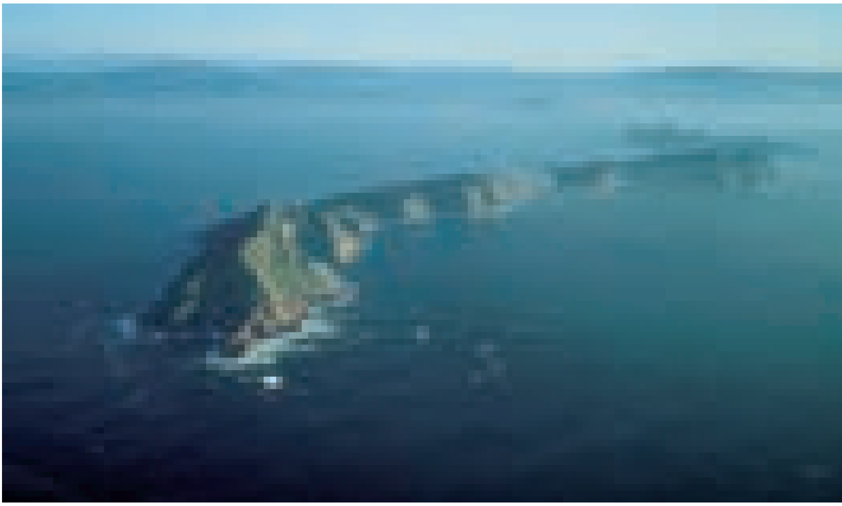
II. Natural environment

Physical setting



THE ORIGIN OF THE ISLANDS

Both the islands and the surrounding Rías Baixas have a common origin. Ancient movements of the Earth's crust caused the coast to sink, which was chiefly responsible for shaping these estuaries and islands. The subsequent rise in sea level caused the flooding of the coastal river valleys and the coastal ranges thus became the capes that separate the estuaries, while the peaks that were completely isolated became the islands that we know today.

Some of the rocks in this region were formed 400 million years ago and others 300 million years ago, crystallizing inside the Earth's crust under extreme temperatures and pressures. Tectonic processes and erosion over many millions of years thrust these rocks to the surface, where we can see them today.

Different geological events shaped the current landscape and can be divided into the following stages:

540 million years ago

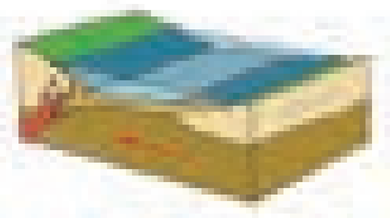
The Iberian Peninsula as we know it today did not exist. The zone it now occupies (highlighted on the map) was underwater. Marine sediments accumulated on the sea floor.

From 380 to 280 million years ago (Variscan orogeny)

Period of movement of crustal plates that caused the union of the continents into one super-continent: Pangaea.

The seabed between the ancient continents were put under pressure and lifted to form the large Variscan belt, which was part of the Iberian Massif (in the area highlighted on the map).

Below them, under extreme temperatures and pressure, the molten sediments together with magma intrusions crystalized to form granite rocks.



245 million years ago.

- Pangaea fractures and slowly forms the continents. The Iberian Massif fractures, giving it its recent coastline lapped by the nascent Atlantic Ocean.
- The split of Pangaea causes the appearance of faults along the coast of what is today Galicia, predominantly in NE-SW and NS directions.
- The rivers that flow into the Atlantic along the NE-SW faults erode and greatly widening the river valleys.
- The granite and metamorphic rocks are brought to the surface after the material deposited on top erodes.

60 million years ago (Alpine orogeny)

New movements of the Earth's crust begin. The African plate collides with the European plate, forming mountain ranges including the Pyrenees and the Betic range. The Galician coast adapts by giving rise to vertical movements of the various blocks created by the faults. The coastal blocks generally sink under the inland ones, forming tiered plains with the lowest points in the coastal river valleys.

2.5 million years ago

Successive ice ages cause the polar ice caps to expand and sea level to consequently fall. The melting of the ice caps in interglacial periods make the sea level rise.

A rise in sea level about 120,000 years ago flooded the coastal river valleys for the first time and the region's estuaries and islands appeared. Subsequent drops in sea level expanded the coast line and the river valleys reappeared.

The last ice age occurred 18,000 years ago and the sea level fell to 120 m below its current level. The sea gradually rose and the estuaries and islands we know today were formed 6,000 years ago.

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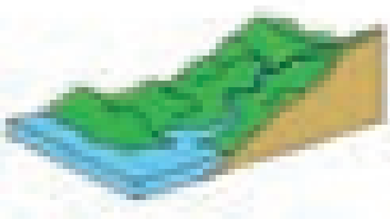
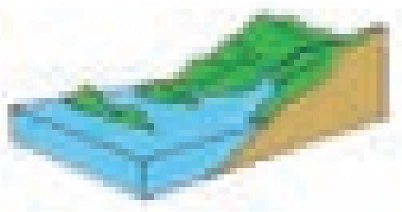
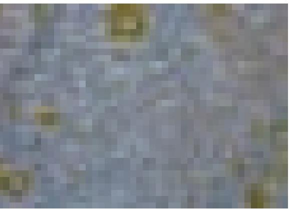




Source: Costas, 2008.

ROCKS THAT TELL THEIR HISTORY

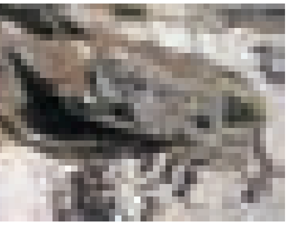
The Variscan orogeny transformed the sediments into metamorphic rocks and caused the magma to repeatedly rise. It gradually solidified within the crust, forming granite rock. When the latter's formation coincided with the beginning of the orogeny there was a greater orientation of minerals than in the final periods.



In the **two-mica granite** predominant on Cíes and Ons, where the granite formed during the second phase of the Variscan orogeny over 300 million years ago, the minerals are oriented in planes. Subsequent erosion by water and wind acted on the planes, creating fissures in the rock and angular blocks.

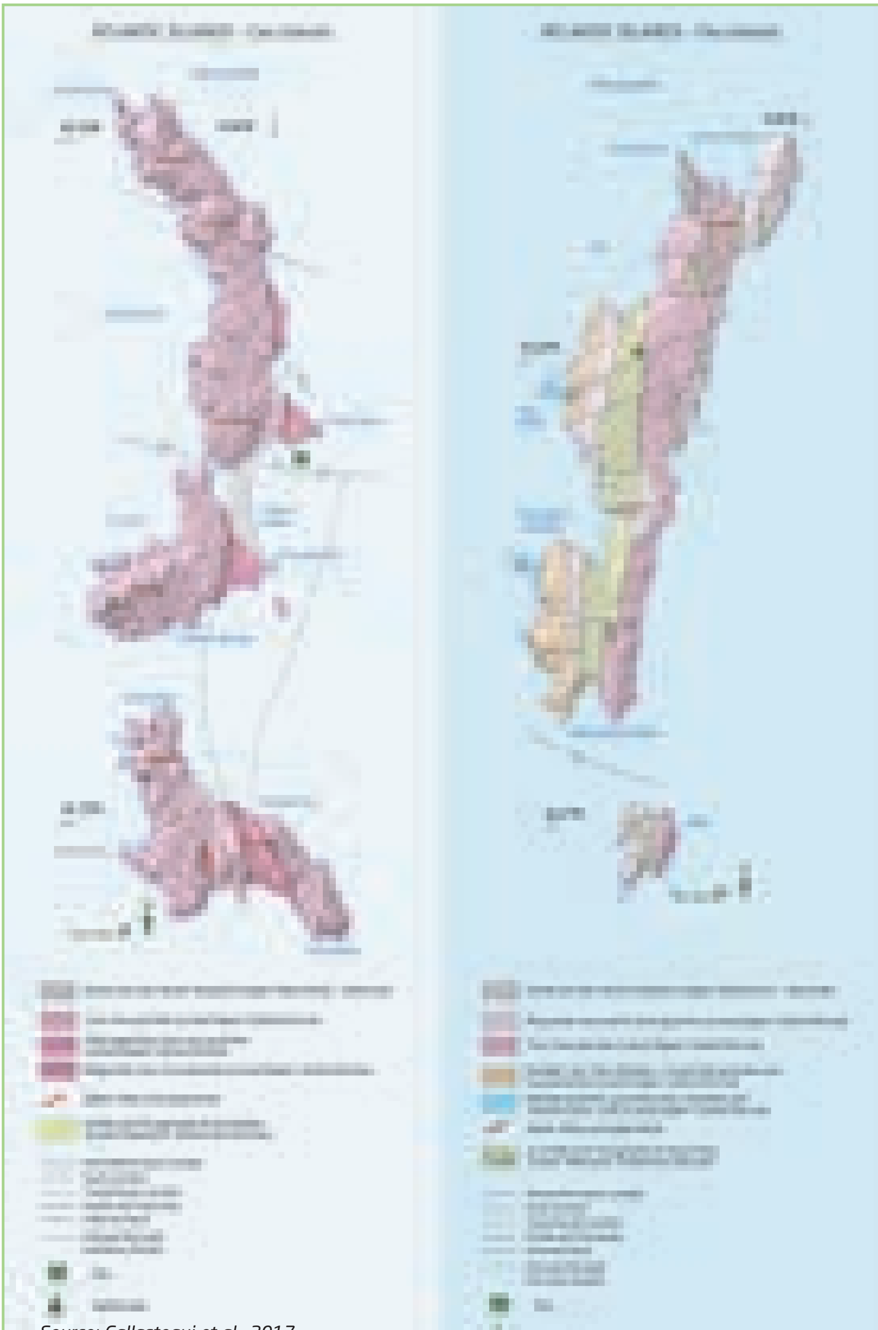
Granodiorites and tonalities are formed prior to the Variscan orogeny's second phase of folding. These somewhat older igneous rocks are also often deformed and appear in different areas of the western coast of the island of Ons: Punta Xubenco, Cabo Liñeiro and around the islet of As Freitosas.

Sálvora's **late-Variscan biotite granites**, pink from oxidation or because its minerals were enriched with iron, formed when magma solidified and reached into the interior of the Variscan massif right at the end of the orogeny and thus do not have mineral orientations like the rocks on Ons and Cíes.



The **granite** on Cortegada is welded to the metamorphic rock predominant on the island: **schists and gneisses**, formed by thin, overlapping layers of rock. These metamorphic rocks were formed from pelite (clayey) sediments due to the rise in pressure and temperature during the Variscan orogeny.

The oldest rocks in the park are the schists and gneisses on Cortegada, while the youngest are Sálvora's late-Variscan granites.



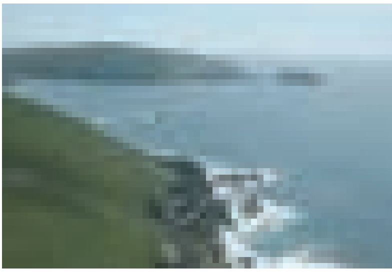
Source: Gallastegui et al., 2017
& González Menéndez et al., 2013.

Source: Gallastegui et al., 2017 & González Menéndez et al., 2013

FOUR VARIOUSLY-SHAPED ARCHIPELAGOS

Cíes and Ons are elongated islands featuring very different morphology on the western and eastern sides. To the west, cliffs are exposed to the ocean, whereas the eastern side, facing the estuaries, slopes down to sea level, where there are rocks and stretches of sand. The spray from the waves breaking on the cliffs puts visitors in mind of high walls defending the calm sea of the rías from the force of the Atlantic waves.

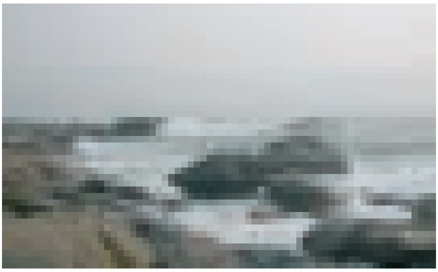
The prominent reliefs on the Cíes Islands.



The cliffs on Ons have a softer slope.

Sálvora eschews the elongated sloping forms of the neighbouring islands in favour of a more rounded flatter outline, high angular cliffs being replaced by a series of large spherical rocks. These "bolos" are made smooth and slippery by the pounding waves.

Sheltered in the ría, Cortegada avoids the ocean waves. Its low relief features stretches of sand and flat rock.



Granite blocks smoothed by the sea, on Sálvora.

Cortegada has an estuarine coastline, sheltered and with gentle relief.

The rocky coastline fending of the sea is the islands' most rugged facet

In the exposed parts of the islands of Ons and Cíes, cliffs are continually lashed by the ocean waves.

A **cliff** is a coastal formation which varies from sloping to sheer. It typically involves emerged rock affected by wave erosion. Granite adds hardness and stability to the cliff.

View of Onza from inside sandy - bottomed Fedorentos Cave (Ons).

The ***furnas*** or caves are a result of erosion at certain points in the cliff which degrade more quickly than the nearby rocks. On these islands they are associated with fractures in the rock. The morphology of the 55 caves in the park (33 on Ons and 22 on Cíes) depends on the kind of rock, fracture orientation, and the degree of erosion. The roof of O "Buraco do Inferno" on Ons has collapsed, creating a well with a height difference of 43 metres between the surface and the cave bottom.

Pebble/boulder ramp on Sálvora, partially covered in sand.

Pebble ramps are horizontal coastal areas consisting of rock fragments that have been rounded by wave action (pebbles/boulders). They were once under the sea. Cantareira Beach on Cíes is a good example. Ramps are very typical features on the island of Sálvora.

Erosion creates mysterious shapes in the rock

Bolos: large blocks rounded and smoothed by water and wind

Large round granite boulders are very typical of Sálvora. Erosion by water and wind among the horizontal fractures in the rock leaves them smooth and rounded.

Honeycombing and pías: wedthered rock

They are shaped by erosion of the chemical kind (mineral transformation, salt crystal formation) rather than mechanical (wind) or biological (moss and lichens). Rainwater loaded with sea salt accumulates in small hollows in the granite or in areas more prone to erosion. The hollows get larger as the water gradually breaks up the minerals in the rock. In the case of honeycombing and *taffoni* there are theories that claim that these are created when the granite is still underground.

Pías occur on horizontal and vertical surfaces, respectively. *Taffoni* are cavities in rock which appear when honeycombs develop and perforate the rock.

Examples of honeycombing and taffoni on the road to O Alto da Campá on Cíes. Right, a pía in O Alto do Príncipe on Cíes.

Sandy Coast: beaches and dunes moulded under the sea's influence

Beaches are areas where sand or gravel is deposited. Marine currents along the coast and wave action are weaker on the coasts protected from Atlantic winds (interior of estuaries, eastern side of islands, etc.). The drop in the speed of the sea reduces its ability to carry sediment, resulting in deposition on beaches.

The sand on Cortegada's beaches chiefly comes from rivers, whereas the sand of the other islands are granite sands deposited by ancient rivers that flowed into the sea near the islands in periods when the sea level was lower. Thus, the current beach of Rodas, on Cíes, is reusing sands that, due to successive fluctuations in sea level, were shifted in different periods to form different beaches over time. This shifting explains the sand's fineness and colour (darker minerals erode more quickly).

Quartz, feldspar, remains of shells and sea urchin spines are hidden from view in the sand.

Dunes are deposits of sand that the prevailing wind blowing in from the sea carries inland from the upper part of the beach. When there is some kind of obstacle in its way (vegetation or rocks), the wind slows down and deposits the sand.

The dunes at Muxieiro on Cíes and those at Melide on Ons are remarkable for their size and botanical importance.

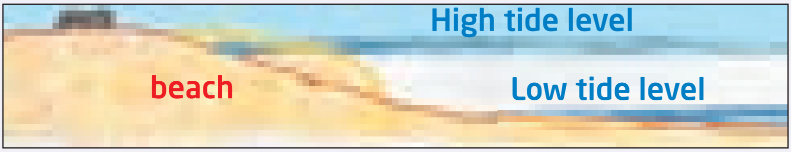
The beach-dune ecosystem is characterised by unstable morphology involving constant changes and dynamics influenced by wind, currents and waves. This explains why it is so fragile and vulnerable to any action on the coast that alters costal dynamics (quays, quarrying, etc.).

Dunes of Rodas and Muxieiro on Cíes.
The old cement walk was replaced by an elevated wooden walkway, which has less of an impact on dune dynamics.

Dune formation and dynamics

Sand accumulating on the upper part of the beach and the subsequent influence of the wind form dune ridges parallel to the beach.

The wind causes sand to accumulate on the upper part of the beach.

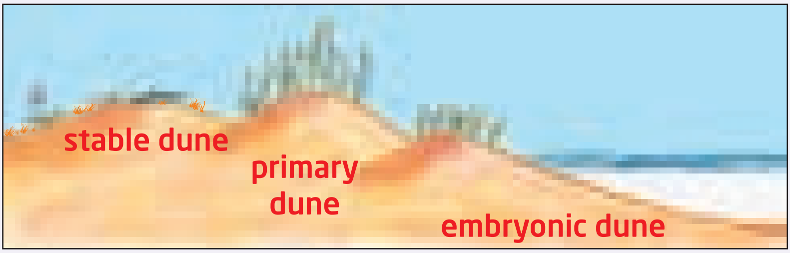


The first dune slack forms a little higher than the beach, but enough to be colonised by plants, which help to stabilise the sand.

As the sand accumulates, the shifting dune forms behind the initial dune. The latter is by then higher and further from the sea and therefore hosts a greater variety and density of plant life.

In winter, when the waves are stronger and the prevailing winds blow toward the sea, the dune supplies the beach with sand as currents and waves sweep sand out to sea. In summer, the beach recovers its sand and the winds blowing off the sea deposit it again on the dunes. It is a very fragile equilibrium.

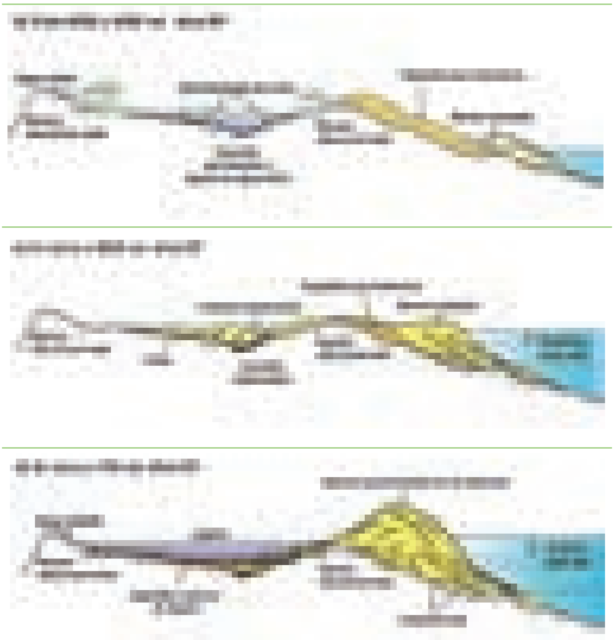
The ongoing accumulation of sand forms a complete dune system with three slacks. The shifting dune protects the stabilised dune from the wind and sea spray, providing more benign conditions for the many plants that grow on the latter. The carpet of vegetation immobilises the sand.



The fragility of Rodas beach and the lake.

A geomorphologic system as stunning as it is fragile is located in the Cíes Archipelago between the islands of Monteagudo and Faro. It consists of a sand bar (Rodas beach and dune) which acts as a natural bridge between the islands and protects a saltwater lagoon.

