

Relief of the Podyjí National Park and Geomorphologic Aspects of its Protection (Czech Republic)

*Il rilievo del Parco Nazionale Podyjí e gli aspetti
geomorfologici della sua protezione
(Repubblica Ceca)*

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ABSTRACT – Two National Parks - the Podyjí National Park in Czechia and the Thayatal National Park in Austria, are situated along canyon-like valley of the Dyje/Thaya R. in the SE part of the Czech Republic and in the NE part of Austria. The area is famous for its unique natural beauties among the cultural landscapes of the Central Europe. Due to Iron Curtain the economic activities in the area were very limited in the second half of the 20th century, especially on the territory of Czechia. Therefore natural values of above-mentioned area were protected.

Czech naturalists started intensive scientific research of this area after foundation of the Podyjí National Park (NP) in 1991, incl. geomorphologic studies. Field survey resulted in compilation of detailed geomorphologic maps in the scale 1:5000 and 1:10,000. Authors distinguished three main relief types: i) etchplain, ii) eastern border slope of the West European platform and iii) canyon-like valley of the Dyje/Thaya R. Quantitative measurements of geomorphic processes (e.g. gravitational processes) are carried out on tests plots and in pseudokarst caves. Steep rocky slopes of the Dyje/Thaya R. valley are particularly deformed by gravitational movements (rock slides and deep seated slope deformations with unique pseudokarst caves).

Geomorphologic maps were used as base for delimitation of landscape-ecological units for management and landscape protection of the Podyjí NP. Nineteen landscape-ecological units were delimited and characterized by unique complex of landforms, recent geomorphologic processes and valuable biotopes, incl. proposals for management.

Within the framework of geomorphologic investigations special attention was paid to anthropogenic landforms, since the area of the NP was formed as a part of the cultural landscape in the border zone between Czechia and Austria du-

ring the last millennium. Especially, the eastern part of the NP was modeled by mining, agriculture, settlement, transportation, water engineering, until recently also by military activities and at the present by growing number of visitors. However, historic anthropogenic landforms do not disturb the typical character of the landscape. On contrary they contribute to its specific character, especially in the case of agricultural landforms.

The paper presents new results of geomorphological investigations (particularly of geomorphologic mapping) in relief of the Podyjí NP and its application of its results for needs of the nature conservation and landscape protection.

KEY WORDS: Geomorphology, Landscape protection, Nature conservation, NP Thayatal (Austria) and NP Podyjí (Czechia).

RIASSUNTO – I due Parchi Nazionali di Podyjí nella Repubblica Ceca e di Thayatal in Austria, sono ubicati lungo la stretta valle a canyon del Fiume Dyje/Thaya nel settore sud-orientale della Repubblica Ceca e nel settore nord-orientale dell’Austria. L’area è famosa tra i paesaggi culturali dell’Europa centrale per le sue bellezze naturali uniche. A causa della presenza della Cortina di ferro le attività economiche dell’area sono state limitate nella seconda metà del ventesimo secolo, specialmente nel territorio della Cecoslovacchia. Per questo motivo i caratteri di naturalità della sopra citata area sono rimasti preservati.

I naturalisti cecoslovacchi iniziarono a svolgere approfondite ricerche scientifiche, inclusi studi geomorfologici, in quest’area dopo la fondazione del Parco Nazionale del Podyjí nel 1991. Carte geomorfologiche di dettaglio a scala 1:5000 e 1:10.000 sono state elaborate dopo approfonditi rileva-

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menti di campagna. Gli autori hanno distinto tre grandi tipi di rilievo: i) pianure incise, ii) orlo orientale del pendio della piattaforma europea occidentale e iii) la stretta valle a canyon del Fiume Dyje/Thaya. Misurazioni quantitative dei processi geomorfici (per esempio i processi gravitazionali) sono state effettuate su aree campione e in cavità psuedocarsiche. I ripidi versanti rocciosi della valle Fiume Dyje/Thaya sono interessati da movimenti gravitativi (scivolamenti in roccia e deformazioni gravitative profonde con cavità psuedocarsiche uniche).

Le carte geomorfologiche sono state usate come documenti di base per la delimitazione delle unità di paesaggio-ecologiche per la gestione e la protezione del paesaggio del Parco Nazionale del Podyjí. Diciannove unità sono state individuate e sono caratterizzate da un complesso unico di forme del rilievo, recenti processi geomorfologici e preziosi biotopi.

