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Evaluación de los Ecosistemas
del Milenio en Bizkaia



NATURE AND HUMAN WELL-BEING IN BISCAY

Ecosystem Services
Assessment; research
applied to management

Miren Onaindia, Iosu Madariaga, Igone Palacios and Xabier Arana
Management and Coordination





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We have way passed the dichotomy of conservation and development and, only a few years after the completion of the Millennium Ecosystem Assessment, the paradigm of ecosystem services has become mainstream. With the caveat that the term 'services' seems to indicate to some the notion that nature is marketable. Some think nature should enter the market, others that nature is mother to all things (as referred to in the Bolivian law); yet others that nature is to be recognized as common heritage. Perhaps we should frame our thinking differently: nature provides benefits, hence it is perceived as good; it can also impact adversely on social organization, such as in the case of disasters. In any event, we need to cope with it, but how best to do this so as to minimize risks and maximize opportunities?

The paradigm of ecosystem services (or benefits) conceived in the context of the Millennium Ecosystem Assessment will prove crucial to the achievement of the sustainable development agenda. It illustrates how, if one is to benefit from drinkable water, soil fertility and hence food and fibers, medicaments based on natural compounds, climate regulation from the local to the sub-regional level, and spiritual stimulation, one has to preserve and enhance the ecosystems of the area in which one lives (and why not those for which one cares, if she or he is in a financial or logistical position to support dedicated restoration programmes).

The Biscay Ecosystem Assessment has demonstrated this paradigm in action. It has gone much beyond studying, describing and assessing the status and trends of the services provided by the ecosystems in the Biscay Region: it has created a social process by which multiple stakeholders representing different types of interests gather and – collectively, responsibly, in a visionary way, and in a manner bearing the faith of future generations in mind – have chosen how management of their land, river and coastal systems should take place. The Biscay Ecosystem Assessment should therefore be seen as a science-driven, social experiment which has been carried out in a living laboratory – the Biscay Region – and which has completely succeeded. Naturally, lessons have been learned, but overall the experiment demonstrates the validity of the paradigm of ecosystem services in action. So, what next?

When an experiment such as *the Biscay Ecosystem Assessment* succeeds, the temptation is to scale it up. One way of doing so is by replicating it somewhere else and connecting the various assessments at a later stage; another is by enlarging the experiment to the next spatial and temporal scales, as in a system of concentric circles. But these are mere conceptual and methodological considerations. What really matters is to apply what has worked, to continue experimenting, and to be open to the possibility that adaptive management may be required at any stage of applying the findings of the assessments.

But there is an equally important path to pursue when it comes to defining on what future efforts should concentrate, which is dictated by the goal that ultimately ecosystem assessments ought to bring benefits locally. This requires a continuous effort of enhancing the methods of studies on people-nature interactions and their implications for ecosystem services, including through co-design of the research questions by scientists, civil society, policymakers and the private sector; there also is a need to ensure that communication, education and public awareness efforts be maintained and implement throughout the assessment cycle.

For having followed, with interest and care, *the Biscay Ecosystem Assessment* since its very inception over the years, I am confident that its follow-up, further ambitious, phase can grow to becoming the framework for implementing the post-2015 development agenda in the Basque Country. Long life to the Biscay Ecosystem Assessment!

Salvatore Aricò

Leader, UNESCO IPBES Team
Member of the Advisory Committee on the Network of
Sub-global Assessments of Biodiversity and Ecosystem Services

The Biscay Millennium Ecosystem Assessment research project was developed based on the application of the conceptual framework and methodology of the International Science Programmes (ISPs) of the United Nations **“Millennium Ecosystem Assessment”**, generating quality scientific knowledge on natural heritage, ecosystems services in this territory and the resulting socio-environmental relationships. Furthermore, this research responds to the goals established in the **EU Biodiversity Strategy to 2020**, highlighting the need for knowledge in order to maintain and restore our natural environment and, specifically, to preserve ecosystem services as our life insurance.

Focusing on ecosystem services is an enriching manner of perceiving the relationship between nature and human well-being, and for understanding the need to maintain and restore our natural heritage.

This project has allowed for the identification, mapping and assessment of the most important ecosystems and the diverse services that they provide in the historic territory of Biscay. Furthermore, a catalogue of ecosystem system indicators has been defined in order to measure their evolution over time, as well as the impacts acting on them.

This project serves as a reference in its field, in terms of its detail (both in the territory and in the four pilot study areas). It offers highly specific information for direct application of its results for management purposes. And from the onset, the work team has been the result of the collective participation of researchers, social organizations, administrative personnel and policymakers. This interdisciplinary work group has made it possible to integrate scientific methodologies with policymaking practices in order to create useful tools for the sustainable management of Biscay.

Given the importance of knowledge, awareness and training in this area, special interest has been paid to the dissemination of the project results in the educational and social areas at all levels, both in formal and informal education. Clearly, attaining the goals of conservation of natural heritage requires the full commitment and participation of society as a whole. On the one hand, it is necessary to better integrate the environmental implications and the conservation of natural diversity into other policies, such as those related to water, the climate and agriculture. The participation of the private sector in public-private alliances is vital in achieving these goals. In addition, we cannot forget the necessary implication and participation of all of the social agents and of everyone who takes responsibility in this passionate task of contributing to the improvement of our natural wealth, leading to a just and inclusive society that is in harmony with its environment.

It is our hope that the results of this research may be applicable to strategies, policies and models of management in order to lead to the conservation and improvement of ecosystems and natural environment in general, thereby contributing to an increased well-being of the Biscay population.

Miren Onaindia, Iosu Madariaga, Igone Palacios and Xabier Arana

Key messages

- 01 ›** Our well being and that of our future generations depends on ecosystems and the services that they provide to society, many of which are currently being degraded. Through the Biscay Millennium Ecosystem Assessment, different paths have been defined based on scientific knowledge, management experience and a social perspective, to help us respond to the challenges of environmental deterioration and thereby better direct decision-making from a sustainable land management perspective.
- 02 ›** Biodiversity is the variety of living organisms on our planet that come together to make up ecosystems. The ecosystem is a natural system made up of a set of living organisms that interact with one another and with the environment surrounding them, making up a functional unit. As a result of the ecosystem functions, a series of flows result, also known as ecosystem services.
- 03 ›** The mapping of ecosystem services and natural diversity is fundamental for the appropriate management of the territory, permitting knowledge of their spatial distribution and identifying the areas that contribute the most to their supply (multifunctional areas), as is the case for example, with natural forests. These multi-functional areas should be considered priority areas of conservation.
- 04 ›** Analysis of the evolution and trends of ecosystem services over recent years is necessary in order to determine the validity and functioning of environmental and sectoral policies. In the case of Biscay, some drivers of direct change, such as atmospheric pollution, have decreased considerably over the past 50 years, suggesting that some ecosystem services have improved.
- 05 ›** The detailed case studies allow us to relate research to the natural and social diversity within Biscay. Studies conducted in Bilbao Metropolitan GreenBelt, in the Urdaibai Biosphere Reserve, in the Lea River Basin and in the Urkiola Natural Park, offer an integrated approach to the environmental and the social, the urban and the rural and the compatibility of distinct land uses.
- 06 ›** Determining the long term evolution of the Ecological Footprint is vital to evaluating the evolution of the balance between human production and consumption and therefore, of the sustainability of the territory. Biscay has decreased its Ecological Footprint over recent years; however, there is still a long way to go. Sustainable management guarantees the essential services of ecosystems and a reduction of the Ecological Footprint.
- 07 ›** The creation of different future scenarios and the selection of the most desired of these scenarios for Biscay through participatory processes, allows for the creation of a much desired and realistic vision of the future, helping to balance the socio-economic and environmental objectives in order to work towards sustainability and human well-being. In these participatory processes, different social agents should be included, as well as individuals responsible for public administration policies and techniques, in order to achieve a greater impact on regional policies.

Key messages

- 08 › The specific strategies that have been proposed for Biscay include sustainably reinforcing the local provision of food products, as well as other material and energy-related goods; the conservation and recovery of natural forests and the promotion of sustainable forest management; and a redirection of demand towards more sustainable consumption models.
- 09 › The creation of a catalogue of the ecosystem services of Biscay has been included within the Biscay 21 Program (2011-2016), a regional strategy for sustainable development contributing to the objective established by the Regional Government of Biscay of preserving ecosystems by fostering “green” infrastructures, thereby generating employment and socioeconomic development.
- 10 › The Biscay Millennium Ecosystem Assessment is pioneering the practical application of a conceptual and methodological framework of ecosystem services to participatory and integrated territorial management. So much so that, in international forums on this topic, the experiences of our Historical Territory have been recognized as an example to follow in the integration of society, science and management. The results obtained from this local-regional scale assessment suggest that this integrated and participatory approach is an innovative and useful tool that should be supported and developed in order to create significant changes towards a caring society and a more economically and environmentally sustainable territory. For all of these reasons, the Basque government has decided to take a leadership position in this project, widening this transforming initiative to the scale of the Basque Country, and therefore including other regional councils and carrying out pilot studies on different municipalities and counties.

01 › *MILLENNIUM ECOSYSTEM
ASSESSMENT IN BISCAY PROJECT:
INTRODUCTION, OBJECTIVES
AND GENERAL CONCEPTS*



What is the Millennium Ecosystem Assessment in Biscay?

In Biscay, as in other parts of the world, the use of ecosystems has improved the well-being and economic development of the population, but not without social and environmental costs.

Determining and evaluating our best ecosystems, as well as the services and benefits that they provide, may provide us with a healthier environment, necessary for our well-being and that of future generations. Thus, *the Millennium Ecosystem Assessment in Biscay* was conducted. This assessment applied a conceptual framework that was developed based on the scientific program of the United Nations *Millennium Ecosystem Assessment (MA)*, a global study of the relationships between human well-being, the state of ecosystems and their sustainable use (2000-2005). The results of this assessment revealed that, over the past 50 years, the exponential growth of the human population has transformed the ecosystems more intensely than in any other period of time over history, mainly in order to resolve the growing demands for food, fresh water, wood, minerals, fibre and fuel. This intense transformation has led to a loss and degradation of natural ecosystems and therefore, to a major loss of biodiversity and its services. This assessment provided an innovative approach that focused on how this global change, that is, the change in ecosystems, affected, continues to affect and shall affect human well-being, as well as the relevance of the appropriate management of these ecosystems.

In addition to the global assessment, the United Nations' scientific program initiated a series of sub-global assessments in order to obtain smaller scale information, including regional, national and sub-national assessments, including the Biscay Assessment as of 2009. In fact, the follow up of these assessments (*Millennium Follow up*) was conducted through the Sub-Global Assessments that are now coordinated through its network (the Sub-Global Assessment Network-SGA).

This United Nations initiative was a milestone and a change in paradigm regarding our conception of ecosystems, and thanks to it, today many initiatives have been implemented at an international level, in line with the Biscay Assessment. The Biscay assessment is coordinated by and forms a part of these international networks of relevance, like the previously mentioned Sub Global Assessment Network, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), which includes practical examples of application such as that of Biscay, or the Ecosystem Services Partnership, which is a community of individuals and institutions researching the ecosystem services. Through the coordinated work of these and other relevant international networks, the local results and information may be rescaled to a global level, and vice versa.

In this context, *the EU Biodiversity Strategy to 2020* establishes the goal of improving knowledge of ecosystems and their services and establishing priorities for their restoration, through the development of green infrastructures. The European Commission recognizes that ecosystems, through a "green" infrastructure, may greatly contribute to the application of a wide range of community policies related to rural development, climate change, disaster risk management, agriculture, forestry and the environment. The Biscay assessment, in line with new European policies, aims to maintain and improve the green infrastructure and to recover the degraded ecosystems, applying the acquired knowledge and results from this ongoing learning process to management.

The Millennium Ecosystem Assessment in Biscay has made it possible to determine the paths that should be taken in response to the challenges of our territory's degraded ecosystems and their services, based on scientific knowledge, management experience and a social perspective. Our well-being and that of our future generations depends upon it.

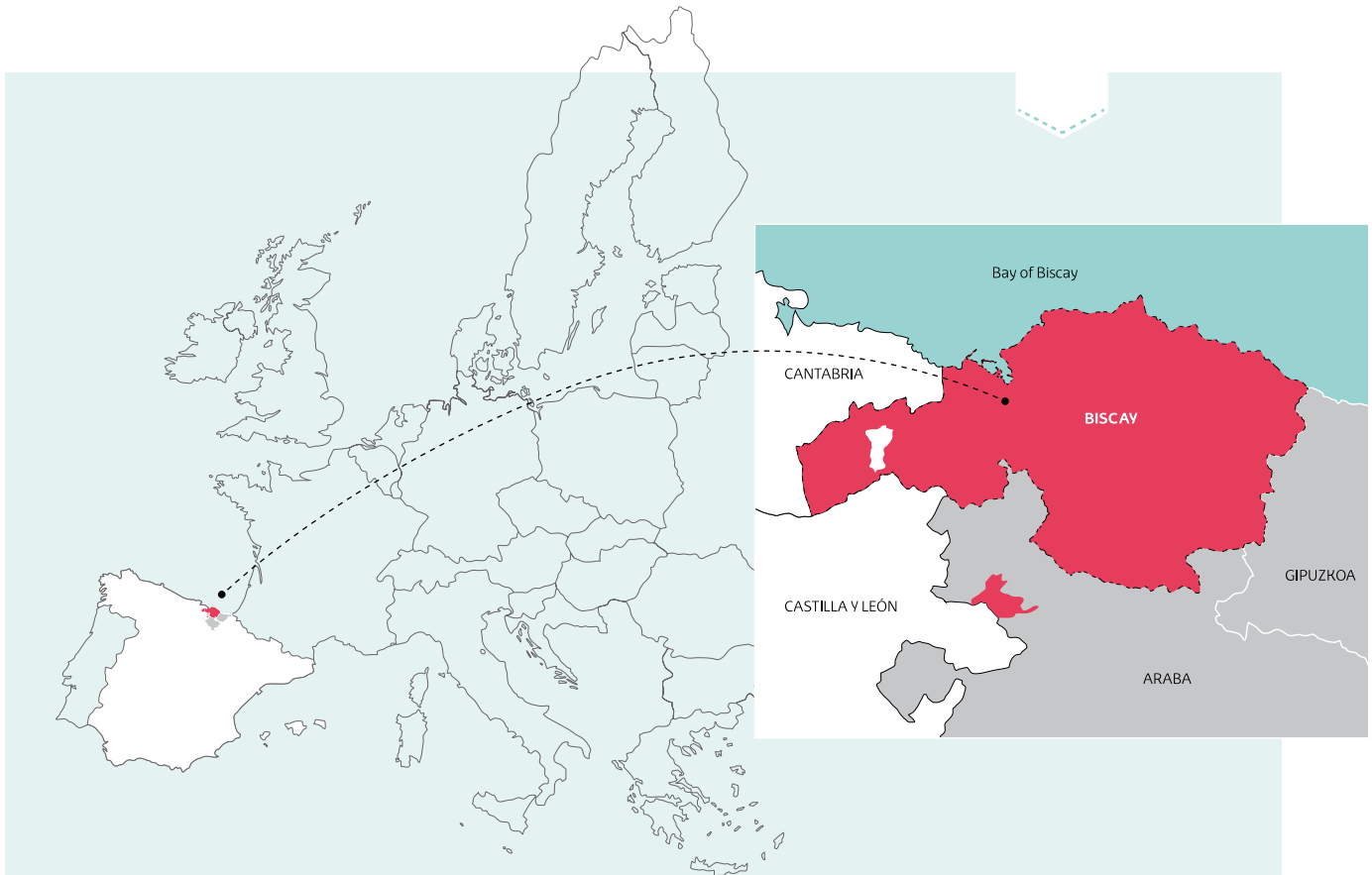


FIGURE 1.1. The location of Biscay.

The Historical Territory of Biscay is located to the north of the Iberian Peninsula (43° 07' N; 2° 51' W), in the Autonomous Community of the Basque Country (Figure 1.1), and extends over 2,217 km². It is located on the Atlantic coast and has a mild ocean or Atlantic climate.

In the early 20th century, the economic development of Biscay was based primarily on the steelmaking industry, mainly focusing on iron, which characterized the socio-economic development of the city until the 1980s. This recent Biscay past led to a large population density (517.2

inhabitants/km²) with the Metropolitan Bilbao area being especially significant, with its population density of 2,332 inhabitants/km² (EUSTAT, 2014).

This province has been greatly industrialized and transformed and is quite heterogeneous. Despite its largely humanized landscape, today it maintains some areas of great environmental interest, such as the National Parks of Gorbea, Urkiola and Armañón, as well as the Urdaibai Biosphere Reserve. This is evidenced by the fact that 11.38% of its territory (252 Km²) forms a part of the Nature 2000 network.

Following the economic crisis suffered by the Basque Country over the early 1990s, and in Biscay in particular, a profound transformation process was initiated in the secondary sector leading to the well known "neo-industry" support of the tertiary sector, with numerous Basque institutions supporting environmental and sustainability measures.

For all of these reasons, Biscay is a very interesting area of study, both due to its industrial past as well as its potential for change towards an increased sustainability.

What are its objectives?

The Biscay Assessment serve as a tool for the identification of the priority measures that may prevent or mitigate the negative human impact on the ecosystems, and to highlight the policies and actions that have a positive effect on the conservation and sustainable use of the natural heritage. Therefore, the specific objectives of the project are:

- A** › To generate knowledge and tools to help better assess our ecosystems, as well as the services or benefits that they offer, studying their evolution and relationship with human well-being.
- B** › To obtain scientific results regarding the ecosystem services of Biscay, which integrate citizen participation.
- C** › To characterize and estimate the direct and indirect drivers of change and their relationship with the flow of services offered by ecosystems.
- D** › To create tools and models to facilitate decision making related to the territory's integrated planning and management.
- E** › To generate future scenarios for Biscay that allow for the detection of the potential consequences of decisions that may affect individuals and their environment.
- F** › To inform citizens of Biscay of the value of their environment and the benefits that ecosystems provide.
- G** › To help maintain and improve "green" infrastructure as well as the degraded ecosystems, thereby contributing to the well-being of the population.

Who is participating in the project?

Aware of the importance of making links between science and management, from the onset, a multidisciplinary work group was formed, consisting of the Regional Government of Biscay (DFB), UNESCO Chair on Sustainable Development and Environmental Education of the University of the Basque Country (UPV/EHU), and UNESCO Etxea - UNESCO Centre of Basque Country, as well as with the collaboration of the Autonomous University of Madrid, through the Social-Ecological Systems Laboratory of the Inter-University Ecology Department.

One of the most important characteristics of the Biscay Assessment, which differentiates it from many other sub-global assessments, is the strong implication, since its onset, of policymakers, managers and technicians from the local administration, who, as the project has advanced, have managed to involve an increasing number of decision-makers and technical personnel from the institutions.

Another fundamental basis of the project has been its projection towards society. The Biscay Assessment, for this reason, is also characterized by the participation and implication of all of its agents, through direct contact, on-going communication and specific meetings with all interested parties (socio-economic agents, professionals and citizens) in all project phases. Similarly, the implementation of a communication plan has contributed significantly to connecting the ecosystem service concepts, as well as the results of the Biscay Assessment, to society. This makes the results obtained from this "Administration-University-Society" work more applicable to management (Figure 1.2).



FIGURE 1.2. The Biscay Assessment works by integrating scientific knowledge, management needs and citizen participation through participatory processes and the coordination of distinct agents.

What is trying to answer questions?

- › What services are provided by each ecosystem?
- › How are ecosystem services distributed across the territory?
- › What is the described trend for the ecosystem services of Biscay over recent decades?
- › What are the drivers that stimulate these changes?
- › Is it possible to reduce the territory's dependence on external ecosystem services?
- › How do we imagine Biscay in 2050?
- › What are our response options and what decisions may be taken?

Ecosystem services are vital for human well-being, the economy and the maintenance of our societies.

What are ecosystem services?

Biodiversity is the variety of living organisms on the planet that come together to form ecosystems. An ecosystem is a natural system made up of a set of living organisms that interact with one another and with the environment surrounding them, forming a functional unit. As a result of the ecosystem functions, a series of flows are obtained, better known as “ecosystem services”.

Ecosystem services are the benefits that individuals obtain from nature. These services contribute directly or indirectly to human well-being and quality of life, as they have consequences on the prosperity of the society, not only in its economy but also in terms of health, social relations, freedoms and safety (MA, 2005). Furthermore, natural diversity is the basis of their functioning, therefore their maintenance and sustainable management is fundamental for the proper functioning of the same, and therefore, for the well-being of mankind.

In accordance with the international scientific community, ecosystem services have been classified into three groups: provisioning services, regulating services and cultural services (Figure 1.3). **Provisioning services** are those benefits that are provided directly from an ecosystem, such as food, water or raw materials. **Regulating services** are indirect benefits that result from the functioning of ecosystems, such as climate regulation, flood control or regulation of pests. **Cultural services** are intangible benefits that the population obtains from its direct experience with the ecosystems, such as aesthetic enjoyment of landscapes, recreational activities or scientific knowledge, among others.

