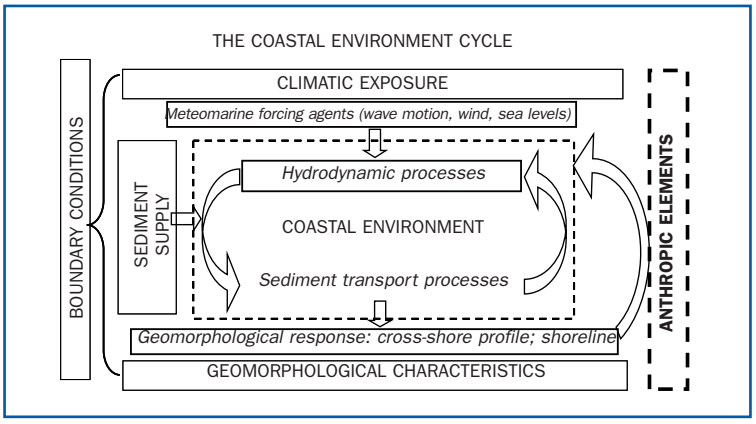
CHAPTER 9

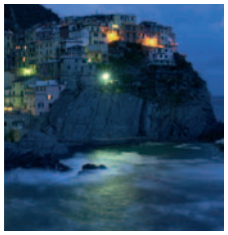
COASTAL AREAS

Introduction

The coast is a continually evolving area. Its changes are more clearly visible near low and sandy shores, where there are new adjustments of the seashore and land surfaces that emerge and are submerged by the sea. Coastline dynamics mainly depend on the sea's action (wave action, tides, currents and storms), but they are also influenced by all those direct and indirect natural and human activities that intervene on the coastal balance changing its morphological characteristics. The extraction of inert material from riverbeds and the remediation of banks and mountain slopes reduce the flow of sediments at the river mouths when they should be naturally distributed along the coast. Urban and productive settlements in coastal areas as well as land and sea transport infrastructures and protection works invade the sea and the coastal areas interacting with their natural evolution.



In the previous edition the phenomenon of coastal erosion and the impacts on the coastline were discussed in detail, even in view of the expected climate change and the relative adjustment policies. Other issues were also mentioned, such as: knowledge of marine forcing and the territorial structure; response with regard to territorial planning and national and regional action plans.
These elements that describe the coastal environment are not subject to short term change and the updating of information



Adoption of the ICZM Protocol within the framework of the Barcelona Convention.

requires a time span of several years. Therefore, this year we thought of giving more attention to other marine and land components that characterize our coastal habitats. This approach was also suggested by the recent adoption of the ICZM (Integrated Coastal Zone Management) Protocol within the framework of the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean. It was signed during the diplomatic Conference that took place on January 20-21th 2008 in Madrid. The Protocol was signed by the European Union and by 14 States, including Italy. It was subsequently published on the Official Gazette of the European Union of 4/2/2009.

The ICZM Protocol promotes the definition a national integrated management strategy for all environmental, socioeconomic and cultural issues. The Protocol aims at the protection and sustainable development of coastal regions of the Mediterranean. It intends to create a new and more efficient approach to the many protection needs of the coastal and island habitats and landscapes in order to preserve the cultural heritage while developing economic activities.

Therefore, apart from providing more details on the coastal sedimentary dynamics and its balance, this edition will also talk about other natural phenomena and the qualification of habitats (such as dunes and *Posidonia* banquettes). We will also illustrate some elements of change in the marine and coastal environment (water quality and marine algae) which are often induced by human action but perceived as a problem only in the summer season, due to the utilization of the beaches for tourism and bathing.

The situation

The Italian coast has a length of 8,353 km, of which 4,863 km are low sandy or delta coastlines (Tables 9.1 and 9.2). From a physical point of view, the latter are more vulnerable to sea action and subject to intense geomorphological dynamics. Indeed, in Italy coastal zone risks are mainly related to erosion phenomena and to storms or floods, which are mostly relevant for low and sandy coasts and for coastal alluvial plains.

On the Italian coast, 4,863 km of sandy or delta coastlines are more vulnerable to sea action.

Table 9.1: Distribution of Italian coast by type[1]

Type of coast	km	%
Natural	7,687	92.0
Artificial	314	3.8
Fictitious	352	4.2
TOTAL	**8,353**	**100**

Table 9.2: Distribution of natural coast by type[2]

Type of coast	km	%
High	2,824	36.7
Low	4,863	63.3
TOTAL	**7,687**	**100**

The coastal system suffered a very strong anthropic process.

In Italy, over 300 km of coasts host commercial or leisure port facilities.

About 30% of the total population lives in the 642 coastal municipalities.

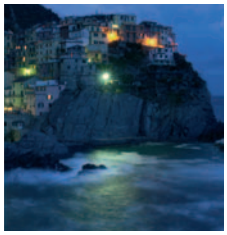
In the last century, the coastal system suffered a very strong anthropic process that, in many areas, has considerably changed and altered the natural and environmental features of the territory. Due to their accessibility, low coastal areas are more densely occupied by residential settlements and intense business activities (even for tourism) as well as by roads and sea transport infrastructures. Indeed, in Italy more than 300 km of coasts host commercial and leisure port facilities.

According to surveys carried out by the National Statistics Institute (ISTAT) 16.8 million inhabitants permanently live in the 642 coastal municipalities, which represent about 30% of the total population. This gives an idea of how populated coastal areas actually are in Italy, given that both seasonal and tourism flows are not included.

Coastal urbanization has transformed the evolution of coastline and has turned the natural phenomenon of coastal erosion into a serious problem, particularly near urban centres where homes, infrastructures and economic activities are at risk.

There are many human activities in coastal zones (industries, tourism, fishing, aquaculture, etc.). Problems arise when these activities tend to develop together on the narrow coastal area and

[1] Source: ISPRA
[2] Source: ISPRA



come into conflict both with each other and with the protection of natural environments and landscape.
Data on land use collected by the Corine Land Cover 2000, covering an area of 10 km from the coast towards the hinterland, shows that 58.7% of land is used for agriculture and 6.6% is occupied by urban centres, industries and road, air and sea transport infrastructures. In other words, in Italy two thirds (over 65%) of land within the 10km strip from the shore, is used for human activities and is moulded even by invasive and irreversible human action on the environment (Figure 9.1).

58.7% of land within the 10 km strip from the shore is used for agriculture while 6.6% is occupied by urban centres, industries and various infrastructures.

Over 65% of land is included within the 10 km strip from the shore, which is used for human activities and moulded by invasive and irreversible action on the environment.

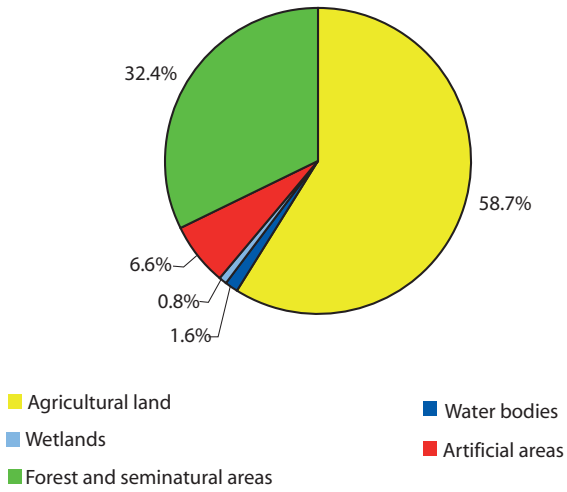


Figure 9.1: Land use in Italy within the 10 km strip from the shore[3]

As a result, Italy is among the countries having the highest risk of coastal erosion in Europe.
Table 9.3 summarizes the analysis of variations in the coasts over the last 50 years extended to all Italian coasts. It shows that 30% of the shoreline is subject to an intense geomorphological evolution.

Italy is among the countries having the highest risk of coastal erosion.

[3] Source: ISPRA

Moreover, the study showed that only in the low coasts (Table 9.4) out of the 4,863 km of low and delta coasts in Italy 1,170 km are definitely eroding. In other words, over the last 50 years 24% of sandy coasts suffered an average erosion of over 25m.

30% of the coast is subject to an intense geomorphological evolution. Furthermore, over the last 50 years, 24% of sandy coast has eroded by an average of over 25m.