Nell'ambito delle ricerche geomorfologiche particolare attenzione è stata data alle forme antropiche, poiché l'area del parco nazionale è stata creata come parte del paesaggio culturale nella zona di confine tra la Cecoslovacchia e l'Austria. In particolare modo, l'area orientale del parco è stata interessata e, conseguentemente, modellata da attività mineraria, da attività agricola, dagli insediamenti, recentemente anche dalle attività militari e attualmente dal continuo crescente numero di visitatori. Tuttavia, le forme del rilievo legate alle attività antropiche non alterano il carattere tipico del paesaggio, ma, al contrario, esse contribuiscono a conferirgli il suo specifico carattere.

In questo articolo vengono presentati i nuovi risultati delle ricerche geomorfologiche (in particolare la cartografia geomorfologica) nel rilievo del Parco Nazionale del Podyjí e l'applicazione dei risultati alla conservazione e alla protezione della natura.

PAROLE CHIAVE: Geomorfologia, Protezione del paesaggio, Conservazione della Natura, Parco Nazionale di Thayatal (Austria) e Parco Nazionale di Podyjí (Repubblica Ceca).

1. – INTRODUCTION

National Park Podyjí is situated in the SW part of South-Moravian Region (Czechia), neighbouring with NP Thayatal in Austria (fig. 1). The Dyje/Thaya R. forms in a long section the historical state frontier between the Czech Republic and Austria (the Dyje R. is the name of the border river in Czechia, the Thaya R. is name used in Austria). The deep incised, canyon-like valley of the Dyje/Thaya R. forms the axis of both NP between towns of Znojmo in the East, Hardegg in the central part and Vranov nad Dyjí in the West. The relief strongly influenced the human activities in this particular area since the Neolithic. During the medieval time border castles were built on steep slopes of the Dyje/Thaya R. valley (Hardegg in Austria, Vranov, Nový Hrádek and Znojmo in Czechia). On some slopes there were terraced crop fields and vineyards. In the modern time several mills and paper mills used the waterpower of the Dyje/Thaya R. Due to Iron Curtain established after World War II, economic activities in the area



Fig. 1 – Position of the Podyjí National Park in Czech Republic.
– Ubicazione del Parco Nazionale di Podyjí in Repubblica Ceca.

were very limited in the second half of the 20th century. Natural values of this area were therefore protected and the landscape is less damaged here than in the other cultural landscapes of the Central Europe.

The area is famous for its unique natural beauties among the cultural landscapes of the Central Europe. The Czech government proclaimed the National Park Podyjí in 1991 and the National Park Thayatal in Austria was proclaimed in 2000 (ROETZEL, 2005). The protected area of the NP Podyjí reaches 63 sq. km. Natural forests cover about 84 % of the area. The high geodiversity and biodiversity (especially concerning plants and invertebrates) ranks the area among the most naturally valuable territories in the Central Europe.

2. – GEOMORPHOLOGIC CONDITIONS

Political changes in Europe in the autumn 1989 have brought for Czech scientists a possibility to investigate the formerly forbidden territories adjacent to Iron Curtain. Authors studied relief of the NP Podyjí using the method of detailed geomorphologic mapping (DEMEK, 1972) in the scale 1:5000, quantitative measurements and geoecological methods. Morphostructurally NP Podyjí is situated in the SE marginal part of the Bohemian Massif (part of the West European Platform), composed of Proterozoic metamorphic and granitic rocks. From the geomorphologic point of view it is a part of the Českomoravská vrchovina Highland exhibiting flat or rolling topography in altitude of 300 to 600 m a.s.l. On the other hand, this rather leveled relief contrasts strikingly with deeply incised valley of the Dyje/Thaya R. (fig. 2) and valleys of its short tributaries (IVAN & KIRCHNER, 1994).



Fig. 2 – Canyon-like valley of the Dyje/Thaya River is incised into granite of the Dyje Massif in the eastern part of Podyjí National Park. Steep valley slopes contrast with the flat relief (remnants of the planation surface of etchplain type). Photo M. Havlíček.

– La stretta valle a canyon del Fiume Dyje/Thaya è incisa nel granito del Massiccio di Dyje nel settore orientale del Parco Nazionale di Podyjí. I ripidi versanti della valle contrastano con il rilievo pianeggiante, ciò che resta della superficie di pedepianazione. Fotografia di M. Havlíček.

Authors described three main relief types:

i) Etchplain, which is planation surface leveling folded and faulted Proterozoic metamorphic rocks and granites of the Bohemian Massif which developed by the stripping off thick weathered mantle of the Mesozoic-Tertiary regional planation surface (peneplain) and by the exposition of basal surface of weathering; on some places (e.g. in fractured zones) remnants of kaolinic weathered mantles are preserved; basal surface of weathering is undulated with ruwares and tors;

ii) Eastern marginal slope of the West European platform controlled by a system of faults in the border zone with the Carpathians (fig. 3);



Fig. 3 – Eastern part of the Podyjí National Park is situated on the eastern marginal slope of the West European platform. The marginal slope is controlled by a system of faults in the border zone with the Carpathians. Photo M. Havlíček.