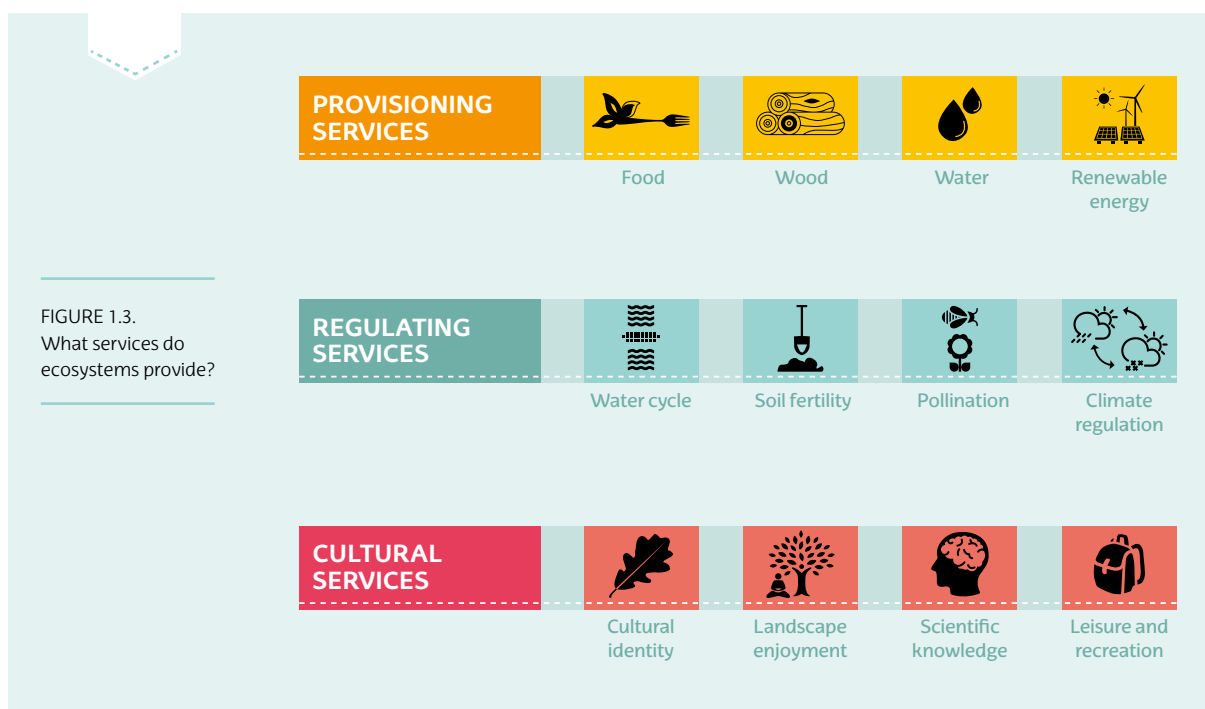


FIGURE 1.3.
What services do
ecosystems provide?

Everyone depends on the Earth's ecosystems and the services that they provide us, such as food, fresh water, climate regulation, regulation of air quality, recreation, aesthetic enjoyment, etc.

In the following tables (Table 1.1, 1.2 and 1.3) the definition of the main services provided by the ecosystems of Biscay are explained along with some examples.

PROVISIONING SERVICES		WHAT ARE THEY?
	FOOD	<p>Food products provided by the ecosystems. E.g: Agricultural products, fishing, hunting, honey, wine, wild berries, livestock. In Biscay, over recent decades, the primary sector (agriculture, livestock, fishing) has seen a decrease in importance in the territory.</p>
	WATER	<p>Underground and surface water coming from aquifers and surface bodies of water for different uses (human consumption, domestic use, agricultural use, industrial use). E.g: The numerous limestone formations in Biscay house large aquifers from which fresh water is obtained. In the Santa Eufemia-Ereñozar Hydrogeology Unit of Urdaibai, there are numerous drains and fresh water areas that are used for distinct purposes.</p>
	BIOTIC MATERIALS	<p>Materials from living beings for the creation of consumer goods. E.g: Wood, cellulose, textile fibres, leather, wool. In Biscay, for example, the annual production of Monterrey pine is approximately 650,000 m³ of good quality wood, for use in carpentry, packaging and the construction industry, according to data from the Regional Government of Biscay.</p>
	GEOTIC MATERIALS	<p>Mineral-based materials used for the creation of consumer goods. E.g: Marble, slate, limestone, sand, iron. Iron was one of the main materials extracted from the Biscay mines. But, currently, this service focuses on extraction of quarry materials.</p>
	RENEWABLE ENERGY	<p>Taking advantage of natural energy that is used or transformed as a source of energy. E.g: Biomass or hydroelectric, wind, geothermal and marine energies. In Biscay, in 2012, 7.2% of the gross internal energy consumption came from renewable sources, according to data from the Basque Energy Board (EVE).</p>
	GENE POOL	<p>Diversity of genetic resources in a territory. E.g: Native breeds (Latxa sheep, euskal oiloa, Betizu cattle, Pottoka ponies, etc.), local agricultural varieties (Gernika beans and peppers). In Urdaibai there is a seed bank where 38 local agricultural varieties have been collected (cabbage, lettuce, tomatoes, turnip, etc.).</p>
	NATURAL MEDICINES	<p>Natural active principles with medicinal uses. E.g: Medicinal plants, infusions, oils, alkaloids. In Biscay it is possible to find different plants with medicinal properties such as chamomile, hyperico and valerian or bee venom.</p>

TABLE 1.1. Definition, examples and specific cases of provisioning services that are provided by the ecosystems of Biscay.

REGULATING SERVICES		WHAT ARE THEY?
	CLIMATE REGULATION	<p>Ability of vegetation, soil and sea to absorb and store greenhouse gases and to promote thermal damping. <i>E.g. The capture and storage of CO₂ which helps in the relief of climate change.</i> In Biscay, forest bodies are the primary sources of carbon storage.</p>
	REGULATION OF AIR QUALITY	<p>Ability of vegetation and some organisms of soil to capture and retain polluting substances in the air and to keep the atmospheric cycles in balance. <i>E.g. Maintenance of the balance of carbon and oxygen in the atmosphere.</i> In Biscay, in 2014, no countries were found to have poor air quality, according to data from the Basque government.</p>
	WATER REGULATION	<p>Ability of vegetation and soil to regulate flows of water within the system. <i>E.g. Well structured and permeable soils favour infiltration and aquifer recharge, while the vegetation regulates the return of water to the atmosphere via evapotranspiration.</i> In Biscay, there are large limestone formations in which part of the precipitations falling annually infiltrate allowing water to reach the aquifers.</p>
	EROSION CONTROL	<p>Ability of vegetation and soil to regulate and minimize ground loss and erosion. <i>E.g. Tree roots, especially in steeply sloping areas, stabilize the ground and prevent erosion caused by heavy rainfall. Furthermore, vegetation, reducing the impact and the amount of rain reaching the ground, prevents erosion.</i> In Biscay, the demand for this service is high due to the steep sloping topography of the territory.</p>
	MAINTENANCE OF SOIL FERTILITY	<p>Ability of vegetation and soil to store and recycle nutrients. <i>E.g. Vegetation extracts nutrients from the ground, metabolises them, stores them and slowly returns them to the ground, allowing them to be used by other organisms and preventing their loss by leaching.</i> In Biscay, marshlands are extremely fertile and in some cases, they have been used as cultivation areas.</p>
	REGULATION OF NATURAL DISASTERS	<p>Ability of vegetation and soil to cushion natural disasters (floods, fires, strong winds, etc.). <i>E.g. The presence of vegetation, floodplains, aquifers and wetlands naturally cushion flooding while regulating the quantity and speed of the water flow during times of intense rainfall.</i> In Biscay, the cliffs and dunes of the coastal areas help to protect from strong winds and tides from the sea.</p>
	BIOLOGICAL CONTROL	<p>Ability of living beings to control pests and illnesses. <i>E.g. The food chains established by nature act as natural biotic regulators. When a link from this chain is substituted, an imbalance occurs which may lead to pests or illness.</i> In Biscay, the Monterrey pine processionary is a source of major economic expense and significant environmental loss as its elimination via fumigation negatively affects other species.</p>
	POLLINATION	<p>This is the process of transfer of pollen from the stamens to the receptive part of the flower for the production of seeds and fruit. The transportation of pollen is carried out by animals, water or wind. <i>E.g. Insects are some of the main pollinators of the agricultural crops.</i> In Biscay, bees are responsible for almost 80% of the pollination carried out by insects.</p>

TABLE 1.2. Definition, examples and specific cases of regulating services provided by the ecosystems of Biscay.

CULTURAL SERVICES		WHAT ARE THEY?
	RECREATION	Participating in outdoor recreational and leisure activities, offering health, relaxation and well-being. E.g. <i>Hiking, climbing, fishing, etc.</i> In Biscay, the environmental and cultural heritage comes together to offer a wide variety of recreational possibilities.
	SCIENTIFIC KNOWLEDGE	Ecosystems may function as laboratories, since they offer sites for the development of scientific awareness and on-site experimentation. E.g. <i>Studies regarding ecological processes, wood production, species conservation, etc.</i> In Biscay, there are many internationally known centres and institutions that are devoted to the research and development of scientific knowledge, including the University of the Basque Country (UPV/EHU) and various technological centres.
	ENVIRONMENTAL EDUCATION	Ecosystems provide information for education and awareness of ecosystem functioning and their relationship with mankind. E.g. <i>Information for nature classrooms, interpretation centres, farm schools, Agenda 21 scholastic programs, etc.</i> The parketxes of Biscay's natural parks play an important role in environmental education.
	TRADITIONAL KNOWLEDGE	Experiences, practices, beliefs and customs of local ecological knowledge passed from generation to generation that link humans with nature. E.g. <i>The practice of pollarding (partial pruning of trees), the ordering in rows, grazing pastures, the production of charcoal and lime, etc.</i> In Biscay, beeches and oaks are usually pruned since their wood was formerly used for charcoal production.
	AESTHETIC ENJOYMENT OF LANDSCAPES	Appreciation of natural sites that provide satisfaction based on their aesthetics. E.g. <i>Natural landscapes, cultural landscapes, landscape landmarks, etc.</i> In Biscay there is a great diversity of landscapes, from the mountainous (Gorbea, Pagasarri...) to the coastal (San Juan de Gaztelugatxe, Barrika beach, etc.).
	CULTURAL IDENTITY AND SENSE OF BELONGING	Places, objects or ways of handling and taking advantage of landscapes associated with the cultural identity of a territory and the sense of belonging of a society, making up a part of the collective memory. E.g. <i>Constructions such as hamlets, symbols such as the oak leaf, landscapes such as the Atlantic Countryside, etc.</i> In Biscay the Gernika tree is a symbol of the Basque people's cultural identity.
	CULTURAL, INTELLECTUAL AND SPIRITUAL INSPIRATION	Individuals have inspirational and transcendent experiences during their contact with nature. E.g. <i>Artistic inspirations from paintings and sculptures, intellectual experiences with books and spiritual ones in emblematic places.</i> In Biscay, some emblematic locations such as the Urkiola Sanctuary or the Camino de Santiago are valuable sites of self-transcendence.

TABLE 1.3. Definition, examples and specific cases of cultural services provided by the ecosystems of Biscay.

Ecosystem services contribute to human well-being and quality of life in many ways. Therefore, the application of methodologies based on an approach, which permits a wide and integrated knowledge of the natural and cultural values of the territory, is necessary in order to implement the sustainable management of the same.

The decisions made on an individual and collective level affect nature and the services that it provides. If we wish to continue enjoying these services, it shall be necessary to direct our actions and policies towards the sustainable management of nature.

What are the drivers of change?

The drivers of change for ecosystem services are factors, both natural and man-made, pressuring ecosystems and leading to changes in their structure and functioning and thereby, in the services that they provide. These factors may act directly on ecosystems (direct drivers: climate change, pollution and changes in land use) or indirectly (indirect drivers: demographic and economic changes), which affect ecosystems by acting on the direct drivers. Therefore, the individual and collective decisions that we take influence, either directly or indirectly, the functioning of ecosystems and, therefore, the services that they provided to society, thereby affecting human well-being in a positive or negative manner, as revealed in figure 1.4.

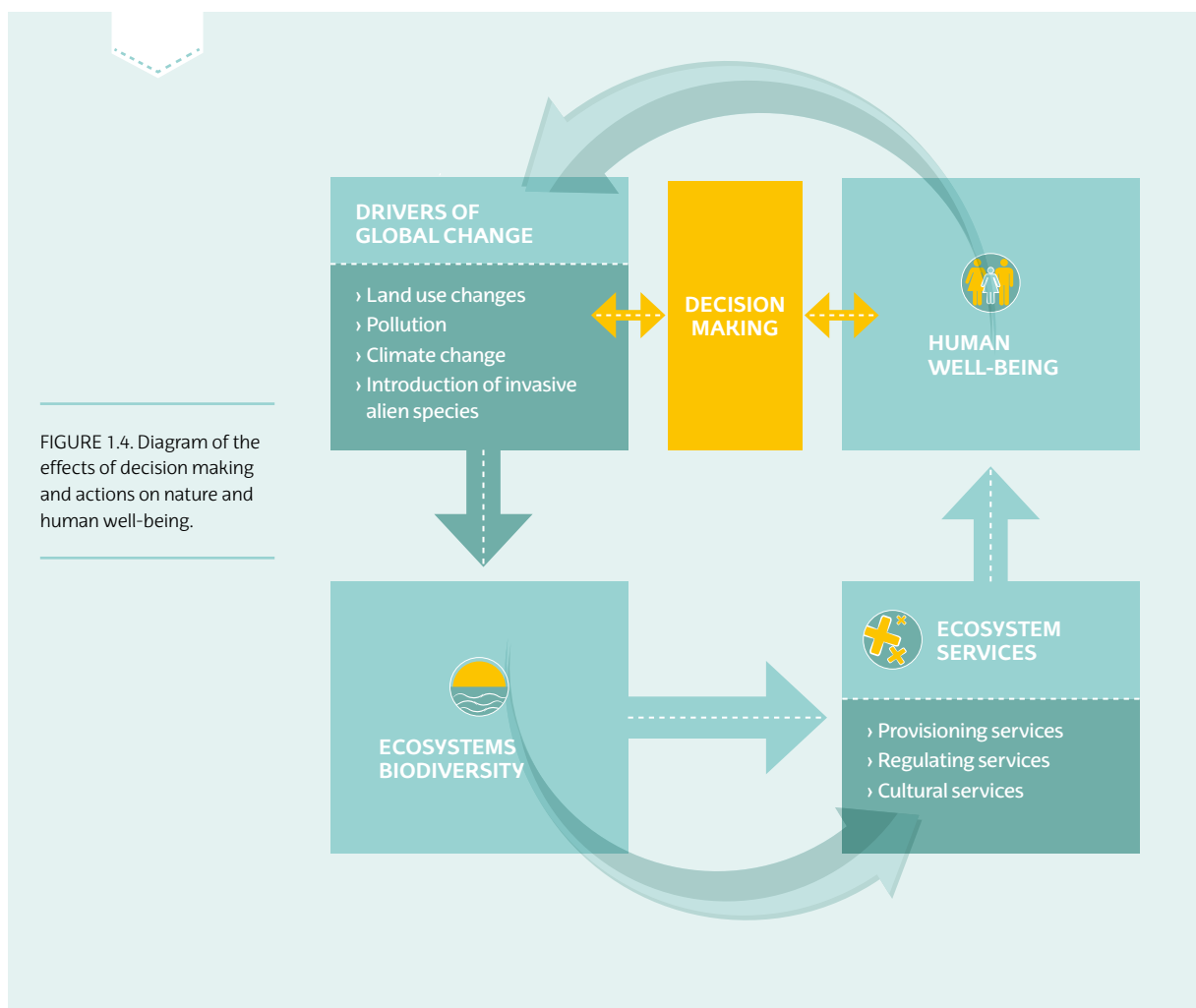


FIGURE 1.4. Diagram of the effects of decision making and actions on nature and human well-being.

02 › WHAT SERVICES ARE PROVIDED BY THE ECOSYSTEMS OF BISCAY?

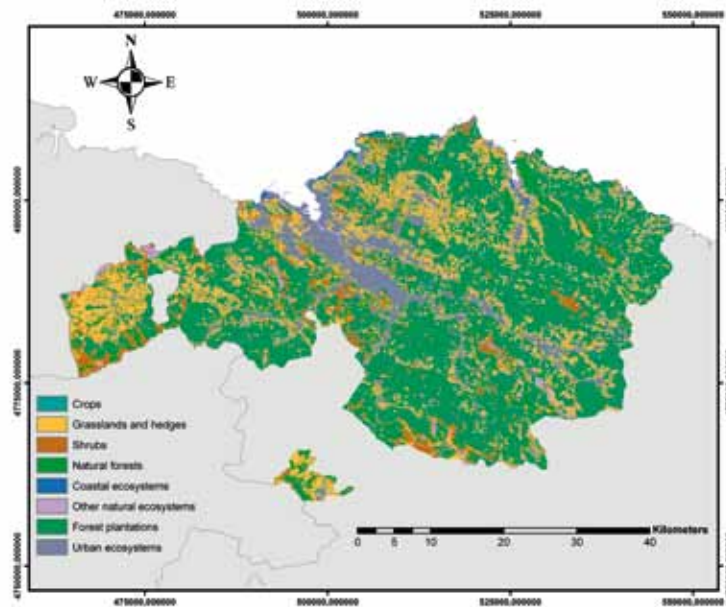


SERVICES PROVIDED BY THE ECOSYSTEMS OF BISCAY

The following ecosystems are discussed in this chapter (Figure 2.1) along with the services that they provide to society:

- › Coastal ecosystems
- › Grasslands and hedges
- › Shrubs
- › Natural forests
- › Other natural ecosystems (bodies of water, mires and rocky lands)
- › Forest plantations
- › Crops
- › Urban ecosystems and other artificial areas

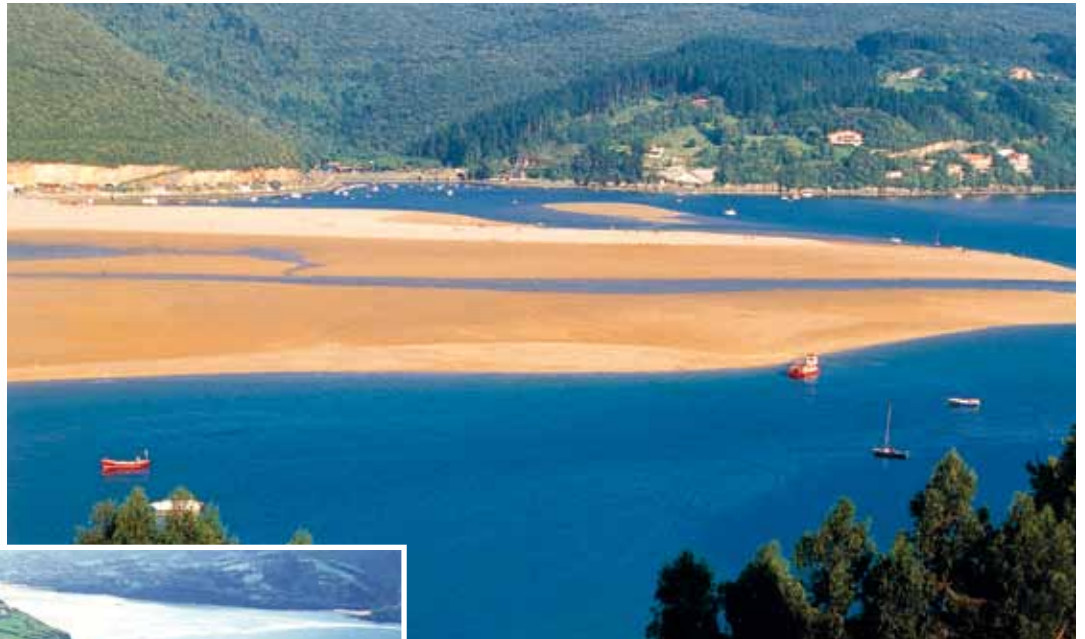
FIGURE 2.1. Distribution of the ecosystems of Biscay.



This chapter provides a general description of the ecosystems found in Biscay as well as the main services that they provide to its inhabitants. For a more detailed description of these ecosystems, see **the catalogue of the ecosystem services of Biscay**, which is included as Annex I.

A catalogue of the services provided by the ecosystems of Biscay has been created as part of the Biscay 21 program (2011-2016), the regional strategy on sustainable development, contributing to the objective established by the Regional Government of Biscay of preserving ecosystems, promoting “green” infrastructures in order to generate employment and socio-economic growth.




Coastal ecosystems



Biscay has an extensive coastal surface area containing a variety of coastal ecosystems including **marshlands, dunes, beaches, cliffs, coastal reed beds and coastal heathlands**.

Historically, these ecosystems have been significantly affected by mankind and they tend to be found in very poor states with a greatly reduced extension. Currently, coastal ecosystems **make up 0.7% of the territory**.

The main services provided by the coastal ecosystems of Biscay are presented below:

SERVICES PROVIDED BY COASTAL ECOSYSTEMS	
PROVISIONING	 <p>Food It is possible to find fish and seafood as well as edible algae in these ecosystems.</p>
	 <p>Biotic materials Some varieties of algae such as <i>Gelidium sesquipedale</i> may be collected to create natural preservatives, although this use is not very common in Biscay.</p>
	 <p>Renewable energies Waves from the sea may be used as a source of marine energy. For example, there is a testing area in Armintza for this type of energy.</p>

SERVICES PROVIDED BY COASTAL ECOSYSTEMS

REGULATING



Climate regulation

Marshlands, in particular, are important for carbon storage since their vegetation and absorbent grounds hold and retain large quantities of it, contributing to the balancing of global climate change.



Regulation of air quality

Vegetation, particularly in the marshlands and coastal heathlands, helps to retain some air pollutants through the exchanges of gas with the environment, thereby maintaining good air quality.



Water regulation

The vegetation of the marshlands retains and promotes water infiltration in the ground and aquifer recharge. Furthermore, marshlands act as powerful water purifiers, retaining the particles that are transported in them.



Erosion control

The vegetation of the dunes and marshlands helps to stabilize the ground and prevent erosion caused by tides and strong winds.



Maintenance of soil fertility

The nutrients carried by water (rainwater, river, etc.) reach the marshlands where they accumulate, making these highly fertile ecosystems. In fact, many of these areas are used as cultivating soils.



Regulation of natural disasters

The marshlands help regulate flooding since they are capable of absorbing and storing large quantities of water that arrive from rivers during periods of heavy rainfall. Furthermore, the coastal ecosystems offer protection from strong winds and waves, decreasing their speed and strength.