The formation of the present landscape began about 6,000 years after the last ice age and the subsequent rise in sea level. Waves and currents freed the sands from ancient fossilized beaches that existed in the area to gradually form the sand bar that exists today. A freshwater lagoon formed behind the sand bar as the result of a wetter climate and because sea level was a few meters lower than it is today. This wetland became silted over the years, a process which was accelerated 3,600 years ago due to a period of lower rainfall which, together with a slow but steady rise in sea level, pushed back the Rhodes beach and dune to create a large field of dunes



Graphics adapted from Costas, 2008

on the old wetland. It was not until 700 years ago that the sea reached such a level that the ocean flooded the western part of this dune field, thus forming the current salt-water lagoon behind the Rodas sand bar.

The decrease in the depth of the lake and erosion on some parts of the beach are red flags for the conservation of this landscape. In addition to the lagoon's natural silting and the current rise in sea level, some human activities have had their consequences: over-mining of sand from Rodas beach for constructive purposes over the twentieth century and the old concrete walk from the port to the interior of the islands on the dunes (now replaced by a wooden walkway) made a significant impact difficult to overcome for a system created with fossil sands and that rarely receives new sands to help replenish the system and heal these wounds.

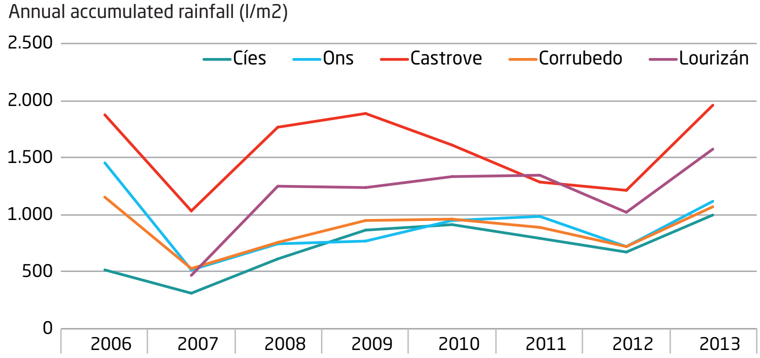
Detail of the fossil beach in Rodas. Beaches formed 120,000 years ago after being "left behind" when the sea level later lowered. Its sands were cemented between reddish iron and aluminum oxides.

Every year the bar that forms Rodas beach is broken by the force of the sea. The bar reforms in a matter of days.

DO THE ISLANDS HAVE AN ATLANTIC CLIMATE?

Galicia's Rías Baixas are part of a region with an oceanic climate involving high precipitation and moderate seasonality in terms of both temperatures and water.

However, on the archipelagos lying outside the *rías* (Cíes, Ons and Sálvora), less rain falls than nearer the coast due to the fact that the low altitudes of the islands barely represent an obstacle to cloud in contrast to the barrier of the coastal hills up to 700 metres high.



Clouds release more moisture when they come up against a geographical obstacle. The stations on Cíes and Corrubedo record less rainfall as they are somewhat further from the hills surrounding the rías.

The relative scarcity of rainfall, together with the shallow soil, means that there is a dry period in the summer months when less water is available in the ground for plants.

The islands' climate is far from Atlantic (despite their name) as the kind of dry period that they experience is typically Mediterranean.

Plants typical of more Mediterranean climates, such as Mediterranean mezereon, can be found on the islands.

Authors such as Allué describe the islands as a "Mediterranean type phytoclimatic subregion with Atlantic tendencies". Autumn and winter rains make up for the shortage in summer, yielding a positive overall annual balance (i.e. the amount of rainfall is greater than water lost through evaporation).

Cortegada's location on an estuary leads the same author to define its climate as a "European Atlantic subregion", casting off the Mediterranean character of the other islands.

Average annual temperature on the islands ranges between 13 and 15 °C. There is a slight difference between average temperature in the hottest months (July and August: 18- 20°C) and the coldest months (December and January: 10- 12°C). Temperatures on the islands are milder than on the coast due to the fact that minimum temperatures on the islands are higher, mainly on cold days, and the maximum is somewhat lower, especially on hot days.

The prevailing winds in summer blow from the North-Northeast, while in winter they blow mainly from the South-Southwest.

The doors and windows of island houses face east, sheltered from the wet south-westerly winds.

SOILS FOR LIFE

Slope, bedrock, climate and living things are the ingredients of the various soils. Soil type, nutrients and depth determine the life any given soil can sustain.

Slope plays an important part in soil formation due to its relation with erosionability. Soils are deeper the less steep the slope.

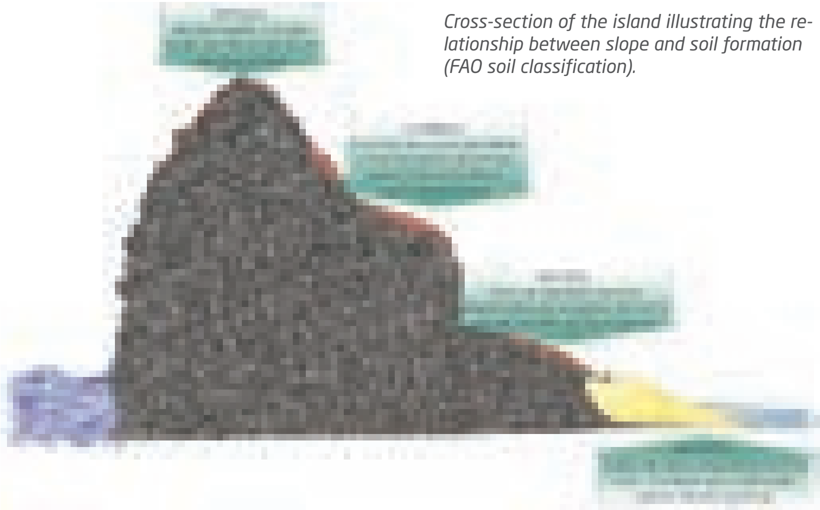
The **rock type** on which soils develop determines the mineral and nutrient content, as well as its structure (proportion of sand and clay). Soils formed on metamorphic rock are better than granite soils (predominant in the park) for plant growth as they are more clayey, retain moisture better and supply more micronutrients (calcium, magnesium, potassium and sodium). The low amount of these cations means the park soils can be defined as acid.

Climate is another contributory factor in soil formation, especially rainfall, as rain causes rocks to break up faster and removes nutrients from the soil, making it more acid.

Micro-organisms, **soil fauna** and **vegetation** supply or alter nutrients and increase soil porosity (of galleries, etc.).

On the island of Malveira Grande there are two kinds of rock: quartz schist (metamorphic) with deeper soils containing more nutrients, and biotite granite (granitic) with very thin soils poor in nutrients. Pyrenean oaks grow on both islands, those on quartz schist being more developed as they are more sheltered from the wind.

On the islands of Cíes and Ons, which are granite and have a west-east orientation, the basic layout of soil types is as follows:



Cross-section of the island illustrating the relationship between slope and soil formation (FAO soil classification).

The four abovementioned soil types occur on Cortegada and Sálvora, but due to the gentle relief, cambisol or even flooded soil is more common. Cortegada's location at the mouth of the River Ulla means there are fluvisol soils with marine and river sediment which are regularly replenished with new matter (e.g. via tides).

Only the deepest and wettest soils have native tree vegetation (or agriculture). In the environs of the cliffs there is gorse scrub, while arenosols host highly fragile and botanically important dune plants.

Angelica grows on cliffs where gulls breed. Nitrogen and phosphate content increases thanks to the gull droppings. Sea spray provides calcium, magnesium, sodium and potassium-.

ROCK FISSURES CONTAIN WATER RESERVES

When defining the hydrological features of a site, weather and soil water storage capacity have to be taken into account.

The **climate** features a summer dry period, but the overall annual water balance is positive.

The **rock** (granite and metamorphic) is impermeable enough to create important aquifers.

This leads to the loss of most of the rainwater either via runoff to the sea or through evapotranspiration (water trapped by plant roots and via direct evaporation from the ground).

It is difficult to imagine how the towns and villages on the islands were supplied with water. It was possible thanks to the many fractures in the jointed granite along which water seeps, creating small shallow aquifers. The joints also allow the retained water to escape, forming springs. Losses were made up for naturally by autumn and winter rains.

Cortegada town, now deserted, was established in the environs of a spring and associated washing place located alongside the chapel; there was also a well in the island interior.

Although Sálvora has been less studied in terms of water, there are known to be four springs, which are put to a variety of uses: two old mills (one of which supplied a small tile factory), two fountains and a water outlet for the lighthouse.

The 11 springs on the island of Ons contrast with the absence of any on Onza. Many of the springs emerge in contact zones between granite and metamorphic rock.

In the Cíes archipelago, the island of Faro has six springs, the island of Saint Martin has four and the island of Monte Agudo has two.

On Cíes, past reforestation schemes for areas of scrub have led to an increase in evapotranspiration, leading some of the aquifers to dry out.

Making use of springs by building wells, wash troughs, fountains or irrigation channels has altered the breeding ecosystems of some amphibians (springs, flooded ground, etc.). Some overflows of fountains and wash troughs have become artificial substitutes.

There is no extensive permanent network of surface water. Any small streams and brooks that appear barely last through summer.

Sign along the little path leading to the monastery on Cíes.

The marine environment

THE SEA OF THE GALICIAN ATLANTIC ISLANDS

The Atlantic Islands of Galicia are, along with the Cabrera Archipelago in the Mediterranean, one of two Maritime-Terrestrial National Parks that exist in Spain. As their protection rating indicates, the sea plays a fundamental role in these spaces. In our case, about 86% of the protected area corresponds to the sea, with 7,285.20 marine hectares protected out of the park's total of 8,480 hectares. The water surrounding each of the islands and the sea beds it covers are protected by the National Park. This protected marine area not only includes the shallower waters closer to the islands but also waters that at some points reach depths near 70 meters. In addition to making up the majority of the Park's area, the highly-valuable marine environment is also one of the main reasons these islands were declared a National Park. Despite the factors that threaten them, these waters are home to healthy communities of sea life and valuable ecosystems.

In this region the sea is impossible to escape, even on land. Ecosystems found on the islands are predominantly coastal ecosystems like dunes, cliffs and coastal scrub. The proximity of the sea also strongly influences life on land and is likely the factor that most impacts the island's terrestrial plants and wildlife, which must adapt to the salt in the air, the ocean winds, the spray of the waves, etc.

If we focus on the 86% of protected marine area in the Atlantic Islands the importance and value of the ocean becomes even more apparent. This marine area is highly valuable in terms of the environment and is a stunning attraction both for its spectacular underwater scenery and its rich fauna and flora, either benthic (living on the bottom), plankton (the organisms that live in water column, carried by the movements of the same) or nektonic (those who actively move independently of water currents).

The high biodiversity that characterizes this marine environment is a consequence of the special oceanographic conditions and of the many habitats, which create ideal conditions for the establishment and development of a large variety of communities representative of the Galician Atlantic seabed.

A WORLD IN CONSTANT MOVEMENT OCEANOGRAPHIC CONDITIONS

In the same way as plants and animals on a mountain must adapt to cold and wind, life in seawater is largely determined by the physical conditions and movements of the sea. Thus, surface and deep currents largely determine aspects like water temperature, nutrient content and water velocity, factors that are key to understanding biodiversity on the islands and how this life is distributed along the different types of seabed.

CURRENTS

Marine currents, both deep currents and those at the surface, play a very important role in biological phenomena, affecting salinity, temperature and water turbidity, and creating favourable conditions for the growth of organisms that have adapted to take advantage of the properties of the currents.

SEA BLUE

When sunlight reaches the sea, part of it is reflected off the surface and part enters the water column, where it is gradually absorbed. Orangey red light is more quickly absorbed. Blue light is the least absorbed and penetrates deepest in clear waters, making them blue.

In turbid waters, such as coastal waters with a large load of particles and suspended micro-organisms, blue radiation is absorbed before the yellow-green kind, giving them their characteristic green hue.

The colour of the water is one of the most spectacular and striking features of the Atlantic Islands. Greenyblue hues, from the palest to the darkest and most unsettling depending on the seabed, the wind, colour of the sky at any given time, etc., are among visitors' most lasting memories.

The primary mechanism giving rise to currents is solar energy. Solar radiation heats the atmosphere and gives rise to winds which move large stretches of the ocean surface and generate surface circulation. Furthermore, solar energy, by causing variations in temperature and salinity by heating or evaporation, also gives rise to differences in seawater density which are the driving force behind deep currents given the tendency of more dense water (colder or more saline) to remain below less dense water.

The following sections describe the great influence on the coast of Galicia of surface currents (the Gulf Stream, which brings warm water from the Equator) and of masses of water moving at depth (ranging from water of Mediterranean origin to the cold waters of the North Atlantic, which play an essential role in upwellings).

TEMPERATURE

Ocean **temperatures are more stable** than those on land due to the fact that water has a high specific heat capacity (the amount of energy that has to be supplied to a unit of mass so that the temperature rises by 1ºC). This implies that natural temperature ranges are much lower in the sea or ocean than above sea level: the temperatures that can be found in marine waters range from -4°C to 42°C, while temperatures recovered above sea level range from -89°C to 58°C. This is why the climate in a geographic area is usually milder on the coast than inland, with more moderate temperatures and fewer seasonal variations.

Water temperature depends to a great extent on latitude and on cold or warm marine currents, the most important variations occurring on the surface, which is more affected by solar radiation and atmospheric phenomena. The Gulf Stream reaches the coasts of Galicia as it does those of all Western Europe. The warm surface waters from the Caribbean make the climate much milder (average temperature of surface waters in Galicia is 14ºC compared with 5ºC on the coast of North America at the same latitude). These warm waters logically also have a significant impact on ecosystems and flora and fauna.

SALINITY

Salinity is the amount of salt in grams in a specific volume of sea water in litres. It is usually expressed in terms of per thousand, ‰. Sea water contains a lot of dissolved salts, the most common being sodium chloride, although there are small amounts of many others such as magnesium chloride or sulphate, calcium sulphate, potassium chloride, etc.

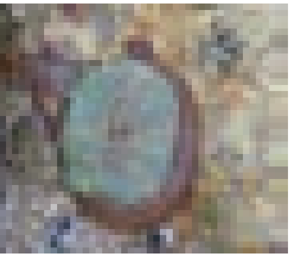
Average salinity of sea water ranges between 33 and 36‰, but on the coast and on the surface it can vary greatly due to meteorological factors, river input, currents, winds, etc. At the ria mouths where the three larger archipelagos are situated it stands at nearly 35%, and is higher in the south because the rias drain through the northern mouth with the resulting input of fresh water from the rivers.

TIDES: LUNAR PROPULSION

Tides are **oscillating movements** of oceanic water which alternatively give rise to an increase in sea level, known as high tide or high water, and a decrease in sea level, called low tide or low water.

By the 18th century Newton discovered that the gravitational pull that the Moon and the Sun exerted on the Earth was the cause of that phenomenon. The Moon, which is much closer to the Earth than the Sun, exerts a pull on large bodies of water on the face of the Earth nearest to it at any given time. The ocean bulges into a very big wave, whose crest corresponds to high tide and the midpart to low tide.

Low tide on Cortegada



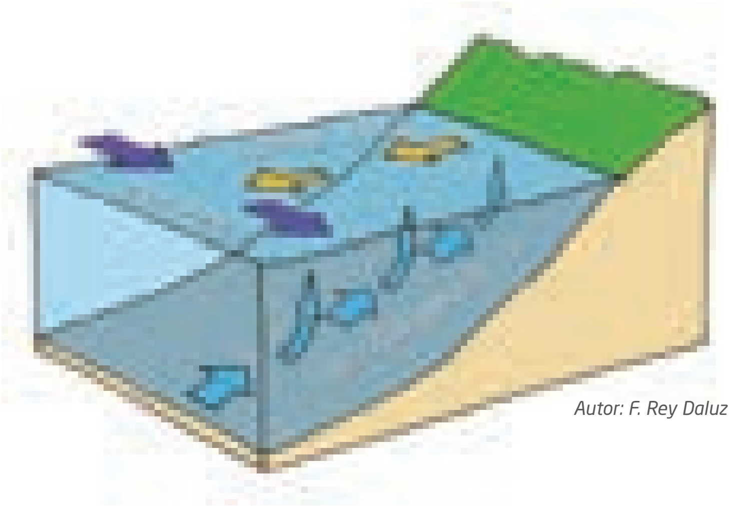
Anemone at high and low tide, respectively

Tides are a complex phenomenon and their breadth and frequency vary greatly among different seas and oceans and even between different regions of the sea or ocean. On these coasts **tidal breadth** (the difference in height between high and low tide) can be as much as 4 metres, but there are also seasonal variations within the same zone due to the relative position of the Earth, Sun and Moon. When the three are aligned close to a full or new moon, the forces of attraction of the Sun and Moon conjoin, generating greater tides. These higher high tides and lower low tides are known as **spring tides**. The breadth gradually dwindles until, in the first or last quarter, the stars being arranged at a right angle and the gravitational force of the Sun counteracting that of the Moon give rise to weak tides known as neap tides, when the tidal breadth can reach around one meter.

These regular variations have an extremely important effect on organisms living in the coastal zone as they have to adapt to drastic changes in living conditions every six hours. Thus, an animal like a mussel that lives on rocks in the intertidal zone and is consequently exposed at low tide must be able to withstand the ebb and flow of tidal currents and also survive conditions found at each low tide: rises in temperature, heat, terrestrial predators and lack of oxygen (the vast majority of marine animals need to be underwater to breathe).

UPWELLINGS: A SOURCE OF LIFE

The richness of the islands' waters is due to the phenomenon known as **local upwellings**. Due to the Earth's rotation, currents in the northern hemisphere tend to deviate their trajectory to the right. On the coast of Galicia the prevailing winds in spring and summer come from the north so the surface water they bring is driven towards the outer part of the rias. During this period the space left by this surface water is filled by deeper cold water, which partially comes from subpolar regions.



Autor: F. Rey Daluz

The water that wells up is rich in nutrients, since there is not enough light at depth there are no algae to metabolize these nutrients, which are available to organisms living in the illuminated surface zone, including the microalgae that make up plankton and are the basis of the food chain. The availability of nutrients, together with high temperatures and large amount of light, lead to a large increase in microalgae and a rich marine fauna, which feeds on them.

Upwellings therefore form the foundation for the great biodiversity found in the water in Galician estuaries and are the reason behind the significantly lower temperature of coastal waters in summer, when winds from the north dominate, an easily-noticed phenomenon when swimming on the islands' beaches.

The nutrients in the waters that well up make the high productivity of the rias

WHEN THE SEA CATCHES FIRE

As a result of the high temperatures, the relative summer calm of the water and plentiful nutrients, microscopic organisms, such as dinoflagelates, multiply and proliferate. Their coloration changes the colour of the sea water, which takes on yellow, blue, brown, green and orangey hues. This phenomenon is generally known as a "red tide".

Water full of minuscule inhabitants commonly changes into spectacular patches of phosphorescent light at night. In Spanish this phenomenon is called ardora or ardentía (burning); in other words, the sea is on fire. This is due to the fact that some species of dinoflagelates give off light when subject to certain stimuli, including disturbance in the water. It is noticeable when a swimmer or shoal of fish crosses areas containing these organisms or when waves containing them break on the beach. They can even sometimes be seen on wet sand as flickering dots of light around one's feet. This phenomenon can surprise island visitors taking a summer night's stroll.

Looking for a place to live.

Organism distribution in the coastal ecosystem and zoning

Coastal zone

The presence of animals and plants in the coastal zone is **determined by a series of environmental factors** such as substrate, light, currents, wave action, nutrients and relations with other species. Variations in these factors lead to zoning of marine organisms living on the seabed. Known as benthonic organisms, they occupy specific belts or strips according to their needs and limitations.

