CATALOGUE OF THE ECOSYSTEM SERVICES OF BISCAY

This annex presents a catalogue of the ecosystem services of Biscay. This catalogue contains a brief description of the different ecosystems that are found in Biscay as well as the services that they provide to society.

Natural diversity has not been included in this catalogue since it is not considered to be a service, but rather, is the basis of the functioning of all ecosystem services, as mentioned earlier in Chapter 1.

In this catalogue, the general ecosystems described in Chapter 2 have been classified in the following manner:

01 › **Coastal ecosystems**
- ›› Marshlands and reed beds
- ›› Coastal habitats (beaches, cliffs, etc.)

02 › **Grasslands and hedges**

03 › **Shrubs**
- ›› Non-heath shrubs
- ›› Heathland

04 › **Natural forest**s
- ›› Riparian forests
- ›› Beech forests
- ›› Broadleaves forests dominated by ***Quercus***
- ›› Cantabrian green oak forests

05 › **Other natural ecosystems**
- ›› Bodies of water
- ›› Mires and peatland
- ›› Rocky lands

06 › **Forest plantations**
- ›› Broadleaves plantations
- ›› Eucalyptus plantations
- ›› Coniferous plantations

07 › **Crops**

08 › **Urban ecosystems and other artificial areas**

The services provided by these ecosystems have already been described in a general manner in Chapter 2; therefore, this catalogue attempts to offer a more detailed description of the most relevant services offered by each specific ecosystem.

MARSHLANDS AND REED BEDS

Marshlands are wetlands that form in the mouths of the largest rivers, where they are affected by the tides, thereby regularly flooding to varying degrees. They are some of the richest and most fertile land areas, since the rising tide brings sediment deposits and nutrients which are absorbed into the soil. They may even be used as cultivation areas. Furthermore, these unique areas are home to a large number of organisms, from tiny planktonic algae to many varieties of flora and fauna.

Within these ecosystems, there are **marshlands** as well as **reed beds and estuary rushes**.

Currently, they make up 0.1% of the Biscay surface area and are located in the municipalities of Muskiz, Plentzia, Mendexa-Lekeitio and Ondarroa, with the most important marshland, based on its state of conservation, being that of the **Urdaibai Biosphere Reserve**, located in the municipalities of Busturia, Murueta, Forua, Kortezubi and Gautegiz Arteaga.

MOST RELEVANT SERVICES PROVIDED BY THE MARSHLANDS AND REED BEDS

Provisioning		**Food:** numerous fish and seafood varieties.
Regulating		**Climate regulation:** they help alleviate climate control by absorbing and storing carbon in vegetation and soil. **Regulation of air quality:** vegetation in the marshlands helps maintain the air quality as it retains pollutants in the air by exchanging gases with the atmosphere. **Water regulation:** vegetation retains and assists water infiltration in the ground and ground-water recharge. Also, the marshlands act as powerful water purifiers, retaining particles that are transported by water. **Erosion control:** vegetation helps stabilize the ground with its strong roots, preventing ground transport and erosion caused by the tides and strong winds. **Maintenance of soil fertility:** these are very fertile ecosystems since they retain a large quantity of sediments and nutrients that are moved by the water. Some marshlands are used as cultivation areas. **Regulation of natural disasters:** they help prevent flooding since they can absorb and store large quantities of water coming from heavy rains. Furthermore, they buffer the high tides and strong swells.
Cultural		**Recreation:** a number of recreational activities may be carried out here, including bird watching, canoeing, fishing, etc. **Scientific knowledge:** research of these lands is very important in order to preserve the eco-system in a good state. For example, studies have been made in all of the Biscay estuaries related to *Baccharis halimifolia*, a non-native species that is present in almost all of them and that is causing environmental problems and therefore requires examination. **Environmental education:** different environmental education programs are carried out related to the marshlands, such as the *Azterkosta* program. **Aesthetic enjoyment of landscapes**: the coastal landscapes are greatly appreciated by the population. **Cultural identity and sense of belonging:** Basque mythology has strong ties to the marshlands, since it is said that in ancient times, mythological characters lived in these areas, such as the Lamiak.

COASTAL HABITATS

Coastal habitats are distributed along the coastline; therefore, they are strongly influenced by the sea. Also, they are the site of numerous human activities so they are subjected to considerable pressure, particularly during the summer season.

Numerous areas are included within this ecosystem, including **cliffs, beaches, different types of dunes and coastal heathlands**.

The coastal habitats **make up 0.6% of the Biscay surface area** and they are located across the entire coast of Biscay.

Some of these coastal habitats, in addition to having a high environmental value, also have great cultural and landscape values as well, as is the case with San Juan de Gaztelugatxe.