Biological control

When coastal ecosystems are in a good state, they are capable of regulating certain pests. Invasive species are difficult to control, as is the case of *Baccharis halimifolia*, an invasive species that is found in almost all of Biscay's estuaries.



Pollination

The numerous flowering species, particularly in the coastal heathlands, serve as nourishment for a number of pollinators.

CULTURAL



Recreation

Coastal ecosystems offer the opportunity to carry out numerous leisure and recreation activities such as canoeing, sunbathing on the beaches, bird watching, fishing, etc.



Scientific knowledge

Their study is an important source of scientific knowledge that may be used for the conservation and management of the environment, as is the case with studies on dune dynamics carried out by the University of the Basque Country (UPV/EHU) in Urdaibai.



Environmental education

They are a major source of environmental education for the general public. Information regarding these ecosystems is disseminated via interpretation centres, nature learning centres, environmental programs, etc.



Traditional knowledge

Some important traditional uses developed in these ecosystems including traditional fishing techniques, water mills, etc. have been passed down from generation to generation.



Aesthetic enjoyment of landscapes

They have a great aesthetic value and a high degree of biodiversity which enhances their enjoyment. Coastal ecosystems are greatly appreciated by the population due to their aesthetic value.



Cultural identity and sense of belonging

Traditional culture and folklore is closely related to these ecosystems, particularly in coastal villages where the Lamiak (mythological characters living in the water regions, including the marshlands) are a major part of their traditional folklore.

Grassland and hedges







In Biscay, grasslands play a major role in livestock exploitation systems. They tend to be located in softly sloping areas where grass grows, offering pastures for livestock and fodder.

Biscay is strongly linked to different types of grasslands, considered to be a pillar of its society, culture, economy and landscape. These include **high mountain pastures, dry grasslands and meadows** for mowing. Currently, these ecosystems **make up 20.2% of the territory**.

A great diversity of species is found in the grasslands, although grasses predominate. Grasslands are typically separated by hedges, which consist of trees and bushes. This mosaic landscape of hedges and grasslands makes up the typical landscape of Atlantic countryside.

The main services provided by the hedges and grasslands of Biscay are presented below:

SERVICES PROVIDED BY GRASSLANDS AND HEDGES	
PROVISIONING	 <p>Food Grasslands are the basis of sustenance for livestock that are used to produce a variety of food products such as milk and meat. Honey production is also very closely associated with the hedges and grasslands since pollinators feed on their flowers.</p>
	 <p>Biotic materials Grasslands are the source of sustenance for livestock which are used to produce different materials such as leather goods or wool.</p>
	 <p>Gene pool These are important in terms of genetic resources since, in addition to having a large genetic diversity, they also shelter a wide diversity of native breeds (Latxa sheep, Betizu cattle, Pottoka ponies).</p>
	 <p>Natural medicines Certain plant species found in the grasslands have established medical properties such as chamomile and plantain.</p>

SERVICES PROVIDED BY GRASSLANDS AND HEDGES

REGULATING



Climate regulation

Vegetation and grounds act as a carbon sink which help control climate change, although to a lesser extent than the forest or shrub ecosystems.



Regulation of air quality

Through the exchange of gases carried out by its vegetation with the atmosphere, pollutants are retained, helping to maintain good air quality, although to a lesser extent than the forest or shrub ecosystems.



Water regulation

Vegetation strengthens the ground structure, promoting water infiltration in the ground, although to a lesser extent than the forest and shrub ecosystems.



Erosion control

The roots of the vegetation stabilize the ground and prevent erosion caused by water.



Maintenance of soil fertility

The distribution of livestock across the different types of pastures, based on the seasons of the year (from summer to winter), helps maintain soil fertility.



Regulation of natural disasters

The grasslands and hedges help regulate floods, since during periods of heavy rainfall, the vegetation slows down the water flow, allowing for control of the river discharge. Furthermore, hedges help cushion the strong winds. For example, a hedge containing trees may offer protection to a grassland up to a distance of 10 times its height.



Biological control

A large variety of birds live in the hedges, feeding on the different insects that cause pests, therefore their conservation is necessary.



Pollination

The large number of flowering species in the grasslands and hedges helps feed the numerous pollinators that carry out this important function.

CULTURAL



Recreation

Numerous leisure activities may be carried out in these ecosystems, such as hiking and hunting.



Scientific knowledge

Research carried out in grasslands and hedges is directed at their increased production and profitability, as well as towards the improvement of their quality without harming the environment. Different groups work in this field, including NEIKER and the University of the Basque Country (UPV/EHU).



Environmental education

Grasslands and hedges are an important source of environmental education for all. This information is disseminated at interpretation centres, such as the *Parquetxes* of Urkiola, Gorbeia and Armañon.



Traditional knowledge

Some important traditions have been developed in these ecosystems which should be passed on from generation to generation, including shepherding.



Aesthetic enjoyment of landscapes

They have a high aesthetic value and a great degree of biodiversity that allows for their enjoyment. Despite being ecosystems that are managed by mankind, they are greatly appreciated by the population due to their aesthetic value.



Cultural identity and sense of belonging

Basque culture and folklore is closely linked to these ecosystems, particularly in rural areas. Some rural sports such as *segalaris* (grass cutting competition) are related to these ecosystems.

Shrubs



Shrubs are bushy formations and large ferns that make up the area preceding forests.

In Biscay, shrubs have an Atlantic distribution and they tend to contain **gorse thickets, bramble, ferns and heath**. Currently, they **make up 7.5% of the territory**.

Heathlands are quite diverse; however, the other shrubs are generally dominated by a single species and therefore are low in diversity.

The shrubs of Biscay have been greatly affected by human influence and they are often the subject of controlled burnings in order to increase pasture resources or prevent fires.

The main services provided by the shrubs of Biscay are presented below:

SERVICES PROVIDED BY SHRUBS	
PROVISIONING	<p>Food</p> <p>Many of the species found in these ecosystems contain berries which are widely appreciated by the general population, including blackberries, sloes and blueberries. Also, heather honey is a highly valued product.</p>
	<p>Biotic materials</p> <p>Some of their species are used to extract materials for handicrafts or to make textile fabrics. For example, Boj wood or briar wood is quite commonly used in making handicrafts.</p>
	<p>Natural medicines</p> <p>A variety of plant species from these ecosystems, including hawthorn, rosemary and heather are used in traditional medicine.</p>

SERVICES PROVIDED BY SHRUBS

REGULATING



Climate regulation

Vegetation and soils act as carbon sinks and thereby help control global climate change. On a more local level, their vegetation allows for temperature regulation, offering shade and moderating wind speeds.



Regulation of air quality

Through gas exchange by vegetation with the atmosphere, some pollutants are retained and air quality is improved.



Water regulation

The vegetation of shrubs slows down water flow, regulating runoff and improving infiltration. Evapotranspiration also helps regulate the return of water to the atmosphere.



Erosion control

The roots of the vegetation in these areas stabilize the ground and thereby prevent erosion caused by water. This is of special importance in steeply sloping areas.



Maintenance of soil fertility

The roots of the vegetation help extract nutrients from the ground and store them in their tissues, preventing their loss by leaching. Falling leaves from the shrubs are a major source of nutrients to the ground and may be used by distinct organisms.



Regulation of natural disasters

Shrubs help to regulate flooding, since in periods of heavy rainfall, their vegetation slows the flow of water and helps control river discharge. Furthermore, they offer protection from strong winds and cushion their speed. They also provide stability through their roots, preventing landslides.



Biological control

When the shrubs are in a good state they can help to control pests, which tend to be caused by insects, since they contain a large diversity of bird species that feed off of these insects.



Pollination

The wide diversity of berries and flowers in the shrubs serves to feed a number of different pollinators, helping to preserve their populations.

CULTURAL



Recreation

Shrubs offer a number of leisure activities such as berry picking and hunting, since different hunting species tend to live in these ecosystems.



Scientific knowledge

Research on shrub ecosystems is necessary in order to maintain and manage an appropriate natural environment.



Environmental education

Shrubs offer information on their past and present uses in Biscay. This information is disseminated by many of the interpretation centres as a part of their environmental education. A good example of this may be found in the parketxe de Armañon.



Aesthetic enjoyment of landscapes

Heathlands are greatly appreciated for their great plant diversity.

Natural forests






Due to its historical, climatic and geographic conditions, Biscay has a strong connection to its natural forests, which are a major pillar for its society, culture, economy and landscape.

However, these forests have suffered from a considerable decline in size, among other things, due to the increased demand for wood by the foundries, for transformation into charcoal and for construction uses (shipbuilding, housing construction, etc.).

Due to the on-going demand for wood supply there has been a need for continuous production, resulting in pollarded trees and rockrose which have been the most common responses to this need. This growing demand has thereby conditioned the Biscay woodlands, leading to a predominance of pruned trees and rockrose, and causing the deterioration of these forests.

This demand has combined with an interest in creating open mountain pasture spaces and farmlands in the low lands, therefore controlled brushfires have diminished the forests. Currently, natural forests **make up only 13.3% of the surface area of Biscay**. Of these, **riparian forests, beech forests, Cantabrian green oak forests and mixed oak forests** are especially significant.

The main services provided by the natural forests of Biscay are presented below:

SERVICES PROVIDED BY NATURAL FORESTS	
PROVISIONING	 <p>Food Forests offer a variety of berries such as blackberries, chestnuts, hazelnuts, acorns, sloes, etc., edible fungi and mushrooms and hunting animals.</p>
	 <p>Biotic materials Today, many municipalities continue to extract firewood for domestic use (fuel, handicrafts, natural oil production, etc.) or for construction purposes.</p>
	 <p>Natural medicines In these forests, different species are found such as linden, hawthorn or St. John's wort, having medicinal properties. Also, certain resins and natural oils obtained from their fruits possess medicinal properties, such as acorns from oaks which are rich in tannins.</p>

SERVICES PROVIDED BY NATURAL FORESTS

REGULATING



Climate regulation

Forests are major carbon sinks, since their vegetation and grounds absorb and store large quantities of carbon which helps to control global climate change. On a more local level, their considerable canopy and underbrush allows for temperature control as they provide shadow and moderate wind speed.



Regulation of air quality

Through atmospheric gas exchange carried out by forest vegetation and some soil organisms, some pollutants are retained and air quality is improved.



Water regulation

The well structured forest floors foster water infiltration and aquifer recharge. Their vegetation helps regulate the return of water to the atmosphere via evapotranspiration. Also, the abundant organic material in their grounds helps to retain a large amount of water.



Erosion control

Tree roots, especially in steeply sloped areas, help to stabilize the ground, thereby controlling erosion caused by heavy rainfall. Furthermore, their large canopy and abundant organic material in the ground also helps to prevent erosion from rainwater.



Maintenance of soil fertility

Tree roots extract nutrients that are deep in the ground, storing them in their tissues and preventing their loss by leaching and recycling them through the falling leaves whose nutrients may be used by different organisms.



Regulation of natural disasters

Forests help regulate floods since during periods of heavy rainfall, their vegetation helps to cushion rainfall and slows down its flow, preventing flooding of the ground and offering time for river runoff control. They also offer protection from strong winds, cushioning their speed and stabilizing the ground with their roots, thereby preventing landslides.



Biological control

When forests are in good condition, they have the ability to prevent certain pests and illnesses.



Pollination

The wide diversity of berries and flowers in the forests serve to nourish numerous pollinators. Also, trees serve to support bee swarms.

CULTURAL



Recreation

Forests may be used for different leisure activities, such as hiking, mushroom picking and hunting.



Scientific knowledge

Research on forests is a major source of scientific knowledge that is necessary in order to preserve and manage the natural environment. This research is carried out by different groups such as the University of the Basque Country (UPV/EHU), the Regional Government of Biscay, Neiker, etc.



Environmental education

Forests are a major source of environmental education for all. Some of the environmental campaigns that have been carried out in Biscay are directed at these ecosystems, as is the case with that of Zuhaitz Eguna.



Traditional knowledge

Forests are the site of major traditional uses that should be passed on from generation to generation, as in the case of pollarding.



Aesthetic enjoyment of landscapes

Natural forests are some of the most greatly valued ecosystems by the Basque population. For example, forests of the Urkiola National Park receive numerous visitors, mainly on weekends.



Cultural identity and sense of belonging

Basque culture and mythology is closely related to the forests. For example, oak is a part Biscay's cultural identity and this is reflected in certain symbols such as the Tree of Gernika.

Other natural ecosystems



This section includes those ecosystems making up a small part of the territory such as the **bodies of water (rivers, lagoons, etc.), peatland and rocky lands**. Together, they **make up only 1.5% of the territory**, although they are quite important since they offer vital services.

Each of these ecosystems, together with the services that they provide, have been described in more detail in the **catalogue of the ecosystem services of Biscay** which is included as Annex 1.



Forest plantations







Since the 18th century, the increased demand for wood by foundries and the construction industry has led to major deforestation of the Biscay mountains. However, during the 1930s, this landscape was transformed by pine plantations which have filled the mountains with their forests, while also providing wood.

Currently, they make up almost **half of the Biscay surface area, at 46.2%**, and they include **broadleaves plantations, eucalyptus plantation and coniferous plantations**, with the latter being the most numerous (38.7%).

Over recent decades, wood production has been an important activity in the primary sector. However, inappropriate management and handling of forest plantations has led to great environmental problems related to the loss of soil fertility due to rapid tree growth, soil compacting problems due to the use of heavy machinery, a decreased biodiversity, an increased vulnerability to fires and pests due to their homogenous structure, etc. Therefore, today, almost a century after the introduction of the pine plantations in Biscay, it is necessary to transform this forest panorama so as to adapt it to current environmental needs and the new economic situation.



The main services provided by the forest plantations of Biscay are presented below:

SERVICES PROVIDED BY THE FOREST PLANTATIONS	
ROVISIONING	 <p>Food One of the most greatly appreciated food products offered by the forest plantations are the edible fungi and mushrooms, but it is also possible to find different types of berries and hunting animals. However, these plantations have a lower diversity of food products than the natural forests.</p>
	 <p>Biotic materials Forest plantations mainly provide wood, although resins may also be found.</p>
	 <p>Renewable energies In some cases, the biomass found in these plantations may be used as energy sources.</p>
	 <p>Natural medicines Some of the species grown in Biscay have medicinal components, like eucalyptus. However, these trees tend to be used for wood in order to extract paper pulp.</p>

SERVICES PROVIDED BY THE FOREST PLANTATIONS

* REGULATING



Climate regulation

Forest plantations are major carbon sinks, since their vegetation and grounds absorb and store large quantities of carbon which helps to control global climate change. On a more local level, their canopy and underbrush allows for temperature control as they provide shadow and moderate wind speeds.



Regulation of air quality

Through atmospheric gas exchange carried out by vegetation and some soil organisms, some pollutants are retained and air quality is improved.

However, the use of machinery during forestry works creates environmental contamination which negatively affects this service.



Water regulation

Their vegetation and some organisms in their soil help to regulate the return of water to the atmosphere via evapotranspiration.

In eucalyptus forests, the rate of evapotranspiration is so high due to their rapid growth that it causes water scarcity problems.



Erosion control

Tree roots stabilize the ground preventing erosion caused by heavy rains. Furthermore, their canopies and organic material in their soil also serves to control its impact and the quantity of rainwater entering, further preventing erosion.

However, the compacting of their soil due to the use of machinery does not allow for water infiltration, so the superficial runoff may lead to intense erosion that worsens when the plantation is young.



Regulation of natural disasters

Forest plantations help regulate flooding since during periods of heavy rainfall their vegetation retains water and slow its flow, controlling river runoff. Furthermore, they offer protection from strong winds, slowing their speed and stabilizing the ground with their roots, thereby preventing landslides.

Regarding fire control, the homogenous nature of these plantations makes them more vulnerable.



Pollination

These plantations offer habitats and nourishment to pollinators, contributing to the maintenance of their populations.

***All of these services disappear when the plantation is harvested.**

CULTURAL



Recreation

These forest plantations offer the possibility of carrying out different leisure activities such as hiking, mushroom and fungi collection and hunting.



Scientific knowledge

Research conducted on forest plantations is directed towards improving productivity and profitability.



Environmental education

Environmental education on these ecosystems relates to their sustainable exploitation and the changes in landscape that have been produced.



Aesthetic enjoyment of landscapes

Some of the Biscay population positively values these forest plantations as they are considered to be associated with a "green" landscape.



Cultural identity and sense of belonging

Rural culture and sporting activities are related to the exploitation carried out in these forest plantations. An example of this is the *Aizkolaris*.






Croplands in Biscay tend to be small agricultural farms spread out across the entire territory, **currently making up 0.8% of the area**. These ecosystems include **orchards and nurseries**, as well as **intensive monocultures and vineyards**.

As for the orchards, their cultivation tends to be carried out in small village plots or in peri-urban areas of the cities and towns. They are often used for self-consumption or for sale in village markets. In these orchards, fruit and vegetables are grown, as well as legumes and cereals. As for nurseries, in addition to the previously described products, ornamental plants and timber products are also grown.

The main vegetables grown in Biscay are lettuce, tomatoes and peppers. In some villages, these agricultural products have their own designation as products with a quality label, as with the Gernika pepper and beans. Currently, a wide diversity of local agricultural varieties are being recovered and maintained, as is the case with red onions of Zalla, Derio dwarf chard, the grapes of Orduña, the hanging tomatoes of Busturia, Elorrixoko Porrúa, Munguia beans, etc.

Biscay is a point of reference for quality agricultural products with distinct quality references such as the Bizkaiko Txakolina, Euskal Baserri, Bizkaiko Sagardoa and the Organic Agriculture Production Agency designation of origin, among others. The latter, over recent years, has revealed an increased surface area for organic agriculture and vineyards used to produce txakoli, a regional white wine.

The main services provided by the crops of Biscay appear below:

SERVICES PROVIDED BY CROPS	
ROVISIONING	 <p>Food Croplands are the source of a wide variety of food products from fruits and vegetables to legumes, cereals or <i>txakoli</i>. Some of these products have labels of quality.</p>
	 <p>Gene pool Agricultural crops are necessary genetic resources since they have a wide variety of diversity in their local varieties which should be preserved.</p>
	 <p>Natural medicines Some of the species that are grown in the orchards and nurseries have medicinal properties in their main components, such as rosemary.</p>

SERVICES PROVIDED BY CROPS

REGULATING



Pollination

Orchards and croplands offer nourishment to pollinators, contributing to their population maintenance.

CULTURAL



Recreation

Croplands offer the opportunity for carrying out different leisure activities such as gardening, vineyard visits, etc.



Scientific knowledge

Research related to crops is underway; particularly in regards to increasing their productivity and profitability.



Environmental education

Many schools have their own orchards where students work and learn about the different varieties that are grown.



Traditional knowledge

Traditional agricultural practices and the cultivation of local varieties is an important source of traditional knowledge.



Aesthetic enjoyment of landscapes

Some agricultural landscapes such as orchards, the Atlantic Countryside or vineyards are the source of aesthetic enjoyment.



Cultural identity and sense of belonging

Local agriculture is very closely related to the Biscay cultural identity. Many towns hold weekly markets where local products are sold.

Urban ecosystems and other artificial areas



Within this group are those artificial ecosystems created by mankind, such as **parks and gardens, urban areas, mines and quarries and reservoirs**. In all, they **make up 9.9% of the territory**.

All of these ecosystems, along with the services that they provide, have been described in greater detail in the **catalogue of the ecosystem services of Biscay** which is included as Annex 1.



03 › HOW ARE ECOSYSTEM SERVICES DISTRIBUTED ACROSS THE TERRITORY?



MAPPING ECOSYSTEM SERVICES

To ensure appropriate territorial management, it is first necessary to determine the needs of the population as well as its biophysical characteristics. In other words, it is important to know the spatial distribution of the resources in order to understand the potential resulting interactions, what areas should be maintained, or what regions may require more sustainable management.

For these reasons, mapping is of great importance as it offers a different type of spatial information in a specific territorial or geographical area, thereby helping policymakers to manage the territory. As for the natural diversity and provision of ecosystem services, mapping allows us to determine their spatial distribution to ensure that appropriate management decisions are made. Also, mapping allows us to identify the areas of priority for the conservation of natural diversity, as well as those areas that contribute the most to service provision.



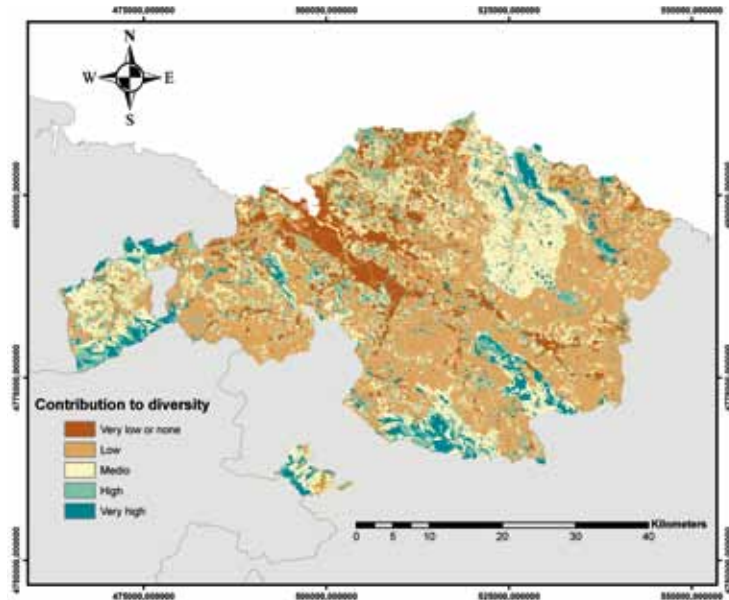
As a part of the Biscay Assessment, mapping was carried out for the entire Biscay territory, including the contribution of the different areas to the conservation of natural diversity and the supply of the provisioning (wood supply), regulating (water regulation, pollination and carbon supply) and cultural (potential recreation service) services. The results are presented below.

