# European Environment Agency

# Europe's biodiversity

## – biogeographical regions and seas

### Biogeographical regions in Europe

# The Mediterranean biogeographical region

## – long influence from cultivation, high pressure from tourists, species rich, warm and drying

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## Summary


- The Mediterranean biogeographical region and the Mediterranean Sea constitute a frontier zone between Europe, Asia and Africa in terms of climate and species
- The climate is warm with hot summers and mild winters. Arid and desert conditions are increasing and water will become more and more scarce
- Soils are low in humus, and the erosion risk is great in most areas
- The number of indigenous species is still the highest in Europe, the wider Mediterranean area being one of the two hotspots for species in Europe
- There is also a high number of endemics as well as wild ancestors to cultivated plants
- The cultural influence on nature is the longest in Europe, but rural areas are increasingly being depopulated and abandonned
- More than 35 % of the tourists visits in Europe take place in the region, exerting heavy pressure on land and coasts, water and nature resources
- Formerly widespread dry grasslands and traditional agro-forestry with dehesa and montados are decreasing, the areas turned to intensive agriculture or abandonned to scrub formation
- The intensive agriculture, vegetable growing and the large citrus orchards require intensive irrigation
- The region is the olive oil, fruit and nut production region of Europe
- Though there is only around 25% forest cover trees are a dominant feature in the landscape (incl. orchards, olive groves etc.)
- Oaks are important, natural old forests are scarce
- Sclerophyllous (evergreen) trees, shrubs and dwarfshrubs are characteristic, many with aromatic oil contents
- There are few lakes and bogs, the area covered by mires is reduced
- However, some of Europe's most important wetlands for birds migrating between Europe and Africa are found both in eastern and western parts
- Wolf and wildcat have spread, but the Iberian lynx is close to extinction


# 1. What are the main characteristics and trends of the Mediterranean biogeographical region?

## 1.1 General characteristics

The area treated in this chapter is the Mediterranean biogeographical region as defined by the European Commission and the Council of Europe for evaluation and reporting on nature conservation (Table 1, Map 1 and BOX 1).

The Mediterranean region meets the Mediterranean Sea in 12 countries along its northern coast. Only on the western side of the Iberian Peninsula the region borders on the very different North Atlantic Ocean in Portugal.

**Table 1. Statistics for the Mediterranean biogeographical region.**

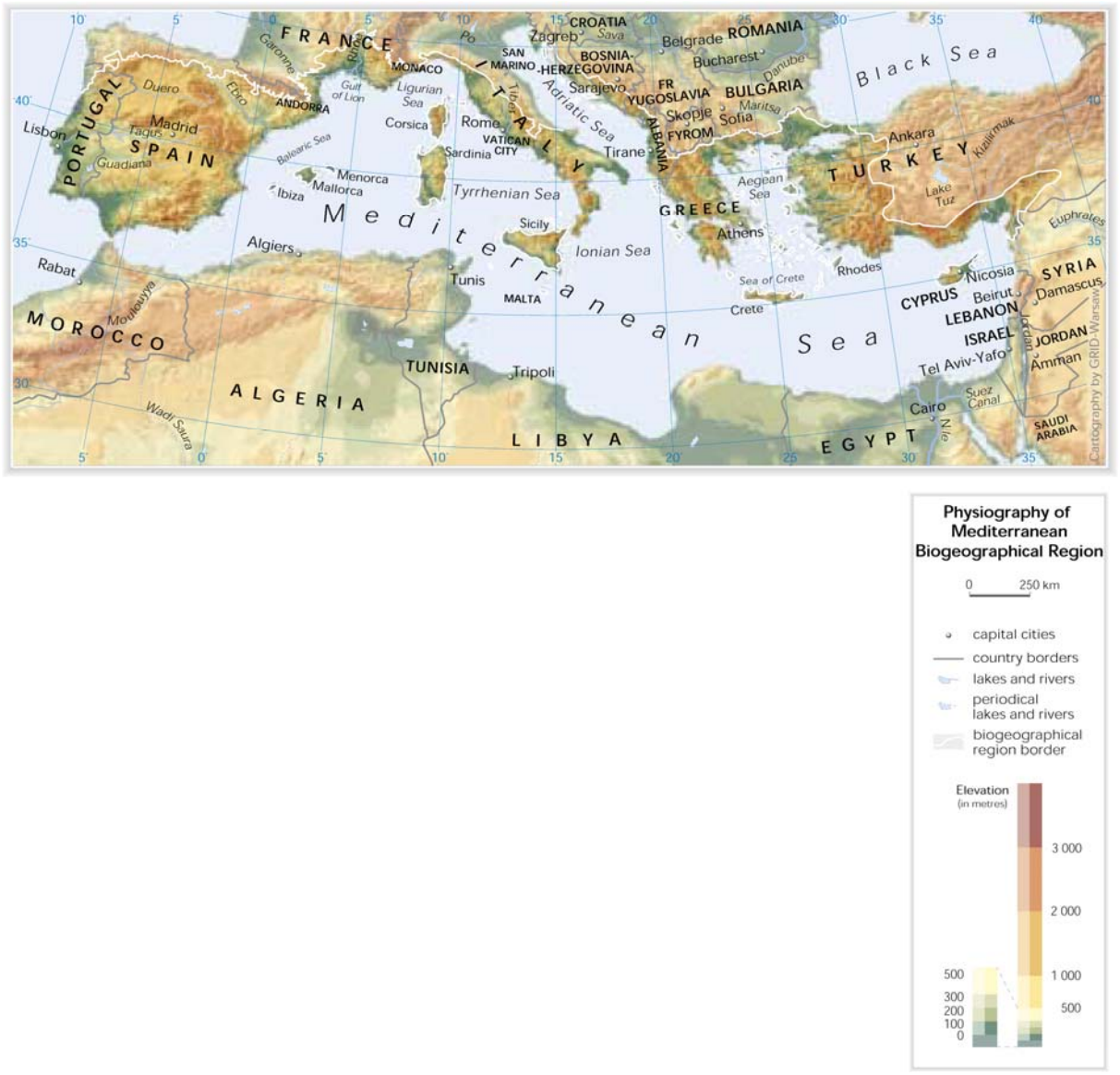
| Surface area ($km^2$) | Number of countries in region | National composition by area | Population: inhabitants/$km^2$ | Main habitat types |
|---|---|---|---|---|
| 1 200 000 (ca 11 % of Europe) | 13 | Spain 37 %<br>Turkey 20 %<br>Italy 14 %<br>Greece 11 %<br>Portugal 7 %<br>France 6 %<br>Albania 2 %<br>Cyprus, Coroatia 1 %<br>Bosnia and Herzegovina, Serbia and Montenegro, Malta < 1 % | Varies between ca 80 and 200 | Agriculture 36 %<br>Forests (including olive groves and orchards), heathlands and scrubs 54 % |

*Source: compilation from various sources by EEA/ETC BD..*

The Mediterranean region borders the Atlantic region in the west, the Continental region in several places to the north while in the east the region is linked to both the Black Sea region and the Anatolian region. In the mountain reaches of the Pyrennees, the Alps, the Balkans, the Dinaric and Rhodopian Alps as well as in the Caucasian Alps the Mediterranean region neighbours the Alpine sub-regions, creating a mosaic in species composition and habitat types.

The region covers ca 11 % of Europe's territory and stretches over more than 4 000 km from Lisbon in the west (Portugal) to Adana in the east (Southern Turkey). The total coastal length is more than 46 000 km.

**Map 1. The Mediterranean biogeographical region.**




*Source: EEA. UNEP/GRID Warsaw final map production.*

### 1.1.1 Topography and geomorphology

The Mediterranean biogeographical region is characterised by a hilly mountaneous landscapes with inland plateaus between low mountain ranges. The coasts are rocky, interspersed with sandy beaches and sand coves. However, most plateaus only lie between 200 and 500 m above sea level. Central Spain has the most extensive and high lying plateau.

The region is located at the meeting point between the two vast continental plates of Africa and Eurasia. Millions of years of tectonic and associated volcanic activity in the region have given rise to the very complex morphology and geology. The collisions between the plates have resulted in the uplifting of the huge mountain ranges along the northern border of the region (treated in the Alpine chapter) as well as the ranges within the region such as the Apennines in Italy (also in Alpine chapter), Sierra Nevada in Spain, the Pindus in Greece and the Taurus in Turkey. Volcanic fields, sulfataras, old and more recent calderas are found from Italy stretching over the Balkan Peninsula eastwards to Turkey, both on the mainland and on islands. There is still tectonic activity

and this constitutes a hazard especially in the central and eastern parts of the region. Several volcanoes such as Etna, Vesuvius and Stromboli are still intermittently active.

The region is also characterised by its broken form with numerous large (Italy, Iberian Peninsula, Greece) and smaller peninsulas, several large mountainous islands (Cyprus, Crete, Malta, Sicily, Corsica, Sardinia) as well as a multitude of smaller islands (the Balearic Islands, the islands of the Aegean Sea): with nearly 5 000 islands, the Mediterranean basin has one of the largest groups of islands in the world. The coast of the islands extends some 18 000 km, comprising nearly 40 % of the total Mediterranean coast.

**Box 1. 'Mediterranean'.**

**Use of the term 'Mediterranean'**

This report uses:

- The Mediterranean biogeographical region (this chapter): the varying, not very extensive band of land surrounding the western and northern coast of the Mediterranean Sea, Europe including parts of Turkey.
- The Mediterranean Sea (the marine chapter): the Mediterranean Sea as such. In this report the chapter on the Mediterranean Sea, however, also gives some information on the coasts focused on the European part.
- The Mediterranean basin: a very wide concept covering all the sea and all land adjacent to the sea (north, west, south, east). Often used to denote a geologic concept. The basin consists of parts from three continents: Europe, Asia minor and Africa
- The Mediterranean area: approximating the basin, but losely used to denote a broader concept than the biogeographical region

### 1.1.2 Soils and erosion risk

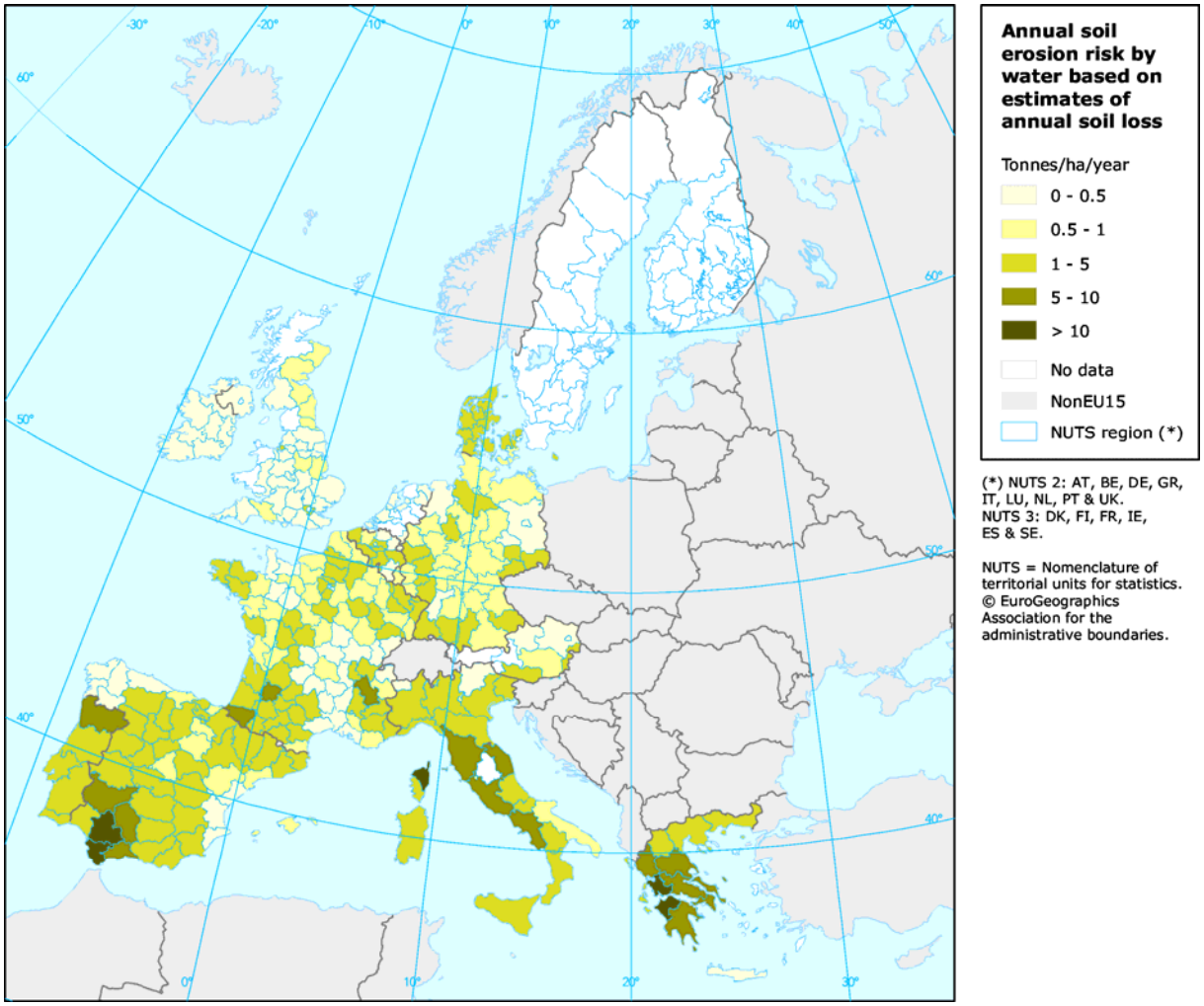
Soils in the region vary, but limestone is widespread and is the parental material for many local soil types, especially in the central part (Italy and the Balkan Peninsula). Soils generally have a low content of humus (organic matter).

The ferrugineous brown 'terra rossa' soils are common. They are rich in minerals but poor in humus and are often associated with the garrigue habitat type. Siliceous soils are often associated with maquis habitats. Unusual soil types, including volcanic soils, contribute to the local and regional diversity of habitats. Rendzinas, loess, regisols and lithosols also occur more scattered in many parts. The richest arable land is, however, to be found on alluvial soils in coastal plains. During the last decades the extension of dry and arid lands has been increasing, due to changes towards drier climates and heavy use of water resources (see 1.1.3).

