings taken from the terminal part of stout shoots containing two complete annual extensions. Green cuttings are only feasible with *J. dahurica* and *J. sargentii*. Cuttings should be rooted at the beginning or in the first half of the growing season; summer/autumn rooting is preferable only for *J. rigida*. The cuttings should be inserted at an angle - greatest for cuttings of prostrate species and least (i.e nearly upright) for arborescent species. *J. dahurica*, *J. sibirica* and *J. conferta* root easily, mainly from the rudiments of adventitious roots and also from wound meristems, in one growing season; *J. rigida* and *J. sargentii* are more difficult to root, forming only wound callus in the first growing season and rooting in the second year.
6. Malynovs'kyi, K. A.; Klymyshyn, O. S., and Popadyuk, R. V. Effect of the reserve regime on the regeneration of indigenous vegetation in the high Carpathian Mountains Ukrainian SSR USSR. Ukrayins'Ky Botanychnyi Zhurnal. 1987; 44(3):62-66.

Keywords: *Juniperus sibirica*/ *Pinus mugo*/ *Duschekia*/ phytocenoses/ Carpathian Mountains/ USSR/ restoration/ community/ *Piceetum myrtillosum*

Abstract: *Pinus mugo* Turra, *Duschekia viridis* (Chaix) Opiz and *Juniperus sibirica* Burgsa in phytocenoses on the upper boundary of the forest and in the subalpine belt of the Carpathians at a height of 1450-1650 m above sea level are analyzed for their seed renewal and vegetative growth. Possible ways to rehabilitate the native forest and shrubby plant cover in the place of degraded pastures are determined. The rate of natural restoration of native associations depends on ecological and cenotic conditions, biological properties of their dominants and a degradation degree of derivative communities. Complete rehabilitation of communities of the association *Duschekietum herboso-myrtillosum* which are at the dense-turf stage of digression is possible under favourable conditions for 15-20 years. Rehabilitation of communities of the association *Piceetum myrtillosum* under favourable conditions occurs through the intermediate communities of and may last for dozens of years.

Juniperus squamata (12)

1. Adams, R. P. Reconciling differences among morphological, chemical and molecular data in the taxonomy of *Juniperus*. Acta Horticulturae. 2003; 61291-106.

Keywords: *Juniperus blancoi*/ *Juniperus mucronata*/ *Juniperus scopulorum*/ *Juniperus convallium*/ *Juniperus excelsa*/ *Juniperus procera*/ *Juniperus pingii*/ *Juniperus recurva*/ *Juniperus squamata*/ chemical composition/ genomes/ plant morphology.

Abstract: Several cases involving apparent discordance in morphological, chemical (terpenoids) and molecular data are discussed that relate to species of *Juniperus*. These examples include *J. blancoi*, *J. mucronata*, *J. scopulorum*, *J. convallium* var. *convallium*, *J. convallium* var. *microsperma*, *J. excelsa*, *J. procera*, *J. pingii* var. *pingii*, *J. pingii* var. *carinata*, *J. recurva* var. *recurva*, *J. recurva* var. *coxii*, *J. squamata* var. *squamata*, and *J. squamata* var. *morrisonicola*. In these cases, the morphological characters of several putative *Juniperus* species are essentially identical, yet terpenoids and/or molecular data separate some taxa previously merged. To reconcile these discordant data sets, a multidimensional perspective must be taken to evaluate the sum of these gene differences and then integrate these gene differences into the taxonomy. A three-dimensional model is presented to attempt to explain these perspectives.

2. ---. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). USABiochemical Systematics & Ecology. 2000; 28(6):529-543.

Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus*

pseudosabina/ Juniperus recurva/ Juniperus saltuaria/ Juniperus squamata/ Juniperus tibetica/ Juniperus wallichiana/ RAPD/ DNA/ essential oils

Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallichiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

3. Behrens, V. Cold storage of unrooted coniferous cuttings III. correlation of food reserves and rooting. *Gartenbauwissenschaft*. 1987; 52(4):161-165.
Keywords: *Juniperus squamata/ Picea glauca/ Chamaecyparis lawsoniana/ Taxus/ storage/ cuttings/ rooting*
Abstract: Cuttings of four species [*Chamaecyparis lawsoniana*, *Juniperus squamata*, *Picea glauca* and *Taxus .times. media*] were stored over winter in order to save energy. Respiration of food reserves during storage depended on storage conditions. Decrease of carbohydrate content was clearly less at a temperature of -2° C in comparison to a temperature of +2° C. A controlled atmosphere of 3% CO₂ and 3% O₂ was superior to normal atmosphere for two of the tested species only. The carbohydrate content depended essentially on the sucrose content. Within the investigated range a significant linear correlation was found between the carbohydrate content and the rooting potential after storage. The longer the rooting period, the weaker was this correlation. Protein and fat could not be proved to be an energy source for the stored cuttings. The influence of food reserves on rooting is discussed.
4. Chaturvedi M. Studies on the pollen grains of *Juniperus* L. *Current Science*. 50(12). 1981. 548-549.
Palynol. Lab., National Bot. Res. Inst., Lucknow 226 001, India. 1981; 50(12):548-549.
Keywords: *Juniperus excelsa/ Juniperus macropoda/ Juniperus pseudosabina/ Juniperus squamata/ Juniperus wallichiana/ Himalayas/ pollen*
Abstract: Light microscopic and SEM studies of 5 species (*J. excelsa*, *J. macropoda*, *J. pseudosabina*, *J. squamata* and *J. wallichiana*) from the Himalayas.

5. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secret Arboretum. Special Circular Ohio Agricultural Research and Development Center. 1992; 14032-34.
Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus virginiana*/ *Juniperus scopulorum*/ *Juniperus squamata*/ growth habit
Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate or convergent. All plants were also evaluated for growth characteristics of open or closed outline.

6. Dar, G. H. and Christensen, K. I. Gymnosperms of the Western Himalaya. 1. The genus *Juniperus* (*Cupressaceae*). Pakistan Journal of Botany. 2003; 35(3):283-311.
Keywords: *Juniperus communis*/ *Juniperus squamata* / *Juniperus recurva*/ *Juniperus semiglobosa*/ *Juniperus polycarpus*/ *Juniperus wallichiana*/ *Juniperus pseudosabina*/ Himalaya
Abstract: A thorough study of an extensive collection of herbarium specimens and literature of *Juniperus* (*Cupressaceae*) from the Western Himalaya, during our work on gymnosperms of this region, has revealed that the taxonomy of West Himalayan Junipers has been confusing. A total of up to 6 taxa have been reported from this region by various earlier workers under a large number of specific and infraspecific names, most of which are synonyms. Seven taxa are recognized from the Western Himalaya in the present study: one belonging to *Juniperus* Sect. *Juniperus*, *J. communis* var. *saxatilis*, and the other six to *Juniperus* Sect. *Sabina*. The latter section includes two acicular-leaved species, *J. squamata* and *J. recurva*, and four scale-leaved species: two multiseed, *J. semiglobosa* and *J. polycarpus*, and two monoseed, *J. wallichiana* and *J. pseudosabina*.

7. Jain, K. K. A taxonomic revision of the Himalayan Junipers. Indian Forester. 1976; 102(2):109-188.
Keywords: *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ *Juniperus communis*/ *Juniperus pseudosabina*/ taxonomy/ Himalayas
Abstract: Discusses the taxonomy of *Juniperus* in the Himalayas. On the basis of morphological and anatomical studies (including studies of wood anatomy) eight taxa were identified. Of the species that are trees, *J. wallichiana*, *J. recurva* and *J. fargesii* [*J. squamata* var. *fargesii*] are restricted to the eastern Himalayas and *J. macropoda* and *J. excelsa* to the western Himalayas. Of the shrubs, *J. communis* subsp. *nana* occurs only

in the western Himalayas, but *J. pseudosabina* and *J. squamata* occur throughout the area. Each species is briefly described.

8. Kaushal, P. S. Studies in the Western Himalayan junipers: I. distribution pattern and taxonomic considerations. Research Bulletin of the Panjab University, Science. 1994; 44(1/4):53-62.
Keywords: *Juniperus communis*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ taxonomy/ India
Abstract: Five taxa of *Juniperus*, of which two with tree habit, are recorded from Western Himalaya in the States of Himachal Pradesh and Jammu and Kashmir, India and are studied for their morphological variation and distribution. The genus is represented by two distinct tree species (*J. macropoda* and *J. excelsa*) and three with shrubby forms (*J. communis*, *J. squamata* and *J. pseudosabina*). Several variants are observed in the polymorphic *J. squamata*. *Juniperus communis* and *J. pseudosabina* are morphologically conservative. A putative hybrid, intermediate in characters between *J. squamata* and *J. pseudosabina*, has also been recorded.
9. Mehra, P. N. and Jain, K. K. *Abies* and *Juniperus* complexes in the E. Himalayas with observations on *Larix griffithii* Hook. f. and *Tsuga dumosa* Eichler. *Abies* and *Juniperus* Complexes in the E. Himalayas With Observations on *Larix Griffithii* Hook. F. and *Tsuga Dumosa* Eichler. 1976; 143.
Keywords: *Juniperus pseudosabina*/ *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus fargesii*/ *Juniperus squamata*/ *Abies forrestii*/ *Abies spectabilis*/ anatomy/ morphology/ taxonomy/ classification.
Abstract: The main part of the book describes in detail the morphology and anatomy of leaves, young shoots, wood, bark and female cones of *Abies* and *Juniperus*, with 77 photographs and line drawings. Evolutionary trends in *Juniperus* and the *Pinaceae* are discussed and a short bibliography is included. It is concluded that *A. forrestii* is distinct from *A. spectabilis* and that the sabinoid group of *Juniperus* includes *J. pseudosabina* and *J. wallichiana* and the oxycedroid group *J. recurva*, *J. fargesii* and *J. squamata* var. *wilsonii*.
10. Rioux, J A.; Richer, C., and Lamy, M P. Tolerance evaluation of eleven junipers (*Juniperus* sp.) under north-eastern Canadian climatic conditions. Canadian Journal of Plant Science. 2004; 84(4):1135-1153.
Keywords: *Juniperus communis*/ *Juniperus sabina*/ *Juniperus squamata*/ *Juniperus horizontalis*/ Canada/ winter hardiness/ growth
Abstract: Young plants of 11 species and cultivate of junipers were planted between 1987 and 1994 in six or eight sites distributed in northeastern Canadian climatic zones 2a to 5b (the most populated zones of Quebec). These plants were evaluated over a 5-yr period to provide more detailed information about the winter hardiness and growth under these climatic conditions. *Juniperus sabina* 'Blue Danube', the control, was established five times and compared to the 10 other junipers. These

plants were observed for a 5-yr period in order to determine their winter hardiness and growth under these climatic conditions. Survival and usage potentials of *J. sabina* and its cultivars Blue Danube and Broadmoor, *J. horizontalis* 'Douglasii', *J. communis* 'Rependa' and 'Depressa Aurea' and *J. squamata* 'Blue Carpet' were established in zone 2a. These potentials could be extended to zone 1b for *J. sabina*, *J. s.* 'Blue Danube' and 'Douglasii' and 'Rependa' cultivars, no mortality was observed in the coldest zone (2a). *J. squamata* 'Blue Star' is the less hardy cultivar, and its survival and usage potentials were fixed to zone 4. Furthermore, *J. sabina* 'Wapiti' can survive and be used in zone 2b. *J. x media* 'Pfitzeriana' and *J. squamata* 'Meyeri' can survive in zone 2b, but can be used in zone 4. The three *J. squamata* cultivars and *J. x media* 'Pfitzeriana' are often affected by foliage desiccation in their respective usage zones. The full ornamental potential was observed in zone 2a for *J. horizontalis* 'Douglasii', in zone 2b for *J. sabina*, his 'Blue Danube' and 'Broadmoor' cultivars and *J. communis* 'Rependa', and in zone 5b for *J. x media* 'Pfitzeriana', *J. squamata* 'Blue Carpet' and 'Blue Star'. This potential has been observed only in zone 4a for *J. communis* 'Depressa Aurea', *J. sabina* 'Wapiti' and *J. squamata* 'Meyeri', snow cover being an important factor.

11. Su, H. J. The communities of *Juniperus squamata* in the alpine regions of Taiwan. Technical Bulletin, Experimental Forest of National Taiwan University. 1974; 113:101-112.
Keywords: *Juniperus squamata*/ *Abies kawakamii*/ synecology/ ecotones/ succession.
Abstract: Describes two communities of trees (see below) and five of shrubs (ranging from closed thickets to open tundra with 'cushion-like krummholz') of *J. squamata*, the dominant species on both sides of the tree-line. The work is based on 35 plot surveys in 1971-73 for which mean cover and frequency data are given for each community. Stand tables are also given for 5 stands each of (a) the 'consociation of trees of *J. squamata*', and (b) the 'association of trees of *J. squamata* and *Abies kawakamii*'. The seral relations of the seven communities were determined: (a), which has a well developed grass layer, forms a climax on cirque-like valleys and sheltered ridges, whereas (b) forms an ecotone with *A. kawakamii* forest at lower altitudes. Fire causes a secondary succession that takes thousands of years to complete. These communities are important for soil and water conservation.

12. Yu Y. F. and Fu L. K. Notes on Gymnosperms II. New taxa and combinations in *Juniperus* (*Cupressaceae*) and *Ephedra* (*Ephedraceae*) from China. Novon. 1997; 7(4):443-444.
Keywords: *Juniperus chengii*/ *Juniperus baimashanensis*/ *Juniperus pingii*/ *Juniperus squamata*/ *Ephedra*/ China/ varieties
Abstract: Two new species, *Juniperus chengii* L. K. Fu and Y. F. Yu and *J. baimashanensis* Y. F. Yu and L. K. Fu, and three new varieties, *J. pingii* Cheng ex Ferre var. *carinata* Y. F. Yu and L. K. Fu, *J. squamata*

Buchanan-Hamilton ex D. Don var. *parvifolia* Y. F. Yu and L. K. Fu, and *J. squamata* var. *hongxiensis* Y. F. Yu and L. K. Fu, are described. Two new combinations in *Juniperus* and one in *Ephedra* are proposed.

***Juniperus standleyi* (1)**

1. Adams, R. P. The serrate leaf margined *Juniperus* (section Sabina) of the western hemisphere: Systematics and evolution based on leaf essential oils and Random Amplified Polymorphic DNAs (RAPDs). *Biochemical Systematics and Ecology*. 2000; 28(10):975-989.

Keywords: *Juniperus angosturana*/ *Juniperus ashei*/ *Juniperus californica*/ *Juniperus coahuilensis*/ *Juniperus comitana*/ *Juniperus deppeana*/ *Juniperus durangensis*/ *Juniperus flaccida*/ *Juniperus gamboana*/ *Juniperus jaliscana*/ *Juniperus monosperma*/ *Juniperus monticola*/ *Juniperus osteosperma*/ *Juniperus occidentalis*/ *Juniperus pinchotii*/ *Juniperus saltillensis*/ *Juniperus standleyi*/ essential oils/ DNA/ RAPD

Abstract: The volatile leaf essential compositions of all 17 serrate leaf margin species of *Juniperus* (sect. Sabina) of the western hemisphere are reported and compared: *J. angosturana*, *J. ashei*, *J. californica*, *J. coahuilensis*, *J. comitana*, *J. deppeana*, *J. durangensis*, *J. flaccida*, *J. gamboana*, *J. jaliscana*, *J. monosperma*, *J. monticola*, *J. osteosperma*, *J. occidentalis*, *J. pinchotii*, *J. saltillensis*, and *J. standleyi*. A number of previously unidentified compounds of the leaf essential oils have now been identified. In addition, DNA data (RAPDs) of all these species were analyzed. Both the leaf essential oils and DNA show these species to be quite distinct with few apparent subgroups, such that the species groupings were not strong in either data set. These data support the hypothesis that this group of junipers originated in Mexico as part of the Madro-Tertiary flora by rapid radiation into new arid land habitats, leaving few extant intermediate taxa.

***Juniperus taxifolia* (1)**

1. Adams, Robert P.; Hsieh, Chang-Fu; Murata, Jim, and Pandey, Ram Nanresh. Systematics of *Juniperus* from eastern Asia based on Random Amplified Polymorphic DNA's (RAPDs). *Biochemical Systematics and Ecology*. 2002 Mar; 30(3):231-241; ISSN: 0305-1978.

Keywords: *Juniperus chinensis*/ *Juniperus communis*/ *Juniperus conferta*/ *Juniperus formosana*/ *Juniperus procumbens*/ *Juniperus rigida*/ *Juniperus taxifolia*/ RAPS's/ DNA/ Taiwan/ China
Call Number: QD415.A1B5

Abstract: DNA was examined by RAPD banding for *Juniperus chinensis*, *J. c.* var. *sargentii*, *J. c.* var. *tsukusiensis*, *J. communis*, *J. c.* var. *nipponica*, *J. c.* var. *saxatilis*, *J. conferta*, *J. formosana*, *J. procumbens*, *J. rigida*, *J. taxifolia*, and *J. t.* var. *lutchuensis*. The DNA data readily separated junipers of section *Sabina* from section *Juniperus*. *J. c.* var.

tsukusiensis from Taiwan was found to be sufficiently different from *J. c.* var. *tsukusiensis* (Yakushima) to warrant the recognition of a new variety: *J. chinensis* var. *taiwanensis* R.P. Adams and C-F. Hsieh *nov. var.* *Juniperus formosana* from mainland China was found to be different from *J. formosana* from Taiwan and a new variety is recognized: *J. formosana* var. *mairei* (Lemee and Lev.) R.P. Adams and C-F. Hsieh *comb. nov.* *Juniperus communis* var. *nipponica* was found to be distinct from *J. communis* and this supports its recognition as a variety. The recognition of *J. conferta* as a variety of *J. rigida* [*J. rigida* var. *conferta* (Parl.) Patschke] is supported by the data. The data also supports the recognition of *J. lutchuensis* Koidz. [= *J. taxifolia* var. *lutchuensis* (Koldz.) Satake] and *J. morrisonicola* Hayata [= *J. squamata* var. *morrisonicola* (Hayata) H.L. Li and H. Keng] at the specific levels.

***Juniperus thurifera* (36)**

1. Adams R. P.; Mumba L. E.; James S. A.; Pandey R. N.; Gauquelin T., and Badri W. Geographic variation in the leaf oils and DNA fingerprints (RAPDs) of *Juniperus thurifera* L. from Morocco and Europe. *Journal of Essential Oil Research*. 2003; 15(3):148-154.
Keywords: *Juniperus thurifera*/ *Juniperus foetidissima*/ *Juniperus africana*/ Morocco/ Europe/ leaf oils/ populations/ seeds/ cones
Abstract: Samples of *J. thurifera* were collected from the Atlas Mountains, Morocco, northern and southern Spain, the Pyrenees, France, French Alps and Corse Island, France. The leaf oils were analyzed and were found to be polymorphic for several major compounds (sabinene, limonene, linalool, piperitone, linalyl acetate and sesquiterpenes). In general, the Moroccan trees were higher in sabinene, gamma -terpinene, cis-sabinene hydrate and terpinen-4-ol, but lower in limonene, delta -2-carene, and piperitone than trees from Europe. Analysis based on random amplified polymorphic DNAs (RAPDs) for the aforementioned population plus *J. foetidissima* (as an outgroup), revealed that the Moroccan *J. thurifera* populations were most similar to plants from southern Spain, then to populations from France. Although the trees generally clustered by populations, there appear to be some differentiation in the RAPDs between the European *J. thurifera* populations and the Moroccan populations. Combining previous studies on seeds per cone, proanthocyanidins, and the current report on the leaf essential oils and RAPDs, there is some support for the continued recognition of *J. thurifera* vat. *africana* syn. *J. africana*; *J. thurifera* subsp. *africana* in Algeria and Morocco.
2. Badri, W. and Gauquelin, T. The hydrological cycle and changes of soil water storage in a *Juniperus thurifera* stand in the Moroccan High Atlas mountains. Cycle de l'eau et variations du stock d'eau dans le sol dans une station a Genevrier thurifere (*Juniperus thurifera* L.) dans le haut Atlas du Maroc. *Ecohydrology of High Mountain Areas: Proceedings on*

Ecophysiology, Kathmandu, Nepal, 24-28 March 1996. 1998; 315-321.

Keywords: *Juniperus thurifera*/ soil water/ Morocco

Abstract: As part of an integrated research project on the ecology of *Juniperus thurifera*, the redistribution of rainfall by tree crowns located in the Marrakech High Atlas Mountains was studied for 2 years. The average interception for this period was 43.8%, the monthly values varied between 14.8 and 100%. In spite of significant variability in the annual rainfall of this region (23%), the components of the hydrological cycle varied only slightly. However, the presence of juniper trees induced some important modifications in the distribution of rainfall on the ground. As a consequence, soil moisture beneath trees differed considerably from that in open ground.

3. Barbero M. ; Mammoud A., and Quezel P. Discovery in the Maritime Italian Alps of the juniper *Juniperus thurifera* L.
Sur la decouverte dans les Alpes maritimes italiennes du genevrier thurifere (*Juniperus thurifera* L.). *Webbia*. 1988; 42(1):49-55.
Keywords: *Juniperus thurifera*/ *Quercus pubescens*/ Italy/ Alps
Abstract: *Juniperus thurifera* was discovered on southern facing cliffs of the Supramediterranean *Quercus pubescens* series in the low-lying Gesso and Stura valleys. Its presence in the southern Piedmont demonstrates the biogeographic originality of this region where West and East Mediterranean species mix.
4. Barrero A. F.; Quilez Del Moral J. F.; Herrador M. M.; Akssira M.; Bennamara A.; Akkad S., and Aitigri M. Oxygenated diterpenes and other constituents from Moroccan *Juniperus phoenicea* and *Juniperus thurifera* var. *africana*. *Phytochemistry*. 2004; 65(17):2507-2515.
Keywords: *Juniperus thurifera*/ *Juniperus phoenicea*/ Morocco/ diterpenes
Abstract: Six new diterpenic acids isolated as their methyl ester together the isovalerate derivatives of p-methoxycinnamyl alcohol and 8-hydroxylinalool, were isolated from the leaves of *Juniperus thurifera* and *Juniperus phoenicea*, grown in Morocco. The cytotoxicity of the abietane diterpenoids was tested against five cell lines. Six new diterpenic acids isolated as their methyl ester derivatives, i.e., methyl 12-oxo-8a,15-dihydroxyabiet-13-en-19-oate, methyl 12-oxo-8a-hydroxyabiet-13-en-19-oate, methyl 15-hydroperoxy- 8a,12a-epidioxiabiet-13-en-19-oate, methyl 15-hydroxy-8a, 12a-epidioxiabiet-13-en-19-oate, methyl 15-hydroperoxy-8a,14a, 12a,13a-diepoxiabietan-13-en-19-oate, and methyl 7a,12a-dihydroxysandaracopimarate, together with two new isovalerate derivatives of p-methoxycinnamyl alcohol and linalool, were isolated from the leaves of *Juniperus thurifera* var. *africana* and *Juniperus phoenicea*, grown in Morocco. The structures of these compounds were established by using spectroscopic techniques, including 2D NMR spectra. The cytotoxicity of the abietane diterpenoids was tested against five cell lines.

5. Bertaudiere, V.; Montes, N.; Badri, W., and Gauquelin, T. Multicaulis structure of *Juniperus thurifera*: Adaptation to severe environment?
La structure multicaule du genévrier thurifère: avantage adaptatif à un environnement sévère? *Comptes Rendus De L' Academie Des Sciences Serie III*. 2001; 324(7):627-634.
Keywords: *Juniperus thurifera*/ Morocco/ growth/ multi-caulis structure
Abstract: A comparative study of radial growth and biomass between multi-stemmed trees with variable number of stems and single-stemmed trees was carried out to better understand determinism and organization of multicaulis structure of a juniper species (*Juniperus thurifera* L.) growing in high Mediterranean mountains (High Atlas, Morocco). It appears that all the stems of the same tree have similar ages and so simultaneous development. Their mean annual radial increments show significant differences because of probable competition for water and nutrient supply and obvious physical competition for space. The multi-stemmed trees characterized by low number of stems have the same mean annual radial growth as single-stemmed trees and more generally all multi-stemmed junipers have a higher biomass. The multi-caulis structure of *Juniperus thurifera* thus could be considered as an adaptation to severe environment, characterized not only by hard topographical, edaphic and climatic conditions, but by strong human pressure too.