– Il settore orientale del Parco Nazionale di Podyjí è situato nel settore marginale orientale della piattaforma europea occidentale. Il versante marginale è controllato da un sistema di faglie nella zona a confine con i Carpazi. Fotografia di M. Havlíček.

iii) Deep incised, canyon-like valley of the Dyje/Thaya R.; this valley is not only of geomorphologic importance, but also a climatic and biological phenomenon.

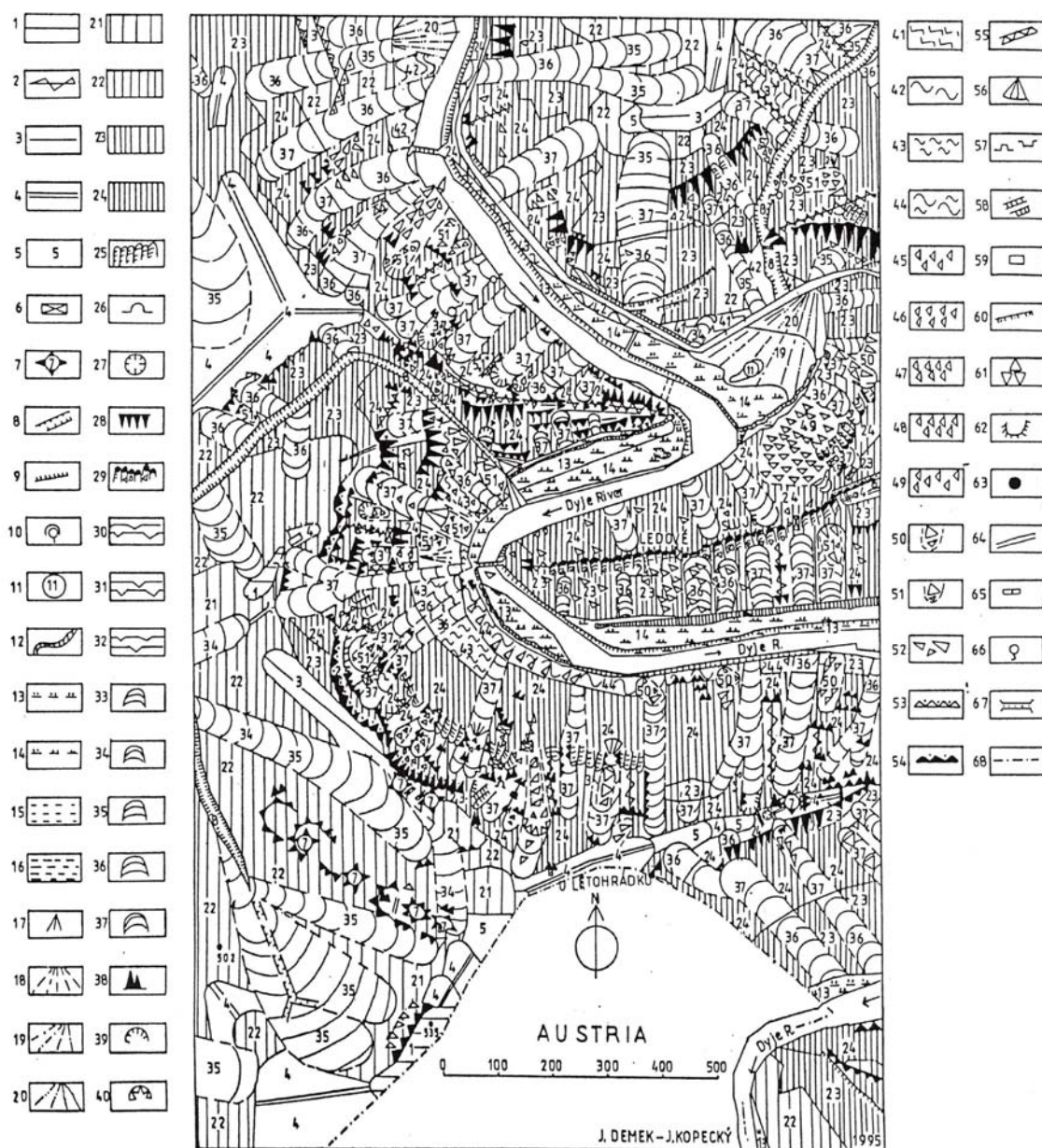
From the point of view of morphostructure, the area under study consists of two main units, the structurally lower Moravian Unit in the East and the tectonically higher Moldanubian Unit in the West. At the present time these units are morphostructurally interpreted as terranes, which were welded together during Variscan orogenetic period in Paleozoicum. In the NP Podyjí and Thayatal, both situated within the Moravian unit, the bedrock is composed of resistant metamorphic and granitic rocks of Proterozoic age (more than 600 million years old). The Bohemian Massif consolidated by the Variscan Folding as an eastern part of the West European platform developed since Permian under subaerial conditions. As early as at the end of Permian a post-Variscan planation surface developed. Tectonic movements in the Upper Cretaceous, caused by the beginning of Alpine Orogenesis, started the development of younger Mesozoic-Tertiary planation surface of the Bohemian Massif. Tropical climate caused deep, tropical weathering of dry land during the Paleogene Period. Thick weathering mantle of laterite and china clay was formed during this time on the planation surface. In the Eocene, the rise of Alps and Carpathians created a marine basin between the Bohemian Massif and young mountains, called Paratethys. During the Miocene the area of National Parks was frequently inundated by sea from Paratethys. Tectonic movements and climate changes during the Neogene Period firstly caused removal of thick tropical weathering mantles and formation of etchplain and secondly incision of rivers on the southeastern margin of the Bohemian Massif. There is evidence of repeated filling in of river valleys by marine deposits and repeated exhumation. Little is unfortunately known about geomorphologic processes in Pliocene, correlated deposits are missing in this part of the Bohemian Massif. During the Pleistocene many changes of cold and warmer periods together with rise of the margin of the Bohemian Massif caused repeated accumulation and erosion. Many Pleistocene cryogenic forms are the evidence of permafrost presence during cold periods (ice-ages). Pleistocene river terraces are rather rare, loess deposited in cold periods on etchplain and to a lesser extent also in valleys. Through continued incision of rivers, bedrock become unloaded on sides of deep incised valleys and gravitationally forms as rock slides and pseudokarst caves developed (see figure 4). Man settled the area during the whole Holocene. Human activities formed anthropogenic forms as heaps, piles, dams, dumps and agricultural