Because of the dry climate periods and the topography with exposed slopes there is a constant risk of erosion in more than half of the region. In those parts erosion will occur where there is no protective vegetation to properly bind the soil. Therefore overgrazing, deforestation and surface disturbance (tilling, vehicles, trampling) on dry and sloping grounds increase erosion risk locally. Also fires may denude the protective top layers such as litter in forests and in scrubs. Spain has the largest actual area at risk of soil erosion (44 % of the soil, 90 % of which in the Mediterranean region), but as shown in

Map 2 also the other countries in the area have considerable areas at risk

**Map 2. Annual soil erosion risk.**




*Source: EEA. UNEP/GRID Warsaw final map production.*

### 1.1.3 The Mediterranean climate – getting warmer and drier

The warm Mediterranean climate of today has basically existed for several million years with hot summers and mild winters. It is semi-arid in many parts and truly arid in some minor parts. The Mediterranean climate is unpredictable, with diurnal temperature fluctuations, significant influences of winds, short lived but powerful deluges and occasional prolonged droughts. At the local scale, the Mediterranean region is known for pronounced climatic differences over very short distances because of factors such as slope, exposition, distance from sea, steepness, and parent rock type. Temperatures are generally highest in the east, but annually protracted periods with temperatures over 30°C occur in all parts of the region.

Average annual rainfall range varies between 600 and 1 200 mm/year but can be as low as 350 or even 100 mm. Most species in the region will from time to time experience a water deficit. The period of water shortage varies, typically between at least two months in the western Mediterranean and five to six months in the east.
The short spring and autumn seasons are critical periods for plant growth. Apart from in the mountains, snow rarely falls in the Mediterranean, but periods of hard and dry frost

are not infrequent on plateaus and in mountain ranges.

Wind plays a prominent role in the Mediterranean. For example dominant dry and cold winds from the north (the mistral of southern France and the bora from land to the eastern coasts of the Adriatic Sea on the Dalmatian coasts) can provoke sudden springtime or winter anomalies, including high diurnal temperature fluctuations. Dalmatian islands may lack vegetation on the landward side because of the strong bora. The sirocco brings extremely dry and hot air – sometimes with sand and dust – from Sahara across the sea to the region. Several other winds can be locally important. Wind can strongly increase evaporation, hence aggravating the effects of drought and high temperatures. Strong winds may influence migration of species such as birds and insects as well as contribute to spreading of seeds between continents.

Very strong climatic fluctuations occurred during the various ice ages when the climate of the Mediterranean region was colder and drier, though most of the region was less influenced by direct glaciation. Most of the indigenous species of the Mediterranean region survived, but a large contingent of species from northern and central Europe were pushed southward in front of the ice and took refuge in the region. As the post-glacial climate became milder in northern Europe many species started a re-distribution northwards, a movement which is supposed to still continue for some slow spreading species such as some trees and insects. Some migrating species such as birds may in the future chose to stay over winter in northern and central Europe, thus reducing the importance of the Mediterranean wither quarters.

The prospects for the climate of the Mediterranean region points towards a general rise in temperature with more and longer periods of higher temperatures and with changes in precipitation and distribution of water. The higher temperature will increase evatranspiration and increase the general aridity.

### 1.1.4 Population and settlement

The Mediterranean region is characterised by a high population density in many areas, though mostly along the coasts. The Plan Bleu predicts a stable total resident population in the region during the coming decades, except for a rise of more than 20 % in Turkey. The African countries along the southern rim of the Mediterranean Sea are predicted to increase the population steeply. The rate of urbanisation has been high for centuries and is still growing. Rural areas are increasingly depopulated. The area used for agriculture has declined in some countries such as Italy, Spain and Malta, while it has increased in some Balkan areas.

Tourism is the most visible trait of the region. Europe is the world's favorite tourist destination and in many parts tourism is fast becoming the most important service sector and industry. The Mediterranean region is by far the most intensively visited region in Europe, especially in summer, but increasingly also in winter: ca 35 % of destinations in Europe go to the region, especially to the coasts: during the last 20 years the number of incoming tourists in the western part of the region nearly doubled. Tourism has spread to the major islands as well as to even very small and remote islands. The French and Spanish parts of the region are currently the areas to which most retired persons immigrate from other parts of Europe or where people buy second homes for seasonal stays.

The demands for land (tourism facilities, increased infrastructure), for drinking water and problems with sewage and waste disposal exert strong and varied pressures on the ecosystems and habitats.

## 1.2 Main influences

**Main influences**

The main influences on biodiversity are:

- climate change
- urbanisation and tourism
- economic use of species
    - agriculture, with irrigation, grazing and abandonment
    - hunting of birds

Other important influences are:

- de- and afforestation and forest fire
- exploitation of wetlands
- contaminants
- alien species

## 1.3 Main political instruments

**Main political instruments**

The main political instruments of direct importance for biodiversity in the region (some are limited to parts of the region):

- the Convention on Biological Diversity (CBD)
- the Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat)
- the Bonn Convention (Convention on Migratory Species)
- the Convention to Combat Desertification (UNCCD)
- the UNECE Convention on Long-range Trans-boundary Air Pollution (CLRTAP)
- the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats)
- the European Landscape Convention
- the Ministerial Conference on Protection of Forests in Europe (MCPFE)
- the pan-European Biological and Landscape Diversity Strategy (PEBLDS)
- the Barcelona Convention (Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean)
- the UNEP Mediterranean Action Plan and the Mediterranean Commission for Sustainable Development and the associated Blue Plan for Environment and Development in the Mediterranean Region

European Community legislation and policy, in particular:

- EU Birds and Habitats Directives
- EU Biodiversity Action Plans

- EU Environmental Action Plan
- the Common Agricultural Policy and its accompanying measures
- the Forest Action Plan and its accompanying measures
- the EU Water Framework Directive

## 1.4 Biodiversity status

Because the Mediterranean region and sea are frontier zones between Europe, Asia and Africa the Mediterranean ecosystems are composed of species originating in almost all known climatic zones, though the number of afro-tropical origin is relatively low. Therefore the wider Mediterranean basin including parts of western Morocco is one of the richest biodiversity areas in the world. Together with Caucasus the basin is considered a globally important hot spot concerning species (update with other info or check Conservation International web site, Ramade et al., 1997).

The very variable topography and the complex geology with many isolated areas, together with favourable climatic conditions over long periods of time have made the Mediterranean basin a centre of diversification for fauna and flora species of great importance (Blondel, 1999). The region is thus the original home of a large proportion of crops and horticultural plants now used in Europe and other parts of the world. It still houses many of their wild relatives, though many are threatened. For the same reasons the level of species endemism is high: it greatly exceeds that found in any other parts of Europe for most groups of plants and animals. The region has the highest number of endemic habitat types listed by the EU Habitats Directive. Special centra of endemism are found in the Turkish part of the region, in most of Greece, Cyprus and Corsica as well as in southeastern Spain.

### 1.4.1 Ecosystems and habitat types

The Mediterranean region has around one third agricultural land, including grasslands. Areas with agro-forestry were formerly much more widespread, but still play a locally important role. Wine, olive and fruit growing are widespread. Vegetable production is increasing, largely in green-houses around the bigger urban areas.

Forests and other wooded land, scrub and heathlands with dwarfshrubs together dominate more than half of the region. Abandonment of agricultural practice and fires lead spontaneously to scrub formations and from that to secondary forests, but afforestation is also increasing. Thus with the open forests and scrubs – largely being agro-forestry systems in more or less intense use - olive and fruit growing areas much of the Mediterranean landscape is not covered in, but widely interspersed with trees.

Though some of the region's wetlands are very well known (Camargue in France, Doñana in Spain) and there are some large lakes and rivers, the total surface of wetland habitats is small.

The region only contains a few percent of the global zone of truly dry or arid area (Mainly in Spain, Italy (Sicily), and Turkey), but the extension of semi-arid conditions is much wider. Both dry and semi-arid areas are expected to increase in the near future.

**Table 2. Main habitat types of the Mediterranea biogeographicalal region.**

| Agriculture and gardens | Grass-land | Forest and other wooded land | Heath-land and scrubs | Wetlands (bogs and mires) | Rivers and lakes | Coastal and halophytic habitats |
|---|---|---|---|---|---|---|
| 36 % | 6 % | 25 % | 29 % | >1 % | ca 1 % | > 1 % |

*Source: Compiled by ETC/NC and EEA from Corine Land Cover (EEA) and PELCOM map (Pan-European Land Cover Monitoring, Alterra 1999, NL). June 2000.*

Note: Habitat definition according to EUNIS Habitat Classification (top categories)

In the EU-27 part of the region, 147 habitat types are of Community importance as set out in the EU Habitats Directive, Annex I. Of these 37 are EU-27 priority habitat types, (ETC/BD and EU Commission NATURA2000 database, November 2008). Within EU-27, 26 types occur only in the Mediterranean region (Table 3).

**Table 3. Habitat types of European importance only present in the Mediterranean biogeographical region (EU-27). Habitats Directive, Annex I, terrestrial part**

| Code | Habiatat type name |
|---|---|
| 1520 | Iberian gypsum vegetation (Gypsophiletalia) |
| 2210 | Crucianellion maritimae fixed beach dunes |
| 2220 | Dunes with Euphorbia terracina |
| 5140 | Cistus palhinhae formations on maritime wet heaths |
| 5220 | Arborescent matorral with Zyziphus |
| 5310 | Laurus nobilis thickets |
| 5320 | Low formations of Euphorbia close to cliffs |
| 5410 | West Mediterranean clifftop phryganas (Astragalo-Plantaginetum subulatae) |
| 5420 | Sarcopoterium spinosum phryganas |
| 5430 | Endemic phryganas of the Euphorbio-Verbascion |
| 62B0 | Serpentinophilous grassland of Cyprus |
| 6310 | Dehesas with evergreen Quercus spp. |
| 6460 | Peat grasslands of Troodos |
| 8140 | Eastern Mediterranean screes |
| 9250 | Quercus trojana woods |
| 9280 | Quercus frainetto woods |
| 9290 | Cupressus forests (Acero-Cupression) |
| 92B0 | Riparian formations on intermittent Mediterranean water courses with Rhododendron ponticum, Salix and others |
| 9310 | Aegean Quercus brachyphylla woods |
| 9350 | Quercus macrolepis forests |

*Source: EEA/ETC BD, November 2008*

Note: The Habitats Directive, Annex I also covers the Mediterranean Sea marine *Posidonia* beds (Posidonion oceanicae, code 1120).

#### *1.4.1.1 Mediterranean forests, scrubs and heathlands*

The tree, bush and dwarfshrub dominated habitat types (forest, scrub and heathlands) occupy more than half of the region's landscape. The total area has increased over the last decades. The increase in areas with forest and scrubs is due to active afforestation such as in Spain, France, Greece and Turkey, but in many areas it is also the result of abandonment of agriculture. In Spain a national forestry plan in 2002 foresaw an increase in forest area of 14 % to reduce $CO_2$ and reduce erosion.

Because of the hot and dry climate conditions in most parts, the crown coverage of many Mediterranean forests and scrubs is much lower than in the Continental or Boreal regions. Forests are thus often open with ample light, giving room for layers of scrubs and dwarf scrubs, resulting in a complex vertical structure. Forest, scrubs and heathlands often appear in close interconnection and may merge into one another. Dense forests occur mostly in plantations or in natural forests under humid conditions by wetlands or in valleys.

Mediterranean forests are highly diverse in species composition. It is estimated that more than 100 tree species contribute to the various forest types. The forests are mainly broadleaved, but conifers occur e.g. at montaineous sites with shallow soils, as plantations and/or special purposes, e.g. umbrella pines (*Pinus pinea*) for seed production).

Many of the dominant broadleaved tree species are sclerophyllous (evergreen with leathery leaves): holm oak (*Quercus ilex* and spanish sub-species *Quercus rotundifolia*), cork oak (*Quercus suber*) and Turkey oak (*Quercus cerris*). These have over the course of the last two – three millennia progressively replaced deciduous trees, which are now mostly found at higher altitudes or in areas with higher humidity. Forests in Mediterranean mountain ranges also contain endemic or rare conifer species of *Abies, Pinus, Juniperus* and *Taxus*. Holm oak (in forests) encircles the whole Mediterranean Sea, as does kermes oak (*Quercus coccifera,* in maquis). Cork oak (in maquis) and the Mediterranean oak (*Quercus canariensis*) are more westerly in distribution. Deciduous oaks in less dry conditions are downy oak (*Quercus pubescens*) in Spain, France and Italy; Valonia oak (*Quercus ithaburensis macrolepis)* is found in the northeastern part of the region, while golden oak *(Quercus alnifolia)* is native to Cyprus.

The Mediterranean forests have been used for millennia, much longer than e.g. the forests of the Continental and Boreal region. The forests have been much degraded by overgrazing and exploitation for firewood, but also as a result of fires. Such forest areas may become open, secondary forests with several understories, but if not properly managed they may turn into varied types of high or low mattorals (dry scrubs) or in some areas to heathlands or degrade into sparsely vegetated areas. Along rivers, in wetlands and in mountains natural and planted forests may find enough humidity in air or soil to become high and close stands.

*Dry open forest in Spain. Photo & copyright: Ulla Pinborg.*

Mattorals cover extensive areas, under many forms and with many names, which are also often mingled in use. The most well-known forms are maquis of dense shrubs (often on siliceous soil, with wild olives, western part of the region) and garrigue with open low and sparse shrubs (for the most part on limestone, dominated by Labiatae and Leguminosae). Both types take different forms according to geographical location, altitude, exposure, soil-composition. These habitats contain many types of species adapted to light and draught and are rich in trees, shrubs, flowering plants, amphibians, mammals and insects. There are relatively few birds, though raptors exploit the areas. Greece has some of the most extensive areas with sclerophyllous habitats: sclerophyllous forests on ca 13 % of the total forest surface (by comparison: deciduous oaks cover 30 %), while scrubs such as maquis (up to 2 m high, up to 800 m above sea level) covers around 26 %, and phrygana scrubs (very low) cover around 15 % of southern Greece and the Aegean islands. Intensively flowering scrub species are dominant, many also being highly aromatic: *Cistus* (Photo, NCCPG web site), *Genista, Calluna, Arbutus*, thyme and sage. The field layer of forest and mattoral is normally rich in flowers in spring, but may dry out in summer. Lichens and mosses are sparse and the soil is often low in humus and bare in patches or covered by dry litter. Burrowing animal species such as ants and rodents have a significant influence on the nutrient cycling, water infiltration and in maintaining a seed bank. These areas are highly vulnerable to erosion and to new establishment of plants, though the deep-penetrating roots will protect the existing established vegetation for a long time. The characteristic plant genera often show a large number of species, though many may have limited geographical distribution.