Within the coastal zone, the frontier between the ocean and the land, there are several benthonic environments, which are particularly obvious on rocky coasts:

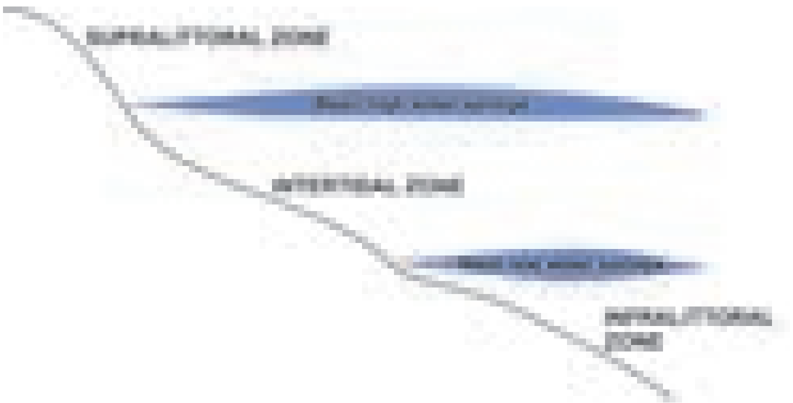
- The **supratidal** zone lies above the highest level of the high tides. It is only reached by wave splash, and although the atmosphere is loaded with salt, prevailing conditions are terrestrial.
- The **intertidal** or **mesolittoral** zone includes between the highest and lowest tides of the year, and is in turn divided into upper, medium and lower mesolittoral. It is a very selective level as every 6 hours it undergoes drastic changes in temperature, salinity, humidity and turbulence. Ability to withstand such conditions determines the vertical distribution of organisms, which however enjoy some advantages such as well-oxygenated water, light and plentiful food.

- The **subtidal** or **infralittoral** is completely marine and includes from the lower limit of the intertidal to the upper limit of the distribution of photophilic algae (those that prefer illuminated zones), at a depth of approximately 30 metres. There is much less turbulence from wave action here and physical and chemical factors are not so variable.

- The **circalittoral** is the barely illuminated zone below the lower limit of the infralittoral as far as the edge of the continental shelf (underwater shelf with a slightly sloping surface near the coast) at a depth of approximately 200 metres. Communities of algae adapted to low light intensity become established in the upper zone, and are progressively replaced by exclusively animal communities.

In each of these environments there are clear differences depending on whether it is a section of exposed, semi-exposed or protected coast, and on whether the substrate is rocky or shifting (sand, mud, shingle, etc.).

Furthermore, in is the **pelagic zone** where the water column goes from the surface to the maximum depth, there are organisms that do not need to be in contact with the bottom.



MARINE ORGANISMS

Human beings are essentially terrestrial. That may be the reason for our ignorance in general of organisms living in the sea. In this framework there are some notions of the nomenclature and basic classification that was used when talking of marine organisms to facilitate the reading of paragraphs specifying the organisms that live in each kind of bed.

Rock with marine organisms

SPECIES SCIENTIFIC NAMES

Living things are classified at several levels. The main ones are: kingdom, phylum, class, order, family, genus and species. A particular species is referred to by its generic name beginning with a capital letter and its specific name in lower case, and we always write it in italics or underlined. For example, the scientific name of the mussel is *Mytilus galloprovincialis*, in which *Mytilus* refers to the genus, and *galloprovincialis* to the species.

When we mention only the genus of a species because we are not interested in going into more detail or because we know the species name, we refer to it as *Genus* sp. (for example, *Patella* sp., an indeterminate species of limpet). However, *Genus* spp. (as in *Zostera* spp.), refers to several species belonging to the same genus.

MAJOR GROUPS FOUND IN THE MARINE ENVIRONMENT

PLANTS

- **Algae** or non-flowering aquatic plants: may be unicellular or very large. The latter are divided into **green** algae (Chlorophyta), **brown** or **dark** (Phaeophyta) and **red** (Rhodophyta).
- **Phanerogams**: flowering plants, like the *Zostera* sp. and *Posidonia* sp. in the Mediterranean.

Green and red algae

LICHENS

They are associations between a fungus and an alga. They are typically terrestrial although some can be found in the coastal zone near the sea.

ANIMALS

- **Porifera** or sponges, so called because their bodies are full of orifices interconnected via an internal system of channels. Natural bath sponges are the skeletons of organisms belonging to this group.
- **Cnidaria** have tentacles with special cells like harpoons (cnidoblasts), with a highly irritating substance, used to catch prey. This group includes jelly fish, corals, anemones and similar animals.
- Worms **platyhelminthes** (flat), **nemertini** (with a proboscis or eversible mouth with sensorial functions), **nematodes** (unsegmented cylindrical worms) and **annelids** (segmented), including the polycheate worms.
- **Crustaceans.** Marine arthropods have a chitinous shell that protects the body and is completely shed to enable them to grow. This group includes goose barnacles, sand hoppers, isopods, crabs, prawns, etc.
- **Molluscs**. This is the most diverse group of marine invertebrates. They have soft bodies covered in a membrane called a mantle which secretes the shell (small, internal or non-existent in some). Includes bivalves such as mussels, gastropods such as winkles, cephalopods such as octopus and squid, and sea slugs.
- **Echinoderms**. Group of organisms with pentarradial symmetry, internal calcareous skeleton covered by the epidermis, with a hydraulic locomotive system (ambulatorial apparatus). Includes ophiurida, starfish, sea urchins and sea cucumbers.
- **Fish** (ichthyofauna). Vertebrates totally adapted to aquatic life may be cartilaginous, such as sharks and rays, or with a bone skeleton such as sole, grouper, etc.
- **Marine mammals**. Vertebrates adapted to aquatic life but breathing air; includes whales, porpoises, dolphins, etc.

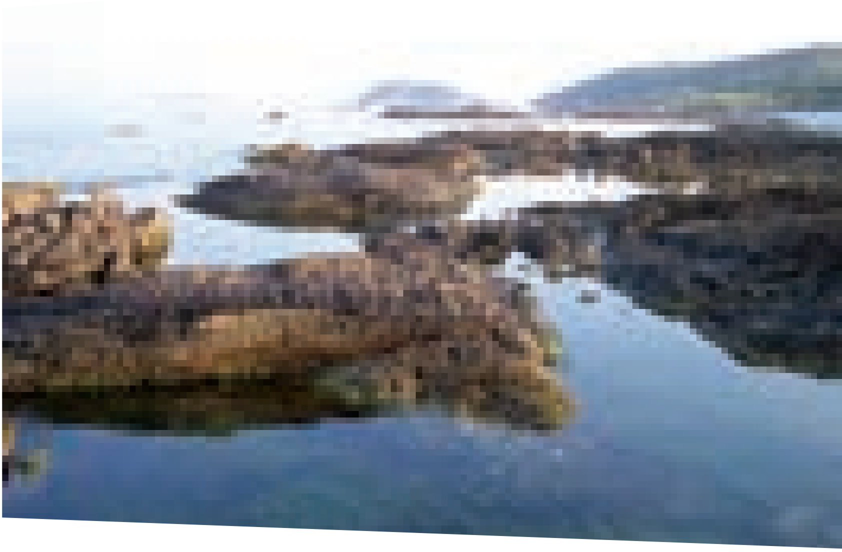
Rocks. A very crowded area

The characteristic that unequivocally identifies coastal rocks is most definitely **water turbulence, which erodes and shapes the coast**. The organisms living there must develop mechanisms able to hold firm to the substrate and withstand the force of the sea. The adaptations that these organisms have developed may be grouped into:

- protective features such as the shells of winkles or mussels, which prevent their being squashed by the force of the water
- features that anchor them to the substrate, as in the case of algae and mussels, which stop them from being dragged along by the currents

On the other hand, thanks to turbulence, coastal water is virtually saturated with oxygen and there is a large amount of organic matter in suspension due to the force of the water breaking up all kinds of dead organisms, which implies certain advantages for organisms in these areas.

Rocky coast on Ons



This, together with the **great variety of habitats** in rocky areas, such as fissures, caves, walls, etc., explains the great diversity of species there, which in turn gives rise to a high degree of competition for space. So, communities usually feature a species that thrives in the prevailing conditions and is replaced by another as conditions change across the supratidal, intertidal and subtidal zones.

SUPRATIDAL

Most of the inhabitants are typically terrestrial organisms such as plants or lichens that have adapted to live in this salt-laden environment. The only representatives of marine fauna are the small winkle (*Littorina neritoides*), a small brown sea snail that lives in fissures and holes in rocks, and the isopod *Ligia oceanica*, which hides under rocks and comes out at night to feed on algae.

INTERTIDAL

Characterised by **high diversity**, it features rather marked zoning in organisms which live according to the time each strip is emerged.

Large areas are occupied by **mussels** (*Mytilus galloprovincialis*) and, in the areas most exposed to the sea, by **goose barnacles** (*Pollicipes pollicipes*), on a base of **barnacles** (balanomorph crustaceans) of the genera *Balanus* and *Chthamalus*, which include the winkle *Littorina neritoides* and limpets (*Patella* spp.).

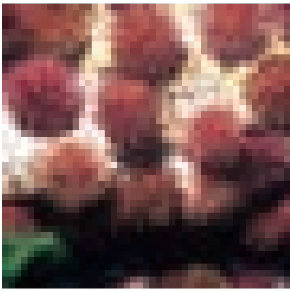
Limpets are a good example of adaptation to avoid desiccation. They adhere so tightly to the rock that they are hermetically sealed and a small amount of water remains inside. When the tide rises, they begin to move slowly in search of food, but when the tide starts to ebb they adhere to the rock again, always in the same spot that the shell has perfectly adapted to in order to improve the tightness of the seal.

Among the algae there are large numbers of incrustating calcareous organisms of the genus *Lithophyllum*, which live on other species such as the small red alga *Ceramium rubrum* on mussel shells, and some other species such as the red alga *Corallina elongata, Gelidium sesquipedale*, the moss *Chondrus crispus* and the genus *Fucus*.

Lithophyllum tortuosum

The gastropods living here include winkles (*Littorina* spp.), thick topshell (*Monodonta lineata*) and *Nucella lapilus*, a predator of limpets, barnacles and mussels, perforating the shell with teeth to eat the soft parts. The purple sea urchin (*Paracentrotus lividus*), marbled rock crab (*Pachygrapsus marmoratus*), sea anemones (*Actinia* spp.) and spiny starfish (*Marthasterias glacialis*) whose staple diet is the mussel, live at this level.

All these animals and plants compete for a place to live, forming a veritable multicoloured carpet on the rock faces.

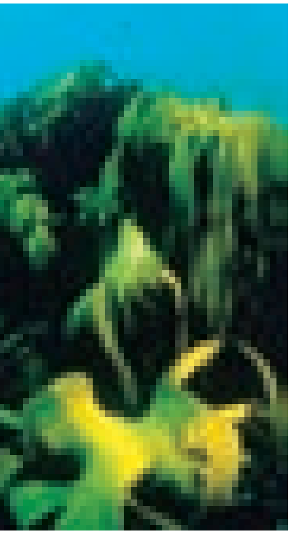


Purple sea urchins

These and many other species who are less able to withstand desiccation live submerged in pools where they seek shelter when the tide goes out. They include anemones (*Anemonia sulcata*), common prawns (*Palaemon serratus*) and fish like gobios (*Gobius* spp.) and blennies (*Blennius* spp.), superbly adapted to life in this environment. These ponds, true oasis where all these organisms find shelter, are also an excellent opportunity to learn more about marine life just by taking a look at the rocks near the beach at low tide, being careful not to disturb the animals in their habitat and to respect the reserve areas.

Gobio sheltered in an intertidal pool

SUBTIDAL



Kelp forest

Spider crab

European conger

Here the outstanding features are the **forests of large brown algae**, regarded as one of Spain's coastal communities that host the greatest wealth of species. They consist of *Saccorhiza polyschides, Laminaria ochroleuca* and *Laminaria hyperborea*, species of large algae that may grow to 2.5 m, strongly anchored to the substrate in exposed and semi-exposed areas. Like great trees, they allow a large number of animals and plants to live among and on them so that a large diversity of species finds their ideal habitat in this ecosystem, which functions like a veritable forest. Regarding plants, the rich undergrowth of red algae also grows on the kelp itself.

These areas supply food and shelter to many species of animals such as polychaeta (bristleworms), abalones or ormers (*Haliotis tuberculata*), the limpet *Helcium pellucidum*, which feeds on the kelp, the velvet swimming crab (*Necora puber*) and the common spider crab (*Maja brachydactyla*). Spider crabs camouflage themselves by attaching fragments of algae, sponges and other organisms to their shell and feet, enabling them to go unnoticed when at rest.

In summer, nudibranchs or sea slugs are common, with bright colours that warn they are toxic in order to put predators off.

Many fish also seek refuge and food in this forest, e.g. pollack (*Pollachius pollachius*), conger eel (*Conger conger*), grouper (*Polyprion americanus*), gobies and blennies.

The kelp undergrowth and kelp-free areas contains the brown alga *Cystoseira baccata*, which although not rich in species, does indicate the presence of the clean pollution-free water that it needs to grow.

"Fields" of anemones often occur among the forests of brown algae. They arise from the herbivorous action of sea urchins. This action controls and limits the spread of the brown algae, which in turn aids the growth of calcareous incrustating algae of the genus *Litophyllum* on which the anemone *Anemonia viridis* grows, forming "fields".

These kelp forests have great ecological value for their productivity and the richness of the species that find refuge here. While these forests are fairly dense across all the rocky areas surrounding the island throughout the National Park, *Laminaria* spp. populations have undergone considerable decline in recent years. The causes is as yet unknown, although a hypothesis has been posed that the decline is due to an increase in water temperature resulting from climate change.

The morphology of the substrate determines the organisms that can live in each area. Where it is vertical, there are Crinoidea of the Echinodermata (*Antedon bifida*) and Ophiuroidea (*Ophiotrix fragilis*), and in caves and fissures, the soft coral known as dead man's fingers (*Alcyonium* spp.), gorgonias (*Lophogorgia* sp. and *Eunicella* sp.) and the sponge *Cliona celata*. Where there are small caves there may be octopus (*Octopus vulgaris*).

Dead man's fingers

RECENT ARRIVALS:
THE THREAT OF INTRODUCED SPECIES

The species in a specific ecosystem are the result of an equilibrium which normally needs hundreds of years to develop and can be upset by different factors in a much shorter time. One of the most important threats to algae is the introduction of alien species, which may replace native species and great changes in the communities of algae and, as a result, in the entire food chain, as just like in the terrestrial ecosystems, plants are the basis.

The major problems currently affecting the Galician coasts are caused by the brown alga *Sargassum muticum* from Japan. It most likely arrived in a consignment of Japanese oysters and was discovered for the first time in Europe in 1973, on the Isle of Wight (United Kingdom). From there it spread rapidly to the Mediterranean, the first record for Spain being on the coast of Guipuzcoa in 1987. In Galicia it is very widespread, inhabiting sheltered and semi-exposed rocky coasts. Sometimes so thick that the local algae die out (in this case kelp are the worst affected), it also represents an important problem to shipping and local economies.

Another aspect of human activity that needs to be borne in mind as regards this plant in the wild is that it is sometimes difficult to control, and we must be aware of the huge impact that our actions are having. In such cases, we must always be cautious and refrain from acting unless we are absolutely sure of the effects that our actions will have on the environment.

Shifting Beds

Life under cover

In areas with less hydrodynamics in which sedimentation prevails over erosion, the seabed has shifting substrates consisting of loose material. The common denominator is the fact that wave action and currents constantly stir up the surface layer to varying degrees depending on the degree of exposure in any given area. Such **substrate mobility** makes it difficult for species to stabilise so most organisms bury themselves in the sediment while always maintaining a link with the surface (endofauna) or move over it or clinging to shell fragments. A glance at the shifting substrates produces an initial impression of desert-like bleakness, when, in fact, they host large numbers of animals. The major shifting beds in the park consist of sand, maërl and shingle; there are, however, also muddy areas around Cortegada and in Cíes Lake.

Sandy stretch on Ons

SANDY BOTTOMS

These form in areas where the water loses force and deposits the sandy sediment that it carries, eroding it at the same time. They form fine sands with a large proportion of clay and silt in more sheltered areas and large and medium-grained sand (except for the fine-grained sand on Cortegada) in the more open areas of the islands. These features are in constant motion either due to the sea or to the wind in the subaerial part. However, defining vertical horizons of distribution like those in the rocky beds is particularly complex as a result.

Supratidal and intertidal: Beaches

The upper part of the beach, which only gets wet at high tide, is home to sand hoppers (*Talitrus saltator*), an impressive jumper that remains buried at shallow depth to keep wet during the day and comes out at night to feed among the seaweed and debris that are washed onto the beach with the tide.

On the strip closest to the water **the permanent ebbing and flowing of the tide and the waves continually sweeps the seabed** in such a way that there is virtually no macrofauna and the only algae are microscopic.

Cuttle fish

Subtidal

Rock with algae on a sandy bed

Like the supratidal and intertidal zones, here the algae are predominantly microalgae, although species such as *Cystoseira tamariscifolia* and *Dyctiota dichotoma* take advantage to anchor themselves to isolated rocks amidst the sand. In more sheltered and lighter zones *Padina pavonia*, *Taonia atomaria* and *Colpomenia peregrina* occur.

Here the abundance of faunal species increases in relation to the beaches. **Sand-dwelling populations of bivalve molluscs** live here, e.g. great scallop (*Pecten maximus*) and queen scallop (*Aequipecten opercularis*) which beat both valves (or shells) to propel themselves along. There are also banks of goose barnacle (*Cerastroderma edule*), pullet carpet shell (*Venerupis pullastra*), rayed artemis (*Dosinia exoleta*) and razor fish (*Ensis* spp.). The latter live buried in permanent deep dens where they move to the upper part and send out extendible appendices to breathe and filter feed.

Gastropods are not so numerous in rocks, but *Hinia incrassata* and cowries (*Trivia* spp.) are common. The cuttle fish (*Sepia officinalis*) is also common, camouflaging itself perfectly on the seabed by varying the colour of its skin. The longest animal found in the National Park also lives on the seabed: the bootlace worm (*Lineus longissimus*). Specimens up to 30 meters have been found.

Turbot

Among the crustaceans the most representative species are crabs such as hermit crab (*Diogenes pugilator*), which occupies empty snail shells to protect its soft abdomen, or the hairy *Atelecyclus undecimdentatus* crab.

The heart urchin *Echinocardium cordatum* buries itself and feeds on organic matter mixed into the sand. Other echinoderms are the Ophiuras (brittlestars) and the sand star *Astropecten irregularis*, voracious predator.

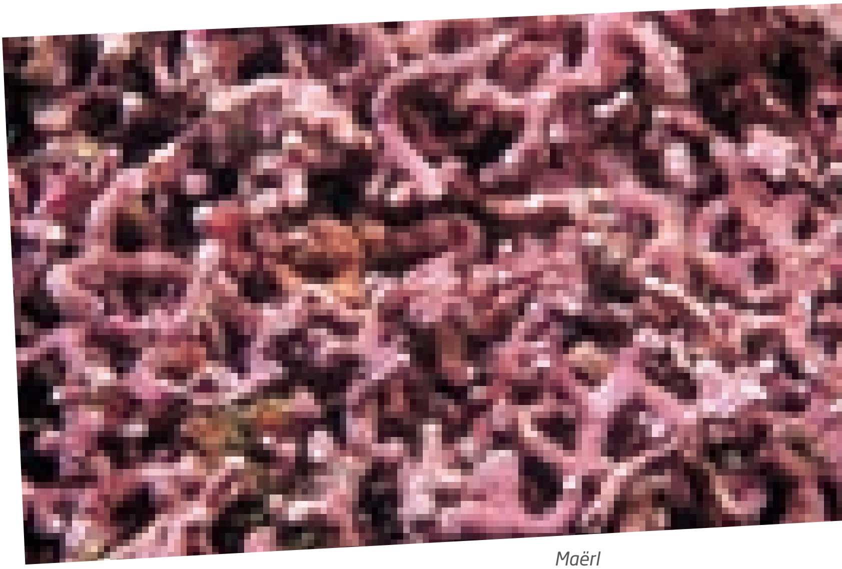
A number of flat fish live on the seabed and blend into the bottom or partially bury themselves, such as the flounder (*Platichthys flesus*), turbot (*Psetta maxima*) and rays (*Raja spp.*). Other fish that bury themselves in the sand are the lesser weever fish (*Echiichthys vipera*), which can inject poison into the feet of any bathers who step on it at low tide, and the lesser sand eel (*Ammodytes tobianus*), which can also be found swimming in large shoals.

