

European Environment Agency

Europe's biodiversity

– biogeographical regions and seas

Biogeographical regions in Europe

The Macaronesian region

– volcanic islands in the ocean

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Summary

- The Macaronesian biogeographic region comprises volcanic islands in the Atlantic Ocean, in three archipelagos, the Canary Islands, Madeira and the Azores
- The regions' climate is heavily influenced by the ocean
- Large differences in habitats and species diversity among islands and groups of islands
- The laurel forest of Madeira, a unique habitat, is now protected
- High level of endemism, both in plants and animals
- High level of impact on biodiversity from agriculture and tourism industry
- Several endangered species, especially among sea birds

1. What are the main characteristics of the Macaronesian biogeographical region?

1.1 General characteristics

The Macaronesian biogeographical region is comprised by volcanic islands in the Atlantic ocean and includes the archipelagos of the Azores, Madeira and the Canary Islands.

- The archipelago of the Azores consists of nine islands halfway between the American and European continents and covers around 2 300 km²
- Madeira, Porto Santo, and the Desertas cover 800 km² of land located 750 km west of Morocco
- The Salvage Island, only covering 4 km² is located between Madeira and the Canary Islands
- The Canary Islands comprise seven main islands 100 km off the coast of Africa. With its 7 200 km² it constitutes 75 % of the region

Table 1: Statistics for the Macaronesian biogeographical region

Surface area (km ²)	Number of countries in region	National composition by area	Population (people/km ²)	Main habitat types
10 372	2	ES 69 % (Canary Islands) PT 31 % (Azores and	203	evergreen broad-leaved forest, deserts and uplands (ca 74 %)

		Madeira)		
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Sources: Sunyer (2000) and various sources by ETC/NPB and EEA.

Note: ES: Spain, PT: Portugal.

The area considered in this chapter is the European Macaronesian biogeographical region as defined by the European Commission and the Council of Europe for evaluation and reporting on nature conservation.

1.1.1 Topography, geomorphology and climate

The volcanic islands of Macaronesia cover an array of landscapes ranging from deserts and xerophytic scrubs in arid and rocky areas in the eastern Canary Islands to humid mountain evergreen broadleaf forests and sand dunes in Madeira and the Azores.

The three archipelagos differ substantially. In the east, the Canary Islands Lanzarote and Fuerteventura are arid and rocky, low lying and vegetated with xerophytic scrubs (macchia/phrygana). The western Canary Islands are more mountainous with altitudes reaching over 2000 m and harbouring extensive coniferous as well as laurel forests.

In Madeira, the terrain is generally rugged, with a mountain ridge running east-west. The eastern part is very steep with inaccessible cliff areas. The western part is lower and hosts a high plateau with numerous gorges.

The most westerly archipelago, the Azores, is not so rugged. The landscape of these islands has prominent river valleys in eroded volcanic rocks as well as vast lava flows and active volcanos.

A distinguishing feature of the region is the historic and present importance of the volcanic activity, with resulting special landscape components such as steep mountain sides and lava flows. The highest mountain peak in the region is Pico de Teide (on Tenerife, Canary Islands) reaching 3 718 m. The area is geologically young and still active, the island El Hierro is only 750 000 years old, and volcanic eruptions have occurred in the region also in recent times. The ongoing seismic activity and recent eruptions, together with high-reaching mountain peaks creates an extremely complex and varied landscape.

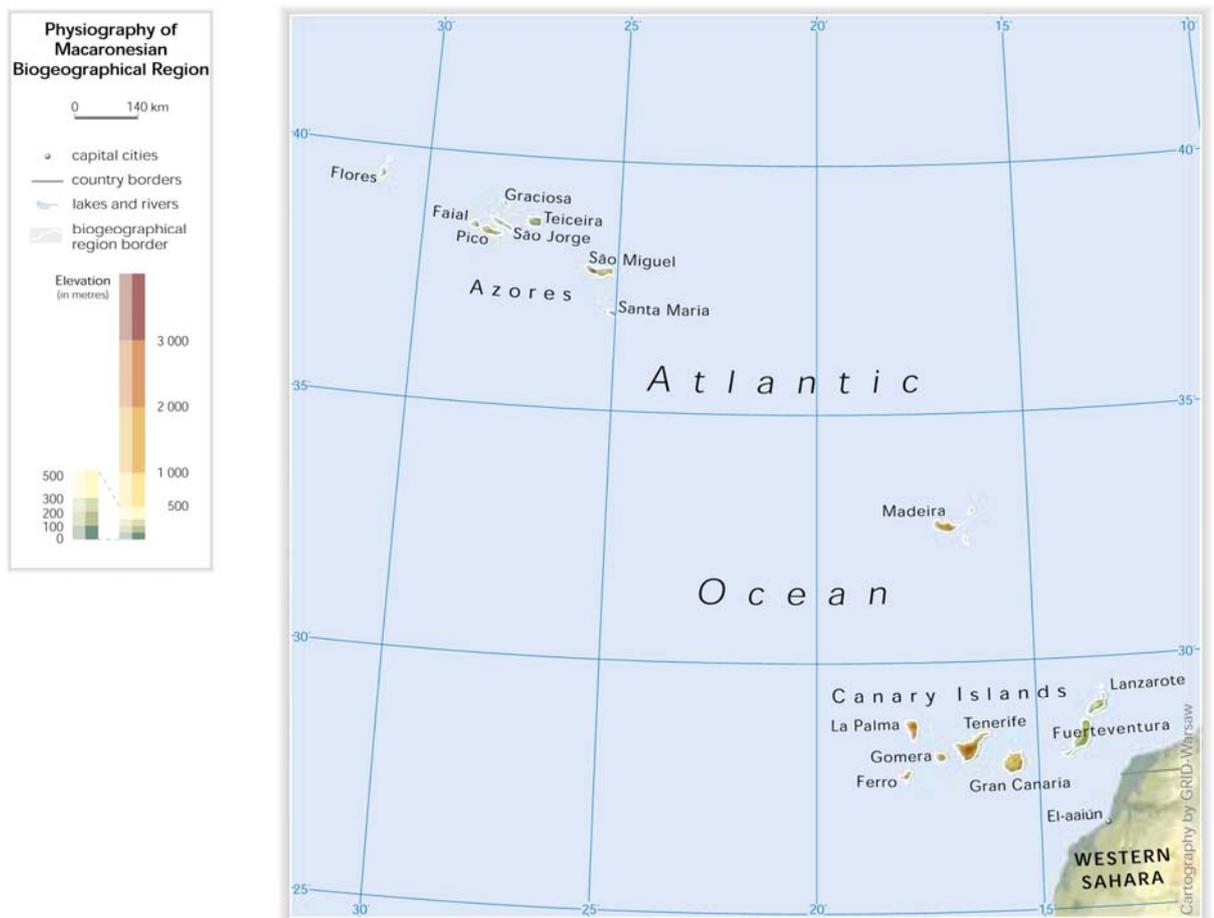
A typical Mediterranean climate dominates in the subtropical islands of Madeira and the Canary Islands, with key features as low seasonal variation in temperatures and low amounts of precipitation (rarely more than 250 mm concentrated in November–December) and generally dry conditions. Wind exposure and mountain peaks are prominent factors allowing the development of climax communities of native species and evergreen forests by creating a cloud layer at ca 1 000 m altitude by a combination of high dry winds and lower humid sea breezes. At higher altitudes, both frost and snow may occur.



