

Ecosystem Protection

Spanish scale





Co-Evolve4BG

Analysis of Threats and Enabling Factors for Sustainable Tourism at Pilot Scale

Ecosystem protection Spanish scale

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OVERVIEW

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REVIEW

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Abstract

This report aims to identify the state of the ecosystem protection in Spain, with special emphasis on the Mediterranean ecosystems. The document is structured as follows:

Section 1: is a brief introduction about the existing biological diversity in Spain.

Section 2: addresses the strategies and measures taken at European and regional levels for the ecosystem protection, explaining the concept of Integrated Coastal Zone Management and the Spanish measures undertaken against the Climatic Change.

Section 3: expounds the human pressure on ecosystems.

Section 4: provides information about the impact of tourism on Mediterranean ecosystems.

I. Introduction

Spain is one of the countries of the European Union with the greatest biological diversity due to its geographical position, geological diversity, the great climatic, orographic, and edaphic variability, the paleobiogeographic history and the existence of islands. It is ranked as the second country with the largest forest area, after Sweden, and the second most mountainous, after Switzerland.

This country is considered one of the “hotspots” of biodiversity on the planet, with more than 85,000 species that represent more than 50% of the animal species in Europe and more than 5% worldwide. 54% of the terrestrial habitats of community interest described in the Habitats Directive are in Spain, keeping 27% of its terrestrial territory and more than 8% of the marine one under the protection of the Natura Network (Fundación biodiversidad, 2018) (Fig. 1).

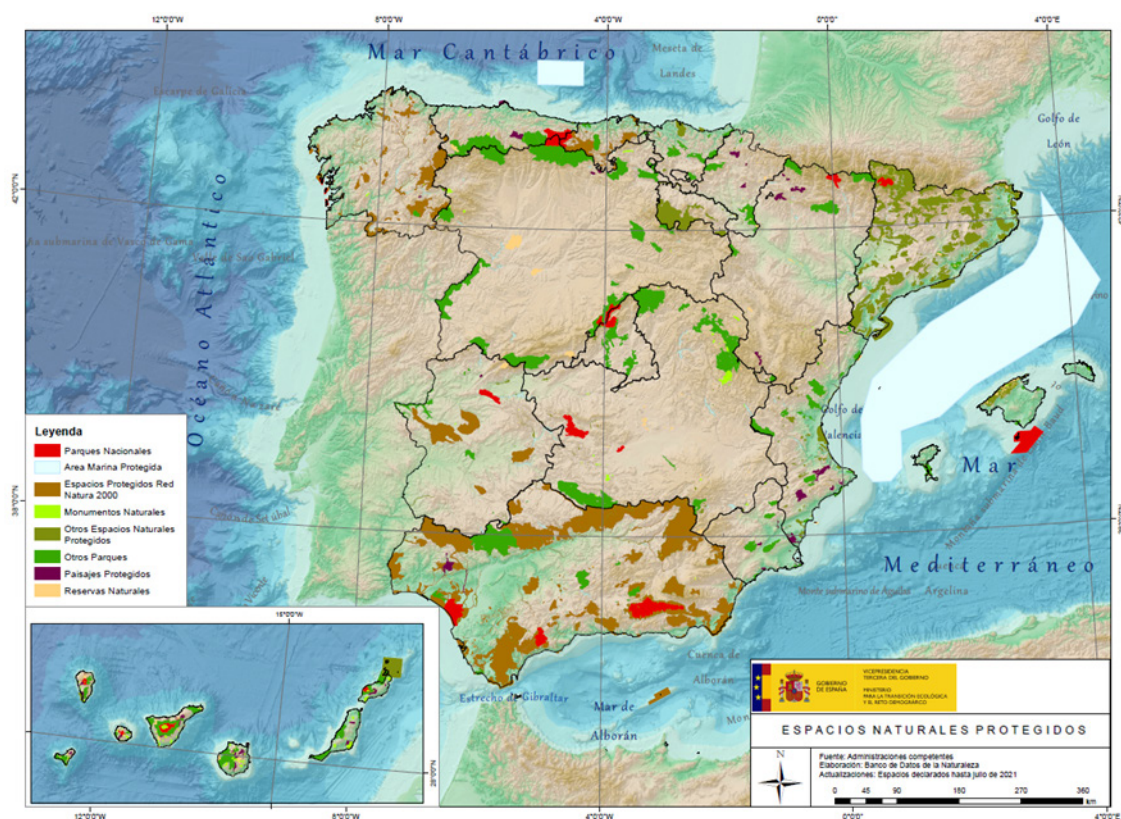


Figure 1. Map of protected land in Spain (Ministerio para la Transición Ecológica y el Reto Demográfico (2019))