Table 9.3: Stable and changed coast, both erosion and accretion[4]

COAST	km	%
TOTAL	**8,353**	**100.0**
Stable	5,385	64.5
Changed	2,448	29.3
Unclassified	520	6.2
Changed	**2,448**	**29.3**
Erosion	1,285	15.4
Accretion	1,163	13.9

Table 9.4: Stable and changed low coast, both erosion and accretion[5]

COAST	km	%
TOTAL	**4,863**	**100.0**
Stable	2,387	49.1
Changed	2,227	45.8
Unclassified	248	5.1
Changed	**2,227**	**45.8**
Erosion	1,170	24.1
Accretion	1,058	21.7

The regions that are mostly affected by coast erosion are: Sicily (313 km), Calabria (208 km), Apulia (127 km) and Sardinia (107 km).

The area subject to potential flood risk (RICE), in coastal areas, is equivalent to 3.17% of the national surface and involves 9.12% of the population.

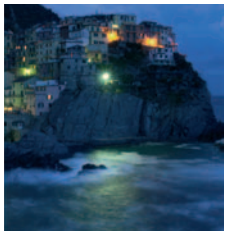
The most affected regions are: Sicily (with as many as 313 km of eroding coast); Calabria (208 km), Apulia (127 km), Sardinia (107 km), Lazio (63 km) and Tuscany (60 km). With regard to coast length, most decreasing beaches are found in Marche (38.6%), followed by Basilicata (38.1%), Molise (34.7%) and Calabria (32%).

Considering the evolutionary trend of Italian shoreline and the concentration of activities and urban settlements along the coast, it can be assessed that the area subject to potential flood risk (RICE - Radium of Influence of Coastal Erosion[6]) in coastal areas covers 954,379 ha. This is equivalent to 3.17% of the national surface and involves 5,276,535 people (9.12% of the whole population). It is also estimated that 336,746 ha of land

[4] Source: ISPRA

[5] Source: ISPRA

[6] The area of RICE is defined as the locus of points that satisfy at least one of the following two conditions: distance from the coast up to 500 meters altitude not exceeding * 5 meters above sea level. (*) To take account of the errors associated with the definition of DTM (Digital Terrain Model) and to avoid underestimation of areas with altitude of more than 5 m, was considered as the level curve corresponding to the limit value of 10 m.



(1.12% of the national surface) and 2,133,041 people (3.69% of the total population) are exposed to a medium-high and high risk.

Interventions have taken place over the years to protect eroding shoreline. Hard structures, such as beams and barriers, have been realized on long sections of coastline which have not resolved the erosion problem especially in the medium and long term. In many cases they even contributed to increasing the process of artificialization and marine/coastal habitat degradation.

Coastal defence works with hard structures have not resolved the erosion problem.

Figure 9.2 shows the distribution of protection works and harbours over the whole national territory.

Distribution of protection and harbour works over the whole national territory.

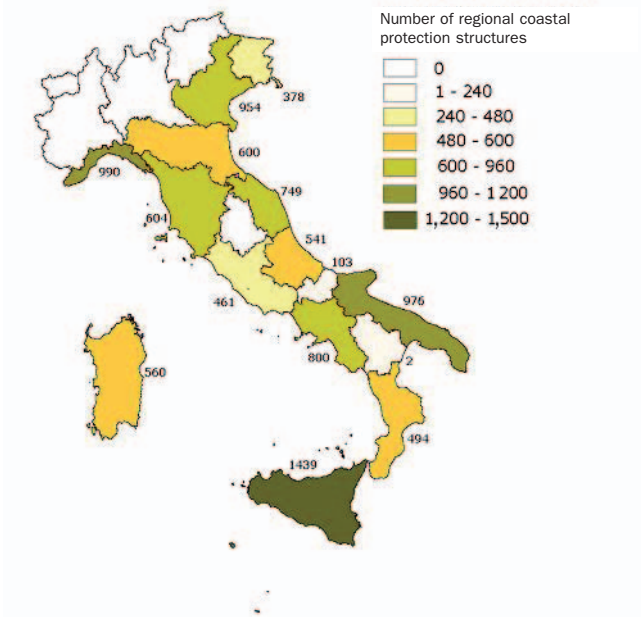


Figure 9.2: Distribution of harbour and protection works by region[7]

An alternative technique to recover eroding coastlines is beach nourishment, which consists in reconstructing the eroded beach by replacing the sand lost by erosion with nourishment material

Beach nourishment is an alternative technique for the recovery of eroding coastlines.

[7] Source: ISPRA

(usually sand). The material is normally taken from land, river or marine quarries.

The search for new beach nourishment material has focused on sea beds.

In the last few years, the search for new sources of material to be used for the nourishment of eroding coastlines has focused on the study of sea bottoms. Indeed, deposits of relict sand (generally referable to paleo-beaches) that can be used for beach nourishment are found on the continental shelf. These deposits may be covered by pelitic sediments of recent deposition, or, alternatively, by outcropping sediments) and are located at different depths between 30-130 m.
Using relict sand deposits has some advantages with respect to using land quarries, such as: availability of large quantities of sediments (millions of m^3); potentially similar composition to the sand on our coastlines; limited effects on the environment and lower costs (for beach nourishments requiring large volumes of sediment).

The utilization of marine sand deposits for beach nourishment has been a widely used practice for various years both in Europe and in the rest of the world (nourishment of the Coney Island Beach, NY, USA, 1922-23).

The first nourishment activities in Italy were carried out on the beaches of Cavallino and Pellestrina (Venice).

In Italy, the first documented activities of beach nourishment using relict sands were carried out on the beaches of Cavallino and Pellestrina (Venice). The operation involved the dumping of about 6,000,000 m^3 of sand dredged from a marine sand deposit located between the mouths of the Rivers Tagliamento and Adige at a depth of 20 m.

In the Tyrrhenian Sea, the first nourishment was carried out on the coastline of Ostia (Rome) in 1999.

In the Tyrrhenian Sea the first experiences regarded the nourishment of the Ostia coastline in 1999, conducted by the Lazio Region local authority using sands from a marine deposit off Anzio (Rome). The Lazio Region has started the first programme of relict sand dredging for beach nourishment on a regional scale in 1999. Activities are still going on today sediment from the above mentioned deposit of Anzio and from other two relict sand deposits located respectively off Montalto di Castro (VT) and Torvaianica (Rome) (Figures 9.3 and 9.4).
Other dredging operations for beach nourishment were conducted offshore Ravenna and Civitanova Marche (AP).

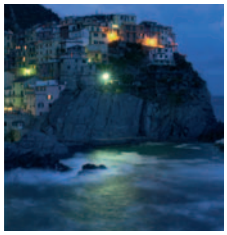


Figure 9.3: Overflow plume caused by dredging operations[8]

Figure 9.4: Some phases of relict sand dredging off Montalto di Castro (Lazio)[9]

Table 9.5 summarizes all relict sand dredging operations for beach nourishment carried out in Italy until 2007.

[8] Source: ISPRA
[9] Source: ISPRA

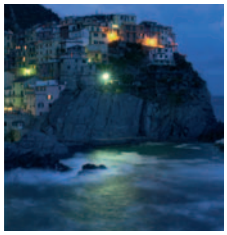
Dredging and nourishment operations carried out in Italy.

Table 9.5: Relict sand dredging interventions for beach nourishment carried out in Italy until 2007[10]