terraces on slopes. Within the National Parks, the power station above the town of Vranov nad Dyjí sends a flood wave downstream twice each day, which has not only enormous effect on the fish population in the Dyje/Thaya R. but also reduces the water temperature and significantly increases erosion of the river bed.

The deep incised, canyon-like valley of the Dyje/Thaya R. valley is the main and unique landscape feature of both National Parks. The river enters the Podyjí NP in the town of Vranov nad

Dyjí in Czechia, flows through the town of Hardegg (the smallest town in Austria) in NP Thaya-tal and its end at the town of Znojmo in Czechia. The actual length the Dyje/Thaya R. valley on the territory of both Parks is 41,6 km. Authors distinguished in the section of the Dyje/Thaya R. valley on the territory of National parks three parts with different morphology:

i) The W part incised in the Bíteš orthogneiss between the towns of Vranov nad Dyjí and Hardegg; it is the most incised part of the valley up to 235 m



deep; the valley forms incised meanders, slopes are very steep, vertical at some places with many features of deep-seated creep, cliffs and block streams; pseudokarst ice caves called Ledové sluje developed in the slip-off spur of incised meander;

ii) The central part is incised in less resistant two-mica schist of the Lukov unit (with the important intercalations of marbles); the valley is 120 to 150 m deep, but some slopes are less inclined in comparison with the first part; in this part of the Dyje/Thaya R. valley at the town of Hardegg the only road crosses the Dyje/Thaya R. valley from Austria to Czechia; on less inclined slopes there were orchards and narrow agricultural terraces with vineyards (e.g. in the vicinity of castle Nový Hrádek);

iii) The E part incised into granite of the Dyje Massif is almost 20 km long and the valley depth does not extend 160 m; steep slopes with many tors and exfoliation forms are accompanied with large block fields, block streams and screes; the rock forms are very spectacular and the valley exhibits special natural beauty; there are abandoned incised meanders (e.g. Lipina); since 1497 till 1950 there were 9 mills and a paper mill in this part of valley; famous vineyards are situated on south facing agricultural terraces on the incised meander spur Šobes; the lowest part of the valley above the town of Znojmo fills water of the Znojmo dam.

3. – GEOMORPHOLOGIC MAPS AND LANDSCAPE-ECOLOGICAL UNITS

Geomorphologic maps in the scale 1:5.000 and 1:10.000 were compiled in NP Podyjí based on IGU Unified key to the detailed geomorphologic map of the World (see DEMEK, 1972). These geomorphologic maps represent morphography and morphometry, origin and age of the relief and its different forms according to map scale (fig. 4). Knowledge about relief as the abiotic geomorphologic component of landscape and namely ecological assets (see PANIZZA & PIACENTE, 2003) enabled delimitation of the landscape-ecological units of the Podyjí NP.