6. Bertaudiere, V.; Montes, N.; Gauquelin, T., and Edouard, J. L. Dendroecology of thuriferous juniper (*Juniperus thurifera* L.): Example from a French Pyrenean site at Rie mountain. *Annals of Forest Science*. 1999; 56(8):685-397.
Keywords: *Juniperus thurifera*/ dendroecology/ France/ growth/ climate
Abstract: According to its distribution area (western Mediterranean basin) and its current and past use, the cultural and biogeographical interest of *Juniperus thurifera* is today recognized. A dendroecological study was carried out to better understand the radial growth responses to climate and the population dynamics of a stand submitted to rural activity decline. According to the comparison of inter-annual variations in radial growth with monthly climatic parameters (response functions and pointer-year analysis), the influences on the annual tree-ring width of water availability during the current summer and other climatic conditions during the previous autumn were demonstrated. The occurrence of double rings were correlated with variations in summer precipitation. This may emphasize the capability of Thuriferous juniper to react promptly to precipitation events in xerothermic conditions associated with peculiarities of the sub-Mediterranean climate. The width and the interannual structure of tree rings indicated that Thuriferous juniper growth is strongly correlated with climate variability. An extended dendrochronological study considering its distribution range would allow us to decipher the species' autecological peculiarities.

7. Bigot, L; Boumezzough, A, and El-Fels, A El A. Contribution to study of the insects of the frankincense-producing juniper (*Juniperus thurifera* L.) in the Moroccan High Atlas: biology of two dominant pest *Microlepidoptera* of the galbuli and seeds: *Argyrestia reticulata* (*Yponomeutidae*) and *Pammene juniperana* (*Tortricidae*), species new for Morocco (Lep.). Bulletin De La Societe Entomologique De France. 1989; 93(7-8):233-238; ISSN: 0151-0517.
Keywords: *Juniperus thurifera*/ damage/ Seeds/ Insect pests/ distribution/ biology/ pests/ trees/ geographical distribution/ agricultural entomology
Abstract: *Argyresthia reticulata* and *Pammene juniperana* are recorded for the 1st time from Morocco, where they are the 2 most important pests of the galbuli and seeds of *Juniperus thurifera*. The adult genitalia are described and notes on their biology and injuriousness are provided from observation at 2 places in the Atlas Mts. in 1986-87. Up to 45% of the galbuli and 34% of the seeds were attacked by *A. reticulata*, which was the more important of the 2 pests.

8. Borel, A. and Polidori, J. L. Spanish juniper (*Juniperus thurifera*) in the Mercantour National Park, Alpes-Maritimes department, France. Le genevrier thurifere (*Juniperus thurifera* L.) dans le Parc National du Mercantour (Alpes-Maritimes). Bulletin De La Societe Botanique De France, Lettres Botaniques. 1983; 130(3):227-242.
Keywords: *Juniperus thurifera*/ France

9. Carrion, S. E-mail carrion@um.es; Yll, E. I.; Willis, K. J., and Sanchez, P. Holocene forest history of the eastern plateau in the Segura Mountains (Murcia, southeastern Spain). Review of Palaeobotany & Palynology. 2004 Dec; 132(3-4):219-236.
Keywords: *Juniperus thurifera*/ Holocene/ Spain/ *Quercus*
Abstract: This paper presents a mid- to late-Holocene vegetation sequence of a *Juniperus thurifera*-dominated area in the eastern, continental plateau of the Segura Mountains of southeastern Spain. A mid-Holocene maximum of mesic tress is recorded in the pollen diagram between c. 6640 and 4790 cal years BP with the vegetation dominated by deciduous oaks. A dramatic decline in deciduous oaks occurred from approximately 4700 cal years BP to be replaced initially by evergreen oak, and then junipers and other xerophytes from c. 4500 cal years BP. This trend of xericness in the vegetation is coherent with regional and extra-regional palaeoclimatic records for increased mid-Holocene aridity. Significant anthropogenic modification of the vegetation occurred in this region from c. 1350 cal years BP represented by a large reduction in all tree taxa (except *Juniperus*) and increases of thorny scrub and nitrophilous assemblages. Increased fire incidence, pastoralism, and arboriculture were associated with this anthropogenic activity. We conclude that present-day *J. thurifera*-dominated communities in this region have become established through a combination of two predominant processes;

increased aridification from c.4500 cal years BP and anthropogenic activity from c. 1200 cal years BP.

10. Cerro-Barja A. del and Lopez-Serrano F. R. Structural, mensurational and silvicultural aspects of a mixed stand [*Quercus ilex*, *Q. rotundifolia*, *Q. faginea*, *Q. coccifera*, *Juniperus thurifera* and *J. oxycedrus*] in the south east of Spain. Mixed Stands: Research Plots, Measurements and Results, Models Proceedings From the Symposium of the IUFRO Working Groups S401, Apri -25-29, 1994 in Lousa/Coimbra, Portugal. 1994; 159-177.
Keywords: *Juniperus thurifera*/ *Juniperus oxycedrus*/ *Quercus ilex*/ *Q. rotundifolia*/ *Q. faginea*/ *Q. coccifera*/ Spain/ stands/ models/ mixed forests
11. Costa, M; Perez Badia, R, and Soriano, P. The *Juniperus thurifera* forests of Valencia. Acta Botanica Malacitana. 1990; 15297-301.
Keywords: *Juniperus phoenicea*/ *Juniperus thurifera*/ *Quercus rotundifolia*/ *Juniperus hemisperica*/ Spain/ distribution
Abstract: The distribution and main features are described of the Junipereto phoeniceae-thuriferae, Junipereto thuriferae-Querceto rotundifoliae and Junipereto hemisphaerico-thuriferae communities in the Valencia region of Spain.
12. Costa-Tenorio M.; Gomez-Manzaneque F.; Morla-Juaristi C., and Sainz-Ollero H. Geobotany and phytosociology of *Juniperus thurifera* communities in Spain.
Del tratamiento geobotanico y fitosociologico de los sabinares albares espanoles. Anales Del Jardin Botanico De Madrid. 1996; 54(1):490-503.
Keywords: *Juniperus thurifera*/ Spain/ geobotany/ vegetation
Abstract: Data from previous studies and from studies throughout the Iberian Peninsula indicated that *Juniperus thurifera* communities in Spain lack a unique floristic character that would permit their distinction from accompanying scrub vegetation. The forests could not be ascribed to a specific phytosociological class because of the ecological amplitude of *J. thurifera*. It is suggested that it may be inappropriate to retain almost all *J. thurifera* communities within the *Pino-Juniperetea* class.
13. Costa Tenorio, M; Gomez Manzaneque, F; Morla Juaristi, C, and Sainz Ollero, H. Phytogeographical assessment of the vascular flora of the *Juniperus thurifera* forests of the Iberian Peninsula. Ecologia Madrid. 1993; 7127-148.
Keywords: *Juniperus thurifera*/ Iberian Peninsula/ flora/ phytogeography
Abstract: A list is presented of the vascular flora of the *Juniperus thurifera* forests (762 taxa) in the Iberian Peninsula (Spain and Portugal). Chorological and systematic analyses are made, and the results are discussed.
14. Costa Tenorio, M.; Morla Juaristi, C., and Sainz Ollero, H. Contribution to the

typification of the white juniper, *Juniperus thurifera*, scrubs in the southern Iberian Mts., Spain. Lazaroa. 1985; 7307-317.

Keywords: *Juniperus thurifera*/ Spain/ phytosociological

Abstract: The distribution of the ecological groups, previously established by comparison of phytosociological and ecological catalogues, can be explained by variations of the environmental factors, including human influence.

15. Fels, M. A.; Alaoui, Roques A., and Boumezzough, A. The arthropods related to cones and seeds of incense-juniper, *Juniperus thurifera* L., in Atlas mountains of Morocco. *Ecologia Mediterranea*. 1999; 25(1):95-110.
Keywords: *Juniperus thurifera*/ cones/ berries/ seeds/ arthropods/ Morocco
Abstract: The arthropods inhabiting cones (berries) and seeds of incense-juniper, *Juniperus thurifera* L., were surveyed in six sites of the High Atlas mountains and in seven sites of the Middle Atlas mountains. A total of 17 species, including six major phytophagous pests, were identified. The attack periods of the pest species were synchronised with the different phases of cone development. The annual fluctuations in cone crop resulted in a large variation in the percentage of cone damage. However, more than 50% of the berries were usually damaged. Cone damage increased from the base to the top of the tree crown but the position of the cone within the crown did not influence pest attack. Overall and specific pest damage differed between sites in the High and Middle Atlas mountains. At Tizrag (High Atlas), an average number of 1.1 seeds per cone was observed before insect attack, but the number of full, sound seeds was only evaluated to 0.13 per cone after insect attack. In this stand, we estimated that a tree disseminated 3382 full seeds on the average whilst 24454 were likely to be released before pest attack ; i.e. a decrease of 86.2%.
16. Fromard, F. and Gauquelin, T. Thuriferous juniper stands in Morocco: research and conservation for an endangered environment and species. *Unasylva English Ed.* 1993; 44(172):52-58.
Keywords: *Juniperus thurifera*/ Morocco/ afforestation/ nature conservation/ degraded forests
Abstract: Juniper (*Juniperus thurifera*) stands in the highlands of the Mediterranean basin are heavily degraded as a result of intensive wood removal and livestock activity. Ecology, exploitation and degradation are described for *J. thurifera* in the Atlas Mountains of Morocco, and proposals made for a sustainable forest management system for *J. thurifera* and some reforestation with well-adapted alternative, local species (e.g. *Cedrus atlantica*).
17. Garcia Lopez, J M and AllueCamacho, C. Phytoclimatic characterization and potentiality of *Juniperus thurifera* L. in the Iberian Peninsula. *Investigacion Agraria, Sistemas y Recursos Forestales*. 2005; 14(1):98-

Keywords: *Juniperus thurifera* / *Quercus*/ *Fagus*/ Iberian Peninsula/ phytoclimatic

Abstract: This paper presents some contributions to the phytoclimatic characterization of stands of *Juniperus thurifera* L. in the Iberian Peninsula. For the phytoclimatic characterization, 1,098 sampling points from the 2nd National Forest Inventory of actual vegetation in which *Juniperus thurifera* was the principle species in the forest were considered. The phytoclimatic diagnosis followed the phytoclimatic models of Allue-Andrade. Phytoclimatic territorial models were constructed in digital format on the basis of preliminary territorial factorial estimations, which were used to determine climatic factors and phytoclimatic terns. The potential phytoclimatic area and the factorial ambits for the existence of *Juniperus thurifera* was performed in five phases of increasing strictness, based on factorial comparison (convex hull), phytoclimatic terns comparison, phytoclimatic suitability and evaluation of competitor *Quercus* and *Fagus* species. *Juniperus thurifera* stands are found in the phytoclimatic subtypes VI(IV)1, VI(IV)2, IV(VI)1, IV3, IV4, VI(VII) and VIII(VI). Subtype VI(IV)1 is both the most prevalent of the species (70% of stations studied) and the one with the highest index of phytoclimatic suitability. The highest phytoclimatic suitability is found in the phytoclimatic terns (VI(IV)1; VI(IV)2;-;-) and (VI(VI)2; IV(VI)1;-;-). These terns are also the most prevalent of the species. In the strictest phase this calculation determined potential areas of high phytoclimatic viability for *Juniperus thurifera* totaling 1,958,700 ha in the center-east of the Iberian Peninsula. However, any practical interpretation of these results must take into consideration the phytoclimatic capacity for competition from some forest species. The territorial highest suitability phytoclimatic data set is available at www.fitoclimoal.com.

18. Gauquelin, T.; Bertaudiere, V.; Montes, N., and Badri, W. Biogeochemical cycle and soil heterogeneity in stands of *Juniperus thurifera* in the Atlas mountains, Marrakech, Morocco. *Cycle biogeochimique et heterogeneite edaphique des groupements forestiers pre-steppiques a genevrier thurifere du Haut Atlas de Marrakech (Maroc)*. *Ecologie*. 1998; 29(1/2).

Keywords: *Juniperus thurifera*/ Morocco/ degraded forests/ vegetation types

Abstract: Some *Juniperus thurifera* stands in the High Atlas Mountains of Morocco correspond to pre-steppe vegetation formations, where juniper trees grow in low-density open woodland, with a steppe-like shrub strata between the trees. Relations between pedological features and the biogeochemical cycle, were studied. Canopy influences and functional heterogeneity of these ecosystems are noted. However, soil microclimate beneath the juniper trees is dependent on their vitality, and these juniper stands are heavily degraded as a result of intensive wood removal and livestock activity.

19. Gauquelin, T.; Bertaudiere, V.; Montes, N., and Wadii-Badri Asmode, J. F. Endangered stands of thuriferous juniper in the western Mediterranean basin: ecological status, conservation and management. *Biodiversity and Conservation*. 1999; 8(11):1479-1498.
Keywords: *Juniperus thurifera*/ endangered stands/ Mediterranean/ Morocco/ Algeria/ conservation/ management
Abstract: Thuriferous juniper (*Juniperus thurifera*) is only found in isolated parts of the western Mediterranean: France (Alps, Pyrenees and Corsican highlands), Spain, Algeria and Morocco. These semiarid mountain stands, where thuriferous juniper trees grow in low-density open woodland, are seriously endangered: (i) In the Atlas mountains of Morocco, the thuriferous juniper stands are heavily degraded as a result of the intensive wood removal and livestock activity in these densely populated areas. This situation, which will soon become irreversible unless remedial measures are urgently taken, has produced impoverished soils and hillside instability while contributing to desertification. (ii) In Spain, although livestock activity and cultivation have strongly reduced areas occupied by *Juniperus thurifera*, stands are still numerous and, in some regions, show a good regeneration due to conservation measures. (iii) In France, the decline in human and livestock activities over recent decades has led to a recolonization of some of the Juniper stands by pines or oak. A forest management system that enables these original stands to survive and regenerate must be undertaken without delay. The dynamics of evolution of these stands is quite different north and south of the Mediterranean. In both cases, conservation measures are urgently required to protect or rehabilitate these original stands with floristic, ecological and socioeconomic interest.
20. Gauquelin, T. ¹; Bertaudière-Montès, V. ¹; Badri W.², and Montès, N. ³. Sex ratio and sexual dimorphism in mountain dioecious thuriferous juniper (*Juniperus thurifera* L., *Cupressaceae*). *Botanical Journal of the Linnean Society*. 2002; 138(2):237-244.
Keywords: *Juniperus thurifera*/ sex ratio/ dioecy/ population dynamics/ population structure/ reproduction.
Abstract: Thuriferous juniper (*Juniperus thurifera* L.) a dioecious bush or tree is only found in isolated parts of the western Mediterranean: France, Spain, Algeria and Morocco. These mountain juniper stands are seriously endangered in Morocco as a result of intensive wood removal, and in Europe as a result of recolonization of stands by pines or oaks. Field studies were conducted to investigate sex ratio and sexual dimorphism, never previously examined, in eight different populations in Atlas mountain and, for comparison, in one of two populations in the French Pyrenees. The sex ratio was female-biased for six of the eight Moroccan stands and especially for the oldest populations. The Pyrenean population showed a similar female-biased ratio. This particular sex ratio is possibly linked to cost of reproduction, paid by both males and females. Sex ratio can also be linked to population dynamics. Males begin to flower slightly

younger than female, which explains their apparent dominance in young populations in Morocco or in a recolonization zone with young trees in the Pyrenees. Studies concerning sexual dimorphism in the western High Atlas sites showed no significant difference in phytomass between males and females. Females appear to be significantly taller but with a lower radial growth.

21. Gonzalez J. and Candas M. A. Characteristics of soils developed on calcareous material under *Juniperus thurifera*. Caracteristicas de suelos bajo sabinares albares sobre material calizo. Suelo y Planta. 1991; 1(3):425-438.
Keywords: *Juniperus thurifera*/ soil chemistry/ chemical properties/ forest influences
Abstract: The chemical characteristics of soils developed over calcareous materials under *Juniperus thurifera* in Spain were studied. These soils are strongly influenced by the vegetation cover, contain large amounts of fresh organic matter, and have high levels of N in the organic horizon. Two types were distinguished: (1) carbonate soils, with dolomite, low levels of free iron, and a weak structure - they are poorly developed and are of recent origin; (2) decarbonated soils, with a high base saturation, a large proportion of clay, and high levels of free iron oxides - they have a red color, with a dark upper horizon due to the accumulation of organic matter. These soils are classified as Rendzic Leptosols and Mollic Leptosols, resp.
22. Gonzalez, J; Cruz, M T; Fernandez, M C; Gonzalez, C; Hernando, J; Hernando, M I; Lopez, A; Moreno, A M, and Palomar, M L. The nature of Juniper soils (*Juniperus thurifera*). Memorias Del XI Congreso Latinoamericano y II Congreso Cubano De La Ciencia Del Suelo, 11 17 De Marzo 1990, La Habana, Cuba Volumen II: Genesis, Clasificacion y Cartografia De Suelos Recursos Hidricos, 11-17 Marzo 1990, La Habana, Cuba. 1993; 376-379.
Keywords: *Juniperus thurifera*/ Spain/ soils/ Leptosols/ limestone/ sandstone/ organomineral horizon
Abstract: Soils situated to the north of Guadalajara province, Spain, at altitudes above 1000 m, mostly on Jurassic limestones and sandstones or Cretaceous marls and limestones in a dry Mediterranean climate under predominantly *Juniperus thurifera* vegetation are described. They are shallow soils with a well structured dark or reddish organomineral horizon. Organic matter content is high in the surface layers, with a calcic mor humus type. They are saturated, calcium being the dominant cation. Their texture varies with the type of parent material, but is generally clayey. They contain mainly micaceous minerals, with kaolinite in a lesser proportion, and traces of vermiculite, feldspars and quartz. They are classified as Leptosols.
23. Jimenez, J. F.; Werner, O.; Sanchez-Gomez, P.; Fernandez, S., and Guerra, J.

Genetic variations and migration pathway of *Juniperus thurifera* L. (*Cupressaceae*) in the western Mediterranean region. Israel Journal of Plant Sciences. 2003; 51(1):11-22.

Keywords: *Juniperus thurifera*/ Spain/ North Africa/ DNA/ RAPD/ genetic variation

Abstract: Random amplified polymorphic DNA (RAPD) analysis and length variations in the chloroplast trnL-trnF intergenic spacer were used to analyze the geographic structure of *J. thurifera* populations in Spain and North Africa. The chloroplast DNA analysis indicated three size classes of the spacer, but was uninformative of any geographic pattern. In contrast, the RAPD data based on 127 polymorphic bands clearly showed the existence of three population groups: (a) a group comprising two populations from northeastern Spain and two from southern Spain, (b) a group comprising the rest of the Spanish populations, and (c) a group which consisted of the two Moroccan populations. Analysis of molecular variance (AMOVA) showed that 24% of the variation is found between groups of populations, 15% between populations within groups, and 61% within populations. The results are consistent with a hypothetical migration of *J. thurifera* starting from central Europe, passing through France and Spain, and finally reaching North Africa.

24. Martinez Conde, M E; Ayerbe, L, and Albacete, M. Contribution to the study of growth regulators in fruits of *Juniperus thurifera*. Anales Del Instituto Nacional De Investigaciones Agrarias, Recursos Naturales, Spain. 1980; 4113-123.
Keywords: *Juniperus thurifera*/ fruit/ growth regulators
25. Martinez-Conde, M. E.; Ayerbe, L., and Albacete, M. Study of growth regulators in fruits of incense juniper (*Juniperus thurifera* L.). Contribucion al studio de reguladores de crecimiento en frutos de sabina (*Juniperus thurifera* L.). Recursos Naturales. 1980; 4113-123.
Keywords: *Juniperus thurifera*/ fruits/ seeds/ berries/ growth regulators/ stratification
Abstract: Endogenous growth regulators contents in fruits and seeds of *Juniperus thurifera* L. are studied, after different temperature treatments. Warm stratification and warm plus cold stratification of seeds increased the amount of stimulatory substances in relation to those found in seeds without stratification. Stratified seeds also show a lower level of inhibitors compared to non treated seeds. Presence of IAA and ABA is discussed.
26. Mohrig W. and Blasco-Zumeta J. The sciarid fauna (*Diptera, Sciaridae*) of a *Juniperus thurifera* L. forest of the Monegros region (Zaragoza, Spain) with description of ten new species. Miscellanea Zoologica. 1996; 1899-116.
Keywords: *Juniperus thurifera*/ Spain/ geographical distribution/ agricultural entomology/ sciarid fauna
Abstract: In a survey carried out in a *Juniperus thurifera* forest in the

Monegros region, Spain, the use of different trapping methods produced a sample of 3388 specimens of sciarids belonging to 8 genera and 35 species. The material contained 10 new species of the genera *Trichosia*, *Corynoptera*, *Lycoriella*, *Bradysia* and *Epidapus*. Some of the collecting methods and their effectiveness are compared.

27. Montes N.; Bertaudiere-Montes V.; Badri W.; Zaoui El H., and Gauquelin T. Biomass and nutrient content of a semi-arid mountain ecosystem: the *Juniperus thurifera* L. woodland of Azzaden Valley (Morocco). *Forest Ecology and Management*. 2002; 166(1/3):35-43.
Keywords: *Juniperus thurifera* / plant composition/ semiarid zones/ degraded land/ Morocco
Abstract: Among all the forest ecosystems those situated in semiarid conditions have only been sparsely studied. In North Africa, these ecosystems are often degraded due to their economical importance in energy supply. In mountain woodlands, this dependence on the tree is even stronger, like in the High Atlas mountains in Morocco. Because of the strong human impact that affects mountain tree species, and to prepare an efficient management of Moroccan forest resources, a clear evaluation is required of their biomass and nutrient content. It was in this scope that we studied the *Juniperus thurifera* woodland of Azzaden Valley (western High Atlas, Morocco), where these two parameters were estimated. The results presented here show that in spite of a strong degradation of the trees and severe climatic conditions, the aerial biomass is included in the brackets defined by other authors for this kind of ecosystem. The mean biomass was approximately 49 tonnes ha⁻¹ with 95% of woody organs. The nutrient concentration (calcium, nitrogen, potassium and magnesium) for the different components shows that Ca >> N > K > Mg in trunks/branches, branchlets and leaves, and K > N > Ca > Mg in female cones. It appears that the strong concentration of calcium in all tissues (except in reproductive organs) participates in the neutralization of top soil acidity through litterfall. The nutrient content study shows that Ca and N storage were significantly higher in trunks or branches (71.2 kg ha⁻¹ for calcium and 43.5 kg ha⁻¹ for nitrogen). For all elements, the nutrient content in leaves was significantly higher than the nutrient content in branchlets and female cones.
28. Ouhammou, A.; Muller, S., and M' Hirit, O. Grazing activities' impact on floristic biodiversity in thurifer juniper stand bordering the Toubkal National Park, High Atlas of Marrakesh, Morocco. Impact des activites pastorales sur la biodiversite floristique dans une thuriferaie limitrophe du Parc national de Toubkal, Haut-Atlas de Marrakech, Maroc. *Acta Botanica Gallica*. 1996; 143(4-5):393-401.
Keywords: *Juniperus thurifera*/ Morocco/ grazing/ biodiversity
Abstract: A comparison of vegetation along permanent transects in ungrazed and grazed areas was carried out. The study of these two areas permitted an evaluation of the affect of grazing on vegetation structure by

computing the specific richness, determination of the Shannon-Weaver diversity index, and analyzing life form. The results showed that the value of parameters was highest four years after grazing ceased. This study shows that it is necessary to find a compromise between biodiversity conservation and grazing.