View of a Macaronesian dry habitat with shrub vegetation. Photo: Biofoto.

The Azores, strongly influenced by its oceanic location, are climatologically different from Madeira and Canary Islands with high precipitation and high humidity. Precipitation shows a prominent east-west gradient with substantially higher annual rainfall in the westerly islands.

Map 1: The Macaronesian region physiography



Source: UNEP/Grid Warsaw.

1.1.2 History and influence of human presence

The Canary Islands have a relatively long history of human occupation. The Guanches brought domesticated animals (goats, pigs, dogs and possibly sheep) and culture plants (barley, beans, peas) from the mainland to the islands about 4 000 years ago, while Madeira and the Azores were uninhabited until the early 15th century.

The rich volcanic soils and a favourable climate allowed a rapid expansion of areas used for agriculture production for export. By the end of the 15th century, Madeira was the worlds' leading producer and exporter of sugar. Other products included wheat, wine, maize and sweet potatoes. The expanding agricultural industry had a major impact on topography and original biodiversity. Large native areas, including forests, were transformed into cultivation (at places to monocultures of sugar cane) and extensive irrigation systems were constructed to bring water from mountainous areas to dry lowlands.

The introduction of grazing animals, especially rabbits, has had a particular devastating effect on the ecosystems of the islands. Fragile forest ecosystems have been irreversibly degraded. The original vegetation of low-lying islands composed by *Phoenicia juniper*, *Dracaena draco* and *Appolonias barbujana* is no more present.

Agricultural activities also developed on the Azores, islands which became important as a stop-over for transatlantic crossings.

1.2 Main influences on biodiversity

The main influences on biodiversity in the Macaronesian region are:

- Growing human population and tourism
- Agriculture
- Forestry
- Alien species

1.3 Main political instruments

Main political instruments

The main international organisations and policy instruments of direct importance for biodiversity of the Macaronesian regions are:

At international level:

- the Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat)
- the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals)
- the Convention on Biological Diversity (CBD) with the Ad Hoc Technical Expert Group on Island Biodiversity (ATHEG) and its Canary Island Declaration for Protecting Island Biodiversity from the Impacts of Alien Species
- the Man And Biosphere programme with the IBSICA - Integrated Biodiversity Strategies for Islands and Coastal Areas project and the network REDBIOS

At European level

- the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats)

At EU level

- EC Birds and Habitats directives and the Natura 2000 network

Two INTERREG III projects:

- ATLANTICO – The development of a Macaronesian Biodiversity Data Base
- CENTINELA – Monitoring and Planning Endangered Species of Macaronesia

1.4 Biodiversity status

1.4.1 Ecosystems and habitat types

The three main habitat types of the Macaronesian region are:

- coastal; very varied with ravines, freshwater outlets, steep rocky shores and dunes of volcanic sand influenced by the ocean and local wind conditions
- evergreen forests; remnants of humid evergreen broad-leaved forests and dry evergreen pine forests in the Canary Islands
- upland vegetation; high-altitude habitats, influenced by severe climate as large differences in temperature and strong dry winds

The distribution and biological components of different habitat types in the Macaronesian biogeographical region are heavily influenced by altitude and local climate.

Table 2: Main habitat types in the Macaronesian biogeographical region, as defined by EUNIS (European Nature Information System) habitat classification

Inland sparsely vegetated or unvegetated habitats	Heathland and scrub habitats	Woodland and forest habitats and other wooded lands	Cultivated habitats and gardens
34 %	25 %	15 %	14 %

Sources: ETC/NPB.

The habitats found in the Macaronesian region can be grouped into three main vegetation types: coastal habitats, evergreen forest and uplands. In the Canary Islands and Madeira, natural habitats are closely linked with altitude, with many key species occurring in narrow belts.

1.4.1.1 Coasts and islets

The coastline of the Macaronesian region is varied with cliffs falling to the sea, ravines and outlets. Gran Canaria and Tenerife have sand dunes in the south while Madeira has the 630 m high Cabo Girao – one of the highest sea cliffs in the world. Smaller islands, like La Graciosa, are mountainous and heavily influenced by wind and hosts a seasonal vegetation.

The herb and shrub vegetation of Madeira is fully developed at altitudes above 300 m. It is broken by urban development areas and land used for agriculture purposes. The shrub area is not always present and introduced species like cactus (*Opuntia tuna*), gorse (*Ulex europaeus*) have replaced indigenous species like globe daisy (*Globularia salicina*) and spurge (*Euphorbia piscatoria*).

Shallow bays, reefs and marine caves are found in the archipelago of the Desertas. Here a rich and important endemic flora can be found as well as the monk seal (*Monachus monachus*), marine birds and tarantulas.