Mapping of the ecosystems services and natural diversity is necessary for a proper territorial management, as it allows for the determination of their spatial distribution and identification of those areas offering the greatest contribution to its supply.

What are priority areas for the conservation of natural diversity?

Natural diversity and ecosystem services are closely connected since changes in biodiversity, geodiversity, and landscapes may compromise the functioning of ecosystems, as well as their capacity to provide services.

FIGURE 3.1.
Contribution
of the different areas
to the conservation
of natural diversity.



Approximately 21% of the Biscay surface area has a large value (high or very high contribution) in terms of conservation of natural diversity (Figure 3.1). These areas of great value include primarily the natural forests, which make up some 64% of these areas, followed by shrubs and heathlands, at 27%. **Together with the natural forests, the coastal ecosystems** (beaches, dunes, marshlands and cliffs) **as well as other natural habitats** (such as peatlands and rocky areas), despite their reduced size, **are also necessary in order to preserve natural diversity**, since almost 80% of their surface area contributes to this in a significant manner.

On the other hand, over 50% of the Biscay surface area has a low value (low, very low or no contribution) corresponding to the conservation of natural diversity. Urban ecosystems and other artificial areas, forest plantations and croplands are the ecosystems contributing the least to its conservation (Figure 3.2).

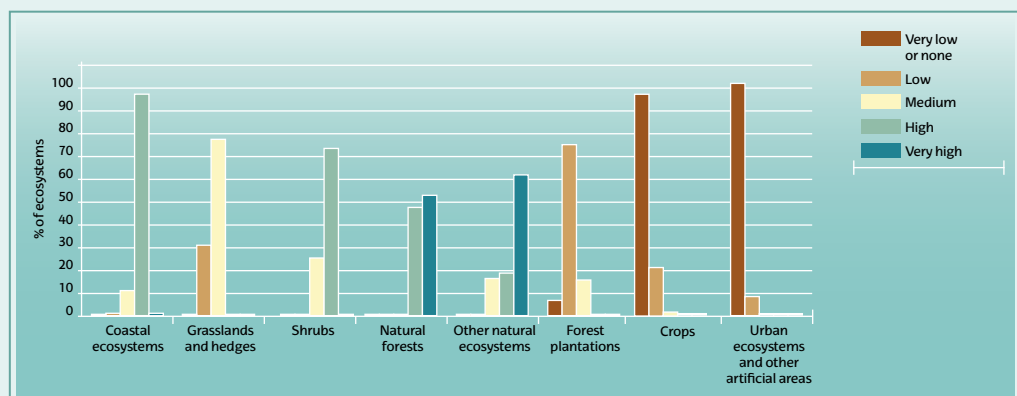
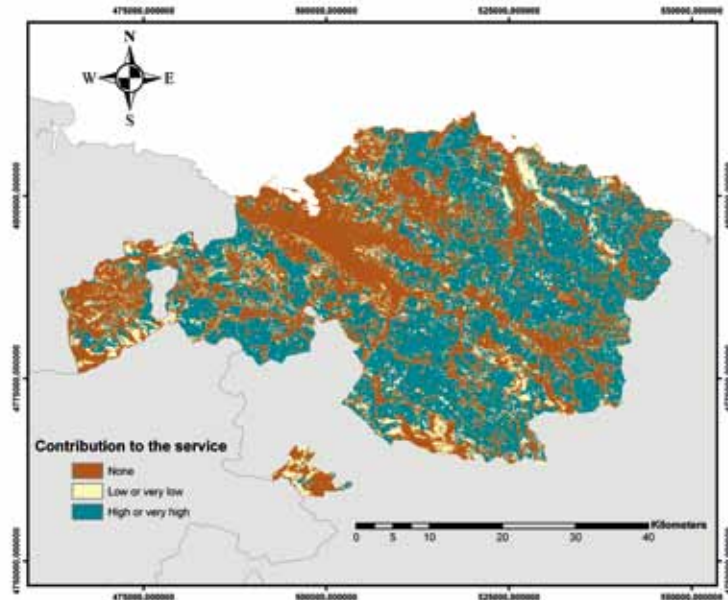


FIGURE 3.2. Percentage of each ecosystem based on type of contribution to conservation of natural diversity.

Which areas contribute the most to the provision of wood?

Generally speaking, ecosystems provide a large variety of biotic materials such as wood, resins, oils, natural fertilizers and preservatives, furs and wools, etc. In Biscay, biotic provision services focus primarily on wood production.

FIGURE 3.3. Contribution of the different areas to the provision of wood service.



Approximately 46% of the Biscay surface area has a high value (high or very high contribution) for wood provision (Figure 3.3). **Forest plantations are the ecosystems contributing the most to the provision of wood**, with the entire area receiving a high value. Approximately 94% of the natural forests also contribute to wood provision but their magnitude is much lower (a low or very low contribution), since wood is extracted from these forests but in greatly reduced quantities (Figure 3.4).

On the other hand, non-forest ecosystems, making up 42% of the territory, do not offer any contribution to the provision of wood.

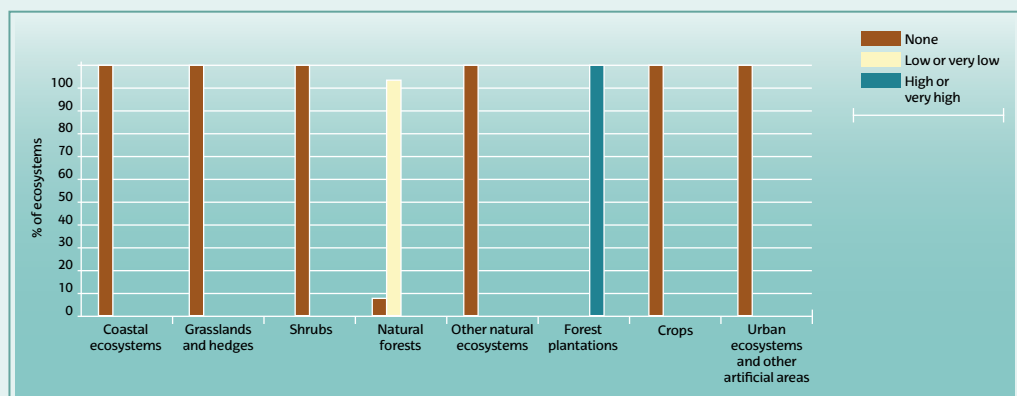
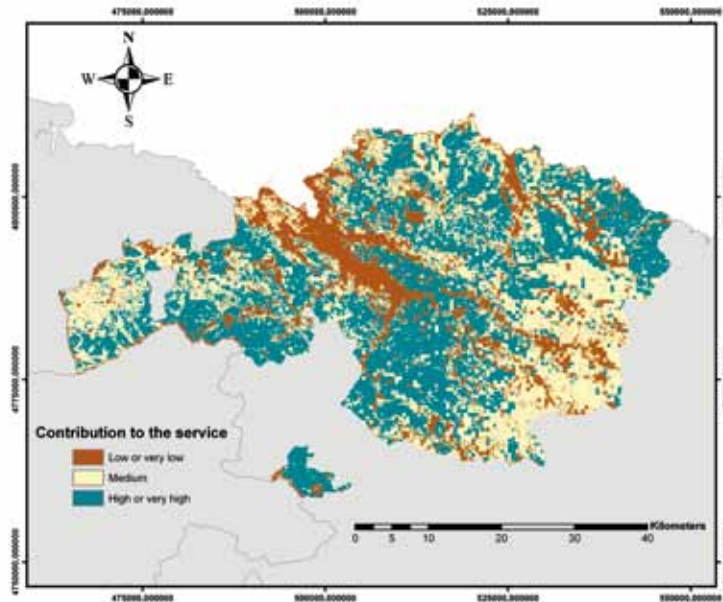


FIGURE 3.4. Percentage of each ecosystem based on type of contribution to wood provision.

Which areas contribute the most to water cycle regulation?

Ecosystems have a great influence on the water cycle, as they regulate run off and therefore, the flow regime of the water courses.

FIGURA 3.5.
Contribution of
the different areas
to water cycle
regulation service.



Approximately 43% of the Biscay surface area receives a large value (high or very high contribution) for the regulation of the water cycle (Figure 3.5). These high value areas are primarily the forest systems, both natural forests and forest plantations, receiving 20% and 72%, respectively. The larger contribution of the forest plantations to these high value areas is due to their greater extension. However, in both cases, more than 60% of their surface area contributes with a high contribution to this regulation, thus **both natural forests as well as forest plantations are the greatest contributors to the regulation of the water cycle** (Figure 3.6).

On the other hand, 20% of the Biscay surface area receives low values (low or very low contribution) in regards to the regulation of the water cycle, with artificialized areas making up almost 50% of these areas.

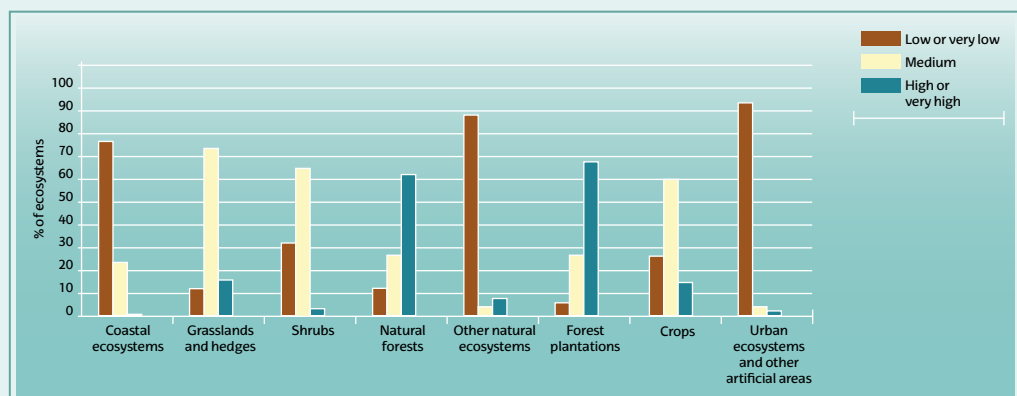
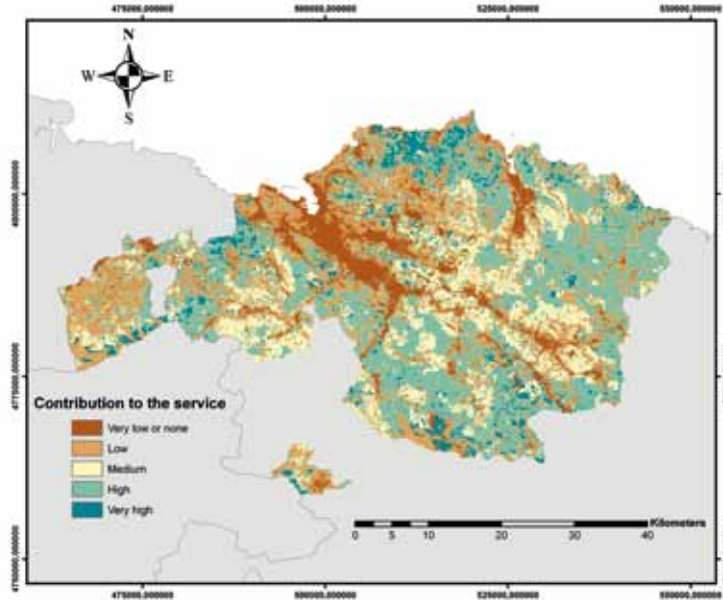


FIGURE 3.6. Percentage of each ecosystem based on type of contribution to water cycle regulation.

Which areas contribute the most to carbon storage?

Ecosystems play a major role in the fight against climate change, acting as carbon sinks which store large quantities of carbon in their vegetation and in the ground.

FIGURE 3.7.
Contribution of the different areas to carbon storage service.



Approximately 43% of the Biscaya surface area receives a large value (high or very high contribution) for carbon storage (Figure 3.7). These areas of large values consist entirely of the forest systems, both natural and forest plantations, making up 28% and 72% of said areas, respectively. The greater contribution of the forest plantations is due to their greater extension. However, over 90% of the natural forests offer a high or very high contribution as compared to only 65% of the forest plantations (Figure 3.8). This suggests that **both natural forests and forest plantations are the ecosystems contributing the most to carbon storage**, with the contribution of the natural forests being somewhat greater.

On the other hand, 40% of the Biscaya surface area receives a low value (low, very low or no contribution) for carbon storage services and this percentage consists of the non-forest ecosystems.

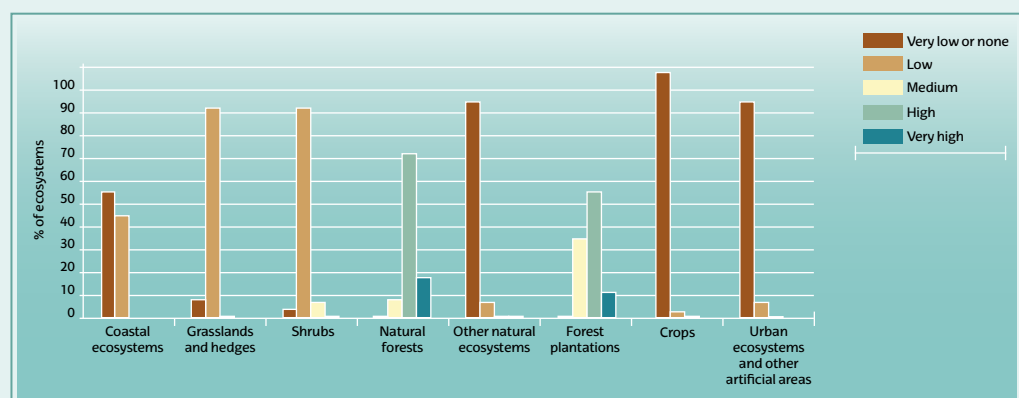
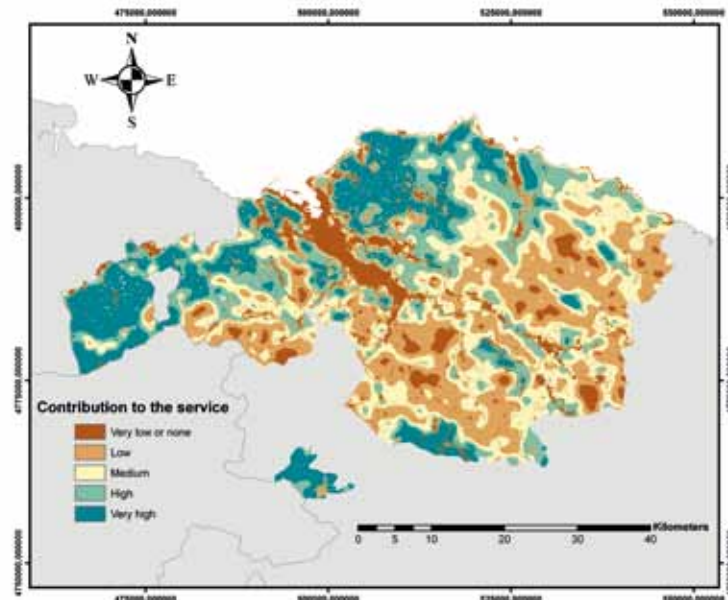


FIGURE 3.8. Percentage of each ecosystem based on type of contribution to carbon storage.

Which areas contribute the most to the conservation of pollinators (insects)?

Almost all of the natural ecosystems of Biscay depend on pollination for subsistence. Furthermore, insects are the principal pollinators of crops, both agricultural as well as forest-based, therefore many provisioning services depend directly on the maintenance of these insect populations.

FIGURE 3.9. Contribution of the different areas to the conservation of pollinators service.



Approximately 36% of the Biscay surface area receives a large potential value (high or very high contribution) for the conservation of insects pollinators since they provide habitat and food sources (Figure 3.9). These high value areas consist primarily of forest systems (21% natural forests and 29% forest plantations), grasslands and hedges (36%) and shrubs (12%). The large contribution of forest plantations in these areas is due to their great extension. However, only 23% of the same have a high value, while in the case of natural forests, grasslands and hedges and shrubs almost 60% of these make high contributions (Figure 3.10). Furthermore, over 84% of the cases of maximum values (very high contribution) are found in the natural forests. Therefore, **natural forests, grasslands and hedges and shrubs are the ecosystems that contribute the most to the conservation of pollination services.**

On the other hand, 38% of the Biscay surface area receives low values (low, very low or no contribution) for the conservation of pollination, consisting primarily of non-forest ecosystems and urban ecosystems.

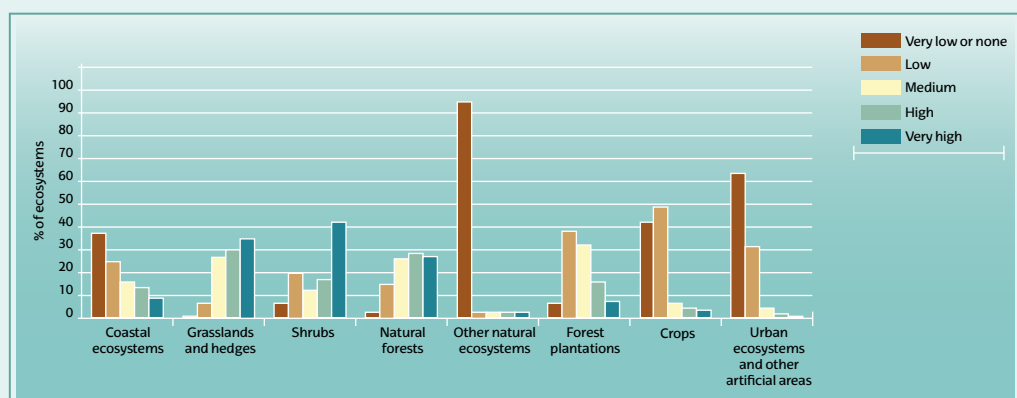
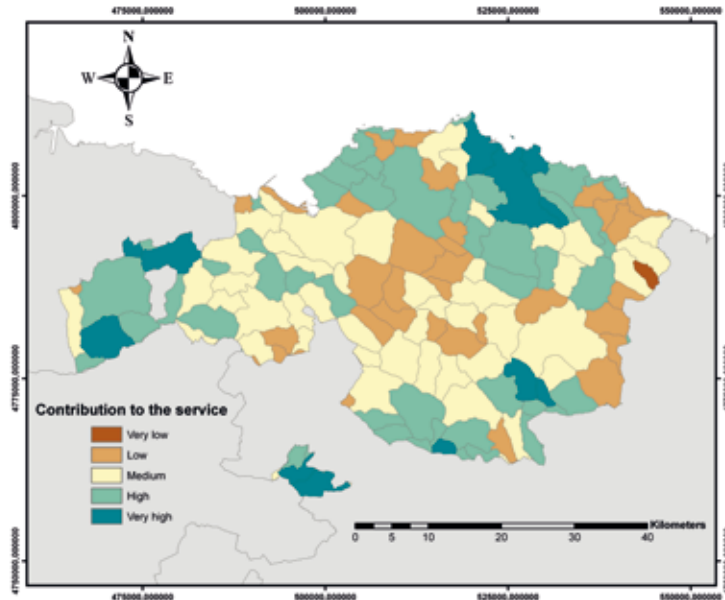


FIGURE 3.10. Percentage of each ecosystem based on type of contribution to conservation of pollinators.

Which areas potentially contribute the most to recreation?

Ecosystems offer sites where it is possible to carry out recreational activities that are beneficial to our physical and mental health. In Biscay, culture, heritage and nature come together to offer a wide range of recreational possibilities including hiking, cycling, horseback riding, mountain climbing, hunting and fishing and bird watching and many others.

FIGURE 3.11.
Contribution of
the different areas
to recreation service.



The mapping of the recreation services varied with respect to the other services, as it was carried out based on view sheds. This map also considers the other ecosystems present, the relief and the presence of summits as well as the presence of landscape landmarks. The results reveal that 44% of the view sheds of Biscay (42% of the territory) have great potential value (high or very high contribution) for recreation (Figure 3.11). These view sheds of great value are characterized by a higher presence of natural ecosystems and steeper reliefs as compared to the view sheds having a low or very low contribution which make up 19% of the territory.

Thus, **the natural ecosystems, such as natural forests, coasts, bodies of water and rocky lands, are the ecosystems that potentially contributing the most to the recreation service.**



Are there multi-functional areas in Biscay?