Besides all these organisms, the stretches of sand contain a diminutive and rich interstitial fauna in the tiny holes between the grains of sand.

MAËRL BEDS

The term "maërl", from Breton, refers to coral bottoms, which have very a specific substrate and fauna. They consist of **calcareous algae** in the form of free branched strongly calcified arbuscules several centimetres wide. The species that form the maërl banks in Galicia are *Lithotamnion corallioides* and two different species of *Phymatolithon* (*P.calcareum* and another yet to be identified). The maërl banks in Galicia and the islands appear as either pure maërl or mixed beds with different proportions of shingle, stone, gravel, sand or mud.

This structure of vertical layers of sedimentation in which only the algae at the surface level are alive provides an **intricate network of refuges that ena-**



Maërl

bles the beds to host a wide diversity of animal life. The maërl beds are primarily an important habitat for populations of bivalves (many of them commercially valuable) like the yellow carpet shell rayed artemis (*Dosinia exoleta*), queen scallop (*Aequipecten opercularis*) and great scallop (*Pecten maximus*), as well as gastropods such as turban top shell (*Gibbula magus*), hermit crabs of the species *Anapagarus hyndmany* and the long-clawed porcelain crab (*Pisidia longicornis*). For its variety and abundance the polychaeta and small crustaceans such as amphipods and isopods stand out, and among the fish, the lesser sand eel (*Ammodytes tobianus*) are noteworthy. The amphioxus (*Branchiostoma lanceolatum*), which looks like a fish even though it is an invertebrate, spends the day buried with its head sticking out.

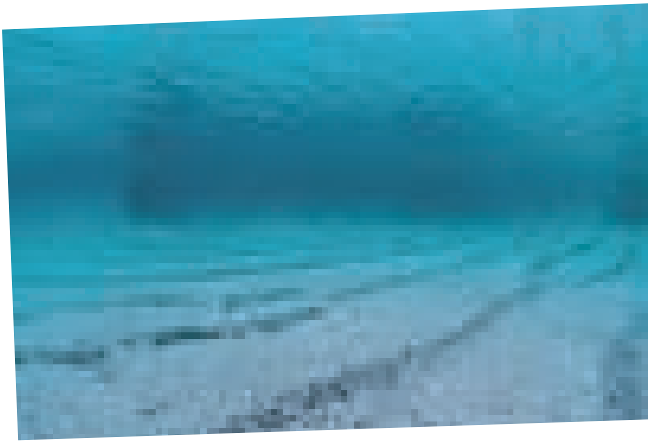
Besides these species, which live in the maërl all their lives, others seek refuge there in their juvenile phases, e.g. velvet swimming crab (*Necora puber*), spider crab (*Maja brachydactyla*), common cuttlefish (*Sepia officinalis*) and commercial fish species. These beds serve as a refuge where the young of these species can survive and grow to become part of the breeding population.

The maërl beds are considered a coastal habitat of high ecological value at a European level due to their high faunal and algae diversity and as areas of high productivity. Moreover, the algae that form maërl are very slow growing and these beds are particularly vulnerable to a number of influences: trawling, the proliferation of invasive species, accumulation of fine sediments, etc. All this means that uses of the beds must be strictly regulated.

SHINGLE BOTTOMS

Shingle bottoms consist of **remains of mollusc shells**, above all bivalves and gastropods. The remains form a layer several centimetres thick where most of the animals living there are buried. The only plants are microscopic algae or small incrusting algae on shell fragments or on the shells of living animals.

There is a variety of hidden fauna: bivalves such as the great scallop (*Pecten maximus*), variegated scallop (*Chlamys varia*), yellow carpet shell (*Venerupis romboides*), goose barnacle (*Cerastoderma edule*), razor fish (*Ensis spp.*) and rayed artemis (*Dosinia exoleta*); gastropods such as the Nassaridae (*Nassariidae spp.*) and the snail Charonia lampas; cephalopods such as the cuttle fish (*Sepia officinalis*) and octopus (*Octopus vulgaris*);



hermit crabs (*Eupagurus spp.*); and a variety of polychaeta (bristleworms), echinoderms, sponges, Ophiurae and Holoturiae (sea cucumbers), which live among the shells or on them. There are also flat fish, rays (*Raja spp.*), lesser weever fish (*Echiichtys vipera*), etc., already mentioned above in connection with other kinds of beds.

Octopus on a mixed maërl-shingle bed

THE LAGOON, AN UNDERWATER MEADOW

Located on the Cíes Archipelago, between the islands of Monteagudo and El Faro, closed off by a dike and by Rodas Beach, this shallow saline lagoon can boast high biodiversity. Although it has a small surface area, there is a great variety of different environments of inter and subtidal sand and rock, and in spite of the fact that its characteristics correspond to a protected area, the tide coming in across the dike transports organisms from exposed areas species associated with different kinds of seabed with different degrees of exposure found there.

Fish fauna is particularly important in the lagoon thanks to the broad range of refuges and plentiful food there. Just strolling along the adjacent dike, you can spot a good sample of this diversity in the shape of thick-lipped grey mullet (*Chelon labrosus*), two-banded seabream (*Diplodus vulgaris*), ballan wrasse (*Labrus bergylta*), pollack (*Pollachius pollachius*), rainbow wrasse (*Coris julis*), conger eels (*Conger conger*), gobies (*Gobius* spp.), blennies (*Blennius* spp.) and even eels (*Anguilla anguilla*); the latter has been declared as vulnerable in the Red Book of Vertebrates of Spain.

From the same place, with a little patience and luck, you may spot octopus (*Octopus vulgaris*), cuttlefish (*Sepia officinalis*) and spider crabs (*Maja brachydactyla*) in the wild.

The sensitivity and fragility of this system mean that the lagoon's great ecological value is easily threatened and so it is important to minimize human pressure on it by avoiding walking in certain areas and by studying and monitoring the potential effects of artificial structures such as the dike or quays. In fact, there has been a degree of saturation in recent years due to sediment accumulation in the lagoon caused by sand from the sand dune and the effects of the dike on the lagoon's hydrodynamics. Its vulnerability has led to its being declared a Reserve Area in the Atlantic Islands of Galicia Natural Resources Plan, one of the legal instruments governing national parks.

Rainbow wrasse

Swimming in the Pelagic Zone

The pelagic zone, which extends from the water surface down to depths, contains organisms that do not need to be in contact with the bottom and do not depend on it directly although they may do so due to the kind of food they ingest. They are divided into:

- plankton: organisms that move passively, being swept along by the currents. It is in turn divided into phytoplankton or plant plankton, and zooplankton, made up of animal organisms.
- nekton: more active organisms able to withstand marine currents.

The original Greek term "plankton" means "wandering". It consists mostly of microscopic beings, but also includes other easily visible ones such as jelly fish. Although small, these organisms form a kind of living broth which forms the basis of marine food chains, and as such regulates to a large extent the structure of oceanic ecosystems.

School of Salema porgy (Sarpa salpa)

As regards fish, part of the nekton, it is possible to tell apart pelagic species, which spend their entire lives in the water column or in contact with the bottom only at specific periods, and demersal species, which are indirectly associated with the bottom via food, e.g. sea bream (*Diplodus* spp.) and thick-lipped grey mullet (*Chelon labrosus*), from those mentioned in the sections devoted to the various kinds of seabed.

Pelagic fish are not brightly coloured, and, as is often the case in Nature, have cryptic colouring that imitates the natural habitat and serves to fool predators and to stalk its own prey. So, most have a greyish blue back to blend in with the blue of the sea as seen from above, while their silver abdomens blend into the shimmering surface when seen from below.

Their long spindly, hydrodynamically-shaped bodies help them move very fast in this **domain of great swimmers**, where they tend to live in large shoals for protection.

Amongst the most common fish in this area are the lesser sand eels (*Ammodytes tobianus*) and Atlantic mackerel (*Scomber scombrus*), which occur in large shoals, and solitary fish such as John Dory (*Zeus faber*).

Cetaceans also pass through this area. Perfectly adapted to pelagic life, the bodies of these marine mammals have undergone important changes that have left them with a fish-like appearance very different from the typical body patterns of mammals. Bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), porpoises (*Phocoena phocoena*) and pilot whales (*Globicephala melas*) can occasionally be seen, although never close by, around the islands and also from boats travelling to them.

Diving around the Atlantic Islands:

Site location

The geological composition and oceanographic conditions of currents, wave action, etc. determine the kind of seabed in any given zone.

More exposed to the continual beating of the waves, the western side of the Atlantic Islands in Cíes, Ons and Sálvora is quite homogenous as far as the seabed is concerned. It almost totally consists of rock. The force of the ocean prevents small-grain sediment being deposited there, and constantly erodes the coast, forming cliffs. However, in deeper waters of this western side, where the force of the waves is lower at 25-30 meters depth, some areas of medium and coarse sand and shingle have been deposited, especially in the Cíes Islands and Sálvora.

There is a greater variety of marine habitats in the more protected eastern part facing the estuaries. The various types of substrates in different areas are the product of hydrodynamics and sediment dynamics. There are beds with different-sized shingle and maërl sand as well as

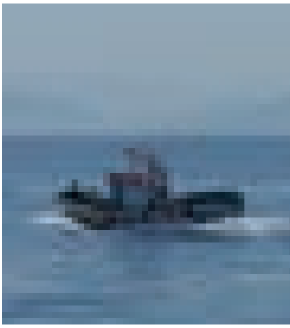
rock. Sálvora's eastern side is flanked by a strip of mixed rock, sand and maërl, with sands located in deeper waters. The entire eastern coast of Ons is surrounded by a rocky platform that gives way to large areas of predominately medium-grained sand and maërl banks at approximately 10 meters deep. Finally, sand beds in the Cíes are located in shallower waters, occupying almost the entire eastern side of the islands, and are interspersed with areas of rocks and maërl.

Cortegada is an exception within the Atlantic Islands as it is located in the innermost part of the Arousa Estuary, with less marked hydrodynamics, where the surrounding seabed chiefly consists of predominantly fine and muddy sands; even when rocks appear on the strip adjacent to Cortegada and the islets they are interspersed with sand.

The marine environment is the national park's chief asset, one of the reasons underlying its status, and one of the best conserved ecosystems within the park. Protecting and improving it are priority aims in park management.

Sustainable fishing, a viable alternative

Nowadays when, worldwide, 30% of major fishing reserves are over-exploited and 52% are exhausted, requiring efficient management to prevent further decline (FAO, 2012), any references to fishing always seem to signify something negative. However, viable alternatives to unsustainable fishing do exist, bearing in mind that managing the exploitation of marine resources must be compatible with biological, economic and social resources.



The rich seabed of the Atlantic Islands has helped to sustain local populations through fishing and shell fishing. The fishing has been largely of the inshore kind on a small scale and more environmentally friendly than the industrial variety as catches are smaller and more selective.

The current aim is to regulate this activity in order to **make conservation and improvements to this exceptional marine ecosystem compatible with maintaining sustainable inshore fishing in park waters**. This is based on:

- setting out the kinds of fishing tackle and number of catches compatible with conservation
- marine zoning, which would regulate the different uses (sailing, anchorage, subaqua diving, fishing, etc.) and would include totally off-limits integral reserves; they would act as natural nurseries that could even help to regenerate the park's external marine ecosystems.

Regulating fishing in the national park not only makes conservation and sustainable use possible, but also yields economic and social benefits for the entire surrounding community, enhancing social cohesion and becoming a powerful management tool.

Terrestrial flora and vegetation

ATLANTIC ISLANDS FLORA ON THE EARTH.

BIOGEOGRAPHY

Biogeography is the science that links geography and ecology in the study of the distribution of living things on the Earth. On the basis of climatic, geological, soil criteria, etc., there is a hierarchical arrangement of units to classify the Earth's flora and vegetation. On the basis of that classification the national park's four archipelagos come within the Eurosiberian Region, Atlantic superprovince, Atlantic-European province and occupy the Miñense Subsector of the Galaic-Portuguese sector, the latter having a markedly Mediterranean climate, with more severe summer drought.

Different bioclimatic belts resulting from the lowering of temperatures according to altitude leads to vegetation zoning. As altitudes in the national park are low, it is part of the thermocoline horizon. Being strictly coastal and featuring mild winters means that many heat-loving plants unable to withstand cold occur there.

Flax-leaved daphne, a Mediterranean plant

As regards rainfall and temperatures (ombroclimate) and taking into account complete data from the past seven years (prior to 2014), the average temperature is 15ºC and the average rainfall is above 1,000 mm, except on the Cíes Islands. Thus, even though Cortegada is classified as humid, the ombroclimate is considered warm and subhumid.

VERY VARIED PLANT LIFE

Today's plant life on the archipelagos in the national park is essentially determined by the confluence of environmental factors and the by-products of human occupation, each one offering a different panorama.

The **Cíes** Islands, with their rugged cliffs, host a varied flora, which adds more colour to the marine setting.

They are covered in gorse in the higher areas, and eucalyptus, acacias and pines further down, broad forest cover contrasting with the white sand of the beaches and dunes.

Cíes

Ons

On the **Ons** Archipelago, with its gentle and flat outline, there are large stretches of gorse with isolated formations of eucalyptus, acacias, pines and small stands of willow. Some parts of the cliffs are carpeted in ground hugging formations of thrift (Armeria pubigera) and offer lovely panoramic views.

Sálvora

On **Sálvora**, the island's large characteristic blocks of granite occasionally show through the low vegetation of gorse, ferns and other herbaceous species. The cliff flora is bent by strong winds and mixed in with the nearby dunes in some areas. The adjacent islands, Sagres, Vionta, Noro, Gaboteira, Herbosa, etc. have low vegetation and herbaceous formations. Vionta, the sandiest of the five, has dune flora and a few broom bushes.

Cortegada

Unlike the above archipelagos, the image that visitors take away of **Cortegada** Island is one of trees: patches of forest, shady woodland of oaks, laurels and willows with climbing plants carpeting the ground, tracts of pine and eucalyptus concealing the ruins of a former settlement, and small patches of ground covered in alders.

Predominantly herbaceous plants grow on the islets of Malveira Grande, Malveira Chica and Briñas, although Malveira Grande has a small stand of Pyrenean oak.

FACTORS THAT ALTERED THE LANDSCAPE

The Atlantic Ocean washes the four archipelagos in the national park, giving form to unique and spectacular scenery on each of the islands. It is the main agent in shaping the landscape either directly through wave action on the coast or indirectly via factors such as strong winds from the sea, making it difficult for living things to survive in such environmental conditions.

An essential feature of the landscape, vegetation is greatly determined by wind, high salinity, summer drought and poor soil development. These factors give rise to a mantle chiefly composed of scrub, in which tracts of woodland are likely to be in the most sheltered spots where soil is deeper, e.g. river beds. Thanks to its sheltered location in the ría and its topography, environmental conditions on Cortegada are milder, differentiating them from the rest of the park's archipelagos.

This landscape has been artificially altered to a great extent since ancient times so the plant life now found on the four archipelagos bears little resemblance to the original island vegetation. Although manmade change began in prehistoric times, most existing information dates from the last few hundred years, when diverse factors led to alterations to the landscape:

Ons Island

- **Fertilization**, crops or livestock excrement altered soil composition, benefiting some species over others. On cliffs, nutrient input from gull colonies also altered plant communities.
- Traditionally, vegetation **growth was controlled** by livestock grazing, a practice which still impacts the scrub on Sálvora today, and by felling for firewood, which mainly affected gorse and broom.
- Arable fields on fertile land and trampling and foot-paths caused by livestock and by people led to **surface erosion**, which the increase in tourism has aggravated on the dune systems.
- **Fire** was another factor in transforming the landscape, from burning to create grazing land to wildland fires.
- Ranging from market gardening species to large-scale reforestation schemes involving pines, eucalyptus and acacias in the mid-twentieth century, the **introduction of exotic species** has been a determining factor in altering the vegetation. It is very marked on the Cíes Archipelago.

Gulls on the cliffs

Horses on Sálvora

With the depopulation of the islands in the twentieth century, and the subsequent declaration of the Cíes Islands as a natural park in 1980 and the rest of the archipelagos as a national park in 2002, many of the abovementioned factors either disappeared or were minimised. On Cortegada and Sálvora, for example, there is still grazing by herbivores.

Although the landscape is constantly evolving naturally, it often does so brusquely due to human action. That is when people must once again intervene to turn back the clock. As regards landscape, the Management Plan for the National Parks Network states: “landscape shall be preserved as one of the parks’ main values”, and “attempts shall be made to return to a state as close as possible to that resulting from natural evolution”. It is the responsibility of the national park to preserve, and when necessary, recover, natural development and the ecosystems and landscape which that development gives rise to.

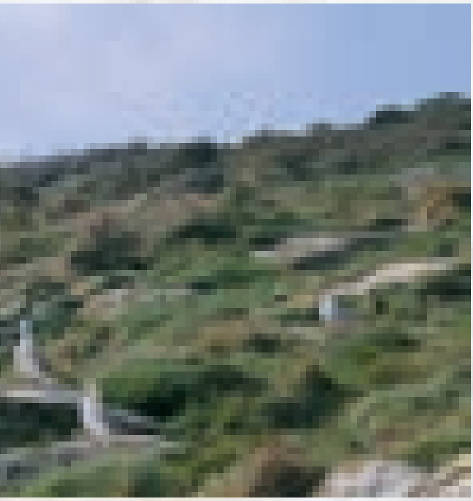
Crops on Ons Island

LARGE NUMBERS OF SEABIRDS ON THE CLIFFS LEAD TO MAJOR CHANGES IN THE DOMINANT VEGETATION

The typical vegetation on most of the Atlantic cliffs does not correspond with the typical community in that same vegetation belt in the rest of Galicia. Environmental conditions on the cliff, including intense winds, steep slopes and high salinity, make the development of plant life difficult. However, over a large part of the Atlantic Islands there is a unique factor that greatly impacts the islands' plant life and biodiversity: seabird colonies, especially Yellow-legged gull.

The strong impact gulls have during the breeding season by trampling, digging and providing nutrients from their droppings gives this habitat its own environmental characteristics and results in a distribution of plant communities on the cliffs that is much more complex than those on the mainland, which are not impacted by the presence of gulls.

Soil analyses on the Cíes Islands and Ons yielded significantly greater values for nitrogen and other compounds, which appear in high concentrations in gull droppings. As a result, there are some markedly nitrophilous plant communities (which grow in nitrogen-rich soils), with species such as common velvet grass (*Holcus lanatus*), angelica (*Angelica pachycarpa*) or nettle (*Urtica membranacea*). This differentiates them from typical Galician communities. Vegetation that has been shaped by the gull colonies is part of the island landscape, which is always under the influence of the sea and, in this case, that of the birds living in close association with it.



SURVIVING A HARSH ENVIRONMENT: PLANT ADAPTATIONS

Over time, environmental conditions have fluctuated in different geological time periods. Since they first appeared 400 million years ago, plants have had to evolve gradually in tandem with changes in the environment. Only the species that underwent evolutionary processes which improved adaptation to the new conditions have managed to survive to the present day.