MOST RELEVANT SERVICES PROVIDED BY THE COASTAL HABITATS

Provisioning		**Food:** there is a large diversity of fish and seafood in the rocky areas of the cliffs and beaches. In addition, the pollination of the coastal heathlands allows for the production of honey. **Renewable energies:** the strong waves are used to generate renewable energy, such as marine energy. For example, in Armintza there is a testing area for the production of this type of energy.
Regulating		**Erosion control:** Dune vegetation, through its strong roots, stabilizes the sand on the dunes and prevents it being transported by the tides or strong winds. The coastal heathlands also help stabilize the fragile grounds of the coast. **Regulation of natural disasters:** the cliffs as well as the beaches and dunes help to dampen the high tides and the strong waves reaching the coast. **Pollination:** the coastal heathlands serve to nourish a wide variety of pollinators thanks to the abundance of flowers located here.
Cultural		**Recreation:** many recreational activities are carried out here, including spearfishing, sunbathing, walking, etc. **Scientific knowledge:** these are major research areas and a variety of centres specializing in these ecosystems exist, including AZTI and the Plentzia Marine Station (PIE) which is of international notoriety. **Environmental education:** different environmental education programs are related to these areas, such as the ***Azterkosta*** program. **Aesthetic enjoyment of landscapes:** the coastal habitats are greatly appreciated by the general population. **Cultural identity and sense of belonging:** some coastal habitats are part of the cultural identity of Biscay, as is the case with San Juan de Gaztelugatxe.

GRASSLANDS AND HEDGES

Typically, grasslands are found in areas of smooth topography, where grass grows, creating pastures and feeding areas for livestock. In these areas, there is a large diversity of species although the grasses dominate.

Separation between fields tends to be made by hedges, consisting of different types of trees and bushes.

This landscape, consisting of grasslands and hedges, is a part of the Atlantic countryside.

Within this ecosystem, there are distinct types of meadows, grasslands and hedges in Biscay, including **mountain pastures, dry grasslands and meadows for mowing**.

Currently, **they make up 20.2% of the Biscay surface area** and they are **distributed across the territory**.

MOST RELEVANT SERVICES PROVIDED BY GRASSLANDS AND HEDGES

Provisioning		**Food:** they are the food source of the livestock from which different food products are extracted, such as milk and meat. Honey production is also very closely associated with grasslands and hedges since pollinators feed on their flowers. **Biotic materials:** they are the source of livestock sustenance, which, in turn, produce different materials, including leather and wool. **Gene pool:** they are important in terms of genetic resources since in addition to possessing great genetic diversity, they also maintain a large diversity of native breeds. **Natural medicines:** they are the source of distinct plants with medicinal properties such as chamomile and plantain.
Regulating		**Water regulation:** the presence of hedges slows the flow of water across the ground, helping to regulate runoff. **Erosion control:** the presence of hedges favours the slow distribution of water across the ground, helping to prevent erosion. **Biological control:** hedgers offer a great diversity of birds which are fundamental to preventing pests since they feed on the insects which cause these pests. **Pollination:** the great diversity of flowers serves to nourish a large number of pollinators.
Cultural		**Recreation:** numerous leisure activities may be carried out here, including hiking, hunting, etc. **Scientific knowledge:** they are a major source of research. For example, in the Gorbeia Natural Park, many studies have been carried out on these ecosystems. **Environmental education:** they are important sources of environmental education that is distributed at interpretation centres, such as in the ***Parketxes*** de Urkiola, Gorbeia and Armañon. **Traditional knowledge:** shepherding is a traditional skill related to the pastures. **Aesthetic enjoyment of landscapes:** despite the fact that these ecosystems are managed by humans, they have a considerable aesthetic value, especially the high mountain pastures. **Cultural identity and sense of belonging:** the sense of identity offered by these ecosystems has been reflected in numerous rural sports such as, ***sega jokoa*** ("scythe game," a grass cutting competition).

NON-HEATH SHRUBS

The non-heath shrubs are bushy formations and formations of large ferns that make up the area preceding the forests. Typically, they are dominated by one species and they tend to have a low degree of diversity.

Within these shrubs, we may find **gorse thickets, brambles, berry bushes, shrubs, kermes oak, thorn bushes and ferns**. Currently, **they make up 2.9% of the Biscay surface area** and are **distributed across the territory**.

These shrubs have historically suffered and tend to suffer from considerable pressure due to the controlled burning that is often carried out on them, in order to increase pasture terrain or to prevent forest fires.

MOST RELEVANT SERVICES PROVIDED BY THE NON-HEATH SHRUBS

Provisioning		**Food:** blackberries, sloes and blueberries are some of the most widely appreciated fruits gathered from these shrubs. As for hunting, many migratory fowl feed on these shrubs and take refuge in these ecosystems. **Biotic materials:** some of the species are used to extract materials for handicrafts. For example, Boj wood is used for these purposes. **Natural medicines:** a variety of plants which are used in popular medicine, such as hawthorn and rosemary are found here.
Regulating		**Climate regulation:** vegetation cushions the temperature given the shadow provided and the moderation of wind speed. Furthermore, these shrubs help maintain climate control, storing carbon in the vegetation and ground. **Regulation of air quality:** vegetation helps maintain good air quality by retaining polluting particles through gas exchange with the atmosphere. **Water regulation:** their vegetation helps slow the flow of water across the ground, helping to regulate runoff. **Erosion control:** the strong roots and rhizomes, particularly in the areas of steep slopes, stabilize the ground and prevent movement caused by strong rain. **Maintenance of soil fertility:** they provide and recycle many ground nutrients. **Regulation of natural disasters:** during periods of heavy rain, the vegetation slows water flow, thereby reducing the magnitude of flooding. **Biological control:** the large diversity of birds inhabiting and feeding off of the shrubshelps to control pests, since they feed on the insects that cause these pests. **Pollination:** the diversity of wild fruits and berries found in the shrubs serves as nourishment for different pollinators, thereby contributing to the maintenance of their populations.
Cultural		**Recreation:** many leisure activities may be carried out in these areas, including berry collecting and hunting (as there are a number of different birds with a high hunting value living in this ecosystem).