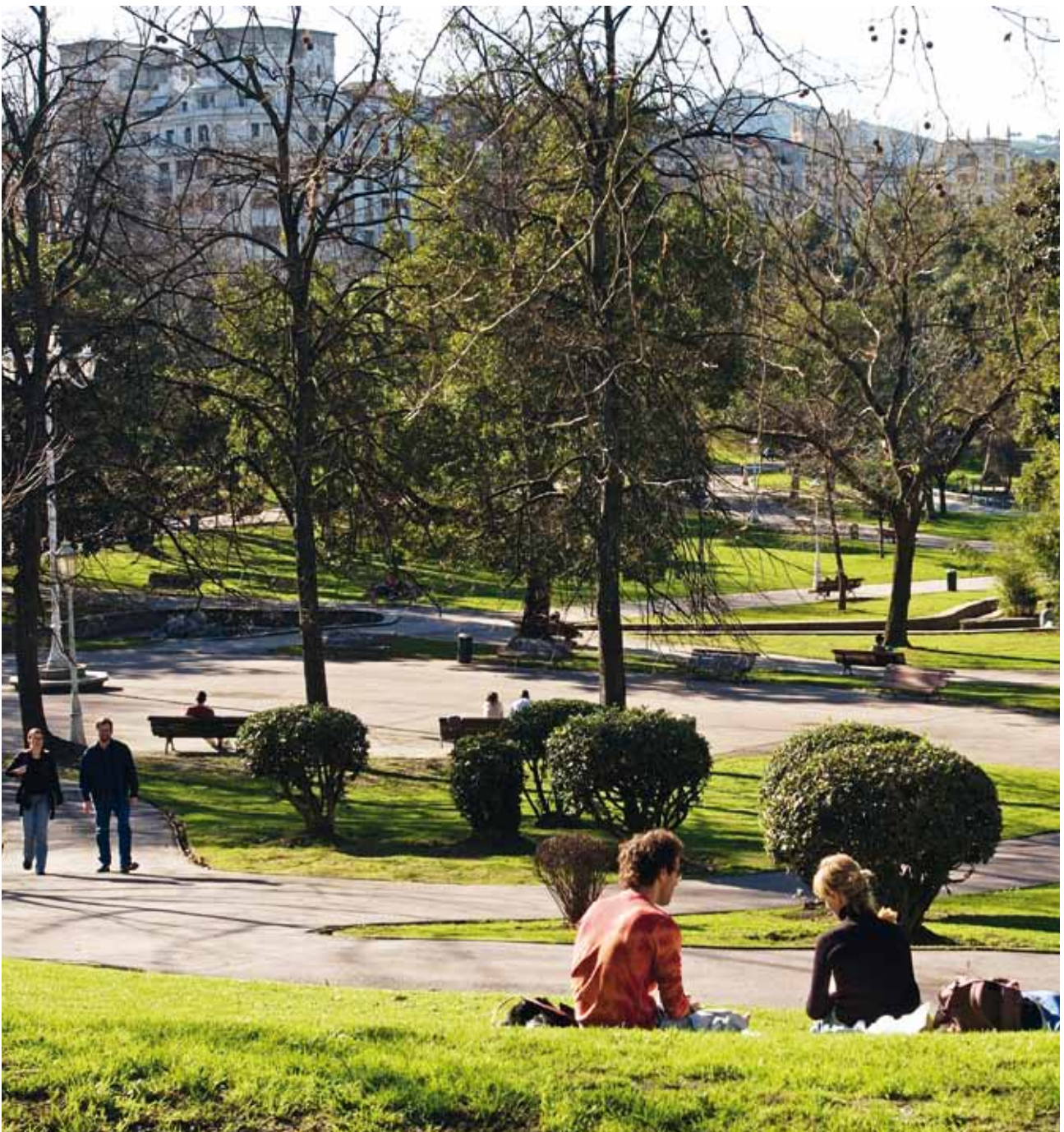
Multi-functionality is one of the primary objectives of territorial management, in reference to ecosystem services; in other words, to ensure the conservation of natural diversity and the supply of multiple ecosystem services. Thus, it is necessary to identify those areas that are essential for both, the conservation of natural diversity and ecosystem services.



Some 12% of the Biscay surface area is essential to the conservation of natural diversity and the supply of at least two of the five mapped ecosystem services. These multi-functional areas consist entirely of natural forests and make up over 80% of the same. Therefore, **natural forests of Biscay provide multiple ecosystem services and are priorities for the conservation of natural diversity**. Therefore, their conservation and regeneration must be included in territorial management objectives.

The natural forests, in addition to being essential for the conservation of natural diversity, are the most important ecosystems in terms of multiple service supply (water cycle regulation, carbon storage, maintenance of pollinators, recreation, etc.), therefore, their conservation is essential to the sustainable management of the territory.

04 › WHAT IS THE TREND IN THE ECOSYSTEM SERVICES OF BISCAY OVER RECENT DECADES?



WHAT HAS BEEN HAPPENING IN BISCAY OVER RECENT DECADES?

Historically, Biscay has been a strongly industrialized and urbanized territory which has become economically successful thanks to different services provided by its ecosystems, mainly those related to provision: initially, charcoal and wood for the naval industry and later, industrial metalworking and large-scale mining. These provisioning services obtained from the ecosystems of Biscay have led to considerable benefits for human well-being and local and regional economic development, even contributing to the wealth of the overall country and European continent. All of this however, has had a major impact on the ecosystems of Biscay which have been greatly affected and altered, therefore compromising the flow of other services such as the regulating ones. Over recent years however (the past 15-25 years), Biscay has seen a major transformation with the closing of the largest industries (a major case in point being “*Altos Hornos de Vizcaya*”, which closed definitively in 1996), the transformation and redirecting of the economy towards the services sector, and the strong support from the (local, regional and autonomous community) administrations of industrial emissions control and the recovery of specific areas, helping to recover certain ecosystems and their services.

The industrialization of Biscay brought with it the abandoning of its agricultural lands and since this time, the rural sector has suffered major transformations. By the early 20th century in Biscay, there were no remaining forest areas. In order to face this rural crisis, starting in the 1940s, there was a proposal for the massive use of non-native forest species, significantly contributing to the economy of the small villages. Currently, over half of the territory is dominated by forests, mainly forest monoculture of non-native species (most notably the *Pinus radiata* or Monterrey pine), which, though no longer providing significant income, do present some environmental problems.



To analyse the evolution and trends occurring in ecosystem services over recent years, it is necessary to understand the validity and functioning of the environmental and sectoral policies.

What are the current trends in the ecosystem services of Biscay?

Below are the results from the analysis of the evolution of the services provided by the ecosystems of Biscay over the past two decades (Table 4.1, 4.2 and 4.3).

			↑ Increase	↔ Remained the same	↓ Decrease	↕ Contradictory trend
PROVISIONING SERVICES	TREND					
	FOOD	↓	While agricultural production in Biscay has remained stable with little variation, the fishing and livestock industries have been diminishing, with a decrease in livestock and in coastal fishing by over 30% in recent years (Nasdap, 2013).			
	WATER	↔	Being that Biscay's water is supplied mainly from nearby reservoirs outside of its own territory, this service is not considered to be of great relevance in the Biscay territory, although measurements are taken in their bodies of water. Demand for this service is high however, due to the large population and intense industrial activity. The overall Basque Country demand is found to be in slight decline, as indicated by the total water volume that was registered and distributed for both residences and non-residences (INE, 2014).			
	BIOTIC MATERIALS	↑	Due to the crisis of the construction industry as well as other factors, the demand for wood from Biscay's plantations has drastically declined, and therefore logging has reduced significantly. This has led to an increase in the available wood resources (CAPV forest inventory, 2005 and 2011). Thus, while service supply has increased, the demand for the wood resources has decreased.			
	GEOTIC MATERIALS	↓	Over past decades, iron ore was the primary land-based raw material extracted from Biscay, but in 1984, a dramatic decrease occurred in this industry, leading to the closure of the last remaining iron ore mine in 1993. Previously, this service focused on the extraction of quarry materials and ornamental rocks for use in the construction industry. However, the crisis affecting this sector has led to a diminished demand for these types of products and therefore, the trend for this service over recent years is negative.			
GENE POOL	↓	There has been a decrease in the variety of species used in the agricultural- forestry-livestock sector, along with a loss of local seeds, and a trend towards monocultures, both in agriculture and forests. As for the genetic pool of animal resources, it is interesting to note that there are 18 native domestic animal breeds in the Basque Country, of which, the large majority are currently endangered and even threatened (DECREE 373/2001, of 26th of December).				

TABLE 4.1. Trend in provisioning services provided by the ecosystems of Biscay.

↑ Increase

↔ Remained the same

↓ Decrease

↕ Contradictory trend

		TREND
REGULATING SERVICES	CLIMATE REGULATION	↑ There has been an increase in the coverage of forest ecosystems, which have increased by over one thousand hectares since 2005. This extension has led to an increase in forest biomass and therefore, a rise in carbon stocks (CAPV Forest Inventory, 2005 and 2011).
	REGULATION OF AIR QUALITY	↑ An improvement in air quality has been observed in Biscay, due primarily to the decrease in emissions of industry pollutants.
	WATER REGULATION	↓ Over recent years, the urban surface area of Biscay has increased by over 1,800 hectares (CAPV Forest Inventory, 2005 and 2011), giving rise to soil sealing and therefore, the disappearance of the water cycle regulation service.
	EROSION CONTROL	↑ Two factors related to forest ecosystems have led to an increase in erosion control in Biscay. On the one hand, there is the increase in forest coverage and on the other hand, there is a reduction in logging in forest plantations. The increased forest coverage has helped to slow down the speed of the rain water falling to the ground, thereby controlling erosion. The decreased forestry has helped to erosion control because forestry has led to severe changes in the physical properties of the land, caused by the traffic of machinery used during the plantation preparation and logging processes, thereby affecting erosion.
	MAINTENANCE OF SOIL FERTILITY	↓ Due to the increase in agricultural and forestry activity over the past two decades, there has been an observed decrease in the fertility of the Biscay land.
	REGULATION OF NATURAL DISASTERS	↓ Flooding is the number one natural disaster occurring in Biscay. In this region, the flood plains, whose role is essential in controlling flooding, tend to be filled up to their edges, and in many of these, retaining walls have been built or riverbeds have been channelled or drained, reducing their functioning.
	BIOLOGICAL CONTROL	↓ There has been a trend towards crop intensification and the planting of monocultures, leading to a more homogenous landscape and increasing the vulnerability to pests and illnesses.

TABLA 4.2. Trend in regulating services provided by the ecosystems of Biscay.

↑ Increase

↔ Remained the same

↓ Decrease

↕ Contradictory trend

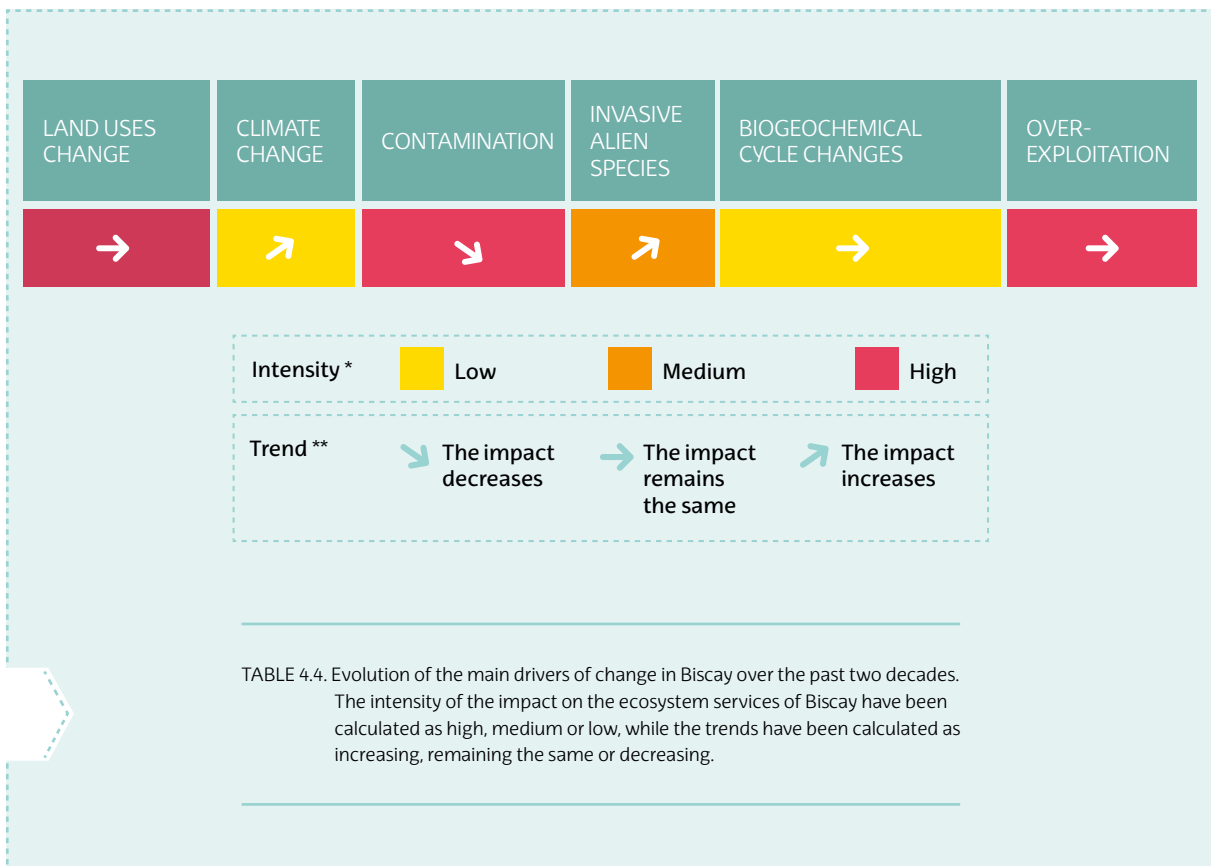
		TREND
CULTURAL SERVICES	RECREATION	↑ The preparation of recreational areas has increased considerably in Biscay over recent decades. There has also been a significant increase in the following indicators: no. of overnight agrotourism stays, no. of agrotourism accommodations and no. of agrotourism positions (EUSTAT, 2012).
	SCIENTIFIC KNOWLEDGE	↑ There has been an observed increase in the number of scientific publications in Biscay in the areas of agriculture, livestock and fisheries, earth sciences, vegetable and animal biology and ecology (No. of Thomson-Scientific-ISI publications).
	ENVIRONMENTAL EDUCATION	↑ The Regional Government has expressed its commitment to environmental education, approving the 2007 Action Plan for Education in Sustainability (PAES) forming a part of its County Agenda 21 (Biscay Program 21). This program collects an extensive diagnosis and assessment analysis of the state of environmental education, including a descriptive listing of the initiatives that have been undertaken in Biscay in this area. This analysis has revealed a major recent increase in publications and other initiatives in the area of environmental education.
	TRADITIONAL KNOWLEDGE	↓ The transfer of traditional knowledge from generation to generation is found to be declining due to a lack of generational transfer. For example, the percentage of farmers under the age of 35 as compared to those over the age of 55 is very low and the few remaining charcoal burners in Biscay are over 70 years of age.
	AESTHETIC ENJOYMENT OF LANDSCAPES	↓ The trend in this service in Biscay is negative, mainly due to the increase in artificialized areas (primarily residential and infrastructures). Also, the visual barrier created by the replanted perennial forests, creating a continuous forest in the landscape, jeopardizes this service.
	CULTURAL IDENTITY AND SENSE OF BELONGING	↑ Over recent years in Biscay there has been an increase in the number of products having quality labels from the cultural heritage of the territory, such as products with the "Eusko label", "Euskal baserri" labels or goods with designation of origin, such as txakoli from Biscay.

TABLA 4.3. Trends in cultural services provided by the ecosystems of Biscay.

What factors influence the provision of ecosystem services of Biscay?

The ecosystems of Biscay are impacted by different factors, both natural and man-made, leading to changes in the structure and functioning of these ecosystems and therefore, in the services that they provide. These factors are known as *drivers of change*, and they may be either *direct or indirect* depending on their manner of action, as previously mentioned in Chapter 1. Direct drivers, such as pollution or land use changes, result in direct changes to ecosystems, whereas indirect drivers, such as demographic or economic changes, indirectly cause the change.

Below are the results of the analysis on the evolution of the main direct drivers of change in Biscay, showing the intensity of their impact on ecosystem services and their trend over the past two decades (Table 4.4).



It is evident that the land use change and over-exploitation are closely related in the territory (urbanization and construction of infrastructures, intensive forestry model, river modification, agricultural transformations, etc.), with these two aspects being the main direct drivers that have affected and continue to affect the supply of ecosystem services in Biscay. Pollution has had a major impact on the ecosystems over the past decades; however, generally speaking, it has tended to decrease as the result of the closing of the largest industries and the subsequent transformation of the territory, as well as due to the applied environmental policies.



In addition to these changes, the effects on the biogeochemical cycles (related primarily to the intense management of the productive species forests and to the use of pesticides and fertilizers), and the introduction of invasive alien species also affect the ecosystem services of Biscay, although their pressures and negative effects have been much lower over recent decades. However, they should be taken into consideration since the pressure that they exert is increasing and may lead to major environmental and economic problems over the coming years.

The trends of the ecosystem services of Biscay over the past two decades have been primarily negative for provisioning services, and positive for regulating and cultural services. This last trend is due to specific drivers of change such as atmospheric pollution which have decreased considerably over recent years.

05 › CASE STUDIES: Bilbao Metropolitan GreenBelt, the Urdaibai Biosphere Reserve, the Lea River Basin and the Urkiola National Park



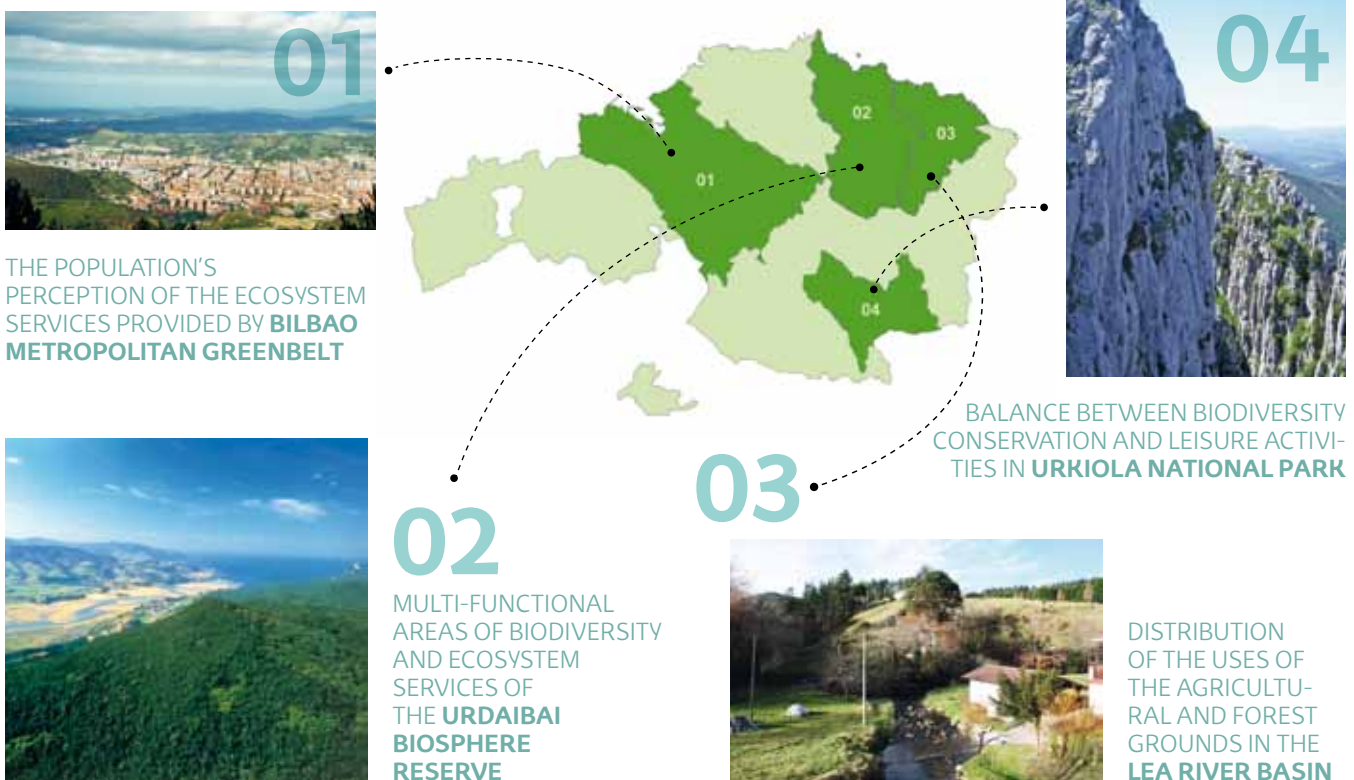
CASE STUDIES

In Biscay, there are areas with different environmental and socio-economic characteristics. Therefore, specific case studies are necessary in order to obtain more detailed information and more precise results that may be applied to the sustainable management of the territory based on the specific needs of each area.

Regarding the socio-economic issues of Biscay, four areas have been selected: the Bilbao Metropolitan Green Belt, the Urdaibai Biosphere Reserve, the Lea River Basin and the Urkiola National Park. By studying these specific areas, we aim to determine the population's perceptions regarding the services provided by these peri-urban areas; the development of sustainable management in the protected areas; the relationship between the primary production systems and biodiversity; and finally, the compatibility between biodiversity conservation and leisure activities in a natural park (Figure 5.1).

The four case studies correspond to diverse socio-ecosystems and in each of these, a specific issue has been addressed, always with the goal of obtaining useful results for decision making processes regarding resource use and territorial management.

FIGURE 5.1. Map of the case study locations.



Detailed case studies allow us to apply the research to the natural and social diversity found in Biscay.

In your opinion, what are the most important services provided by the ecosystems of the Bilbao Metropolitan GreenBelt?