Nowadays, too, environmental conditions vary a great deal from one region of the world to another. This means that in some zones there is tropical forest and in others desert vegetation. That also occurs on a smaller scale in the sense that conditions on the coasts differ from those in the interior. Along with soil type, environmental conditions largely determine the existence of one or other kind of vegetation.

On the coast, vegetation growing on the strip closest to the sea has to withstand high salinity, strong winds, spray, highly porous soils with little capacity to retain water and nutrients, intense insolation due to reflection from the sand, a shifting sandy substrate, etc. The success of plants growing in this environment lies, therefore, in their adaptations to withstand impediments to growth. They have developed mechanisms such as:

- **Adaptations to wind:** Rounded ground-hugging plant formations to withstand the wind. These adaptions are commonly found in thrift (*Armeria pubigera*) or gorse, which grow on cliffs.

The ground-hugging form of armeria.

Cottonweed

Lily of sea

Linaria polygalifolia

- **Adaptations to insolation:** Occurs mainly on dunes where the reflection of light from the sand enhances the effect and increases temperatures. Examples can also be found on cliffs. The plants develop white colouring, hairs, coverings of wax and other substances, thickened cuticles, etc., to reflect light, which has such a direct impact on them. The dune plant known as cottonweed (*Otanthus maritimus*), for example, is covered in hairs.

- **Adaptations to drought:** On beaches porosity of sand makes water retention difficult and leads to very dry environments that are poor in nutrients. To counteract such adverse conditions, some plants develop roots to trap water, e.g. marram grass (*Ammophila arenaria*), or water storage structures like the bulbs or tubers of sea daffodils (*Pancratium maritimum*), or the thickened leaves of sea rocket (*Cakile maritima*). To avoid water loss, plants develop mechanisms that reduce transpiration, e.g. a small leaf surface, hard pointed leaves, a protective wax coating on the epidermis.

- **Adaptations to living in sand:** Apart from the problems already mentioned, life on the sand poses other difficulties. The shifting substrate moves in the wind, leaving roots exposed or burying plants. Having to endure the scarcity of nutrients and the impact of sand on the plant surface, which leads to tissue abrasion and flexion of aerial parts. Reinforced tissues, long roots, smaller leaf size and association with nitrogen-fixing bacteria are a few of the adaptations to counteract the affects. Examples can be found in the hardened leaves of maritime crosswort (*Crucianella maritima*) and the narrow leaves of *Linaria polygalifolia* and *Helichrysum italicum* subsp. *serotinum.*

Sarcocornia perennis

- Adaptations to salinity: High salinity levels in the environment make life difficult for plants as they impede water absorption. Halophilous plants are specially adapted to such settings, and usually look fleshy as they accumulate salts and water in their cells to make up for the salt concentration outside and to facilitate water absorption. Another mechanism involves saving water. To do so, many species reduce their leaf surface area, e.g. *Sarcocornia perennis* and *Salicornia ramosisima*, or excrete salt via glands, which makes them white, thus preventing the parts exposed to the sun from heating up.
- Adaptations to immersion: Plants that spend most of their lives under water are not affected by desiccation. In their case, the difficulties lie in the exchange of gases, trapping light and withstanding water currents. As a result, aquatic plants develop different kinds of leaves: submerged leaves may well be narrow and thin to promote the exchange of O2 and CO2 and light absorption; floating leaves, with no light- and gas-trapping problems will be thicker and rounded to increase floatability. These two kinds of leaves occur in pondweed (*Potamogeton* spp).

ECOSYSTEMS

This section covers different kinds of vegetation on the four archipelagos of the national park. Eight groups of vegetation have been described depending on the habitat occupied or the kind of formation.

Rocks and coastal cliffs

They are highly influenced by the sea, where the beating of the waves, high salinity and poor soils impose very adverse conditions for plant growth and where only specialised vegetation is able to get established. The strong winds in this area also hamper plant growth. As a result the vegetation adopts a ground-hugging form that offers less resistance. The nesting colonies of seabirds, chiefly gulls, are also a factor as their droppings enrich and fertilize the soil causing changes in the plant communities.

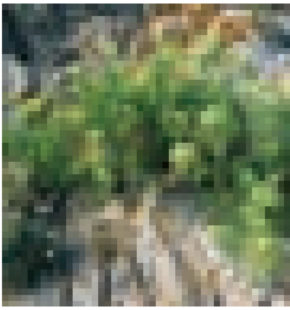
On the Atlantic Islands these ecosystems are broadly represented from the rugged cliffs of the Cíes and Ons archipelagos to the gentler ones on Sálvora, or the uncommon rocky coasts of Cortegada, where the limiting factors are minimised as they are sheltered within the Ría de Arousa.

On the cliffs of Cíes, Ons and Sálvora there are several different vegetation belts which vary according to their proximity to the sea. In the lowest parts nearest the sea, a community occupies cracks in the rocks and is very affected by spray. It features rock samphire (*Crithmum maritimum*), and thrift (*Armeria pubigera* subsp. *pubigera*).

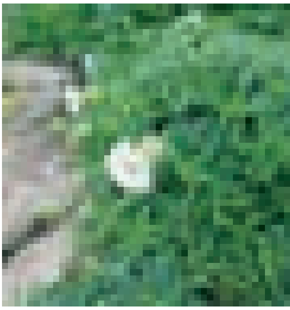
In parallel, in wetter and shadier sectors such as furnas, or caves, there is a community in which sea spleenwort (*Asplenium maritimum*) is predominant. This **vegetation** belt is known as **halocasmophytic**, a term that refers to its ability to withstand salinity and to grow among the rocks. It is the only belt on Cortegada, except for the island of Malveira Grande, where cliff scrub also grows.

In the same belt in areas much affected by seabird colonies, the previous community is replaced by another halonitrophilous one that is resistant to salinity and high nitrogen contents, whose typical species are scentless chamomile (*Matricaria maritima* subsp. *maritima*), *Cochlearia danica* and nettle *Urtica membranacea*.

The next vegetation belt of **aerohalophilous grassland** lies above the previous one. It is splashed by sea spray, which leads to the high salinity to which the term refers and to the strong winds in this area. Greater soil development allows the establishment of grassland dominated, depending on the zone, by thrift (*Armeria pubigera*) or sea campion (*Silene uniflora*) and orchardgrass (*Dactylis glomerata* subsp. *maritima*). The typical cliff grassland communities of the northwest of the Iberian Peninsula are dominated by festuca (*Festuca rubra* subsp. *pruinosa*) and Queen Anne's lace (*Daucus carota* subsp. *gummifer*), but in the park it is only common on Ons, being very scarce on the Cíes Islands due to the nitrifying effect of the gull colonies. In the parts most affected by the colonies, these communities have been altered and contain more markedly halonitrophilous plants such as common velvet grass (*Holcus lanatus*) and angelica (*Angelica pachycarpa*). On south-facing slopes associated with this influence, there is a community endemic to southern Galicia consisting of the marigold Calendula suffruticosa subsp. algarbiensis and wall pellitory (*Parietaria judaica*).



Rock samphire



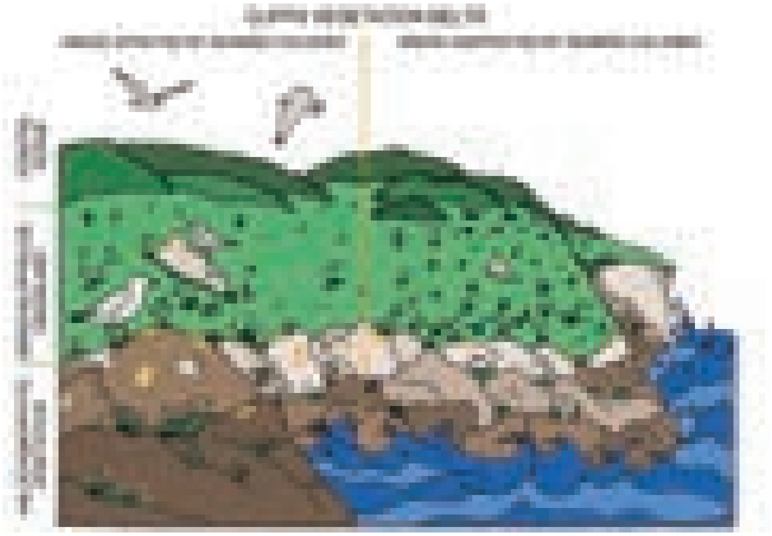
Sea campion

Sea marigold

Coastal gorse

Angelica pachycarpa

Finally, on the upper part of the cliff (the belt least affected by spray) there is **coastal scrub, cliff scrub or aerohalophilous scrub**. This belt chiefly consists of a subspecies of endemic Galaic-Portuguese gorse (*Ulex europaeus* subsp. *latebracteatus*), which is highly adapted to the harsh ecological conditions in this environment. It grows together with common herbaceous species in aerohalophilous pastures such as *Silene uniflora*; angelica (*Angelica pachycarpa*) and the cliff daisy *Leucanthemum merinoi*, endemic to the coasts of Galicia and northern Portugal; *Dactylis glomerata* subsp. *maritime*; and several ligneous species of optimum Mediterranean e.g. rockrose *Cistus salvifolius*, flax-leaved daphne (*Daphne gnidium*) and broom *Osyris alba*. This scrub extends beyond the domain of the cliff into the east of the islands. On some slopes there are also stands of blackthorn (*Prunus spinosa*), which is dealt with in the section on scrub.



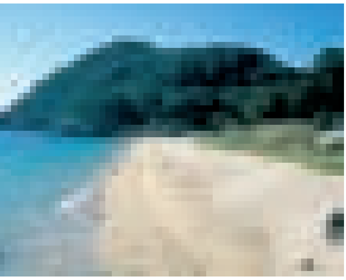
TRADITIONAL CURES USING MEDICINAL PLANTS: DISAPPEARING KNOW-HOW

The geographical isolation and harsh living conditions, including a lack of medical care, that led the inhabitants to leave the islands for good in the closing decades of the 20th century gave rise to a wealth of knowhow relating to the medicinal uses of plants. This knowledge is gradually being lost as people emigrate to the mainland and the last generations that used them disappear. Current knowledge about this cultural heritage comes from Ons, the only one still populated and the last one where such remedies are still applied.

Visiting the doctor was normally difficult and sometimes impossible in winter. At best it meant missing at least a whole day's work, so people only tended to go when traditional remedies did not work.

This traditional medicine was based, on the one hand, on the application of plant-based remedies, and on the other, on rites and magic incantations to ward off illness, especially when the nature of the ailment was unknown and attributed to the evil eye. The few studies conducted in this field indicate that over 40 plants were used for medicinal purposes, including tansy ragwort (*Senecio jacobaea*), honeysuckle (*Lonicera periclymenum*), common mallow (*Malva sylvestris)* and elderberry (*Sambucus nigra*). The remedies were prepared in infusions, ointments or by extracting plant sap, and used for all kinds of ailments, colds, diarrhoea, wounds and rheumatic pains. Now that almost the entire island population has moved to the mainland, where going to the doctor is not usually very difficult, these written documents look set to be the only depositaries of the immense cultural wealth that this knowhow represents.

Honeysuckle flowers were used to treat asthma



San Martiño Beach

Sea rocket

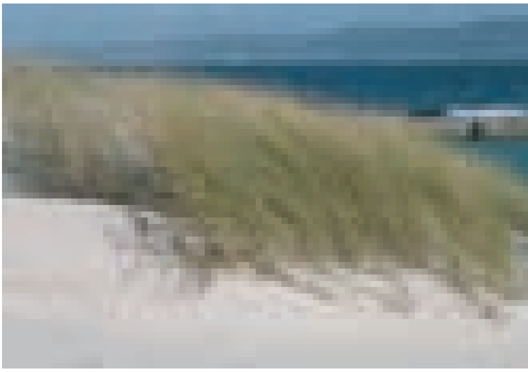
Sea holly

Beaches and Dunes

These habitats withstand high insolation and severe drought and salinity, with a substrate very poor in nutrients which, due to the winds and the lightness of the sand, give rise to shifting and constant changes. These characteristics require species to have a high degree of specialization, forcing the arrangement of different plant communities in belts according to the distance from the sea.

The first vegetation belt closest to the sea corresponds to **beach vegetation**, which is present on all the National Park archipelagos, but not on all the beaches. Here, the accumulation of nitrogen due to the deposit of marine organic remains washed ashore favours the growth of a small number of nitrophilous species with a short life cycle and which are affected by tidal drag. It features a plant association that includes sea rocket (*Cakile maritima*), sea sandwort (*Honkenya peploides*) and sea knotgrass (*Polygonum maritimum*), etc.

Dune vegetation is found in the belt above beach vegetation and is present in all dune systems on all the archipelagos, e.g. the Figueiras-Muxieiro dune complex, the San Martiño Beach complex, both on the Cíes Islands, Melide Beach on the Ons Islands and Lagos Beach on Sálvora.



Marram grass

The **first dune front (primary dunes)** is nearest the coast in an area very exposed to marine dynamics so it is often transported by the waves and plant colonization must start over again. The vegetation basically involves sand couch (*Elytrigia juncea* subsp. *borealis-atlantica*) whose long roots enable it to stabilise the substrate and withstand the effect of wave action at high tide and wind, and gradually stabilise the sand behind it. Other species are sea thistle (*Eryngium maritimum*) and shore bindweed (*Calystegia soldanella*).

Secondary dunes form the second vegetation belt. They are still shifting dunes but not as unstable as those mentioned above. As a result a larger variety of species can get established, which stabilises a greater amount of substrate, acting as sand reservoirs, thereby contributing to beach equilibrium. It is a system in constant movement due to the wind and sea which erode it and at the same time enable it to take shape. This strip features marram grass (*Ammophila arenaria* subsp. *australis*), which colonizes the dune crests thanks to its roots up to 4 metres deep. They enable it to become stabilised and successful in this setting, in which the wind blows more strongly and dune morphology is variable. Accompanying species are cottonweed (*Otanthus maritimus*), shore blindweed (*Calystegia soldanella*) and sea spurge (*Euphorbia paralias*).

Linaria Arenaria - A SMALL UNCOMMON DUNE PLANT

Its distribution range is restricted to the western coasts of France and Galicia

Scientific name: *Linaria arenaria*

Family: Scrophularials

Linaria arenaria populations can still be found in the dune systems on the Cíes Islands, Ons and Sálvora. The range of this little plant is restricted to a few points on the French coast and four islands on the Galician coast and it is classified “Endangered” on the Galician Endangered Species List and as “Critically Endangered” in the Red Book of Endangered Vascular Flora of Spain.

This annual plant can grow up to 15 cm and has small yellow flowers from May to June. It lives on relatively well established coastal dunes and stretches of sand. Although undisturbed by slight alterations to the terrain (it may grow along quiet roadsides), it tends to disappear when human pressure increases, and is particularly sensitive to trampling and artificial changes to habitat.

Thanks to the fact that there is no public access the Sálvora population is the highest and densest in Galicia, while on Ons the population is scarce and declining due to pressure from tourism. Given the sensitivity of this species special care must be taken on beaches with dune systems, and access has sometimes to be restricted or denied using fencing in order to protect plants threatened by alterations to the dunes.

Linaria arenaria

Armeria pungens, A PLANT WHICH ONLY GROWS ON THE ISLANDS IN GALICIA, IS A REMINDER OF CLIMATES PAST

Galician name: Herba de namorar das dunas

Scientific name: *Armeria pungens*

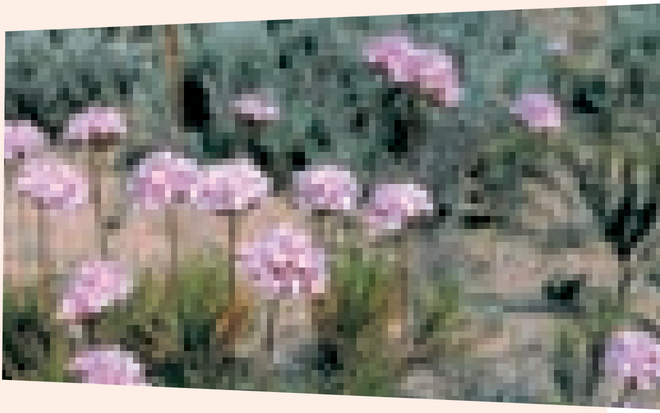
Family: Plumbaginaceae

This species of the genus Armeria lives on dunes and stretches of coastal sand, and occasionally on cliffs. It should not be confused with the more common *Armeria pubigera* (Herb of Love), which grows mainly on cliffs.

This small bush may reach 50 cm high, with many long branches that keep the dry leaves. It flowers between March and May.

The importance of this plant in the national park lies in the fact that the only populations in Galicia and northern Spain occur in the dune systems of the Cíes Islands. The species is otherwise distributed across the southwest of the Iberian Peninsula, Corsica and Sardinia. Its presence here reveals a formerly broader distribution range corresponding to a time when climatic conditions in Galicia were more similar to current conditions in southern Spain.

In the event of their disappearance, recovery of such isolated populations would be a very complicated task. Their natural habitat is under permanent threat from tourist pressure and the plants that live there are particularly sensitive to continual transit across the dunes. For that reason it is advisable to avoid walking on them.



Armeria pungens

PLACE NAMES TELL US ABOUT THE FORMER ABUNDANCE OF PORTUGUESE CROWBERRY IN GALICIA, A PLANT NOW FOUND ON THE CÍES ISLANDS

Iberian-Atlantic endemic species

Galician name: Camariña, caramiña.

Scientific name: *Corema album* subsp. *album*.

Family: Empetraceae.

Although this species was cited in the past as being abundant along the entire coast of Galicia, as the names of settlements such as Pobra do Caramiñal suggest, its current situation reflects a severe decline. Nowadays, inside the national park Cíes is the only one in the archipelago hosting this species, more specifically on the strip of scrub on the Muxieiro dunes. This population, together with the Trece Inlet in A Coruña, is one of the main Galician populations, the most northerly one. In the south of the Peninsula it is still widespread.

The Portuguese crowberry is a long-lived and slow-growing shrub that lives on coastal dunes and grows to just over half a metre high. Its narrow leaves are arranged in four rows; the round fleshy fruits are food for several animal species which play an important role by dispersing seeds via their droppings. Young plants grow mainly in open areas so the processes that lead in a non-natural way to greater plant coverage of the dune (e.g. colonization by pines and acacias) will reduce the populations' regenerative capacity. Other causes for their decline are the disappearance of dune systems due to pressure from tourism along the coast and trampling, to which Portuguese crowberry is very sensitive.

The Muxieiro Dunes are fenced in to restrict visitor access and protect this emblematic species and others However, conservation must not limit restriction on access; rather it should demand a joint effort by managers and visitors.

Portuguese crowberry

As the further away one goes from the sea, the less harsh the environmental conditions, tertiary dunes or dune fields form. Here the effects of wind and salinity diminish, leading to a rise in the numbers of species colonising this belt and to the extent of coverage. It features a scrub comprising halophilous species (which grow in saline soils) dominated by plants exclusive to the Ibero-Atlantic coast such as “helicriso” (*Helichrysum italicum* subsp. serotinum), figwort (*Scrophularia frutescens* var. *frutencens*), “artemisia de playa” (*Artemisia crithmifolia*) and iberis (*Iberis procumbens* subsp. *procumbens*), and others with a wider distribution range like maritime crosswort (*Crucianella maritima*). On Cíes Archipelago there is a community of Armeria pungens and Portuguese crowberry (*Corema album*).