HEATHLAND

Heathlands are areas of bushes formed mainly by the ericaceous family, although they are always accompanied by other types of shrubs such as rockrose or gorse. They can withstand fire since they re-sprout from root buds located in subterranean organs or root systems. This offers them a great advantage over other vegetation that must blossom and germinate, making them very abundant in the territory.

Heathlands **currently makes up 4.6% of the Biscay surface area**, being found **across the territory**.

Within these shrubs, there are distinct types of heathlands that are differentiated by their dominant species. There include **heathlands with gorse, *Erica arbórea* heathlands, heathlands with *Erica vagans* and *Erica cinerea*, heathlands with *Ulex sp.*, heathlands with *Spiraea sp.* and heathlands with *Erica ciliaris* and *E. tetralix***.

This type of shrubs, like those described previously, have suffered and continue to suffer from strong pressures due to controlled burning which are carried out in order to increase pasture resources or to prevent forest fires.

MOST RELEVANT SERVICES PROVIDED BY HEATHLAND

Provisioning		**Food:** heather honey is highly valued by the population. **Biotic materials:** briar wood is used for different purposes, including handicrafts. **Natural medicines:** different species of heather possess a variety of diuretic properties such as ***Calluna vulgaris*** or ***Erica arborea***.
Regulating		**Climate regulation:** they help combat climate control by storing carbon in their vegetation and ground. Regulation of air quality: vegetation helps to maintain good air quality by retaining the polluting particles through atmospheric gas exchange. **Water regulation:** their vegetation helps slow the flow of water across the ground, helping to regulate runoff. **Erosion control:** their strong roots, particularly in areas of steep slopes, stabilize the ground, preventing erosion due to heavy rain. **Regulation of natural disasters:** in periods of heavy rain, vegetation slows the water flow and reduces the extent of flooding. **Pollination:** the diversity of flowering species serves to nourish numerous pollinators, thereby contributing to the maintenance of their populations.
Cultural		**Aesthetic enjoyment of landscapes:** heathland is greatly appreciated from an aesthetic perspective, due to its great floral diversity.

RIPARIAN FORESTS

Riparian forests are deciduous forests growing on both sides of the rivers and streams. In these ecosystems, it is possible to find a large variety of riparian species positioned transversally to river flow, due to their water needs, with those requiring the most water being located the closest to the source, with their roots anchored directly in the water, such as in the case of willows, followed by the less demanding species that are situated a few of meters away, such as the alders, poplars, ash trees and elms, to name a few.

Within these types of forests, we find **riparian alder groves, ash groves and willows groves**. They **currently make up 0.9% of the Biscay surface area and** are **distributed across the entire territory**.

Historically, these forests have been significantly diminished due to the spread of agricultural lands and ranching, the development of modern forests and occupation for human settlements. Urban areas, communication channels and other infrastructures have invaded areas previously covered in forest, particularly in the main valleys where human populations have concentrated.

MOST RELEVANT SERVICES PROVIDED BY RIPARIAN FORESTS

Provisioning		**Natural medicines:** in some riparian forests, it is possible to find Royal Fern and St. John's Wort, species that are typically used in popular medicine for their anti-rickets and anti-inflammatory properties, respectively.
Regulating		**Climate regulation:** their vegetation offers coverage to the water surface, thereby preventing high temperatures during the daytime. Like all forest ecosystems, they are some of the most important sources of carbon storage, and are therefore useful in alleviating climate change. **Water regulation:** they regulate the speed of water flow of the rivers. Their powerful roots dampen the current and the drainage of the waters, slowing them considerably. Furthermore, they help in the sedimentation of articles, improving water quality. **Erosion control:** they protect the river borders from erosion. **Maintenance of soil fertility:** they offer numerous nutrients to the river, in the form of falling leaves in the autumn season, some of which are deposited in the floodplains. **Regulation of natural disasters:** they help prevent flooding, slowing the river flow during periods of heavy rainfall.
Cultural		**Scientific knowledge:** their research is necessary for the conservation of the riparian forests as well as the aquatic ecosystems that are associated with them. **Aesthetic enjoyment of landscapes:** they contribute to the natural appearance of the landscapes, a factor that is greatly appreciated by the population.

BEECH FORESTS

These are dense and heavily covered deciduous forests dominated by beech trees (***Fagus sylvatica***). They tend to be situated in the most highly elevated and shadiest areas of the territory, since beech requires a great deal of humidity and soil.

Its canopy offers great coverage and therefore few plant species are capable of existing here, leading to a very scarce undergrowth, although this also depends upon the type of substrate on which it is situated. Therefore, beech forests situated on acidic substrates (acidophilus) have a lower diversity than those situated on basic substrates (basophils).

These forests **make up 1.8% of the Biscay surface area** and are **found across the mountains of Duranguesado, in the slopes of Gorbeia and Oiz and in the upper parts of the Ordunte and Salvada mountain ranges**, at altitudes of over 500 and 600 metres.