29. Peiro, J M. A new silicicole locality of juniper (*Juniperus thurifera*) in the Central Massif. *Ecologia-Madrid*. 1992; 6107-110.
Keywords: *Juniperus thurifera*/ Spain/ silicicole
Abstract: A note is given on a relict enclave of *Juniperus thurifera* in the SW of Guadarrama (Central Spain).
30. Penas-Merino, A.; Puente-Garcia, E.; Herrero-Cembranos, L.; Perez-Morales, C., and Llamas-Garcia, R. The *Pino-Juniperetea* class in the province of Leon La clase *Pino-Juniperetea* en la provincia de leon. *Acta Botanica Malacitana*. 1990; 15217-230.
Keywords: *Juniperus thurifera*/ Spain/ subassociations
Abstract: A phytosociological account is given of five associations of montane juniper (*Juniperus thurifera*) in Leon province, Spain. Four new subassociations are described.
31. Quezel, P. and Barbero, M. Pre-steppe juniper associations in Morocco. Contribution a l'etude des formations pre-steppiques a Genevriers au Maroc. *Boletim Da Sociedade Broteriana*, 2. 1981; 53(2):1137-1160; 6 tab.
Keywords: *Juniperus phoenicea*/ *Juniperus oxycedrus*/ *Juniperus thurifera*/ High Atlas/ phytosociology
Abstract: A phytosociological study of associations dominated by arborescent *Juniperus* spp. (*J. phoenicea*, *J. oxycedrus*, *J. thurifera*), with special reference to vegetation of the High Atlas.
32. Rodriguez, M R and Velasco, F. Ecological and biochemical considerations on humification in *Juniperus thurifera* L. forest developed on limestone and gneiss. *Anales De Edafologia y Agrobiologia*. 1988; 47(7-8):1041-1053.
Keywords: *Juniperus thurifera*/ humification/ limestone/ gneiss
Abstract: Leaching carbonates from and ultrasonic dispersion of limestone soils allowed the extraction of strongly attached residual humin, showing that lignin can be directly humified without the intervention of a soluble phase. Filtration of humic acids through Sephadex showed that the molecular size fraction > 10 000 is small, and that > 100 000 varies from 7.1 to 14.3%. The visible spectra of humic acid solutions indicated that the degree of condensation between polymeric aromatic constituents is greater for those extracted from juniper forest on limestone than for those on gneiss. Humic acids from juniper forest on limestone are more hydrophobic and thus have greater structural stability.
33. Roques, A.; Raimbault, J. P., and Goussard, F. The colonization of mediterranean juniper cones and galbuli by insects and acarids and its effect on possibilities of natural regeneration of these species. *Ecologia*

Mediterranea. 1984; 10(1-2):147-170.

Keywords: *Juniperus oxycedrus*/ *Juniperus phoenicea*/ *Juniperus thurifera*/ seed/ berries/ seed pests.

Abstract: Pests of the female reproductive forms of Mediterranean juniper seem to be confined to *Cupressaceae* and in majority strictly to genus *Juniperus*. The fauna appears to be climate-linked. *J. oxycedrus* L. and *J. phoenicea* L., characteristic of the mediterranean vegetation, present in their whole French distribution area the same fauna, very different from *J. thurifera* L. species distributed in the supra Mediterranean level. High attack rates of berries are frequently observed for the 3 spp., with some differences between continental and Corsican stands. But the low number of seed pests and the number of sound seeds/berry limits (excepted for *J. thurifera* L.) the reduction of the regeneration possibilities of natural juniper stands by insect or mite action.

34. Santos T.; Telleria J. L., and Virgos E. Dispersal of Spanish juniper *Juniperus thurifera* by birds and mammals in a fragmented landscape. *Ecography*. 1999; 22(2):193-204.

Keywords: *Juniperus thurifera*/ seed dispersal/ mammals/ birds/ seed deposition/ Spain

Abstract: Dispersal of Spanish juniper *Juniperus thurifera* was examined in a farming landscape of central Spain to study the effects of fragmentation on the dispersal effectiveness of the different dispersers, and the consequences for the plant. The study was conducted in two large forests (LF; 280 and 150 ha) representative of unfragmented conditions, and 18 small isolated fragments (0.1-3 ha) which were classified in two groups: 1) F1, forest remnants with both high juniper cover and cone production (N = 5); and 2) F2, remnants in which fragmentation has caused a heavy reduction in junipers (N = 13). Cone production, disperser abundances and quantity of dispersal by birds (*Turdus* thrushes) and mammals (carnivores, rabbits and sheep) were estimated throughout two study years. Dispersal by thrushes was measured in three types of trees representing a decreasing attraction focus to birds: Spanish junipers with cones (SJ1), Spanish junipers without cones (SJ2) and holm oaks (HO). Cone production greatly decreased from LF to F1 and F2 in both study years, affecting F2 dramatically. Thrush abundances were similar in LF and F1, but thrushes lacked or were very scarce in F2. Carnivores showed an even distribution throughout the whole area, but herbivores were relatively scarce in F2 fragments, especially rabbits, which were lacking in the fragments under 0.6 ha. Patterns of seed deposition around trees showed decreasing dispersal activity of thrushes from SJ1 (83.1% of the examined trees had seed-packets-thrush pellets) to SJ2 (53.6%) and HO (23.6%). Both distribution patterns and density of pellets were roughly similar in LF and F1, but pellets were only recorded in one (SJ1) out of 159 trees examined in F2, supporting thrushes behaved as specialist feeders and thus avoided the patches devoid of juniper cones. Average densities of

pellets in LF reached 397.6 pellets ha⁻¹, surpassing at least 30 times the quantitative effectiveness (seed-packets ha⁻¹) of mammal dispersers. Juniper seeds were present but very scarce in the mammal feces collected in both fragments F1 and F2. Overall, the quantitative effectiveness of carnivores was nearly 4 times lower in the fragments than in LF, and that of herbivores 11 times lower. This result is consistent with the lower availability of juniper cones in the fragments and, together the distribution of mammal abundances, fits the prediction that mammals (except rabbits) moved among landscape patches according to the total availability of food supplies. Overall, results showed that dispersal of Spanish juniper in fragments F2 is seriously impaired by the loss of their main dispersers (thrushes), and that recruitment became dependent upon mammal dispersers with a low quantitative effectiveness, namely carnivores and sheep.

35. Santos, Tomas Author and Telleria, Jose L. Author. Influence of forest fragmentation on seed consumption and dispersal of Spanish juniper *Juniperus thurifera*. *Biological Conservation*. 1994; 70(2):129-134.
Keywords: *Juniperus thurifera*/ Turdus/ fruit/ seed/ forest fragmentation/ avian/ birds
Abstract: We examined the effects of fragmentation on Spanish juniper *Juniperus thurifera* in central Spain by comparing eight small forest fragments (SF: 0.2-16 ha) with two large forests (LF: 150 and 270 ha). Wood mice *Apodemus sylvaticus*, the only rodent seed eaters, were 8.9 times more dense in SF, whereas thrushes *Turdus* spp., the main avian seed dispersers, were 4.6 times more abundant in LF. Finches (seed eaters) were sin both forest groups. Mean fruit abundance was significantly higher in LF. Seed consumption was mainly by mice in SF and by finches in LF. Thrush pellets with intact seeds, seedling abundance and the proportion of trees with nearby seedlings, were all higher in LF. This evidence points to a decrease in the dispersal efficiency of Spanish juniper in SF. We suggest that the processes leading to reduced dispersal ability might be inherent to fragmentation and represent a threat for the survival of fruit-bearing plants in patchy environments.
36. Velasco, F and Rio, J del. Humification in the juniper forests of the Somosierra (Segovia) region, Spain. *Anales De Edafologia y Agrobiologia*. 1977; 36(9/10):979-988.
Keywords: *Juniperus thurifera*/ Spain/ gneiss/ humification/ decomposition
Abstract: The decomposition of residues of juniper (*Juniperus thurifera*) in soils overlying gneiss was studied in Spain. A meridional forest brown soil with mull-like moder humus has developed on gneiss, while on limestone a forest rendzina with calcic mull humus has formed. In both soils fulvic acids predominate over humic acids. The humic acid:fulvic acid ratio and degree of humification are higher on limestone than on gneiss.

There is a greater degree of condensation of aromatic rings and a higher aromatic:aliphatic ratio in the humic acids of the rendzina than in those of the meridional brown soil.

Juniperus tibetica (1)

1. Adams, R. P. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). USABiochemical Systematics & Ecology. 2000; 28(6):529-543.
Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus pseudosabina*/ *Juniperus recurva*/ *Juniperus saltuaria*/ *Juniperus squamata*/ *Juniperus tibetica*/ *Juniperus wallichiana*/ RAPD/ DNA/ essential oils
Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallachiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).

Juniperus turbinata (2)

1. Diez-Garretas B.; Asensi A., and Martin-Osorio V.E. Phytosociological behaviour of *Juniperus phoenicea* L. s.l. in southern Iberian Peninsula. Comportamiento fitosociológico de *Juniperus phoenicea* L. s.l. en el sur de la Peninsula Iberica. Lazaroa. 1995; 16:159-167.
Keywords: *Juniperus phoenicea*/ *Juniperus turbinata*/ plant communities/ Spain
Abstract: The plant communities dominated by *J. phoenicea* in S Spain (Rondeno sector) were studied pointing out a new record of *J. turbinata* subsp. *turbinata* in Rondeno sector. Two new syntaxa are described: *Asparago horridi-Juniperetum turbinatae* and *Rhamno myrtifoliae-Juniperetum phoeniceae* subass. *rhamnetosum oleoidis*.
2. Nogales, Manuel Hernandez Elizabeth C. Valdes Francisco. Seed dispersal by common ravens *Corvus corax* among island habitats (Canarian Archipelago). Ecoscience. 1999; 6(1):56-61.
Keywords: *Juniperus cedrus*/ *Juniperus turbinata*/ germination/

ravens/ *Corvus*/ seed dispersal/ seeds/ Canary Islands/ *Lycium*/
Opuntia/ *Rubia*/ *Plocama*/ *Phoenix*/ *Asparagus*/ *Myrica*

Abstract: The role of the common raven (*Corvus corax*; Corvidae) as a seed dispersal agent for plants in the Canary Islands was studied by analyzing 2672 pellets collected from all islands of the archipelago. Seeds of 16 species of phanerogams were found (four endemic to the Canaries, three endemic to the Macaronesian islands, six not endemic, and three introduced by man). Vegetation in this archipelago is highly structured according to altitude creating different types of macrohabitats. The quality of the transport of seeds between habitats was evaluated in a preliminary way by making use of the very high fidelity of the plant species to particular macrohabitats. Of the 102 580 potentially fertile seeds (excepting the other 51 061 infertile *Ficus carica* seeds) transported by common ravens, 76.5% were regurgitated in theoretically suitable habitat while the remaining 23.5% were taken to habitats that were not appropriate for the establishment. Common ravens improved germination of six species, whereas an opposite effect was observed for three others. The percentage of viable seeds did not differ for any species between pellet seeds and seeds collected directly from the plants. Considering results from germination and viability experiments and macrohabitat patterns of dispersal, the common raven seems to be an important disperser for nine plant species: *Lycium intricatum* (*Solanaceae*), *Opuntia ficus-indica* (*Cactaceae*), *Rubia fruticosa* and *Plocama pendula* (*Rubiaceae*), *Juniperus turbinata* and *J. cedrus* (*Cupressaceae*), *Phoenix canariensis* (*Arecaceae*), *Asparagus pastorianus* (*Liliaceae*), and *Myrica faya* (*Myricaceae*).

Juniperus turcomanica (4)

1. Abseitov, S Yu and Osipov, Yu S. Basis of the process of extracting seeds from juniper 'berries'. *Lesnoi Zhurnal*. 1985; 326-30.

Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turcomanica*/ seeds/ processing/ machinery/ extraction/ conifers

Abstract: Data are presented on the physical and mechanical properties of the arils and seeds of four Central Asian junipers, viz. *Juniperus semiglobosa*, *J. turkestanica*, and (together) *J. seravschanica* and *J. turcomanica*. Permissible forces that can be used in extracting seeds from the flesh of arils are calculated, and details are given of the design and basic parameters of an appropriate mechanical extraction process. Arils are dried to 6-25% m.c., screened, rasped between two metal surfaces, and then screened with a set of three screens having openings of 1.2, 2.5 and 3.2 mm. Some data are given from trials with a prototype machine. Sound seed was undamaged, and cleaning was good, with a throughput of 87.6 kg/h of arils.

2. Aleksandrovskii E. S. Biology of flowering and fruiting of *Juniperus turcomanica*. Lesovedenie. 1972; 376-84.
Keywords: *Juniperus turcomanica*/ pollination/ seed production/ flowering
Abstract: Gives phenological data for this Central Asian species obtained from observations made over 2 years in its natural range (Kopet-Dag mountains, Turkmen SSR). The reproductive cycle is described and illustrated, and the use of artificial pollination to improve seed quality and yield and a method of forecasting seed yield from current fruiting are discussed.

3. Karryev, M. O. Juniper - a medicinal plant
 Archa - lekarstvennoe rastenie. Archa Lekarstvennoe Rastenie. 1971; 75.
Keywords: *Juniperus turcomanica*/ *Turkmenistan*/ needles/ chemistry/ fruits/ essential oils
Abstract: A monograph on *Juniperus turcomanica*. The resources of this species in Turkmenistan are briefly described, and the chemistry of the needles and fruits is surveyed. Details are given of the chemical composition of the essential oil of the needles and fruits, and of the resin extracted by acetone from the needles. The medicinal forms and galenical preparations, and the antibacterial, diuretic and wound-healing action of the preparations are described.

4. Sakhatskii, V. M. The sowing qualities of seeds of junipers in Central Asia. Posevnye kachestva semyan mozhzhevel'nikov v Srednei Azii. Lesnoe Khozyaistvo. 1979; 1240-42.
Keywords: *Juniperus turcomanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turkestanica*/ sowing rates/ nursery/ seed/ handling seed/ Central Asia
Abstract: On the basis of studies in Soviet Central Asia in 1963-70, data are tabulated on the physical characteristics and sowing qualities of seed of *Juniperus turcomanica*, *J. semiglobosa*, *J. seravschanica* and *J. turkestanica*. Standard sowing rates are calculated for each species; for 1 ha of nursery area this ranges from 400 kg clean seed of *J. semiglobosa* to 2970 kg clean seed of *J. turkestanica*. The treatment and handling of juniper seed are discussed, and sowing dates are given for various areas, depending on alt.

Juniperus turkestanica (12)

1. Abseitov, S Yu. Installation for extracting seeds from juniper berries. Lesnoe Khozyaistvo. 1983; 1064-66; ISSN: 0024-1113.
Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ seeds/ processing/ variation/ equipment/ seed size/ conifers
Abstract: Data are presented on the large variations in thickness, width and length

of seeds and 'berries' of three species of Central Asian junipers, viz. *Juniperus semiglobosa*, *J. seravschanica* and *J. turkestanica*. The seeds can be extracted from the flesh by rubbing the berries between two discs (one rotating, the other fixed). The biometric data on the berries and seeds can be used to determine the optimum gap between the discs so as to avoid damaging the seed. Data are also given on berry and seed weights, % flesh, and the crushing force of the berries and seeds. For *J. semiglobosa* the optimum gap is 5.5 mm (88% berries crushed, with only 1% seed damage); for *J. seravschanica* 6 mm (89%; 1.7%), and for *J. turkestanica* 10.5 mm (89%; 1.8%). With hand extraction seed damage amounts to 7.6-10.4%. The disc-type seed extractor has a throughput of berries of 127 kg/h.

2. Abseitov, S Yu and Osipov, Yu S. Basis of the process of extracting seeds from juniper 'berries'. *Lesnoi Zhurnal*. 1985; 326-30.
Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turcomanica*/ seeds/ processing/ machinery/ extraction/ conifers
Abstract: Data are presented on the physical and mechanical properties of the arils and seeds of four Central Asian junipers, viz. *Juniperus semiglobosa*, *J. turkestanica*, and (together) *J. seravschanica* and *J. turcomanica*. Permissible forces that can be used in extracting seeds from the flesh of arils are calculated, and details are given of the design and basic parameters of an appropriate mechanical extraction process. Arils are dried to 6-25% m.c., screened, rasped between two metal surfaces, and then screened with a set of three screens having openings of 1.2, 2.5 and 3.2 mm. Some data are given from trials with a prototype machine. Sound seed was undamaged, and cleaning was good, with a throughput of 87.6 kg/h of arils.
3. Adams R. P. and Turuspekov Y. Taxonomic reassessment of some Central Asian and Himalayan scale-leaved taxa of *Juniperus* (*Cupressaceae*) supported by random amplification of polymorphic DNA. *Taxon*. 1998; 47(1):75-83.
Keywords: *Juniperus centrasiatica*/ *Juniperus turkestanica*/ *Juniperus pseudosabina*/ *Juniperus indica*/ RAPD/ DNA/ taxonomy
Abstract: Analysis of central Asian *Juniperus* using RAPD revealed that *J. centrasiatica*, *J. turkestanica*, and *J. pseudosabina* appear to belong to a single species, to be named *J. pseudosabina*. This conclusion is also supported by previous work on terpenoids. Putative *J. indica* from Nepal (shrub form) was found to be distinct from *J. pseudosabina*. It appears that the common scale-leaved shrub or tree juniper of the Himalayas should be called *J. indica* not *J. pseudosabina*.
4. Chub A. V. Trial in growing Juniper seedlings by sowing freshly collected seeds. *Kul' Tura Lesnykh Porod v Kirgizii*. 1973; 52-57.

Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/ seeds/ berries/ germination/ mulching/ seedlings

Abstract: Gives data on the germination of seeds of *Juniperus turkestanica* and *J. semiglobosa* in nursery experiments at 2500 m alt. in Kirghizia. Seeds removed from the 'berries' germinated better than 'berries' sown complete, and mulching (with moss) improved germination. When seeds collected at various dates were removed from the 'berries' and sown within a few days of collection, germination differed according to date of sowing, results being best for *J. turkestanica* sown in late July and in August, and for *J. semiglobosa* a month later.

5. Esper, J. Long-term tree-ring variations in *Juniperus* at the upper timber-line in the Karakorum (Pakistan). *Holocene*. 2000; 10(2):253-260.

Keywords: *Juniperus excelsa*/ *Juniperus turkestanica*/ climate/ dendrochronology/ Pakistan

Abstract: Ring-width series of *Juniperus excelsa* and *Juniperus turkestanica* from six different sites, in the Hunza-Karakorum, were used in reconstructing modes of regional climate over the past 500 years. All reconstructions were derived from trees growing close to the upper timber-line (approx. 4000 m a.s.l.). Standardized site chronologies, derived from ring-width measurements, display common low- and high-frequency variation that is synchronous between all sites. Since the documented increase in atmospheric CO₂ loading, roughly 150 years ago, Hunza-Karakorum trees are not growing as well as they were previously. From the mid-nineteenth century to the present, these trees appear to be alternating between states of more extreme favourable and unfavorable growth periods of different amplitude and duration. Maximum (favourable) variations occurred between AD 1579 and 1603, whereas minimum (unfavourable) variations occurred between AD 1825 and 1850.
6. Golovina, R. D. Root systems of juniper in the forests of the Alai ridge. *Lesovedenie*. 1991; 371-74.

Keywords: *Juniperus semiglobosa*/ *Juniperus turkestanica*/ roots/ phytomass

Abstract: Details are given of the root systems of 4 sample trees of *Juniperus semiglobosa* in stands at 2560-2570 m altitude, and 4 trees of *J. turkestanica* in stands at 2650 and 33200 m altitude in Kirghizia. The trees ranged in age from 50 to 309 years, and the aerial phytomass was greater at the higher (moister) altitudes. In *J. semiglobosa* the root projection area was much greater than the crown projection, some of the large roots extending for up to 12 m. In *J. turkestanica*, at the tree line the root system is smaller, viz. only 0.21-0.23 t of roots per t of aerial phytomass. The importance of the juniper roots in protecting the soil from erosion is discussed.
7. Konnov, A. A. and Molotkovskii, Yu. I. Ecology of juniper stands in the Pamir-Alai. *Soviet Journal of Ecology*. Transl. From *Ekologiya* . 1981; 12(5):14-

24.

Keywords: *Juniperus semiglobosa*/ *Juniperus seravschanica*/
Juniperus turkestanica/ phytomass structure

Abstract: Diurnal and seasonal variations in transpiration intensity were measured in *Juniperus semiglobosa*, *J. seravschanica* and *J. turkestanica* in 2 vegetation types at 2450 m alt., and in *J. seravschanica* in 2 thermophilic vegetation types at 1850 and 1100 m alt. The vegetation is described. Data are also presented on seasonal needle water content and seasonal water use (mm) in 1969-71, and the phytomass structure of the vegetation types at 2450 and 1850 m. Results show that the water balance of junipers varies considerably in response to water supply.

8. Merkulov, P. I. Variability of annual growth of juniper at different levels in Tien-Shan. Vestnik, Leningradskogo Universiteta, Seriya Geologiya i Geografiya . 21. 1985; 21108-110.

Keywords: *Juniperus turkestanica*/ growth/ Terskey-Alatoo Mountains

Abstract: Describes growth of *Juniperus turkestanica* in the Terskey-Alatoo Mts.

9. Molotkovskii, Yu. I. and Konnov, A. A. Some characteristics of the growth and water exchange in juniper affected by a plant parasite, *Arceuthobium oxycedri* (DC.) M.B. Russian Journal of Ecology. 1995; 26(4):296-299.

Keywords: *Juniperus turkestanica*/ *Juniperus semiglobosa*/
Arceuthobium oxycedri/ mistletoe/ infection/ Turkestan/ transpiration

Abstract: Studies on water relations of junipers (*Juniperus turkestanica* and *J. semiglobosa*) infected with the mistletoe *Arceuthobium oxycedri* were conducted on the northern slope of Turkestan Ridge [Tajikistan]. Diurnal and seasonal variation in transpiration rate and shoot growth were measured for the junipers and the mistletoe. Transpiration rate was greater in *J. semiglobosa* than in *J. turkestanica*. Transpiration rate of the mistletoe was generally higher than that of its host and was greater on *J. semiglobosa* than on *J. turkestanica*.

10. Mukhamedshin, K. D. and Sartbaev, S. K. The increment cycle of Juniper in the high mountain conditions of the Tien Shan. Izv AN KirgSSR. 1972; 255-60.

Keywords: *Juniperus seravschanica*/ *Juniperus semiglobosa*/
Juniperus turkestanica/ water relations/ growth rings.

Abstract: Describes studies on 1580 trees of *Juniperus* spp. It is shown that wood is laid down annually, even at the alpine forest limit, and therefore Junipers can be used for dendrochronological and dendroclimatic research. In the arid lower regions the growth of *J. seravschanica* and *J. semiglobosa* is determined mainly by moisture, and high temperatures in the growing season (especially in July) have an adverse effect. In the colder and moister higher regions the increment of *J. turkestanica* is determined mainly by the temperature in June/July.

11. Sakhatskii, V. M. The sowing qualities of seeds of junipers in Central Asia.

Posevnye kachestva semyan mozhzhevel'nikov v Srednei Azii. Lesnoe Khozyaistvo. 1979; 1240-42.

Keywords: *Juniperus turcomanica*/ *Juniperus semiglobosa*/ *Juniperus seravschanica*/ *Juniperus turkestanica*/ sowing rates/ nursery/ seed/ handling seed/ Central Asia

Abstract: On the basis of studies in Soviet Central Asia in 1963-70, data are tabulated on the physical characteristics and sowing qualities of seed of *Juniperus turcomanica*, *J. semiglobosa*, *J. seravschanica* and *J. turkestanica*. Standard sowing rates are calculated for each species; for 1 ha of nursery area this ranges from 400 kg clean seed of *J. semiglobosa* to 2970 kg clean seed of *J. turkestanica*. The treatment and handling of juniper seed are discussed, and sowing dates are given for various areas, depending on alt.