Relict sand deposits (Location/name/ executive authority)	Dredge execution year	Dredged volumes	Sand destination	Overflow volumes
		m^3		m^3
Adriatic Sea/ Deposit in the open sea between the mouths of the Rivers Tagliamento and Adige / Magistrato alle Acque di Venezia	1995 - 1999	7,231,570	Pallestrina coastline (VE)	4,097,119
	1994 - 1999		Cavallino (VE)	1,921,604
	1999 - 2000		Jesolo (VE)	565,362
	1999 - 2003		Jesolo - Cortellazzo (VE)	351,000
	2003 - 2004		Eraclea (VE)	296,485
Tyrrhenian Sea/ Marine sand deposit off Anzio (Site AN) / Lazio Region	1999	950,000	Ostia (RM)	950,000
Adriatic Sea / Marine sand deposit off Ravenna (Area C1) /Emilia Romagna Region	2002	799,850	Misano Adriatico (RN)	165,300
			Riccione sud (RN)	253,750
			Igea Marina (RN)	65,200
			S. Mauro Pascoli - Savignano (FC)	27,000
			Gatteo a Mare (FC)	28,000
			Zadina (FC)	43,500
			Milano Marittima nord (RA)	176,100
			Lido di Classe - Foce Bevano (RA)	41,000
Tyrrhenian Sea / Marine sand deposit off the Gulf of Cagliari / Cagliari Province	2002	370,000	Poetto (CA)	370,000
Tyrrhenian Sea / Marine sand deposit off Anzio (Site AZ) / Lazio Region	2003	2,039,265	Ostia centro (RM)	409,895
			Ostia levante (RM)	554,773
			Anzio (RM)	191,192
			Focene nord (RM)	407,942
			Ladispoli (RM)	475,463
Tyrrhenian Sea / Marine sand deposit off Montalto di Castro (Site A2) / Lazio Region	2004	480,000	Tarquinia (VT)	480,000
Tyrrhenian Sea / Marine sand deposit off Montalto di Castro (Site A2) / Lazio Region	2005	330,000	Ostia (RM)	330,000

continues

[10] Source: Prepared by ISPRA based on data provided by: Consorzio Venezia Nuova for the marine sand deposit located between the mouths of the Rivers Tagliamento and Adige; by the University of Cagliari for the sand deposit off Poetto; by the ARPA Emilia Romagna for the sand deposit off Ravenna and by the ICRAM (today's ISPRA) for the remaining data



follows

Table 9.5: Relict sand dredging interventions for beach nourishment carried out in Italy until 2007[10]

Relict sand deposits (Location/name/ executive authority)	Dredge execution year	Dredged volumes	Sand destination	Overflow volumes
		m³		m³
Tyrrhenian Sea / Marine sand deposit off Torvaianica (Ardea Site C2) / Lazio Region	2006	1,429,000	Terracina Porto Badino - Centro (LT)	375,000
			Terracina Porto Badino - F. Sisto (LT)	420,000
			Fondi (LT)	634,000
Adriatic Sea / Marine sand deposit off Civitanova Marche (Area B1) / Arenaria s.r.l. for Abruzzo Region	2006	1,106,039	Pineto Silvi (TE)	64,245
			Martinsicuro (TE)	184,850
			Montesilvano (PE)	93,106
			Francavilla (CH)	159,325
			Casalbordino (CH)	85,612
			Sand storage in Marina Palmense (AP)	518,901
Adriatic Sea / Marine sand deposit off Ravenna (Area C1) and (Area A) / Emilia-Romagna Region	2007	825,349	Misano Adriatico (RN)	149,000
			Riccione sud (RN)	105,065
			Igea Marina - Rimini nord (RN)	105,788
			Cesenatico nord (FC)	78,391
			Milano Marittima nord (RA)	90,108
			Lido di Dante (RA)	107,128
			Punta Marina (RA)	189,869
Tyrrhenian Sea / Marine sand deposit off Anzio (Site AS) / Lazio Region	2007	1,658,000	Terracina Porto Badino-Centro (LT)	283,000
			Minturno (LT)	563,000
			San Felice Circeo (LT)	432,000
			Fondi nord (LT)	150,000
			Formia (LT)	230,000

Although beach nourishment contributes to resolving coastal erosion on a local scale in the short term, it would be appropriate to plan a series of activities aimed at the preservation of the coastal system's resilience capacity, particularly with reference to natural elements that ensure the stability of coastal dynamics such as dunal environments.

Coastal dunes develop behind the beaches due to the effect of several factors. Three of these are essential: the availability of sediment in proportion to the width of the beach; the energy of

It would be appropriate to plan a series of activities aimed at the preservation of the coastal system's resilience capacity, particularly with reference to dunal environments that ensure the stability of coastal dynamics.

dominating winds; the presence of specialized vegetation that stabilizes sands moved and deposited by the wind. These factors must reach a dynamic balance to allow the sediment to accumulate and consolidate until a more or less stable permanent deposit is formed. Dunes can be made of incoherent sand (mobile dunes) or by sediments fixed by specialized vegetation (fixed dunes).
Once the vegetation has colonized the Aeolian deposit (Figure 9.5) it not only stabilized the sand but even fertilizes it increasing the humidity rate. Pioneer plant species are actually able to survive due to their high tolerance to salinity and high sedimentation rates. Vegetation therefore has a deep influence on the morphology of foredunes that evolves accordingly.
Coastal dunes not only have a high landscape value but they also play an essential role to protect the coastal zone increasing its resilience. In particular, they are able to annul the erosion risk since they act as a sediment reservoir that is able to reduce the beach. Depending on their characteristics, dunes can also contrast the inland flooding risk. Due to their height with respect to the surrounding areas and good filtration capacity, coastal dunes can also prevent saline intrusions in freshwater aquifers (groundwater table). Finally, coastal dunes host specific and characteristic ecological niches and are therefore extremely important both for the plant communities and for the animal species associated to them. For some species they are actually essential ecological corridors for the coastal environment.
It should not be forgotten that the preservation of dunes and beaches natural conditions are closely related to those of other equally important ecosystems, such as humid retrodunal environments, coastal lagoons and lakes, *Posidonia oceanica* meadows and other marine phanerogams[11].

[11] http://www.apat.gov.it/site/_contentfiles/00140500/140589_R54_2005.pdf

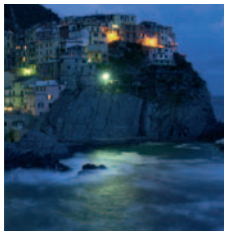


Figure 9.5: Dunal habitat[12]

In Central and Northern Europe in the 1990s only 45% of coastal dunes were in integral conditions.

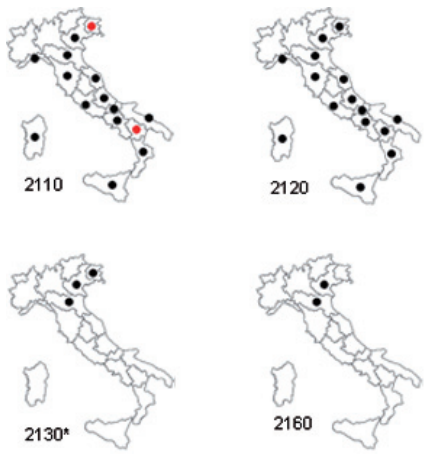
Data provided by the EUCC (1994) show that in the 1990s in Central and Northern Europe coastal dunes covered areas of about 5,300 km^2 (about 75% of dunal areas in the last century) of which only about 3,200 km^2 (45%) were in integral conditions[13]. As regards Italy, a study[14] was conducted to compare the current presence and distribution of protected habitats listed under Attachment I of Directive 92/43/EC with data reported in the *Natura 2000* Data Bank of the Ministry for the Environment, Land and Sea (updated in 2007) in order to find possible variations, lacks and/or inconsistencies and prepare the "Manuale italiano di interpretazione degli habitat della direttiva 92/43/CEE" (Italian Interpretation Manual of habitats described by Directive 92/43/EEC). The study identified 10 habitats with a clear presence of coastal dunes. Three of them were included in the list of priority habitats, always according to the same Directive, falling under two different macrocategories of reference:

[12] Source: ISPRA

[13] http://www.apat.gov.it/site/_contentfiles/00140500/140589_R54_2005.pdf

[14] Biondi E., Blasi C., Burrascano S., Casavecchia S., Copiz R., Del Vico E., Galdenzi D., Gigante D., Lasen C., Spampinato G., Venanzoni R., Zivkovic L.: *Manuale italiano di interpretazione degli habitat della direttiva 92/43/CEE*, 2009 http://vnr.unipg.it/habitat/index.jsp

"Sea dunes of the Atlantic, North Sea and Baltic coasts" and "Sea dunes of the Mediterranean Coast". Figures 9.6 and 9.7 show the distribution of these habitats in the different Italian regions. It can be noted that most of them exist all along the national coastline, with some exceptions.