Flat fertile areas ('fajas'), with a plant community dominated by grasses, mainly the endemic *Festuca petraea*, are found around the Azorean coastline. The fajas are influenced by wave actions, lava streams and depositions of volcanic ash. The numerous introduced species in the area mainly occur in the coastal zone and in connection with human settlements.

Coastal cliffs and islets are important as breeding habitats for pelagic birds. Cliffs in the Macaronesian region offer breeding grounds for among others Cory's shearwater (*Calonectris diomedea borealis*), Manx shearwater (*Puffinus puffinus*) and little shearwater (*P. assimilis*). Islets also serve as staging areas for a number of migrating birds. Birds stopping over during migration are a natural food source for breeding raptors, e.g. Eleonora's falcon (*Falco eleonora*).

The Habitats Directive in Macaronesia

Annex I of the Habitats Directive (92/43/EEC) lists in total 198 habitat types of which 38 Annex I habitat types are found in the Macaronesian region, nine of which are priority. The proportion of habitats types among the two member states is similar; 23 habitats (seven priority) are found in the Canary Islands and 28 (nine priority) in Madeira and the Azores.

1.4.1.2 Desert ecosystems

The arid regions of Europe have mainly arisen due to human activities. Original vegetation has been cleared, leaving the light soil exposed to wind and sunlight. In the Canary Islands, the desertification was enhanced by a lowered water table due to water extraction or tapping springs. The resulting halophytic vegetation has been overgrazed by livestock (especially goats) leaving the soil bare.



Opuntia sp. growing in volcanic sand.
Photo: Biofoto.

In desert ecosystems, a high proportion of the biomass of the system occurs in soil organisms and to extensive root systems of shrubs. Vegetation of desert systems in the Macaronesian region are dominated by the plant families *Euphorbiaceae*, *Asteraceae*, *Caryophyllaceae*, *Crassulaceae* and *Fabaceae*. In the region we find these systems in parts of the Canary Islands. The Canarian deserts represent an outpost of an arid vegetation zone extending from India to Mauretania. The area in Macaronesia hosts several endemic species or subspecies among them Purpurian lizard (*Lacerta atlantica*) and the Canary Islands chat (*Saxicola dacotiae*). The most threatened bird species in this arid zone is the Houbara bustard (*Chlamydotis undulata*), with a race endemic to Fuerteventura and Lanzarote.

1.4.1.3 The evergreen forests

The humid evergreen laurel forest and the dry evergreen forest – now confined to the Canary Islands – are characteristic for the Macaronesian region. The most ancient elements, including ancient endemics, are found in the laurel forest.

The evergreen humid forests – the Laurisilva

The laurisilva forest develops in areas with reduced solar radiation, moderate temperatures, high precipitation (500–1 200 mm) and presence of fog and is especially rich in deep, extensive ravines. Tree trunks are generally covered by a

thick carpet of mosses and lichens and is usually colonized by ferns. The dominant trees are Canary laurel (*Laurus azorica*), Madeira mahogany (*Persea indica*) Acotea (*Ocotea foetens*). In Madeira, the forest is also characterised by the presence of the endemic lily of the valley tree (*Oxydendrum arboreum*). The laurel forest in the Azores also has a presence of juniper (*Juniperus brevifolia*) and Azorean heath (*Erica azorica*). The islands Sao Miguel, Pico and Terceira have the largest remnants of this unique laurel-juniper forest. On other islands, remnants are mostly found in caldeiras and deep ravines.

The unique humid evergreen forests in the Macaronesian region are today degraded. Human activities have decreased their coverage from an original 60 % in Madeira to the present ca 20 % (15 000 hectares). The same reduction in area of this type of forest has also been recorded in other islands. In Tenerife, the humid forest today covers less than 20 %, in Gran Canaria 1 % and in the Azores 2%.

The dry evergreen forest

The combination of high solar radiation, high temperatures, low precipitation and sporadic sea fogs are pre-requisites for the development of the dry evergreen forest of Macaronesia, today exclusive to the Canary Islands. A number of endemics are found in this habitat: holly (*Ilex canariensis*), Azorean candleberry (*Myrica faya*) and willow (*Salix pedicellata*).

At lower altitude the forest hosts species of both Mediterranean and North African origin, such as *Pistacia atlantica* and *Juniperus phoenicia*, or endemic species like the Canary palm (*Phoenix canariensis*) and *Dracaena draco*. At levels over 400 m above the sea level forests are harbouring species like yew (*Erica scoparia* ssp. *platycodon*), Canary pine (*Pinus canariensis*), with an undergrowth of *Cistus montepeliensis*, *Cistus symphytifolius* and *Chamaecystus proliferus*.

1.4.1.4 Uplands

At dryer places and altitudinally above the laurisilva forest a pine forest belt is found. Here the endemic Canary pine (*Pinus canariensis*) grows together with tree heath (*Erica arborea*), *Cistus*-species and the endemic escabon (*Chamaecystus proliferus*). The higher part of this belt hosts the endemic *Juniperus cedrus*.



Erica arborea, tree heath, is a common species in the dryer uplands of the Macaronesian region. Photo: Biofoto.

This forest type provides breeding habitats for the blue chaffinch (*Fringilla teydea*).



The blue chaffinch *Fringilla teydea* is endemic to the Canary Islands and comprises two subspecies, one found on Tenerife (F. t. *teydea*) and the other on Gran Canaria (F. t. *polatzeki*). Its habitat is Canary pine (*Pinus canariensis*) woodland which is listed in Annex I of the EU Habitats Directive. Although there has not been a census of the Tenerife population, its situation is thought to be stable, while the estimated population on Gran Canaria is 185–260 birds, which means that the latter subspecies is classified as endangered both nationally and internationally.

Source:

http://europa.eu.int/comm/environment/nature/nature_conservation/focus_wild_birds/species_birds_directive/birdactionplan/fringillateydea.htm

At even higher altitudes (above 2 600 m), one finds a unique xerophytic and cold-resistant vegetation with the endemic Teide violet (*Viola cheiranthifolia*).