12. Sultanov, Yu and Padalko, V V. Growing plantations of junipers. Lesnoe Khozyaistvo. 1988; 1153-54.

Keywords: *Juniperus seravschanica*/ *Juniperus semiglobosa*/ *Juniperus turkestanica*/ seed collection/ plantation/ root/ growth

Abstract: A note is given on the techniques of seed collection and treatment, and plantation establishment, used successfully in Tadzhikistan for growing *Juniperus seravschanica*, *J. semiglobosa* and *J. turkestanica*. Height growth is typically slow, but root growth is quite rapid, and the total length of roots in the third year is 54.57 m per plant, and the root penetration depth is 117 cm.

Juniperus utahensis (1)

1. Meagher, G. S. Reaction of pinyon and juniper seedlings to artificial shade and supplemental water. Journal of Forestry. 1941; 41480-482.

Keywords: *Juniperus monosperma*/ *Juniperus utahensis*/ *Pinus edulis*/ seeds/ germination/ drought/ artificial shade

Abstract: Pinyon and juniper seeds were planted in four locations for each species and received supplemental watering, artificial shade, and a combination of these treatments. Total germination for the four treatments was normal for the species. Shading, watering, and both treatments together speeded up germination as much as a month for *Pinus edulis* and *Juniperus monosperma*. Seedling mortality was caused by frost heaving and drought. Watering and shade reduced these effects on pinyon and one-seed juniper. Utah juniper (*Juniperus utahensis*) was not killed by frost but was affected by drought. Greatest survival and growth of all species was under combined water and shade treatments. There was no survival on the control plots.

Juniperus virginiana (138)

1. Afanasiev, M. Storage of after ripened seed of eastern redcedar. USDA Forest Service Tree Planters' Notes . 1955; 2128-30.

Keywords: *Juniperus virginiana*/ eastern redcedar/ after ripening/ germination/ temperature

Abstract: After ripening and germination can be arrested by storing after ripened but ungerminated seed at +15 ° to +20 ° F. Germinating seed is injured by subfreezing temperature and does not resume growth later.

2. Afanasiev, M. and Cress, M. Producing seedlings of eastern red cedar (*Juniperus virginiana* L.). Oklahoma Agricultural Experiment Station Bulletin . 1942; B-25621.

Keywords: *Juniperus virginiana*/ eastern redcedar/ germination/ seed/ seedlings/ after ripening/ collection/ storing/ cleaning

Abstract: Description of nursery practices, including collection, storing, and cleaning seed; treating seed to insure germination; and growing seedlings from after ripened seed.
3. Afanasiev, M; Enstrom, A., and Johnson, E. W. Effects of planting dates and storage on survival of eastern red cedar in central and western Oklahoma. Oklahoma Agricultural Experiment Station Bulletin . 1959; B-52719.

Keywords: *Juniperus virginiana*/ eastern redcedar/ survival/ seedlings/ planting

Abstract: Planting dates from November to May and fresh-lifted and stored seedlings were compared for 3 successive years. Plantings made between mid-December and mid-March survived best. There was little difference between freshly lifted stock and that stored for 7 days. Weather and soil conditions at time of planting had a strong effect. Survivals ranged from 40 to 90 percent.
4. Alexander H. Controlling juniper: fire and goats, a combination? Rangelands. 1993; 15(6):257-259.

Keywords: *Juniperus pinchotii*/ *Juniperus ashei*/ *Juniperus virginiana* / fire/ goats

Abstract: Control of *Juniperus pinchotii*, *J. ashei* and *J. virginiana* in Texas rangelands using fire and goats, and the ecological impact of these methods, are discussed.
5. Anonymous 1. Juniper seeds. American Nurseryman. 1938; 68(11):18.

Keywords: *Juniperus virginiana*/ eastern redcedar/ stratification/ seed/ collection/ nursery/ cloning/ storage

Abstract: Collection, cloning, storage, and stratification of redcedar seed. Nursery techniques.
6. Anonymous 3. Red cedar germination. American Nurseryman. 1946; 84(12):18-19.

Keywords: *Juniperus virginiana*/ eastern redcedar/ stratification/ seed/ germination

Abstract: To insure rapid and satisfactory germination the waxy coat must be removed by repeated soakings in alcohol and the seed stratified overwinter in moist sand and peat at about 40 ° F. Seed should be sown

around March 15 to April 1.

7. Baer, Norman W. Nutrient content in eastern redcedar foliage: seasonal variation. TB 86 South Dakota Agricultural Experiment Station. 1985; 861; ISSN: Nutrition.
Keywords: *Juniperus virginiana*/ eastern redcedar/ foliage/ nutrition/ Great Plains
Call Number: 100
Abstract: Seasonal variation in foliage nutrient concentration of out-planted eastern redcedar (*Juniperus virginiana* L.) seedlings from three Great Plains nurseries were examined. Foliage nitrogen, phosphorus, sulfur, and magnesium concentrations generally increased significantly during the growing season. Calcium zinc, and iron remained fairly constant. Potassium decreased until July and then increased back to initial levels. Differences in foliage nutrition concentration between nursery sites and years within the study were also significant.
8. Bagley, W. T. and Read, R. A. Some temperature and photoperiod effects on growth of eastern redcedar seedlings. Iowa State Journal . 1960; 34595-601.
Keywords: *Juniperus virginiana*/ eastern redcedar/ growth/ light/ Nebraska
Abstract: Supplemental light increased and sustained height growth of seedlings at a minimum temperature of 75 ° F. in the greenhouse and in environmental control chambers. Supplemental light increased height growth in early summer in an outdoor environment at Lincoln, Nebraska, but failed to sustain it after mid-August.
9. Banko, T. J. Propagation of upright junipers. Combined Proceedings, International Plant Propagators' Society. 1982; 31658-666.
Keywords: *Juniperus chinensis*/ *Juniperus virginiana*/ cuttings/ rooting/ seasonal variation.
Abstract: *Juniperus chinensis* cv. Hetzii cuttings were rooted at monthly intervals over 2 years, with IBA treatments of 0, 2000, 4000, or 8000 p.p.m. Rooting varied greatly but was consistently poor in early spring (March). IBA did not significantly improve rooting percentages when rooting capacity was low, but did increase numbers of roots/cutting during favorable rooting periods. Trimming the upper half of the leaf had no effect on rooting. In another experiment, rooting medium temperatures of 20 ° or 25 ° C improved rooting of cuttings of *J. virginiana* cvs Skyrocket and Hillspire and *J. chinensis* cv. Kaizuka, compared with rooting at 15 °C. Cuttings of *X Cupressocyparis leylandii* rooted equally well at all 3 temperatures.
10. Barth, Z. Invasion of the Eastern Red Cedar: This juniper is rapidly claiming Oklahoma rangelands. Here's an update on the economic and environmental impact, and a review of control strategies. Rangelands. 2002; 24(4):23-25.

Keywords: *Juniperus virginiana*/ invasion/ Oklahoma/ rangelands/ windbreak

Abstract: This juniper, although the name implies cedar, has increased in population more rapidly than any other woody plant on the central grasslands today. It was first used in the 1930s as a windbreak. Even though the red cedar is native to Oklahoma, it is not indigenous to many of the areas it now grows. When the first USDA Soil Conservation Service survey was done to see the extent of the red cedar in 1950, this individual species had invaded more than 1.5 million acres in the state of Oklahoma alone. It has increased in distribution nearly 80% during a nine year period, from 1985 to 1994, and now occupies almost 50% of the native grassland in Oklahoma. Once the forest are developed, their effect on the rangeland economy is mind boggling. These trees can cut the carrying capacity and stocking rate for cattle down by at least 70% in a short time frame, sometimes as little as 10 to 15 years. The broad base of the juniper, which can easily exceed 15 feet, chokes out a large number of desirable vegetation in the area equal to the percentage of canopy. Besides affecting the grazing area of cattle, the red cedar also influences another financial avenue; that of timber and paper mills.

11. Barton, L. V. Germination of seeds of *Juniperus virginiana* L. Contrib. Boyce Thompson Institute. 1952; 16387-393.

Keywords: *Juniperus virginiana*/ eastern redcedar/ seed/ after ripen/ temperature/ sulphuric acid

Abstract: Seeds are dormant and require 3 months at 5 ° C. to after ripen; 1 °

C. is less effective and 10 ° is totally ineffective. Seedcoats may be made permeable (to improve stratification) by exposure to moisture at approximately 25 ° C. for 2-8 weeks, or by soaking for 30 minutes in concentrated sulphuric acid.

12. Bauch, J.; Puls, J.; Klupsch, R., and Vogel, C. Biological and chemical characteristics of "included sapwood" of *Juniperus virginiana* L. Holzforschung. 2004; 58(1):74-81.

Keywords: *Juniperus virginiana*/ *Coniophora*/ wood destroying fungi/ wood properties

Abstract: The reddish-violet heartwood of *Juniperus virginiana* contains irregularly distributed and longitudinally oriented streaks of light-colored wood, described as included sapwood. A histological study revealed that a blockage of the rays, which is caused by wounds often associated with tiny shakes, branch stubs and included bark, may lead to this anomaly. A study of fresh wood immediately after felling of the trees showed that included sapwood lacks physiological activity similar to the adjacent normal heartwood. Cellular UV-spectroscopic analysis revealed a secondary metabolism particularly of phenolic compounds in the pit membranes of tracheids during included sapwood formation, whereas the reddish-violet flavonoid compounds did not develop in this anomalous wood. Chemical

analyses of petrol ether, diethyl ether, acetone and ethanol/water extracts of sapwood, included sapwood and heartwood showed that the accessory compounds cedrol, alpha -cedrene, widdrol, thujopsene and cuparene increased in included sapwood compared to sapwood. As opposed to the reddish-violet heartwood compounds, these sesquiterpenes turned out to be highly toxic against a brown-rot fungus (*Coniophora puteana*) in a bioassay. These findings justify defining included sapwood as a heartwood anomaly, since the important wood characteristics of this tissue obey the definition of heartwood rather than sapwood. This anomaly should no longer be a reason to exclude this type of wood from commercial utilization.

13. Bekele A. and Hudnall W. H. Response of soil $\delta^{15}\text{N}$ and nutrients to eastern red cedar (*Juniperus virginiana*) encroachment into a relict calcareous prairie. Plant and Soil. 2005; 271(1-2):143-055 .
Keywords: *Juniperus virginiana*/ encroachment/ prairie/ Louisiana
Abstract: The calcareous prairies of Louisiana have been threatened by the encroachment of woody plants, primarily eastern red cedar (*Juniperus virginiana*). The restoration and management of these rare plant communities require a thorough understanding of the soils supporting them. The knowledge of whether eastern red cedar encroachment has altered these soils is also of interest. We studied the depth distribution, at contrasting vegetation types (prairie, transition, forest) and landscape positions, of $\delta^{15}\text{N}$, total N, organic C, C/N ratio, Ca, Mg, K and pH of three relict prairie-forest associations in north central Louisiana, USA. The effect of vegetation type was significant for soil $\delta^{15}\text{N}$ and Ca. Plant leaf samples from prairie, transition, and forest showed similar $\delta^{15}\text{N}$ signals, and mean values ranged between -1.6/mille and -1.1/mille. The order of soil $\delta^{15}\text{N}$ enrichment of the 0-10 cm depth relative to corresponding leaves was forest soil > transition soil > prairie soil. The forest soil was significantly enriched with $\delta^{15}\text{N}$ compared with the prairie soil and transition soil. Except for C/N ratio, all the soil properties significantly decreased with depth while $\delta^{15}\text{N}$ increased with depth. Significant differences in C/N ratio, Ca and Mg were associated with landscape position. The change in soil pH due to woody encroachment was restricted to the 0-10 cm depth. The results suggest that the prairie soil was distinctly different from the forest soil and that the vegetation at transition (encroaching woody plants) was altering the surface soil pH towards 'forest-like' conditions.

14. Box, Benton H. and Beech, Lenville C. Vegetative propagation trials of eastern redcedar and Arizona cypress in the greenhouse. USDA Forest Service Tree Planter's Notes. 1968; 19(3):2.
Keywords: *Juniperus virginiana*/ *Cupressus arizonica*/ eastern redcedar/ Arizona cypress/ rooting/ Christmas trees/ cuttings
Abstract: Rooting potential of eastern redcedar (*Juniperus virginiana*)

L) and Arizona cypress (*Cupressus arizonica* Greene) was studied for trees phenotypically selected for desirable Christmas tree traits. Five root hormone treatments replicated four times with two light regimes were used for 6 months. Cuttings 5 to 9 inches long from the upper two-thirds of the trees were obtained from a 9-year old Arizona cypress and 5-year old eastern redcedar. Coarse sand was used as media and maintained at 70 ° F. A greater percentage of the cuttings developed roots under the 7-hour photoperiod than under the 14-hour photoperiod. An overabundance of soil moisture rather than light conditions was the cause for the difference. The 5-second dip in 3-indolebutyric and naphthalene acetic acid (10,000 pp.m.) produced the greater percentage of rooted cuttings than in untreated checks for both species (eastern redcedar 82% and Arizona cypress 25%). No statistically significant differences were found between root hormone treatments.

15. Briggs, J. M.; Hoch, G. A., and Johnson, L. C. Assessing the rate, mechanisms, and consequences of the conversion of tallgrass prairie to *Juniperus virginiana* forest. *Ecosystems* . 2002; 5(6):578-586.
Keywords: *Juniperus virginiana*/ eastern red cedar/ plant succession/ growth/ species diversity.
Abstract: We assessed the determinants and consequences of the expansion of *Juniperus virginiana* L. (red cedar) populations into central US grasslands using historical aerial photos and field measurements of forest extent, tree growth, fire-induced mortality, and responses in herbaceous species diversity and productivity. Photos from northeast Kansas dating back to 1956 indicate that native tallgrass prairie can be converted to closed-canopy red cedar forest in as little as 40 years (a 2.3% increase in forest cover per year). Mean tree density in 21 forested sites ranged from 130 to 3500 trees/ha, with most sites at more than 800 trees/ha. In younger stands, maximum growth rates of individual red cedar trees exceeded 20 cm/y in height. Land management practices were critical to the establishment and growth of red cedar forest. Grazing reduced the fuel loads by more than 30% in tallgrass prairie. Based on measurements of mortality for more than 1800 red cedar trees, fire-induced mortality in grazed areas averaged 31.6% versus more than 90% at ungrazed sites. When tallgrass prairie was converted to red cedar forest, herbaceous species diversity and productivity were drastically reduced, and most grassland species were virtually eliminated. Consequently, community structure shifted from dominance by herbaceous C4 species to evergreen woody C3 species; this shift is likely to be accompanied by alterations in carbon storage and other ecosystem processes in a relatively short time period. Here we present a conceptual model that integrates the ecological and socioeconomic factors that underlie the conversion of grassland to red cedar forest.
16. Bryant, W. S. Redcedar (*Juniperus virginiana* L.) communities in the Kentucky River gorge area of the Bluegrass Region of Kentucky. General Technical

Report North Central Forest Experiment Station, USDA Forest Service. 1989; NC-132254-261.

Keywords: *Juniperus virginiana*/ Kentucky/ composition/ stand structure

Abstract: Stand structure and composition were studied in redcedar (*Juniperus virginiana*) communities on the soil borders of the exposed cliff-tops of gorges of the Kentucky River and its tributaries in central Kentucky. Redcedar accounted for approximately 76% of the density and 79% of the basal area; because of its clear dominance, species diversity was low and evergreenness high. The small tree/shrub associates formed a distinct and characteristic component of the communities. The harsh cliff-top environments serve to reduce competition from more site-demanding species. The absence of fire has also served to select for redcedar. The coefficients of determination and the species replacement patterns indicate that these cliff-top communities are rather stable and persistent.

17. Buckley, A. R. The grafting of *Juniperus virginiana* varieties on unrooted cuttings. Plant Propagators Society Proceedings. 781-83.
Keywords: *Juniperus virginiana*/ eastern redcedar/ graft/ cuttings
Abstract: Cutting-graft combinations are a quick means of ascertaining the stocks which may be used for grafting in the ordinary way.

18. Cadenasso, M. L. and Pickett, S. T. A. Experimental test of the role of mammalian herbivores on old field succession: Community structure and seedling survival. Journal of the Torrey Botanical Society. 2002 Jul-2002 Sep 30; 129(3):228-237.
Keywords: *Juniperus virginiana*/ herbivore/ succession/ New Jersey
Abstract: When elucidating plant community dynamics, investigators have focused on plant-plant and plant-environment interactions and on the characteristics of individual plants. The role of animals has been relatively neglected. Herbivory may affect vegetation dynamics by altering community composition and structure and by influencing the performance of species. Therefore, herbivory can be an important factor in succession. We experimentally tested the role of mammalian herbivores in two fields at the Hutcheson Memorial Forest Center in central New Jersey. Both fields were released from active cultivation, one at the beginning of the experiment and the other 17 years earlier. Large enclosures (5 X 5 m) were used to exclude mammalian herbivores, and open units of the same size were used as controls. The effect of herbivore exclusion on the structure and composition of the plant community was analyzed. In addition, tree seedlings of three species-*Acer rubrum*, *Cornus florida*, and *Juniperus virginiana*-were planted in the experimental units in both fields. These species typically invade early-to mid-successional old fields. The survival of these individuals was calculated and, using height as an indicator, their performance assessed. Herbivore exclusion primarily influenced the structure of the plant community rather than its composition. Percent

cover of species and species richness of all plants were not affected by herbivory, but in one field the relative cover of exotics was greater in the enclosures. The height profile of the plant community in the enclosures was significantly taller than the community in the open plots. The survival and growth of planted *A. rubrum* and *C. florida* seedlings was significantly greater when protected from herbivores. In contrast, the survival and growth of *J. virginiana* seedlings was not affected by herbivores. Growth and survival of *J. virginiana* did differ by the field they were planted in, suggesting that physiological constraints may be more important than herbivory for this species. These results reinforce that herbivorous mammals play a key role in old field succession, particularly in the pivotal shift of dominance from herbaceous to woody cover.

19. Chadwick, L. C. On and off the nursery - seeds of red cedar. American Nurseryman. 1946; 83(9):10.
Keywords: *Juniperus virginiana*/ eastern redcedar/ seeds/ stratification/ germination
Abstract: The waxy seedcoat and a resting condition of the embryo delay germination of redcedar. The coat can be removed by soaking for several hours in alcohol or by pouring warm water over the seeds and bringing the water to a boil; this process should be repeated three times. Recommends stratification in moist sand or peat at 40 ° F. for 3 months.
20. Chong C. Simultaneous grafting and rooting of juniper . HortScience. 1981; 16(4):561-562.
Keywords: *Juniperus virginiana*/ *Juniperus sabina*/ rootstock/ cuttings/ grafting
Abstract: Scion cuttings of *Juniperus virginiana* cv. Skyrocket were grafted on *J. sabina* cv. Blue Danube rootstock cuttings and rooted together under intermittent mist. Successful grafts and rooting were 46% by a paired-cutting procedure, 57% by conventional side grafting, and 75% by a new procedure in which side grafted cuttings are held together by a styrofoam block.
21. Cochran, K D. Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secret Arboretum. Special Circular Ohio Agricultural Research and Development Center. 1992; 14032-34.
Keywords: *Juniperus horizontalis*/ *Juniperus sabina*/ *Juniperus conferta*/ *Juniperus communis*/ *Juniperus procumbens*/ *Juniperus chinensis*/ *Juniperus davurica*/ *Juniperus virginiana*/ *Juniperus scopulorum*/ *Juniperus squamata*/ growth habit
Abstract: Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum* and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate or

convergent. All plants were also evaluated for growth characteristics of open or closed outline.

22. Coppedge B. R.; Engle D. M.; Masters R. E., and Gregory M. S. Predicting juniper encroachment and CRP effects on avian community dynamics in southern mixed-grass prairie, USA. *Biological Conservation*. 2004; 115(3):431-441.
Keywords: *Juniperus virginiana*/ landscape ecology/ natural grasslands/ nature conservation
Abstract: The probability of occurrence of 30 bird species was modeled as a function of landscape covertype in northwestern Oklahoma, USA. This grassland region has been extensively fragmented by agricultural activity, and remnant grassland patches are undergoing severe degradation from encroaching juniper (*Juniperus virginiana* L.). In addition, many marginal or highly erodable croplands have been placed into perennial pasture dominated by exotic grasses under the Conservation Reserve Program (CRP). Based on temporal patterns of landscape change observed between 1965 and 1995, we estimated the covertype composition of the landscapes in the year 2015 under various CRP administrative and juniper expansion/control scenarios. We then used logistic regression to predict bird responses to these landscape composition estimates. Our estimates suggest that at the current rate of expansion, juniper will overtake substantial areas of remnant grassland even with extensive control measures. As a result, some obligate and facultative grassland birds are projected to decline, while numerous species tolerant of or partially reliant on woody vegetation will increase. Landscape dynamics due to changes in the CRP might be significant and could be designed to benefit declining grassland birds, but these benefits thus far are relatively minor compared to the effects encroaching juniper woodlands will have on the landscape and the avian community.
23. Cotrufo, C. Pretreatment of eastern white pine seed. USDA Forest Service Southeastern Forest Experiment Station Research Note 176. 1962; 1762.
Keywords: *Juniperus virginiana*/ eastern redcedar/ citric-acid/ seed
Abstract: Citric-acid treatments were effective on redcedar seed.
24. ---. Stimulation of citric acid of germination of eastern red cedar (*Juniperus virginiana* L.) . *Nature*. 1963; 19992-93.
Keywords: *Juniperus virginiana*/ eastern red cedar/ germination/ seed/ citric acid/ stratification
Abstract: Pretreatment with citric acid increases both speed and total germination. The recommended treatment is to soak seed 4 days in a 10,000 p.p.m. solution of citric acid, and then stratify for 90 days.
25. Craighead, F. C. Insect enemies of eastern forests. USDA Miscellaneous Publication 657. 1950; 657679.
Keywords: *Juniperus virginiana*/ eastern redcedar/ insects/ injuries
Abstract: Practical keys (based on types of injuries) to the orders, families, and genera of forest insects

26. Cregg, B. M. Leaf area estimation of mature foliage of *Juniperus*. Forest Science. 1992 Feb; 38(1):61-67; ISSN: 0015-749X.
Keywords: *Juniperus scopulorum/ Juniperus virginiana/* specific leaf area/ surface volume ratio
Call Number: 99.8 F7632
Abstract: The ratio of total surface area to projected leaf area was determined from mature foliage samples collected at three canopy heights from *Juniperus virginiana* and *Juniperus scopulorum* from four seed sources grown in southeastern Nebraska. The relation of projected leaf area to leaf dry weight and volume was also determined. Total surface area was estimated to be 3.2 times the projected surface area. This relationship was independent of seed source or crown position. Projected leaf area can be satisfactorily estimated from weight or volume. However, these relationships differed by crown position or seed source. These results indicate that leaf area of mature juniper foliage may be rapidly estimated through measurement of projected surface area. Further, the leaf area of large samples may be estimated by determining the appropriate specific leaf area or surface-to-volume ratios.
27. Cunningham, R. A. and King, R. M. Juniper seed sources in the Great Plains. General Technical Report Rocky Mountain Research Station, USDA Forest Service. (RMRS-GTR-51): i + 19. 2000; 51(1):19.
Keywords: *Juniperus virginiana/ Juniperus scopulorum/* seeds/ geographical variation
Abstract: At age 10, 100% of eastern redcedar (*Juniperus virginiana*) and Rocky Mountain juniper (*Juniperus scopulorum*) trees from several seed sources throughout the Great Plains had survived. Seed sources from southeastern Texas had the poorest survival. Eastern redcedar trees from Kansas seed sources grew tallest, and trees from Montana and southeastern Texas seed sources were the shortest. Rocky Mountain juniper trees survived better, were shorter, had smaller crowns, exhibited greater damage from *Cercospora* blight ((Ellis and Everh.) Sutton and Hodges, formerly var.) and *Kabatina* tip blight (Schneider and V. Arx) and less damage from cedar-apple rust than did eastern redcedar trees. Eastern redcedar trees were larger, had more horizontal branching, and exhibited a greater incidence of cedar-apple rust and bagworm. In the northern Great Plains, trees from seed sources 1 to 4 degrees latitude south of each test site survived best and grew the tallest. In the central Great Plains, trees from seed sources from 1 to 4 degrees latitude north of each test site survived best, while those from 4 degrees latitude north and 6 degrees longitude east grew the tallest. Cluster analyses differentiated groups of seed sources that performed in a similar manner in terms of survival, height, and crown characteristics. Although most clusters were composed of seed sources from the same species and geographic area, one cluster contained seed sources of both species and ranked near the median for most traits. Age/age correlations indicated that seed sources may be successfully

selected for good survival and fast growth rate at age 5.