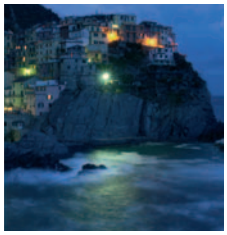


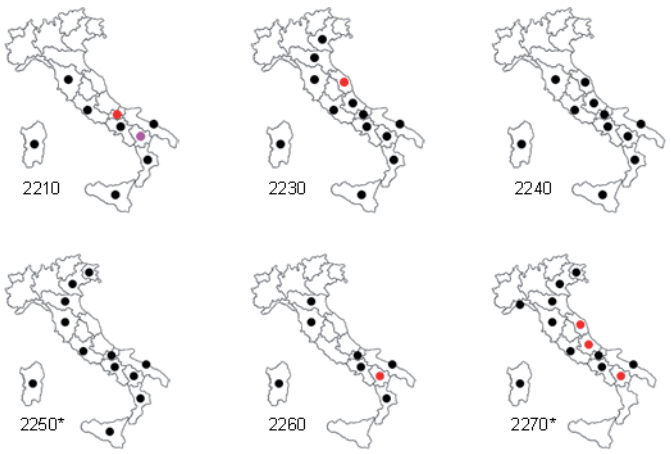
NATURA 2000 code	Habitat
2110	Shifting embryonic dunes
2120	Mobile dunes of the sand bar with presence of *Ammophila arenaria* (white dunes)
2130*	Fixed coastal dunes with herbage (grey dunes)
2160	Dunes with presence of *Hippophae rhamnoides*

● Datum taken from the *Natura 2000* Data Bank of the Ministry for the Environment, Land and Sea (2007), confirmed in Biondi et al. (2009)
● New identifications (Biondi et al., 2009)
* Priority habitats (amended by Biondi et al., 2009)

Figure 9.6: Distribution of habitats falling under the macro-category: "Sea dunes of the Atlantic, North Sea and Baltic coasts" in Italy[15]

[15] Source: Ibidem





NATURA 2000 code	Habitat
2210	Fixed dunes of the littoral *(Crucianellion maritimae)*
2230	Dunes with *Malcolmietalia* meadows
2240	Dunes with *Brachypodietalia* meadows and annual vegetation
2250*	Coastal dunes with *Juniperus* spp.
2260	Dunes with *Cisto-Lavenduletalia* sclerophyllous scrubs
2270*	Dunes with *Pinus pinea* and/or *Pinus pinaster* forests

● Datum taken from the *Natura 2000* Data Bank of the Ministry for the Environment, Land and Sea (2007), confirmed in Biondi *et al.* (2009)
● Datum taken from the *Natura 2000* Data Bank of the Ministry for the Environment, Land and Sea (2007), not confirmed in Biondi *et al. (2009)*
● New identifications (Biondi *et al., 2009*)
* Priority habitats (amended by Biondi et al., 2009)

Figure 9.7: Distribution of habitats falling under the macro-category: "Sea dunes of the Mediterranean Coast" in Italy[16]

The only currently available reference that provides a national framework of the presence and features of coastal dune systems is the "Geographical Data Bank of Coastal Dunes in Italy" that was realized within the framework of the project on "Aeolic deposits of Italian coasts and the flow of sediments between

In Italy, a national framework of coastal dunes was produced within the framework of a project funded by the Ministry of Education, University and Research.

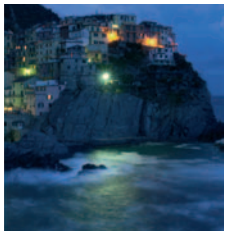
[16] Source: Ibidem

beaches and dunes" funded by the Ministry of Education, University and Research. This data bank contains vectorial data on the distribution and conservation conditions of coastal dunes in all the Italian regions with respect to their evolutionary trend and the utilization of the littoral in front. In accordance with the EU's INSPIRE Directive, data are reported on a scale of 1:10.000 and are updated as at 1998-99[17]. For example, according to results produced by the research, in Lazio none of the regional dune systems (occupying an area larger than 20 km^2 and about 200 km of coast) are sufficiently natural. This is due to the high human impact and the general withdrawal of the coastline. In Emilia Romagna, instead, just over 28% of the 130 km of coast is bordered by dune ridges. Of this area, only 0.6 km^2 (3%) is occupied by active dunes, whose evolution is largely compromised by human activities (about 59%). 60% of this area also develops along eroding coastlines. According to a study conducted by the WWF (2007) along the Peninsula's coasts, preserved dune systems are found in:

- Tuscany (dunes of the Migliarino San Rossore Park and of the Tuscan Maremma);
- Lazio (dunes of the Circeo National Park);
- Veneto (fossil dunes of the Po Delta);
- Emilia Romagna (fossil dunes of the Po Delta);
- Basilicata (dunes along the Ionic coast);
- Apulia (dunes of the Torre Guaceto Natural Reserve);
- Sicily (dunes of the Torre Salsa, Vendicari and Capo Passero Natural Reserves);
- Sardinia, which hosts some of the largest dunes in Europe (dunes of Piscinas-Pistis, important for the endemic vegetation of *Juniperus macrocarpa*, and dunes of Porto Pino, characterized by the presence of a spontaneous pine forest of *Pinus halepensis*).

A widespread and very current phenomenon that involves large sections of the Italian coast is the stranding of seabed vegetation and its compatible management. This is what occurs with the marine phanerogam *Posidonia oceanica*, an endemic species of

[17] AA.VV., Studi Costieri – *Dinamica e difesa dei litorali – gestione integrata della fascia costiera*, n. 11, GNRAC, 166 pp (2006)



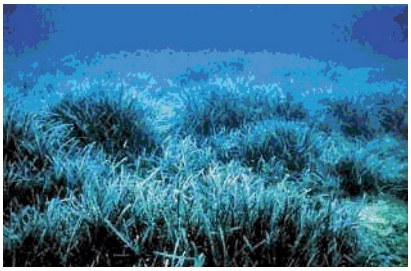


Figure 9.8: *Posidonia oceanica* meadow[18]

Figure 9.9: Lamellar structure of a *banquette*[19]

the Mediterranean (Figure 9.8) that colonizes large areas of the seabeds forming actual underwater meadows. The meadows are one of the fundamental components of the coastal environment's balance and richness and are acknowledged as a priority habitat and thus protected by the Habitat Directive (92/43/EC).

The stranding of remains of *P. oceanica* (dead leaves, rhizomes and fibrous remains) is a natural phenomenon that is annually observed on the coasts, especially after autumn and winter seastorms. The accumulation of stranded remains, combined with sand, form structures known as "*banquette*s" (borrowing the French term). These can reach heights of even 2 metres and develop for hundreds of metres along the coastline, according to its geomorphological structure. In general, *banquettes* are mainly made of *Posidonia oceanica* leaves since their string-like shape and way of accumulating contribute to the formation of a very compact and elastic lamellar structure (Figure 9.9). In any case, these are temporary deposit structures that can easily be deformed by the swell they are submitted to.

Banquettes and their sediment fractions carry out an important role providing a mechanical protection against erosive phenomena by preventing the swell's energy and action thus contributing to ensure beach stability. They also both directly and indirectly contribute to the activity of animal and plant biocoenosis on the

Autumn and winter seastorms annually accumulate remains of Posidonia oceanica on our beaches.

[18] Source: M. Magri
[19] Source: G. Bovina

beach, since leaf degradation products provide great quantities of fundamental nutrients for the life cycle of flora and fauna of the coastal area. For the above reasons, the SPAMI Protocol of the Barcelona Convention has included them in the list of priority habitats that should be protected.

Pollution produced by the discharge of chemical and organic substances often generates irreversible environmental changes in marine habitats.

The sea is a large ecological system in which plant and animal organisms establish a series of complex relationships and balances both between each other and with the environment. But the effects of human activities are threatening these balances and the survival of marine species.

The utilization of marine and coastal waters has an important role especially in industrialized societies. However, it is generally known that pollution produced by the discharge of chemical and organic substances (deriving from human activities) often generates irreversible environmental changes that can destroy marine habitats. Currently, microbiological pollution and eutrophication are the main critical factors for coastal areas but we do not have homogeneous and continuous data on chemical, physical and biological parameters of marine waters. With the exception of marine areas submitted to special protection regimes, the effects of pollution, are monitored and faced only for the protection of citizens' health and for purposes of tourism activities carried out on the coasts. We still lack of a holistic vision for the protection of marine and coastal ecosystems.

Italy is among the European countries with the highest number of marine bathing waters.

Along the Italian coast there are 4,615 sites where recreational and bathing activities can be practiced. This places Italy at the top of the list of European countries with the highest number of marine waters used for this purpose. In order to protect bathers' health the quality of beach waters is controlled by a very strict monitoring programme that provides for the establishment of chemical and microbiological parameters. At the beginning of each bathing season, the Ministry of Labour, Health and Social Policies publishes a report that summarizes the results of the monitoring programme on the quality of Italian bathing waters carried out in the previous bathing season. According to the "Bathing Waters 2009" Report, in Italy 5,175 km of coastline was checked of which 4,969 km was suitable for bathing. This value represents 33.8% of bathing coast in Europe and 55.2% of bathing coast in the Mediterranean area.