Beech forests in Biscay have long been used as sources of diverse natural forest resources, mainly wood. This wood, though traditionally used in carpentry, cabinetmaking and shipbuilding, was used primarily as domestic fuel for cooking and heating or as a raw material for creating charcoal. Exploitation of the beech tree through pollarding was the most common practice, since this form of exploitation allowed for the production of firewood as well as use of the undergrowth for livestock grazing. Thus, today, the pruned beech trees have a unique appearance and are shaped like candelier with thick trunks that are short and straight, topped off with a crown of branches at one or two metres above the ground.

MOST RELEVANT SERVICES PROVIDED BY BEECH FORESTS

Provisioning

Food: they are home to edible mushrooms and fungi, berries and hunting products.

Biotic materials: they provide firewood for domestic and artisanal use, and seeds for the creation of natural oils.

Gene pool: they offer great genetic diversity since these forests provide coverage to a large number of organisms.

Natural medicines: beech has been used in traditional medicine as a laxative.

Regulating

Climate regulation: vegetation of these forests provides intense coverage and prevents high temperatures in their interior. Furthermore, through evapotranspiration, water is returned to the atmosphere, maintaining humidity in the air. Like all forest ecosystems, they are some of the largest carbon storage systems, making them key in the alleviation of climate change.

Regulation of air quality: through the exchange of gases carried out by vegetation with the atmosphere, air pollutants are reduced, helping to maintain a good air quality.

Water regulation: the forest grounds are well structured and therefore favour infiltration of water in the earth and the recharge of aquifers, especially in limestone areas.

Erosion control: the powerful tree roots stabilize the ground, preventing erosion from heavy rainfall, especially in steep sloping areas.

Maintenance of soil fertility: they provide and recycle numerous ground nutrients.

Regulation of natural disasters: in periods of heavy rainfall, they slow water flow, preventing flooding. They also provide protection from strong winds.

Cultural

Recreation: a number of recreational activities may be carried out in these ecosystems, such as hiking, hunting or mushroom collecting.

Traditional knowledge: the pollarded beech trees provide information regarding traditional use of forest ecosystems. Their wood has been traditionally used for charcoal making and shipbuilding.

Aesthetic enjoyment of landscapes: the landscapes that they make up are greatly appreciated by the population due to their lushness.

Cultural identity and sense of belonging: the pollarded beech forests are a greenprint of our history and form a part of Biscay's cultural identity.

BROADLEAVES FORESTS (dominated by *Quercus*)

Broadleaves forests contain a large variety of native tree and shrub species (hazelnuts, ash trees, lime trees, holly, hazelnuts, hawthorn, etc.), although they are dominated by the species of the ***Quercus*** genus (oaks, gall oaks, downy oaks, etc.).

They are including **mixed forests, hazelnut forests, gall oak groves, Pyrenean oak groves, regular oak groves, birch groves, chestnut forests and non-riparian alder s groves**.

Although these forests make up the majority of the potential vegetation of Biscay, currently, they only make up **8.4% of its surface area** and they are **distributed across the entire territory**.

Over the years, these forests have decreased considerably in their surface area, being reduced to small forests that dot the landscape across the valleys. Their reduction has been due to the growing demand for wood by foundries for their transformation into charcoal for the production of iron and by the shipbuilding industry for building. This exploitation may often be seen in the characteristic pruned shape of the trees.

MOST RELEVANT SERVICES PROVIDED BY THE BROADLEAVES FORESTS

Provisioning

Food: many mushrooms and fungi, berries and hunting animals may be found in these areas. The boletus mushroom is one of the most greatly appreciated varieties.

Biotic materials: providing firewood for domestic use and artisan crafts, and seeds for the creation of natural oils.

Gene pool: they possess a great genetic diversity, housing a wide multitude of organisms. They are the site of almost all of the forest vertebrates living in Biscay.

Regulating

Climate regulation: being one of the most extensive natural forests of Biscay, they play an important role in controlling climate change, as they store large quantities of carbon.

Regulation of air quality: they are capable of retaining large quantities of polluting particles from the air, helping to improve air quality.

Water regulation: the forest grounds are structured to support water infiltration and aquifer recharge. Furthermore, the organic material provided by vegetation to the ground helps to retain a larger quantity of water.

Erosion control: the powerful tree roots stabilize the ground, preventing erosion due to heavy rainfall, especially in steep sloping areas.

Maintenance of soil fertility: they provide and recycle numerous soil nutrients.

Regulation of natural disasters: during periods of heavy rainfall, they slow water flow, collecting river runoff and thereby preventing flooding. They also provide protection from strong winds.

Pollination: due to their diversity of flowering species and berries, they nourish distinct pollinators. Furthermore, the trees serve to support bee swarms.

Cultural

Recreation: different recreational activities may be carried out here, including hiking, hunting, etc.

Traditional knowledge: these pruned trees offer information regarding traditional use of forest ecosystems. As is the case with beech trees, their wood has been traditionally used for charcoal making and shipbuilding.

Aesthetic enjoyment of landscapes: their landscapes are greatly appreciated thanks to the diversity of the trees that they contain.

Cultural identity and sense of belonging: oaks are considered highly significant in Biscay cultural identity. A good example is the tree of Gernika.