Differentiated natural management represents the base for nature conservation and landscape protection of the territory of National Parks. The whole territory is divided into three zones for this purpose. The most valuable and interesting part represents so-called first zone. In the case of the NP Podyjí this zone includes the unique Dyje/Thaya R. valley and narrow strip of land along the valley, which is strictly protected (e.g. restrictions of visitors movements). In the first zone 19 most interesting and representative landscape-ecological units were delimited. From the point of view of nature conservation and landscape protection, every unit of the first zone represents homogenous landscape-ecological segment with characteristic features in relation to morphography (slope inclination, slope

Fig. 4 – Detailed geomorphological map of the Landscape-ecological unit Ledové sluje (Ice caves) with the incised meander of the Dyje/Thaya River in the western part of the Podyjí National Park (after DEMEK & KOPECKÝ, 1996).

Legend to the detailed geomorphologic map. Explanations:

1. Remnants of the polygenetic planation surface (etchplain), 2. narrow and rocky ridge, 3. narrow and rounded ridge developed by intersection of valley slopes, 4. broad and rounded ridge developed by the intersection of slopes, 5. spur, 6. rock pillar, 7. monadnock, 8. gully, 9. scarp developed due to lateral river erosion, 10. spring niche, 11. cutoff, 12. abandoned riverbed, 13. low floodplain, 14. high floodplain, 15. accumulation bottom inclined to the axis of valley with inclination 0-2 degrees, 16. accumulation bottom inclined to the axis of valley with inclination 2-5 degrees, 17. accumulation bottom inclined to the axis of valley with inclination 5-15 degrees, 18. surface of alluvial cone with inclination 0-2 degrees, 19. Surface of alluvial cone with inclination 2-5 degrees, 20. surface of alluvial cone with inclination 5-15 degrees, 21. valley slope inclined 2-5 degrees, 22. valley slope inclined 5-15 degrees, 23. valley slope inclined 15-25 degrees, 24. valley slope inclined 25-35 degrees, 25. valley slope inclined 35 and more degrees, 26. pseudokarst cave, 27. pseudokarst doline, 28. frost-riven cliff, 29. rock wall modeled by cryogenic processes, 30. cryoplanation terrace inclined 0-2 degrees, 31. cryoplanation terrace inclined 2-5 degrees, 32. cryoplanation terrace inclined 5-15 degrees, 33. dell inclined 0-2 degrees, 34. dell inclined 2-5 degrees, 35. dell inclined 5-15 degrees, 36. dell inclined 15-25 degrees, 37. dell inclined 25-35 degrees, 38. tor, castle-koppie, 39. nivation hollow with smooth slopes covered by soil and scree, 40. nivation hollow with cliffs, 41. crest, 42. talus slope inclined 5-15 degrees, 43. talus slope inclined 15-25 degrees, 44. talus slope inclined 25-35 degrees, 45. block field inclined 0-2 degrees, 46. block field inclined 2-5 degrees, 47. block field inclined 5-15 degrees, 48. block field inclined 15-25 degrees, 49. block field inclined 25-35 degrees, 50. block stream composed of angular block inclined 5-15 degrees, 51. block field composed of angular blocks inclined 15-25 degrees, 52. angular block, 53. root area of rock slide, 54. headwall of rockslide, 55. trough, dilated fissure, 56. dejection cone, 57. quarry, active, abandoned, 58. sunken road, 59. pit, 60. agricultural balk, 61. agricultural damp, 62. mine dump, 63. bunker, 64. road, 65. country seat, 66. spring, 67. bridge, 68. state boundary.