In Madeira, the upland vegetation occurs above the limit for the evergreen forest. It is characterised by high differences in temperature, intense winds, high precipitation and even snow. Most plant species are in danger of extinction. This ecosystem hosts several endemics; Madeira heath (*Erica maderensis*), a violet (*Viola paradoxa*) and Madeira trift (*Armeria maderensis*).

1.4.1.5 Mires

The humid climate at high altitudes of the Azores allows the development of several types of mires. Bogs, fens and forested peat bogs – covering an area of 2 100 hectares – are found on Sao Miguel, Terceira, Pico, Faial, Sao Jorge and other islands. Mires hosts several endangered species, among them juniper (*Juniperus brevifolia*), Azorean heath (*Erica azorica*) and fern species (e.g. *Culcita macrocarpa*).

Data are not available for assessing earlier extensions of mires, but recent human activity, including forestry and agriculture, has decreased the area of mire habitats. However, certain areas are still not influenced beyond repair and restoration is still an option.

1.4.1.6 Inland waters

The Canary Islands have no permanent rivers, but Madeira has a large number of small rivers, streams and springs. Rivers and streams in the north of Madeira flow permanently, while southern rivers normally become dry in summer. In addition to natural water courses, a network of conduits and tunnels – the levadas – collect and transfer rainwater to farms and gardens. The levadas on Madeira is estimated to have length of 700 km on an island that is 60 km long.

1.4.1.7 The Macaronesian Sites of Community Importance

The total surface area of the Sites of Community Importance officially adopted under the Habitats Directive is 5 340 km² (3 292 km² in terrestrial areas and 2048 km² in marine areas). Therefore, 39 % of the terrestrial area of the Canary Islands, 29 % of the Madeira and 10 % of the Azores contribute to the Natura 2000 network.

Table 3: The Macaronesian Sites of Community Importance (SCI)

	Macaronesian region		Sites of Community Importance adopted by EC in December 2001				
	Area (km ²)	% of the region	Number of sites	Total area (km ²)	Marine areas (km ²)	Terrestrial areas (km ²)	% of terrestrial area
Canary Islands	7 242	70	174	4 573	1 760	2 813	39
Madeira	797	8	11	431	Ca 200	231	29
Azores	2 333	22	23	336	88	248	10
Total	10 372	100	208	5 340	2 048	3 292	32

Source: ETC/NPB and EEA.

1.4.2 General species richness and endemism

A diverse landscape and lack of direct effects of glaciation makes the Macaronesian archipelago a hotspot for biodiversity in Europe. Further, the volcanic origin of the islands and the fact that they have never been directly connected to any mainland are reasons why the region also hosts a large number of endemic plant and animal species. A considerable number of the endemics are ancient relict endemics, with a great affinity with Tertiary flora and fauna. For some species groups the level of endemism is remarkably high, for plant species the highest in Europe. The isolated location of the islands and the moderating effect the ocean has on the climate further strengthen the development of a unique flora and fauna. This taken together has allowed the biological diversity to escape significant alterations.

Recorded differences in flora and fauna among islands can be attributed to trade winds, distances to source areas for dispersal from the mainland and differences in human history and settlements for the islands in the region.

Table 4: Endemic species in the Macaronesian biogeographic region as listed in Annex II of the Habitats Directive

Region	Plants	Plants priority	Animals	Animals priority
Canary Islands	66	35	6	2
Madeira	46	10	18	2
Azores	26	6	2	1

Source: EU/ETC.

Note: Priority species are species for which the Community have particular responsibility because a high proportion of their natural range falls within the EU territory.

Endemism and disjunct species distributions

Endemism is a term indicating a restricted distribution of a species. A species that is indigenous in a single, naturally restricted area – like a mountain top, an island, a gorge – or in a floristically/faunistically uniform region – is termed endemic. Endemism can arise as a result of evolutionary processes, where the species has evolved in a certain area from which it has not – or cannot – spread. Endemism can also be the result when a formerly more widespread species has withdrawn to a restricted geographical area where competition is less severe or where the habitat is more favourable. Endemism is however a relative term. The emu is endemic to Australia, common beech (*Fagus sylvatica*) is endemic to Europe and the plant *Canarina canariensis* is endemic to Canary Islands. Species may also have disjunct distributions, with two or more separated and clearly restricted areas of occurrence.