CANTABRIAN GREEN OAK FORESTS

Cantabrian green oak forests are evergreen forests. They tend to be dense and low in height, but having a great density of trees, shrubs and lianas. The dominant species is the holm oak (***Quercus ilex***), although they may also be accompanied by cork oaks, strawberry trees and laurels. Lianas, as well as ivy, sarsaparilla and rubia are also abundant in these forests. The holm oak is a common species in Mediterranean environments, but in Biscay it may be found in dry and sheltered areas, growing over limy substrates that are strongly karstified as well as in coastal areas.

These forests **make up 2.2% of the Biscay surface area** and are **distributed** primarily across the karstified limestone massifs, such as those located in **Urdaibai, Peñas de Ranero and the lower sections of the Duranguesado Limestone Mountains**.

In Biscay Cantabrian green oak forest, like other natural forests, has been exploited over time by mankind. They have been used mainly for their wood, for domestic use as combustibles and to produce charcoal. However, with the end of this practice there has been a major recovery of these forests, which are currently those in the best state of development and conservation.

MOST RELEVANT SERVICES PROVIDED BY THE CANTABRIAN GREEN OAK FORESTS

Provisioning

Gene pool: they possess a great genetic diversity as they contain a large number of Mediterranean species which are rare in the Biscay climatology.

Natural medicines: they are the home of many plant species that are used in popular medicine such as the bay leaf.

Regulating

Climate regulation: Storing large quantities of carbon, they play a major role in the control of climate change. Furthermore, through evapotranspiration, water is returned to the atmosphere, maintaining humidity in the air.

Regulation of air quality: their vegetation retains large quantities of polluting particles from the air, helping to improve air quality.

Water regulation: their vegetation regulates the return of water to the atmosphere through evapotranspiration. The substrates upon which these forests are situated promote the infiltration of water in the ground and aquifer recharge.

Erosion control: the strong tree roots, particularly in steeply sloped areas with little soil, stabilize the ground to prevent erosion from heavy rainfall.

Maintenance of soil fertility: they provide and recycle numerous nutrients from the ground, despite being located in areas with little soil.

Regulation of natural disasters: during periods of heavy rainfall, they slow water flow, collecting river runoff and thereby preventing flooding. They also provide protection from strong winds, especially in coastal areas.

Cultural

Scientific knowledge: the presence of Mediterranean flora in some coastal areas reveals that in other climatic periods, the Mediterranean vegetation reached coastal areas. This type of information is of great importance for improving scientific knowledge regarding these forests and for understanding the climate that existed during other time periods.

Aesthetic enjoyment of landscapes: the landscapes created by these forests are greatly appreciated by the population since they are unique forests in the Atlantic landscape.

BODIES OF WATER

Bodies of water are permanent water sources found on the Earth's surface (rivers, streams, creeks, lagoons, etc.).

These ecosystems consist of **rivers** as well as **natural ponds**. Currently, **they make up 0.5% of the Biscay surface area** and are **distributed across the entire territory**.

In Biscay, short rivers predominate, having narrow and deep valleys of a markedly torrential nature. Some of the main rivers are: Nerbioi-Ibaizabal, Cadagua, Butroe, Barbadun, Oka, Ea, etc. Many of them have been transformed by mankind due to the modification of their mouths with the installation of dams or channels, leading to a variety of environmental problems. Some rivers still have riverside forests in good conditions, although this is not normally the case.

MOST RELEVANT SERVICES PROVIDED BY BODIES OF WATER

Provisioning		**Food:** they provide a large variety of food products (fish, crabs, frogs...). **Water:** they contain deposits for the supply of fresh water for distinct uses (human consumption, industrial use, irrigation, etc.). **Renewable energies:** the force of the water from the rivers may be used to create hydraulic energy. **Natural medicines:** some provides thermal springs that are beneficial to the health.
Regulating		**Water regulation:** they help evacuate water produced by rain or melting snow, thereby regulating the water cycle. **Maintenance of soil fertility:** the rivers drag a large quantity of nutrients that are deposited in their flood plains, transforming them into very fertile areas. **Regulation of natural disasters:** during periods of very heavy rainfall or snow melts, the river flood plains help to control the excess water and thereby prevent flooding.
Cultural		**Recreation:** numerous leisure activities may be carried out here, including canoeing, fishing, etc. **Scientific knowledge:** their research is an important source of scientific knowledge that may be used for the preservation and management of the environment. Here, the Basque Water Agency (URA in its Basque acronym) plays an essential role. **Environmental education:** they are a major source of environmental information that is spread by interpretation centres or programs such as ***Ibaialde***. **Traditional knowledge:** ironworks, water mills and other traditional uses have been provided by these ecosystems. **Aesthetic enjoyment of landscapes:** landscapes containing water tend to be greatly appreciated by the population. **Cultural identity and sense of belonging:** regional legends and folklore are very closely related to these ecosystems. Some mythological characters such as the Lamiak dwell in these ecosystems.