In planted forests the most widespread native pines and sclerophyllous oaks are becoming dominant, the combination dependent on soil and level above the sea: Aleppo pine (*Pinus halepensis,* western to middle region) and Calabrian pine (*Pinus brutia*, eastern region), holm oak (*Quercus ilex*) and cork oak (*Quercus suber*).


Cistus salviifolius.
*Photo: John Crellin*, © www.floralimages.co.uk

In the region several exotic tree species have spread into forest plantation during the last decades. Several species of *Eucalyptus* (though mostly *Eucalyptus globulus)* are used. It occurs in France and Spain mostly in the Atlantic region, but in Portugal also in the Mediterranean region. In all Portugal *Eucalyptus globulus* is now the third most grown forest tree (close to 20 % of the forested area and increasing, extensively used for short fibre pulpwood). Research on present *Eucalyptus* forest stands has shown that they clearly contain less species of plants, insects and birds than for instance nearby oak stands. They also show changed soil and litter conditions.

Date palms are hardy to dry and even saline conditions. The date palm (*Phoenix dactylifera*) was introduced for date harvesting to southern Europe more than 1 500 years ago from Northern Africa and the Middle East. Very old continuously grown stands still exist at Elche in southeastern Spain and in Bordighera in Italy. Palm species indigenous to the region are the eastern Creta date palm (*Phoenix theophrastii,* only southwestern Turkey and Crete) and the western *Chaemerops humilis* (western Balkan, Italy mainland, Sardinia, eastern Spain and Morocco). Many other palm species can be found as ornamental trees in the region. The interest in use of date palms and of other palms for fruit and other products is growing in view of future drier conditions in the region.

*Very few remaining untouched forests* – The FAO-hosted Temperate and Boreal Forest Resource Assessment 2000 (TBFRA 2000) contains national data from all natural forests. However, there is no allocation of the information to regions and since the term 'natural forest' is being used differently, it is not possible to directly compare between countries and regions.

Despite the uncertainty of the precise extent, only very limited forest areas remain without influence from human activities. The fragments are fragile and under high pressure, and comprise areas with old oaks, pines and wild olive such as oak formations in Corsica and on the islands of Cote d'Azur (Port Creux) and Mediterranean fir formations in restricted areas in the south and southwestern part of the region. In Sicily very few individuals remain of the critically endangered and relic Sicilian fir (*Abies nebrodensis)*. Ca 20 mature individuals exists and replanting have had limited success.

*Forests of European Community importance* – In the EU-15 part 33 forest types are of European Community importance (Table 4). Of these 13 are deciduous forests, 11 sclerophyllous and 8 coniferous forest types. Grazed sclerophyllous forests occur as one

type in the EU Habitats Directive, occurring mostly in Spain and Portugal (mostly dehesa or montados) and in Italy. The grazed sclerophyllous forests can be alternatively considered forests or grazed areas. They are treated in this chapter under agriculture.

**Table 4. Mediterranean forests and dehesas in proposed sites of Community Importance**

| Country | Number of sites with Annex I forest/dehesa habitat-type | Area of proposed sites (pSCIs) (x 1000 ha) | Estimated area of forest in proposed sites (pSCI) (x 1000 ha) |
|---|---|---|---|
| Cyprus | 28 | 64,709 | 39,081 |
| France | 165 | 1.160,787 | 125, 748 |
| Greece | 197 | 2.557,343 | 337,432 |
| Italy | 788 | 1.990,482 | 451,494 |
| Malta | 13 | 3.269 | 41 |
| Portugal | 47 | 1.529,159 | 183.913 |
| Spain | 768 | 9.984,850 | 1.577,730 |
| Total for Mediterranean region | 2006 | 20.556,33 | 2.756,398 |

*Source: EEA/ETC BD extract from EC Natura2000 database, November 2008.*

#### *1.4.1.2 Agro-forestry and permanent grasslands*

Agriculture, including grasslands, occupies around 40 % of the region. There are large, intensively used areas in the plains of Spain, Italy and other countries, but other parts are characterised by a small scale mosaic structure with gardens and orchards, being surrounded by open forests, scrubs and heathlands.

*Traditional mosaic farming system, Portugal. Photo: Chris Steenemann.*

Large, but decreasing parts are managed as so-called agro-forestry or silvo-pastoral areas, where annual crops or grazing land occur together with and under wooded species. Agro-forestry occurs as both large and as small holdings. They are well known from Portugal (montados) and Spain (dehesas), in southern France and in the rest of the region, often close to or in low mountains (Box 3).

*Traditional silvo-pastoral system*
*Photo: Mercedes Rois Dias*

**Box 3. Dehesa and montados – disappearing sustainable land management systems and cultural landscapes.**

The dehesa or montados of the Iberian peninsula are examples of agro-forestry systems with a combination of grazing and mostly sclerophyllous tree cover of varying density. They have been developed over hundreds of years on moderately poor land in lowland hills and plains of Spain and Portugal. They are systems of rotation of pastoral and arable activities in open woods. The tree cover represents roughly a quarter of the land, mostly with evergreen oak or cork oak trees, more or less evenly distributed, creating a much fragmented ecosystem with alternating full light and light shade, giving rise to a large variation in species. In habitat classifications and mapping their range include

forests (Habitats Directive), in others as agro-forestry (Corine Land Cover) or even as grasslands.

Relatively long periods of grazing of sheep, goats, cattle, and pigs clear the land of unwanted shrubs and fertilise the soil, preparing it for the growing of cereals and leguminous plants for shorter periods. The trees, generally quite big, give shade, retain moisture and provide acorns as food for the pigs. Leaves contribute nutrients to the top soil.

Though of great age and long continuity, dehesas are not stable and may change very quickly, especially as trees age. They may be cut and not replaced and the areas turned into fully open grasslands or to intensive agriculture. In many areas the land has proved to be too poor to support the production of cereals on a long-term basis. Such areas have been used for monoculture plantation of *Eucalyptus,* which had degraded the land still further. Many dehesa areas have also progressively been abandoned due to the rapid development of intensive animal husbandry, not using the dehesa areas, which may then turn to scrubs as mentioned above.

Remaining dehesa and montado systems cover almost five million hectares in southwestern Spain and more than half a million in Portugal (Blandin, 1992, EEA, 1995a). There are less than 300 dehesa and montado sites proposed for NATURA 2000 as of Community importance (EU15), covering over 600 000 ha (more than 15 % of all Mediterranean forest protected under Natura 2000). The largest sites are to be found in Spain and Portugal. The dehesas of Sierra Morena in Andalucia were designated a Biosphere Reserve in 2002.

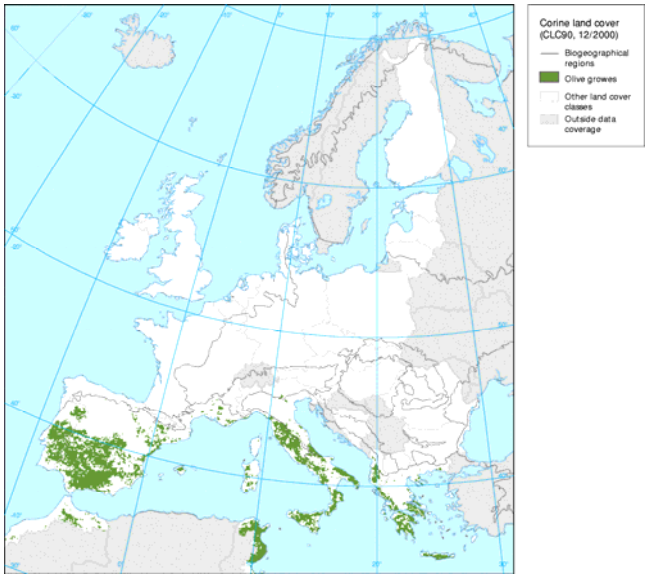
Both the agro-forestry and the mosaic areas normally have high numbers of wild plant, reptiles, insects and bird species and show relic populations of the ancestors of crops, horticultural and medicinal plants.

The Mediterranean region has permanent grassland all over the region, but it only covers around 6 % of the total land area and is decreasing. Major remaining areas can be found in central Spain and in Portugal, where they are part of or associated with the dehesas and montados. The region has had a significant part of the grazing land under so-called transhumance management, where herds of sheep or cattle were moved to alternative grazing areas during different seasons (mostly in mountains). With the present continuous de-population of many rural areas, such older grazing regimes are discontinued just as in other regions. The land is either abandoned and transferred into scrub in mountainous, rocky or arid areas or it is cultivated more intensively where this is possible. Afforestation is less frequent than in other regions such as the Continental, Atlantic or Boreal regions.

*Vines, olives and fruit trees: woody species in Mediterranean agriculture* – Woody species such as vines, olives and fruit trees are very important in Mediterranean agricultural production. Olives, native fruit trees and oaks occur both in wild forms and as cultivated. While vines are normally intensively cultivated and alone, olives, fruit trees and large trees such as cork oak and holm oak often occur in mixed stands. The native species are also still found as wild outside gardens and orchards in scrubs or they exist on former cultivated, now abandoned land.

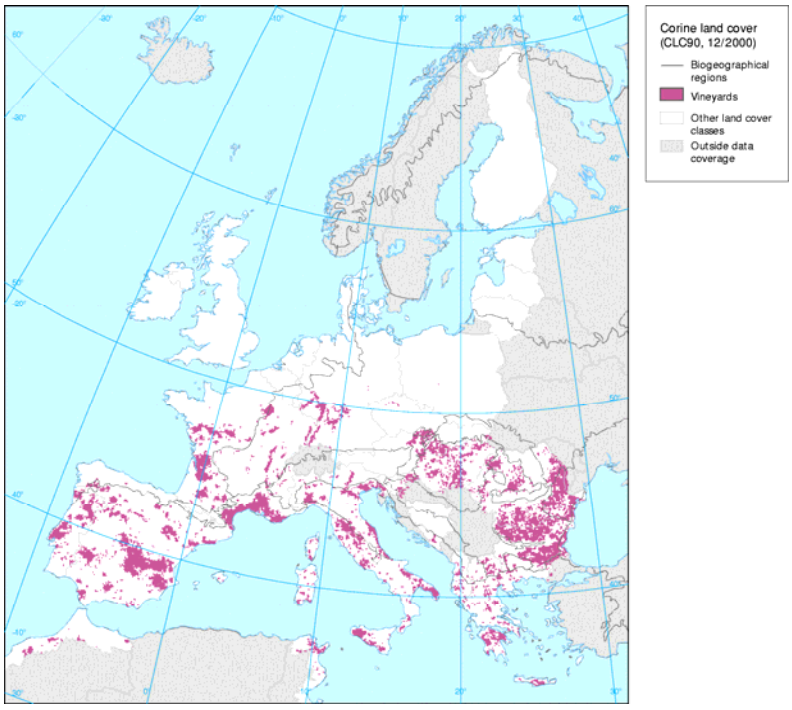
Because of the lack of forests in many areas, the woody species, their open cultivation pattern and their stature contribute much to the visual experience of the Mediterranean landscapes. They also have basic ecological functions for birds and insects. E.g. nearly all olive growing in Europe occurs within the Mediterranean region (Map 3).

**Map 3. Olive growing in Europe.**



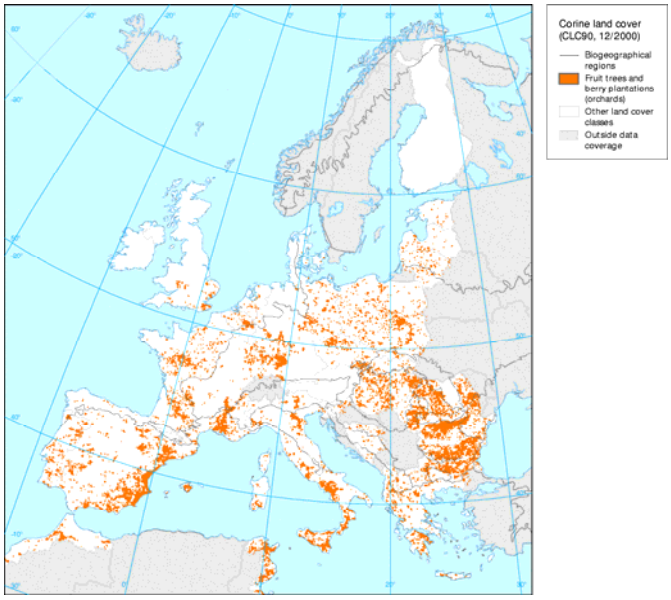

Though much wine growing also occurs in other parts of Europe, the Mediterranean region has the largest area as well as the largest number of varieties. Most of the vine varieties grown in the rest of the world originated from the region (Map 4).

**Map 4. Wine growing in Europe.**




Fruit and nut carrying trees are characteristic for the whole region, both from originally native species (olive, apples, pears) and from introduced species (such as citrus species). Cultivation occurs in numerous small or large orchards (Map 5).

**Map 5. Major orchard areas in Europe.**




The water needs for these cultivations depend on species and soils, but especially citrus orchards need irrigation. Frost in the flowering and pollination period in spring is a determining factor for insect pollinated species.

*Medicinal and aromatic plants* – A wide variety of medicinal and aromatic plant species are naturally occurring in the whole region, both in open forests, scrubs and heathlands. Many species have been taken into cultivation for horticulture or increasingly also in large-scale production as alternative agricultural production. The medicinal and aromatic species (both wild and cultivated) are mostly dependent on insect pollination for seed production. These species are however also among the most important for honey production. Most of the species are perennial or small shrubs and dwarfshrubs; they have woody parts and are resistant to dry-arid conditions. The wild species often grow in sun-exposed areas on thin soils or in crevices.