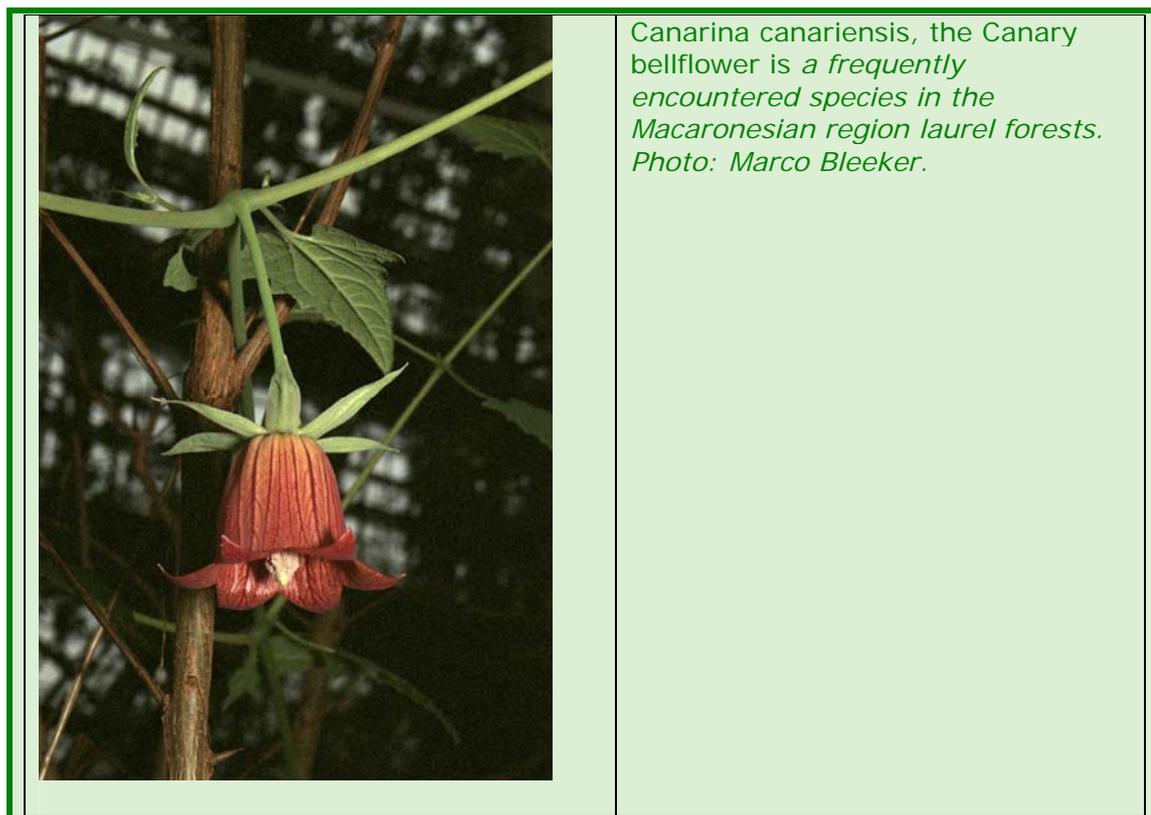


Table 5: Species of European importance in EU-15 Member States in the Macaronesian biogeographical region. Birds Directive, Annex I and Habitats Directive, Annex II

Number of all Habitats Directive Annex II species and sub-species present in the EU-15 Member States in the Macaronesian biogeographical region	150
Mammals	4
Reptiles	4
Amphibians	0
Fishes	1
Invertebrates	13
Vascular plants	124
Mosses/Liverworts	4

Source: ETC/NPB.

1.4.2.1 Plants

The remote and isolated location of the islands has allowed a whole series of the Tertiary subtropical flora to still exist in the Macaronesian region. This includes many tropical plant families, such as the palm family (*Arecaceae*), the sapote family (*Sapotaceae*) and the tea family (*Theaceae*) as well as a number of species

in the laurel and olive families (*Lauraceae* and *Oleaceae*).

The Macaronesian region hosts a high number of plant species and especially endemics. In this region, the Canary Islands are outstanding in terms of endemism. Of the 5 452 plant species recorded (2 176 vascular species), 705 vascular plant species are endemic, constituting a 32 % endemism. This figure is the highest estimated in Europe and surpassed only by Galápagos and Hawaii. A majority of the endemics are ancient relict endemics with their greatest affinities in the Tertiary flora. A characteristic feature of these species is that they are systematically isolated or have systematic relatives in remote geographical areas. A Macaronesian endemic, the Canary Island pine (*Pinus canariensis*) is closely related to chin pine (*P. roxburghii*) in the Himalayas. Further, the endemic adorno (*Heberdenia excelsa*) is closely related to *H. penduliflora* in Mexico. Most of the endemics are found among trees and shrubs and fewer among annuals.

Table 6: Number of species in selected taxa in the Canary Islands.

Vascular plants	Marine algae	Fungi	Lichens	Bryophytes
2 176	613	1 200	1 000	463

Source: ETC/NPB and EEA.

Note: For fungi and lichens the figures are estimates.

Also Madeira and the Azores have an interestingly high level of endemism of plants, though lower than that of the Canary Islands. Of special importance for Madeira is the high number of species of pteridophytes, with 75 species represented in the evergreen forest, 14 of them endemic.

In contrast with other archipelagos of the Macaronesian region, the Azores are lacking xerophytes of African origin. Instead the Azores show a significant number of associations with the Iberian flora.

Table 7: Endemism in the vascular flora of Madeira and Azores

Archipelago	Vascular plant species	Of which are endemics	Percentage
Madeira	1 141	120	10.5
Azores	843	40	4.7

Source: ETC/NPB.

1.4.2.2 Faunal richness

The table below reports the faunal diversity of the three subregions of the Macaronesian regions.

Table 8: The number of vertebrate species (excluding fishes) found in the Macaronesian biogeographic region and the number of species threatened at the European level

	Mammals	Breeding birds	Amphibians	Reptiles
Canary Islands	46	82	2	18
Madeira	22	50	1	9
Azores	32	34	2	8

Source: ETC/NPB.

1.4.2.3 Mammals

Species with low dispersal abilities living on islands or under isolated conditions are sensitive to changes in both biotic and abiotic conditions, especially so deteriorations of habitat. With a low possibility to migrate or disperse, species may face a risk of extinction.

Volcanic and seismic activities and more recently influences of human settlements may have caused significant alterations in habitats resulting in changes in species richness in the Macaronesian region. Findings of fossil species of tortoise and a fossil mouse (*Canariomys bravoii*) indicate that species richness was earlier higher than it is today.

Human influences not only have negative impact on biodiversity in isolated areas. Several species of mammals have recently been introduced to the islands, among them wild rabbit (*Oryctolagus cuniculus*), rats (*Rattus rattus* and *R. norvegicus*) as well as field mouse (*Mus musculus*).

There are few native terrestrial mammals in the Macaronesian region. Exceptions are found among bats, for instance the Madeira pipistrelle (*Pipistrellus maderensis*) which is endemic to Madeira and the Canary Islands. Further, greater mouse-eared bat (*Myotis myotis*) and Azorean bat (*Nyctalus azoreum*) are both indigenous to the area.

1.4.2.4 Birds

The Macaronesian region hosts three endemic bird species, the plain swift (*Apus unicolor*), Berthelot's pipit (*Anthus berthelotii*), and the house canary (*Serinus canaria*) are widely distributed in the region and fairly common on Madeira.