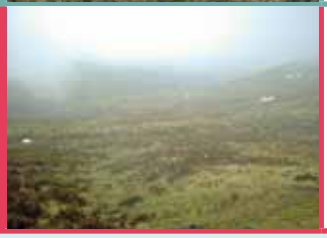
MIRES AND PEATLAND

Mires are acidic wetlands in which a large quantity of organic material is accumulated in the form of peat. They are permanent communities that do not evolve towards other levels of greater structural complexity. Typically, they are located at the heads or upper sections of ravines, giving rise to streams that go on to form part of rivers. These types of ecosystems are home to a very special type of flora.

Within this type of ecosystems, there are **peat bogs** with singular species such as Drosera or Pinguicola, **reeds of *Phragmites*, mires that are dominated by *Juncus effusus* and swamps. They make up 0.1% of the total surface area of Biscay** and they are distributed mainly across the **Ordunte mountain range, the Gorbea massif and Urkiola**.

The Ordunte Mountains are one of the areas of the greatest concentration of peat mires, such as the Zalama mire. Saldropo is significant mire, previously exploited by humans in order to extract the peat which was used as mulch. It was the most extensive of the Basque Country mires and the most valuable from an ecological perspective; however, due to its exploitation, it has been depleted. Currently it is in a recovery phase.

MOST RELEVANT SERVICES PROVIDED BY THE MIRES AND PEATLAND

Provisioning		**Biotic materials:** supplied peat for use as mulch. **Renewable energies:** peat may be used for biomass.
Regulating		**Climate regulation:** vegetation and grounds act as carbon sinks, helping to control climate change. **Water cycle regulation:** their grounds act as sponges, allowing for the retention of large quantities of water and distributing it very slowly. **Erosion control:** the quantity of organic material contained in their grounds helps control erosion caused by water, as it is slowly stored here. **Maintenance of ground fertility:** they are one of the most fertile land ecosystems, containing a large quantity of nutrients in their grounds. Peat that may be extracted from these grounds may be used as mulch. **Regulation of natural disasters:** during periods of heavy rainfall, the organic material in their grounds helps to slow down the water flow and thereby prevent floods.
Cultural		**Traditional knowledge:** the use of peat has traditionally been very common throughout Biscay.

ROCKY LANDS

The rocky lands of Biscay are made up of stony areas and limestone outcrops at the base of the ledges, steep lands, rocky slopes, etc. Typically, there is no vegetation in these areas or it is quite scarce, since there is little soil in these ecosystems. When there is vegetation, it is unique and almost exclusive, based on the specific conditions of the land.

Within this type of ecosystems, there are **gravel areas, crag vegetation and semi-nude platform vegetation**. The limestone formations are of special importance due to their functions.

These ecosystems make up **0.9% of the Biscay surface area and are located in the** areas to the **northeast and south of the territory. Of special note are the massifs of Gorbeia and Urkiola**.

Rocky lands in Biscay have traditionally been used by humans in quarries for the extraction of different materials such as limestone, aggregates and sands, etc., both for industrial and construction or ornamental uses.

MOST RELEVANT SERVICES PROVIDED BY THE ROCKY LANDS

Provisioning

Water: the aquifers forming in the limestone areas supply fresh water for distinct uses (human consumption, industrial uses, irrigation, etc.).

Geotic materials: they supply a large quantity of materials for industrial, ornamental uses, etc. The quarries are located in the rocky limestone areas.

Gene pool: they contain great genetic resources since they possess a unique genetic diversity. Furthermore, they feed some native species that help to maintain the gene pool.

Regulating

Climate regulation: they act as important carbon sinks, since carbon is stored in the carbonate rocks that make them up.

Water regulation: the limestone formations are very permeable areas that foster the filtration of water from rain and aquifer recharge, supporting the regulation of the water cycle.

Erosion control: the limestone formations are very permeable and favour the infiltration of water, preventing the flow across its grounds and thereby controlling erosion.

Regulation of natural disasters: water infiltration in the grounds of the rocky lands helps to control the excess of water resulting from periods of heavy rainfall, thereby preventing flooding.

Cultural

Recreation: different leisure activities may be carried out in these areas, including climbing, hiking, cave visits, etc.

Environmental education: they are an important source of environmental education, particularly in regards to recharge and water cycle regulation.

Aesthetic enjoyment of the landscape: they are greatly valued by the population for their aesthetics.

Cultural identity and sense of belonging: Basque mythology is closely tied to these ecosystems, which are supposedly the home of Mari (main character of Basque mythology).

BROADLEAVES PLANTATIONS

Broadleaves plantations are those decidious forests that have been planted for their subsequent exploitation.

Within these broadleaves plantations may find ***Platanus sp., Populus sp., Quercus rubra, Robinia pseudoacacia* and fruit tree**. These ecosystems **make up 2.2% of the total Biscay surface area** and are **distributed across the entire territory**.

The broadleaves plantations in Biscay are exploited mainly to extract wood for a variety of uses, such as furniture manufacturing, construction, etc.