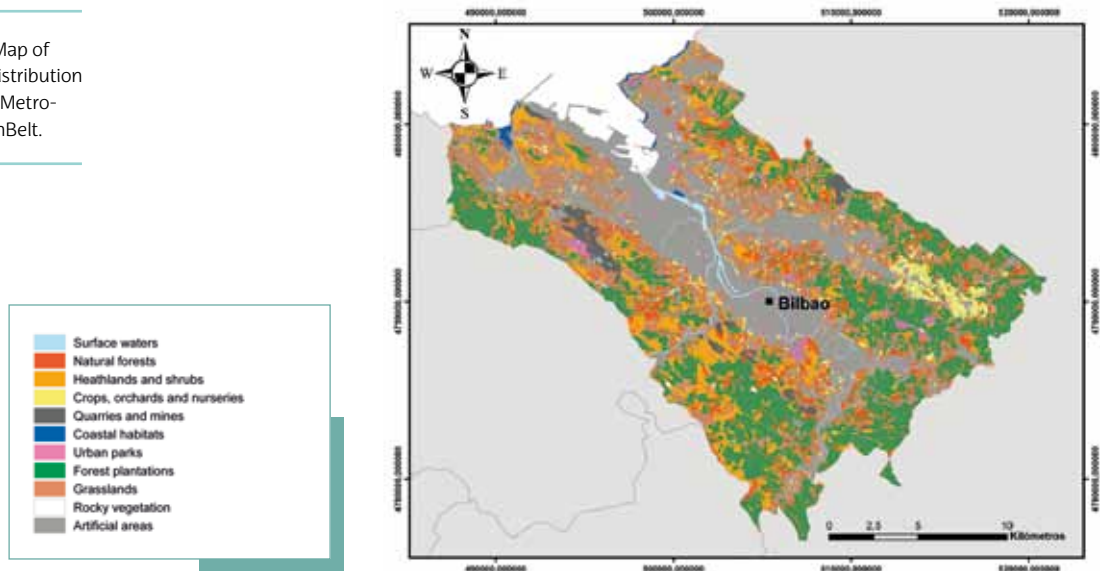
Bilbao Metropolitan GreenBelt is an emblematic area of Biscay having great significance in terms of the region's socio-economic development. Historically, it has been linked to strong industrial activity (mining and steelmaking industry), and it is currently immersed in a major transformation process. Its current population consists of 77% of the Biscay inhabitants, distributed across 29 municipalities.



The urban area of Bilbao and the towns located on its two riverbanks have collectively evolved with the peri-urban areas and with the ecosystems in which they are located. There has been a great deal of permeability between the urban-rural environments as well as integration of the peri-urban landscape in urban processes (mutual dependency).

The urban areas are primarily located in the valley, surrounded by low mountains, through which the Ibaizabal River runs, discharging in the Bay of Biscay. Despite its high population density (2,170 inhabitants/km²), it maintains a series of valuable ecosystems, such as the coastal ecosystems, including the coastal wetland biotype of Barbadun. Furthermore, the mountains house small areas of natural vegetation, although they are mostly covered by forest plantations (Figure 5.2).

FIGURE 5.2. Map of ecosystem distribution in the Bilbao Metropolitan GreenBelt.



Research objectives and methodology

The objective of the research was to determine the population's perception of the value of the ecosystems of the Bilbao Metropolitan GreenBelt and the services that they provide.

For this, a total of 500 surveys were completed by individual users of this area and by key agents (personnel from public administrations, associations, research centres and universities).



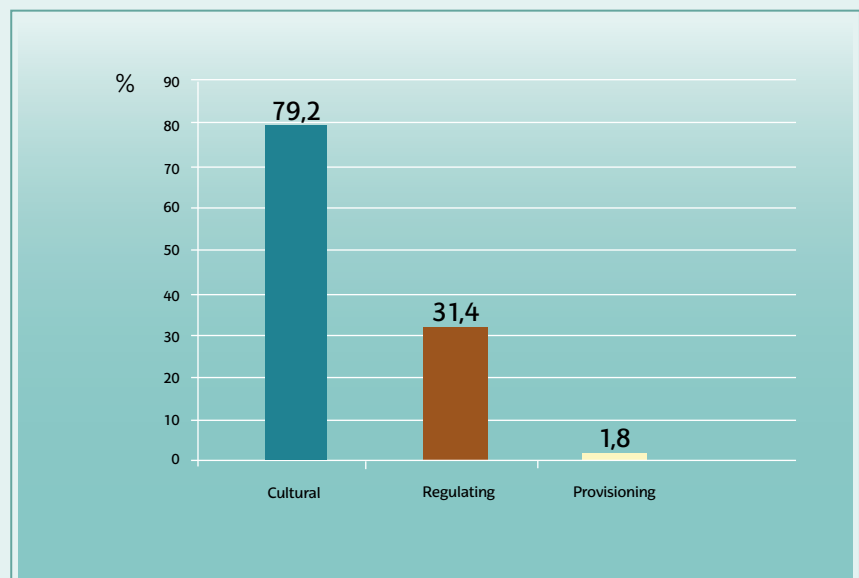
The results of this case study may help direct decision making for the sustainable management of this territory, offering an integrated urban and rural approach.

Results and conclusions

Over 90% of the surveyed individuals identified benefits provided to society by the ecosystems of the Bilbao Metropolitan GreenBelt.

The majority of the ecosystem services that were identified by the individuals/users were cultural (recreation, beautiful landscapes, rest and relaxation, etc.), with the regulating services being identified to a lesser degree (air purification, water purification, etc.) and virtually no identification of the provisioning services (food production, wood, etc.) (Figure 5.3). This may be due to the fact that the majority of the surveyed individuals are aware of the fact that the products that they consume (food, water, etc.) are produced in other distant territories.

FIGURE 5.3. Percentage of the surveyed individuals that indicated each type of ecosystem service when questioned about the benefits they provided.



In conclusion, the natural ecosystems of the Bilbao Metropolitan GreenBelt, making up approximately 13% of the same, are considered important due to their contribution to the well-being of the population. Therefore, it is necessary to preserve and regenerate these areas, since they are unique natural spaces in a highly urbanized region.

The cultural services provided by ecosystems are the most highly valued and are considered to be of great importance to the population's well-being.

Which ecosystems are the most important in terms of biodiversity and ecosystem services?

The Urdaibai Biosphere Reserve is a territory of great ecological and landscape value in a moderately urbanized area (45,000 inhabitants distributed across 22 municipalities) located relatively close to the metropolitan Bilbao area. It offers a great diversity of ecosystems and habitats (dunes, Cantabrian green oak forest, marshlands, Atlantic countryside, etc.) and a high degree of biodiversity.

The largest and most well-preserved wetlands of the Basque Country are found in Urdaibai.



Understanding the distribution of biodiversity and ecosystem services in the territory is important in order to ensure its sustainable management. Mapping permits visualization of their distribution over the area as well as identification of the priority areas to be preserved.

Research objectives and methodology

The objective of the research was to determine the spatial distribution of the biodiversity and ecosystem services in the Urdaibai Biosphere Reserve as the basis for defining multi-functional priority areas for conservation.

For this, the distribution of the biodiversity and ecosystem services of the territory were analysed, identifying the areas of the greatest value in terms of biodiversity and at least two of the studied services.

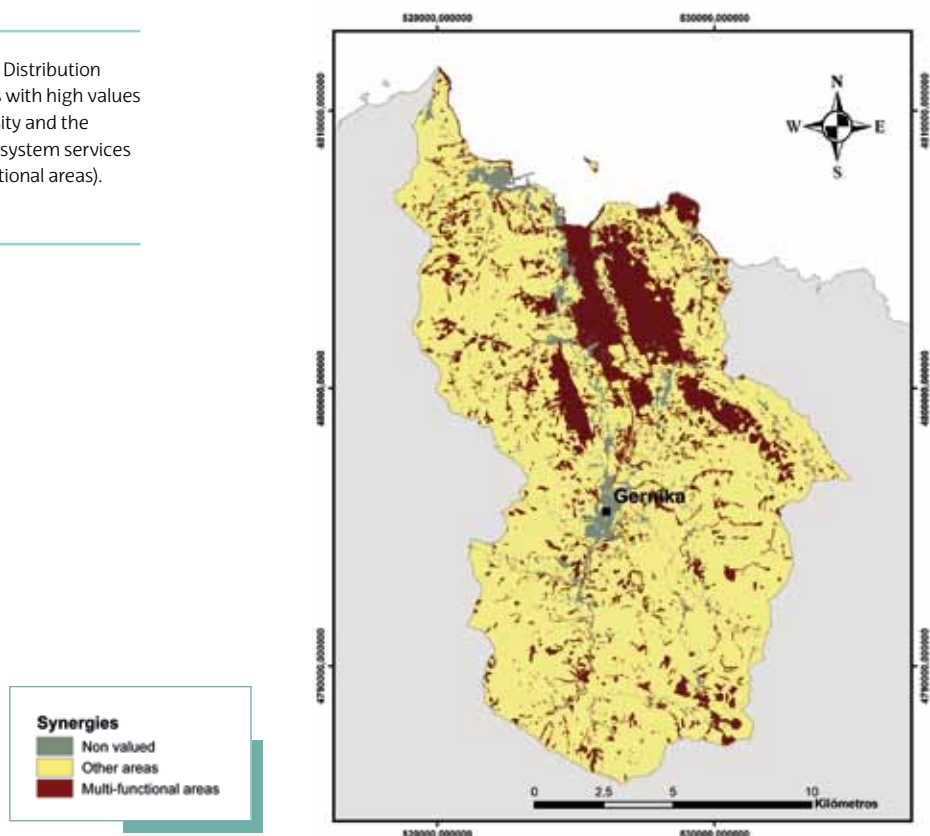
The following ecosystem services were studied:

- A** › Regulating services
 - Carbon storage
 - Water cycle regulation
- B** › Cultural services
 - Potential for recreation
 - Aesthetic value

Results and conclusions

A large part of the territory was found to simultaneously have high values for biodiversity and ecosystem services (Figure 5.4). The following ecosystems contribute the most to the multi-functionality of the territory: marshlands, coastal ecosystems and natural forests.

FIGURE 5.4. Distribution of the areas with high values of biodiversity and the studied ecosystem services (multi-functional areas).





These multi-functional areas should be preserved in order to ensure the present provision and to guarantee future provision of these ecosystem services.

The areas that are currently protected for biodiversity conservation in the Urdaibai Biosphere Reserve also include a major part of the studied ecosystem services. More than 80% of the areas of special protection are made up of areas that are important for the conservation of biodiversity and multiple ecosystem services.

The majority of the ecosystems providing the greatest amount of biodiversity and ecosystem services are included in the current strategy for the Biosphere Reserve's conservation. By including the mixed oak forests within these protected areas, we would help to maintain biodiversity and multiple ecosystem services.

How is the primary sector related to the conservation of biodiversity in the Lea River Basin?

The Lea River Basin is made up by 7 municipalities and is characterized by a low population density (102 inhabitants/km²). This river basin has a rural landscape that is made up of forest plantations and native forests in the mountainous slopes of the valley, as well as meadows for mowing and rural and urban settlements (the most populated area of Lekeitio) in the plains. The flattest section makes up part of the Atlantic countryside, characterized by a mosaic of land uses, most of which are agricultural-livestock related. Although the primary economic activities of this river basin are industry and services, there is also a large primary sector. Also, the Lea River Special Area of Conservation (SAC) is found here.



The ecosystems services approach is the ideal framework for understanding the synergies and incompatibilities of land use in a territory such as the Lea River Basin.

Research objectives and methodology

The objective of this research was to determine the distribution of the ecosystems dedicated to provisioning services in the Lea River Basin and their relationship with biodiversity.

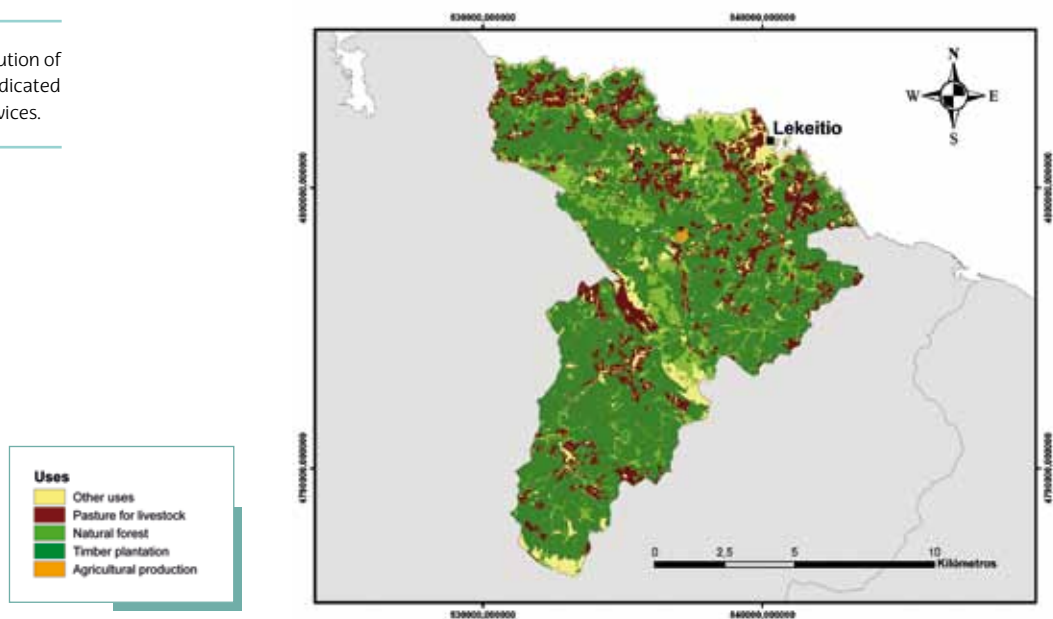
For this, the territorial distribution of biodiversity and provisioning services provided by the different ecosystems were analysed (Figure 5.5). Only wood production and agricultural and livestock production services were considered.

Results and conclusions

The most valuable ecosystems in terms of biodiversity are the natural forests (riparian forests, Cantabrian green oak forests and mixed Atlantic oak forest), with the eucalyptus and coniferous plantations receiving low or very low values.

As for land use, forest production is the dominant use in the Lea River Basin (Figure 5.5), although it is not the primary economic activity of the area. Thus, forest plantations make up 64% of the basin surface area, mainly in the form of conifers, with grasslands and hedges making up 15% and natural forests only making up 13%. The latter, despite providing the greatest amount of biodiversity and multiple ecosystem services, are quite fragmented.

FIGURE 5.5. Distribution of the ecosystems dedicated to provisioning services.



Agricultural production, on the other hand, which has suffered a clear decline over recent decades in favour of forest production, makes up a small part of the land surface area and contributes to the primary economic sector and to the maintenance of the Atlantic countryside landscape. Pastures are the main engines of this sector, also being important in the conservation of biodiversity.

Sustainable management of the river basin requires the analysis of the territory's characteristics and the needs of the population and other relevant agents.

Is it possible to reconcile the conservation of biodiversity with leisure activities in the Urkiola National Park?

The Urkiola National Park is located in a natural landscape having a low population density (76 inhabitants/km²). The mountains offer an exceptional relief system, converting it into one of the most unique and attractive sites of all of Biscay. Furthermore, it has a deep rooted pastoral tradition that has been preserved even today.

Urkiola is an area of great natural and cultural diversity. Approximately 700 plant species have been catalogued here and its karstic massif, in addition to housing emblematic species such as the Egyptian vulture, is the main dwelling site of **Mari**, the Lady of Anboto (a Basque mythological character).



Leisure activities in the natural area are the source of a powerful sense of territorial identity and belonging, as well as sources of health and well-being. However, based on the type and intensity of the activity, they may have a major impact on the land, potentially affecting its biodiversity.

Research objectives and methodology

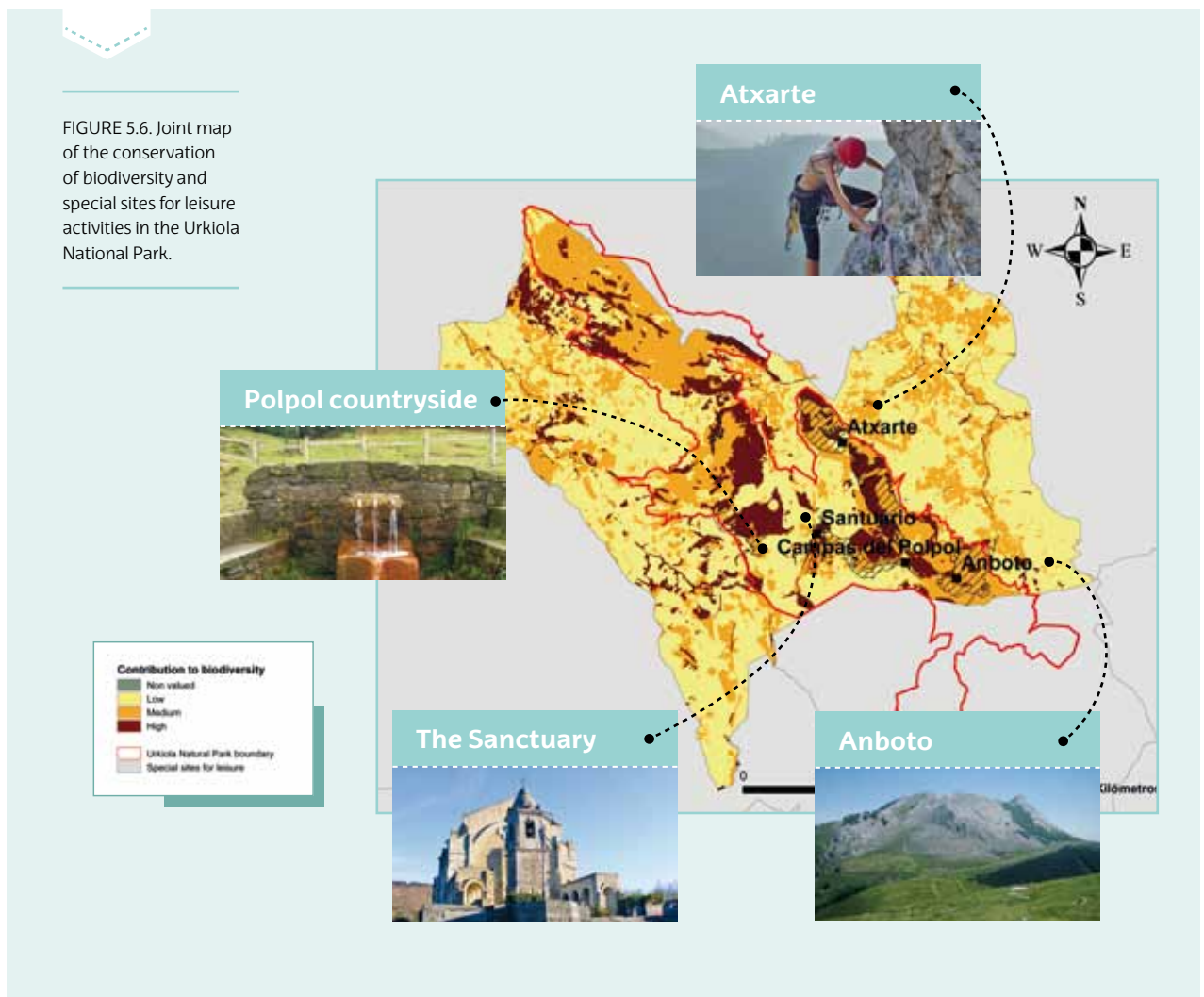
The objective of the research was to study the links between the individual users with the Urkiola National Park, as well as to determine the relationship between conservation of biodiversity and leisure services in the same park, in order to facilitate its management.

For this, 20 in-depth interviews were held with visitors of the Urkiola Natural Park, in order to determine and capture the meaning and significance of their outdoor leisure experiences. In addition, both biodiversity as well as the special sites of leisure activities in the park were assessed and mapped, in order to analyse any spatial overlapping.

Results and conclusions

In the study of the characterization of the links established by the recreational visitors with the Urkiola National Park, the following special sites were found to be significant: Anboto, the Polpol countryside, Atxarte and the sanctuary (Figure 5.6).

Although a few of the special sites are found in the areas of maximum biodiversity (for example, the beech forest near the sanctuary), there are also many of these sites in areas of minimal biodiversity (for example, the sanctuary) (Figure 5.6).



When analysing the significance of the Urkiola National Park, seven meanings arise in the form of the links that individuals establish with the territory:

- A** › Urkiola as *life histories: belonging, identity, home and friendship.*
- B** › Urkiola as *landscape: aesthetic enjoyment, majesty and originality.*
- C** › Urkiola as *a place of magic, mythology and Basque culture.*
- D** › Urkiola as *trials and tribulations.*
- E** › Urkiola as *teaching and learning about the natural world.*
- F** › Urkiola as *peace, tranquillity and spiritual well-being.*
- G** › Urkiola as *recreational diversity.*

The fact that the areas of the greatest biodiversity value do not stand out as special sites for leisure activities is considered to be positive in terms of compatibility of biodiversity conservation and recreation in nature. Therefore, the conservation of biodiversity and leisure activities in nature may be compatible.

In conclusion, there is a high potential for use of the links with Urkiola created by individuals through their leisure experiences, in order to improve its management and foster the conservation of biodiversity.



This study, providing information on the location of special sites for leisure as perceived by the individual users and comparing them with the biodiversity conservation assessment, is of great interest for management purposes, as it provides comparison information in order to reconcile the uses of the Natural Park.

06 › CAN WE REDUCE THE
TERRITORY'S DEPENDENCE
ON EXTERNAL ECOSYSTEM
SERVICES?



HUMAN IMPACT ON ENVIRONMENT

All human communities draw on the earth's biodiversity for food, energy and other resources as well as using it as a place to discard of waste generated as a result of extracting and manufacturing these resources. The environment is clearly affected as a result of this use.

The effect on the environment is measured by the Ecological Footprint, which analyses the interaction between the production and consumption of goods, revealing the intensity of their impact on the environment. In this way, it is possible to evaluate the degree of effect on the environment and the sustainability of a population.

The Ecological Footprint

The Ecological Footprint is the area of an ecologically productive territory (crops, pastures, forests or aquatic ecosystems) that are necessary to produce the resources that are used and to assimilate the waste produced by a specific population (Figure 6.1). In other words, it indicates the impact of a specific population or person on nature, as a result of its specific habits and consumption behaviour.

Nature is capable of producing resources and absorbing waste, also referred to as "Biocapacity". When nature's production and human consumption are at a balance, society is considered to be sustainable. However, if consumption exceeds Biocapacity, there is an ecological deficit or *overshoot*.



From a sustainability perspective, the goal is to have an Ecological Footprint that is as balanced as possible with the Biocapacity, thereby maintaining the territory's Natural Heritage.