The region also offers important breeding grounds for less common raptors. The Canary Islands offers the most southern breeding habitats for Eleonora's falcon (*Falco eleonora*) and the only European population of barbary falcon (*Falco pelegrinoides*). Houbara bustard (*Chlamydotis undulata fuerteventurae*) is an endemic subspecies to a few of the Canary Islands and has a total breeding population of 700–750 individuals.

Several ocean-related bird species have unique occurrences in the region. Madeira supports the only known breeding population of Zino's petrel (*Pterodroma madeira*) and the island Desertas hosts the only European breeding population of

Fea's petrel (*Pterodroma feae*). Zino's petrel is occurring in Madeira with a very small population (20–30 pairs) and measures have been taken to legally protect the breeding site.



Photo: Göran Ekström.

*Madeira petrel or Zino's petrel –
Pterodroma madeira*

*IUCN STATUS CATEGORY Critically
Endangered.*

*HABITAT The Petrel nests on ledges
where there is sufficient soil in which to
burrow and spends the rest of the time
at sea.*

*GEOGRAPHICAL SPREAD Restricted to
the island of Madeira, south-west of
Portugal.*

*CURRENT POPULATION 250 to 400
birds.*

SIZE 32 to 37 cm. WEIGHT 0.2 kg.

*AVERAGE LIFE EXPECTANCY Not
available.*

NORMAL DIET Fishes and cephalopods.

*NORMAL LIFESTYLE Birds live at sea and
return to the central massif of Madeira
to breed in late March or early April. It
creates a nest by burrowing on a fairly
inaccessible ledge. A female lays one
egg, hatching in late July and early
August, fledging in late September or
early October. There are only 20 to 30
breeding pairs.*

*PREVIOUS GEOGRAPHICAL SPREAD As
present, but more widespread.*

*REASONS FOR DECLINE Predation by
rats, cats and humans; degradation of
habitat where it nests.*

*CONSERVATION PROJECTS The Petrel
has been the subject of many
conservation projects, including the
Freira Conservation Project, started in
1986, which involves reducing predation
by rodents and cats, and wardening;
LIFE funded activities in the National
Park between 1994 and 1996. The
breeding site was designated a Special
Protected Area under the European
Union's Wild Birds Directive. The species
is classified by IUCN as Endangered and
listed on Annex I of the European
Union's Wild Birds Directive, and
Appendix II of the Bern Convention, and
is protected by Portuguese law.*

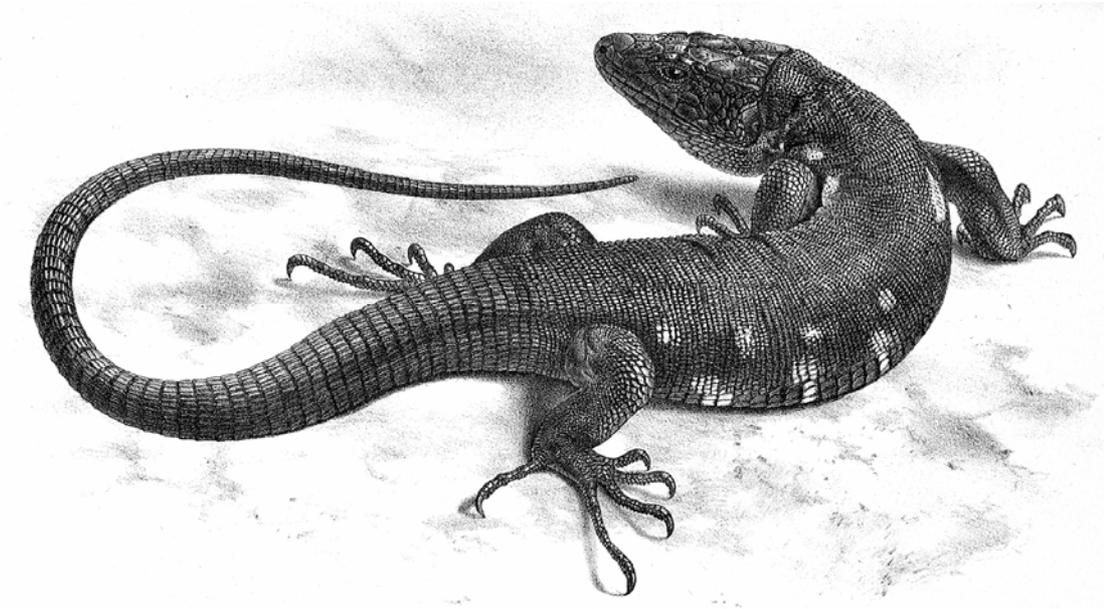
SPECIAL FEATURES Thought to be Europe's rarest breeding seabird. Endemic to Madeira. Formerly believed to be extinct in the 1960s.

1.4.2.5 Reptiles and amphibians

The remote and isolated locations of islands in the Macaronesian region may contribute to the generally low diversity of species observed in the herpetofauna. The region lacks systematic units as snakes and amphibians, but recent introductions of – for instance marsh frog (*Rana perezii*) and tree frog (*Hyla meridionalis*) – have occurred.

Isolation and low levels of flow of genetic material has caused a significant speciation in reptiles, especially so in the Canary Islands. The region now hosts endemic genera, species and subspecies. Each of the main islands in the Canary Islands have endemics in the families Gekkonidae, Lacertidae and Scincidae. The speciation can be illustrated by the genus *Gallotia* which is represented by six species.

Gallotia simonyi



The Hierro giant lizard (Gallotia simonyi) is the most threatened reptile in Europe and one of the five most threatened species in the world. Although it was originally widespread over much of the island of Hierro in the Canary Islands, its distribution is now confined to a mere one hectare situated along an inaccessible cliff edge. Here the last remaining 200 individuals can be found. Numerous factors have led this species to the brink of extinction: severe degradation of its habitat, losses due to capture of individual specimens, predator introduction on the island and competition with the Canarian lizard (G. stehlini), which is widespread in the area. The limited number of surviving individuals is a major handicap for the long-term viability of the species.