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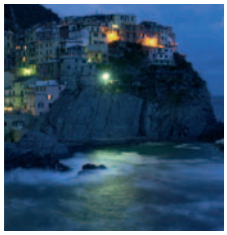


According to microbiological parameters, 91.43% of Italian sites fall within the European guide values, with respect to the average of 88.6% in other member States. If we consider imperative values fixed by European regulations, the suitability percentage of Italian sites is of 92.8%, against a European average of 96.3%. The above percentages show the high quality of Italian bathing waters. It should also be taken into account that, for microbiological parameters, Italy adopted the European Directive imposing limit values that in some cases were even more restrictive. Furthermore, the Presidential Decree no. 470/82 imposes the closing of a site if for two consecutive seasons it should not be suitable for bathing. Most other member States, instead, only advise against bathing. A site can only be reopened after an improvement programme has been implemented.
Results of monitoring activities carried out in 2008 show that at national level 62 sites do not fall within the given parameters and need to be submitted to improvement programmes. These sites will be included among the closed ones and suspended from monitoring activities until an improvement programme establishes that they are suitable for bathing again. Since the implementation of beach recovery programmes requires availability of financial resources and long realization periods, over the years the number of prohibited sites has by far exceeded that of recovered ones. Indeed, while 301 marine water sites were closed in 2008 (281 in 2007), only 6 sites were recovered in the 2009 season. As at today, only 23 improvement projects have been presented. For this reason, according to the EEA's "Annual Report on the quality of bathing waters", Italy has the highest number of closed sites. However, with the application of Directive 2006/7/EC this value will probably improve since all permanently prohibited sites (such as river mouths and inaccessible areas for monitoring activities) will not be counted as bathing areas. Table 9.6 and Figure 9.10 show bathing suitability percentages of the Italian coast calculated with respect to the total coast length.

Out of the 7,375.3 km of coastline, 5,175 km is checked and 67.4% is suitable for bathing.

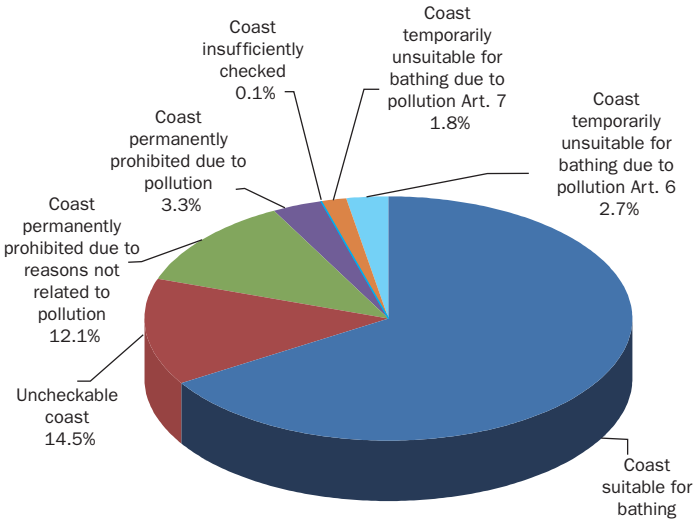


Figure 9.10: Bathing suitability percentages with respect to the coast length (2009)[20]

4,969.1 km of coast is suitable for bathing, which represents 67.4% of the total length.

Table 9.6: Bathing suitability of the coast (2009)[21]

			km	%
Coast length[22]			**7,375.3**	**100**
Unchecked coast	Uncheckable coast		1,067.6	14.5
	Coast permanently prohibited due to reasons not related to pollution		892.3	12.1
	Coast permanently prohibited due to pollution		240.2	3.3
Coast insufficiently checked			8.1	0.1
Coast temporarily prohibited due to pollution		Art. 7	135.9	1.8
		Art. 6	62.1	0.8
		TOTAL	198	2.7
Coast suitable for bathing			**4,969.1**	**67.4**

[20] Source: Ministry of Labour, Health and Social Policies data processed by ISPRA
[21] Source: Ministry of Labour, Health and Social Policies data processed by ISPRA
[22] Length of Italian coast considered by the Ministry of Labour, Health and Social Policies to asses the quality of bathing waters

4,969.1 km of coast is suitable for bathing, which represents 67.4% of the total length.

Table 9.6 shows that about 2,200 km of coast has not been checked for different reasons. This can be due to the inaccessibility of sites to monitoring activities (1,067 km) or reasons related to permanent prohibition from bathing either for pollution (240 km) or for other causes such as port areas, marine reserves or military areas (892 km). The remaining 5,175 km of coast has been checked and 4,969 km of the total length (67.4%) is considered suitable for bathing, while 198 km is polluted.
Where there is major algal proliferation, especially of potentially toxic species such as *Ostreopsis ovata,* the local authorities issue temporary closure provisions for the sections of coast involved by the phenomenon. However, being exceptional cases that are not easily predictable, these provisions are not considered when judging the suitability of beaches for the next season.

The bentonic microalga Ostreopsis ovata, which has been existing in the Mediterranean for several years, can cause toxicity events that can harm human beings and the marine environment.

Microalgae belonging to the *Ostreopsis* genus and the *ovata* species have received growing scientific attention over the last ten years both due to their implication in toxic events and the apparent extension of their geographical distribution from the tropical and sub-tropical areas where they originate to temperate areas. They are benthonic epyphitic oval-shaped dinoflagellate organisms that can produce toxins, with a width of 27-35 μm and a length of 47-55 μm (Figures 9.11 and 9.12). They are found at low depths and are associated to substrata such as rocks and macroalgae. In particular, in the Mediterranean area, molecules responsible for toxicity, such as palytoxins, have been identified both in their cells and in their water matrix. This is a risk for both human beings and the marine environment.

Ostreopsis ovata.

Figure 9.11: *Ostreopsis ovata* under electron microscope[23]

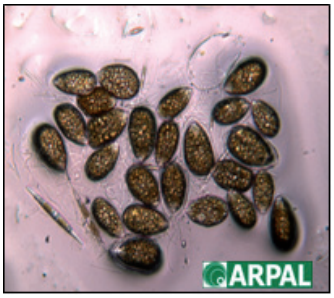


Figure 9.12: Ostreopsis ovata under optical microscope[24]

As regards damages to human health, the first recorded cases of intoxication started in 1998 in Tuscany on the Apuan littoral section. In July 2005, many cases of intoxication occurred to people who bathed in some beaches of Genoa. These cases were referred to the verified presence of the above dinoflagellate in water samples and microalgae. The case raised the attention towards the issue of both citizens and institutions.

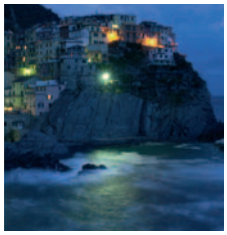
In the following years, other coastal areas were affected by the same phenomenon.

The blooming of algae of the Ostreopsis genus occurs annually in different areas and periods and can cause serious damages to the existing bentonic communities.

It has been observed that episodes of blooming or finding of microalgae of the *Ostreopsis* genus do not always appear in the same areas and in the same period. Surveys realized during the blooming period show that the latter is characterized by: a uniform layer of reddish gelly covering the seabed; the presence of beige, brown or reddish mucillaginous and foamy aggregates on the water surface; a diffuse opalescence with a reduction of clearness and flakes of suspended material in the water column; traces of anaerobiosis and sufferance of the existing bentonic communities.

On the basis of results obtained from monitoring activities carried out to check the quality of bathing waters and within the framework of a three-year programme implemented by the Ministry for the Environment, Land and Sea (Law 979/82), the presence of

[23] Source: *Florida Marine Reaserch Institute*
[24] Source: ARPA Liguria



the toxic microalga (with or without signs of blooming) was found in most coastal regions except for Basilicata, Emilia Romagna and Veneto (Figure 9.13).

Despite the scientific consistency of monitored parameters, the controls carried out to check the suitability of waters and the proliferation of algae are still focused only on the protection of citizens' health, for a better utilization of coastal areas especially during the summer season.

Facing problems related to the pollution of the marine ecosystem requires the continuous monitoring of marine waters and river runoff in order to identify the causes and therefore implement concrete initiatives to mitigate the negative effects both on people's health and on the survival of marine habitats and their animal and plant species.

The presence of the toxic microalga was found in most coastal regions except for Basilicata, Emilia Romagna and Veneto.

The presence of the toxic microalga was found in most coastal regions except for Basilicata, Emilia Romagna and Veneto.