Calculating the Ecological Footprint and Biocapacity

The Ecological Footprint is expressed in hectares per inhabitant (gha/capita) and year. To calculate it, it is necessary to consider the consumption of different types of productive territory (pastures, croplands, forests and aquatic ecosystems), as well as the consumption of land for settlements and that necessary for waste neutralization. These consumptions are turned into productive surface areas through a series of indices (www.footprintnetwork.org).

Total consumption of each resource is obtained from the following formula:



Given that the planet has a finite surface area, when the Ecological Footprint of a region exceeds its Biocapacity, this means that this region uses more than that which is available to it, and on the other hand, if the Biocapacity exceeds the Ecological Footprint, this guarantees the availability of the resources for future generations.

The Global Ecological Footprint

Today, mankind uses an equivalent of 1.4 planets annually. This means that the earth will need one year and five months to regenerate what has been used in one year.

However, clearly not all regions of the earth have the same impact. Industrialized countries have much larger Ecological Footprints than developing countries. The greatest footprint is found for the United Arab Emirates (10.68), with Europe having a footprint of 4.70, and Spain's being 5.42 (Global Footprint network, 2010).

These data reveal the economic and social inequality existing between global populations and future generations.

The Ecological Footprint of Biscay

The Ecological Footprint of the Biscay population is 3.5 hectares per person, while its Biocapacity is 1.0 hectares (as compared to the global average which is 1.8). That is, it uses 2.5 times more territory than that which is available to it.

Like the majority of industrialized regions, the Ecological Footprint of Biscay exceeds its Biocapacity and therefore, it overshoots. Our consumption habits have led to this situation, exceeding the Biocapacity or the ability to support the land where we live. This confirms the fact that we are quite dependent on the importation of food, energy and other services.

The Biscay Ecological Footprint: evolution over time

Biscay has been overshooting throughout the 13 year study period (Figure 6.2).



FIGURE 6.2. Evolution of Biocapacity and the Ecological Footprint of Biscay between 2000 and 2012 (gha/capita: hectares per inhabitant).

Of all of the factors determining the Ecological Footprint of Biscay, the Carbon Footprint contributes the most to its increase. A large proportion of this carbon footprint is primarily produced from transportation emissions associated with product importation. Therefore, reducing the quantity of CO₂ emissions from transportation will help to reduce Biscay's Ecological Footprint (Figure 6.3).

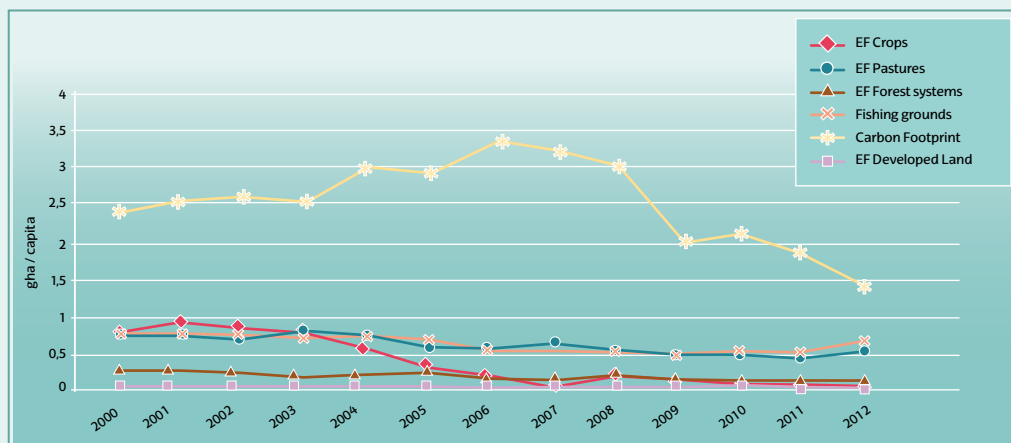


FIGURE 6.3. Distribution of the Ecological Footprint of Biscay based on land demand categories over the 2000-2012 period (gha/capita: hectares per inhabitant).

During the period of study, a positive trend was seen, as a slight decrease in the overshooting was found, indicating that there is a trend towards greater sustainability in the area.

Favouring this decline are the current recycling programs and the contribution of recently applied sustainability policies such as Local Agenda 21 and the Bizkaia 21 program. The effects of the economic crisis are also evident in the decrease in consumption and importations.

Understanding the evolution of the Ecological Footprint over time is important in order to assess the evolution of the balance between human production and consumption and, therefore, the sustainability of the territory.

Ecological Footprint and ecosystem services

The integration of the Ecological Footprint concept within the framework of ecosystem services is useful in order to understand the relationship between the footprint and sustainable management practices in the territory.

The Ecological Footprint represents the demand for ecosystem products and services in terms of allocation of the different types of land uses. Thus, it may be possible to manage the offer of ecosystem goods and services by carrying out sustainable land planning in order to adjust the footprint.

In the case of Biscay, an increased supply of local food products would lead to an improved balance with demand, and a decrease in the Carbon Footprint (less transportation energy).

This objective would lead to significant transformations in land management, suggesting the regeneration of a multi-functional landscape that reinforces food production while improving biodiversity, ecosystem regulation and cultural services.

Implications for territorial management

The Ecological Footprint may decrease with the development of a multi-functional landscape that combines a wide range of land uses with sustainable agricultural and forest practices and with the regeneration of natural ecosystems. This type of management increases food production reduces energy consumption for transport and subsequent emissions and maximizes synergies with biodiversity and ecosystem services.

The global economy promotes a lower multi-functionality of ecosystems and landscapes. If we apply a multi-functional approach to local land management, we will enhance ecosystem services and contribute to the reduction of the Ecological Footprint both locally and globally.



Actions to improve the sustainability

For the past 20 years in Biscay, environmental policies and education in sustainable development have been making headway, both in the public and private sectors. Considerable advances have been made in this sense (protection of natural areas, improvement in the supply and sanitation of water, reduction of industrial contamination, etc.), but there are still areas in which environmental degradation is increasing (artificial development of land, increased energy demand and consumption of goods, etc.) and there is still a long way to go.

Therefore, in order to move towards sustainability, the following are necessary:

- A › Learning to “live better with less”.
- B › Promotion of responsible consumption.
- C › Promotion of territorial multi-functionality.
- D › Reduction of overall supply service consumption (energy, water, etc.)
- E › Support of local goods as opposed to importations (foods, energy, etc.), thereby reducing emissions caused by merchandise transportation.
- F › Promotion of sustainable forest management.
- G › Taking advantage of fishing based on the biological cycles of the species.
- H › Use of renewable energy sources.
- I › Limiting the artificial development of land.
- J › Fostering non-motorized mobility and the use of public transport.



Sustainable management of the territory ensures the essential ecosystem services and reduces the Ecological Footprint

07 › HOW DO WE IMAGINE BISCAY IN 2050?



FUTURE SCENARIOS FOR BISCAY

In response to the question: How do we imagine Biscay in 2050? (Figure 7.1), four future scenarios have been created, in order to facilitate reflection on what decisions and actions should be taken now to lead to a more sustainable future. The analysis of scenarios is of special interest in the context of ecosystem assessment since it allows for prior reflection of the positive and negative consequences of specific land management decisions on ecosystems and human well-being, thereby assisting in the decision making process.



FIGURE 7.1. What is our vision of Biscay in 2050? (Old photos: Bilbao City Hall).

Long term vision and reflection help us to harmonize the socio-economic and environmental objectives in order to work towards sustainability and human well-being. This includes designing a future and proposing a path in order to reach it.

A participatory method for creating future scenarios for Biscay

The future scenarios were created based on a participatory process including the use of surveys and workshops in which the present use and the future evolution of Biscay ecosystem services were analysed along with their repercussions on human well-being. Citizen participation is essential in order to guarantee a legitimate scenario planning process and to foster the application of its conclusions, especially when these are used to support policy-making processes.

The following steps were followed in the participatory process:

- A › Identification of the main drivers of change in Biscay.
- B › Creation of scenarios for Biscay for 2050, based on global scenarios of the Millennium Ecosystem Assessment and the identified drivers of change.
- C › Analysis of the described scenarios based on the provision of ecosystem services and variables of human well-being.
- D › Identification of positive elements to be encouraged and negative elements to be avoided for the creation of the desired scenario based on group discussion.
- E › Proposal of strategic work lines to establish the steps to be taken to achieve the desired future.



This work emphasises the importance of assessing different opinions when managing the territory, as well as the vital importance of including the participation of different social agents as well as leaders of political and technical departments of public administrations, in order to make a greater impact on regional policies.

Possible scenarios for Biscay: what could Biscay look like in 2050?

The main drivers of change identified for Biscay were economic, socio-political and governmental. Based upon these, the following scenarios for Biscay were described:

Authoritarianism and exclusion

In this scenario, decisions are made by an authoritarian government based on a reactive form of governance, where problems are only treated when they are clearly present. Social participation is reduced due to the imposition, audio-visual manipulation and influence of the multinational companies. Social exclusion and marginalization increase. There is an emphasis on individualism and commercialism and consumerism continues to play a major role as well as de-localized production, with a great deal of importation of food, energy and raw materials. The primary sector, in the wake of the crisis and the abandonment of land, has become a quality and elitist tertiary-tourism sector that supports strongly protected isolated areas, so-called "islands", that do not ensure biodiversity. On a landscape level, these "islands" include areas that are of great use as well as other areas that have been abandoned. This creates a generalized state of unrest and serious social conflicts, leading to the emergence of alternative movements and centres of minority resistance.

Global elitism

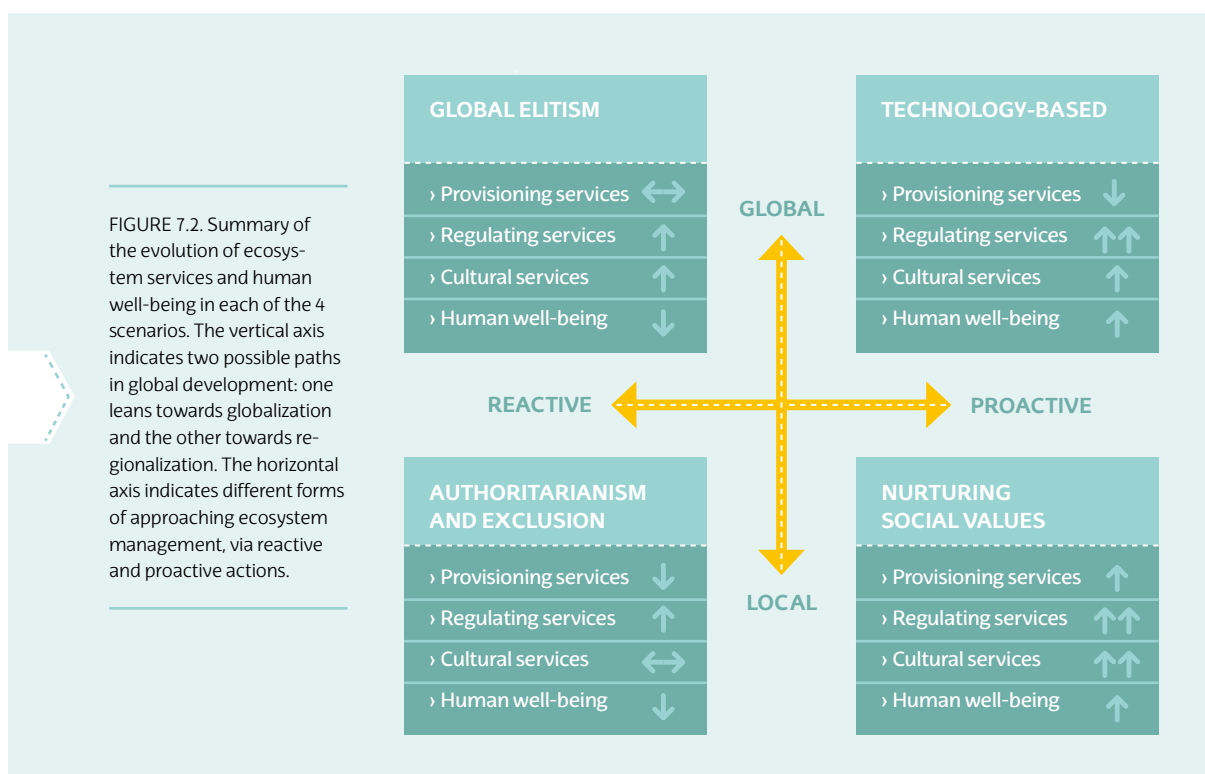
In this scenario, local institutions lose power to international ones and the decisions affecting Biscay tend to be made at a global level. Biscay specializes in an "elitist" ecological production which is not accessible to the majority of the local population; therefore the majority of the population consumes imported products, mainly genetically modified goods. The territorial model is primarily geared towards the services sector, with recreation and tourism taking on a special importance, and thereby maintaining and even improving the quality of the landscape. In this scenario, social values decrease and the global market is an essential element.

Technology-based

This is a consumer society that focuses on the importation of products, putting its faith in technological solutions. In this scenario, multinational companies have great power in the decision-making processes and ecosystems have been greatly modified. The economic model of Biscay is based on intellectual production and services. Rural areas are mainly devoted to recreational service activities oriented to the urban population. There are few partnerships created due to the high level of individualism and the society is quite submissive.

Nurturing social values

In this scenario, education and socialization of awareness are considered to be the backbone and foundation of society. Decisions are taken in a participatory manner and governance is carried out at a local level with much coordination with other institutional levels. The key aspects of this scenario, which presents very positive social values, are the following: participation, responsibility, proactive governance, education in values, local "green" industry, high sustainability of the primary sector, and multi-functionality of the landscape. In the proactive government, work is carried out in advance in order to create the desired changes and to prevent environmental and social problems before they arise. In this scenario, however, an excessive degree of localism is detected.



Each of the 4 scenarios reveals different trends in regards to the supply of ecosystem services and in regards to the different variables associated with human well-being (Figure 7.2). The “*Nurturing social values*” scenario has the greatest increase in terms of the ecosystem service provision and human well-being variables, with respect to the current situation. However, participants identified major difficulties and limitations in reaching a scenario of this sort, particularly considering the current situation of high population density and high rates of importation and consumption.

Despite the fact that none of the four scenarios created for Biscay are entirely desirable and/or possible, certain common elements may be seen in the different scenarios. Among these elements, we find, for example, the support of local ecological production, the recovery of native forests or knowledgeable society and the use of appropriate technology. Although, depending on the specific scenario, potential negative aspects may have been related with these elements, it is possible that Biscay’s future shall include these aspects and, if well managed, they may be desirable, as seen in the desired scenario created by the participants.

Desired management proposals for a sustainable future

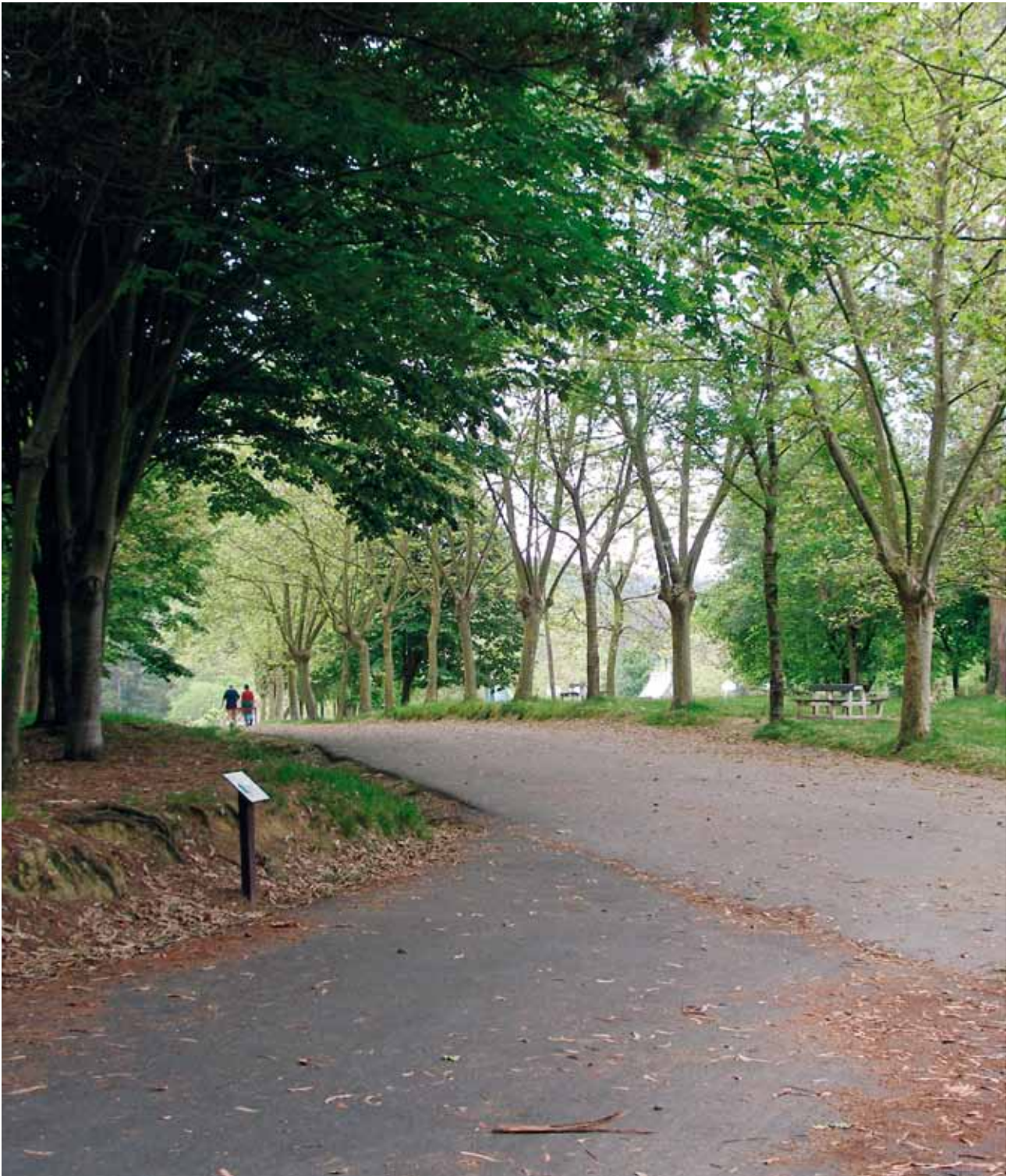
In the desired scenario described for Biscay, referred to as “*Biscay, from local to global, and vice versa*”, work is proactive, focusing on the importance of equality and sustainability from local to global, and vice versa. Similarly, education, training and participation of citizens have a special importance. In this scenario, a joint analysis shall be carried out on local and global levels, coordinating the macro and microeconomic policies. Thus, the local is considered important, with special influence in issues relating to provisioning and regulating services, but without being excessively local, particularly in terms of cultural aspects and issues of human well-being, thus strengthening the multicultural relations and the benefits of an interconnected and united world. Local production however, is favoured and the quality and variety of agricultural and forest-based products improves, although self-sufficiency is not fully achieved. Furthermore, sustainable technologies play a large role and shall be applied based on social equality and environmental respect criteria.



In order to achieve this shared vision of a more sustainable future for Biscay, major transformations are proposed to current policies, as well as changes in societal attitudes overall, leading to the creation of new methods of relating with individuals and the environment that surrounds us. In order to reach this desired scenario, some major pillars of coherent and exemplary governance and citizen education, awareness and sensitization must be achieved, suggesting increased implication and active participation in the transformation process towards a more sustainable future. It is important to note that in all of the working groups, an emphasis was placed on the need to decrease consumerism and to change habits. Also, the participants felt that it was necessary to carry out strategic and balanced modelling of the territory, using an integral and proactive vision, considering the multi-functionality of ecosystems, the relationships between different ecosystem services and the social and human well-being aspects. For this process, it is necessary to promote and strengthen research, eco-innovation and their relationship with the recovery of traditional knowledge.

The construction of different future scenarios and the selection of the scenario that was considered to be the most desired for Biscay through participatory processes, allows for the designing of a realistic and long-awaited future that will help balance socio-economic and environmental objectives in order to work towards sustainability and human well-being.

08 › WHAT ARE OUR RESPONSE OPTIONS AND WHAT DECISIONS MAY BE TAKEN?



FROM THEORY TO PRACTICE

This chapter presents the specific sustainability response options that were collected during a participatory process (the design of future scenarios and other type of meetings), in which social, economic, administrative and scientific agents participated. Subsequently, these response options were reinforced using qualitative indicators.



Results reveal that in Biscay, the following three large management strategies need to be undertaken in order to achieve the objectives of strengthening sustainability, reducing the dependence on external ecosystem services and improving the well-being of the population:

- › Reinforcing local provision of food products as well as other material and energy-based goods, in a sustainable manner.
- › Maintaining and recovering natural ecosystems, natural forests in particular, and promoting sustainable forest management.
- › Decreasing demand and redirecting it towards more sustainable consumption models.

The first two strategies focus on improving and reinforcing the provision of territorial ecosystem services, while the last one suggests the need to reduce and modify demand. This combined management of measures suggests a connection between demand and ecosystem service provision and highlights the importance of redefining the relationships existing between the rural and urban world.

Coordinated work, carried out in networks of different social and political agents, strengthens our efforts, thereby making a sustainable future more possible.

As for the strategy of **sustainably reinforcing the local provision of food products**, one of the most extensive proposals suggested the reinforcement of local ecological knowledge, promoting its production and commercialization and strengthening generational transfer via the promotion of work opportunities in sustainable agriculture. Another relevant proposal for this strategy involves the fostering of sustainable urban agriculture in order to connect the urban and the rural worlds, through the promotion of urban gardens by city halls.