Of the 11 large marine ecosystems described in Europe, 3 are present in Spain, highlighting the fact that the Mediterranean Sea is a home to a great diversity of marine species. Although it only occupies 0.8% of the world's surface of the set of seas and oceans, the Mediterranean Sea is considered as a home to about 6% of the marine

species known worldwide. The numbers of species fall as we move eastward: 85% are present in the western basin and 45% in the eastern basin. This is because the Mediterranean biota comes from successive invasions from the Atlantic after its almost total desiccation approximately 5 million years ago. Today, due to the progressive water warming caused by climate change, there is a flow of subtropical species that penetrate through the Strait of Gibraltar. This added to the introduction of species by humans (most coming from the Red Sea through the Suez Canal in what is known as Lessepsian migration) points to a tropicalization of this sea (Linares, 2010).

Due to the loss and degradation of Mediterranean habitats, caused largely by the construction of dams and the development of coastal infrastructure, in addition to other important factors such as pollution, droughts, invasive species and overexploitation, nearly 2,000 threatened species have been evaluated in the Mediterranean region, of which 19% are in danger of extinction and at least 16 irreplaceable species are extinct, some of them endemic, such as the Canarian unicolor oystercatcher (*Haematopus meadewaldoi*) (IUCN, 2008).

Focusing on coastal ecosystems, the complexity of biotic systems and the interrelation of their components requires that a complete system management, since the treatment of individual components or species, or fragmentary management would be unsuccessful. The most influential external sources in coastal water systems must also be integrated into management. Therefore, the defined ecosystem should encompass a complete and integral unit that includes a coastal water basin and adjacent coasts to the extent that they have significant influence on coastal waters.

In addition, the management program should include the biological processes that explain the high levels of production of coastal seas such as (Clark, 1992):

- The key role of freshwater and marine waters in the supply and renewal of nutrients, organic material and oxygen.
- Solar radiation that is maximized as an energy source due to the shallow depth characteristic of these zones.
- High mixing rates help gas exchange, nutrient circulation, and waste removal

II. Existing strategies and measures facing relevant threats to ecosystems

In most countries, owners of land property rights decide how their land or water areas are used and have the right to deny access to their land. Therefore, the safest way to conserve biodiversity and protect critical areas is for the government to acquire the property, and then it would be able to dictate its use, to reserve it for the protection of resources, and to establish proper control and survey systems. Duly designated areas may be given a variety of uses assigned through a zoning scheme. The designation of protected areas does not have to prohibit all uses, but only those that are incompatible with the main purpose of the area.

Protected zone management will be more effective if addressed in the integrated coastal zone management program. Similarly, protected area planning is essential for the proper development of a country's integrated coastal zone management program, so marine and coastal protected areas should be considered in the broader context of an overall program for coastal and marine resources. The overall program should cover the following conditions:

- Limit the exploitative uses of coastal and marine waters, their resources and related areas that affect life in them.
- Protect particularly vital parts of coastal or ocean ecosystems.
- Restore the above conditions in areas damaged by human activities for the recovery of the natural state.
- Obtain and transfer information through research, education and interpretation programs.

The creation of coastal and marine protected areas can help achieve practical development objectives. These areas can be designed to support multiple uses and promote sustainable use. Properly selected and designed protected areas ensure a variety of uses and usage controls in an integrated resource management scheme (Salm et al., 1984).

II.1. Main initiatives and guidelines at European level

The EU nature directives, that is, the Habitats and Birds Directives (EU, 1992 and 2009), coordinate conservation efforts for more than 2,000 species and habitats through EU Member States. Its overall goal is to restore or maintain these species and habitats in a favorable long-term conservation status. At the heart of these policies is the Natura 2000 network, which covers almost 20% of the EU's terrestrial waters and 10% of marine waters, making it the largest coordinated network of nature conservation areas in the world.