Figure 9.13: Blooming and/or presence of O. ovata along the Italian coast[25]

[25] Source: ARPA Tuscany data processed by ISPRA

The evolution of Italian coastlines is mainly influenced by sediments coming from river flows.

Causes

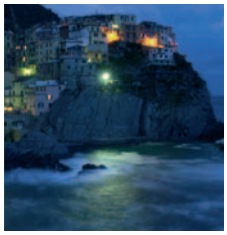
In ancient times, the amplitude of the Italian coast was due to deforestation caused by the intensification of trading and agricultural activities, first by the Italic and then by the Roman people. This activity increased the speed of land erosion processes in the countryside and in the hilly area, favouring the flow of large quantities of sediment through rivers to the sea. Many river mouths therefore benefited, receiving a great availability of sediment. This enabled the development of wide and branched deltas and favoured the structuring of coastal plains as well as the accretion of beaches. In recent times, this availability of sediment has lacked due to: control of water flows, urbanization of coasts (with the dismantling and hardening of dunal structures), cautious use of soil (to reduce loss of fertile soil) and stabilization of slopes. This has favoured beach regression and triggered off erosion phenomena in the whole peninsula. The blockage of sediment and the drainage of water for irrigation and reclamation works (which have created healthy soils in many coastal areas) have contributed to creating vast depressed areas subject to floods, which today are below sea level.

Sea storms, relative increase in sea level and subsidence phenomena contribute to the erosion of Italian coasts.

In brief, the phenomenon of erosion on Italian coasts is constantly increasing due to:

- The reduction in the contribution of solid river sediments flowing towards beaches, either collected from riverbeds or caught up by slope stabilization, river control and dam works (mainly human and not natural);
- Sea storms occurring in concomitance with floods causing paroxysmal erosion phenomena at river mouths;
- The relative increase in sea level and concomitant lowering of land level due to natural and human-induced subsidence processes.

Coastal erosion phenomena can have a serious impact on the loss of biodiversity, of landscape and environmental heritage (coastal pine woods, dunes, beaches, etc.) and of areas where very valuable economic activities can be developed.
In the Mediterranean and in Italy, coastal areas are among the most vulnerable and seriously threatened natural ecosystems of



today, even though they are largely protected by specific tools both at national and community level. To confirm this, the European Environmental Agency[26] even newly acknowledged that the European coastal area is affected by a diffuse and progressive degradation in terms of habitat loss, eutrophication, contamination, erosion and invasion of alien species.

As regards dune habitats, their destruction can be due to both natural and human causes. They can act independently or more often jointly, triggering off feedback mechanisms that are difficult to control. For example, the formation of blowouts (areas subject to intense wind deflation) occurs where there is a reduced plant coverage. This can be related to natural factors (e.g. grazing by herbivorous communities) and human ones (e.g. excessive treading due to tourism pressure).

The destruction of dune habitats can be due to both natural and human causes, which often act jointly.

According to studies carried out by the European Union for Coastal Conservation[27], in the last decades there have been daily losses of about 30 hectares of dune surface mainly due to uncontrolled tourism exploitation and human activities. These are the main threat for these coastal areas which translates into a compromised integrity and stability of dune systems[28]. In this regard, it should be underlined that when dunes are demolished (especially those covered by vegetation) they need extremely long periods to regenerate and the phenomenon can be considered practically irreversible.

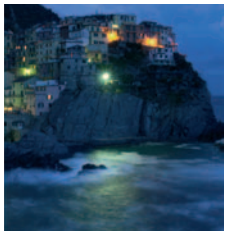
If on one side it can be useful to keep accumulated banquettes of *Posidonia oceanica* on the beaches (to prevent their erosion and favour the productivity of coastal waters), on the other their presence in touristic and bathing areas can discourage swimmers both because of floating residues and for the smell produced by bacterial degradation processes. These aspects reduce the touristic value of beaches. Local administrations are therefore asked to remove these deposits in order to make the beaches more appealing.

[26] EEA, 2006
[27] EUCC, 2002
[28] http://www.apat.gov.it/site/_contentfiles/00140500/140589_R54_2005.pdf

The main cause of marine water pollution is the release of chemical and microbiological pollutants originating from human activities.

The good quality of the coastal environment is in any case closely related to the quality of marine waters. The potential causes of marine pollution can be many, but the main ones are related to the release of chemical and especially microbiological pollutants in the environment. In 2009, these caused a bathing prohibition in 84% of beaches.
The sources of sea pollution are mainly from insufficiently purified liquids, industrial discharges and agricultural soil runoff. Therefore urban effluent water purifiers, industrial activities, farming activities (fertilizers, pesticides, etc.), animal breeding and solid waste treatment are all potential sources of bathing water pollution. The risk for bathers caused by a contamination source can vary according to the hydrological features of the drainage basin. Generally, the presence of a large river mouth near a bathing area can represent a potential risk according to the substances that are carried by that specific water flow. In this regard, meteorological phenomena are also particularly important. Indeed, it is generally known that the quality of bathing waters can worsen after strong rains because both chemical and microbiological pollutants are washed out of soils and directed towards bathing areas through rivers.

The fundamental mechanisms that determine toxic blooming phenomena are still not well known today but a few probable causes can be assumed, although their interactions have still not been defined.
Blooming of *Ostreopsis ovata* and *Ostreopsis* spp. along the Italian coasts have occurred almost only in the summer season and recently even in autumn during conditions that favour their development. These are: presence of rocky substrata; low water depth; poor hydrodynamism (due to the natural morphology of the coast or the presence of artificial brushes and barriers to control beach erosion); reduced swell; very stable meteomarine conditions and prolonged high atmospheric pressure; high sun ray exposure; water overheating >25°C; absence of thermocline; presence of macroalgae. During the blooming period, environmental stress situations were highlighted with fish-kill or pathologies affecting marine organisms and effects on



human health. These were reported by bathers, fishermen and residents.

Response

Regulations and planning

There is a greater awareness of improving coastal management.

In the last decades, there is a growing awareness on the need to improve the management of coastal areas, both at national and international level. Over the years, this has generated specific regulations at European level as well as national strategies, regional plans, studies, inventories and researches. Indeed, today many regulations and tools are applied, which contribute to protecting the coastal environment. In Italy the main regulations on coastal areas are indicated below:

The main regulations.

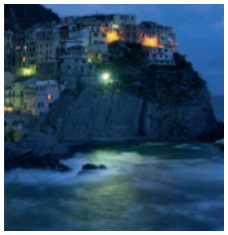
- The Marine Navigation Code regulates action on state maritime property.
- Law 431/85 (Galasso law) establishes landscape obligations in the coastal area within 300 m from the water's edge. However, these obligations are very general, passive and insufficient in contrasting the growing coast transformation initiatives.
- Law 183/89 on land protection gives the State the function of defining geneal approaches, criteria and administrative functions on the protection of coast in basins and areas of national relevance for the security of the State and maritime navigation. In other areas, administrative functions are carried out by the regional authorities.
- Legislative Decree 112/98 gives the state the function of defining general approaches and criteria for protecting coasts. Administrative functions related to planning and integrated management of coastal areas are given to regional authorities. The subsequent Legislative Decree 96/99 also involves provincial authorities in the administrative part. Land protection and specifically coast erosion problems have contributed to increasing the awareness on the need to allocate resources and plan interventions aimed at preventing risks rather than taking emergency action.

- Reform of Chapter V of the Constitution (Constitutional Law 3/2001).
- Law no. 179 dated 31 July, 2002 on «Environmental provisions» and in particular Art. 21 on authorizations for action aimed at the protection of the coastal area.
- Legislative Decree 152/2006 that rearranges and integrates the regulations of all environmental sectors.
- Legislative Decree 116/2008 for the implementation of Directive 2006/7/EC on the management of bathing water quality.
- Decree of the Ministry for the Environment, Land and Sea no. 56 dated 14 April, 2009, containing the «Technical criteria for monitoring water bodies and identifying conditions to amend technical regulations of Legislative Decree no. 152 dated 3 April 2006, indicating environmental provisions in accordance with Article 75, paragraph 3 of the same Legislative Decree».

Adoption of the ICZM Recommendation (2002/413/EC) by the European Council and Parliament.