*Cultivation of* Lavender, lavandula *spp. Photo and copyright: Ulla Pinborg.*

*Wild relatives to cultivated plant species* – FAO considers the Mediterranean area as one of the most important centres of origin for globally important crops, covering many cereals, legumes, vegetables, fodder plants, fruit trees and nuts as well as medicinal, aromatic and ornamental plants. The region continues to provide new sources to improve agricultural production. The material used are wild plant species and wild relatives, but also landraces.

Over the centuries, hundreds of varieties of olive, almond, wheat and grape etc were preserved in gardens and orchards. In many cases the horticultural and agricultural varieties of past generations have been lost in recent decades. At the turn of the 20$^{th}$ century, 382 named cultivars of almond were in use on the island of Mallorca alone (Socias y Company 1990), where now only 5 or 10 can be found. The great majority of minor fruits, nuts, vegetables and other plant varieties selected in the past are extinct and lost forever. Conservation of genetic material in viable and varied populations in the region is of large economic importance, but the conservation is threatened by afforestation, intensified cultivation and overgrazing, as is lack of awareness among landowners (for details visit <http://medplant.icimod.org/>).

#### *1.4.1.3 Arid lands and deserts in the Mediterranean region*

The region presently only contains minor areas that are so arid as to be included in pre-desert or desert in e.g. Spain, Portugal, on Sicily and in Turkey. With an expected rise of the mean temperature in the region the very dry vegetation of the southern part of the region may expand considerably to the north of the region and into the mountain foothills of the Appenines, Southern Alps, Cevennes and Pyrenees as well as in the Balkan Peninsula and Turkey. A number of species are strongly related to Mediterranean arid lands (e.g. birds see 1.4.2).

The desertification risks are therefore increasingly high in all countries: it changes habitats, limits useage of habitats and increases the risk for soil erosion. The counter-measure to keep such areas productive is mainly irrigation, both an environmental and political problem, but also planting with desert-tolerant species, including new tree species or change to other crops may be a future solution. (See also 2.1 on climate change, 2.2.2 on fires and 3.1 on the Convention to Combat Desertification).

#### *1.4.1.4 Rivers and lakes*

*Rivers* – Eight river systems with total catchments of more than 50 000 km$^2$ cross or originate (only four rivers) in the Mediterranean biogeographical region. The Rhône and Ebro drain into the western Mediterranean Sea, while the Sarkarya drain into the eastern Mediterranean Sea (Mediterranean rivers). The Iberian rivers Douro, Tajo, Guadiana and Guadalquivir rivers as well as Garonne in France, drain into the Atlantic Ocean ((Table 5, EEA, 1995a, RiverNet).

Many Mediterranean and nearly all Iberian rivers have low annual volume and irregular regimes. The predominant fluvial regime is characterised by an extended summer period of low water. In addition to this, the flows of many Mediterranean streams have been reduced by water extraction for permanent irrigation systems, which are widespread in the Mediterranean lowlands.

**Table 5.** Rivers crossing or in the Mediterranean region, with total catchment areas larger than 50 000 km$^2$.

| River | Country | Total catchment (km$^2$) | Approx. catchment in the Mediterranean region (km$^2$) | Approx. % of the total catchment in the Mediterranean region (%) |
|---|---|---|---|---|
| Douor | ES, PT | 98 375 | 98 375 | 100 |
| Rhône | CH, FR | 96 000 | 20 000 | 20 |
| Garonne | FR | 85 000 | 5 000 | 6 |
| Ebro | ES | 84 000 | 65 000 | 77 |
| Tajo | ES, PT | 82 000 | 82 000 | 100 |
| Guadiana | ES, PT | 72 000 | 72 00 | 100 |
| Guadalquivir | ES, PT | 57 000 | 57 000 | 100 |
| Sarkarya | TR | 55 000 | 17 000 | 30 |

*Lakes* – Natural fresh water lakes are infrequent in the region. The region only has nine lakes larger than 100 km$^2$, but a fair number of smaller lakes. The lakes Burdur and Acigöl in the Turkish part of the region are saline. Most saline or salt lakes are shallow and dry out from time to time. With increasing temperature more lakes in the region may eventually become saline.

Table 6. Natural lakes in the Mediterranean Biogeographic region with surface areas of more than 100 $km^2$

| Name | Country | River catchment | Surface area ($km^2$) | Volume ($km^3$) | Max depth (m) |
|---|---|---|---|---|---|
| Egridir* | TR | None | 590 | 4 | 14 |
| Skadar | AL, former YU | Drin | 370 | 4 | 50 |
| Iznik | TR | | 250 | | |
| Burdur | TR | None | 200 | | |
| Acigöl | TR | None | 150 | | |
| Trasimeno | I | None | 124 | 0.6 | 6 |
| Manyas | TR | Nilüfer | 120 | | |
| Ulubat | TR | Nilüfer | 120 | | |
| Bolsena | I | Marta | 114 | 9 | 151 |

Note: *The lake Egridir shares its watershed with the Anatolian biogeographical region.

Many river valleys in the region have been dammed to create reservoirs for hydroelectricity production, many of these in mountain ranges. No reservoirs in the region have surface areas larger than 100 $km^2$. However, the region does hold a large number of smaller reservoirs. For instance, in Spain the number of reservoirs exceeds 1 000. The region also holds some of the deepest European reservoirs: the Almendra reservoir in Spain (190 m deep) and the 132 m deep Greek reservoir Kremasta, with the highest earth-fill dam in Europe (150 m). Reservoir building in EU has now fallen off and growth in total reservoir area seems to be stagnant (EEA 1995a, Box 4).

**Box 4. Reservoirs may lead to environmental problems.**

Reservoir construction leads to a number of environmental problems, both during the building phase and after completion. Access to spawning sites for migratory fish is prevented, which significantly reduces the populations of salmon, trout, and sturgeon. As reservoirs trap the suspended matter flowing into them, they reduce the transport of suspended matter to downstream reaches; in reservoirs with high phytoplankton productivity, the organic load to the downstream reaches increases. The different quality and nature of the suspended matter downstream reservoirs significantly influence the benthic communities and river metabolism.

Reservoirs regulate the water flow, influencing the natural flow, normally leading to stabilisation of the water flow, of benefit to land use, but often negative for natural habitats and dependent species. Changes in the flow regime and water temperature may affect the downstream aquatic communities leading to a reduction of macrophytes, a reduction in richness both of fish and invertebrates, and a reduction of fish biomass, density and growth (EEA 1995, Casado et al. 1989).

Deep reservoirs are thermally stratified during the summer, with a warm surface layer

and a cold bottom layer. In eutrophic reservoirs with bottom water outlets, the water oxygen concentration may be low. Reservoirs may, however, also be beneficial to such species, which can move widely in the landscape: several of the Spanish reservoirs in dry regions have become much used by birds.

#### *1.4.1.5 Mire bogs and fens*

Because of the water deficits in most of the region, wetlands such as mires, bogs and fens are naturally limited. Most are situated in valleys, where the land is low lying and can be inundated from rivers, at the coasts in the river deltas or as lagoons. The mires, bogs and fences of the region remained largely intact until the 1900s, when most were drained or heavily influenced to provide agricultural land or to eradicate malaria such as west of Rome.

However, there are some very spectacular and ecologically important wetlands in the region. The deltas of the northern-shore of the Mediterranean Sea contain some of the most extensive and varied wetlands areas remaining in the whole of the Mediterranean Basin. In the region the deltas of Ebro in Spain, Rhone in France (Box 5), Axios and Evros in Greece, Menderes, Seyhan and Ceyhan in Turkey are all complex mosaics of wetland and dryland habitats, including dunes with juniper and pines on sand and gravel, lagoons, freshwater and brackish marshes, and freshwater lakes. The Po delta in Italy lies in the Continental region, but drains to the Mediterranean Sea.

**Box 5. Camargue in southern France.**

Camargue is the collective name for a large area of cultivated and natural lowlying land around the outlets and delta of several rivers, including the Rhone. The park's existence is based on a continuous struggle for land reclamation and regulation over many centuries. The regulation of sea and river in the area was finally succesfull in the 19th century with dikes against rivers and tide. The soil is mostly saline sediments, but the irrigation of the main crops vine and later also rice has lead to wide desalination of the soil. The irrigation and flooding control has lead to the remaining nature areas being cut off from fresh water and natural silting. Much of the area is thus now highly influenced and controlled. Salt exploitation has occurred in the area for many centuries.

Although much land is under cultivation, the area is interspersed with vast wet and salty marshlands, river stretches, lakes and lagoons (often highly salty) as well as dry grasslands.

Camargue is a regional nature park, large parts are a Natura 2000 site and a Ramsar site. It is a very popular tourist area, well known for its landscape, its horses and bulls and for its huge number of birds.

The area is of high importance both for local flora and fauna (birds, bats), but also for large numbers of migrating birds. 350 bird species (among which 111 nesting species) have been registered, 25% of all red-crested pochards (*Netta rufina*) in southwestern Europe over-winter here, and the 10 000 pairs of pink or greater flamingo (*Phoenicopterus ruber roseus*) constitute the most important colony in the Mediterranean basin. It is also known for its population of purple heron (*Ardea purpurea*).

The area has an enormous population of mosquitos. A LIFE Nature project (1999) concerns how to control mosquitos, including by biological pest control using of Bacillus thuringensis, var. israelensis. The goal is to reach a methodology that can be applied to other similar areas.

Source: Parc naturel regionaux http://tinyurl.com/2gxsgy

Coastal wetlands (deltas and lagoons) of the region support large numbers of birds during their migratory, wintering or breeding seasons. They are of major importance for wintering of European ducks. They provide nesting for rare and threatened birds such as the squacco and purple herons (*Ardeola ralloides*, *Ardea purpurea*), collared pratincole (*Glareola pratincola*), slender-billed and Audouin's gulls (*Larus genei* and *Larus audouinii*), penduline tit (*Remiz pendulinus*) and pink flamingo. The drying and the warmer climate may change the importance of these areas.

Coastal lagoons host several fish species of economic interest: seabass (*Dicentrarchus labrax)*, gilt-head (*Sparus auratus)*, common sole *(Solea vulgaris)*, common carp *(Cyprinus carpio),* pike *(Esox lucius)*, sand-smelt (*Atherina boyeri),* eel (*Anguilla anguilla*) (see also the chapter on the Mediterranean Sea).

Esox lucius, *the common pike, is a common and aggressive predator of European freshwaters and brackish waters. It is also appreciated by anglers.*
*Photo: Anders Nilsson*

Floodplain freshwater marshes are rare and most were drained for agriculture. Remaining habitats are found in a fragmentary and highly modified state such as in the Languedoc and Crau regions in southern France, on the River Guadiana in central Spain. Diking, grazing, agriculture and forestry (timber cutting) have destroyed the riverine forests. Only a few isolated relic stands still exist in the Mediterranean region, such as in the Ramsar site of the Nestos Delta in Greece (Box 6) and around the Moraca River in Serbia-Montenegro at the border of the Dinaric Alps of the Alpine region[1].

[1] See Living Lakes web site, http://tinyurl.com/37yf6v

**Box 6. Nestos Delta in northeastern Greece.**

The Nestos Delta in north-eastern Greece is a national park, designated also as an EU Birds Directive site and Ramsar site

The area is under pressure both from inside as well as from the surroundings. Intensive agriculture is one of the greatest threats to the lakes:

- large quantities of water are pumped for irrigation
- use of fertilisers and pesticides causes problems
- the quality of the drinking water has deteriorated

The area is an example of colliding interests of EU policies: subsidies for agriculture and protection of a site of Community importance for nature protection. Tourism is heavy and growing, especially along the coast.

The Nestos park is situated in a dead arm area of the river Nestos. The area has 7 lakes, 7 lagoons and more than 10 ponds. The wetlands cover more than 120 $km^2$ and the water surface is around 23 $km^2$. The water is very shallow. The salinity varies among the lakes, ponds and lagoons. The large undisturbed areas of sand dunes constitute the largest in northeastern Greece. They are dominated by *Ephedra distachya* in combination with *Silene subconica*.

The area houses 22 amphibians and reptiles, 17 species of fish, more than 30 species of dragonflies and nearly 30 species of orchids. There are recorded more than 200 species of birds (around ¼ are threatened species). The wetland parts are very important for migratory waterfowl: more than 190 migratory species breed, winter, or stage in the area, 67 of which are protected under EU legislation. The wintering populations of waterbirds include large numbers of ducks, geese and of two cormorant species (such as the smallest existing cormorant, the pygmy cormorant, *Phalacrocorax pygmaeus*). The dalmatian pelican also occur during the migratory period. The Nestos Delta houses the largest breeding population of spur-winged plover (*Hoplopterus spinosus*) in Europe (35 pairs, about 70-80% of the European population).

The rare golden or yellow jackal (*Canis aureus*) also occurs. Seven of the fish species are endemic and threatened. The river mouth and the lagoons are important spawning and/or nursery grounds for fish species of commercial interest (European Commission, DG Environment, Nature web site, Ramsar web site, Global Nature web site, WWF web site).

#### *1.4.1.6 Mediterranean coast*

Mediterranean coasts are very varied, even within short distances, with rocky stretches and sandy and gravely beaches or coves, including habitats such as rocks and sea cliffs, sand dunes, caves, lagoons and deltas (mentioned under bogs, mires and fens above). Vast areas of dunes and wetlands have totally disappeared. Sea level rise may increase coastline erosion especially for beaches and effect caves and low-lying areas. Several aspects of the Mediterranean coast are also described in the chapter on the Mediterranean Sea.

*Dunes* – Mediterranean dunes are of various types, following the same pattern as dunes elsewhere in Europe: white dunes, grey dunes, wooded dunes. However, the climate conditions determine the habitat types. Dunes play a major role in preserving beaches and protecting the forests, biological communities and amenities situated behind them.

The decline in Mediterranean dunes has been severe: more than 70% are estimated lost since 1900. Most of the former dune area has been used for urbanisation, not the least for tourism purposes or they have been planted to stabilise mowing sands and have gradually been turned into dry forests, often with pines. Thus only few areas remain untouched.