– Carta geomorfologica di dettaglio dell'unità di paesaggio-ecologica di Ledové sluje (Ice caves) con il meandro inciso del fiume Dyje/Thaya nel settore occidentale del Parco Nazionale di Podyjí (da DEMEK & KOPECKÝ, 1996). Legenda: 1. Resti della superficie di pedepianazione poligenica., 2. stretta cresta rocciosa, 3. stretta e arrotondata cresta sviluppata dall'intersezione di fianchi vallivi, 4. larga e arrotondata cresta sviluppata dall'intersezione di versanti, 5. sperone roccioso, 6. colonna rocciosa, 7. monadnock, 8. incisione, 9. scarpata dovuta ad erosione fluviale laterale, 10. sorgente, 11. taglio, 12. letto abbandonato, 13. bassa piana alluvionale, 14. alta piana alluvionale, 15. depositi di accumulo inclinati verso l'asse della valle con inclinazione 0-2 gradi, 16. depositi di accumulo inclinati verso l'asse della valle con inclinazione 2-5 gradi, 17. depositi di accumulo inclinati verso l'asse della valle con inclinazione 5-15 gradi, 18. cono alluvionale con inclinazione 0-2 gradi, 19. cono alluvionale con inclinazione 2-5 gradi, 20. cono alluvionale con inclinazione 5-15 gradi, 21. fianco vallivo con inclinazione 2-5 gradi, 22. fianco vallivo con inclinazione 5-15 gradi, 23. fianco vallivo con inclinazione 15-25 gradi, 24. fianco vallivo con inclinazione 25-35 gradi, 25. fianco vallivo con inclinazione 35 gradi o superiore, 26. grotta pseudo carsica, 27. dolina pseudo carsica, 28. scogliera frost-riven, 29. parete in roccia modellata da processi criogenici, 30. terrazzo di crioplanazione con inclinazione 0-2 gradi, 31. terrazzo di crioplanazione con inclinazione 2-5 gradi, 32. terrazzo di crioplanazione con inclinazione 5-15 gradi, 33. vallecchia con inclinazione 0-2 gradi, 34. vallecchia con inclinazione 2-5 gradi, 35. vallecchia con inclinazione 5-15 gradi, 36. vallecchia con inclinazione 15-25 gradi, 37. vallecchia con inclinazione 25-35 gradi, 38. tor, 39. nicchia di nivazione con pareti levigate coperta di terra e detrito, 40. nicchia di nivazione con pareti verticali, 41. cresta, 42. cono detritico con inclinazione 5-15 gradi, 43. cono detritico con inclinazione 15-25 gradi, 44. cono detritico con inclinazione 25-35 gradi, 45. campo di pietre con inclinazione 0-2 gradi, 46. campo di pietre con inclinazione 2-5 gradi, 47. campo di pietre con inclinazione 5-15 gradi, 48. campo di pietre con inclinazione 15-25 gradi, 49. campo di pietre con inclinazione 25-35 gradi, 50. block stream composto da blocchi spigolosi con inclinazione 5-15 gradi, 51. campo di pietre composto da blocchi spigolosi con inclinazione 15-25 gradi, 52. blocchi spigolosi, 53. area sorgente di rock slide, 54. scarpata di rock slide, 55. trugolo, fessura dilatata, 56. cono di deiezione, 57. cava, attiva, abbandonata, 58. strada che ha ceduto, 59. miniera, 60. terrapieno agricolo, 61. discarica agricola, 62. discarica mineraria, 63. bunker, 64. strada, 65. residenza di campagna, 66. sorgente, 67. ponte, 68. confine di stato.

orientation), morphostructure (bedrock), genesis, soils and biota. Most of these units (12) are situated on steep slopes of the Dyje/Thaya R. valley and in deep valleys of its tributaries, 6 units are situated on the eastern marginal slope of the Bohemian Massif with xerothermic steppe flora and 1 unit on the etchplain (wetland with fishponds) (fig. 5).

The following criteria were applied in the process of selection of landscape-ecological units:

- i) Representativity – segments represent all main relief types and biotopes;
- ii) Cover – segments cover the whole Dyje/Thaya R. valley;
- iii) Degree of nature qualities – this criterion concerns mainly the state of biota, especially vegetation;
- iv) Degree of biodiversity;
- v) Exceptionality – natural abiotic and biotic phenomena specific for NP (e.g. pseudokarst caves in gneiss with cave ice called Ledové sluje (Ice Caves), virgin forest on steep valley slopes in segment Braitava);
- vi) Historic values – typical land-use forms, e.g.

system of agricultural terraces on slopes which developed in medieval time and preserved up to present time – segment Hradištské terasy in the vicinity of Znojmo, prehistoric and medieval castle sites and their surroundings with many anthropogenic forms – segment Nový Hrádek (New Castle).

Landscape-ecological units were mapped in the scale 1:10.000, characterized (e.g. altitude, areal extent, morphography, geological composition, specific phenomena, biota, forestry, historical monuments, proposals for management, etc.), digitalized and stored in computers.