Until recently, giant lizards were believed to be extinct in La Gomera. In June 1999, a population of giant lizards at Risco de La Mérica (Valle del Gran Rey) was discovered. This population corresponds morphologically to the form described as G. simonyi gomerana. Serious threats for the survival of this lizard include: a small area of distribution of about one hectare, a small population size estimated at less than 20 individuals, decimation by harmful foreign predators such as cats and rats and modification of their habitat by livestock.

The Hierro giant lizard is classified as Critically Endangered (CR B1 + 2e, C2b) on the IUCN Red List 2003 and is listed on Appendix I of CITES. It is also listed on Annex IV of the European Species Directive.

1.4.2.6 Invertebrates

8 500 invertebrates have been recorded in the Canary Islands, of which 1 800 are marine species and 6 700 are terrestrial. In line with the high endemism found in plants, also invertebrates in general show a high 45 % of species being endemic. Even higher levels of endemism has been recorded in the 1 700 coleopterans (70 %).

The volcanic origin of the islands is of utmost importance for the development of special life forms in invertebrates. Lava tubes harbour unique life forms, with 13

genera and 120 species being endemic.

Further, the Madeira archipelago is of special importance for endemic and threatened invertebrates, especially for land molluscs (171 endemic species), many of these with very restricted distributions.

2. Main pressures on biodiversity

The main pressures on biodiversity in the Macaronesian region are:

- Human population increase
- Tourism
- Agriculture
- Forestry
- Alien species

2.1 Human population increase

In line with other areas of Europe, the Macaronesian region has experienced a significant increase in human population since the beginning of the 20th century. Simultaneously, inhabitants of the islands of the region began to move to the capitals and other centres of the islands. Today, the major island of the Canary Islands, Gran Canaria, hosts more than 450 inhabitants per km² and is the most densely populated area in the region. Fuerteventura, also in the Canary Islands, has the lowest population density with 26 inhabitants per km². The present tendency is an ongoing depopulation of rural areas and a resulting population increase of urban and tourist areas.

Table 9: Human population size and density in the three subregion of the Macaronesian biogeographical region

	Surface area (km ²)	Population (1996)	Inhabitants/km ²
Canary Islands	7 242	1 606 549	222
Madeira	797	257 670	326
Azores	2 333	242 620	103
Macaronesian region	10 372	2 106 839	203

Source: Sunyer, 2000.

The Maderian human population has been relative stable in recent years with most people living in the only large town of the island, Funchal.

2.2 Tourism

There is a great seasonal fluctuation in the human population of the region due to the large number of visitors. Tourism started in the mid-19th century and has increased to high levels. In 1998, 11 million visitors arrived to the Canary Islands, mainly from UK, Germany and Spain. Today tourism represents up to 80 % of the GDP (gross domestic product) in the Canary Islands.

The growing tourism industry of the region, and especially that of the Canary Islands, has caused dramatic changes to coastal areas. The establishment of hotels and other tourist facilities partly use rich agriculture lands and have pronounced negative impact on natural coastal habitats. Further, the increasing number of visitors to the islands pose threats to, among others, nesting areas of sea birds.

2.3 Agriculture

Agriculture is an important feature of the Macaronesian region, 14 % of the land in the region is cultivated habitats. More than 50% of the Canary Islands' area has over time been used for agriculture purposes. The prime agricultural products are tomatoes, maize, potatoes and bananas. Vast areas of indigenous forest have been transformed to managed forest due to the use of young timber in banana plantations and by the plantation of California pine (*Pinus radiata*).

Fruit producing trees were first introduced by early settlers. Figs (*Ficus carica*) and date palm (*Phoenix dactylifera*) were introduced more than 2 000 years ago in the Canary Islands, while the major part of fruit producing trees were introduced much later. Avocado, mango and apples have been commercially cultivated for less than 40 years. Of special importance in this respect is the cultivation of olive trees (*Olea* spp.) which form open woodlands on high south-facing slopes.

The production of sugar, wine and bananas is the backbone of the agricultural economy of Madeira, together with numerous common European vegetables. Further, temperate fruits like oranges, lemons, guavas and mango together with pineapple and figs are cultivated for export.

Agricultural production in the Azores differs substantially from the Canary Islands and Madeira. Here livestock and dairy production is the main trade using more than 100 000 hectares of the total farmland. Most of the farms are relatively small, hosting between 5 and 20 heads.

2.4 Forestry

Most of the forest of Madeira has during the last 500 years been destroyed through exploitation for agricultural purposes and ship-building. Today felling is strictly controlled and the main threat to forest today is forest fires. Fires are commonly deliberately started to improve grazing for livestock. In the Azores forests have been cleared for pastures but have also been replanted with alien tree species (*Acacia* and *Cryptomeria*).

2.5 Alien species – introduced fauna and flora threaten biodiversity

2.5.1 Fauna

Introducing alien species into an ecosystem usually causes an ecological imbalance that frequently results in decreasing population sizes of indigenous species due to increased or changed competition, changes in the physical habitat by ecological engineering and alien species acting as vectors for parasites and diseases. Of special importance and of immediate risk for biodiversity is the

change in predation pressure usually inflicted by an introduced predator.

In the Macaronesian region rats (*Rattus* spp.) are a special problem when they impose a predation pressure on birds, which are the main vectors for dispersal of seeds in the laurel forest. The introduction of rabbit (*Oryctolagus cuniculus*) to Porto Santo in the Madeira archipelago caused a degradation of the natural vegetation, a situation that has remained due to continued grazing by both rabbits and livestock. Overgrazing by rabbits and livestock has led to severe regression of the endemic flora on Desertas and Salvages, which in turn has caused erosion of the coastline.

Seabirds and indigenous predators evolve a natural coexistence with indigenous predators, but introduced predators can cause severe reduction and even extinction of seabird populations.

2.5.2 Flora

Two thirds of the vascular flora of the Canary Islands are not native. Ca 700 species of the islands' flora are introduced and an additional 1 300 species are cultivated plants, a majority of species have a Mediterranean origin. The share of alien tree species is remarkably high. 300 tree species have been introduced, compared with the 40 indigenous species.