Dunes are the exclusive habitat of many plant and animal species and many dune species are endemic. The animal life is often not very visible: snails, arthropods, insects, lizards, tortoises, rabbits.

One third of the dune flora is endemic to the Mediterranean. Many dune species are useful pioneer plant species, which help to colonise or to repair sandy substrata. They are relatives of many cultivated ornamental plants such as anthemis, fodder plants such as lucerne, cereals such as couch grass (related to wheat) (see wild relatives). Indigenous dune vegetation is also in this region endangered by the invasion of exotic species, which have escaped from gardens or have been introduced to fix the dunes, such as marram (*Ammophila arenaria).*

*Rocky habitats, cliffs and caves* – In the mountains and along the coasts rocky landscapes with cliffs, gorges, crevices and caves are frequent. They present extreme living conditions for plants as well as for animals and vegetation is sparse. Cliffs and gorges harbour cliff-dwelling plants and also a number of tree species with dwarf forms because of water and nutrient limitations as Phoenician juniper (*Juniperus phoenicea*) and holm oak (Blondel, 1999). Narrow crevices serve as macro-habitats for a large number of endemic species (Grabherr, 1997). Cliffs also provide breeding sites for rare birds such as griffon vultures (*Gyps fulvus*), eagle owl (*Bubo bubo*), raven (*Corvus corax*) (Blondel, 1999). Cliffs and caves present a vast variety of micro-relief with crevices, ridges, holes, etc. Often inaccessible, they are amongst the few areas of the region that have largely escaped human influence, and they serve as refugees for many species of fauna such as bats and for flora.

### 1.4.2 Species

As mentioned above, the Mediterranean basin is one of the richest biodiversity areas in the world and is considered a globally important hot spot concerning species. Parts of the region have a very high endemism[2].

The life strategies for a large part of the species reflect adaptations to arid and semi-arid conditions. Several adaptation mechanisms are parallel to those adopted by species in other extreme conditions such as in the Arctic region:

- short life or growing season with high vitality
- protective measures against drying out
- behaviour maximised to withstand dry conditions

The change in climate may be expected to further those species with are flexible and adjustable to arid and hot conditions. North African species may gain importance.

[2] E.g. Biodiversity hotspots website, http://tinyurl.com/2pab4b

**Table 7. Species of European importance in EU Member States in the Mediterranean biogeographical region. Birds Directive, Annex I (B AI) and Habitats Directive, Annex II (FFH AII).**

| | |
|---|---|
| Number of all Birds Directive Annex I species and sub-species in the EU-15 Member States in the Mediterranean biogeographical region (March 2000), limited to breeding bird species | 121 |
| Number of all Habitats Directive (FFH) Annex II species and sub-species present in the EU-27 Member States in the Mediterranean biogeographical region | 425 |
| | |
| Number of all Habitats Directive Annex II species and sub-species in EU-15 Member States in the Mediterranean biogeographical region, by group | |
| Mammals | 32 |
| Reptiles | 19 |
| Amphibians | 18 |
| Fishes | 48 |
| Invertebrates | 41 |
| Vascular plans | 251 |
| Mosse/Liverworts | 16 |

*Source: EEA/ETC BD November 2008..*

#### *1.4.2.1 Flora*

The flora of the whole Mediterranean basin in a wide sense includes more than 25 000 species of flowering plants, making it the third richest in the world. More than 30 Mediterranean plants are considered to have become extinct during the last century. It has been estimated that nearly 25 % of the Mediterranean flora may be threatened in the decades to come (Leon et al*.*, 1985).

In the Mediterranean biogeographical region (northern part of the basin) the number of species for a given area (areal richness) may be twice the number found in corresponding areas in Northern Europe. For example, the number of species found in 10 000 $km^2$ in the Côte d'Azur in France amounts to 2 300, while an area of the same size in the Lake District in England hosts 1 080 species (Ozenda, 1994).

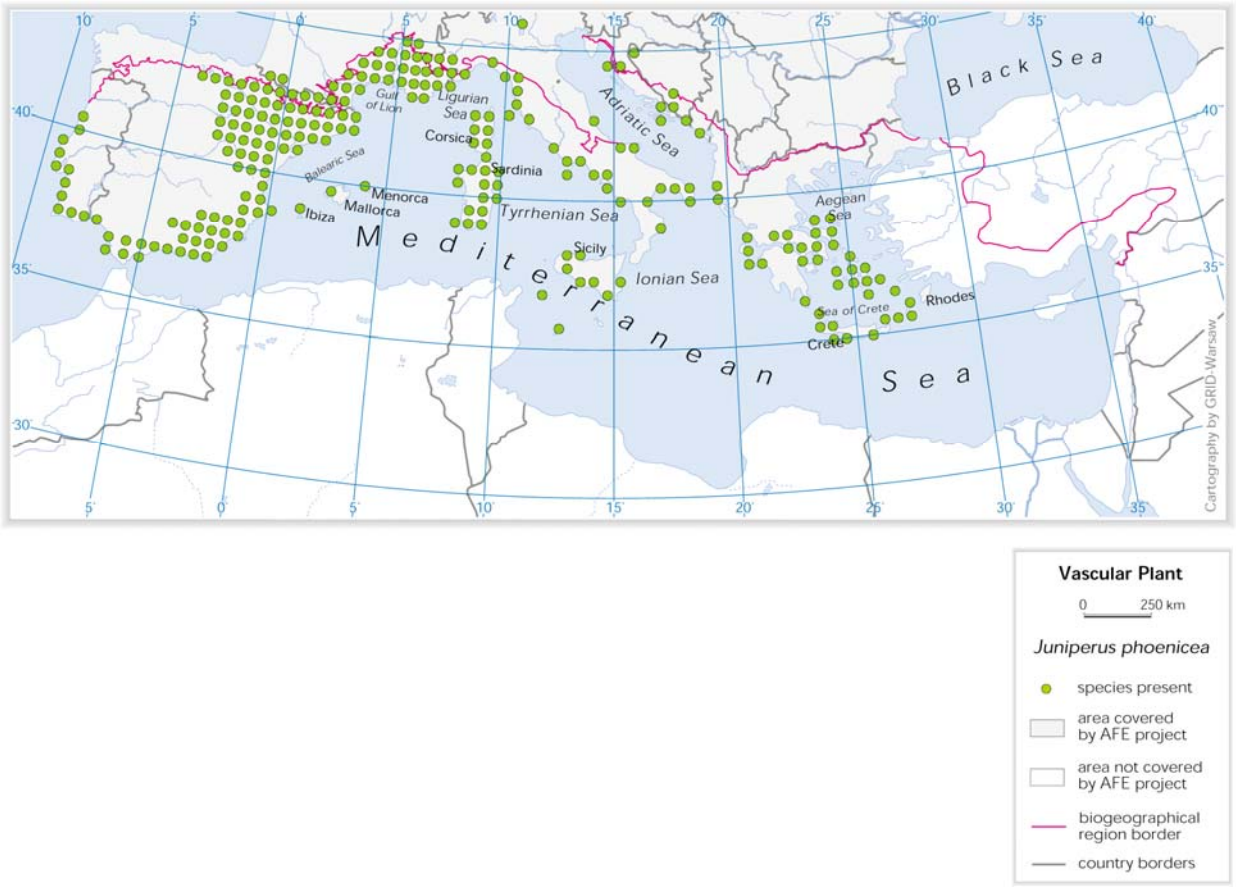
A main characteristic of Mediterranean basin plant biodiversity is the remarkable number of endemics. More than half the plant species are endemic and 80% of all European plant endemics are Mediterranean. Thus, the Mediterranean region is an important reservoir of plant diversity. Many species are restricted to a single or a few localities in sandy areas, islands, isolated areas of unusual soil or rock types or isolated mountain ranges. In general, the levels of endemism increase as altitude increases: for example, among the 400 endemic plant taxa in Andalusia, 125 (31%) are restricted to the mountains. A high

level of endemism is also found on large mountainous islands: Corsica has 11 % endemic plants (240 endemics out of 2 150 species) as compared to ca 7 % for nearby southeastern France.

Two-thirds of European tree species are found in the Mediterranean region. The same richness applies for the herbaceous flora. Entire families have their centre of origin in the Mediterranean basin (Labiatae, Caryophyllaceae) and even sometimes their exclusive European representative (Cistaceae, grass species from the sub-family of Paniceae).

Some plant life-forms, adapted to drought and perturbation of soils, are typical of, but not exclusive to Mediterranean flora: they are evergreen, have bulbs or are annual. Many fire resistant or even fire stimulated plant species occur in the region.

**Map 6. *Juniperus phoenicea* – a Mediterranean dwarf conifer in rocky habitats.**




*Source: EEA/ETC BD based on data from Atlas Flora Europaea. Data extracted March 2000.*

### *1.4.2.2 Fauna*

The Mediterranean region also has a great variety of fauna. In comparison to other European biogeographical regions, the region has the largest number of amphibians, reptiles and mammals (Tables 7 and 8). The figures should however be viewed in the light of what the region once had. It is estimated that the region suffered heavier loss of higher vertebrates in historical time than any other region (Chauvet, 1993).

**Table 8. Number of vertebrate species in the Mediterranean region (Turkey and Cyprus not included).**

| | Total | Amphibians | Reptiles | Mammals (3) | Breeding birds |
|---|---|---|---|---|---|
| Number of species (1) | 599 | 57 | 89 | 134 | 317 |
| Number of threatened species at European level (2) | 142 | 6 | 6 | 32 | 98 |

Source *: EUNIS from the major European species Atlases (2000).*

Note: 1) Only species present are taken into account, extinct or introduced species are excluded. 2) Sources are not exhaustive (European Atlases cover 81 % of the region). 3) Only species present are taken into account.

*Mammals* – The region houses 134 species of mammals (not including Turkey and Cyprus). Of these at least 30 are threatened: the Iberian lynx (*Lynx pardinus*) being close to extinction, and several species have very small or isolated populations. The Mediterranean region is also important to the wider European fauna: more than 20 % of mammals threatened at European level are present in the Mediterranean region.

During the last decades there has been a decrease in human disturbance in the Mediterranean mountains as compared to the plains because of abandonment and population moveing to cities. This concerns not only the mountain ranges within the region, but also the alpine ranges bordering the region. While it may be unfavourable to light-dependent grassland plants and associated insects, it has been favourable to animals that require large undisturbed areas such as wolf (*Canis lupus)* and wildcat (*Felis sylvestris).* The network of interlinking habitats in the mountains has favoured the expansion of wolves from south Italy towards Maritime Alps and the Bohemian Forest since the early nineties (Delbaere 1999). Today there are few local or regional mammal endemics: Spanish hare (*Lepus granatensis*), spiny mice (*Acomys minous* in Crete, *Acomys cilicicus* in Turkey).

*The Iberian lynx*, Lynx pardinus*, is critically endangered and re-introduction programmes have been launched.*
*Photo and copyright: Programa de Conservación Ex-Situ del Lince Iberico*

*Birds* – Only a few species of birds have become extinct in recent times, but many formerly widespread species are now threatened and confined to small, scattered populations. A major pressure over long time has been the ongoing habitat changes and destruction. The high level of use of pesticides in the past decades caused considerable damage, but after the banning of the most dangerous substances in Europe many species, for example the peregrine falcon have steadily recovered. Populations have declined also through reduction of surface water as a result of drainage and irrigation works. Indiscriminate shooting and trapping of protected species still occur on a large scale in all countries around the Mediterranean Sea. Several bird species have shown drastic increase in numbers in recent years, such as geese and some ducks.

*The peregrine,* Falco peregrinus*, was formery threatened to extinction. After the banning of dangerous substances throughout Europe the species has recovered. Photo and copyright: US Fish and Wildlife Services.*

Migratory birds use the region as

- stop-over for feeding (Palaearctic species) before migrating to/from Africa (spring and autumn)
- winter grounds (pre-Saharian species)
- tropical species (trans-Saharian) may have limited foothold in Europe (summer)

The Mediterranean region is the main region to cross or to stop over in for those migratory species, which winter in Africa or in Asia minor. They use three main routes or flyways, an eastern, a central and a western route. Migrant species are still threatened because of widespread use of highly toxic pesticides south of the Sahara, resulting in birds being poisoned or else starved through lack of insects as a food resource. Changes in survival rate have also been shown to be strongly linked with the severity of drought and scarcity of food in the Sahel.

The mild winter weather conditions of the region make the arid lands of the region very suitable as wintering grounds for many migratory species coming south from northern Europe, who will stay in the region or use the region for shorter or longer stop-overs before proceeding to the final wintering grounds. The region is also in itself the breeding ground for African species, which will return to Africa in winter, and which have their only European occurrence in this region: in Spain for example Dupont's lark (*Chersophilus duponti*), black-bellied sandgrouse (*Pterocles orientalis*), trumpeter finch (*Bucanetes githaginus*).

The Mediterranean region is well known also for its eagles and vultures. These species have been low in numbers over several decades but now seem to recuperate in some areas, not the least in connection with the bigger protected areas. They are however very sensitive to land use change and to disturbance such as from dense tourism: examples are the Spanish imperial eagle (*Aquila adalberti)* which only breeds in very limited and now again decreasing numbers (less than 300) in central Spain, or Bonelli's eagle (*Hieraatus fasciatus*) with a wider distribution, in Europe closely connected to the region's mountain scrubs in Spain, Sardinia, Sicily and in Greece and on islands of the Aegaen Sea. Other predating birds such as vultures are wider distributed and more numerous.