28. Dai, Y. S. A nursery blight of Sabina [*Juniperus*] virginiana. Journal of Nanjing Institute of Forestry. 1986; 237-46.
Keywords: *Juniperus virginiana*/ *Juniperus chinensis*/ *Phomopsis juniperovora*/ nurseries/ diseases/ fungi.
Abstract: A fungus producing pycnidia on dead shoots and leaves of seedlings in nurseries in Jiangsu, China, was identified as *Phomopsis juniperovora* [*P. juniperivora*] and described. Seedlings of *S. chinensis* [*Juniperus chinensis*] cv. 'pyramidalis' *Fokienia hodginsii*, *Cupressus funebris* and *C. gigantea* were infected as well as *J. virginiana*.
29. Davlenbaev, K. K. Features of the flowering and fruiting of *Juniperus virginiana*. Vestn Karakalp Fil AN UzSSR. 1972; 2(48):55-59.
Keywords: *Juniperus virginiana*/ phenology/ fruiting/ Soviet Central Asia
Abstract: Gives data on the phenology of flowering and fruiting of *J. virginiana* in various botanical gardens and parks in Soviet Central Asia.
30. Dayharsh, V. J. Stratification vs. scarification for cedar seed. USDA Forest Service Plant Quarterly . 1934; 315-16.
Keywords: *Juniperus virginiana*/ eastern red cedar/ scarification/ stratification/ seed
Abstract: Recommends scarification of the coat to improve germination of freshly gathered seed.
31. Deusen, J L van. Eastern redcedar [*Juniperus virginiana*] seed sources recommended for North Dakota site . Research Note, Rocky Mountain Forest and Range Experiment Station, USDA Forest-Service. 1979; 3716 pages.
Keywords: *Juniperus virginiana*/ provenance trials/ conifers
32. Diavanshir, K. and Fechner, G. H. Pollen germination and pollen tube growth of *Juniperus* from autumn and winter collections. Silvae Genetica. 1975; 24(1):26-29; ISSN: 0037-5349.
Keywords: *Juniperus virginiana*/ pollen collection/ pollen shedding/ stobili/ germination / viability
Call Number: 99.8 Z36
Abstract: Branches of *J. virginiana* L. collected periodically from October to March were forced in water and pollen shedding began with November 10 collections. The periods of predehiscence, dehiscence and pollen shedding shortened gradually from November through March, and pollen germination percent increased during that period. Germination percent and pollen-tube growth of forced pollen were much higher than those of pollen extracted from the stobili at the time of collection. Storage of up to 3 months did not affect germination percent or pollen tube growth of either forced or extracted pollen. Germination of viable pollen occurred within 3 to 5 days after culturing, and pollen-tube growth proceeded

slowly to its maximum in 16 or 17 days. The best medium for germination and pollen-tube growth was 10 percent (w/v) sucrose plus 0.5 percent agar. The increase in concentration of sucrose in the culture chambers, caused by evaporation of the medium, produced greater pollen-tube growth than constant sucrose concentration did. This study suggests that pollen forced from autumn or winter collections could fertilize female stobili of *Juniperus* in spring.

33. Djavanshir, K and Fechner, GH. Epicotyl and hypocotyl germination of Eastern Redcedar and Rocky Mountain Juniper. *Forest Science*. 1976; 22(3):261-266; ISSN: 0015-749X.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ seeds/ germination/ treatment/ seed treatment/ conifers
Abstract: Seeds of (a) *Juniperus virginiana* and (b) *J. scopulorum* were subjected to various treatments and germinated at 18 deg /8 deg C on damp paper. The treatments included removal of the seed tip or the seed base (hilum), extraction of embryos followed by chilling at 5-6 deg C, soaking of all or part of the seed in concentrated H₂SO₄, and cold storage of seed at -20 deg C. Seeds of (a) were also soaked in lukewarm water, dilute growth regulator or acid solutions. Chilling of the seed was required for hypocotyl development, but not for epicotyl development. Softening of the seed coat by H₂SO₄ for 35 and 120 min for (a) and (b) respectively increased the rate of germination provided that the carbonized surface was removed. Prolonged soaking or seed-base excision, two methods that remove the hilum, caused some abnormal germination in which only epicotyl development occurred: these epicotyls developed into normal seedlings under artificial conditions. It is concluded that slow germination is due to a combination of dormancy and seed-coat impermeability, and it is suggested that artificially germinated seedlings be transferred to peat moss/vermiculite in the greenhouse.
34. Dooley K. L. and Collins S. L. Ordination and classification of western oak forests in Oklahoma USA. *American Journal of Botany*. 1984; 71(9):1221-1227.
Keywords: *Juniperus virginiana*/ *Quercus*/ *Ulmus*/ *Celtis*/ *Bumelia*/ *Acer*/ Oklahoma.
Abstract: Ordination and classification techniques were used to analyze patterns of forest vegetation, species diversity and soil type in the Wichita Mountains Wildlife Refuge of southwestern Oklahoma. Cluster analysis based on tree species produced 3 general community types: *Quercus stellata*-*Q. marilandica* forests; *Q. stellata* forests; and mesophytic forests. A polar ordination produced a gradient of vegetation that corresponded to a moisture gradient. Many high diversity forests were located on loamy drainage way soils or north facing slopes. Tree species diversity (H') was inversely related to the importance of *Q. stellata*. Cluster analysis based on species composition of the tree seedlings produced 4 general community types: *Q. marilandica* type; *Q. marilandica*-*Q. stellata*-*Juniperus virginiana* type; *Ulmus americana*-*Celtis reticulata*-*Bumelia lanuginosa*

type; and *Acer saccharum* type. The 3rd seedling type occurred almost exclusively on loamy drainage way soils. There was no relationship between stand location on the 1st axis of the tree ordination and the 1st axis of the seedling ordination, suggesting that trees and seedlings respond differently along the moisture gradient.

35. Doran, W. L. Effects of treating cuttings of woody plants with both a root-inducing substance and a fungicide. American Society Horticultural Science Proceedings . 1952; 60487-491.
Keywords: *Juniperus virginiana*/ eastern redcedar/ cuttings/ fungicide/ rooting
Abstract: Combined hormone and fungicidal treatment resulted in a maximum of 83 percent rooting of redcedar cuttings in 200 days.
36. Drori A.; Meirowitz A., and Ben-Jaacov J. Grafting junipers. Hassadeh. 1983; 63(10):2138-2139.
Keywords: *Juniperus virginiana*/ *Callitris cupressiformis*/ techniques/ assessment/ rootstocks
Abstract: The grafting of *Juniperus virginiana* cv. Grey Owl onto rootstocks of *Cupressus sempervirens* and *Callitris cupressiformis* in March and July is reported. The successful take was 70% and plant development was normal over the 9 months of observation. The advantages of grafted as opposed to own-rooted *Juniperus* are discussed.
37. Early, R. P. The effect of a combined fungicide-hormone treatment on the propagation of redcedar (*Juniperus virginiana* L.) by cuttings. Oklahoma State University Processed Ser. 1960; 5.
Keywords: *Juniperus virginiana*/ eastern redcedar/ fungicide/ rooting/ hormone/ propagation
Abstract: The combination of a fungicide and a hormone produced the greatest percentage of rooting, but maximum success was only 20 percent and root systems were poor.
38. Eastman, R. E. Care of the seed of red cedar. Forestry Quarterly . 1911; 9173-174.
Keywords: *Juniperus virginiana*/ eastern redcedar/ stratification/ seeds
Abstract: Recommends stratification of seeds for approximately 17 months in sandboxes buried in soil and mulched with leaves, straw, or grass
39. Engle D. M.; Bernardo D. J.; Hunter T. D.; Stritzke J. F., and Bidwell T. G. A decision support system for designing juniper control treatments. AI-Applications. 1996; 10(1):1-11.
Keywords: *Juniperus virginiana*/ *Juniperus ashei*/ weed control/ computer techniques/ physical control/ chemical control.
Abstract: Juniper (*Juniperus virginiana* and *J. ashei*) encroachment into grasslands of the central USA represents a major threat to the these ecosystems. Considerable control technology is available for treating grasslands subject to juniper encroachment, but reluctance by land

managers to initiate juniper control technology results from the many control alternatives plus the uncertain economic return on the investment in the control treatment. Research literature on juniper control was used to develop an interactive decision support system targeted at managers of tallgrass prairies. The program computes forage and cattle production and economic returns based on inputs on range site, current juniper population, and landscape goal (i.e., populations of juniper after treatment). The system employs heuristics to select technologically feasible control methods from an array of available technologies, including mechanical control methods, herbicides and fire. A forage response model for a 10-year planning horizon is derived from user-supplied data on productivity potential of range sites and modeled juniper population following application of various technologically feasible control practices. Annual cash flows from the user-selected livestock enterprise are discounted and summed to arrive at a net present value for each control practice.

40. Engle, D. M.; Stritzke, J. F., and Claypool, P. L. Effect of paraquat plus prescribed burning on eastern redcedar (*Juniperus virginiana*). *Weed Technology*. 1988; 2(2):172-174.
Keywords: *Juniperus virginiana*/ crops/ cultural control/ burning.
Abstract: Paraquat was evaluated as a pre-treatment for *J. virginiana* before spring burning in tallgrass prairie. Wetting sprays of paraquat at 0.3 or 0.6 g/litre were applied to crowns of small (0.8-1.5 m), medium (1.5-2.5 m) and large (2.5-5.0 m) *J. virginiana* trees in Aug. 1983 and 1984 before prescribed burns in the spring of 1984 and '85. Paraquat alone at 0.6 g/litre killed about 90% of the crown of small trees but as little as 30% of the crown of large trees. Paraquat pre-treatments increased post-fire damage to small- and medium-sized trees and partially compensated for light fine fuel loading.
41. Engstrom, A. Mulching seedbeds with cellophane. *Journal of Forestry*. 1950; 48:283.
Keywords: *Juniperus virginiana*/ eastern redcedar/ cellophane/ burlap/ nursery/ mulch
Abstract: Cellophane, in conjunction with burlap on wire netting, was used to mulch nursery seedbeds of redcedar.
42. ---. Polyethylene film for seedbed mulch. USDA Forest Service Tree Planters' Notes . 1955; 21:26-27.
Keywords: *Juniperus virginiana*/ eastern redcedar/ polyethylene/ seedbeds/ mulch
Abstract: Polyethylene sheets were a satisfactory mulch for cedar seedbeds. Sowing techniques are as follows: in early December clean, dry, untreated seed is sown on conventional seedbeds and lightly covered (1/8 to 1/4 inch thick) with sawdust. After watering, polyethylene film is laid over the beds and covered with burlap. All covering is anchored.

43. Engstrom, H. E. and Stoeckeler, J. H. Nursery practice for trees and shrubs suitable for planting on the prairie plains. USDA Miscellaneous Publication . 1941; 434159.
Keywords: *Juniperus virginiana*/ eastern redcedar/ planting/ prairie
Abstract: Recommends redcedar for planting in Texas, Oklahoma, Kansas, Nebraska, South Dakota, and southern portions of North Dakota
44. Farjon, A. and Garcia, S. O. Towards the minimal conifer cone: Ontogeny and trends in *Cupressus*, *Juniperus* and *Microbiota* (*Cupressaceae* s. str.). Botanische Jahrbuecher Fuer Systematik Pflanzengeschichte Und Pflanzengeographie. 2002; 124(2):129-147.
Keywords: *Juniperus virginiana*/ *Cupressus goveniana*/ *Juniperus phoenicea*/ *Juniperus indica*/ *Microbiota decussata*/ ontogeny/ cone / seeds
Abstract: Morphology and early development of seed cones of *Cupressus goveniana* Gordon, *Juniperus phoenicea* L., *J. virginiana* L., *J. indica* Bertol. and *Microbiota decussata* Kom. (*Cupressaceae*) have been studied under the Scanning Electron Microscope (SEM). The basic process of cone ontogeny is similar in all species observed. Their differences are due to differences in numbers of bracts (= cone scales) associated with ovules, differences in number of ovules produced, and the modifications in the bracts leading to mature cone scales. A tendency towards a reduction of these numbers, observable in the species studied, is interpreted as a probable evolutionary development. This hypothesis is supported by the probable phylogeny of the taxa. The selection pressures that possibly have led to this minimal cone are discussed. It would appear that this evolution to a minimal cone has occurred twice independently within *Cupressaceae*: once from a *Cupressus*-like cone to a 'monoseed' cone in *Juniperus*, and independently from *Platyclusus* to *Microbiota* (Jagel & Stutzel 2001b), both these taxa not being closely related to the former.
45. Fechner, G. H. Controlled pollination in eastern redcedar [*Juniperus virginiana*] and Rocky Mountain juniper [*J. scopulorum*]. USDA Forest Service General Technical Report, North Central Forest Experiment Station. (NC-26). 1976; NC-2624-34.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ control pollination
Abstract: Preliminary results from studies at Fort Collins, Colorado indicate that wind pollination is less reliable than controlled-pollination in obtaining sound seed set in *J. virginiana*. On the basis of fruit set, sound seed set, and 1st-yr gametophyte development, it appears that hybridization between the 2 species is possible.
46. Ferguson, E. R. and Lawson, E. R. Eastern Redcedar (*Juniperus virginiana* L.). American Woods, Forest Service, US Department of Agriculture. (FS-260). 1974; FS-2606 pp.
Keywords: *Juniperus virginiana*

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Keywords: *Juniperus virginiana*/ eastern redcedar/ bibliography
Call Number: A99.9
Abstract: A bibliography of 330 entries on eastern redcedar, *Juniperus virginiana* L., divided by subject with a brief abstract. Articles of scientific interest are included up to 1969.
48. Garanovich, I. M. and Antonova, E. V. Features of propagating junipers by cuttings. Lesnoe Khozyaistvo. 1997; 239-40.
Keywords: *Juniperus communis*/ *Juniperus rigida*/ *Juniperus sabina*/ *Juniperus virginiana*/ vegetative propagation/ shoot cuttings/ rooting.
Abstract: Cuttings of junipers (including *Juniperus communis*, *J. rigida*, *J. sabina*, *J. virginiana*) were rooted in various substrates under mist, with the use of various growth regulators. Data are presented on rooting success and the development of the cuttings. The best substrate was a peat/sand mixture (1:1).
49. Garin, E. J. and Moore, J. C. Christmas tree production. Alabama Agriculture Experiment Station Circular. 1951; 9215.
Keywords: *Juniperus virginiana*/ eastern redcedar/ *Cupressus arizonica*/ Arizona cypress/ Christmas trees/ growth
Abstract: In central Alabama seven species were compared for growth and desirability as Christmas trees. Arizona cypress (*Cupressus arizonica* Greene) ranked first and redcedar second.
50. Garin, G. I. Christmas tree production in eastern redcedar and Arizona cypress plantations . Alabama Agriculture Experiment Station Circular. 1963; 14513.
Keywords: *Juniperus virginiana*/ Arizona cypress/ *Cupressus arizonica*/ plantation
Abstract: In a plantation in central Alabama, both species required some pruning and considerable clipping to shape. Customers preferred Arizona cypress to redcedar for its color and because it was less prickly. It was harvestable earlier and more easily grown from stumps, but survival was slightly poorer.
51. Gehring, J. L. and Bragg, T. B. Changes in prairie vegetation under eastern red cedar (*Juniperus virginiana* L.) in an eastern Nebraska bluestem prairie. American Midland Naturalist. 1992; 128(2):209-217.
Keywords: *Juniperus virginiana*/ *Andropogon*/ *Schizachyrium*/ Nebraska/ Aster/ species composition
Abstract: On a native prairie located on bluffs adjacent to the Platte River Valley in E. Nebraska, plant species composition under and adjacent to isolated 10- to 22-year-old *J. virginiana* trees was examined. *Andropogon scoparius* [*Schizachyrium scoparium*] dominated plots without trees (44% cover) and *Poa pratensis*, a non-native species dominated under trees (19%); this difference represents a 20-year change in herbaceous

composition following establishment and growth of tree crowns over native prairie. In addition to *A. scoparius* (-34%), 11 other species declined under persistent tree cover including *A. gerardii* and *Aster ericoides* (-10 and -5%, respectively); *P. pratensis* and *Carex* spp. cover increased 13 and 10%, respectively. Direction from the main tree stem affected the response of *Bouteloua hirsuta*, *Linum rigidum* var. *compactum*, *B. curtipendula* and *Ambrosia psilostachya* to tree crown development; the percentage cover of these species was generally lower to the N. and E. than to the W. and S.

52. Hall, M. T. Variation and hybridization in *Juniperus*. Annual of Missouri Botanical Gardens . 391-64.
Keywords: *Juniperus ashei*/ *Juniperus virginiana* / ashe juniper/ eastern redcedar/ hybridization
Abstract: Evidence of hybridization of *Juniperus ashei* and *Juniperus virginiana* is the character recombinations in many trees found where thoses species grow together.
53. Hodges, C. S. and Green, H. J. Survival in the plantation of eastern redcedar seedlings infected with *Phomopsis* blight in the nursery . USDA Plant Disease Report . 1961; 45134-136.
Keywords: *Juniperus virginiana*/ eastern redcedar/ *Phomopsis*/ seedlings/ nursery
Abstract: When blighted nursery seedlings were outplanted, their survival after two growing seasons was 24 to 30 percent.
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Keywords: *Juniperus virginiana*/ eastern redcedar/ *Phomopsis*/ seedlings
Abstract: Seedlings showing any symptoms of *Phomopsis* blight in the nursery should be called.
55. Hodges, C. S. Jr. Diseases in southeastern forest nurseries and their control. USDA Forest Service Southeastern Forest Experiment Station Paper. 1962; 14216.
Keywords: *Juniperus virginiana*/ eastern redcedar/ *Phomopsis juniperovora*/ *Cercospora sequoiae*/ disease/ chemical control/ nursery
Abstract: Two diseases of redcedar seedlings, *Phomopsis juniperovora* and *Cercospora sequoiae*, with recommendations for chemical control.
56. Holthuijzen, A. M. A. and Sharik, T. L. The avian seed dispersal system of eastern red cedar *Juniperus virginia* . Canadian Journal of Botany. 1985; 63(9):1508-1515.
Keywords: *Juniperus virginiana*/ seed/ dispersal/ red cedar/ avian/ bird
Abstract: The avian dispersal system of red cedar, a low-quality, fleshy, cone-producing, woody plant, was investigated in southwest Virginia

[USA] over a 2-year period. The red cedar cones ripened from late August through early October and persisted on the trees through May of the next year. Predispersal cone predation amounted to 0.9 and 3.1% of the total cone crop in 1980-1981 and 1981-1982, respectively. The proportion of the cone crop removed by avian dispersers was constant from year to year despite large differences in crop size. Active dispersal took place between November and March. Eight species of avian dispersers were identified. Single consistent feeders, such as the yellow-rumped warbler, accounted for slow, sustained removal of red cedar cones, whereas flock feeders, such as the cedar waxwing, European starling, and American robin, were responsible for rapid removal of entire cone crops. Bird-passed seeds showed 1.5-3.5 times greater total germination than manually depulped seeds. Average dispersal efficiency, defined as the proportion of the cone crop dispersed away (>12 m) from the parent tree, was 68%. The high dispersal efficiency of red cedar may be explained in part by the short duration of visits paid by avian dispersers to cone-producing trees, the high mobility of these dispersers, and the relatively long transit times for ingested seeds. High efficiency combined with enhanced germination of ingested seeds may promote the rapid invasion of abandoned pastures by red cedar in the southeastern United States.

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Keywords: *Juniperus virginiana*/ bird deposited seeds/ endozoochory
Abstract: The shape of a red cedar seed shadow was determined by counting the number of bird-deposited seeds along a 290-m-long fence line in an open pasture in SW Virginia. The seed shadow described a negative exponential relationship of density with increasing distance from the fruit source located along the border of the pasture.
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Keywords: *Juniperus virginiana*/ seeds/ plant physiology/ conifers
59. Holthuijzen, A M A; Sharik, TL, and Fraser, JD. Dispersal of eastern red cedar (*Juniperus virginiana*) into pastures: an overview. Canadian Journal of Botany. 1987; 65(6): 1092-1095. 1987; 65(6):1092-1095; ISSN: 0008-4026.
Keywords: *Juniperus virginiana*/ seeds/ seed dispersal/ Succession/ fields/ germination/ conifers
Abstract: *J. virginiana* is predominantly an avian-dispersed species. Seed dispersal, predispersal and postdispersal seed predation, seed dormancy and germination were followed during the 1981-82 fruiting season on 4 trees in grazed pastures in SW Virginia. Of the total cone crop, 34.7% was recovered within 12 m of the source tree. The remaining 61.3%

of the crop was dispersed at least 12 m. From other studies, it is concluded that <4% of the total cone crop may germinate within 12 m of the source tree, while 26.7% of those dispersed greater distances may germinate. Total germination was greater in seeds that had passed through avian digestive tracts than in seeds that had been manually depulped. Dormant seeds rapidly lost their viability. Seed shadows generated by avian dispersers decreased exponentially with increasing distance from the source tree. The large cone crop, diverse avian dispersers, adaptation to open, xeric sites and availability of seed sources in fence rows contribute to the successful invasion of pastures by this species..

60. Holthuizen A M A [Reprint author] and Sharik T L [Author]. Colonization of abandoned pastures by eastern red cedar *Juniperus virginiana*. Canadian Journal of Forest Research. 1985; 15(6):1065-1068.
Keywords: *Juniperus virginiana*/ avian/ eastern red cedar/ Virginia/ populations
Abstract: Rates and patterns of colonization of the predominantly avian dispersed eastern red cedar (*Juniperus virginiana* L.) were investigated in three abandoned pastures in southwest Virginia [USA]. The three populations, with median ages of 2, 5, and 14 years, showed sigmoid cumulative net increases in numbers of individuals over time. Exponential increase occurred during the first 6-9 years after initial establishment. Densities peaked in about 8-10 years. Only the youngest population showed a significant spatial gradient in the distribution of red cedar individuals, decreasing exponentially with distance from the nearest cone-bearing trees along the edge of the pasture. A decreasing activity gradient of avian dispersers with distance from the seed source may have influenced a differential seed input in the pasture, resulting in the observed spatial trend in tree density. No relationship existed between age and location of individuals within stands. The apparent spatial uniformity of overall density of individuals with increasing age (as noted in the 5- and 14-year-old populations) is probably due to several factors, including the increasing availability of avian perching sites and the addition of seed sources with increasing age of invading red cedar populations.
61. Horncastle, V. J.; Hellgren, E. C.; Mayer, P. M.; Engle, D. M., and Leslie, D. M. Jr. Differential consumption of eastern red cedar (*Juniperus virginiana*) by avian and mammalian guilds: implications for tree invasion. American Midland Naturalist. 2004; 152(2):255-267.
Keywords: *Juniperus virginiana*/ seed dispersal/ plant colonization.
Abstract: Increased abundance and distribution of eastern red cedar (*Juniperus virginiana*), a native species in the Great Plains, has been associated with changes in ecosystem functioning and landscape cover. Knowledge of the main consumers and dispersal agents of eastern red cedar cones is essential to understanding the invasive spread of the species. We examined animal removal of cedar cones in 3 habitats

(tallgrass prairie, eastern red cedar and woodland-prairie margins) in the Cross Timbers ecoregion in Oklahoma, USA, using 3 enclosure treatments during autumn and winter. Enclosure treatments excluded study trees from ungulates, from terrestrial rodents and ungulates or from neither (control). Loss of cones from branches varied by a habitat-time interaction, but was not affected by enclosure type. Loss of cones from containers located under experimental trees varied by a habitat-treatment-time interaction. In December and January, cone consumption from containers in no-enclosure treatments was highest in margins, followed by tallgrass prairie and eastern red cedar habitats. We conclude birds consumed the majority of cones from branches and small- and medium-sized mammals consumed cones on the ground. Both birds and mammals likely contribute to the spread of eastern red cedar but at different scales. Limiting invasion of eastern red cedar in forests may require early detection and selective removal of pioneer seedlings in cross timbers and other habitats that attract a high diversity or density of frugivores.