4. – EXAMPLES OF LANDSCAPE-ECOLOGICAL SEGMENTS IN THE DYJE/THAYA VALLEY

Segment Braitava

The steepest and highest (235 m) concave undercut slope segment with many examples of slope deformations due to undercutting by the

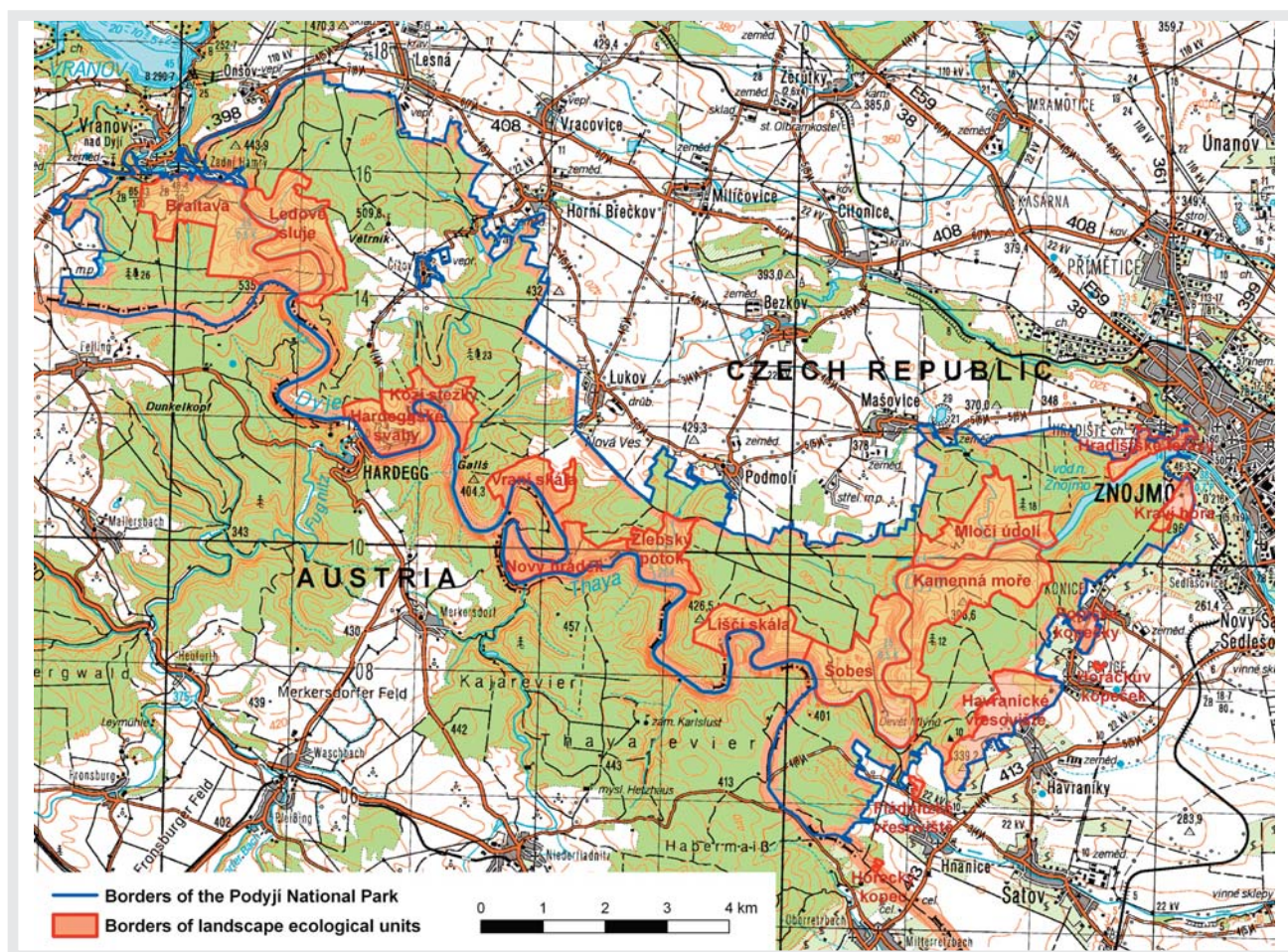


Fig. 5 – Landscape-ecological units in the Podyjí National Park.
– Unità di paesaggio-ecologiche nel Parco Nazionale di Podyjí.

river and following unloading of Bíteš orthogneiss. There are many well-developed rock forms (cliffs, rock pillars, tors, block fields, block streams, pseudokarst caves, honeycomb weathering, etc.). A slope virgin forest covers this steep valley slope.

Segment Ledové sluje (Ice Caves)

Special phenomenon on slip-off spur of entrenched meander and neighboring abandoned meander incised into Bíteš orthogneiss (see DEMEK & KOPECKÝ, 1996). Unloading of bedrock after incision of the Dyje/Thaya R. (and maybe an earthquake) caused rockslides, opening of fissures and formation of several hundred of meters long and tens of meters deep pseudokarst caves in gneiss (fig. 6). Due to special microclimatic conditions cave ice remains in pseudokarst caves up to August. Rare glacial relicts of invertebrates were found in these caves and in block fields on slopes. The segment is a habitat for 17 species of bats. Quantitative measurements of gravitational movements are carried out in caves and in block fields. Segment is closed for public.