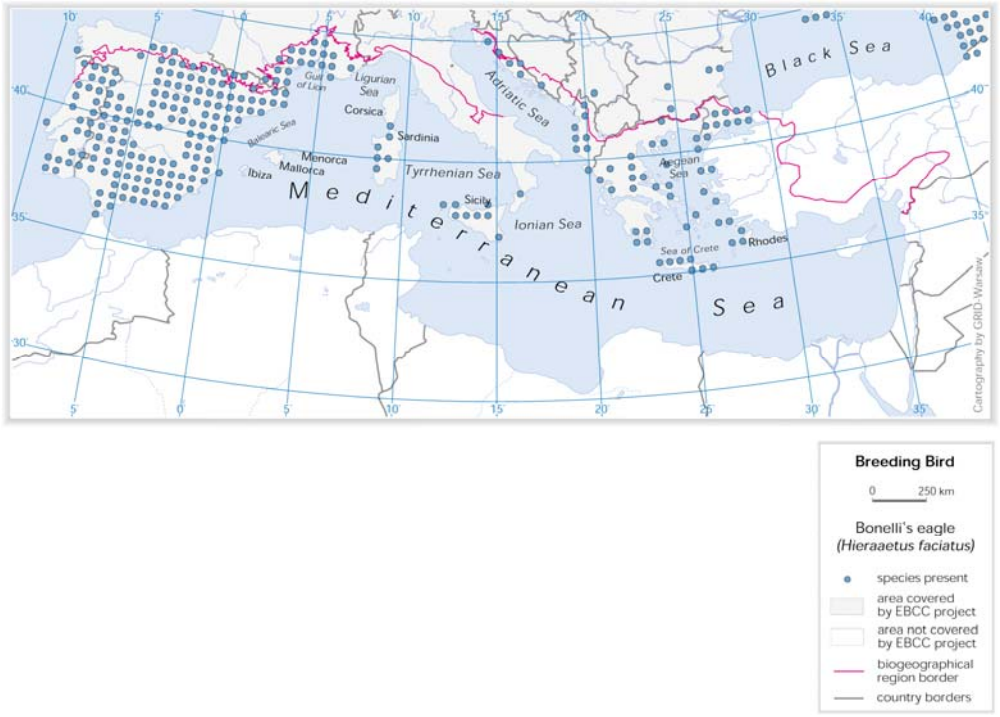
The migration of birds concern millions of individuals, belonging to different groups (e. g. waterfowl, raptors, passerines), both among the common and very rare species (pygmy cormorant (*Phalacrocorax pygmeus)*, dalmatian pelican (*Pelecanus crispus*), ferruginous duck (*Aythya nyroca*) spotted eagle (*Aquila clanga*) and slender-billed curlew (*Numenius tenuirostris).*

The common crane *(Grus grus)* winters in the Mediterranean area. In very early spring they migrate north through the region along a western and central European flyway to the breeding places, mostly in remote mires in northern Europe (Russian Federation, Sweden, Finland). Large numbers rest in winter in the Spanish Estremadura area, where they feed on holm oak nuts.

Examples of birds characteristic for Mediterranean arid and steppic lands are the little and houbara bustards (*Tetrax tetrax, Chlamydotis undulata)* and the stone curlew (*Burhinus oedicnemus).*

For several of these species European Union action plans have been set up, such as for ferrugineous duck (*Aythya nyroca),* greater and lesser spotted eagle (*Aquila clanga, Aquila pomerania), Bonelli's eagle (Hieraatus fasciatus) and little bustard (Tetrax tetrax).* Read more at the European Commission's website <http://tinyurl.com/35lp27>.

**Map 7. Bonelli's eagle of warm mountains.**




*Source: EEA/ETC BD based on data from European Bird Census Council (2000).*

**Box 7. The Göksu Delta in south-eastern Turkey.**

On the south coast of Turkey, the Göksu Delta is a very important wetland on the migration route of many waterbird species. However, there are many threats to the area from pollution of water, change in water level and impacts from the surroundings.

The area covers more than 23 000 ha (including marine areas) and functions as a refuge for many bird species: when the central Turkish lakes in the Anatolian biogeographical region freeze in winter, 50 000 - 100 000 ducks may use the area. Waterbirds also use the region for breeding. The delta houses a very large part of the population of the purple gallinule (*Porphyrio porphyrio*) of Turkey and also a large population of breeding marbled teal (*Marmaronetta angustirostris*), white-tailed eagles (*Haliaeetus albicilla*) and spotted eagles (*Aquila clanga* and *Aquila pomarina*), white pelicans (*Pelecanus onocrotalus*) and thousands of wintering waterfowl. Around 330 different bird species have been observed in the delta, including globally endangered *Phalacrocorax pygmeus* and *Pelecanus crispus*.

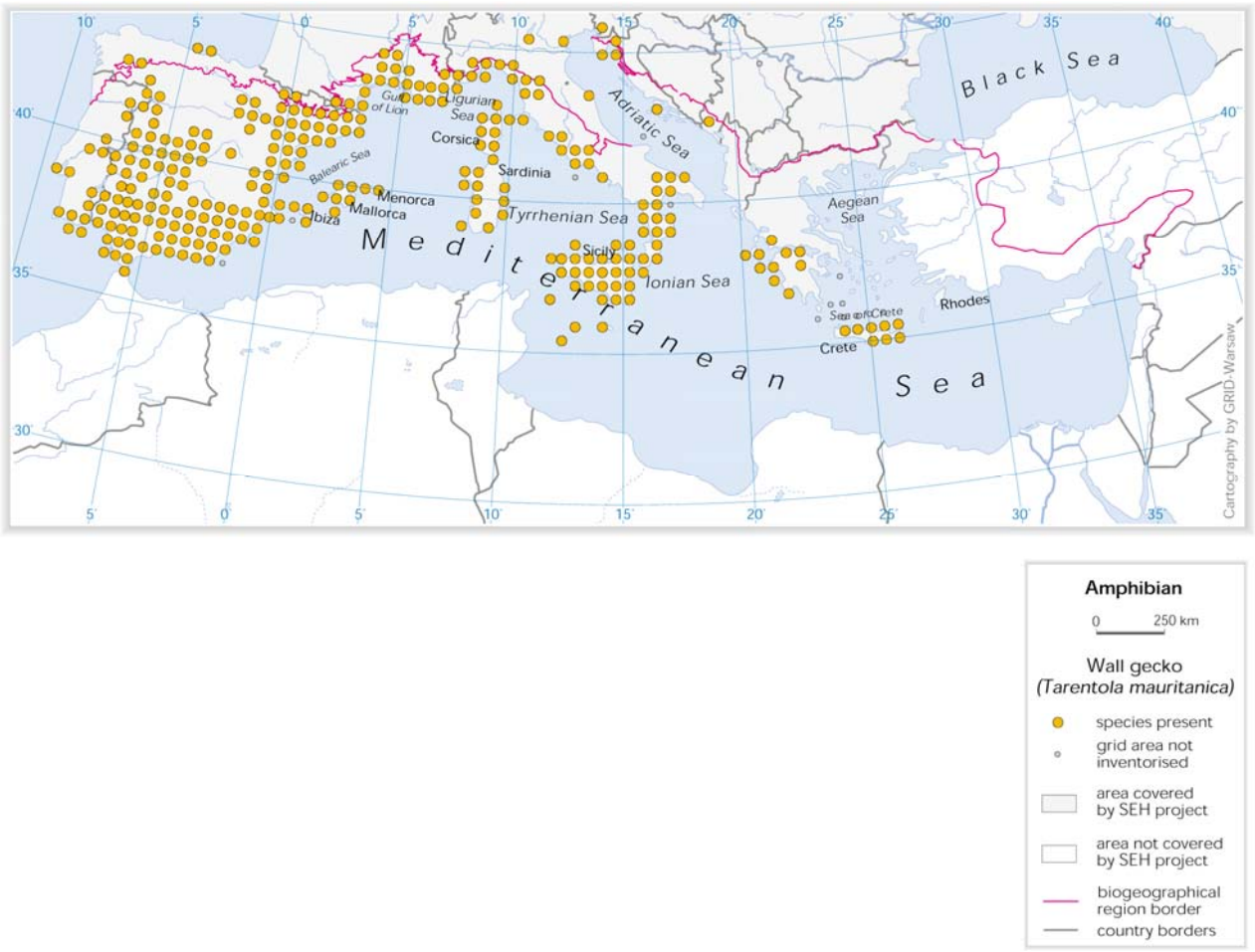
The delta is not only important for birds. 34 species of reptiles and amphibians have been recorded. The marine turtles *Caretta caretta* and *Chelonia myd*a nest on the beaches of the delta.

The delta with its lakes and swamp areas contains vast reed beds and varying fresh and saline conditions but also grasslands and steppic habitats. The wetlands with lakes are estimated to cover more than 2 000 ha, while the sands and steppic areas cover more than the double area.

The Göksu Delta is a nationally important area and a Ramsar site (1994) (Ramsar database; IUCN, 1993).

*Reptiles and amphibians* **–** Due to the need for warm and dry climatic conditions reptiles are mostly concentrated in southern areas of Europe. Many of them are characteristics of the Mediterranean region such as the Montpellier snake (*Malpolon monspessulanus)*, which is found all around the Mediterranean basin, and the wall gecko (*Tarentola mauritanica*) across all western Mediterranean countries and also in some parts of the eastern ones. Several amphibian species are endemic of the Mediterranean peninsulas as Iberian painted frog (*Discoglossus galganoi*) or Epeirus frog (*Rana epeirotica*).

**Map 8. The wall gecko *Tarentola mauritanica*.**




*Source: EEA/ETC BD based on data from Atlas of Amphibians and Reptiles in Europe (2000).*

*Freshwater fish* – The number, diversity and geographic isolation of watersheds in the Mediterranean basin, have favoured a very high species richness among freshwater fish. Most of them live in springs, mountain torrents, lakes and lowland rivers, while a few are restricted to marshes and coastal lagoons. 131 of the 300 (44 %) species are regional or local endemics. Most of these endemics belong to the Cyprinids. Although only four species of freshwater fish have become extinct in recent years, more than 75 % are considered endangered. The main threats to them are habitat destruction through draining, pollution and the introduction of exotic species competing for food or spawning grounds or prey directly upon them. The most problematic invasive fish species for the survival of local fauna are predators such as sheatfish (*Silurus glanis)*, bass (*Micropterus salmoides*) and perch (*Perca fluviatilis*).

*Invertebrates* – The Mediterranean is the richest biogeographic region in Europe on invertebrates: 75 % of the total European insect fauna are found in the basin (Balletto and Casale, 1991). In some isolated mountains and larger islands, endemics may account for 15 – 20 % of the insect fauna, a figure that may rise to 90 % in some caves. As for most other groups, classic refuge areas are mountain ranges.

Butterflies are numerous in the Mediterranean basin, not the least in dry vegetation with many aromatic flowering species. Most butterflies are sedentary and very closely related to a narrow selection of fodder plants. This may make them very abundant when the right plants are available and virtually eradicate them if there are no fodder plants. A

very high number of plant species in the region are dependent on pollination from insects such as butterflies just as the high number of butterflies depends on the plants in a mutual relationship developed over long time. In the region most countries have species numbers well above 200.

Several butterfly species migrate to the European coasts from Africa and further north into other regions, just as several species from the region also migrate northwards in Europe. The migration often occurs in late summer. It is being debated if this is a result of changed climate: better survival conditions in Africa (such as higher humidity) and warm persistent winds from the south, while crossing the Mediterranean Sea: examples are painted lady (*Vanessa cardui*), red admiral (*Vanessa atalanta*), found in both the Continental and the Atlantic regions. Species coming from Africa and the Mediterranean region to other regions are observed trying to migrate back again, but with low success. It is considered possible, that some African species are beginning to establish basic populations in the region, such as in Spain (*Colotis evagore*).

# 2. What is happening to biodiversity in the Mediterranean biogeographical region?

## 2.1 Climate change, desertification and fires

### 2.1.1 Climate change and desertification

Climate change issues have in general been discussed above. In this part desertification and fires are considered.

The climate of the region is presently foreseen to experince a general temperature increase of 2-4° C accompanied by decreasing precipitation, making the region more arid. A decrease in precipitation has already been observed in the whole region and is expected to continue. Despite the decrease in average precipitation, the region has seen a large number of heavy rainfalls during the period of 1990-2007, resulting in flooding landslides and increasing soil erosion (UNEP/Grid Arendal).

Increased aridification and finally desertification can be induced by the dryer and warmer climate alone or by a combination with an intensification of land use, cultivation patterns, choice of species and regimes and demands on water, but also from deforestation and fires.

Though desertification is an even more serious issue in countries south and east of the Mediterranean Sea, the desertification risk is now considered a significant issue in southern Europe: in Portugal and in Spain more than one third of the countries' area is at risk of desertification, and Italy considers that nearly all the country may be vulnerable to effects of desertification. On the Balkan peninsula, the topography is highly variable and the possible effects may have a very high local effect. The Convention to Combat Desertification (See further 3.1) considers that drought and deforestation are two of the major causes of the desertification in Europe. Very severe heat waves and fires in recent years have made the region's drylands increasingly more susceptible, the main problem being destroying and denuding the ground of vegetation (trees and ground vegetation), which anchors the soil and keeps it humid (See 2.2.2 fires).

Symptoms of desertification are seen in a reduction in the biological and economic productivity or value of land and include:

- reduction of crop yields on irrigated or rain fed farmland
- reduction of biomass production and water availability due to a decrease in riverflow or groundwater resources
- encroachment of sand-bodies that may destroy productive land settlements or infrastructure; deterioration of life-support systems. (See also soil erosion in 1.1.2)

In the driest parts of the Mediterranean region the short spring and autumn seasons are critical periods for plant growth and therefore also for many insects and animals feeding off the flowers, fruits and seeds of the plants. Changes in timing and length of these already short seasons may have severe influences. Species adapted to arid and semi-arid conditions will be favoured, while species confined to the mountain ranges' cooler parts may be under the heaviest pressure.

### 2.1.2 Fires

Fires are a major problem in the Mediterranean region. The number and total area of fires have varied over time, but it is only during the last decades that fires have been recorded systematically. From 1980 to 1990 an average of 700 000 hectares (1980-1990) of wooded land including maquis, garrigue, heathland and grasslands, was burnt each year by a total of 60 000 fires, France, Greece, Portugal and Spain accounting for more than half of this total (Turkey not included). In the very dry summers of the first years of this century huge fires consumed large areas in the region. Though fires may be started by lightning, it is considered that today some 95% of the fires in the Mediterranean region are of human origin. Fire presents a significant hazard to humans and to properties, but also influences vegetation and soil in various ways.