The Habitats directive includes a wide range of habitats and species, stand out the forests, which represent more than one third of the habitats covered, incorporating almost 0.5 million km² of surface area, representing approximately 27% of the total forest area of the EU; and natural and semi-natural grasslands that represent 14% of the habitats covered by the directive and which add up to around 0.23 million km². Referring to the number of habitat types, warm heaths and thickets, sclerophyllous thickets, swamps, mud and rocky habitats represent only 5% of the habitats considered (Fig. 2).

For species, almost half of those included are vascular plants, while non-vascular plants (like mollusks) represent 3%. In addition, around 5% of the total species that appear on the European Red Lists of the International Union for Conservation of Nature (IUCN) are included. Species coverage in the Habitats Directive is lower for species-rich groups such as mollusks, arthropods and vascular plants, and higher for amphibians (85%), reptiles (70%), mammals (64%) and freshwater fish (39%). Many species not included in the Annexes to the Directive benefit indirectly, as do their habitats, from the Directive's protection regime (European Environmental Agency (EEA), 2020).

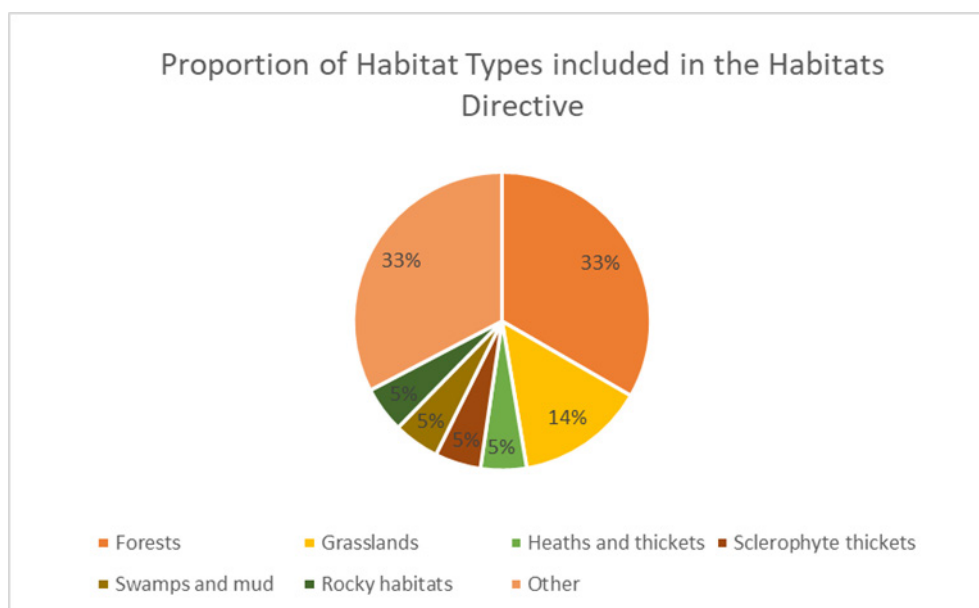


Figure 2. Proportion of Habitat Types included in the Habitats Directive

II.2. The concept of integrated coastal zone management (ICZM)

Coastal areas are among the most productive in the world, offering a wide variety of valuable habitats and ecosystem services that have always attracted human activities. Their beauty and wealth have made them popular as settlement areas and tourist destinations, important business areas and transit points. Today, more than 200 million European citizens live near the coasts, which stretch from the North-East Atlantic and the Baltic to the Mediterranean and the Black Sea.

Integrated Coastal Zone Management (ICZM) aims to the coordinated implementation of the different policies that affect the coastal zone and that are related to activities such as nature protection, aquaculture, fisheries, agriculture, industry, offshore wind energy, maritime transport, tourism, infrastructure development and climate change mitigation and adaptation. With this management we want to give an “ecosystem-based approach” that respects the limits of natural resources and ecosystems, contributing to sustainable development.