In the clearings of secondary and tertiary dunes, annual communities feature the "violeta de dunas" (*Viola kitaibeliana* var. *henriquesii*) and shore campion (*Silene littorea* subsp. *littorea*), which is an endemic Iberian species, while Sálvora and to a lesser extent Ons, host the chief Iberian populations of *Linaria arenaria*. On the tertiary dunes there are other communities, with a Galician-Portuguese range, consisting of short grassland, *Linaria polygalifolia* and the grass *Corynephorus canescens* being characteristic species.

Finally, further inland of the tertiary dune there is a **cross-dune scrub**, only found on Cape Vilán and, in the Figueiras-Muxieiro dune system on the Cíes Islands. The large numbers of Portuguese crowberry (*Corema album*) and gorse (*Ulex europaeus* subsp. *latebracteatus*) differentiate this community from other similar ones further south.

Iberis

Shore campion

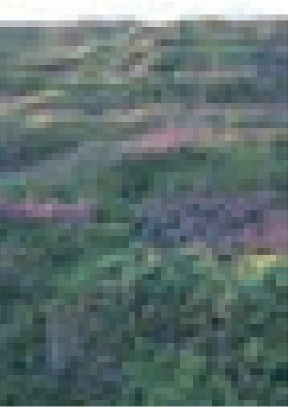
Portuguese crowberries

Coastal gorse scrub

Scrub

Most of the upper part of the national park is covered in scrub, native woody communities whose composition and character varies on the different archipelagos.

Most is coastal scrub (already dealt with in the section on cliff vegetation). It is a climax community, which is a mature and more stable stage of natural vegetation. In other cases it represents a stage prior to the regeneration of arboreal vegetation in the processes of succession, with impenetrable tracts of gorse (*Ulex europaeus* subsp. *latebracteatus*), heathers (*Erica umbellata, E.cinerea, E. ciliaris*), common western brackenfern (*Pteridium aquilinum*) and elm-leaved bramble (*Rubus ulmifolius*). On the Cíes Islands this association is unique in that it does not have any heather (*Erica* spp.), which is common in Galicia.



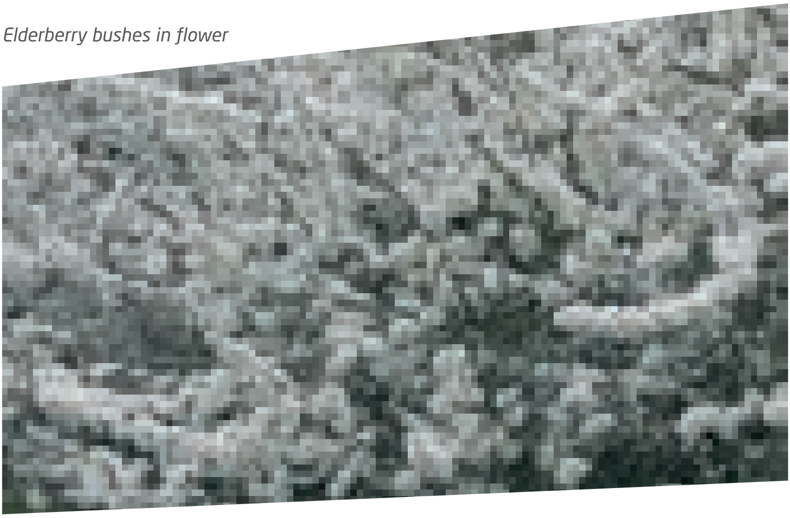
Heather on the island of Ons

On Ons and Sálvora and rarely on Cortegada there are wet or hygrophilous stands of heather, which grow on deeper wet soils. They feature heather (*Erica ciliaris*) and the cardoon *Cirsium filipendulum*, together with gorse (*Ulex europaeus* subsp. *latebracteatus*).

Another kind of scrub is the broom stands, formations of broom that are very scarce on the Cíes Islands, where only the *Cytisus striatus* species is found, and Cortegada, where they are represented by *Cytisus striatus* and *C. scoparius*, a common species in Galicia. They are more abundant on Ons, where *Cytisus striatus* occurs with another very interesting recently discovered broom, recorded in 2001 and the only endemic species exclusive to the national park: the *Cytisus insularis* broom.

The blackthorn formations (*Prunus spinosa*) that live on cliffs as mentioned above are also found in the scrub and are present on all the National Park's archipelagos. While studies on this plant are scare, the species is of great interest as it corresponds to periods that predate the natural tree cover, and could be regarded as native thorn bush communities of the forest ring, i.e. small formations found on the periphery of forests. In this case they replace the forests and are the final stage in this zone. They are spread in patches among the stands of gorse, both on the western cliff slopes and on the eastern face, occupying on deepest soils. On Ons, Sálvora and Cortegada there are also common hawthorn (*Crataegus monogyna*) and elderberry (*Sambucus nigra*).

Elderberry bushes in flower



Cytisus insularis IS THE ONLY BROOM SPECIES EXCLUSIVE TO THE ATLANTIC ISLANDS

Endemic species on Ons and Sálvora

Galician name: Xesta of Ons

Scientific name: *Cytisus insularis*

Family: Legumes

In 1998 in the course of studies conducted to prepare the proposal for declaration as a national park, a large number of the broom bushes on the island of Ons were seen to have morphological differences compared with *Cytisus striatus*, which it was classed as. When studied in detail, it was discovered to be a different and previously unknown species and was named *Cytisus insularis* S. Ortiz & Pulgar in Bot. J. Linn. Soc. 136(2): 00 (2001).

This woody shrub grows up to 2 metres high and has unifoliate leaves (those of *C. striatus* are trifoliate), flat berries and a larger number of seeds per fruit (in *C. striatus* there are no more than 8, while in *C. insularis* there are usually more than 10).

So far the species has only been found on the archipelagos of Ons and Salvora, basically in the cliffs along with gorse. The restricted distribution area explains why it is one of the most interesting plants among Galicia's rare and threatened flora, and why it is regarded as a distinctive species of the Atlantic Islands of Galicia National Park. It is the only species endemic to the park, and is classed by the World Conservation Union (IUCN) as Endangered and is included on the Galician List of Endangered Species under the same category.

Cytisus insularis

Native Forest

The national park's native arboreal vegetation would be classed as Galaic-Portuguese oak woodland featuring common oak (*Quercus robur*), Pyrenean oak (*Q. pyrenaica*), holly (*Ilex aquifolium*), butcher's broom (*Ruscus aculeatus*), broom (*Cytisus striatus*), flax-leaved daphne (*Daphne gnidium*) and *Tamus communis*, etc. However, the actual situation is very different. Cíes, Ons and Sálvora have scarcely any native trees; there are just a few isolated groves as the environ-mental conditions are more suited to ground-hugging scrub. Trees grow only in sheltered areas on the eastern side of the islands.

On the **Cíes Islands**, native tree cover has been largely replaced by forestry crops of eucalyptus, acacias and pines, is reduced to a small stand of Pyrenean oak (*Quercus pyrenaica*) on the island of Monteagudo and a few on San Martiño, a reminder of the tracts of native forest that once grew on the sheltered slopes. Reforestation with native species got underway in some parts of the archipelago at the beginning of the nineties so there are now some areas where strawberry trees (*Arbutus unedo*), birches (*Betula celtiberica*) and Pyrenean oaks (*Quercus pyrenaica*), etc., grow.

Grove of Pyrenean oaks on Cíes

European alder

On **Ons** the chief vestiges of native forest consist of willow (*Salix atrocinerea*) in farm hedges or near springs and ditches, from where they spread to other parts of the island, and, in the north, some Pyrenean oak (*Q. pyrenaica*), which must have been much more numerous in the past. There are also elderberry bushes (*Sambucus nigra*), chestnut trees (*Castanea sativa*) and laurels (*Laurus nobilis*), and as on Cíes, some parts have been reforested with native species.

Sálvora does not have any large tracts of native forest either, although some willows (*Salix atrocinerea*) and elderberry bushes (*Sambucus nigra*) grow around ditches, while laurels (*Laurus nobilis*) are found in the environs of the town.

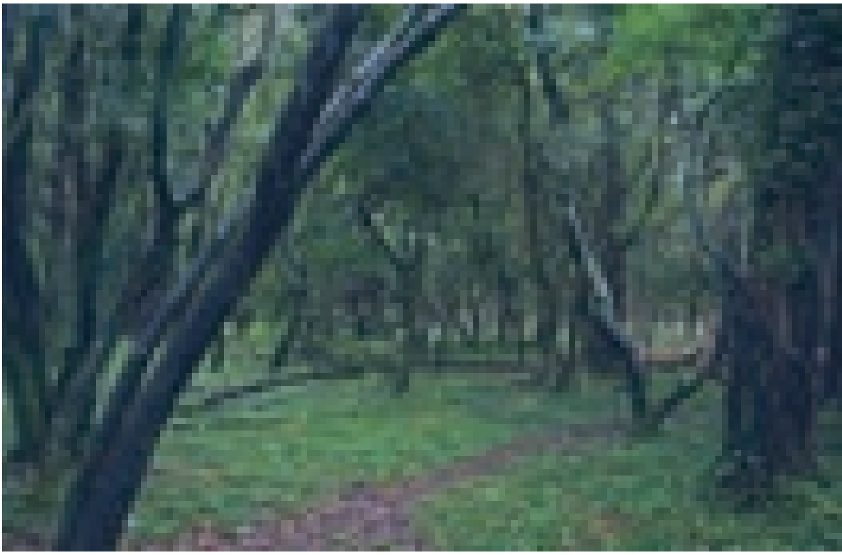
The situation on **Cortegada** is very different; it is almost totally covered in trees, and according to various authors the woodland appears to have spread from hedges surrounding the fields and spontaneously colonised the island territory after being abandoned at the beginning of the 20th century. Young trees and scrub have been affected by pressure from grazing goats, now quite few but which still remain on the island.

A part of the island is covered by an oak stand (*Quercus robur*), together with laurel (*Laurus nobilis*), common hawthorn (*Crataegus monogyna*), willows (*Salix atrocinerea*), some Pyrenean oaks (*Quercus pyrenaica*) and chestnut (*Castanea sativa*), etc. The abundance of willows and laurels could classify these areas as closely linked to wet soils. The undergrowth in these stands includes plants like ivy (*Hedera helix*), escorodonia (*Teucrium scorodonia*), honeysuckle (*Lonicera periclymenun*), stinking iris (*Iris foetidisima*) and *Davallia canariensis*, a fern native to the Macaronesia region, which grows on oaks on Cortegada

Laurels on Cortegada occupy soils containing accumulated water. Still to be studied, these formations are very important for their rarity. Very abundant in the lower parts of Galicia at the end of the Tertiary, most were transformed by human activity and at present the laurel stand on Cortegada is the largest on the Iberian Peninsula. These formations have little undergrowth, being virtually reduced to a carpet of wood sage and ivy on the ground, along with a few wood sage plants (*Teucrium scorodonia*) and friar's cowl (*Arisarum vulgare*). Willows (*Salix atrocinerea*) grow on ground permanently or temporarily flooded in the eastern part of the island as a non-specific formation, while in the west they are mixed with common alders (*Alnus glutinosa*).

On Malveira Grande, the closest island in this archipelago, there is an interesting coastal formation dominated by Pyrenean oak (*Quercus pyrenaica*), together with the occasional laurel (*Laurus nobilis*) and common hawthorn (*Crataegus monogyna*).

Laurels on Cortegada



PYRENEAN OAK, REPRESENTATIVE OF ANCIENT NATIVE FOREST ON THE ATLANTIC ISLANDS

Galician name: Cerquiño

Scientific name: *Quercus pyrenaica*

Family: Fagaceae

In the past, Pyrenean oak (*Quercus pyrenaica*) was the dominant native species in the original oak wood-land due to its greater tolerance to drought.

Pyrenean oak is a medium-sized tree (20-25 metres); it is deciduous although it has dry leaves until the new ones emerge. The leaves are very lobulated and hairy, which enables them to withstand low temperatures and summer drought.

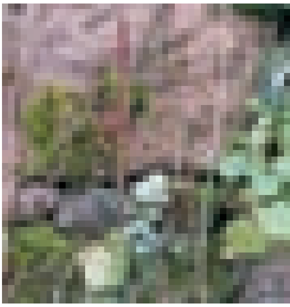
It grows on siliceous terrain like that of the granites of the Atlantic Islands, and the strength and density of its root system are important in forming and stabilizing soil on slopes, which would be more eroded without such cover. Its resistance to drought means that it generally occupies an intermediate position amongst the typical Atlantic oak forests and Mediterranean forest of other species of the genus Quercus, such as holm oaks.

This species has been severely disturbed by human activities, and nowadays few stands remain. On the Atlantic Islands there are only a few groves or isolated examples serving as a reminder of the native tracts that not so long ago grew in sheltered areas, the most important ones being on the Cíes Islands and Malveira Grande on the Cortegada Archipelago. This native vegetation is still threatened by the same factors that brought about its degradation and confinement to small areas, and action is required to boost it, e.g. reforestation or removal of alien species.

Quercus pyrenaica

Rock-dwelling and pioneer vegetation

Rock vegetation grows on rocky outcrops, occupying fissures and spaces among the stones where soil formation begins. The halocasmophytic vegetation of the cliffs would also be classed as rock vegetation, but one with hardly any marine influence, a very common community on rock faces throughout Galicia. It occurs on all the archipelagos in the national park, on crags without halophilous influence, and, on Cortegada, on large trees. It features navelwort (*Umbilicus rupestris*) and the ferns *Polypodium interjectum* and *Davallia canariensis*.



Navelwort

An endangered species of rupicola is found on the National Park's archipelagos. *Rumex rupestris*, a plant classified as "endangered" by the Red Atlas and Book of Endangered Vascular Flora of Spain and as "critically endangered" in the Galician Catalogue of Endangered Species, grows on the Cíes islands and Ons and Sálvora.

Pioneer communities are those that colonize rocks and clearings amongst scrub, also occupying shallow soils. They include sedum (*Sedum arenarium*), *Xolantha guttata* and some grass species.

Aquatic vegetation

• Marsh vegetation

These plant communities are under the direct influence of the sea, where high concentrations of salt are the chief determining factor. Their role as food for many living things makes them of great ecological value. This kind of vegetation is found on the Cíes Islands, on Sálvora and Cortegada on the islets of Briñas and Malveira Chica, where it is the predominant vegetation. Variations in the tides arrange the vegetation into strips or belts in accordance with the degree of immersion.

In the submerged strip, which only occurs on Sálvora, there is a species of flowering plants that may be con-

Halimione portulacoides

Marsh vegetation

fused with algae because of their long thin leaves: the *Zostera marina*, which can be found at depths of up to 10 meters.

Both the Cíes and Cortegada archipelagos have partially submerged vegetation, which is only submerged at high tide, consisting of associations of fleshy plants that accumulate water in their internal tissues as an adaptation to salinity. Sea purslane (*Halimione portulacoides*), with its greenish-silver leaves, *Salicornia ramosissima* and perennial glasswort (*Sarcocornia perennis* subsp. *perennis*) are typical of this belt.

On the shore of the lagoon on Cíes and Cortegada, there is a community adapted to the high salt and nitrate contents associated with organic remains left by the sea, with sea couch (*Elytrigia atherica*), bentgrass (*Agrostis stolonifera* subsp. *pseudopungens*) and annual seablite (*Suaeda marítima*).

In the upper part of these areas there is a stand of sea rush (*Juncus maritimus*), arrowgrass (*Triglochin maritime*) and seaspurrey (*Spergularia marina*). On the Malveira Chica and Malveira Grande islets sea kale (*Crambe hispanica*) is accompanied by mallow (*Lavatera cretica*). The island may, in fact, be named after the latter.

• Freshwater Vegetation

Poorly studied, Sálvora's communities of aquatic freshwater plants are located in small pools near springs. The plants in these floating communities, such as pondweed (*Potamogeton polygonifolius*), have leaves on the water surface and take root at the bottom.

Bog Pondweed

Nitrophilous vegetation

This section includes vegetation that prefers environments rich in nitrogen, both in arable fields and areas altered by humans, such as roadsides. High concentrations of nitrogen are due to the accumulation of organic waste or fertilizer use. Given that there existed or exist human settlements on all the park's archipelagos, it is easy to under-stand why this vegetation occurs on all of them.

Wall pellitory

In their study of Cíes, The Guitián brothers differentiate two communities. One is on walls and rock faces and involves wall pellitory (*Parietaria judaica*) and Cymbalaria muralis. The other occurs in shady areas and consists of "apio de caballo" (*Smyrnium olusatrum*). The Atlantic Islands Natural Resources Plan cites other nitrophilous communities, such as the one covering a large part of the abandoned fields on the island of Ons with sweet fennel (*Foeniculum vulgare*), corresponding to stages prior to the development of broom stands, or the aerohalophilous grassland on the cliffs of the islets of Sálvora, on Boeiro (Cíes) and El Centulo (Ons), with the mallow Lavatera arborea and hastate orach (*Atriplex postrata*).

Tracts of non-native woodland

The fifties saw the advent of large forestry schemes, chiefly on the Cíes Archipelago. They were extended and came to account for a large part of the landscape. They mainly involved eucalyptus (*Eucaliptus globulus*) and maritime pine (*Pinus pinaster*) and the park's four archipelagos. There is also a large tract of blackwood acacia (*Acacia melanoxylon*) which, although it was not introduced as a crop, colonized a large part of Cíes and part of Ons. These tracts are not of any great botanical interest as they have little or no under-growth. Maritime pine (*Pinus pinaster*) has the greatest floristic diversity.

Other alien forest species in the park are false acacia (*Robinia pseudoacacia*), Monterey pine (*Pinus radiata*), stone pine (*Pinus pinea*), and to a lesser extent, cypresses (*Cupresus* spp.), plane trees (*Platanus hispanica*) and poplars (*Populus* spp.), among others.

PLANTS THAT POSE A THREAT TO BIODIVERSITY CONSERVATION

Exotic species are those that have been introduced from far away, and which coexist with native species and sometimes compete with them for space and resources, making them invasive species that displace the native ones. The introduction of invasive exotic species is one of the main causes of global biodiversity loss, as in many cases it leads to the extinction of other native species. This loss of biodiversity is accompanied by alterations to the overall functioning of the ecosystem, leading to a deterioration in resources, with the resulting economic and social cost.

In the Atlantic Islands several exotic or alien species are in many cases displacing the native flora. Some examples are *Acacia melanoxylon, Arctotheca calendula, Arundo donax, Robinia pseudoacacia, Eucaliptus globulus, Carpobrotus edulis, Tradescantia fluminensis, Opuntia maxima, Oxalis pes-caprae, Tropaeolum majus*, etc.

Arctotheca calendula

This is an important problem affecting many countries and covered by different regulations and pieces of legislation. In Spain, Law 42/2007 on Natural Heritage and Biodiversity establishes that “the competent public authorities prohibit the introduction of exotic or alien species or subspecies when these are capable of competing with native wildlife species, altering their genetic purity or ecological balances”. One of the purposes of RD 630/2013, which amends the Spanish List of Invasive Alien Species, is to establish “the necessary measures to prevent the introduction of invasive alien species and to control and possibly eradicate them”.

Moreover, the Atlantic Islands of Galicia National Park prohibits the introduction of alien species in both the Plan for the National Parks Network and the National Park Management Plan.

Although contention and control measures may be applied in the long term as a final resort, most regulation highlight the crucial importance of prevention and early detection as regards monitoring and controlling potential biological invasions.

FUNGI, MOSSES AND LICHENS

This section covers three series of living things little known to the general public, but no less important given the essential role they play in ecosystems. There is still much to discover in the National Park of the Atlantic Islands of Galicia. Thus, the following gives the overall features of mosses; further details on lichens and fungi will be provided when more information becomes available.