The interpretation of the significance of fires is controversial. In the dry and warm climate of the region, fire may be seen as an integral part of the life cycles of ecosystems. Most fires are superficial and will devour the litter layers and the vegetation above ground as well as many trees. Fires do not seem to alter the physical structure of soils below the litter or to destroy their organic matter. Dominant species such as holm and cork oaks show particular adaptability to fire, and a number of other species are pyrophytes (fire tolerant or fire dependent plants). However, animal species above ground will suffer or try to escape. The seriousness also depends on the value of the habitat before the fire (unique old forest, highly productive forest). Fires are most damaging to old vegetated habitats, less to young forests and scrubs, where a new after-growth can rapidly occur. Some forests are dependent on fires occurring in intervals for seed germination. A reduced grazing on forested lands or grasslands will accumulate biomass which in turn can cause more severe fire damage. Deep fires or fires on thin and dry vegetation or where the litter layer is thick may have much deeper effects on the vegetation and soil layers. Where this happens it may lead to soil erosion.

Recuperation after fires depends on the severity and size of the fire, site humidity, the remaining soil and vegetation layer with its seed banks and of the distance to similar areas (re-immigration of species). When fire frequency in the same area is high, there will be no true vegetation succession and the whole fauna and flora of such ecosystems are radically disturbed. However, the effects of fires on the dynamics on forest ecosystems are not always negative. Controlled fires can be used as a management tool to prevent wild fires. Fires started under particular conditions (in winter, with no wind) can be used to reduce undergrowth and litter layers, which are otherwise susceptible to wildfire under hot and/or windy conditions. Whereas unpredictable and uncontrolled fires can cause devastating damage to biodiversity, skilful management of fires as used in the dehesa farming system can even help to enhance biodiversity.

The fire issue is also controversial, because the present vast number of human induced fires are not only ascribed to carelessness with e. g. cigarettes but even to a certain extent been considered deliberate to clear land for other more economically interesting uses. Measures aiming at protection of forests against fire receive support from a number of EU programmes, but also supported by a specific Community regulation in 1992 (EC 2158/92, 804/94) and then during 2004-2006 as part of the Community Forest Focus programme.

## 2.2 Economic use of biological resources

### 2.2.1 Agriculture

Arable agriculture and much of animal husbandry have primarily been concentrated to the southern parts of the region on the best soils and most accessible land. Over the last 50 years there has been a large increase in farming intensity and productivity on optimal agricultural land as elsewhere in Europe. The intensification concerns not only crops such as cereals, but also olive groves, vineyards, citrus and other fruits orchards. Rice growing has increased especially in the surroundings of estuaries or river plains where irrigation water is available.

Some of the highest European pesticide loads on arable land are found in this region (southern France, parts of Spain and Portugal). Water pollution has been shown to affect river, lakes and bogs and fens.

Over the last decades, dry grasslands have been converted to arable land for cereal cultivation and fruit growing, for example in the Crau (France) or in the Ebro Valley (Spain. In Italy, as in other parts of the Mediterranean, dry grasslands formerly maintained by goat grazing have decreased and turned into bushy areas. Agricultural intensification has also resulted in a drastic decline in agro-forestry farming systems (montados and dehesas in Portugal and Spain or in Italian olive groves) (See above under agro-forestry and arid lands in 1.4.2, Box 3 on dehesa and montados).

*Domestication* – Domestication of animals and plants began about 8–10 000 years ago in the Mediterranean basin, especially in its eastern part. The Mediterranean is still exceptionally rich in livestock genotypes, many lineages being very old. The diversity of livestock breeds reflects the diversity of environments, where people selected their animals. Sheep and goats are the domesticated animals that have had the most widespread impact on Mediterranean ecosystems through grazing and browsing. Local traditional systems of dairy sheep and goat production and the region's topography favoured development of genetically isolated populations. Local varieties of sheep and goat occur in almost all the large Mediterranean islands (FAO DAD-IS, Georgoudis 1995).

### 2.2.2 Bird hunting

Trapping, netting and shooting migratory birds on their route between Africa and Europe have been ongoing for centuries in the whole region and is still practised despite regulations. The implementation of national regulations according to the EU Birds Directive (Annex II) in EU countries aim at protecting wild bird species by designation of important areas for protection of birds, but also through control of hunting and other activities. The EU Birds Directive only allows hunting on a limited number of specific birds and only during periods specified bymembers countries. All species should have maximum protection during the time before and under breeding, both for migrating and sedentary birds.

There have been numerous controversies related to hunting since the EU Birds Directive was adopted in 1979. A 'Sustainable Hunting Initiative' was launched by the Commission in 2001 to develop scientific, conservation and awareness raising measures to promote sustainable hunting under the Directive. In 2004, the key partners – BirdLife International and the Federation of Associations for Hunting and Conservation of the EU (FACE) – signed an agreement on ten points which will enable hunting to continue within a well-regulated framework, whilst fully respecting the provisions of the Directive[3].

Box 8. Spring hunting in Malta

Recently (2008) the Commission has taken Malta to the European Court of Justice for allowing the hunting of two species of birds in spring: quails (Coturnix coturnix) and turtle doves (Streptopelia turtur).

The hunting of these migratory birds takes place during their return from Africa to breeding grounds in Europe, before they have had a chance to reproduce. The impact on bird numbers is therefore more significant than it would be in autumn or winter, after the breeding season.

When entering the EU Malta raised this issue and the Commission agreed that a deregation from the Birds Directive would be acceptable, if certain strict conditions are met. This is, according to the Commission, presently not be the case.

Source: EC, 2008

Bird hunting is also regulated within the Bern Convention in very much the same way as for the EU Birds Directive. Also the Bonn Convention and its African-Eurasian Migratory Waterbird Agreement (AEWA) of 1999 on 235 migrating bird species regulates hunting, though there is not yet a wide coverage of countries working under the agreement in the region.

## 2.3 Other major pressures on biodiversity

### 2.3.1 Urbanisation and tourism – The coasts under heavy pressure

The Mediterranean region is the world's most important tourist destination, with more than 30 % of international tourists. The French, Spanish and Italian coasts account for 90 % of the tourists travelling to the Mediterranean, but all other countries are expecting to increase their share in coming years such as the Balkan Peninsula with Greece and the countries along the Adriatic coast. The number of tourists tripled between 1970 and 1990, the coastal parts receiving some 135 million tourists in 1990, with a projected

[3] http://ec.europa.eu/environment/nature/conservation/wildbirds/hunting/index_en.htm

increase to 200-250 million for 2010. It is also forecasted that the area which was occupied by tourist infrastructure in 1984 (4 400 km²) will reach 8 000 km² by 2025.

In Italy, France, and Spain, including the Balearic Islands, large parts of the Mediterranean coastal areas have disappeared under concrete and macadam. On the island of Mallorca (Balearic Islands), for example, 48% of the coastline has been irreversibly "artificialised ". Planned and unplanned hotels, tourism facilities and major roads have led to a major loss of habitats and biodiversity. It has been estimated that since 1960 more than 75% of dune systems have been lost from Gibraltar to Sicily alone. More than 500 Mediterranean plant species are considered threatened by tourism activities. There are still plans to build new roads through protected and unspoiled coastal areas, for example in southern Spain. High tourism numbers also generate increased wastewater and subsequent coastal water pollution, as most towns are not yet well equipped with waste and sewage treatment systems. The quantity of wastewater is expected at least to triple by 2025.

### 2.3.2 Exploitation of wetlands – irrigation

The need for drinking water for the urban areas and water for irrigation in agriculture, fruit and vegetable growing are the main pressures on the water resources of the region. In the dry climate this leads to severe over-exploitation of surface water (changing river flow and lake water volumes) and of groundwater. Because of the economic development and the rapidly increasing population concentrations, the demand for water has often exceeded the available resources in the region in the last decade. Malta, Cyprus, Italy and Spain are recognised as countries with serious water problems (IUCN, 1993, EEA, 2003b). It is estimated that by 2025 one out of every two countries in the Mediterranean will be using freshwater resources in excess of their regeneration rates.

In some areas up to 80 % of the available water is used for irrigation. In Spain and Italy more than 3 million ha are irrigated. The proportion of agricultural land under irrigation is high: more than 19 % in Spain and 18% in Italy.

In rivers, changes in the flow regime and water temperature, depending on reservoir regulation, may detrimentally affect the downstream aquatic communities leading to a reduction of macrophytes and animal richness both of fish and invertebrates, and a reduction of fish biomass, density and growth as well as in the possibilities for migration of fish in the river-lake systems.

The water issues have several different sides:

- drainage of wetlands to make them dry enough for cultivation
- lowering the water table (groundwater, rivers and lakes) to irrigate cultivated areas

and

- irrigation of cultivated land
- building of reservoirs and new lakes to conserve water for irrigation
- salinisation of soils

Extensive areas of wetlands and small ponds have been drained and put under cultivation for example in Andalucia, Tuscany and Languedoc. Large fens have been changed to rice cultivation such as in Portugal. The increasing water demands related to irrigation have influenced the management of rivers such as Bas-Rhone, Guadalquivir and Ebro.

Thus, even though the region is not characterised by its wetlands and water bodies, water is a huge political issue, and water extraction, irrigation or watercourse change plans have caused much political divergences, even among countries in the region. The Spanish National Hydrological Plan (approved in 2001) aims to transfer around 1/3 of the water of Ebro (much of which originate in the Pyrennees) to be used in east- and

southern Spain. The plan has given rise to much controversy and is as yet not implemented. The ecological effects will be on the Ebro ecosystems with less water flow, less nutrients to the Ebro delta, less water surface area, building of a large number of dams and reservoirs (Third World Centre for Water Management 2003). The effects in the receiving areas are not so clear, but many of the large-scale irrigation projects have taken place on areas that are being extensively managed (dehesa in Estramadura in Spain) and are still a serious threat to many remaining dehesa systems.

The coastal wetlands have been used for centuries for fishing, animal breeding, hunting, harvesting of wetland vegetation, mineral exploitation and salt production. Aquaculture (oysters, mussels and fish farms) is more recent and has been expanding rapidly in the last few years. In recent years, drainage and conversion to agriculture, urban and industrial developments as well as tourism and water sports have increased substantially, adding greatly to the rate of wetland loss, much of it through drainage for building land.

### 2.3.3 Contaminants

European mining production increased sharply during the 19th and 20th century. If mining activities are situated at rivers, they often lead to environmental problems in downstream rivers and lakes as a result of the usage of large quantities of water and the discharge of waste products. The less water rivers carry, the more concentrated can problems become if they occur during low water conditions. The most widely known accident with chemical spills in the region concerns the toxic sludge and acid water spill from 1998, impacting on the Doñana wetlands in southern Spain (Box 9).

**Box 9. Mining may threaten inland waters – Experiences from Los Frailes mine and the Doñana National Park.**

In 1998 a chemical spill accident occurred from a broken tailings lagoon at Los Frailes mine near Aznacóllar in southern Spain. The spill of more than 5 000 000 m3 of toxic sludge and acid waters created a serious ecological situation affecting more than 6 000 ha of the Guadiamar river and as well as the wetlands of the Doñana National Park, downstream the mines.

The immediate emergency measures were to prevent as much as possible the polluted water and sludge from entering the park. The follow-up measures concerned securing the mining site against renewed spillage and cleaning up and restoring areas of the park. Not only the park and the river, but also surrounding farmland were polluted as was ground water. The sludge mud contained high levels of toxic chemicals and dried out as a top layer in many of the wetland parts of the park in the first year. The most immediately visible impact was large quantities of dead fish, but after the impact drastically high amounts of toxic metals were found in birds.

In 2000-2001 birds again began using the area after the first cleaning efforts. The park has since then improved thanks to several projects and a large interest, also from international NGOS (BirdLife International, WWF, Wetlands International). Two major projects are running: the green corridor project along the river from mine to park and the Doñana 2005 project, which is a large scale restoration project, covering pollution cleansing, but also a wide range of other tasks from water level and river bank management to tourism facilities. The restoration projects are examples of large-scale collaboration work and funding, which after a slow start may in fact improve an area beyond the status at the disaster.

The Doñana case contributed significantly to inclusion of dangerous mine and quarry waste lagoons into the EU Directive controlling major accident hazards (Seveso II Directive) in 2003.

The Doñana National Park (50 000 ha) is situated at the river Guadalquivir at its estuary

on the Atlantic Ocean. It houses a large variety of habitat types, from lagoons and marshlands (ca 50 %, with calcium and magnesium rich clay) to dunes and sclerophyllous woodlands and maquis on sand. The lagoons and the winter-flooded marshlands create favourable conditions for migrating water birds, which made the area one of the most important wintering sites for water birds in the region. Before the accident ca 365 bird species were recorded, including the Spanish imperial eagle. It is one of the largest flamingo feeding areas (up to 20 000 individuals) of the region and contains several geese and duck species in numbers of more than 100 000, being the most important area for wintering ducks in Spain. The fauna also covers fish, amphibians, reptiles and mammals, among these the Iberian lynx (*Lynx pardinus*) in one of its last breeding sites. The lynx is the vertebrate closest to extinction in Europe (less than 200 still alive). It has in the last years been even more decimated due to an infection.

The park is a UNESCO-MAP Biosphere Reserve as well as a Ramsar site, a UNESCO World Heritage site and a Natura2000 site (WWF web site Spain, European Commission, DG Environment, LIFE projects, UNEP-WCMC protected areas web site).

## 2.3 Alien species

Just as the region is an important centre of origin of many plants taken into use and cultivation (see 1.4.1 on wild relatives), it is at the same time also the region into which a very large number of vascular plant species have been introduced for cultivation and production or accidentally as weeds in connection with agriculture, forestry and horticulture, or via transportation of goods. This process has been going on for so many centuries, that it may now be difficult to discern which species should be considered natural (after long term naturalisation) and which are recent aliens. Many have only become naturalised to a limited extent or have become natural components of for instance the scrubs. Examples are *Ailanthus altissima* (Tree of heaven, Asia) *Acacia dealbata* (winter mimosa trees, widely on acid soils, from Australia) and *Robinia pseudoacacia* (Black locust, USA, widespread tree), *Carpobrotus acinaciformis* (a herb widely spread in coastal areas, from the Cape region in south Africa), *Cortaderia selloana* (Pampas grass from South America, widely adaptable), several *Opuntia* cactus species. *Eucalyptus* trees may with warmer climate become naturally spreading also.