Segment Kozí stezky

The segment occupies the left valley slope of the entrenched meander of the Dyje/Thaya R. and deep valley of the Klapperův potok Creek. Mica schist of the Lukov Unit of the Moravian Unit forms this steep slope. There are many cryogenic forms (frost-riven cliffs, etc) from Pleistocene ice-ages on the slope. Very complex catena developed from rock steppe and forest-steppe in the upper part of the slope, natural broad leaf forest in the middle part up to floodplain forest at the valley bottom. Anthropogenic forms (originated by mining) from the medieval time can be found in this segment. At the mouth of the Klapperův potok Creek karst forms with karst spring in marble developed.

Segment Nový Hrádek (New Castle)

Segment is situated on the left valley slope of the Dyje/Thaya R. valley and on a rocky spur of the entrenched meander with the medieval castle of Nový Hrádek. The bedrock is formed by mica schist with quartzite dikes of the Lukov Unit of the Moravian Unit. Wonderful developed entrenched meanders in Czechia (Ostroh) and in Austria (Umlaufberg NE from the village of Merkersdorf) are unique features in this segment. This segment was settled since prehistoric time and therefore there are many anthropogenic forms (fortification forms, sunken road cut into the bedrock, agricultural terraces). Movements of visitors are allowed on marked tourist trails only.

Segment Šobes

A core of the segment lies on a slip-off spur of an impressive entrenched meander and neighboring abandoned meander Lipina with rocky outlier of the Dyje/Thaya R. The bedrock is for-

med by granite of the Dyje Massif. Man settled this area already 30.000 years B.P. and continuous settlement was established since 4300 years B.C. There are many forms of weathering of granite (large corestones, block fields, block streams). Original forest steppe and xerothermic vegetation were mostly replaced by vineyards on agricultural terraces (already since Roman times – 1st Century A.D.). In this part of the valley 9 mills were situated since 1497, floods destroyed 3 mills already during the 16th century.

Segment Kamenná moře (Block fields)

Landscape-ecological unit is situated on the right steep slope of the Dyje/Thaya R. valley between Papírna (Paper Mill) and the mouth of the Trauznický potok Creek. Bedrock is formed by granites of the Dyje Massif. Detailed geomorphologic mapping in the scale 1:5000 has shown a great variety of granite landforms (see IVAN & KIRCHNER, 1998) in this segment. Due to unloading of granite and following frost weathering in the Pleistocene ice-ages originated rugged ridges, rock pil-



Fig. 6 – Ledové sluje (Ice-caves). Pseudokarst caves in gneiss originated by gravitational processes are unique phenomenon of landscape-ecological unit. Photo J. Kopecký.

– Ledové sluje (Ice-caves). Queste cavità pseudocarsiche nello gneiss dovute a processi gravitazionali sono fenomeni unici nell'unità di paesaggio. Fotografia di J. Kopecký.

lars, tors, pseudokarst caves, block fields and block streams (fig. 7). On granite corestones and rock forms developed pseudokarst lapiés and weather pits. Natural and semi-natural forest covers the most of segment – from floodplain forest on the valley bottom up to pines on granite slopes. In upper parts of slopes rock steppe developed. Segment is open for visitors on marked trails only.

Segment Hradištské terasy (Agricultural terraces of Hradiště)

Man activities substantially changed left granite slope of the Dyje/Thaya R. valley. Medieval farmers built on the steep slope a complex system of agricultural terraces for gardens and orchards, which is preserved up to now. Several old mining forms can be also found among orchards. Around granite tors and corestones preserved remnants of warm forest steppe. This ancient type of South Moravian cultural landscape is still used partly by farmers, partly for recreation. The aim of management is to keep the landscape equilibrium among natural conditions and Man activities in this part of the National Park.

5. – CONCLUSION

Geomorphological mapping was the basic information source for delimitation of landscape-ecological units in the first zone of the National Park Podyjí, especially in deep incised valley of the Dyje/Thaya R. valley. Landscape-ecological division is aimed for purpose of nature conservation and landscape protection of extremely valuable landscape on the frontier between Czechia and Austria.

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Fig. 7 – Landscape-ecological unit Kamenná moře. A lot of granite rock forms (rugged ridges, rock pillars, tors, block fields) are situated on the right steep slope of the Dyje/Thaya R. valley in the eastern part of the Podyjí NP.

Photo M. Havlíček.

– Unità di paesaggio-ecologiche di Kamenná moře. Molte delle forme nelle rocce granitiche (tor, campi di pietre ecc.) sono situate nel ripido versante destro della valle del fiume Dyje/Thaya nel settore orientale del Parco Nazionale di Podyjí. Fotografia di M. Havlíček.

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