62. Jack, J. G. The fructification of *Juniperus*. Botanical Gazette. 1893; 18369-375.
Keywords: *Juniperus virginiana*/ eastern redcedar/ fruit/ mature
Abstract: *Juniperus virginiana* is simply annual-fruited, flowering about the latter part of April and maturing its fruit in the autumn of the same year.
63. Joy, D A and Young, D R. Promotion of mid-successional seedling recruitment and establishment by *Juniperus virginiana* in a coastal environment. Plant Ecology. 2002; 160(2):125-135; ISSN: 1385-0237.
Keywords: *Juniperus virginiana*/ *Prunus serotina*/ *Sassafras albidum*/ chlorides/ coastal areas/ establishment/ microclimate/ mortality/ recruitment/ seedlings/ soil organic matter/ soil temperature/ soil water content/ solar radiation/ species richness/ survival
Abstract: Positive interactions between *Juniperus virginiana* and woody seedlings may influence trends in primary succession along the Atlantic Coast of eastern North America. Woody species richness was greater beneath isolated *J. virginiana* trees than in more exposed, grass-covered dune sites on a Virginia, USA barrier island. Fleshy fruited seeds were more abundant in the seed bank beneath *J. virginiana* than in adjacent exposed sites, suggesting that *J. virginiana* may be utilized by passerine birds. Photosynthetically active radiation was reduced below *J. virginiana*, and soil temperature fluctuations were moderated during the growing season. In addition, moisture content, organic matter, and chlorides were higher for soils under *J. virginiana* than in exposed sites. For planted *Prunus serotina* and *Sassafras albidum* seedlings, mortality was lower beneath *J. virginiana* as compared with the exposed treatment; however, no *S. albidum* seedlings survived beyond mid-August. The effect of *J. virginiana* on the recruitment and distribution of mid-successional woody seedlings in coastal environments may be passive, through the non-random distribution of fleshy seeds by perching birds, or active, through

increased seedling survival due to *J. virginiana* initiated alterations in microclimate and edaphic factors.

64. Keen, R. A. Cutting grafts of juniper: a progress report. American Society Horticultural Science Proceedings. 1951; 58298-300.
Keywords: *Juniperus virginiana*/ eastern redcedar/ grafts/ stock/ propagation
Abstract: Cutting-grafts, in which the stock was an unrooted cutting, were used for the propagation of junipers. While the percentage of successes was low, the process was considered satisfactory.
65. Kishikawa, R.; M-Horiuti, T.; Togawa, A.; Kondoh, Y.; Janzy, P. D.; Goldblum, R. M.; Kotoh, E.; Shimoda, T.; Shoji, S.; Nishima, S., and Brooks, E. G. Juniper pollen monitoring by Burkard sampler in Galveston, Texas, USA and Japanese Cedar pollen counting in Fukuoka, Japan - Introduction of Pan American Aerobiology Association protocol counting technique. Japanese Journal of Allergology. 2004; 53(6):582-588.
Keywords: *Juniperus ashei*/ *Juniperus virginiana*/ pollen/ monitoring
Abstract: We have monitored Juniper pollen which caused winter allergy symptoms by Burkard sampler in Galveston, Texas. We identified and counted Juniper pollen grains by PAAA protocol which was a comprehensive guideline for the operation of Hirst-Type suction bioaerosol sampler, (original of Burkard sampler) in the USA. In Galveston we were able to detect the Mountain Cedar (*Juniperus ashei*) pollen from December to of January, and Eastern Red Cedar (*Juniperus virginiana*) which has cross reactivity to MC from almost middle of January to February. There is no MC vegetation in Galveston. We found the pollen grains were transported from west at Edward Plateau in West Texas where it was thickly wooded. Then, we tried to monitor Japanese Cedar (JC) pollen grains in Fukuoka, Japan according with the same method. We found the significant positive correlation between the pollen counts using one single longitudinal traverse counting technique in the PAAA protocol and the JC pollen counting on the whole of Melinex tape per 24 hours ($R^{2} = 0.9212$, $p = 0.0001$), and the gravitational method that is Durham sampler's pollen counting in 2002 ($R^{2} = 0.489$, $p = 0.0001$), and in 2003 ($R^{2} = 0.948$, $p = 0.0001$) respectively. We suggested that we can use the PAAA protocol for airborne pollen investigation in Japan by Burkard sampler.
66. Lawton, R. O. and Cothran, P. Factors influencing reproductive activity of *Juniperus virginiana* in the Tennessee valley. Journal of the Torrey Botanical Society. 2000; 127(4):271-279.
Keywords: *Juniperus virginiana*/ reproductive activity/ Tennessee/ sex ratio
Abstract: In the dioecious conifer, *Juniperus virginiana*, reproductive activity and the sex ratio among reproductively active trees are strongly

influenced by local circumstances. In managed parkland derived from secondary succession on fertile soils in the Tennessee Valley of northern Alabama, 86% of *J. virginiana* above 10 cm dbh were reproductively active and the sex ratio was 1:1. In mature xeric forests on the rocky mountain sides of the adjacent southern Cumberland Plateau, only 41% were reproductively active and the sex ratio was 2.2:1 male:female. Regression models suggest that it is likely that reproductive activity was (1) lower on the mountain side than in the parkland, (2) increased with tree diameter and tree height, (3) increased with diameter growth rate, and (4) decreased with increased shading by neighboring trees. The analysis suggests that three factors affect the relative likelihood of reproductive activity: tree size, the extent of shading and interaction between size and site.

67. Livingston, R. B. Influence of birds, stones and soil on the establishment of pasture Juniper, *Juniperus communis*, and Red Cedar, *J. virginiana*, in New England pastures. *Ecology*. 1972; 53(6):1141-1147.
Keywords: *Juniperus communis*/ *Juniperus virginiana*/ natural regeneration/ seeds/ dispersal/ birds
Abstract: Describes a study showing that on grazed pastures exposed stones offer advantages to nearly all plants adjacent to the stones, and are virtually essential for the establishment of *J. communis* var. *depressa*. The stones protect seedlings from grazing or trampling damage, and also provide a micro-environment that may save the seedlings from desiccation while still satisfying the stratification requirements for Juniper seed. Robins rest on exposed stones, and their droppings become concentrated on them. Birds are the effective disseminators of Juniper seed, and though their digestive action has a marked inhibitory effect on germination, the depositing of seeds on stones introduces them to a micro-habitat that more than compensates for the reduced germination. Seed is washed from the droppings and carried downward into cracks caused by frost heaving round each stone. Here the seed remains moist during the long period necessary for double stratification. Seedlings growing in the cracks are under the influence of a stone micro-catchment that can provide extra water to aid survival during drought periods. *J. virginiana* var. *crebra* also benefits in the same way but since its germination requirements are less exacting, its seed can germinate even on the surface. Thus, when grazing pressures are light or non-existent, *J. v.* var. *crebra* may become established without the benefit of stones.
68. Lorenzi, R. and Rognoni, F. (). Propagation of *Picea abies*, cv. Ohlendorffii, and *Juniperus virginiana*, cv. Skyrocket, from cuttings. Variations in natural and induced rooting potential. Propagazione per talea di *Picea abies excelsa* Ohlendorffii e *Juniperus virginiana* Skirocket. Variazione del potenziale rizogeno naturale ed indotto. *Rivista Della Ortoflorofrutticoltura Italiana*. 1977; 61(3):191-197.

Keywords: *Juniperus virginiana*/ *Picea abies*/ rooting/ propagation

Abstract: Cuttings of *Picea* rooted best in December/February (74-82%) and July (60%). Rooting in November was increased by treating with 5 X 10⁻⁵M IBA and in March by treating with 2500 or 5000 p.p.m. IBA. The natural rooting capacity of juniper was negligible throughout the year except in January and February (4%). In these months it could be increased to up to 70% by treatment with 5 X 10⁻⁴M IBA with or without 10⁻⁵M catechol.

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Keywords: *Juniperus virginiana*/ pregermination/ eastern red cedar/ seed/ germination
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Keywords: *Juniperus virginiana*/ eastern redcedar/ grafts/ stocks
Abstract: Procedures and requirements for grafting junipers, including use of redcedar for understock, need for healthy stocks, cutting techniques on scions, and shade requirements.
71. Martin, David W. and Young, Donald R. Small-scale distribution and salinity response of *Juniperus virginiana* on an Atlantic Coast barrier island. Canadian Journal of Botany. 1997; 75(1):77-85.
Keywords: *Juniperus virginiana*/ salinity/ Virginia barrier island/ germination/ growth/ tolerance
Abstract: A field and laboratory study examined the hypothesis that the small-scale distribution pattern of *Juniperus virginiana* on barrier islands is related to salinity patterns and plant responses to salinity. Temporal (May-October) and spatial variability in ground water availability, ground water salinity, and total soil chlorides were quantified across a Virginia barrier island. Groundwater depth and salinity increased throughout the summer; microtopographic position and location on the island also affected soil salinities. Highest salinities occurred near the ocean side beach and bay side marsh, as well as in low lying swales that flood during extreme high tides or storms. Median rooting zone chloride level for *J. virginiana* was 54 mu-g/g. In contrast, laboratory germination and growth studies indicated that *J. virginiana* was significantly affected only at high salinity levels (1000 and 1400 mu-g/g), suggesting that salinity is not the only factor regulating small-scale distribution patterns. The broad tolerance to salinity may account for the abundance of *J. virginiana* in coastal environments.
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Keywords: *Juniperus virginiana*/ eastern redcedar/ sporophylls/ seed/ cones/ staminate/ ovulate / stobili

Abstract: Chronological development of sporophylls and seed, beginning with staminate and ovulate cones

73. McDermott, R. E. and Fletcher, P. W. Influence of light and nutrition on color and growth of redcedar seedlings. Missouri Agricultural Experiment Station Research Bulletin . 1955; 58715.
Keywords: *Juniperus virginiana*/ eastern redcedar/ light/ growth
Abstract: Growth responses were the same in the one-third sunlight as in full light, but in one-tenth sunlight seedlings were stunted. Fertilizers did not affect growth under any of the three light intensities.
74. Meiners, Scott J. and Gorchov, David J. Effects of distance to *Juniperus virginiana* on the establishment of *Fraxinus* and *Acer* seedlings in old fields. American Midland Naturalist. 1998 Apr; 139(2):353-364.
Keywords: *Juniperus virginiana*/ *Fraxinus*/ *Acer*/ seedlings/ succession
Abstract: It has been hypothesized that *Juniperus virginiana* facilitates tree seedling establishment in secondary succession. To test this hypothesis, we sampled four old fields in southwestern Ohio and monitored experimentally planted seeds and seedlings of *Acer saccharum* and *Fraxinus americana* for two years. Seeds and seedlings were placed into herbivore enclosures placed 0.3 and 3.0 m from *J. virginiana* trees in an old field in Ohio. We found a significant positive spatial association between *Juniperus virginiana* and tree seedling densities in all four old fields. Soil temperature, soil moisture, evaporative demand and light level in the 0.3 m treatment were significantly reduced, whereas litter depth was increased. Germination of *A. saccharum*, but not *F. americana*, was reduced in the 0.3 m treatment, whereas seedling survival was unaffected in either species. Growth of *F. americana* seedlings was reduced by proximity to *J. virginiana* but *A. saccharum* growth was not affected. Stomatal conductance was reduced in the 0.3 m treatment for *F. americana* but unaffected in *A. saccharum*. Although there was a positive spatial association between *J. virginiana* and tree seedlings in the old fields sampled, experimental seedlings did not exhibit an early demographic response that indicated facilitation
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Keywords: *Juniperus virginiana*/ *Gymnosporangium clavipes*/ rust diseases/ ultrastructure/ forest trees/ conifers/ plant pathology
76. Minckler, L. S. and Downs, A. A. Machine and hand direct seeding of pine and cedar in the piedmont. USDA Forest Service Southeastern Forest Experiment Station Technical Note 67. 1946; 6710.
Keywords: *Juniperus virginiana*/ eastern redcedar/ stratification/ seed/ mulch/ nursery
Abstract: Suggests storing redcedar seed for 1 year and sowing it, after

stratification, in the fall. Seed should be sown in drills and covered with 1/4 inch of soil. For machine sowing in furrows, suggests three viable seeds per linear foot, with vegetative mulch.

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Keywords: *Juniperus virginiana*/ eastern red cedar/ *Juniperus caroliniana*/ *Juniperus arborescens*/ *Juniperus barbadensis*/ *Juniperus faetida*/ *Juniperus australis*/ *Juniperus sabina*/ juniper/ cedar/ savin
Call Number: 1
Abstract: Botanical analysis and distribution of eastern red cedar in the early 1900's
78. Myster; Randall W. [Reprint author]; Pickett, and S. T. A. [Author]. Effects of litter, distance, density and vegetation patch type on postdispersal tree seed predation in old fields. *Oikos*. 1993; 66(3):381-388.
Keywords: *Juniperus virginiana*/ *Quercus*/ *Carya tomentosa*/ litter/ seed/ *Cornus*/ *Fraxinus*/ postdispersal
Abstract: Because the fate of seed rain is critical to understanding the invasion of old fields by trees, we investigated spatial and temporal variation and difference among six tree species in seed predation. Very few *Juniperus virginiana* seeds were lost to predation but predation for all other test species was reduced by additions of *Quercus* litter and *Solidago* litter. *Carya tomentosa* seed predation was also reduced by increasing distance from the forest edge. In addition to litter and distance effects, differing starting densities of *Acer rubrum* seeds significantly affected predation rates but *Fraxinus americana* rates were not affected. Also, predation was greater under patches of woody vegetation compared to herbaceous patches. All results show spatial variation. Temporal variation was implied when, with increasing age of old field (from 7 to 17 years since abandonment), seed predation increased and the order of decreasing seed preference changed from *Acer*, *Cornus florida*, *Carya*, *Quercus rubra*, *Fraxinus* and *Juniperus* to *Quercus*, *Acer*, *Fraxinus* and *Carya*. Overall, for tree seeds in old fields, litter, distance to forest edge and starting density affect predation rates, there is less predation in herbaceous patches compared to woody patches and the amount of predation increases and the order of seed preference changes with increasing old field structure.
79. Myster, Randall W. Contrasting litter effects on old field tree germination and emergence. *Vegetatio*. 1994; 114(2):169-174.
Keywords: *Juniperus virginiana*/ germination/ *Quercus*/ litter/ emergence/ *Solidago*/ *Carya tomentosa*
Abstract: Because the fate of seeds is critical to understanding the invasion of old fields by trees, and plant litter is an important component defining the old field microsite of dispersed seeds, I investigated the effects of litter type (*Solidago* spp./goldenrod, *Quercus* spp./oak, mixed) and litter amount (100-800 g/m²) on tree seed germination and seedling

emergence. I found that at all densities both *Solidago* and *Quercus* litter greatly reduced emergence of the small-seeded, bird-dispersed species, *Juniperus virginiana* and *Cornus florida*. For one of the large-seeded, mammal-dispersed species, *Carya tomentosa*, high density *Solidago* litter and high density mixed litter treatments reduced emergence. For the other large-seeded species, *Quercus rubra*, the high density mixed litter treatment and all levels of *Solidago* litter reduced emergence. *Quercus* seedlings emerged twice as often as the other three species in control pots without litter. *Carya* emerged before the other species but the high density oak treatment delayed the expansion of its cotyledons. My results suggest that litter may contribute to the slow rate of tree invasion and the low probability of tree establishment in old fields. However, old field litter studies taken together point to the difficulty in drawing general conclusions about any 'net effect' of litter on old field tree establishment.

80. Nawrocka, Grzeskowiak U. and Grzeskowiak, M. New cultivar of *Juniperus virginiana* L. 'Micha'.
Nowa odmiana jaowca wirginijskiego *Juniperus virginiana* L. 'Micha'.
Folia Universitatis Agriculturae Stetinensis, Agricultura. 2004; 93289-292.
Keywords: *Juniperus virginiana*/ cultivar/ shoots/ needles/ auxin/ rooting/ cuttings
Abstract: Micha, a new cultivar of *J. virginiana*, is described. This cultivar is characterized by young increases of shoots and needles in yellow color all the year. The auxin IBA at 0.5 and 1% in talc dust was the best for rooting cuttings.
81. Norris, M. D.; Blair, J. M.; Johnson, L. C., and McKane, R. B. Assessing changes in biomass, productivity, and C and N stores following *Juniperus virginiana* forest expansion into tallgrass prairie. Canadian Journal of Forest Research. 2001; 31(11):1940-1946.
Keywords: *Juniperus virginiana*/ colonization/ biomass production/ nutrient uptake
Abstract: An increase in woody plant abundance in regions historically dominated by grasses is a recent land cover change in grasslands worldwide. In tallgrass prairies of North America, this increase in woody plant cover includes the development of dense stands of eastern red cedar (*Juniperus virginiana*). To evaluate the consequences of this ongoing land cover change for ecosystem functioning, we developed allometric equations, using data from Kansas and Oklahoma (USA), to estimate aboveground biomass and productivity in closed-canopy red cedar stands. We then applied these equations to three closed-canopy red cedar stands, 35-80 years old, which developed on sites formerly dominated by tallgrass prairie in eastern Kansas. Aboveground plant biomass for these red cedar-dominated sites ranged from 114 100 kg/ha for the youngest stand to 210 700 kg/ha for the oldest. Annual aboveground net primary productivity (ANPP) ranged from 7250 to 10 440 kg ha⁻¹ year⁻¹ for the oldest and

younger red cedar stands, respectively. Estimates of ANPP in comparable tallgrass prairie sites in this region average 3690 kg ha⁻¹ year⁻¹ indicating a large increase in C uptake and aboveground storage as a result of the change from prairie to red cedar forests. Therefore, the widespread occurrence of red cedars across the woodland-prairie ecotone suggests that this land cover change may have important consequences for regional net C storage.

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Keywords: *Juniperus virginiana*/ succession/ drought resistance/ light.
Abstract: Reports laboratory studies of the effects of irradiance intensity, temperature and leaf water potential on the rates of apparent photosynthesis and transpiration of *J. virginiana*. Results showed that this species grows well in open fields and faster than associated tree species because it is a sun-adapted, drought-resistant species with a long growing season. It is excluded from mature forests because it is intolerant of shade.
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Keywords: *Juniperus virginiana*/ herbicides/ prescribed fire/ Nebraska
Abstract: Eastern redcedar (*Juniperus virginiana* L.) is reducing grassland productivity across much of the Great Plains. Control methods include broadcast prescribed fire, herbicides, cutting, and individual tree ignition. All methods have disadvantages when used alone. Fire can be ineffective against larger trees. Intensive methods can be too expensive for low-productivity grasslands. The objectives of this research were to determine the effects of broadcast prescribed fire alone as measured at 3 weeks after fire; to compare the effects of picloram herbicide application with or without fire, sawing with or without fire, and individual tree ignition with fire; and to compare all treatment costs. Treatments were applied at a central Nebraska rangeland site in 1993 and 1994. Fire mortality was 77% in 1993 and 67 % in 1994. Either picloram or cutting after fire provided nearly 100 % control of trees < 3 m tall, but cutting was more effective for trees > 3 m tall. Total mortality due to treatment combinations generally was higher in 1993, when burning conditions were more favorable. Burning, at an estimated cost of \$4.96/ ha, before picloram application or cutting reduced total costs by nearly half. Picloram application costs were reduced from \$90.10/ ha to \$47.95/ ha, and cutting costs from \$62.92/ ha to 39.26/ ha. Burning first also reduced cutting time from 362 min/ ha to 184 min /ha, but did not significantly decrease picloram application time. Prescribed fire should precede intensive treatment applications if possible, both to reduce costs and improve total effectiveness. Because the costs and effectiveness of burning followed by either picloram or cutting are similar, managers should choose the method

most suitable to individual circumstances.

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Keywords: *Juniperus virginiana*/ *Kabatina juniperi*/ tip dieback/ Nebraska/ wounding/ inoculation/ infection
Abstract: Symptoms are described for branch tip dieback caused by *K. juniperi*, and some cultural characteristics of the organism (isolated from several locations in Nebraska) are given. Wounding of healthy foliage before inoculation was necessary for successful infection; SEM showed that the fungus entered through the wound.
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Keywords: *Juniperus virginiana*/ seedlings/ fungicides/ benomyl/ chlorothalonil/ captafol/ diseases/ control/ ornamental plants/ ornamental conifers/ forest trees/ conifers/ plant pathology
Abstract: Results are presented of a series of experiments. In vitro growth of *P. juniperovora* on agar was reduced by 0.1-0.25 mg/litre benomyl. Benomyl applied as a foliar spray to 2-yr-old potted trees of *J. virginiana* in the greenhouse (suspension of 600 mg/litre weekly for 4 wk), and to 3-yr-old trees in a nursery in South Dakota (0.6 kg/ha a.i. in 190 liters water), significantly reduced severity of disease developing after inoculation. In the nursery trees (also sprayed with chlorothalonil, triphenyl tin hydroxide, and captafol, which were ineffective in preventing disease development), % trees and amount of diseased tissue with pycnidia, and % pycnidia with spores were significantly less than in untreated trees. Benomyl applied as a spray was not translocated to protected portions of the foliage, but when applied as a soil drench to 2-yr-old potted trees in the greenhouse it was translocated and protected against disease when the concn. in new growth exceeded 3 µg/g. *J. virginiana* in the nursery was susceptible to infection by *P. juniperovora* throughout the growing season, but not after dormancy had begun in late Aug. and Sept.
86. Ottley, A. M. The development of the gametophytes and fertilization in *Juniperus communis* and *Juniperus virginiana*. *Botanical Gazette*. 1909; 4831-46.
Keywords: *Juniperus communis*/ *Juniperus virginiana*/ common juniper/ eastern redcedar/ gametophytes/ fertilization
Abstract: Cytological study.
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Keywords: *Juniperus communis*/ *Juniperus virginiana*/ *Juniperus prostrata*/ germination/ after-ripening/ temperatures
Abstract: Seed biology from *Juniperus communis*, *Juniperus virginiana*, *Juniperus prostrata*, were examined with after-ripening

treatments. Freezing and thawing has no forcing action on the germination of juniper seeds, nor did it hasten after-ripening. Freezing causes injury to after-ripened seeds. After-ripening occurred at temperatures between 0 ° C to 10 ° C , although fastest at about 5 ° C. When after-ripened seeds were transferred from 5 ° C to temperatures above 15 ° C , seeds were thrown into a state of secondary dormancy. Seeds that have not split open and developed a short hypocotyl should not be transferred to a germinator above 5° C. Inhibitors were found in the endosperm and embryo but not in the seedcoat.

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Keywords: *Juniperus virginiana*/ hybridization/ *Juniperus horizontalis*/ Wisconsin
Abstract: Analysis of morphological, terpene, and electrophoretic data is consistent with the hypothesis that hybridization is occurring beyond the F"SUB 1" generation. The biogeography of hybridization resembles an archipelago of hybrid populations arrayed along the Drift less boundary. The situation is unusual in that while most hybrid populations are in contact with extensive *J. virginiana* populations, none appear to be in contact with *J. horizontalis*. The one-sided structure of the hybrid zone suggests that hybrids are favored by selection along the eastern boundary of the Drift less Area.
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Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ seeds/ treatment/ vegetative propagation/ techniques.
Abstract: In the Askaniya-Nova botanical park in the Ukraine, seeds of *J. virginiana* and *J. scopulorum* are scarified with sand and sown in autumn, or are stratified at 0-5° C and sown in spring. Other species, especially ornamental species and forms of *J. communis* and *J. sabina*, are propagated by cuttings in a cold frame under plastic; callus forms in 45-50 days, and roots form in 75-80 days. The best time for planting cuttings is late March, and the optimum length of cuttings is 8-15 cm. Some details are given of the growth rates of seedlings and rooted cuttings, and of the ages at which they can be planted out.
90. Parent, J. and Richard, P. J. H. Pollen morphology of *Cupressaceae* from eastern Canada and northeastern United States applied to the study of Quaternary sediments. Canadian-Journal-of-Botany. 1990; 68(1):79-89; ISSN: 0008-4026.
Keywords: *Juniperus communis*/ *Juniperus horizontalis*/ *Juniperus virginiana*/ *Chamaecyparis thyoides*/ *Thuja occidentalis*/ *Taxodium*

distichum/ Cupressaceae/ Pinopsida/ pollen/ morphology/
identification/ palaeoecology

Abstract: Light microscopy was used to study pollen morphology of *Chamaecyparis*

thyoides, *Juniperus communis* var. *depressa* and var. *montana*, *J. horizontalis*, *J. horizontalis* f. *alpina*, *J. virginiana* and *Thuja occidentalis*. Pollen of *Taxodium distichum* (Taxodiaceae), which is present in the study area, was also studied. Four pollen types were identified: *J. communis*/*Thuja occidentalis*, *C. thyoides*, *J. horizontalis*/*J. virginiana* and *Taxodium distichum*. Five shapes of pollen grains, representing different stages of hydration, were found in all species and could not be used for identification. A key is included for identifying pollen in fossil sediments.