# 3. Policies at work in the Mediterranean biogeographical region

## 3.1 Nature protection

### 3.1.1 International agreements

The Mediterranean biogeographical region is covered by several types of international collaboration, where biodiversity is an important issue: Global, pan-European, Mediterranean Sea and surrounding countries and European Community collaboration. Below some of the most important relevant agreements and processes are briefly mentioned[4].

*The UN Convention on Biological Diversity (CBD)* is signed by all countries of the region as well as by the European Community[5].

*The Convention on Wetlands (The Ramsar Convention)* is signed by all countries of the region[6].

*The Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn Convention)* is signed by all countries of the region and by the European Community[7].

*The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, Washington Convention)* is signed by all countries of the region and CITES is implemented in European Community legislation[8].

*The Convention on the Conservation of European Wildlife and Natural Habitats (Bern convention)* under Council of Europe) is signed by all countries of the region and by the European Community[9].

*The Convention to Combat Desertification*[10] offers to northern Mediterranean countries a framework for mutual cooperation and more effective national action. In addition to intra-regional cooperation, the Annex IV calls on its members to cooperate with other regions and sub-regions, particularly with the developing countries of Northern Africa. Dryland degradation has been observed for years in Africa and other regions, but has been increasing in Europe.

*The UNESCO World Heritage Convention*[11] aims at protecting the world's cultural and natural heritage.

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[4] For an update of the EU biodiversity policy and legal measures see http://ec.europa.eu/environment/nature/index_en.htm
[5] See further http://www.cbd.int/
[6] See further http://www.ramsar.org/
[7] See further http://www.cms.int
[8] See further http://www.cites.org/ , http://europa.eu/index_en.htm
[9] See further http://www.coe.int/t/dg4/cultureheritage/conventions/bern/default_en.asp
[10] See further http://www.unccd.int/

[11] See further http://whc.unesco.org/en/about/

*The Pan-European Biological and Landscape Diversity Strategy (PEBLDS)* facilitates cooperation among countries of all Europe in order to stop and reverse the degradation of biological and landscape diversity values[12].

*The Barcelona Convention*[13] includes the Mediterranean region and aims at protecting the environment and to foster development in the Mediterranean Basin. It was adopted in Barcelona, Spain in 1975, under the auspices of UNEP. From the Mediterranean region all countries bordering the Mediterranean Sea, Portugal (which borders only the Atlantic Ocean) and the European Community participate. The current programme of activities includes: Pollution Assessment and Control; Marine Conservation; Coastal Areas Management; Mediterranean Environment and Development Observatory.

### 3.1.2 Protected areas

Areas designated for nature protection may be protected by national legislation as well as under international instruments.

#### 3.1.2.1 Internationally protected areas

Several of the international and European Community instruments lead to area-based protection of nature.

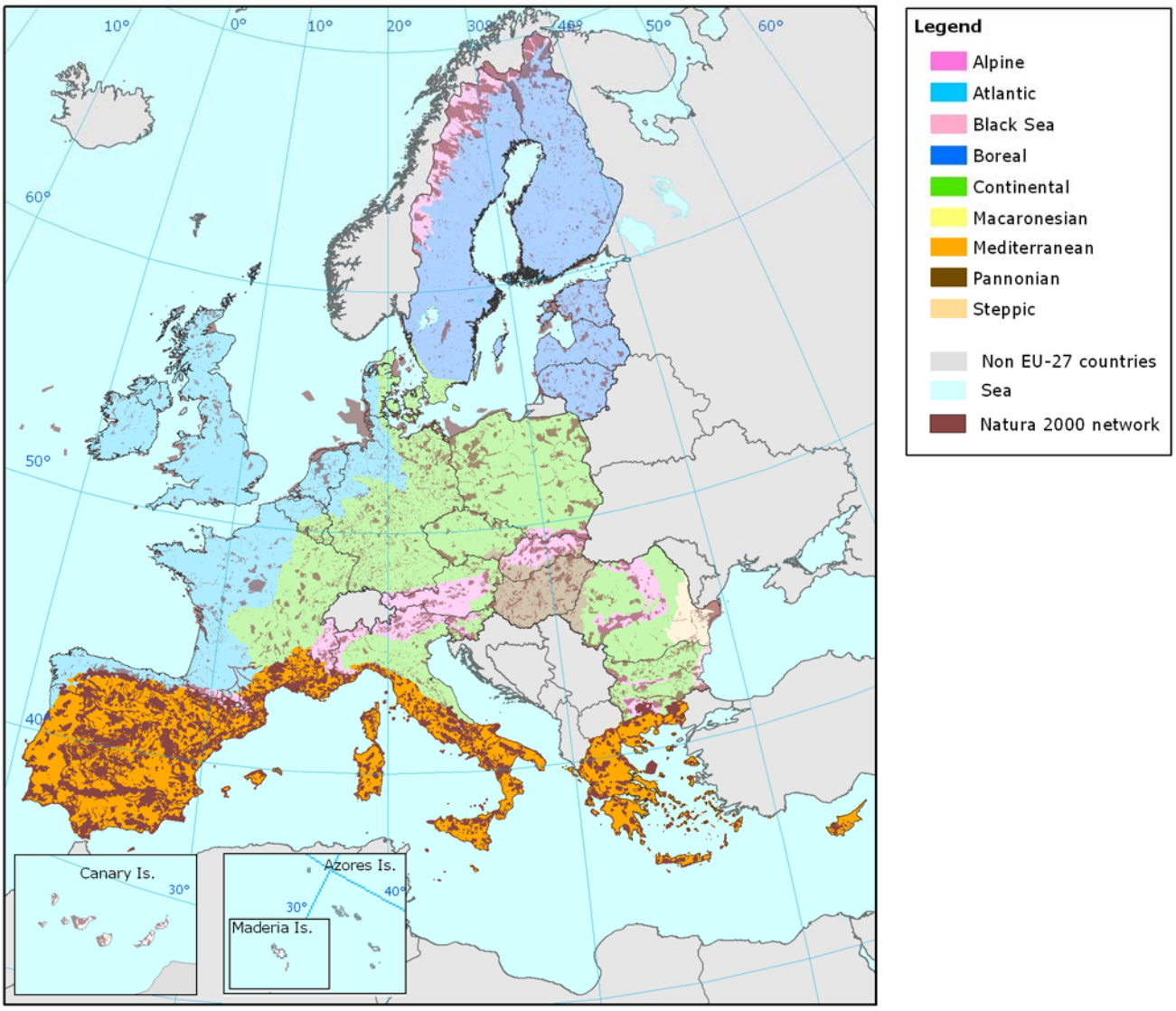
*Ramsar sites:* In the Mediterranean region a number of sites have been designated under the Ramsar convention, mostly focused on larger wetlands such as lakes and deltas (Ramsar database). As mentioned above, all Ramsar sites in the EU countries are also NATURA2000 sites.

*UNESCO World Heritage sites and Biosphere reserves:* Nearly all countries have sites designated in the UNESCO list of World Heritage sites as well as Biosphere reserves under UNESCO's Programme on Man and the Biosphere. The Biosphere reserves in this region, which must 'encompass a mosaic of ecological systems' comprise – in addition to marine areas- mostly wetlands, undisturbed grasslands or mountains.

*European Community NATURA2000 Network:* The Mediterranean list of sites of Community Importance was adopted in 2006. A considerable number of species and habitat types in the Mediterranean region are identified to be of European conservation concern by the EU Habitats and Bird Directives. Under the Birds directive 999 sites have been designated in this region, covering about 147 358 km2. Under the EU Habitats Directive are in the Mediterranean region designated 2928 sites covering 188 580 km².

[12] See further http://www.peblds.org/
[13] http://www.unep.ch/regionalseas/regions/med/t_barcel.htm

Map 6. NATURA 2000 network in the Mediterranean region

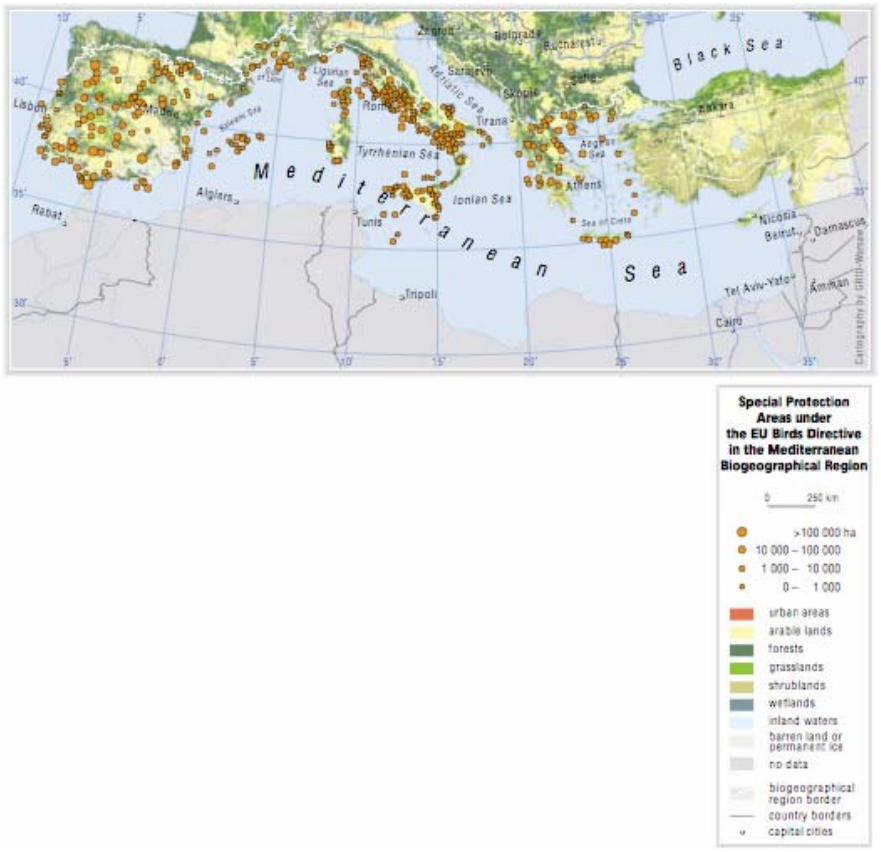



*Source: EEA/ETC BD compiled fromNATURA 2000 database (November 2008).*

*The EMERALD Network:* The designation of sites under the EMERALD Network of the Bern Convention is based on the same principles as Natura 2000, and represents its *de facto* extension to non-EU countries.

*LIFE-Nature* is the European Community funding programme for nature projects, with a significant number of site restoration or species and habitat activities in this region. Box 10 and 11 show examples of many projects on one species and projects with short and long-term aspects. The LIFE-Nature database contains information about all projects supported, but not information about the outcomes (European Commission, DG Environment, LIFE-Nature web site).

**Map 9. Specially Protected Areas (SPAs) under the EU Birds Directive. Only for EU-15 Member States of the region.**




Source: EEA/ETC BD compiled from European Commission birds Directive database (2001).

**Box 10. Little bustard *Tetrax tetrax* – LIFE-Nature projects.**

The world population of the little bustard (*Tetrax tetrax*) is largely concentrated in Europe, where it was widespread. The species has undergone very severe decline because of loss of undisturbed and varied dry grasslands and traditional and mosaic agricultural landscapes with ranges for sheep grazing and extensive crop farming. It cannot exist in intensive large scale agriculture with irrigation or afforestation. It is estimated that the total population is somewhat above 100 000.

Little bustard is partly sedentary, partly migratory. It exists in two distinct areas: a western (around 50 % of the total population) mainly on the Iberian Peninsula but also in some areas in southern France, Sardinia and in southeastern Italy (Apulia), and a smaller eastern area northeast of the Sea of Azovsk in the steppic region, while it is extinct in Turkey.

Little bustard is protected under the Bern Convention, and Council of Europe in 2001 agreed on a pan-European action plan. It is also protected under the EU Birds Directive (EU-15), where the eight LIFE-Nature Programme projects from 1996 to 2002 are an example of multiple actions to protect one species.

Source: http://ec.europa.eu/environment/life/index.htm

**Box 11. LIFE-Nature program for the protection of turtles in Greece.**

Loggerhead turtle (*Caretta caretta*) is a circumglobal species inhabiting the temperate, subtropical and tropical waters of the Atlantic, Pacific and Indian oceans but the major nesting areas are located in warm temperate and subtropical regions. Mediterranean beaches are the only place in Europe where loggerhead turtles breed. It is a priority species for protection under the EU Habitats Directive (annex II).

Now Greece has the most important breeding area in the Mediterranean area, where about 3 000 clutches of eggs are laid on the beaches every year between May and August. Incubation takes 45–65 days. Only 1–2 % of all hatchlings survive to maturity on the beach. When the turtles are at sea, they fall victim to entanglement in nets or to killings by fishermen, making the species survival very precarious.

The most important instrument in protection has turned out to be to create public interest and awareness as well as to create interest among fishermen and tourism agencies. The success, however, hinges on the continued dedicated local work by a combination of volunteers, public authorities and tourism agents. The projects have mostly protected hatchlings. The long-term success will only be seen when the adult animals return to breed in 20–30 years.

Several breeding site projects in Crete and in Peloponnesos have been supported by LIFE-Nature. Other LIFE-projects where loggerheads are involved concern e.g. the Balearic Islands and Sicily.

Source: http://ec.europa.eu/environment/life/index.htm

#### 3.1.2.2 Nationally protected areas

All the countries in the region have a wide number of areas under national protection. Data on nationally protected areas is a priority dataset for countries collaborating with the European Environment Agency. It is updated annually. The information is not available for the region as such, but all data for the EEA countries can be found in the web based EUNIS database and EEA data service[14].

### 3.1.3 Red lists

IUCN's Red List 2006 holds information by country on the global scale of many species[15]. However, there is no Red List for the Mediterranean region as such. Many countries in the region have now developed national red lists of threatened species. The number of species groups considered varies from mammals and birds to a wider number of groups. An overview of red lists is kept by the European Topic Centre for Nature Protection and Biodiversity[16].

[14] http://eunis.eea.europa.eu/
[15] http://www.iucnredlist.org/
[16] http://biodiversity.eionet.europa.eu/

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