At European Community level, between 1996 and 1999 the Commission realized a demonstrative programme on Integrated Coastal Zone Management (ICZM). Then, in 2002, on the basis of the Programme's experience and results the European Council and Parliament adopted the ICZM Recommendation (2002/413/EC).
"*The integrated management of coastal zones is a dynamic, interdisciplinary and interactive process aimed at promoting the sustainable structure of coastal zones"* (Communication no. 547 of the European Council of September 27th 2000). The ICZM principles are very dynamic and all-embracing: they include the possibility of any activity being carried out on the coastal area as long as it is done in a sustainable way. The management of a system consists in overlapping a physical context with the many human activities that are carried out. These can include economic activities and development of the housing and infrastructural system with their relative impacts on the environment and the territory.

At international level, Italy is one of the signatory countries of the Barcelona Convention for the Protection of the Marine Envi-



ronment and the Coastal Region of the Mediterranean and its relative protocols. 21 States of the Mediterranean basin and the European Community have adhered to the Convention. According to Article 4 of the Convention, Protocol VII on Integrated Coastal Zone Management (ICZM) of the Mediterranean was adopted during the conference of plenipotentiaries that was held in Madrid on January 20-21th 2008. It was signed by the European Union and by 14 States, including Italy, and was then published on the European Union's Official Gazette of 4/2/2009.

Adoption of Protocol VII on Integrated Coastal Zone Management (ICZM) of the Mediterranean signed by the EU and by 14 States, including Italy.

Protocol VII is the first binding legal tool in the definition of a national strategy for the integrated management of coastal zones and governance of marine and coastal zones. Both the Protocol and the European Recommendation request the parties involved to first of all prepare a national strategy indicating the fundamental decisions for the future of coastal areas, privileging their conservation and protection or trying to give real sustainability to existing or future economic activities. The ICZM Protocol provides measures aimed at the protection and sustainable development of coastal areas in the Mediterranean introducing a series of principles, objectives and forecasts for the regular analysis of the environmental impact, the protection of marine ecosystems, the safeguarding of coastal and island landscapes, the conservation of the cultural heritage and development of economic activities.
It implies the integration of all the different sector policies involved, the administration at all levels and the integration of the land and sea components in the territory involved.

Currently, the coastal territory in Italy is managed in very different ways. Planning tools are often in contrast and at times indications are not binding. Table 9.7 shows the situation in Italy and summarizes the regional planning tools on the management of coasts in the 15 coastal regions.

Regional coastal management planning.

Table 9.7: Regional coastal plans[29]

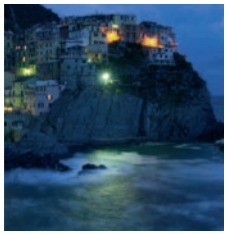
Region	Regional plan		Coastal protection plan			ICZM Plan			Coast protection plans RAP
	Type		period		status	period		status	
Liguria	Yes	Coastal Coordination Territorial Plan	yes	2000	approved				
Tuscany	Yes	ICZM Plan for Hydrogeological Readjustment	yes	2004	published				Yes
Lazio						yes		experimental	Yes
Campania	Yes	Erosion Transitional Plans							
Basilicata									
Calabria	Yes	Hydrogeological Settlement Transitional Plan – Integrated Management Plan (=Protection Plan)	yes	2005	approved	yes	2006	in process	Yes
Apulia			yes	2006	editing				Yes
Molise									Yes
Abruzzo	Yes	Organic Plan for vulnerable areas at risk	yes	2003	approved				Yes
Marche	Yes	ICZM Plan	yes	2005	approved	yes	2004	approved	Yes
Emilia Romagna	Yes	ICZM Plan	yes	1983	approved	yes	2005	approved	Yes
Veneto									Yes
Friuli Venezia Giulia									Yes
Sardinia	Yes	Lanscape Regional Plan				yes		experimental	Yes
Sicily	Yes	Hydrogeological Settlement Transitional Plan	yes	2004	editing				Yes
Plans Total	**9**		**8**			**3**			**12**

11 regions have tools that are extended to the whole regional territory.

Out of 15 coastal regions, 11 of them are endowed with planning tools extended to the entire regional territory. Among these, 6 regions have a specific coastal protection plan and only Emilia Romagna and Marche have an approved integrated management plan of the coastal area.

In Calabria, after having dealt with the coastal erosion problem within the scope of the Hydrogeological Settlement Transitional Plan (adopting an initial risk analysis methodology), the region is now preparing to draw up an integrated management plan. The plan considers previous action as one of the elements functional to the construction of a broader conceptual plan. The remaining

[29] Source: Prepared by ISPRA on the basis of data from coastal regions.



regions mainly have coast protection and Regional Action Plans (RAPs) that merely define a list of protection works to be realized in short sections of the coast.
Indeed, the current coastal planning framework in Italy does not yet reflect the wider scope introduced by the Integrated Coastal Zone Management.

Action is being taken for the preparation of a National Strategy.

However, it should be underlined that since the ratification of Protocol VII on ICZM, the Ministry of the Environment, Land and Sea started a series of studies and projects to prepare Italy's National Strategy. The attention is focused on two indicative elements of the natural, social and economic life of coastal areas, namely:

- The parties that need to be involved at various levels (institutions, productive sector, independent bodies, etc.);
- The area of application (which requires the delimitation of the coastal area).

Institutional, economic and cultural parties operating in the coastal area need to be involved.

The ICZM imposes an agreement on the environment and its resources between all the parties involved in the coastal area. This means that the need to find a harmonized management of the environment (integrating environmental planning policies with economic, cultural and territorial ones) is the primary need. The ICZM promotes and requires the preparation and development of a coordination mechanism between the economic, administrative and cultural sectors. This mechanism must be able to define the strategic elements of a National Policy of integrated management taking into account the interests on the environment and on the territory in order to protect and use it limiting the redundancy and the overlapping of planning tools that are put in place by the administrations and all the parties involved.

Characterization of the environmental and socio-economic scenarios on the coastal area.

Since the environment is the primary value promoted by Protocol VII to achieve a coherent application of integrated management principles, a characterization of the socio-economic scenario (urban centres, infrastructures, economic activities, etc.) needs to be carried out. This should describe the natural environment's

quality as well as the territory in order to confirm eventual decisions aimed at the protection and conservation of the existing ecosystems.

Continuous assessment of the National Strategy implementation progress.

Another primary element is monitoring action, which ensures the continuous assessment of the National Strategy and the efficacy of implemented plans and programs. It also enables to make amendments and integrations to the same programs, if necessary, and to draw up reports on the implementation progress as provided by the European Community.

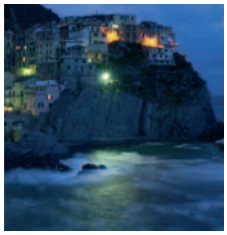
Action aimed at protecting, studying and monitoring the marine and coastal environment

There is an inevitable need to find ways of protecting the coastal areas.

Erosion, loss of coastal resilience, pollution, biological phenomena and human pressure. All these indicators lead to the inevitable need to protect coastal areas and take action keeping in mind the great complexity and vulnerability of this environment. In order to control the phenomenon of beach erosion and the expansion of flood-risk areas, protection measures have been taken mainly by realizing barriers. However, these have not resolved the erosion problem, especially in the medium and long term. In many cases, the barriers even contributed to the process of artificialization and degradation of the marine and coastal habitats. Interventions aimed at the nourishment of beaches using sand from marine quarries started only in the least few decades.

Effects on the marine environment caused by the relict sand dredging for beach nourishment.

The dredging of relict sands for beach nourishment (even with good quality sediments) can, however, induce significant effects on the marine environment. The main ones can be the variation and nature of seabottom features with possible localized effects on fishing activities (e.g. damaging of fishing nets) and the immission of fine-grained sediment in the water column. The latter mainly occurs during dredge-loading operations when the excess water that was sucked in with the sediment is released (overflow). This overflow can damage sensitive habitats (such as *Posidonia oceanica* meadows, Coralligenous biocoenosis, etc.) that can be present in proximity of the dredged areas.



In view of the above, it is therefore important to have a detailed and updated knowledge of the environment where marine sand deposits are located in order to forecast and assess the eventual effects of dredging operations and the choice of eventual impact mitigation measures that need be adopted.
Since 1999, ISPRA started working with the Regione Lazio local authority and the Environmental Agency (ARPA) of Emilia Romagna to carry out a series of environmental studies. These studies have led to the definition of a specific environmental monitoring Protocol for these activities that can be applied also to other geographical areas.