Introduced species represent an array of life-forms from herbs, succulents and shrubs to trees. Few, however, can be regarded as pests although a number of them have become rather common. An aggressive invader is a sedge (*Cyperus rotundus*) which has invaded fields and gardens. It spreads through seeds, bulbs and runners and is in banana plantations fought with special herbicides. The wild tobacco (*Nicotiana glauca*), introduced from South America has established well and is now being found even in the driest parts in the Canary Islands.

In Madeira a number of ornamental plants have been introduced and have naturalised over centuries. These species, e.g. species of *Acacia*, *Papaver*, and *Pittosporum* are most common in the lowlands, while others (*Ageratina* and *Erigeron*) also have penetrated into higher regions.

The native vegetation of the Azores has been severely altered and half of the species are non-native. Some of the species are very competitive and invasive like the mock orange (*Pittosporum undulatum*), Kahili ginger (*Hedychium gardnerianum*) and lily of the valley tree (*Oxydendrum arboreum*).

3. Initiatives to support biodiversity and nature conservation

3.1 World Heritage Sites and Biosphere Reserves

The Macaronesian region hosts two sites included in the World Heritage Sites list:

- Laurisilva of Madeira, listed 1999
- Garajonay National Park on La Gomera, listed 1986

and three UNESCO/MAB Biosphere Reserves in the Canary Islands:

- El Hierro
- Lanzarote
- La Palma

Lanzarote between tourism and traditional activities

The Lanzarote UNESCO/MAB Biosphere Reserve was created in 1993. Lanzarote has a large number of protected areas as well as a vigorous tourist industry. 60 % of the bird species that nest on the island are endemic as well as many of the reptiles and insects. Traditional land use systems have revolved around agriculture, pig raising and salt works. Tourism has profoundly changed the economic and social structure of the island, to the point that three-fourths of the working population is presently employed in this sector. The density of tourists in Lanzarote is currently the highest of all Canary Islands. Waste disposal management and competition for scarce water supplies are two of the main problems.

36 % of the territory of the island is protected to different degrees. This figure rises to 42 % if the Timanfaya National Park is taken into account. The Territorial Management Plan for the Island of Lanzarote is the principle legal instrument of planning. It dates from 1991 and is proving effective in the management of tourism, among other things. Biosphere reserve management is in line with the development of this plan and the initiation of the Sustainable Development Plan is anticipated. Current conservation activities include diverse initiatives to improve the landscape, protect species and support traditional activities, as in the case of the Janubio Salt works or in the lava cultivations in La Geria. Regional activities focus mainly on the improvement of the quality and the sustainability of tourism, though they also support traditional agricultural methods. Attempts are being made to reorientate this model, by promoting new offers that focus on cultural activities and features of the island's landscape.

3.2 Nature conservation strategies

3.2.1 Canary Islands

The Canary Islands have four National Parks as well as a recent network of 145 protected areas (comprising 40% of the total surface). The islands also hosts one World Heritage Site and three Biosphere Reserves.

3.2.2 Madeira

The Parque Natural da Madeira (area 56 700 ha) covers ca two thirds of Madeira and includes basically all of the laurel forests of the island.

In general management plans for the National Parks on Madeira include legal instruments to restrict exploitation and damaging agricultural practices. In addition there is a official policy to acquiring land for reserves. The National Park covers a variety of vegetation types and landscapes and are protected as Reserves covering 2 322 ha and partially protected Natural Reserves covering 6 400 ha.

3.2.3 Azores

The protected-area system in the Azores cover five Natural Reserves and two 'Protected Landscapes'.

Table 10: Natural Reserves in the Azores

Reserve	Date legally established	Area in hectares
Caldeira do Faial	1972	1 086
Ilhen de Villa Franca do Campo	1983	101
Ilheus das Formigas (Santa Maria)	1988	40 000
Lagoa do Fogo (San Miguel)	1974	2 413
Montanha da Ilha do Pico	1972	2 384

Source: ETC/EEA.

3.3 International collaboration

The Macaronesian biogeographical region is integrated through European and international cooperations. Specific cooperations and projects for the region include:

- **Two projects in EU Commission INTERREG III-B:**
 - ATLANTICO – The development of a Macaronesian Biodiversity Data Base
 - CENTINELLA – Monitoring and Planning Endangered Species of Macaronesia
- **Ad Hoc Technical Expert Group on Island Biodiversity**
was designated by the Biodiversity Convention Executive, based on the decision adopted at the COP7 in Kuala Lumpur in order to develop a strategy for island biodiversity. The main task is to establish an action plan for island biodiversity.
- **Canary Island Declaration 'Conserving biological diversity in the face of invading species on Spanish and Portuguese islands'**
Recognising the commitment of Spain and Portugal in the Biological Diversity Convention (Rio de Janeiro, 1992) in preventing the introduction, control and eradication of exotic species that represent a threat to ecosystems, habitats or species.
- **Project – REDBIOS**
is a network which comprises Cap Vert, Morocco, Senegal and the Canary Islands (Spain), Mauritania, Madeira and Azores (Portugal), which is fulfilling the interregional mandate of the IBSICA project in enabling countries from different world regions to cooperate and exchange their experience.
- **The IBSICA Project**
'Integrated Biodiversity Strategies for Islands and Coastal Areas', is trying to implement some of the results of the United Nations Conference on Environment and Development and, particularly the Convention on Biodiversity.

The main conventions with direct influence on biodiversity in the region are:

- **The Ramsar Convention**
The Convention on Wetlands is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. It was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975, and it is the only global environmental treaty that deals with a particular ecosystem. The Convention's member countries cover all geographic regions of the planet. The Ramsar convention has been signed by both Portugal and Spain.
- **The Bonn Convention**
The Convention on the Conservation of Migratory Species of Wild Animals is signed by Portugal and Spain.
- **The Bern Convention**
The Convention on the Conservation of European Wildlife and Natural Habitats is signed by both Portugal and Spain.
- **The Convention on Biological Diversity** is signed by both Portugal and Spain.

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