MOST RELEVANT SERVICES PROVIDED BY BROADLEAVES PLANTATIONS

Provisioning		**Food:** they provide edible fungi and mushrooms, wild berries, fruits, etc. Animals with high hunting value also reside here. **Biotic materials:** they provide materials such as wood, resins, etc. **Renewable energies:** their biomass serves as a source of energy.
*Regulating		**Climate regulation:** they act as major carbon sinks, since their vegetation absorbs and stores large quantities of carbon. On a more local level, their abundant canopy allows for temperature control offering shade and moderating wind speed. **Water regulation:** vegetation regulates the return of water to the atmosphere via evapotranspiration and fosters the slow distribution of water through the ground, supporting the regulation of runoff. **Regulation of natural disasters:** they help regulate flooding since during heavy rainfall periods, their vegetation retains water, slowing the flow and helping to absorb river discharge. Furthermore, they provide protection from strong winds, limiting their speed.
Cultural		**Recreation:** a number of leisure activities may be carried out in these ecosystems, such as hiking, hunting or mushroom collecting. **Aesthetic enjoyment of landscapes:** in some areas, their landscapes are greatly valued due to their "green" association.

These services disappear when the plantation is harvested.

EUCALYPTUS PLANTATIONS

Eucalyptus plantations are exploited by mankind for their wood which, in Biscay, is used mainly to obtain paper pulp. These plantations are dominated by eucalyptus trees; therefore there is little diversity here, in terms of plants and animals.

Eucalyptus trees grow very fast; therefore they require large quantities of water and nutrients. This tends to lead to cases of soil drying and impoverishment where these trees grow and in the surrounding areas.

Eucalyptus plantations make up **5.4% of the Biscay surface area** and they are **distributed primarily across the northern part of the territory**. The most widely used species in these plantations in Biscay is the ***Eucalyptus globulus***.

Over recent years, there has been an increased extension of eucalyptus plantations in Biscay, due primarily to the low profitability of the coniferous plantations.

MOST RELEVANT SERVICES PROVIDED BY THE EUCALYPTUS PLANTATIONS

Provisioning		**Food:** they provide edible fungi and mushrooms. Here, animals with a high hunting value are also found. Furthermore, eucalyptus flowers are an excellent source of nourishment for bees, thereby contributing to honey production. **Biotic materials:** they provide materials such as wood and resins. **Renewable energies:** their biomass serves as a source of energy. **Natural medicines:** eucalyptus has medicinally active components.
*Regulating		**Climate regulation:** they act as major carbon sinks, since their vegetation absorbs and stores large quantities of carbon. On a more local level, their abundant canopy allows for temperature control providing shade and moderating wind speed. **Regulation of natural disasters:** they provide protection from strong winds, controlling their speed and stabilizing the ground with their roots. **Pollination:** eucalyptus flowers are sources of nourishment for pollinating insects, thereby contributing to maintain their populations.
Cultural		**Recreation:** a number of leisure activities may be carried out in these ecosystems, such as hiking, hunting or mushroom collecting

These services disappear when the plantation is harvested.

CONIFEROUS PLANTATIONS

Conifer plantations are made up of rapidly growing species and are exploited by mankind for their wood. This wood is used primarily for construction and furniture making.

Generally, they are dominated by one sole conifer species; therefore they have little diversity, in terms of plants and animals.

Conifer plantations make up **38.7% of the Biscay surface area** and they are **distributed across the entire territory**.

In Biscay, **the most commonly used species is the Monterrey pine (*Pinus radiata*)**, due to its optimal adaptation to the environmental characteristics of this territory. Other conifers used are the ***Pinus nigra, Pinus pinaster, Pinus pinea, Pinus sylvestris, Cedrus sp., Chamaecyparis lawsoniana, Larix sp., Picea sp. and Pseudotsuga menziesii***.

Over recent years, there has been a decrease in the number of these plantations due mainly to their low profitability.

MOST RELEVANT SERVICES PROVIDED BY THE CONIFEROUS PLANTATIONS

Provisioning		**Food:** they provide edible fungi and mushrooms. Here, animals with a high hunting value are also found. **Biotic materials:** they are great wood producers. **Renewable energies:** their biomass is used as a source of energy.
*Regulating		**Climate regulation:** they act as major carbon sinks, since their vegetation absorbs and stores large quantities of carbon. On a more local level, they provide temperature control offering shade and moderating wind speed. **Water regulation:** the vegetation regulates the return of water to the atmosphere via evapotranspiration. **Regulation of natural disasters:** they help regulate flooding since during heavy rainfall periods, vegetation retains water, slowing the flow and helping to absorb river discharge. Furthermore, they provide protection from strong winds, limiting their speed.
Cultural		**Recreation:** a number of leisure activities may be carried out in these ecosystems, such as hiking, hunting or mushroom collecting. **Cultural identity and sense of belonging:** rural cultural and sporting activities are related to these ecosystems, as is the case with ***Aizkolaris***. **Cultural, intellectual and spiritual inspiration:** some of them have been used for artistic expression, as in the case of the painted forest of Oma.

These services disappear when the plantation is harvested.

CROPS

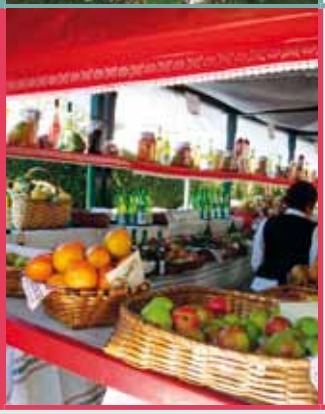
Crops in Biscay are characterized by their main presence in small agricultural farms, appearing in small **areas across the territory**. These areas include **orchards and nurseries, large scale monoculture farms and vineyards**.