ISPRA then extended the experimentation of this Protocol to other Italian regions (Marche region) and presented the Protocol to the European community[30].
The proposed Protocol[31] involves the realization of a specific environmental monitoring study in 3 areas: the dredging area, the transport area and the nourishment area. The study is divided into three phases: before (*ante operam*), during and after (*post operam*) operations. During each of the three phases surveys are carried out on: benthic assemblages; fish assemblages; chemical and granulometric characteristics of the seabottom sediment; physical-chemical characteristics and dynamics of the water column and suspended particulate matter. The environmental monitoring study does not only define the area's environmental compatibility to dredging (in other words the environmental feasibility of such operations).
It also enables to assess the recovery times and modalities of the marine environment. In particular, surveys carried out *ante operam* in the dredging site (characterization of dredging site) not only provide general environmental data for the monitoring but also supply important information to obtain the dredging authorization.

The Protocol proposed by ISPRA involves the realization of a specific environmental monitoring study, divided into three phases: before, during and after the operations.

[30] www.beachmed.eu
[31] Quaderno ICRAM no. 5 "Aspetti ambientali del dragaggio di sabbie relitte a fini di ripascimento: proposta di un protocollo di monitoraggio" ("Environmental aspects in the dredging of relict sands for beach nourishment: proposal for a Monitoring Protocol")

Some European projects [32] considered the different aspects (such as the planning, environmental and economic point of view) of relict sand and/or offshore sand dredging for beach nourishment.

Protection and recovery of dune ridges.

As regards coastal dunes, data recently published in the EEA Report (2006) (Figure 9.14), show that dune environments protected by Directive 92/43/EEC represent 6% of coastal sites included in the *Natura 2000* network, covering a total area of about 250 km^2.

Dune environments protected by Directive 92/43/EEC represent 6% of coastal sites included in the Natura 2000 network.

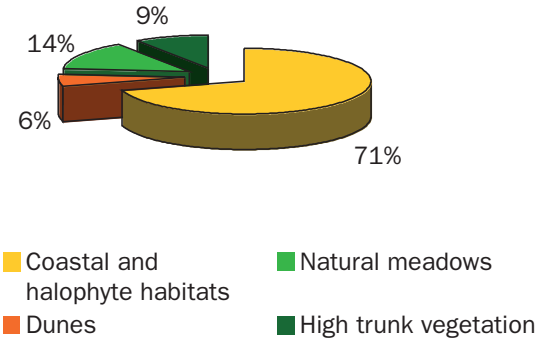
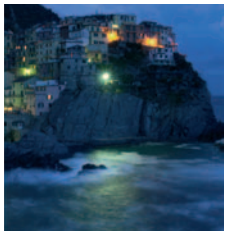


Figure 9.14: Types of coastal sites in Europe[33]

Many studies and interventions for the protection and recovery of coastal dunes scattered over the national territory have been conducted, funded by both local and national administrations and the European Community. Many are also the European projects that have the primary or secondary aim of managing and studying coastal dunes. A recent example is the POSIDuNE project, funded within the framework of the INTERREG IIIC Beachmed-e[34], that promoted activities in the Tuscany region.

[32] www.beachmed.it
[33] Source: EEA, The *changing faces of Europe's coastal areas*, 2006
[34] http://www.beachmed.it/Beachmede/SousProjets/POSIDUNE/tabid/99/Default.aspx



Management of stranded biomass (marine phanerogams and algae).

In the management of beaches, local administrations dealing with the problem of stranded *Posidonia* deposits adopted temporary emergency solutions. This involved expensive operations with clearing and disposal of the deposits in the dumps. In general, the removal of biomass takes place before the summer season and is carried out with mechanical vehicles which also carry away great quantities of sand. The nature of the coastal area where beach clearing operations take place is not taken into account. This triggers off and speeds up the process of beach erosion and compromises the integrity of the coastal habitat obliging the local administrations to intervene with expensive protection measures and beach nourishment operations.
In the absence of shared rules and models, the management of stranded matter is not an easy process. Indeed, the current laws in force are not always easy to interpret. There is no specific reference on this matter being considered waste and only recently are marine phanerogams (such as stranded *Posidonia*) used for the production of compost (Decree dated January 22th 2009 issued by the Ministry of Agriculture, Food and Forests). In view of the above, the Ministry for the Environment, Land and Sea (also in response to clarification requests advanced by coastal municipalities) issued Circular no. 8123/2006 that provides for three possible types of management related to the specific features of the coastal area and the social and economic situation: 1) local maintenance of the *banquettes*; 2) relocation of the deposits; 3) permanent removal and disposal in dumps.
The theme of *banquette management* was also tackled by the European project POSIDuNE, which produced specific technical documentation on the issue.

At national level, ISPRA is collaborating with technical staff of the regional environmental agencies (ARPA) on the coasts and with the Province of Livorno. A programme of activities was started in 2006 as a first step towards the study and management of *banquettes*. The programme also provides background knowledge for the definition of rules or guidelines in order to respond to these problems that local administrations have to deal with on a yearly basis.

New measures for the management of bathing water quality.

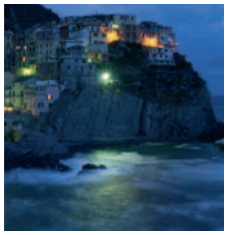
The suitability of beaches to bathing is established every year on the basis of data obtained from monitoring operations carried out by the regional environmental agencies (ARPA) during the previous year's bathing season. The management of bathing waters currently follows provisions established by Presidential Decree 470/82. This establishes the monitoring of water quality every 15 days from 1 April to 30 September, checking the microbiological parameters (fecal contamination indicators) and chemical-physical ones (transparency, colour, pH, dissolved oxygen, etc.).

This control system will soon be substantially changed due to the entrance into force of Legislative Decree 116/2008 in June 2008 to implement European Directive 2006/7/EC (which annuls Directive 76/160/EEC). The main objective of the new law is to protect human health from risks related to the poor quality of waters through a prevention and environmental improvement strategy.

The quality of bathing waters will be classified according to four quality levels (excellent, good, sufficient and poor) based on 90th and 95th percentile values of the two microbiological indicators (intestinal *Enterococci* and *Escherichia coli*) calculated from monitoring data of the last four years.

Although the trend has been to assess the marine environment's conditions only with reference to human health risks, the new law acknowledges the important role played by environmental factors in influencing the quality of bathing waters. Indeed, apart from checking fecal contamination indicators, a series of assessments will also be made on potential pollution sources taking into account the different factors, such as the morphology and hydrogeological features of the territory and the specific meteo-marine conditions in the area. For this reason, each area must have a profile with data on the water itself, a description of the territory and information on the impacts that can influence its quality. These profiles will be prepared for the first time by March 24th 2011.

Directive 76/160/EEC will be definitely annulled with effect from 31 December 2014. In this transitory period, technical regulations are being defined to implement the contents of the new Directive. In the meantime, monitoring activities continue to be carried



out according to indications contained in the Presidential Decree 470/82.
For example, for the surveillance of *O. ovata* the Ministry of Health prepared guidelines to identify operational procedures for the management of risks related to the blooming of *Ostreopsis ovata* on the Italian coast ("Gestione del rischio associato alle fioriture di *Ostreopsis ovata* nelle coste italiane" – May 2007). These guidelines are currently being revised.
Following repeated communication received from the authorities, in 2006 the Ministry for the Environment, Land and Sea appointed ISPRA to activate a working programme on "toxic algae" in agreement with the regional environmental agencies (ARPA). The programme was aimed at sharing knowledge and information on the ecology, monitoring methods and any other aspects that could help understand the phenomenon.
The result of this activity was the identification of elements for a common national strategy aimed at the sampling, analysis, monitoring, surveillance, information, communication and management of the "toxic algae" phenomenon.
Operational protocols for the national management of the phenomenon were produced by ISPRA/ARPA and these were recently adopted by the Ministry for the Environment, Land and Sea during marine and coastal monitoring activities. A brochure was also prepared and distributed to inform the local population on the phenomenon.
In addition to the above activities, ISPRA works closely with the ARPA agencies in coastal regions to prepare an annual report on the "toxic algae" situation, especially in the summer season. Regular seminars are also organized to keep constantly updated.

Scientific studies were also conducted and some of them are still in course (Research programme on *Ostreopsis ovata* and *Ostreopsis spp.*: new microalgal toxicity risks in the Italian seas). The studies are aimed at acquiring more information on toxic algae to understand the environmental conditions that favour their proliferation and the mechanism with which the toxins are transferred in the marine aerosol.

Scientific studies on the toxicity of microalgae.