Liverwort

Mosses

Mosses and bryophytes are regarded as non-vascular plants; they lack the veins for transporting water and nutrients that vascular plants (the most widely known) have and also differ from the latter in not having true leaves, stalks and roots.

Mosses colonize a large diversity of environments, very often being, along with lichens, pioneers in colonizing bare surfaces where other plants cannot get established. As they do not have an external impermeable wall, most require a wet environment in order to avoid water loss.

Mosses, like lichens, are indicators of pollution given their high sensitivity, particularly to gaseous pollutants.

While there are no studies on the moss species found in the National Park to date, the number of known moss species in Galicia is 558, of which 27% are included on the Red List of Bryophytes on the Iberian Peninsula.

Fungi

Of the three groups the best known is undoubtedly the fungi as they share many aspects of our lives. They have become very important in the food and pharmaceutical industries and play an important role in the food chain as decomposers of organic remains, being known from the moulds that grow on walls, yeasts, skin fungi, plant para-sites, etc.

Although initially included in the plant kingdom, they are currently considered to be a kingdom apart given that they share hardly any features with plants other than the method of reproduction and immobility. Fungi, unlike

Cordyceps militaris with processionary

plants, have no photosynthetic pigment such as chlorophyll, and so do not feed in the same way. Like animals, they need "ready-made" organic matter to be able to synthesize their own, a feature that forces them to live at the expense of other living things or previously converted organic substrates. Fungi are divided into three groups depending on how they feed:

- Parasites: live at the expense of another species in a non-mutual relationship, sometimes harming or even killing the host tree. Ex. *Armillaria mellea*
- Saprophytes: feed on dead organic matter and are fundamental for forming soil through the decomposition process. Ex. *Trametes versicolor*
- Symbiotic: obtain food when interacting with another living being to the benefit of both, such as *Lactarius Deliciosus*, a mycorrhizal species of conifers, preferably of the genus *Pinus.*

Some species of fungi in the National Park are mentioned in existing studies for their rarity or abundance. Thus, Sálvora features *Agaricus devoniensis*, a mushroom commonly found on dunes and abundant in the Iberian Peninsula, *Peziza Prothean* f. *sparassoides*, scarce

Tulostoma brumale

in Galicia and the Peninsula, or species that are first recorded in Galicia such as *Amanita muscaria* var. *inzegae*, found associated with *Cistus salvifolius*, and *Myriostoma coliform*, a fungus typical of limestone substrates also found on Ons.

Species of note on Ons are *Calocybe gambosa*, a species found in abundance on the Peninsula that is commonly known as "Perrechicho" or "Mushroom of Saint George", and the *Cordyceps militaris*, which fertilizes by parasitizing pupae of the Pine Processionary moth *(Thaumetopoea pytiocampa). Rhodocybe gemina* is a rarely-found species in Galicia and *Descolea maculata* is a fungus linked to the eucalyptus tree which was probably introduced to Galicia with the tree, and the *Tulostoma brumale* var. *brumale*, a small dune mushroom also found on the Cíes Islands that is easy to identify by its spherical head.

Other fungi of interest on the Cíes are *Campanela caesia*, sparsely distributed on the peninsula, which was first recorded in Galicia on the Cíes Islands, and *Gyroporus ammophilus*, a species associated with pines and which colonizes coastal dunes, although it is found under strawberry trees on the islands.

Cortegada, where more than 600 taxa are found on its barely 45 ha of land, is the archipelago of the greatest mycological interest in the Park, with species that are rare or were first recorded in Galicia on Cortegada and the unique fact that some come from extremely different environments. A perfect example is *Favolaschia calocera*, native to Madagascar, which was first recorded in Galicia on Cortegada; it had only been recorded once before in Spain, in Asturias.

Many of the numerous *Hygrocybes* found are rare and *Hygrocybe flavescens* and *Hygrocybe calyptriformi*, the latter found elsewhere at over 800 m elevation, contrast with the appearance of *Torrendia pulchella*, typical in more southern areas. These latter two species are included on the European Red List.

Other rare species on Cortegada are *Dendrocollybia racemosa* and *Clavulina amethystina*.

Finally, the well-known *Macrolepiota procera*: this is an abundant species on the peninsula and is found on all of the National Park's four archipelagos.

Recent studies in the Park cite taxa that could be new species, but the results are still awaiting publication.

Macrolepiota procera

Lichens

While lichens are one of the organisms that are with us constantly and are found both in the countryside and in the city, in a multitude of substrates, for many people they go completely unnoticed.

Its uniqueness is in its dual nature, as lichens are composed of a fungus and an alga that live symbiotically to create another new organism with unique features. While the algae that forms part of lichens can be found living freely in nature the fungi cannot, since it obtains carbohydrates from the algae. These protect the algae and provide it moisture.

Symbiosis provides advantages for the lichen's two components separately, taking into account the habitats in which they live. Lichens generally live in areas where neither fungi nor algae could grow in isolation, since the first would be destroyed by the weather and the second would be unable to find food. These organisms are found at all latitudes, from Arctic and Antarctic zones to Ecuador and at all altitudes, from sea level to high snowy mountains.

Cross section of a lichen where the fungus and algae cells can be seen

They can live on a range of different substrates such as rocks, bark, sand, soil, wood and even glass, leather, metal, plastic, paint, iron, etc. The only places they are not found is at sea, except on rocky coasts, in places where air pollution is too high (called lichen deserts) and on animal tissue.

In short, as a result of symbiosis lichens are pioneers, cosmopolitan and ubiquitous.

Lichens can take on a wide range of growth forms that can be grouped into seven morphological types:

- Crustose: grows completely adhered to the substrate and is very difficult to separate from it.
- Squamulose: small scale-like structure.
- Foliose: leafy, easy to remove from the substrate.
- Fructicose: looks like small shrub or beards.
- Compounds: have a part that can be encrusting, foliose and squamulose and another fructicose.
- Gelatinous: gelatin appearance as cyanobacteria produce algae that gives them this consistency.
- Leprose: powdery or mealy.

Black belt with Lichina spots

There are transitions between these morphological types.

Lichens have had various uses throughout history: some have been used for medicines like antibiotics while others, like *Roccella* spp., are harvested in Galicia as a natural dye. There are also edible varieties: *Umbilicaria esculenta* is considered a delicacy in Japan and *Aspicilia esculenta*, typical in arid and semi-arid areas and which becomes more visible after heavy rain, is the biblical "*manna*". Today their most important use is as biomarkers of pollution.

In the National Park there are 231 species of catalogued lichens, the majority of which have restricted distribution and 17 species of which are listed on the European Community Red List of Macro-lichens under different threat categories: *Heterodermia leucomelos* on the Cíes Islands and Sálvora, *Phaeophyscia orbicularis* on the Cíes, *Parmelia hypoleucina* on the Cíes, also a newly discovered example in Galicia, *Ramalina siliquosa* on the Cíes and Sálvora, *Sclerophyton circumscriptum* on Ons and Sálvora, *Teloschistes flavicans*, a yellow fruticose lichen that prefers land close to the coast, is found on the Cíes Islands and is in decline in Europe due to pollination, and *Sticta fuliginosa* on the Cíes and *Usnea rubicunda* on the Cíes and Ons.

In addition to these species a number of lichen are noteworthy for their restricted distribution, including *Bactrospora carneopallida* on the Cíes Islands, the only recorded place in grows in all of Europe, and *Physcia scopulorum*, only recorded in Spain on the Cíes Islands and on Sálvora. Sálvora also boasts *Lecanographa dialeuca*, previously known only in the Macaronesia region. On Cortegada there are lichens typical of wet protected areas like *Baeomyces rufus*, which grows on rocks and the ground, and *Porpidia tuberculosa*, a whitish lichen that lives on acidic basic siliceous rocks. On Ons, where the terrain is largely covered in scrub, there is less diversity among the lichens. *Buellia fimbriata* is important as it was only found in the Mediterranean region until now.

The National Park's most representative lichens are those that colonize the rocks along the coast. Three typical coastal lichen belts are clearly represented:

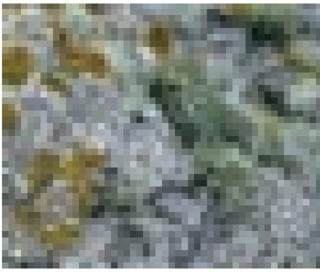
- Coastal zone: Black or *Verrucaria belt*. Between the extremes of spring tides; submerged at high tide. Most representative species: *Verrucaria* gr. *maura* and *Lichina pygmaea*, all very dark blackish or greenish in colour.
- Lower supracoastal zone: Orange or *Caloplaca belt,* subjected to splashing and occasional submerging under spring tides. Species of orange *Caloplaca* - *Caloplaca littorea*, *C. marina*, etc.
- Upper supracoastal zone: Ramalina belt, subjected to ocean spray. Most representative species: *Ramalina cuspidata*, *R. siliquosa*, *Xanthoria parietina* and *Pertusaria gallica*. A characteristic community of whitish-gray lichens grow in this same zone, but on rocks shaded and protected from the wind, predominately *Roccella* spp., *Diploicia canescens* and *Dirina massiliensis*.

In addition to these coastal communities lichens can be found:

- On trees: *Parmelia* spp, *Physcia* spp., *Ramalina* spp. and *Usnea* spp.
- On buildings made with cement: *Caloplaca aurantia, Lecanora campestris.*
- On moss-covered slopes and rocks: *Cladonias* spp., *Leprarias* spp. and *Baeomyces rufus*.
- And in damp and shaded places (particularly in the laurel stands on Sálvora: *Lepraria* spp. and *Trentepohlia* sp., which is very well developed.

Black belt with Lichina spots

Ramalina belt



Orage belt with Caloplaca spots

Lecanora campestris crustose lichen

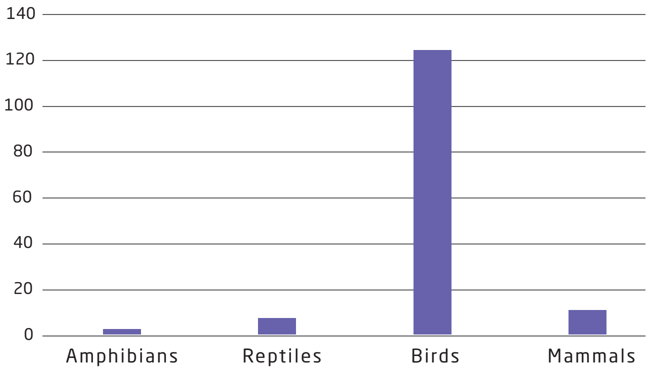
TERRESTRIAL FAUNA

INTRODUCTION

Although the seabed around the islands is home to most of the National Park's animal species, this does not mean that the terrestrial fauna of the islands is any less important. The fact that the islands have been separated from the continent for so long, the specific microclimate of each archipelago and the extraordinarily rich marine resources in their waters, all make the Park's terrestrial fauna a unique natural heritage.

Apart from invertebrates, there are 150 species of terrestrial fauna. Of these, over 80% are birds, as there are far fewer amphibians, reptiles, or mammals in the Atlantic Islands.

Of the birds, the most eye-catching are without doubt the spectacular colonies of seabirds that carpet the islands' cliffs in the spring and summer. They are one of the principal reasons for the National Park's importance at the global level.



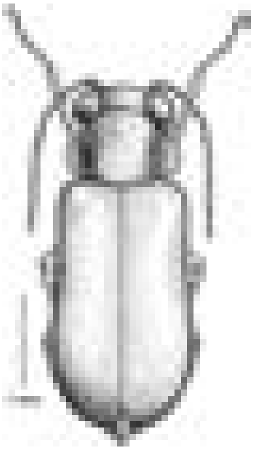
No. of species in the different groups of animals in the National Park

INVERTEBRATES

Despite their relatively small size, terrestrial invertebrates account for over 80% of all species in the animal kingdom. In the Atlantic Islands, most studies so far have focused on the lepidoptera (moths and butterflies) and the coleoptera (beetles).

Other groups are also important, such as the terrestrial **gastropods**, which include the *Portugala inchoata* snail and the *Geomalacus maculosus* slug, species that are otherwise only found in Portugal.

There are some endemic species of **coleoptera** that are only found on the Cíes Islands and nearby areas, such as *Stenosis oteroi* and *Tetramelus parvus*, which live among the gorse on the cliffs. A species new to science has also been discovered on the Cíes Islands the *Ernobius vinolasi* beetle *(Novoa and Baselga, 2000)*, which is found in the in the coastal forests of maritime pine.



Ernobius vinolasi

Of the coleoptera, the **xylophages** or wood eaters/wood borers play a very important role in the National Park's forest ecosystems, and the following are particularly noteworthy: the long-horned beetles (*Ergates faber*) and (*Criboleptura stragulata*), and the spectacular stag beetle (*Lucanus Cervus*), which can be as much as 9 cm long. The majority of these species are classified as protected throughout Europe. The stag beetle has only been found on the island of Cortegada, probably due to its predilection for native species such as the oak, and the need for dead wood to feed their larvae (xylophages). Interestingly, the larvae can live for between one and five years, whereas the adult only lives for between 15 days and a month. To ensure the availability of dead wood for the larval development of these species, Microhabitats for Threatened Xylophages have been installed at different points around the National Park.

Stag Beetle

Other interesting insects found in the Park include: of the **Orthoptera** (grasshoppers, crickets, etc), the scrub cricket *Callicrania seoanei*; and of the **Blattoptera**, the *Ectobius Brunei* wood cockroach. Both the latter species are unique to the northwest of the Iberian Peninsula, while, of the **Dermaptera**, *Mesochelidura occidentalis* is only found on the Cíes islands and in areas close to Lisbon.


Zerynthia rumina


Papilio machaon

The butterflies and moths found on the Park's larger archipelagos (Cíes, Ons and Sálvora) have been studied, and 164 different species of lepidoptera have been surveyed. Of these, the most important are: the Spanish Festoon or *Zerynthia rumination*, which is listed as Endangered, the large Old World Swallowtail *Papilio machaon*, and the *Brithys crini* moth, which is found on the islands of the Cíes and Sálvora archipelagos. Its caterpillars feed almost exclusively on the sea lily (*Pancratium maritimun*).

AMPHIBIANS AND REPTILES

In general, **amphibians and reptiles are** poorly represented on the Atlantic Islands in comparison with their relatively high numbers on the nearby coast of Galicia. However, the isolation of these populations for the past 6,000-8,000 years, as a result of the formation of the islands, makes these species uniquely important in both evolutionary and ecological terms. As a result, almost all the amphibian and reptile populations found on the Atlantic Islands enjoy some special protection status as endangered wildlife.

The differences between the islands in the Park in terms of microclimates, varieties of habitat and availability of water, mean that the number of species of amphibians and reptiles may even vary between the islands of the same archipelago (see Appendix on Amphibians and Reptiles).

Amphibians

As a result of the low number of permanent water courses and the low humidity of the soil, the presence of amphibians on the islands is very limited, in fact, only three species have been detected:

Salamander with offspring

The common salamander (*Salamandra salamandra*) requires the continuous presence of moisture, so it remains underground and lethargic during long periods of drought. It usually lays its larvae in the water (ovoviviparous reproduction), but - surprisingly - the salamanders of the Atlantic Islands are born fully-formed (viviparous), having already metamorphosed. This vivipary is unique because it has originated in relatively recent times, as a result of the islands being formed. This makes the salamanders of the Atlantic Islands one of the National Park's most important natural assets.

Salamander on the Ons archipelago

Listed as "Vulnerable" in Galicia and throughout the Iberian Peninsula, the salamander is found in large numbers on Ons, where they display a higher degree of melanism than usual (the skin is predominantly black, with few yellow spots). On the other hand, there are very few on the Cíes archipelago, where they are virtually only found on San Martiño Island (also called Sur). Both are considered to be isolated and endangered populations threatened. This amphibian has not been found on the islands in the Cortegada and Salvora archipelagos.

Scientists and researchers propose that the salamander populations of the Atlantic Islands National Park as a "significant Evolutionary Unit", with the aim of preventing this newly-evolved subspecies and obtaining a higher degree of protection for them in the Park, especially for the salamander population on the island of San Martino (Cíes) where only a few dozen individuals survive.

Bosca's newt (*Lissotriton boscai*). Unlike the islands' salamanders, all its reproductive phases take place in water, where it remains much of the summer and autumn until it moves to the land. For this move, itsskin becomes tougher and thicker to prevent the body dehydrating. In the the Atlantic Islands, this species - which is unique to the west of the Iberian Peninsula - is found in the archipelagos of Ons and Sálvora.

Bosca's newt

The Iberian painted frog (*Discoglossus galganoi*) is the only tailless amphibian species (Anura) found in the National Park. Until recently, it could be found on all four archipelagos, but has not been detected in the Cíes islands in recent years and it is considered almost extinct in that archipelago. By contrast, there are many on Sálvora. On Ons, however, its populations are scarce and fragmented, so there is a serious risk of extinction in the short term.

There are old records of the common toad and the common frog being seen on Ons, but both are considered to be extinct on the Atlantic Islands. It should also be pointed out that these species may have been brought to the islands by man.

Iberian painted frog

Reptiles

Reptiles are found in the Park in much higher numbers than amphibians, mainly due to the islands' dry and sunny microclimate, which provides the energy required to raise the body temperature of these cold-blooded animals.

The **ocellated lizard** (*Timon lepidus*) with an average size of about 20 cm - not counting the tail - is the largest lizard in Europe, and is present on all of the Parks' archipelagos. The population found on Sálvora Island has been described as a different subspecies: *Timon lepidus oteroi*. The **Iberian wall lizard** (*Podarcis hispanica*) is the reptile most commonly found throughout the National Park, and the only one that also colonizes the smaller islets. On the islands they are, on average, larger than their continental neighbours, especially on the more northern archipelagos of the Park (Sálvora). The Iberian wall lizard is not, however, present on the archipelago of Cortegada, where **Bocage's wall lizard** (*Podarcis bocagei*) predominates. This is possibly due to these islands being so close to the adjacent coast, where the latter is very abundant.

Ocellated lizard

Although it may look elongated and more reminiscent of a snake, the so-called "glass snakes" (Ophisaurus) are in fact lizards that have no legs (slow worms) or have very tiny and atrophied legs (skinks). The **common slow worm** (*Anguis fragilis*) and the **western three-toed skink** (*Chalcides striatus*) are found on all of the archipelagos in the Park.

Bedriaga's skink (*Chalcides bedriagai*), in contrast to the common or three-toed skink, has four well-developed legs, each of which, although small, has 5 toes. This species is endemic to the Iberian peninsula. In the Atlantic Islands, it has only been found on the Cíes archipelago. This population is listed as Endangered in the Galician Catalogue of Threatened Species and in the Red Book of the Amphibians and Reptiles of Spain.

Bedriaga's skink

Ladder snake

Viperine water snake

Southern smooth snake

There are relatively few snakes in the Park, with the exception of the Ons archipelago, where the large **ladder snakes** (*Rhinechis scalaris*) are quite common. They which are usually over a metre long. The longest one measured to date on Ons was 1.40m long, although it is suspected that there maybe longer ones. The other two species of ophidians found in the Park are also harmless, but smaller: the **Southern smooth snake** (*Coronella girondica*) and the **viperine water snake** (*Natrix maura*) whose name alludes to the fact that it mimics the appearance and behaviour of the snakes as a defensive strategy to fool their predators. The latter regularly goes into the intertidal ponds to catch small fish to eat. This "marine" behaviour has surprised researchers and ecologists.

If, when visiting the Park you meet any of these species you must not disturb them, since they are in their natural environment and are completely harmless.