91. Parker, J. Establishment of eastern redcedar by direct seeding. Journal of Forestry. 1952; 50914-917.
Keywords: *Juniperus virginiana*/ eastern redcedar/ seedling/ direct seeding
Abstract: Seedling survival was better where the litter had been removed than where it had been left in place, the better under an open canopy than a closed.
92. ---. Germination of eastern redcedar seeds. Journal of Forestry. 1950; 48255-256.
Keywords: *Juniperus virginiana*/ eastern redcedar/ scarification/ seed/ germination
Abstract: Exposure of seeds to 41 ° F. for 2-3 months appears essential for germination. Ordinarily, sufficient exposure will be obtained when seeds are planted under natural conditions in the autumn. Scarification speeded but did not increase germination.
93. Peterson, G. W. Field survival and growth of *Phomopsis*-blighted and non-blighted eastern redcedar planting stock. USDA Plant Disease Report . 1965; 49121-123.
Keywords: *Juniperus virginiana*/ eastern redcedar/ *Phomopsis*/ blight/ seedlings
Abstract: Blighted stock, even if only slightly damaged, should not be outplanted.
94. ---. Heat treatment of nematode-infested eastern redcedar roots . USDA Plant Disease Report 48. 1964; 48862.
Keywords: *Juniperus virginiana*/ eastern redcedar/ nematodes/ roots
Abstract: Hot water treatment was used to kill root-lesion nematodes (*Pratylenchus penetrans*). Immersion in hot water at 52 ° C. for 2 minutes was the safest and most effective combination. Hot water was more injurious to roots of healthy plants than to roots of nematode-infested plants.
95. ---. Infection of *Juniperus virginiana* and *J. scopulorum* by *Phomopsis*

juniperovora. Phytopathology. 1973; 63(2):246-251.

Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ *Phomopsis juniperovora*/ infection/ lesions/ leaves

Abstract: Young leaves of both *J. spp.* were highly susceptible to *P. juniperovora* but no lesions developed on old leaves. Infection occurred at 12-32 ° C, with greater intensity at 24-28 ° . Small, light colored lesions developed in 3-5 days. Disease was more severe when high (32 °) post-inoculation temps. prevailed. Infection took place in 7 h at 100% RH and 24 ° . Pycnidia with viable spores were present 3 weeks after inoculation. The opt. temp. for germination, germ-tube development and growth in culture was 24 ° , exposure to -22 and +43 ° did not prevent germination. Spores also germinated following hydration, desiccation and the return to favourable conditions. Light had no effect on germination, growth or infection.

96. Peterson, G. W.; Nuland, D., and Weihing, J. L. Test of four fungicides for control of cedar blight. USDA Plant Disease Report . 1960; 44744-746.
Keywords: *Juniperus virginiana*/ eastern redcedar/ blight/ fungicide
Abstract: Redcedar seedlings in an eastern Nebraska nursery were treated with various formulations to control cedar blight (*Phomopsis juniperovora*). Puratized Agricultural Spray gave superior blight control in 1-0 and 2-0 redcedar. The amount of blight in 3-0 seedling was very light, and was unaffected by spraying.
97. Peterson, G. W.; Sumner, D. R., and Norman, C. Control of *Phomopsis* blight of eastern redcedar seedlings. USDA Plant Disease Report. 1965; 49529-531.
Keywords: *Juniperus virginiana*/ eastern redcedar/ *Phomopsis*/ blight/ Nebraska
Abstract: Blight in an eastern Nebraska nursery was controlled by Puratized Agricultural Spray, at concentrations of 1, 1 1/2, or 2 pints per 100 gallons of water. Control was not improved by addition of two spreader-stickers.
98. Quinn; James A. [Reprint Author], and Meiners Scott J. [Author]. Growth rates, survivorship, and sex ratios of *Juniperus virginiana* on the New Jersey Piedmont from 1963 to 2000 . Journal of the Torrey Botanical Society. 2004 Jul; 131(3):187-194.
Keywords: *Juniperus virginiana*/ eastern red cedar/ sex ratios/ growth rate/ survival/ New Jersey
Abstract: Growth rates, survivorship, and sex ratios of *Juniperus virginiana* on the New Jersey Piedmont from 1963 to 2000. J. Torrey Bot. Soc. 131: 187-194. 2004-Studies of the growth, survival, and sex ratios of dioecious species have been predominantly short-term. This research investigated growth rates, survivorship, and sex ratios among cohorts of *Juniperus virginiana* L. from 1963 through 2000. Males (M) and females (F) in six old-fields of different ages on the New Jersey Piedmont were analyzed, starting with the initial data on height and sex expression

collected by John Small on labeled recruits from 1963 through 1976. These plants were relocated and censused during the summer and fall of 2000. No changes in sex expression were recorded between 1976 and 2000. The overall sex ratio was almost 1: 1 (333 M, 332 F); only one of the fields showed a significant departure from 1:1. Males grew slightly, but significantly, faster in height than females, but relative growth rates dropped by approximately 50% for both males and females once they became reproductive. Female trees were on average 23 cm taller (and older) than males at first reproduction. Heights in those males and females surviving to 2000 were not significantly different. There was no effect of an individual's sex on its likelihood of dying, but plants that became established later were shorter, often non-reproductive, and had an increased risk of mortality. These long-term results strongly support genetically-determined sex ratios and a lack of major differences between males and females in growth rates and survival, which had been suggested by single-year studies elsewhere in the species' range.

99. Read, R. A. and Bagley, W. T. Effect of gibberillic acid spray on seedling of eastern redcedar, bur oak, and red oak. U. S. Forest Service Research Note.
Keywords: *Juniperus virginiana*/ *Quercus*/ gibberillic acid/ height growth
Abstract: A 30 p.p.m. solution of gibberillic acid sprayed two or three times a week produced striking increase in height growth on the oaks, but not in redcedar. 1967.
100. ---. Response of tree seedlings to extended photoperiods. USDA Forest Service Research Paper RM-30. 1967; RM-3016.
Keywords: *Juniperus virginiana*/ eastern redcedar/ photoperiod/ growth/ light/ seedlings/ survival
 Call Number: A99.9 F7632U no.30
Abstract: Redcedar seedlings were grown under 14- and 24- hour photoperiods and under 14-hour photoperiods with one and two light interruptions in the dark period. Seedlings were usually tallest and heaviest under continuous light, intermediate under the interrupted dark. Long photoperiods stimulated top growth more than root growth, but did not affect field survival.
101. Reva, M. L. and Reva, N N. *Juniperus virginiana* in the steppe zone of the Ukraine. Byulleten' Glavnogo Botanicheskogo Sada. 1972; 8413-19.
Keywords: *Juniperus virginiana*/ Ukraine/ *Quercus robur*/ *Gleditsia triacanthos*/ natural regeneration
Abstract: Describes the performance of *J. virginiana* as individual specimens and in pure and mixed stands on two estates in the south Ukraine. The oldest trees are 95 years old, and most of the stands are 30-60 years old. Results indicate that *J. virginiana* is fully acclimatized in this region, producing abundant natural regeneration and equaling *Quercus*

robur and *Gleditsia triacanthos* in its resistance to drought. It competes successfully with steppe and weed vegetation, but is very sensitive to shade and should be grown only in pure stands.

102. Rose A. H.; Lindquist O. H., and Nystrom K. L. Insects of eastern larch, cedar and juniper. Insects of Eastern Larch, Cedar and-Juniper. 2000; 104.

Keywords: *Juniperus virginiana/ Larix/ Thuja/* insects

Abstract: This handbook is designed to enable people interested in trees to identify insects causing damage to them. All insect species or groups that have caused damage to larch, cedar and juniper in Canada east of the Rocky Mountains are included. About 85 species are treated and of these, 47 are found on larch (*Larix laricina*), 22 on cedar (*Thuja occidentalis*) and 16 on juniper (*Juniperus virginiana*). The insect and/or its damage can be identified by means of keys using non-technical language along with about 150 color illustrations. Biological sketches of the insect are given, and the need for control measures, along with the timing of application, is prescribed. Common names of insects are used generally, but the scientific names are also given in the text.

103. Rudloff, E. von. Chemosystematic studies of the volatile oils of *Juniperus horizontalis*, *J. scopulorum* and *J. virginiana*. Phytochemistry. 1975; 14(5/6):1319-1329.

Keywords: *Juniperus horizontalis/ Juniperus scopulorum/ Juniperus virginiana/* plant composition/ terpenoids / taxonomy

Abstract: The volatile oil from the foliage of individual plants from different populations of *Juniperus horizontalis*, *J. scopulorum* and *J. virginiana* has been analyzed qualitatively and quantitatively. Some analytical problems are discussed and several new constituents have been identified. *J. horizontalis* can be differentiated from the other two species by the presence of relatively large percentages of cadinane-type sesquiterpenes and less of the elemol-eudesmol type. The ratio of methyl citronellate to citronellol may also have diagnostic value, as may be the virtual absence of aromatic ethers of the safrole-type. The oil of *J. scopulorum* is virtually devoid of the cadinol type sesquiterpenes but differentiation from that of *J. virginiana* is difficult. A useful measure of clinal variation within different populations of each species is the ratio of sabinene and limonene percentages. The occurrence of aromatic ethers in *J. scopulorum* and *J. virginiana* is erratic; in *J. horizontalis* they are present in trace amounts only. Provided an adequate foliage sample size is taken during the dormant season, population studies based on the means of the percentages of the foliage oil components are feasible. Two hybrid swarms of *J. horizontalis* and *J. scopulorum* were sampled and all plants had intermediate foliage oil compositions".

104. Rykiel, E J JR Reprint author and Cook, T L Author. Hardwood red cedar *Juniperus virginiana* clusters in the post oak savanna of Texas USA. Southwestern Naturalist. 1986; 31(1):73-78.

Keywords: *Juniperus virginiana*/ Texas/ savanna/ redcedar/ clusters/ germination/ growth / post oak

Abstract: Hardwood-redcedar clusters occur when several redcedars (*Juniperus virginiana*) germinate and grow beneath the canopy of a single live hardwood tree. Of 187 redcedars observed in 12 clusters, 92% occurred within four m of the cluster center. Redcedar numbers ranged from 6 to 28 per cluster (16 \pm 7 (mean \pm SD)). When the 12 clusters were divided into two types based on the presence (n = 7) or absence (n = 5) of a live post oak center tree, clusters without a live center tree had redcedar with greater height (6.28 \pm 2.13 vs 3.87 \pm 1.59 m) and greater redcedar dispersion (average distance of redcedars from cluster center: 2.57 \pm 1.50 vs 1.95 \pm 1.02 m). Clusters are common in the post oak savanna region, and appear to occur in high density patches following the co-occurrence of hardwoods and redcedars. The vegetation dynamics of clusters is unknown.

105. Sax, K and Sax, H. J. Chromosome number and morphology in the conifers. Journal of Arnold Arboretum . 1933; 14:356-375.

Keywords: *Juniperus virginiana*/ eastern redcedar/ chromosome/ gametophyte/ pollen / morphology

Abstract: Chromosome counts of representative conifers, including redcedar. The materials studied were chiefly the female gametophyte tissue and the two meiotic divisions of the pollen mother cells.

106. Schaefer, P. R. Ten-year results of an eastern redcedar and Rocky Mountain juniper provenance test in eastern South Dakota. Northern Journal of Applied Forestry. 1995; 12(1):30-35.

Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ South Dakota/ statistical analysis/ fungal diseases/ height crown width/ survival/ branch angle/ *Gymnosporangium*/ *Phomopsis*/ *Cercospora*

Abstract: Seedlings of 118 sources of eastern redcedar [*Juniperus virginiana*] and 26 sources of Rocky Mountain juniper [*J. scopulorum*] were established as a provenance test near Brookings, South Dakota, in 1980. Height, crown width, survival, branch angle, foliage density, number of terminal leaders, sex, flowering, and the incidence of 3 diseases (cedar-apple rust [*Gymnosporangium juniperi-virginianae*] galls, *Phomopsis* [*juniperivora*] blight, and *Cercospora* [*sequoiae*] blight) were recorded after 10 yr. ANOVA, Chi-square, simple and rank correlation, cluster analysis, and discriminant analysis methods were used to analyze the data. Eastern redcedar exhibited better overall performance than Rocky Mountain juniper for use as windbreaks. Eastern redcedar originating in central Nebraska showed the best combination of height, survival and crown characteristics. Results indicate that selection for fast growing sources may begin 2-3 yr after field planting, while the ability to select fast growing individuals within sources was only moderate after 5 yr. Correlations among traits after 10 yr were generally weak.

107. Schaefer P. R. and Baer N. B. An eastern redcedar and Rocky Mountain juniper provenance test for windbreak suitability in eastern South Dakota. *Northern Journal of Applied Forestry*. 1988; 5(2):129-132.
Keywords: *Juniperus virginiana/ Juniperus scopulorum/* provenances/ South Dakota
Abstract: A regional provenance test of 118 eastern redcedar [*Juniperus virginiana*] and 26 Rocky Mountain juniper [*J. scopulorum*] sources was established in Brookings, S. Dakota, USA, in 1980. Eastern redcedar exhibited better combinations of traits, with greater ht. growth, larger crown spread, a wider branch angle, and a stronger tendency toward producing a single terminal leader than Rocky Mountain juniper. Based on a windbreak suitability index, best performing seedlots collected from natural stands were all eastern redcedar from a large area of the central Great Plains. These results indicate that eastern redcedar should be favored over Rocky Mountain juniper for planting in eastern S. Dakota, and sources of eastern redcedar south of central Kansas should be avoided.
108. Schmidt T. L. and Wardle T. D. Impact of pruning eastern redcedar (*Juniperus virginiana*). *Western Journal of Applied Forestry*. 2002; 17(4):189-193.
Keywords: *Juniperus virginiana/* pruning/ diameter/ growth/ plant height.
Abstract: In recent years, eastern redcedar (*Juniperus virginiana*) has been the most rapidly expanding tree resource in the Great Plains from Oklahoma to South Dakota, primarily in rangelands and pastures. Based on these increases and potential management-related problems, eastern redcedar is perceived as a threat to the rangeland resource. Pruning eastern redcedar can allow for increased herbaceous growth under the eastern redcedar's crown, improve livestock handling, maintain the species for diversity and habitat contributions, and improve wood quality for potential future utilization by forest industries. To determine the effect of pruning to different heights on tree growth, we compared unpruned trees' total height and diameter to trees pruned from ground level to heights of 60, 90, 120, and 150 cm. No significant differences in the total height were found for all pruning treatments over all time periods. After more than 10 years, trees pruned to 60, 90, and 120 cm had smaller diameters at ground level than unpruned trees. There were no differences in ground diameters for trees pruned to 150 cm compared to unpruned trees after 4 years of growth. There were no significant differences in dbh for eastern redcedar trees pruned to all heights. Management of eastern redcedar, including pruning, is recommended as an alternative to control measures.
109. Schmidt, Thomas L. Reprint author and Hansen, Mark H. Author. Comparing grazed and ungrazed forests in Kansas. *Njaf (Northern Journal of Applied Forestry)*. 1998 Dec; 15(4):216-221.
Keywords: *Juniperus virginiana/* grazing/ forest/ eastern red cedar
Abstract: Differences between grazed and ungrazed forestlands in

Kansas were investigated based on a statewide sample of all forestlands. Grazing forestlands was found to have a significant relationship to the quality and quantity of trees on forest lands, as seen in lower levels of total volume and growing-stock volume when compared to ungrazed forestlands. In addition, grazed forestlands showed lower average basal areas, younger average stand ages, lower potential productivities, and increased percentages of bare ground. Compared to forestlands without grazing, forestlands with grazing had higher levels of eastern red cedar (*Juniperus virginiana* L.) seedling regeneration and lower levels of preferred hardwood species regeneration in several forest type groups. Land managers can use these results in their decision-making process concerning whether to graze their deciduous forests.

110. Schoenike, R. Early evaluation of a seed source study in Eastern Redcedar (*Juniperus virginiana* L.) in South Carolina. Proceedings of the 10th Southern Conference on Forest Tree Improvement. 1969; 165-174.
Keywords: *Juniperus virginiana*/ seed source/ South Carolina/ provenance/ growth/ survival/ foliage/ disease
Abstract: Presents and discusses preliminary data taken from 4- to 9-year-old trees of 21 provenances growing in Clemson Forest, S. Carolina. The characters studied are survival, growth, symptoms of disease, color of winter foliage, amount of foliage and % of juvenile foliage.
111. Slagg, C. M. and Wright, E. The control of *Phomopsis* blight in red cedar seedbeds . Kansas Horticultural Society Trans. 1944; 1945-4376-79.
Keywords: *Juniperus virginiana*/ eastern redcedar/ blight/ *Phomopsis*/ fungicides
Abstract: Description of the blight, incidence of infection in relation to thickness of stand and method of watering, and control by fungicidal sprays, roguing, and other sanitary measures.
112. Smith D. L. and Johnson L. C. Expansion of *Juniperus virginiana* L. in the Great Plains: Changes in soil organic carbon dynamics. Global Biogeochemical Cycles. 2003; 17(2):31-1-31-12.
Keywords: *Juniperus virginiana*/ expansion/ Great Plains/ encroachment/ soil carbon
Abstract: Woody encroachment by *Juniperus virginiana* into Great Plains grasslands allowed us to answer: Does changing the type of plant input to soils alter soil organic carbon (SOC) distribution or soil carbon (C) storage? The answer is critical because woody encroachment may alter C cycling over millions of hectares in the Great Plains and Midwest. We predicted that (1) forest SOC would become concentrated in shallow soil layers compared to SOC distribution in grassland, (2) woody expansion would increase soil C storage, and (3) forest C would be apparent in the larger soil organic matter fractions. Using $\delta^{13}C$ signatures of SOC, 1/5 of the C from 0 to 25 cm in juniper forest soils was

derived from C₃ juniper trees. Forest C₃ input occurred primarily in shallow surface layers: Forest soils developed over former C₄ prairie contained 42% C₃-SOC from C to 2.5 cm depth, and decreased to 6% at 25 cm. Isotopic analysis of SOC size fractions revealed that at 0-2.5 cm, the forest soil fraction >212 μm was -25.7‰. The fraction <2 μm had a ¹³C isotope ratio of -17.0‰ at the same depth, reflecting the predominance of residual prairie C in the smallest fraction. In spite of fast dynamics of soil C turnover, there was no net change in SOC amounts over 40-60 years (cumulative mineral and organic SOC in forest, 8782 g C/m² ± 810; in grassland, 7699 ± 1004). Thus as junipers expand into mesic areas of the Great Plains, juniper forests will provide little additional soil C storage.

113. Smith S. D. Ecology and control of eastern redcedar (*Juniperus virginiana* L.). Dissertation Abstracts International B, Sciences and Engineering. 4376-B. 1987; 47(11):4376-B.
Keywords: *Juniperus virginiana*/ chemical control/ plant competition/ germination/ Rocky Mountains
Abstract: *Juniperus virginiana* is widespread east of the Rocky Mts. and, in the last few decades, has spread across many areas of the Midwest that were formerly pure grassland. Because the tree reduces forage production, studies were made of the control of *J. virginiana* with herbicides and of the ecological relations between the tree and its associated understorey herbaceous vegetation. Hexazinone, picloram and tebuthiuron gave at least 80% kill of *J. virginiana*. Germination of native grass was inhibited by extracts of both foliage and duff of *J. virginiana*, but neither extract had great effects on height or weight growth. Overall forage production was 83% less under the tree canopy than in adjacent open areas. Soil water content and understorey light intensities were less under the canopy than in open areas on all dates when differences were measured. Establishment of *J. virginiana* was less when grass was clipped to 5 cm rather than 25 cm. Vegetation regrew on depauperate areas underneath tree canopies within 2 yr of tree removal.
114. Stoeckeler, J. H. Alkali tolerance of drought-hardy trees and shrubs in the seed and seedling stage. Minnesota Academy of Science Proceedings. 1946; 1479-83.
Keywords: *Juniperus virginiana*/ eastern redcedar/ alkali/ seed/ seedlings/ drought
Abstract: Redcedar had one of the lowest alkali tolerances of the 20 species tested.
115. Stoeckeler, J. H. and Baskin, L. C. The Denbigh disc scarifier, a new method of seed treatment. Journal of Forestry . 1937; 35396-398.
Keywords: *Juniperus virginiana*/ eastern redcedar/ scarification/ seed
Abstract: The machine greatly reduces time required for scarification of

redcedar seed.

116. Stoeckeler, J. H. and Jones, G. W. Forest nursery practice in the Lake States .
USDA Agriculture Handbook 110 . 1957; 110124.
Keywords: *Juniperus virginiana*/ eastern redcedar/ blight/ seed/
nursery/ cedar apple rust
Abstract: Summary table for seed collection, extraction, and nursery
seedling of redcedar. Discusses treatment for cedar blight and cedar apple
rust.
117. Stoeckeler, J. H. and Slabaugh, P. E. Conifer nursery practice in the prairie-
plains. USDA Agriculture Handbook 279. 1965; 27993.
Keywords: *Juniperus virginiana*/ eastern redcedar/ nursery/ seedlings/
seed/ germination/ insects/ diseases
Abstract: Nursery practices for growing redcedar seedlings. Includes
data on collection and handling of seed, preparation and sowing, care
during germination and seedling stage, and nursery protection from
insects and diseases.
118. Strong, F. C. and Cation, D. Control of cedar rust with sodium dinitrocresylate.
Phytopathology. 1940; 30983.
Keywords: *Juniperus virginiana*/ eastern redcedar/ galls/ rust/
Gymnosporangium
Abstract: A 1-percent solution of sodium dinitrocresylate was applied as a
single spray in May, when rust galls were showing signs of activity. It
inhibited telial column extension and teliospore germination from galls of
Gymnosporangium globosum and *G. juniperi-virginianae*
119. Strong, F. C. and Klomparens, W. The control of red cedar-apple and hawthorn
rusts with actidione . USDA Plant Disease Report 39. 1955; 39569.
Keywords: *Juniperus virginiana*/ eastern redcedar/ germination/
cedar-apple/ galls
Abstract: Germination of the teliospores and resultant sporidia were
prevented by a single application of cycloheximide at 100 p.p.m. The
spray was applied to the galls. No injury to the foliage resulted.
120. Strong, F. C. and Rasmussen, E. J. Spray trials on ornamental red cedars .
Michigan Agriculture Experiment Station Quarterly Bulletin . 1939; 21277-
279.
Keywords: *Juniperus virginiana*/ eastern redcedar/ fungicide/ stickers/
insecticides
-
- Abstract:** Trees were sprayed with wettable sulphur, alone and with three
stickers, to determine whether this fungicide could be used without injury
to the foliage and whether the stickers were of value. No conclusions were
drawn about the sulphur, but soybeans oil (as a sticker) injured the foliage.
121. Sudworth, G. B. The forest nursery: collection of tree seeds and propagation of

seedlings. USDA Division of Forestry Bulletin 29. 1900; 2963.