From 1973 to 1976 and from 1977 to 1981 the first European Community environmental action programs were launched, which considered issues relating to the ecological planning and management of coastal zones. The Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention) entered into force on February 12th, 1978 and can be considered one of the cornerstones of the promotion of environmental protection. From 1996 to 1999 the European Commission developed a demonstration program on integrated coastal zone management with the aim of providing technical information on sustainable coastal zone management and to support the implementation of the ICZM Recommendation, the Commission facilitates the creation of a group of experts, who held their first meeting on October 3rd, 2002. The group of experts was formed following the first High Level Forum on ICZM, organized by the Spanish Presidency of the EU from April 19th to 21st in Villajoyosa, Spain. The Forum gave a clear message of support to the ICZM Recommendation and implementation of ICZM in Europe.

A Protocol was developed in 2008 to provide contracting Parties with a common framework to promote and implement integrated coastal zone management, but it was not before September 13th, 2010 that the European Council took the decision to ratify the Protocol on Integrated Coastal Zone Management to the Barcelona Convention and it became effective on March 24th, 2011 (European Commission, 2007).

To support the ICZM and the implementation of the Protocol, the EU co-finances the PEGASO research project. Twenty-three partners are collaborating on the project, both from the EU and from third countries in the Mediterranean, as well as the Black Sea. The project runs from February 2010 to January 2014 and has a total budget of EUR 8.9 million (EU contribution EUR 6.9 million). The main objective of PEGASO is to build on existing capacities and develop new approaches to support integrated policies for the coastal, marine and maritime areas of the Mediterranean and Black Sea basins following the provisions of the Integrated Coastal Zone Management Protocol for the Mediterranean (Universidad Autónoma de Barcelona, 2008).

In the Spanish ICZM there are two strategic objectives defined: the sustainable development of coastal zones and their integrated management. Although sustainable development is the goal that can be achieved through integrated management, both objectives are considered at the same level so that the general public and relevant actors can participate in it. These objectives include the areas of action that will serve as a framework for actions on the coast, establishing on the one hand objectives aimed at the protection of the environment and the sustainable use of resources and on the

other, the objectives related to integrated management, which include participation and training processes.

The strategic objectives of the Spanish ICZM are two:

- The improvement of the environmental, economic and social conditions of the coastal zone and the use of its resources through sustainable development.
- Review and adapt the management and decision-making model incorporating the principles of the ICZM.
- Following the two main objectives mentioned above, eleven specific sustainable development goals are established:
- Sustainable management of the interaction between natural physical processes and the occupation of the coastal strip, including the application of urban planning instruments.
- Protection and recovery of natural ecosystems.
- Optimization of the use of natural resources, living resources, mineral resources and renewable energy sources, respecting the load capacity of the system.
- Safety against the risk of environmental accidents and natural disasters on the coast.
- Improvement in the endowments for public use and accessibility to the coast under sustainability criteria.
- Recovery and promotion of cultural heritage linked to the coast.
- Specific objectives of integrated management:
- Effective integration of information and knowledge about the environment in decision making.
- Coordination between the different administrative levels that facilitates coherence and territorial cohesion in defense of the collective interest.
- Transparency of the management process and effective participation in the planning of actions.
- Financial consolidation that ensures the availability of the necessary technical and economic resources.

In order to achieve these objectives; initiatives, measures and instruments have been established (some of which are planned for the coming years) that allow us to have a planning matrix in which the importance of each measure in each specific objective is established qualitatively.

The Master Plan for the Sustainability of the Coast (MPSC) was developed from Law 22/1988 on Coasts, which despite being efficient in the points that were proposed to control has not been enough to guarantee the global protection of the Spanish coasts. This Plan, in addition to including the European recommendations on the application

of ICZM, specifies the guidelines of the process of implementation of the actions and the criteria of integrated management. Therefore, we could say that the purpose of the MPSC is to serve as a planning instrument to define the actions that are necessary to achieve the strategic and specific objectives established by the Spanish ICZM Strategy.