Orchards and nurseries have the most extensive surface areas, making up 0.7% of the territory, while the large scale monocultures and vineyards only make up 0.1% of Biscay's total surface area.

In Biscay, vineyards are exploited for the production of ***txakoli*** wine. As for the orchards, their crops are grown in small village orchards or peri-urban areas of the cities and towns, and are destined for self consumption or sale in county markets. Here, fruits and vegetables are produced (lettuce, tomatoes, peppers, etc.) as well as legumes and cereals. In the case of the nurseries, in addition to the products mentioned above, ornamental plants and wood products are also produced.

Over recent years, there has been an increase in the surface area of ecological agriculture.

MOST RELEVANT SERVICES PROVIDED BY CROPS

Provisioning		**Food:** they provide a wide diversity of food products from fruits to vegetables, legumes, cereals or ***txakoli***. Some of these products also have quality labels. **Gene pool:** they are important genetic resources as they possess a wide diversity of local varieties that must be conserved. **Natural medicines:** some of the species cultivated have medicinally active components, such as rosemary.
Regulating		**Pollination:** they provide nourishment to pollinators, thereby contributing to maintain their populations.
Cultural		**Recreation:** they provide distinct leisure activities such as gardening, vineyard visits, etc. **Environmental education:** many schools provide their own orchards where students work in them and learn the different varieties to be grown. **Traditional knowledge:** traditional agriculture and the cultivation of local varieties is an important source of traditional knowledge. **Aesthetic enjoyment of landscapes:** some agricultural landscapes, such as orchards, the Basque hamlet farmland or vineyards are sources of aesthetic enjoyment. **Cultural identity and sense of belonging:** the local agriculture is closely associated with cultural identity in Biscay. Many villages have a weekly market where they sell local products.

PARKS AND GARDENS

In general, parks and gardens in Biscay are urban and peri-urban green areas, devoted to recreation and leisure use. These green infrastructures, in addition to recreation service, provide other important services for the health and well-being of mankind.

Within these ecosystems, there are **both large and small parks and ornamental gardens**. They currently **make up 0.3% of the territory**.

MOST RELEVANT SERVICES PROVIDED BY PARKS AND GARDENS

Regulating		**Climate regulation:** parks and gardens play a major role in mitigating heat islands. **Regulation of air quality:** vegetation may help retain air pollutants through the exchange of gases with the atmosphere, helping to maintain good air quality. **Erosion control:** tree roots stabilize the ground, preventing the heavy rains from causing erosion. **Pollination:** species containing flowers found in parks and gardens provide nourishment to different pollinators, thereby contributing to the maintenance of their populations.
Cultural		**Recreation:** the main use of the parks and gardens is recreational (walks, sporting activities, etc.). **Aesthetic enjoyment of the landscape:** they have a great aesthetic value as they are green areas that are situated near urban areas.

MINES AND QUARRIES

Within this group, active quarries and abandoned extractive areas are included. They **make up 0.6% of the territory**.

Active quarries are an important resource for geotic raw materials (limestone, sand, etc.) that are used for different uses (construction, industrial use, ornamental use, etc.).

In the case of the **abandoned extraction area**, they may be used for recreational and educational activities.

MOST RELEVANT SERVICES PROVIDED BY MINES AND QUARRIES

Provisioning		**Geotic materials:** quarries supply a large number of materials such as limestone and sand to be used for a variety of purposes such as industry, ornaments and construction, etc.
Cultural		**Recreation:** abandoned extraction areas may be used for recreational purposes since activities such as rock climbing may be carried out here. **Environmental education:** abandoned extraction areas are an educational resource since here it is possible to determine their previous uses, as well as to observe their geology. Some of them have associated infrastructures for their diffusion, as in the case of the mining museum of Abanto-Zierbana or the environmental interpretation centre of Peñas Negras in Ortuella. **Cultural identity and sense of belonging:** the mines have maintained a cultural legacy related to traditional mining exploitation, as reflected in different rural sporting activities such as ***harrijasotzailes*** (stone lifters) and rock borers.

RESERVOIRS

Reservoirs are artificial fresh water ponds that are created as the result of extractive activities, like the La Arboleda lagoon or as a result of the construction of dams and dykes built in rivers, as in the case of El Regato, Lertutxe and Arkotxa, among others.

These ecosystems make up **0.1% of the territory**.

Although they are artificial, these ecosystems may provide virtually the same services as the other previously described bodies of water.

MOST RELEVANT SERVICES PROVIDED BY RESERVOIRS		
Provisioning		**Food:** they provide a large variety of food products (fish, crabs, frogs, etc.). **Water:** they supply fresh water for different uses (human consumption, industrial, irrigation, etc.).
Regulating		**Water regulation:** they help control the rainwater and melting snow, thereby regulating the water cycle. **Regulation of natural disasters**: during periods of heavy rainfall and thaws, they help control excess water thus preventing flooding.
Cultural		**Recreation:** different leisure activities may be carried out in reservoirs, such as canoeing, fishing, etc.

URBAN AREAS

Urban areas make up **8.7% of the territory**.

These areas include **villages, densely and sparsely populated cities, transportation networks (train, highways, airports, and seaports), cemeteries, landfills, sporting centres, vegetation associated with asphalted land and other artificial habitats.**