Keywords: *Juniperus virginiana*/ eastern redcedar/ seed/ nursery/ propagation/ seedlings

Abstract: Collecting and storing seed, sowing and care in the nursery. Specific information on redcedar includes number of seeds per ounce, approximate seedling height at 1 year, geographical range of species, character of seed, time to collect, and storage methods.

122. Tauer, C. G.; Harris, K. D., and VanHaverbeke, David F. Seed source influence juniper seedling survival under severe drought stress. Research Note RM-470, Rocky Mountain Research Forest and Range Experiment Station, USDA Forest Service . 1987 Jul; 4704 .

Keywords: *Juniperus scopulorum*/ *Juniperus virginiana*/ seed/ Great Plains/ Oklahoma/ seedling

Call Number: A99.9 F7632US

Abstract: Thirty-nine sources of eastern redcedar (*Juniperus virginiana* L.) and 15 sources of Rocky Mountain juniper (*Juniperus scopulorum* Sarg.), representing collections from throughout the Great Plains, were planted in 1980 as 2 + 0 stock in south-central Oklahoma. Extremely droughty conditions during 1980 resulted in 77% first-year mortality. Percent survival of seedlings, by source, showed a low and negative, but statistically significant ($p=0.05$) correlation ($r=-0.21$) with mean nursery height. Survival of Rocky Mountain juniper was greater (32%) than survival eastern redcedar (20%). Analysis of covariance (with height as the covariate) of percent survival by species showed source differences in survival only for eastern redcedar. Selection of optimum species and seed sources should improve survival of junipers in windbreak plantings on severe sites in the Great Plains.

123. Tunnell S. J.; Stubbendieck J.; Huddle J., and Brollier J. Seed dynamics of eastern redcedar in the mixed-grass prairie. Great Plains Research. 2004; 14(1):129-142.

Keywords: *Juniperus virginiana*/ soil seed bank/ seeds/ viability

Abstract: We sampled the soil seed bank underneath and surrounding eastern redcedar (*Juniperus virginiana* L.) trees at two mixed-grass prairie sites in Nebraska. Our objectives were to investigate the seed bank for seed number and seed viability in various directions and distances from individual trees. Additionally, we planted seeds to determine seed longevity and viability in the soil seed bank. Six female trees were selected at each site. At each tree, 16 soil samples were collected using a 10 x 10 cm quadrat at four distances (inside the canopy and 0.5, 2, and 5 m from the canopy) in each of the cardinal directions. Seeds were counted and viability tested using 1% 2,3,5-triphenyltetrazolium chloride. We found that most seeds were recovered inside the canopy, and seed numbers rapidly declined as distance from the canopy increased. Seed recovery and viability over time decreased, with an average of only 3% of the potential seeds recovered. Our results indicate that eastern redcedar recruitment

does not rely on long-term accumulation of seeds in the soil seed bank.

124. Van Elk, B. C. M. Potting soil for stocks. Jaarb Proefsta Boomkwek Boskoop. (Extr.). 1964; 74-75.
Keywords: *Juniperus virginiana*/ eastern redcedar/ stock/ grafting
Abstract: Table shows relative success in grafting cultivars onto redcedar stocks grown in various mixtures of peat and sand.
125. Van Haverbeke, D. F. A population analysis of *Juniperus* in the Missouri River Basin. University of Nebraska Stud. New Ser. No. 38. 1968; 3882 pp.
Keywords: *Juniperus scopulorum*/ *Juniperus virginiana*/ taxonomy/ Missouri River Basin
Abstract: A taxonomic interrelationships between *Juniperus scopulorum* Sarg. and *J. virginiana* L. in the Missouri River Basin is described. An interpretation of the data is presented which proposes that the *Juniperus* have evolved through divergence from *J. scopulorum* rather than from introgression between *J. scopulorum* and *J. virginiana*.
126. Van Haverbeke, D. F. and Barnhart, M. R. A laboratory technique for depulping *Juniperus* cones. Tree Planters' Notes . 1978; 29(4):33-34.
Keywords: *Juniperus virginiana*/ *Juniperus scopulorum*/ depulping/ berries/ cones/ seeds
Abstract: A technique for depulping small lots of *Juniperus virginiana* and *Juniperus scopulorum* uses a 3 speed commercial blender, variable speed rheostat, and timer. It saves time by eliminating presoaking the cones in water and soaking seed in lye solution after maceration to free seeds of residual resins.
127. Van Haverbeke, David F. Genetics of eastern red cedar. Forest Service, U.S. Department of Agriculture Research Paper WO-32 . 1976; 17.
Keywords: *Juniperus virginiana*/ eastern redcedar/ range/ seed/ embryo/ cones/ population
Call Number: A99.9 F76Us No. 32
Abstract: Eastern redcedar (*Juniperus virginiana* L.) is a highly variable and widely distributed conifer complex of Central and Eastern United States. Multi-character analysis studies in natural populations have provided information on genetic variation, and produced theories on migration and interrelationships among other juniper species especially in the western and central parts of its range. Staminate and ovulate stobili are borne on separate trees. Pollination occurs from February to May and fertilization about a month later. Embryo is full-grown about 2 months after fertilization, and thus the seed matures in one season. Seed production is normally abundant every 2 to 3 years. There can be dormancy problems if seeds are allowed to dry after collection and extraction, but various stratification and/or stratification methods will overcome these. Propagation by rooted cuttings and grafting is the common practice of commercial nurseries. A broad delineation of races within the range wide distribution of eastern redcedar is available from

population studies, but considerable research is needed to verify and improve it. Provenance studies of eastern redcedar are few and contradictory. Improvement programs are quite recent and individual tree selection, controlled breeding, progeny testing, and seed orchard establishment are just getting underway.

128. Van Haverbeke, David F. and Comer, C. W. Effects of treatment and seed source on germination of eastern redcedar seed . Research Paper RM. Rocky Mountain Forest and Range Experiment Station USDA Forest Service . 1985; 7.

Keywords: *Juniperus virginiana*/ eastern redcedar/ germination/ stratification/ seed/ citric acid

Call Number: A99.9

Abstract: Two experiments were conducted on eastern redcedar seed using various pretreatments followed by periods of moist-warm (24 ° C) and moist-cool (5 ° C) stratification. The effect of moist-cool (5 ° C) stratification is characterized as a linear increase in germination of about 5% for each 2 weeks of stratification. The results suggest that using the freshest seed available, soaking seed in citric acid (10,000 p.p.m.) for 96 hours, and using 6 to 10 weeks of moist-cool (5 ° C) stratification will yield the greatest germination.

129. Vasiliauskas, S. A. and Aarssen, L. W. Sex ratio and neighbor effects in monospecific stands of *Juniperus-virginiana*. Ecology. 1992; 73(2):622-632.

Keywords: *Juniperus virginiana*/ sex ratio/ Ontario/ neighbor trees/ sexual dimorphism

Abstract: Sex ratio, sexual dimorphism, and neighbor effects were investigated in 20 monospecific stands involving 3500 trees of *Juniperus virginiana*, a dioecious gymnosperm, near its northern limit in eastern Ontario. We tested the hypothesis that the intensity of competition for a given tree will depend on the sex of its nearest neighbor because of differential costs of reproduction in male and female plants. Population sex ratio was significantly male biased in only one stand but was male biased when data from all stands were combined. Stand sex ratio was not related to age structure, stand density, or local competition intensity (based on separation distance/size regressions). Male trees were significantly taller and had greater diameters in only three stands. In the combined data from all stands, however, there was a greater representation of male trees among the larger diameter trees and among the taller trees. Male trees were also significantly taller in the pooled data set. These results suggest that female trees pay a slightly but significantly greater cost for reproduction in terms of reduced vegetative growth. However, the effects of close neighbor proximity did not depend on a neighbor's sex, and male and female trees were randomly distributed relative to each other. Hence, males and females appear to compete with similar intensities against each other and are not spatially segregated into

separate "niches." The overall greater height for males may be interpreted as a consequence of sexual selection, as greater height in male trees would confer greater success as a pollen donor, especially in dense monospecific stands characteristic of this species.

130. Walck, J. L.; Baskin, J. M., and Baskin, C. C. Ecology of the endangered species *Solidago shortii*. VI. Effects of habitat type, leaf litter, and soil type on seed germination. *Journal of the Torrey Botanical Society*. 1999; 126(2):117-123.
Keywords: *Juniperus virginiana*/ *Solidago*/ *Festuca*/ seed / germination/ Kentucky
Abstract: *Solidago shortii* T. and G. (*Asteraceae*) is a federal-endangered species endemic to a small area in northeastern Kentucky. Seeds sown in December 1994 in a *Festuca arundinacea*-dominated meadow, in two *Juniperus virginiana* stands, and in an oak-hickory forest germinated to 39-59% in spring 1995; those sown in gaps of a *J. virginiana* stand and in the open germinated to 48-66%. Peak germination occurred before the oak-hickory canopy leafed-out and before *F. arundinacea* produced new (green) growth. Seeds covered with leaf litter either immediately after sowing (on 23 December 1994) or 40 d after sowing germinated to 79-87% in spring 1995; those kept free of litter or with litter removed 40 d after being covered with litter germinated to 58%. Only seeds continuously covered with litter from time of sowing germinated (3%) the second spring. In the laboratory, cold-stratified (nondormant) seeds germinated to 96-100% after 2 wk incubation at a 12/12 h daily thermoperiod of 30/15 degree C on soil derived from sandstone, black shale, dolomite, calcareous shale, and phosphatic limestone. These and previously-published results show that seeds of *S. shortii* germinate over a broad range of environmental conditions; thus, this phase of the life cycle probably does not contribute to the narrow endemism of the species.
131. Webster, C. B. and Ratliffe, G. T. A method of forcing quick germination of *Juniperus virginiana* L. seed. *Journal of Forestry*. 1942; 40:268.
Keywords: *Juniperus virginiana*/ eastern redcedar/ germination/ lye/ stratification/ depulping/ seed
Abstract: Satisfactory quick germination was achieved by depulping seed with a hammermill in December, storing dry until February, soaking in a lukewarm sodium-lye solution for 20 minutes, washing in cool water for 1 hour, soaking in fresh water for 8 hours, and stratifying in sand from February to March 29.
132. Westervelt, D. D. and Keen, R. A. Cutting grafts of junipers II. Stionic effects. *American Society of Horticultural Science Proceedings*. 1960; 76:637-643.
Keywords: *Juniperus virginiana*/ eastern redcedar/ grafts/ cuttings/ stock
Abstract: Cutting grafts and grafts on potted redcedar stock were

compared for compatibility, and survived.

133. Wilford, B. H. The seed-corn maggot, a pest of red cedar seedlings . Journal of Forestry. 1940; 658-659.
Keywords: *Juniperus virginiana*/ eastern redcedar/ maggots/ seed/ seedling
Abstract: In Tennessee, nursery seedlings were seriously injured by seed-corn maggots. Maggots feed in early May, attacking the roots or boring through and beneath the thin bark of the stem. Recommendations for control include delaying sowing so as to avoid seedling development during the wet weather of April and May, substitution of inorganic for organic fertilizers, and application of miscible carbon disulfide when maggots are feeding.
134. Wright, R. D. and Hinesley, L. E. Growth of containerized eastern red cedar amended with dolomitic limestone and micronutrients. Hortscience. 1991; 26(2):143-145.
Keywords: *Juniperus virginiana*/ media/ container/ micronutrients/ limestone/ growth
Abstract: Eastern redcedar (*Juniperus virginiana* L.) seedlings were grown in 1986 through 1988 in pine bark container media with various levels of dolomitic limestone and micronutrients. Supplemental micronutrients reduced shoot growth, especially in the absence of limestone, and root growth was greatest when neither limestone nor micronutrients were added. Including at least 3.0 kg limestone/m³ in the medium was beneficial, not only as a source of nutrients, but also as a buffer against potentially toxic effects of excess micronutrients.
135. Wycoff, H. B. Redcedar seeding practices. USDA Forest Service Tree Planters' Notes. 1961; 473-4.
Keywords: *Juniperus virginiana*/ eastern redcedar/ nursery/ seedlings/ Illinois
Abstract: Standard procedures at the Mason State Tree Nursery in central Illinois
136. Yao, J.; Holt, R.; Rich, P. M., and Marshall, W. S. Woody plant colonization in an experimentally fragmented landscape. Ecography. 1999; 22(6):715-728.
Keywords: *Juniperus virginiana*/ *Cornus drummondii*/ *Ulmus rubra*/ fragmented landscape/ colonization
Abstract: The pattern of distribution and abundance of woody plants colonizing old fields is influenced by landscape spatial features, in particular, by the distance from the old field to propagule sources and the size of the habitat patches undergoing succession. Colonization is also influenced by species life history traits, such as dispersal mode, growth form, and fecundity. As part of a long-term project studying effects of habitat fragmentation on secondary succession at the prairie-forest ecotone, we have examined the colonization patterns of early-successional woody plants in an experimentally fragmented old field, with emphasis on

the three woody species (*Cornus drummondii* C. A. Mey (rough-leaved dogwood), *Ulmus rubra* Muhl. (slippery elm), and *Juniperus virginiana* L. (red cedar)), which currently dominate the woody community on the site. The shapes of the colonization curve (proportion of colonized quadrats vs time) differed between *C. drummondii* and *U. rubra*. The rate of colonization by *C. drummondii* showed a pattern of acceleration after its initial colonization, consistent with rapid in situ recruitment from clonal growth and early seed production. By contrast, colonization by *U. rubra* fits a roughly linear pattern, consistent with recruitment only from external propagule sources. For both *C. drummondii* and *U. rubra*, density is currently greater in large patches than in small patches. No patch size difference was found for *J. virginiana*. The stem density of both *C. drummondii* and *U. rubra* exponentially decreased with distance to external propagule sources. The negative exponential pattern of *U. rubra* (wind-dispersed) with distance is sharper than that of *C. drummondii* (bird-dispersed). Moreover, the amount of spatial variation in density explained by distance to source is greater on small patches. Our results highlight the importance of life history traits of colonizing species and spatial aspects of habitat during succession.

137. Yeager, A. F. Root systems of certain trees and shrubs grown on prairie soils. *Journal of Agriculture Research* . 1935; 511085-1092.
Keywords: *Juniperus virginiana*/ eastern redcedar/ root/ rainfall/ growth/ North Dakota
Abstract: In North Dakota, in an area with 22.4 inches of rainfall per year, planted redcedars had roots up to 22 feet long at age 25 years. The greatest depth of roots was over 12 feet.
138. Zheronkina, TA. Structure of the seed-coat of Juniper and its role in germination. *Byulleten Glavnogo Botanicheskogo Sada*. 1974; 9167-72; ISSN: 0366-502X.
Keywords: *Juniperus communis*/ *Juniperus virginiana*/ seeds/ physiology/ germination/ anatomy/ conifers
Abstract: In continued work on sowing of unripe seed of *Juniperus communis* and *J. virginiana* [cf. FA 33, 549], an illustrated account is given of the structure of the seed-coat of seeds of these two species collected in May, June, July and October, and the process of the deposition of lignin in the seed-coat is described. In Kazakhstan, the seeds are best able to germinate in early August (*J. communis*) and late Sept./early Oct. (*J. virginiana*) when the lateral suture of the seed-coat is open. When the 'berry' is morphologically ripe, the seeds enter deep dormancy, with closure of the suture, deposition of lignin in the stone cells, and lignification of the parenchyma.

***Juniperus virginiana* var. *silicicola* (1)**

1. Williams, Kimberlyn Reprint author; Meads, Michael V. Author, and Sauerbrey,

Denise A. Author. The roles of seedling salt tolerance and resprouting in forest zonation on the west coast of Florida, USA. *American Journal of Botany*. 1998 Dec; 85(12):1745-1752.

Keywords: *Juniperus virginiana* var. *silicicola*/ *Quercus*/ seedling/ Florida/ salt tolerance/ *Celtis*/ *Ulmus*/ *Acer*/ *Liquidambar*

Abstract: To determine whether the zonation of seven coastal tree species in north Florida correlated with the relative abilities of their seedlings to tolerate soil salinity, we subjected seedlings of *Sabal palmetto*, *Juniperus virginiana* var. *silicicola*, *Quercus virginiana*, *Celtis laevigata*, *Ulmus* spp., *Acer floridanum*, and *Liquidambar styraciflua* to a range of salinities (approx 0, 2, 4, 8, 15, and 22 g synthetic sea salt/L; up to 63% full strength seawater salinity) in a 6-mo greenhouse experiment. Pots with shoot-killed plants were flushed with freshwater for 5 wk to assess recovery. Salt tolerance was assessed as plant survival under saline conditions and as the ability to retain green leaf tissue under saline conditions. Using either criterion, the rank order of seedling salt tolerance correlated significantly ($P < 0.05$) with that expected based on species zonation near the coast. Agreement was better, however, using retention of leaf tissue as an index of salt tolerance. Species from forest zones that were frequently exposed to tidal water retained green leaf tissue under saline conditions. Species from zones occasionally subjected to very high tides were shoot killed but resprouted following removal of salt from the root zone. Those restricted to zones exposed only to infrequent storm surges died at salinities ≥ 4 g/L. Thus, differential seedling salt tolerance was consistent with tree zonation and, although the ability of young seedlings to resprout following salt removal did not appear to allow tree establishment at the extreme seaward margin of the forest, it appeared important in intermediate zones.

Juniperus vulgaris (1)

1. He WeiMing. Distribution characteristics of root area of *Sabina vulgaris* [*Juniperus vulgaris*] in different habitats. *Scientia Silvae Sinicae*. 2000; 36(5):17-21.

Keywords: *Juniperus vulgaris*/ root area/ China/ habitats

Abstract: The root area distribution of the evergreen shrub *Sabina vulgaris*, was studied by excavating the roots of plants growing in the contrasting habitats of the semiarid Mu Us sandland of Nei Menggu, China. The root area index (RAI = root area/soil surface area, m^2/m^2) decreased with decreasing soil water availability, thus alleviating below-ground competition of the plants for water and to making use of the limited water resources. The values of beta (the depth coefficient), R_{max} (the maximum root system depth), R_{50} (the depth of root system including 50% of the total root area) and R_{90} (the depth of root system including 90% of the total root area) increased with decreasing soil water availability, indicating that the root system of *S. vulgaris* compensates for decreasing soil water content by increasing its depth. The distribution

characteristics of root area might be useful in recording changes in the water regime of habitats, and could to some extent also provide some evidence on community.

***Juniperus wallichiana* (5)**

1. Adams, R. P. Systematics of the one seeded *Juniperus* of the eastern hemisphere based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). USABiochemical Systematics & Ecology. 2000; 28(6):529-543.
Keywords: *Juniperus convallium*/ *Juniperus indica*/ *Juniperus komarovii*/ *Juniperus pingii*/ *Juniperus przewalskii*/ *Juniperus pseudosabina*/ *Juniperus recurva*/ *Juniperus saltuaria*/ *Juniperus squamata*/ *Juniperus tibetica*/ *Juniperus wallichiana*/ RAPD/ DNA/ essential oils
Abstract: The compositions of the leaf essential oils of all the one seed/cone species of *Juniperus* (sect. *Sabina*) of the eastern hemisphere are reported and compared (*J. convallium*, *J. convallium* var. *microsperma*, *J. indica*, *J. komarovii*, *J. pingii*, *J. pingii* var. *carinata*, *J. przewalskii*, *J. pseudosabina*, *J. recurva*, *J. recurva* var. *coxii*, *J. saltuaria*, *J. squamata*, *J. squamata* var. *morrisonicola*, *J. tibetica*, *J. wallichiana*). In addition, DNA fingerprinting by RAPDs was utilized. The combined terpenoid and DNA data supported the continued recognition of the aforementioned taxa as distinct species except for four varieties which were recognized at the specific level: *Juniperus carinata* (Y.K. Yu and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. pingii* var. *carinata*); *J. coxii* A.B. Jacks. (Syn.: *J. recurva* var. *coxii*); *Juniperus microsperma* (Cheng and L.K. Fu) R.P. Adams, stat. nov. (Syn.: *J. convallium* var. *microsperma*); *J. morrisonicola* Hayata (Syn.: *J. squamata* var. *morrisonicola*).
2. Chaturvedi M. Studies on the pollen grains of *Juniperus* L. Current Science. 50(12). 1981. 548-549.
Palynol. Lab., National Bot. Res. Inst., Lucknow 226 001, India. 1981; 50(12):548-549.
Keywords: *Juniperus excelsa*/ *Juniperus macropoda*/ *Juniperus pseudosabina*/ *Juniperus squamata*/ *Juniperus wallichiana*/ Himalayas/ pollen
Abstract: Light microscopic and SEM studies of 5 species (*J. excelsa*, *J. macropoda*, *J. pseudosabina*, *J. squamata* and *J. wallichiana*) from the Himalayas.
3. Dar, G. H. and Christensen, K. I. Gymnosperms of the Western Himalaya. 1. The genus *Juniperus* (*Cupressaceae*). Pakistan Journal of Botany. 2003; 35(3):283-311.
Keywords: *Juniperus communis*/ *Juniperus squamata* / *Juniperus recurva*/ *Juniperus semiglobosa*/ *Juniperus polycarpos*/ *Juniperus wallichiana*/ *Juniperus pseudosabina*/ Himalaya
Abstract: A thorough study of an extensive collection of herbarium

specimens and literature of *Juniperus* (*Cupressaceae*) from the Western Himalaya, during our work on gymnosperms of this region, has revealed that the taxonomy of West Himalayan Junipers has been confusing. A total of up to 6 taxa have been reported from this region by various earlier workers under a large number of specific and infraspecific names, most of which are synonyms. Seven taxa are recognized from the Western Himalaya in the present study: one belonging to *Juniperus* Sect. *Juniperus*, *J. communis* var. *saxatilis*, and the other six to *Juniperus* Sect. *Sabina*. The latter section includes two acicular-leaved species, *J. squamata* and *J. recurva*, and four scale-leaved species: two multiseed, *J. semiglobosa* and *J. polycarpus*, and two monoseed, *J. wallichiana* and *J. pseudosabina*.

4. Jain, K. K. A taxonomic revision of the Himalayan Junipers. *Indian Forester*. 1976; 102(2):109-188.

Keywords: *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus squamata*/ *Juniperus macropoda*/ *Juniperus excelsa*/ *Juniperus communis*/ *Juniperus pseudosabina*/ taxonomy/ Himalayas

Abstract: Discusses the taxonomy of *Juniperus* in the Himalayas. On the basis of morphological and anatomical studies (including studies of wood anatomy) eight taxa were identified. Of the species that are trees, *J. wallichiana*, *J. recurva* and *J. fargesii* [*J. squamata* var. *fargesii*] are restricted to the eastern Himalayas and *J. macropoda* and *J. excelsa* to the western Himalayas. Of the shrubs, *J. communis* subsp. *nana* occurs only in the western Himalayas, but *J. pseudosabina* and *J. squamata* occur throughout the area. Each species is briefly described.

5. Mehra, P. N. and Jain, K. K. *Abies* and *Juniperus* complexes in the E. Himalayas with observations on *Larix griffithii* Hook. f. and *Tsuga dumosa* Eichler. *Abies* and *Juniperus* Complexes in the E. Himalayas With Observations on *Larix Griffithii* Hook. F. and *Tsuga Dumosa* Eichler. 1976; 143.

Keywords: *Juniperus pseudosabina*/ *Juniperus wallichiana*/ *Juniperus recurva*/ *Juniperus fargesii*/ *Juniperus squamata*/ *Abies forrestii*/ *Abies spectabilis*/ anatomy/ morphology/ taxonomy/ classification.

Abstract: The main part of the book describes in detail the morphology and anatomy of leaves, young shoots, wood, bark and female cones of *Abies* and *Juniperus*, with 77 photographs and line drawings. Evolutionary trends in *Juniperus* and the *Pinaceae* are discussed and a short bibliography is included. It is concluded that *A. forrestii* is distinct from *A. spectabilis* and that the sabinoid group of *Juniperus* includes *J. pseudosabina* and *J. wallichiana* and the oxycedroid group *J. recurva*, *J. fargesii* and *J. squamata* var. *wilsonii*.