Within the strategy of **maintaining and recovering natural ecosystems and promoting sustainable forest management**, the main proposals presented included promoting the multi-functionality of landscapes through the recovery of natural forests and through sustainable forest management, as well as through a respectful use of the environment. These response options may provide a great opportunity in Biscay to face the challenges of sustainability as well as global change, the preservation of biodiversity, erosion control and the fight against pollution. New forest management approaches should include the exchange of non-native species for indigenous ones and the inclusion of a management model (recovering practices such as silvopasture) in some of the current forest plantations in response to the goals of land protection, biodiversity preservation and improved water regulation. On the other hand, wood production should be based on a diversification strategy, as much as possible, as well as harmonization with other territorial uses, in accordance with the agro-ecological capacity of the land. These conservation strategies, combined with strategies designed to strengthen agriculture and sustainable forest management may help to recover the multi-functionality of the Biscay landscape and thereby, the supply of major ecosystem services such as local ecological knowledge, erosion control, regulation of the water cycle, etc. Furthermore, potential conflicts of interest associated with this landscape transformation can be minimized by ensuring the role of the local population in maintaining the multi-functionality of rural territories, highlighting the benefits of their ecosystem services and finally, creating appropriate incentives for all involved parties.

The specific strategies proposed for Biscay include sustainably supporting the local provision of food and other material and energy-related goods; preserving and recovering natural forests and promoting sustainable forest management; and redirecting demand towards more sustainable consumption models.

As for the **strategy to reduce demand and redirect it towards more sustainable models**, proposals suggested promoting responsible and sustainable direct consumption through training and awareness campaigns, as well as through the promotion of material reuse and recycling. Biscay relies on a system of governance that includes the active participation of social, economic and academic agents, thereby permitting the implementation of sustainability strategies through coordinated and collaborative actions between different involved agents, including: public administrations (City halls, associations, provincial councils, the Basque government), social agents (environmental, social and cooperative associations), academic agents (universities, research centres), primary sector representatives (farmer's unions, forester's associations, beekeeper professionals, etc.), from the industrial or services sector (tourism). It is important to note that each agent, both individually and collectively, plays an important role in the path towards sustainability and the actions and collective learning occurring between one another is fundamental in this ambitious transition process.

The protected areas and public woodlands are perhaps the most appropriate places to begin these types of transformations, due to the availability of land and conservation strategies. On the other hand, the Biosphere Reserves are designed for use as laboratories and here it is possible to put into practice sustainable models of management for the territory. Similarly, the other protected areas and public rural territory may also be used for these purposes. Thus, there should be a large impulse from the public sector to promote these measures, setting a positive example. However, the results of the Biscay ecosystems assessment demonstrates that the sites that may suffer the greatest transformations in Biscay and, therefore, may positively or negatively influence the multi-functionality of the landscape through biodiversity and the provision of ecosystem services are, based on their extensive territorial size, the unprotected, privately owned agro-forest areas (75% of the territory). Therefore, in order to promote significant changes at a territorial level, it may be necessary to apply additional measures that are directed at these groups, attending to their needs and involving them in the participatory process. In this way, their active involvement may lead to more sustainable agricultural forestry practices.



In Table 8.1, along with each of the three large strategies, some specific sustainability response options that may be carried out in the different areas and by different agents are presented, with examples of specific actions that are currently being applied, both by the public administration as well as other areas.

STRATEGIC LINES	SPECIFIC PROPOSALS	
	RECOMMENDATIONS	EXAMPLES UNDERWAY IN BISCAY
1. To sustainably reinforce the local provision of food products		
<ul style="list-style-type: none"> › To reinforce the awareness of global change and of local socio-ecosystems. › To promote sustainable local ecological production and commercialization. › To reinforce local ecological knowledge. › To support generational transfer through the promotion of work opportunities in the primary sector. › To promote sustainable urban agriculture in order to connect the rural and urban worlds. 	<ul style="list-style-type: none"> ✔ To promote research and training in ecosystem services, in a collaborative public-private strategy. ✔ To promote the production, commercialization and consumption of local ecological agricultural and livestock products, for example, in school and municipal cafeterias, public event organizations with local products, in stores and distribution chains, etc. ✔ To redirect grants and funding in the primary sector towards more sustainable practices and to establish stricter controls to verify compliance with requirements. ✔ Incentives to strengthen generational transfer to complement currently existing programs such as the Rural County Development Plans, the Biscay Agricultural Land Fund (Land Bank), support for young farmers or support for agri-environmental measures. ✔ To promote conservation and handling of native varieties and breeds. ✔ To foster local markets and ecological products as well as fair commerce. ✔ To reinforce regulations to reduce and minimize the use of toxic chemical products and pollutants. ✔ To promote urban agriculture and community orchards. 	<ul style="list-style-type: none"> 💡 The Basque Council on Agriculture and Ecological Food (ENEK) identifies and collaborates with the sector of ecological products from the Basque Country. 💡 Slow food Bizkaia defends local cuisine and the use of native products from the land and sea. 💡 Euskal Herriko Hazien Sarea (the Basque Country seed network) works to recover local varieties in our orchards. 💡 Cooperatives such as ESNETIK promote ecological production and consumption of local products, while at the same time, supporting rural traditions. 💡 Local development of municipalities based on citizen participation such as that of Orduña (Urduñako Zaporeak). 💡 The promotion of urban orchards by the city halls of Derio, Iurreta, Markina, Leioa, Gernika-Lumo, etc.). 💡 The installation of ecological orchards in school centres based on 21 <i>School Agendas</i>.

TABLE 8.1. Proposals to be undertaken in different areas and by different agents in the strategic line "To sustainably reinforce the local provision of food products".

STRATEGIC LINES	SPECIFIC PROPOSALS	
	RECOMMENDATIONS	EXAMPLES UNDERWAY IN BISCAY
<h2 style="text-align: center;">2. To maintain and recover natural ecosystems and to promote sustainable forest management</h2>		
<ul style="list-style-type: none"> › To promote the multi-functionality of landscapes and an increase in ecosystem services. › To maintain and recover natural ecosystems, particularly natural forests. › To promote a change in planning and management (urban, forest, etc.) towards a more sustainable model. 	<ul style="list-style-type: none"> ✔ Plans and strategies developed to maintain and recover our national heritage (E.g. the Biscay biodiversity strategy). ✔ To apply fiscal measures in land management to prioritize conservation uses and activities and the regeneration of natural ecosystems, penalizing activities that are hazardous to the environment and therefore, to our well-being. ✔ Repopulation of surfaces and planting of native forest species in publically owned lands (Public Use and Patrimonial Lands). ✔ Public purchase of lands of high ecological value. ✔ Tax advantages for owners having lands of a high ecological value. ✔ Fostering of forest plantings with native species and the promotion of their commercialization (E.g. Ingurubide). ✔ Improvement of current forest production practices through sustainable forest management systems. ✔ Partial Territorial Plans as instruments of integrated management, with a socio-ecosystem based vision of the land (ecosystem services, green infrastructures, etc.). ✔ Planning urban ecosystems considering green infrastructures and the minimizing of land artificialisation, as much as possible. 	<ul style="list-style-type: none"> ✎ Environmental associations such as <i>Fundación Lurguia</i> and <i>Fundación Gizartenatura</i>, taking over the custody of privately owned lands, in order to recover native forests and wetlands. ✎ The transfer of municipal lands to associations for forest regeneration (E.g. Kima Berdea or the City Hall of Muskiz). ✎ Sustainable environmental taxation for companies, property tax (IBI) exemption for owners of natural forests, etc.) ✎ Scientific studies dedicated to the conservation of natural ecosystems (UPV/EHU, Aranzadi). ✎ Development and extension of forest certifications to sustainable products (PEFC, etc.) ✎ PROSILVA, association for the promotion of the most natural forest management processes. ✎ Initiatives such as Biharko Basoa, promoting forest plantings with native species for their commercialization. ✎ Promotion of the use of wood in construction and civil engineering solutions, such as Ingurubide, Naturprotec, Egoin, etc.) ✎ Hiria Kolektiboa carries out urban planning projects based on a social, gender-based and sustainable perspective, in a participatory manner. ✎ Social town planning initiatives such as the Leioa city of <i>children project</i>, the concept of elderly-friendly cities, Mungia SLOW CITY, etc. ✎ The creation of sound islands, offering high acoustic quality, in Bilbao.

TABLE 8.2. Proposals to be undertaken in different areas and by different agents in the strategic line "To maintain and recover natural ecosystems and to promote sustainable forest management".

STRATEGIC LINES	SPECIFIC PROPOSALS	
	RECOMMENDATIONS	EXAMPLES UNDERWAY IN BISCAY
<h3>3. To reduce demand and redirect it towards more sustainable consumption models</h3>		
<ul style="list-style-type: none"> › To reduce excessive consumption of provisioning services (water, energy, wood derivatives, aggregates, etc.) › To promote a change in consumption habits and lifestyle by fostering education on sustainability and active participation. 	<ul style="list-style-type: none"> ✔ To strengthen the design of sustainable management plans both for the administration and for companies and civil organizations. ✔ To support eco-design as R&D&I and to disseminate its usage potential. ✔ To create mechanisms (specific campaigns, technological improvements, good habit patterns, etc.) that help to control excess consumption and promote responsible consumer behaviour. ✔ To foster green hiring and purchase practices by administrations and companies. ✔ Guidelines for facilitating information and training to the population in the area of efficient resource management. ✔ Making housing, office space and warehouse stock available to needs of society and territory. ✔ To foster bioclimatic construction, based on energy efficiency and renewable energies. ✔ To advance “industrial construction” model in buildings, reducing the necessary resources and the amount of waste generated. ✔ To foster the installation of smart meters (water, energy) and other systems for conscientious and responsible management. ✔ To carry out campaigns of environmental awareness and participation. ✔ Actions where the administrations are examples of change towards more sustainable models (energy management, local product consumption, sustainable mobility, etc.). ✔ To create participation forums on local sustainability (environment, gender equality, etc.). ✔ To use different communication media such as Bizkaia 21 web portal, Bizkaimedia, press releases; radio interviews, etc. to diffuse proposals and opportunities. 	<ul style="list-style-type: none"> 👉 Pricing based on quantity by water consortiums to reward low consumption and penalize high use. 👉 The GEURIA tap water consumption campaign, as well as building energy efficiency improvement projects by the Regional Government of Biscay to help reduce excessive consumption. 👉 ACLIMA improves the competitiveness and innovation of products and services destined to achieve more efficient resource management. 👉 Euronet 50/50 max., European project for the integral management of energy in public buildings including schools. 👉 Continuous improvement certification systems (environmental, energy, eco-design, quality, etc.) help companies to maintain good habits. 👉 21 Local Agendas helps to reduce consumption in buildings and municipal facilities, mobile parks, etc. 👉 2nd Purchase Program and Green Public Hiring 2015-2020, fostering green and fair hiring and purchase practices by the Administration. 👉 Renewable energy generation and consumption via cooperatives, such as GoiEner and Energía Gara. 👉 Local currency projects (EKHI) and Ethical Banking systems. 👉 Collaborative consumption initiatives (Shareak); ecological and responsible consumption (the Bilbao Week of Fair and Responsible Commerce and the Euskal Herria Social Market promoted by the Basque federation of associations of ecological and responsible consumption (Ekokontsumo). 👉 Biscay 21 program, a sustainable development strategy of the Regional Government of Biscay. 👉 The Biscay Education for Sustainability Action Program (PAES 2020). 👉 The Activate + program, the Aztertu program, the LasaiUne initiative, the 21 scholars’ initiative, fostering habit changes. 👉 Youth forum on Biscay sustainability. 👉 The Corporate Day of Solidarity in Biscay. 👉 Informal training programs (E.g. Landaberi de Euskadi Irratia, the online TV Go to the Garden program. The Vets without Borders initiative in school cafeterias, etc.)

TABLE 8.3. Proposals to be undertaken in different areas and by different agents in the strategic line “To reduce demand and redirect it towards more sustainable consumption models”.

STRATEGIC LINES	SPECIFIC PROPOSALS	
	RECOMMENDATIONS	EXAMPLES UNDERWAY IN BISCAY
<h3>3. To reduce demand and redirect it towards more sustainable consumption models</h3>		
<p>► Impulse dedicated to the reduction, reuse, recovery and recycling of materials.</p>	<ul style="list-style-type: none"> ✔ To impulse public-private alliances and those with the tertiary sector, for sustainable waste management. ✔ Innovative initiatives for the reduction, reuse, recovery and recycling of materials. ✔ To improve waste management, to go from zero crude dumping to the maximum optimization in its assessment. ✔ To improve and expand facilities and provisions for materials recovery and recycling. ✔ To foster the general population's involvement and commitment and the associations in which it is involved. ✔ Support of companies and cluster groups for material recovery and recycling. ✔ To reduce the food that is wasted along the distribution channels or during its final consumption. ✔ To promote and increase collection of organic waste for compost production. 	<ul style="list-style-type: none"> 💡 2010–2016 Biscay Urban Waste Prevention Plan. 💡 Bizkaia undertakes distinct campaigns of material recovery and recycling, such as the containers of selective collection for citizens, including novelties such as the white container (small-sized domestic goods) and a 5th container for the collection of organic materials. 💡 Bizkaia has facilities for the recovery of materials, such as Berziklatu, Bizkaiko Zabor Berziklategia, Kooperera Reusing Center, Garbiguneak (clean points), etc. 💡 Bizkaia is a leader in waste recycling companies (used oils, batteries, etc.). 💡 Environmental management systems for companies and administrations (EMAS, ISO 14001, Ekoscan, etc.). 💡 Campaigns for the European Week for Waste Reduction ("Recipes to take advantage of and to be taken advantage of", etc.). 💡 "Circular economy" and efficient management of resources as an engine of innovation in companies. 💡 Recycling eco-industries. Companies that use what is waste for others, as their sub-products; companies that use environmental management or Corporate Social Responsibility systems to reduce materials use and for recycling; social companies for product recovery and their resale and donation, such as Kooperera, Emaus, Food Banks, SinDesperdicios, etc.

TABLE 8.3 (Foll.). Proposals to be undertaken in different areas and by different agents in the strategic line "To reduce demand and redirect it towards more sustainable consumption models".

Annex I

CATALOGUE OF THE ECOSYSTEM SERVICES OF BISCAY



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 forests**
 - ›› 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 groundwater 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 ecosystem 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: hedges 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 *Parquetxes* 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 joko* ("sctyhe 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 shrubs helps 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 arborea* 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 alders 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 *Pin-guicola*, **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 MIRRES AND PEATLAND

Provisioning		<p>Biotic materials: supplied peat for use as mulch.</p> <p>Renewable energies: peat may be used for biomass.</p>
Regulating		<p>Climate regulation: vegetation and grounds act as carbon sinks, helping to control climate change.</p> <p>Water cycle regulation: their grounds act as sponges, allowing for the retention of large quantities of water and distributing it very slowly.</p> <p>Erosion control: the quantity of organic material contained in their grounds helps control erosion caused by water, as it is slowly stored here.</p> <p>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.</p> <p>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.</p>
Cultural		<p>Traditional knowledge: the use of peat has traditionally been very common throughout Biscay.</p>

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 deciduous 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		<p>Food: they provide edible fungi and mushrooms, wild berries, fruits, etc. Animals with high hunting value also reside here.</p> <p>Biotic materials: they provide materials such as wood, resins, etc.</p> <p>Renewable energies: their biomass serves as a source of energy.</p>
*Regulating		<p>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.</p> <p>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.</p> <p>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.</p>
Cultural		<p>Recreation: a number of leisure activities may be carried out in these ecosystems, such as hiking, hunting or mushroom collecting.</p> <p>Aesthetic enjoyment of landscapes: in some areas, their landscapes are greatly valued due to their "green" association.</p>

***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		<p>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.</p> <p>Biotic materials: they provide materials such as wood and resins.</p> <p>Renewable energies: their biomass serves as a source of energy.</p> <p>Natural medicines: eucalyptus has medicinally active components.</p>
*Regulating		<p>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.</p> <p>Regulation of natural disasters: they provide protection from strong winds, controlling their speed and stabilizing the ground with their roots.</p> <p>Pollination: eucalyptus flowers are sources of nourishment for pollinating insects, thereby contributing to maintain their populations.</p>
Cultural		<p>Recreation: a number of leisure activities may be carried out in these ecosystems, such as hiking, hunting or mushroom collecting</p>

**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		<p>Food: they provide edible fungi and mushrooms. Here, animals with a high hunting value are also found.</p> <p>Biotic materials: they are great wood producers.</p> <p>Renewable energies: their biomass is used as a source of energy.</p>
*Regulating		<p>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.</p> <p>Water regulation: the vegetation regulates the return of water to the atmosphere via evapotranspiration.</p> <p>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.</p>
Cultural		<p>Recreation: a number of leisure activities may be carried out in these ecosystems, such as hiking, hunting or mushroom collecting.</p> <p>Cultural identity and sense of belonging: rural cultural and sporting activities are related to these ecosystems, as is the case with <i>Aizkolaris</i>.</p> <p>Cultural, intellectual and spiritual inspiration: some of them have been used for artistic expression, as in the case of the painted forest of Oma.</p>

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

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.**



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<http://www.ecomilenio.es/>

› International Millennium Ecosystem Assessment

<http://www.unep.org/maweb/es/About.aspx>

› Sub-Global Assessment Network

<http://www.ecosystemassessments.net/>

› The Ecosystem Services Partnership (ESP)

<http://www.fsd.nl/esp/>

› Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)

<http://www.ipbes.net/>

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<http://biodiversity.europa.eu/maes>

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› Environment Department of the Regional Government of Biscay

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› UNESCO Center of the Basque Country (UNESCO Etxea)

<http://www.unescoetxea.org/>

Glossary

- › **Biocapacity** › The ability of a specific, biologically productive area to generate a regular supply of renewable services and to absorb the resulting waste generated from their consumption.
- › **Biodiversity** › The quantity, variety and variability of living organisms, as well as the relationships established between them. It includes the diversity found within a species (genetic diversity), between different species (species diversity) and between communities (diversity of communities).
- › **Case study** › Examples of real life studies at a local level applying the conceptual and methodological framework of research carried out at a higher level.
- › **Culture** › Ideas, beliefs, rules and values transmitted through social learning, separating the “ideal” component of the culture from the “material” component.
- › **Drivers of change in ecosystem services** › These are the factors, both natural and man-made, that exercise pressure on ecosystems, causing a change in their structure and functioning and, therefore, in their provision of services.
- › **Ecological deficit** › The difference between that which is available (Biocapacity) and that which is consumed (Ecological Footprint). A country faces ecological deficit when its Ecological Footprint exceeds its Biocapacity. If the contrary occurs, the country is in a state of ecological surplus or is considered to be self-sufficient.
- › **Ecological Footprint** › The area of ecologically productive territory (crops, pastures, forest or aquatic ecosystems) necessary to produce the resources used and to assimilate the waste produced by a specific population.
- › **Ecosystem** › A natural system consisting of a set of living organisms that interact with one another and with their environment, forming a functional unit.
- › **Ecosystem functions** › The capacity of ecological structures and processes to provide services that result in human well-being.
- › **Ecosystem services** › The direct and indirect benefits provided by ecosystems and biodiversity to mankind.
- › **Geodiversity** › The diversity of materials, forms and geological processes that make up and shape the Earth.
- › **Global change** › The set of environmental changes induced by human activity, particularly those impacting the bio-geophysical processes that determine the functioning of the Earth system. It is related to the human control of the planet.
- › **Green infrastructure** › A network of natural spaces and ecosystems that contribute to the sustained biodiversity, while at the same time, supplying multiple ecosystem services.
- › **Human wellbeing** › The state of an individual in which their most material needs are satisfied, leading to the proper functioning of their somatic and psychological activity, allowing them to lead a happy, calm, quality and successful life without exceeding the biophysical limitations of their ecosystems.
- › **Local ecological awareness** › The cumulative body of knowledge, practices and beliefs that evolve based on adaptive processes and communicated across generations via cultural transmission regarding the relationship of living beings (including humans) with one another and with their ecosystems.

Glossary

- › **Multifunctional areas** › Areas contributing to natural diversity and providing multiple ecosystem services.
- › **Natural Diversity** › The diversity existing on the planet, made up of biodiversity and geodiversity.
- › **Natural heritage** › Those ecosystems with ecological integrity and resilience and therefore, capable of carrying out functions and supplying services that contribute to the well-being of mankind. This term refers to the socio-ecological dimension of the different ecosystem components, including biodiversity and geodiversity.
- › **Participatory processes** › Specific methods used to attain the active participation of all members of a group in a decision making process. These processes may be used for the majority of problems and should offer equal opportunities for all implicated parties. The main objective is to create productive discussions in order to develop positive solutions.
- › **Quality of life** › The ability of a social group to satisfy its needs using the services available in a given ecological system. It includes the elements necessary to achieve a decent human life. It is considered the equivalent of *human well-being*.
- › **Scenario** › This is a plausible description of what may occur. Future scenarios aim to articulate collective beliefs regarding the future. They require imagining how the future could or should be. They have the challenge of creating a path towards the desired future. The use of scenarios for planning allows us to be prepared for different potential situations.
- › **Socio-ecosystem** › An ecological system that, in a complex way, is related and connected to one or more social systems. The ecological system forms the bio-physical basis (the “natural heritage”) upon which the socio-economic and cultural system containing all components related to human wellbeing are developed.
- › **Sustainability** › The existence of economic, ecological, social and political conditions that result in harmonic functioning over time and space. It consists of satisfying the needs of the current generation without sacrificing the capacity of future generations to satisfy their own needs.



The Biscay Millennium Ecosystem Assessment is pioneering the practical application of a conceptual and methodological framework of ecosystem services to participatory and integrated territorial management. So much so that, in international forums on this topic, the experiences of our Historical Territory have been recognized as an example to follow in the integration of society, science and management. The results obtained from this local-regional scale assessment suggest that this integrated and participatory approach is an innovative and useful tool that should be supported and developed in order to create significant changes towards a caring society and a more economically and environmentally sustainable territory. For all of these reasons, the Basque government has decided to take a leadership position in this project, widening this transforming initiative to the scale of the Basque Country, and therefore including other regional councils and carrying out pilot studies on different municipalities and counties.