BIRDS

The fact that these terrestrial vertebrates can fly, combined with the islands' proximity to the continent, could in principle make one think that there would be nothing especially important about the birds in the National Park. Nothing could be further from the truth, since the low levels of human presence, the availability of good breeding sites and especially the extraordinary abundance of marine resources in the surrounding waters, make the Atlantic Islands the ideal home for a wide variety of birds, especially seabirds, although there are also many others, including migratory birds. The Cíes and Ons archipelagos are therefore classified as SPA areas (Special Protected Areas for Birds) in accordance with the Birds Directive 79/409/EEC.

Seabirds

Seabirds

This group include birds ecologically linked to the marine environment, i.e. those that derive their food from the sea and therefore have evolved to thrive in the sea through specific adaptations such as desalination glands, waterproof plumage, webfeet, etc.

Thousands of seabirds use the Atlantic Islands' cliffs for protection and nesting. They are undoubtedly one of the National Park's most important and best known jewels. The most important nesting species include: the yellow-legged gull, the European shag, the lesser black-backed gull, the Cory's shearwater and the European storm petrel.

TABLE: Seabirds nesting in the Atlantic Islands National Park.

Seabirds	Cíes	Ons	Sálvora	Cortegada
Yellow-legged Gull *(Larus michahellis)*	0	0	0	*
Lesser Black-backed Gull *(Larus fuscus)*		*	*	0
European shag *(Phalacrocorax aristotelis)*	0	0	0	
Cory's Shearwater *(Calonectris diomedea)*	0			
European Storm-petrel *(Hydrobates pelagicus)*	0			

(*) Very few

Yellow-legged Gull

Gull nest

Gull with chicks

Juvenile Gulls

Yellow-legged Gull *(Larus michahellis)*

It is the commonest bird in the Park, and one of the most iconic. In the spring, thousands of pairs of these gulls come together to form a crowded and noisy colony that covers the western sides of the islands.

Although they are found on most of the coasts of southern Europe, around 15,000 pairs (2011 survey) of yellow-legged gulls nest on the Atlantic Islands, making this one of the largest colonies of this species in Europe.

Each pair lays 1 to 3 eggs, and they hatch in early June. The chicks are an inconspicuous greyish colour that helps camouflage them among the vegetation and they are nidifugous, in the sense that, when they detect danger they hide among the vegetation surrounding the nest. They remain under the care of their parents for approximately 2 months, being fed and protected by both members of the breeding pair. At the end of this period, the chicks are already almost as large as their parents, and make their first flights. They now have to leave the nest and start to survive alone, although many fail to survive this critical stage of their first summer. When they are between 3 and 4 years old, they become breeding adults. That is when their plumage turns white, with grey backs, and the bill and legs become completely yellow - the trait that gives this species its name. The yellow colour of the bill and legs of adult gulls intensifies during the breeding season to indicate good reproductive health. In the autumn and winter, however, the colour is much more less pronounced.

A bird that gets a bad press

LARIDAE Family

Scientific name: :

Larus michahellis

Common Name:
Yellow-legged Gull (Eng),
Gaviota patiamarilla (Sp),
Gaivota patiamarela (Gal),
Gavia argentat de potes groges (Cat),
Kaio ankahori (Eusk).

Yellow-legged gulls are omnivores, and can take advantage of a wide range of food, including the waste on rubbish tips. This extra resource provided by humans is the reason why the populations of these gulls shot up in the last two decades, with over 25,000 nesting pairs on the just on the Cíes islands in the early 90's. The subsequent closing down of the nearby coastal towns' landfill sites and expansion towards new locations seem to be the causes of the progressive decrease in the National Park's gull populations over the last few years.

Man is therefore principally responsible for this imbalance, an imbalance that affects many gull populations on the Spanish and Portuguese shorelines and these birds, which most locals mostly know little about although they play a very important ecological role in coastal ecosystems, are not responsible.

Like many seabirds, the yellow-legged gull usually chooses the same mate every year. Both partners take turns hatching the eggs and searching for food for the chicks, which they will fiercely defend against any threat or predator that dares to approach the nest. During the breeding season their main food (up to 60% of the diet) are small crabs called "patexos" that are present in their thousands in the sea around the islands when the water is warmer. They also take advantage of low tide to feed on starfish, mussels, barnacles, etc. Interestingly, they have developed the skill of dropping mussels and other bivalves onto the rocks from a certain height, in order to break the hard shell, so that they can eat them. In addition, they eat fish and other seafood rejected by fishermen and can "grab" mackerels, sand eels and other fish from cormorants and other seabirds. The red dot on the bill seems to be the point of stimulation which chicks peck at to make the parents regurgitate food to feed them.

When visiting the islands, remember that these birds are in their natural environment and must not be fed or disturbed. When nests are close to foot traffic areas, these birds naturally feign threatening attacks to try to keep humans away from their chicks.

LARIDAE Family

Scientific name:

Larus fuscus

Common Name:
Lesser Black-backed Gull (Eng),
Gaviota sombría (Sp),
Gaivota escura (Gal),
Gaviá fosc (Cat) ,
Kaio iluna (Eusk).

Lesser Black-backed Gull (Larus fuscus)

This gull is very similar in size and appearance to the yellow-legged gull, and can only be differentiated because the wings (back) are darker. It is much less common in Europe than the yellow-legged gull, and there are few breeding colonies on the Iberian Peninsula, the Atlantic Islands colony being one of the largest. Within the Park, virtually the entire population of these gulls is found on the Sálvora archipelago, where there are about a hundred breeding pairs. The Cíes and Ons archipelagos occasionally host some breeding pairs.

Adult European shag

Juvenile European shag

European Shag (Phalacrocórax aristotelis)

The Spanish name of this species (Cormorán moñudo) comes from the crest or "moño" of feathers that this bird has on its head during the mating season (February-May).

They are black with a metallic green-tinged sheen and slim body, and congregate on rocky outcrops around the islands' coastlines to dry their feathers in the sun. They flyclose to the water in search of shoals of sand eels and other fish to feed on, which they catch by diving under the water.

Both the breeding season and the number of chicks per pair vary much more than for the yellow-legged gull, but in general they have 1 to 3 chicks between February and August. They build their nests on the rocky ledges of the "furnas" (sea caves) or in crevices between the granite blocks of cliffs in areas close to the sea. In a few months, the chicks eat a very large amount of food and grow fast, reaching almost the same body size as their parents while they are still juveniles. Juveniles can be differentiated from adults by the pale areas on the neck and chest. They often congregate on easy-to-reach rocks close to the sea called "nurseries", from where they make their first dives to try and catch fish, although many of them are still fed by their parents.

The Atlantic Islands European shag colony, with close to 1,000 breeding pairs, is one of this species' largest colonies in the world, and accounts for almost 50% of the Spanish population as well as 80% of the entire population on the Cantabrian and Atlantic coasts (of the *aristotelis* subspecies). In spite of this, it is under threat, and its population on the islands has dropped drastically in recent years, especially on the Cíes archipelago. The main causes of this decline seem to be fishing nets, oil pollution and predation by species that have been introduced. With respect to fishing nets, there is a high level of mortality in birds that get caught in nets when diving, as they drown if they can't return to the surface. The *Prestige* catastrophe also had a very negative effect on the European shag since, in addition to directly causing the death of adults, and having sublethal effects due to the bioaccumulation of pollutants, it also had negative side effects in the long-term, such as the decline in numbers of sand eels, which are one of this species' main sources of food. The arrival of new predators such as the American mink has also seriously affected these birds, since mink prey on both chicks and adults. However, the intensive program of eradication carried out in recent years by the National Park has considerably reduced this latest threat. For all these reasons, the European shag is listed as "Vulnerable" (proposed to be classed as Endangered) in the Galician Catalogue of Threatened Species, and "Endangered" in the Red Book of Birds in Spain, and no effort should be spared to prevent the disappearance of this, the Atlantic Islands' most iconic bird.

European shag nests

Group of adult and juvenile European shag

PHALACROCORACIDAE
Family

Scientific name:
Phalacrocorax aristotelis

Common Name:
European shag (Eng),
Cormorán moñudo(Sp),
Corvo mariño cristado (Gal),
Corvo marí emplomallat (Cat),
Ubarroi mottoduna (Eusk).

Status:
VU (Vulnerable)

An arrow under the water

The European shag is undoubtedly one of the nature's most spectacular examples of adaptation to the marine environment. In spite of the fact that, as a bird, it flies through the air, all its body's structure is designed to cope incredibly well under the sea and and catch the fish it feeds on.

It therefore has a sharp bill with a hook on the end to prevent its prey escaping. Its long webbed feet act as fins, and its slim body allows it to move surprisingly fast underwater. Its long, flexible neck allows it to trawl through the gaps between rocks in search of fish and small crustaceans, while providing the power for the head to be able to "harpoon" its prey. Its eyes have an outer membrane (third eyelid) that acts as a lens, giving these birds magnificent underwater vision. Additionally, unlike most seabirds, its plumage is not completely waterproof because, since it is quite large, it needs to be partially wetted to increase its weight and reduce its buoyancy. This is essential to its effectiveness underwater. This means they have to spend much of their time drying their feathers, and so stay on the sunniest rocks where they stretch out their wings - a typical pose that characterises this species. They often gather together to fish in large groups called "ralleiras", that hunt the shoals of sand eels and mackerel that are plentiful in the waters of the Park and the surrounding area.

European Storm-petrel *(Hydrobates pelagicus)*

Similar in size to a swallow, the storm petrel is Europe's smallest seabird. It is a pelagic bird, i.e. feeds far from the coast, in open water, where it uses its highly-developed sense of smell to find food. It only spends time on land during the mating and nesting seasons. The storm-petrel nests in crevices or cavities on the coast, in places normally inaccessible to humans, and only settles on its nest during the night. The Park is home to a small breeding colony of about a dozen breeding pairs, which nest on the Cíes archipelago.

Despite its small size, it is one of the longest-lived seabirds in Europe and can easily reach 30 years of age. It has a very low birth rate, as it only lays a single egg and, like other seabirds, reproduces intermittently, i.e. does not breed every year. Interestingly, the petrel feeds its chick so much that it grows to 150% larger than the adults. The chick then uses up this accumulated body fat until its body is fully developed and it can fly away from the nest on its own, out to the vast ocean that will be its new home.

It is listed as a Vulnerable species (V) in the Red Book of Birds in Spain and in the Galician Catalogue of Threatened Species. The presence of rats, which have been brought onto the islands by man, is one of the principal conservation problems, and may yet kill off whole colonies of this curious seabird.

HYDROBATIDAE

Family

Scientific name:

Hydrobates pelagicus

Common Name::

European storm petrel(Eng),

Paiño europea.(Sp),

Paiño pequeno ou do mal tempo (Gal),

Ocell de tempesta (Cat),

Ekaitz-txori txikia (Eusk).

Status:

VU (Vulnerable)

Cory's Shearwater (Calonectris diomedea)

It has recently been confirmed that a small group of Cory's shearwaters are nesting on the cliffs of the Cíes archipelago, which is very good news for the National Park. As a result, a specific action program is being developed (lures, fencing to protect against predators, etc), to ensure that this Atlantic Islands colony can become permanent.

Like the storm petrel, the Cory's shearwater is a pelagic bird with nocturnal habits. It is, however much larger, al-

PROCELLARIIDAE
Family

Scientific name:
Calonectris diomedea

Common name:
Cory´s shearwater (Eng),
Pardela cenicienta(Sp),
Pardela cincenta (Gal),
Baldriga cendrosa (Cat),
Gabai arrea (Eusk).

most as big as a seagull. They feed on fish, squid, and also the fish and seafood tossed overboard from fishing boats which they regularly follow. Their flight is very characteristic, with short, quick flaps of the wings followed by a long effortless glide close to the water. They seem to "play" with the waves, to take advantage of the wind that hits a wave and then blows upwards. They therefore commonly follow in the wake of vessels for hours, to take advantage of the waves generated. They often gather in large floating groups called "rafts".

A Cory's shearwater also lays a single egg and doesn't breed every year. It often digs a small burrow to build its nest in. The parents often have to be absent for several days in search of food for their chick. At 3 months, it is fully developed and finally leaves the nest. The young return to the same colony, or one close by, after five years, although many of them do not breed for the first time until they are six to nine years old.

This species is in decline worldwide. Deaths caused by being accidentally caught in fishing gear and by mammalian predators (cats, rats, mice and mink) that have been introduced by humans to the islands where they breed, are the main threats to the species' survival. Light pollution, with dazzled chicks becoming disorientated when they first fly, is a serious threat, as is poaching.

The Cory's shearwater has a complex system of calls that it only makes during the mating and breeding seasons in breeding colonies. The male's mating call is nasal, while in females it is guttural and deeper. These curious guttural sounds ('Guaña-Guaña') have resulted in some authors relating them to the "siren song" that sailors were said to hear in certain parts of the coast in the evenings.

The decline of the Guillemot

ALCIDAE Family

Scientific name:
Uria aalge

Common name:
Guillemont (Eng),
Arao común (Sp),
Arao (Gal),
Somorgollaire t (Cat),
Martin(Eusk).

Status:
(E) Endangered

This small member of the Alcidae family was once commonly seen along the Atlantic coast of the Iberian Peninsula, with a population in Galicia estimated to be around 3,000 in the 60's. It formed dense breeding colonies on the Atlantic Islands, especially on the Cíes islands, where the last nesting pairs were seen around the end of the 80's.

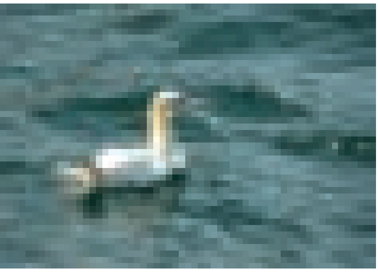
At present, as much a couple of pairs of this bird may still - miraculously - nest on the rugged coast of Cape Vilan (A Coruña). The breeding success rate is not, however, known. The guillemot is listed as Critically Endangered, which means that, within a few short years, it may no longer be nesting on the Spanish coast.

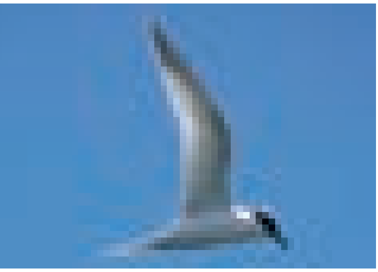
The causes of this acute population decline are not entirely clear. Although, like other seabirds, the guillemot has suffered the damaging effects of drift nets, sport fishing, oil spills, etc, the reasons for its disappearance as a nesting species from the Galician coast have not yet been demonstrated.

Because of their similar appearance and clumsiness on land, some authors have called it "the Galician penguin". This bird, however, does not belong to the penguin family but to the Alcidae, which differ primarily in that they still retain the ability to fly.

In the present, guillemots can occasionally be seen in the waters of the Park during the winter months, but in the spring they return to their breeding colonies in the north Atlantic.

Birds of passage - seabirds, waders and water birds


Northern Gannet


Sandwich Tern


Kentish Plover


Bar-tailed godwit

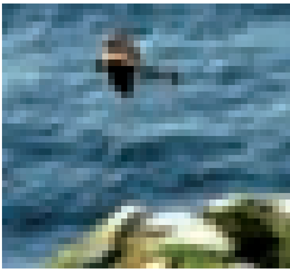
In addition to the birds that breed in the Park, throughout the year many seabirds, waders and waterfowl visit the waters around the Atlantic Islands during their migrations, spending the summer or winter here. Hundreds of **great black cormorants** and **Mediterranean gulls** shelter on the islands during the winter. In spring and autumn there are usually groups of **northern gannets** feeding in the waters around the islands. At the same time, the noisy sandwich tern is commonly seen flying over the transparent water along the beaches in search of fish, which they catch by making spectacularly steep dives.

The shearwaters are also regular visitors to these Atlantic waters, and large numbers of **Balearic shearwaters** (listed as Critically Endangered) come in groups during the summer months to feed along the Galician coast. The many intertidal pools, beaches, and especially the Lagoon on Cíes, are used as places of rest and refuge by many shorebirds, including herons, egrets and curlews, during their migratory passages.

The Kentish Plover (*Charadius alexandrinus*) is an exception. This wader, which is listed as Vulnerable (V), has become a regular nesting species on the dunes of Cíes and Sálvora in recent years. The elusive European oyster catcher has successfully bred on the coasts of the Cíes archipelago, although at the moment there is just one breeding pair.

Terrestrial birds

In spite of the small land area of the Park (1,194 ha.) there are quite a few species of land birds that nest on its islands, many of them in clearly declining numbers, both on the adjacent Galician coast and on the islands themselves.



Common Kestrel on Cíes

Of the birds of prey, the **common buzzard** and the **northern goshawk** are both present on the islands of all four archipelagos. On the cliff ledges of Cíes and Ons, the **peregrine falcon, common kestrel** and the **royal swift** all nest. The red-billed chough has disappeared from the islands where, not so many years ago it nested, while the **western jackdaw** is only seen on the island of Ons, where numbers have declined significantly in recent years. These declines in populations of Corvidae may possibly be related to the reduction in agricultural land-use, such as growing maize and other cereals, on the islands.

Species of medium-sized birds and small passerines (perching birds) also benefit from the islands' mild climate. In the trees, in addition to **common wood pigeons, doves** and **blackbirds** there are also many **greenfinches, blackcaps** and **warblers, finches** and **coal tits**. In the thickets and among the gorse, **nightjars** and **stonechats** are common and there's no lack of **robins** and **goldfinches**, while **wagtails** and **black redstarts** are often seen among the cliff crags (*see Appendix on Birds*).

Nightjar

MAMMALS

Due to their small land area and isolation, the Atlantic Islands are, in general, home to fewer mammal species than the nearby continental coasts.

Some species, such as the rabbit have adapted exceptionally well to the specific island conditions (absence of predators, little human presence) and so are found all over the archipelagos in the Park. Small rodents are frequently seen, including the **house mouse**, the **wood mouse** (*Apodemus sylvaticus*), and especially the **black rat** (*Rattus rattus*), which is a threatened species in the United Kingdom and Central Europe. The **greater white-toothed shrew** (*Crocidura Russula*), the **European hedgehog** (*Erinaceus europeus*) and the **Spanish mole** (*Talpa occidentalis*) - the latter two only on Cortegada - complete the list of small mammals in the Park.

With respect to bats, the presence of at least five species has been detected in the Park: the **common pipistrelle** (*Pipistrellus Pipistrellus*), **serotine bat** (*Eptesicus serotinus*), **gray long-eared bat** (*Plecotus austriacus*), **Savi's pipistrelle** (*Hypsugo savii*) and the **greater horseshoe bat** (*Rhinolophus ferrumequinum*). The latter is listed as Vulnerable (VU) in Spain and Endangered (EN) in the Balearic Islands.

Greater Horseshoe Bat

Other mammals, such as **feral cats** (*Felix catus*), have been introduced by man and constitute a serious threat to the few indigenous small mammals of the islands. The recent presence of the **American mink** (*Mustela vison*), a foreign species from breeding farms that has become established all along the Atlantic coast of the Iberian Peninsula, is also especially worrying, mainly on the islands in the Cíes and Sálvora archipelagos, where is a problem for the colonies of nesting seabirds, since it preys on the eggs and chicks and even adults. In both cases, the National Park is carrying out an ongoing control and monitoring campaign.

American mink

The presence of the **otter** (*Lutra lutra*), which was believed to have disappeared, has been increasing year by year on the islands in the Park, and stable family groups have currently been found on the Ons and Sálvora archipelagos. The fact that Galician otters are the only ones that also inhabit marine islands makes the ones on the Atlantic Islands even more valuable.

Other mammals introduced by man for hunting or farming are horses and deer on Sálvora and sheep and goats on Ons. In the last few years an increase has been detected in the number of wild boar on the island of Cortegada, where a small group of feral goats has also been found.

Young Mink on Salvora