Another instrument created is the Spanish Coastline Sustainability Observatory, whose activity includes the research, selection and calculation of ecological indicators, in addition to the dissemination of the results in order to contribute to the integration of information in the decision-making process and public information about the state of the coast. This latter is insured by annual reports published for the public. One of the main analyses it carries out is the negative trends that need to be corrected, for which it needs the most objective and flexible sustainability assessment model possible.

The collaboration agreements with the coastal autonomous communities aim to establish a framework for coordination and collaboration between the Autonomous Communities and the corresponding Ministry in the field of the environment. All parties undertake to collaborate in different actions such as the protection, defense and restoration of the littoral coast; the development of works and actions on the coast, ensure compliance with current regulations on coasts, the exchange of information and the promotion of citizens participation in the conservation and improvement of the coast.

One of the instrument's pending implementations is the National Council of the Coast, which would have an advisory role for all managers and coordination for the Ministry responsible for the Environment and in general for any ministry with competence in any coastal area and would be an economic and social representation of private agents that have little relevance. Its main function would be to guarantee transparency, administrative coordination and social participation in decision-making that affect Spanish coastal territory.

Research, Development and Innovation (R+D+i) is essential to comprehensively understand the coastal system, including all physical, ecological and socioeconomic processes and their integration for the creation of models and methodological frameworks for integrated management and the participation of agents. Different groups and universities receive support from public administrations to carry out research projects in various areas such as territorial planning or geology, all of them oriented to the ICZM. On the other hand, the administrations have promoted training courses for the technical staff of the central and peripheral services on ICZM (Gobierno de España, 2002).

Despite the initiatives explained above, no major progress has actually been made in coastal management in recent years (Arenas, 2009). According to Andrés et al. (2020), although there is a law focused on the maritime land public domain in Spain, there is no public policy for the management of the coastal zone or the will of the authorities for its creation. Most of the strategic and operational instruments for the ICZM are approved at the level of the Autonomous Communities since at the national level hardly any progress has been made in terms of creation of an integrated management strategy or

plan. In addition, most of the existing instruments at the national level are focused on the planning of engineering works in the public domain, so it is necessary for the state administration to take on the task of creating a national policy for the ICZM.

II.3. Main environmental regulations in Spain

The main regulation in relation to the conservation of the Environment in Spain is Law 42/2007 of December 13th, on Natural Heritage and Biodiversity, which establishes the basic legal regime for the conservation, sustainable use, improvement and restoration of natural heritage and biodiversity. This law is based on the maintenance of essential ecological processes and basic vital systems looking for biodiversity preservation at all levels (biological, genetic, population and species) and the uniqueness, variety and beauty of all-natural ecosystems and geological and landscape diversity.

This law provides a series of instruments for the planning and knowledge of natural heritage and biodiversity, such as the Guidelines for the Management of Natural Resources, the Strategic Plan for Natural Heritage and Biodiversity and the Spanish Inventory of Natural Heritage and Biodiversity.

Regarding the conservation of habitats and natural spaces, this law incorporates Marine Protected Areas and includes provisions related to the European Ecological Network (Natura 2000) and areas protected by other international instruments. Regarding the conservation of flora and fauna, the law stipulates the creation of the List of Species in the Special Protection Regime, the Spanish Catalog of Threatened Species and the Spanish Catalog of Invasive Exotic Species. It also regulates the protection of species in relation to hunting and inland fishing by establishing the Spanish Hunting and Fishing Inventory. Likewise, the law regulates access to genetic resources from wild taxa and the sharing of benefits derived from their use. Regarding marine habitats, the law provides for the collaboration of the Autonomous Communities and scientific institutions to prepare and keep updated the Spanish Inventory of Marine Habitats and Species (SIMHS), which will be part of the Spanish Inventory of Natural Heritage and Biodiversity (SINHB).

The SIMHS has an important role to play in ensuring compliance with national regulations and the provisions of European nature conservation regulations, in addition to the rest of the international conventions ratified by Spain related to the protection and conservation of marine species and habitats. The goal of SIMHS is to assign each habitat included in it its counterpart in the national community and international convention lists. The cataloging and conservation of habitats and natural heritage spaces is also foreseen, focusing on the elaboration and updating of the Spanish Catalog of Habitats in Danger of Disappearance (which is also part of the IEPNB), which includes habitats whose conservation or restoration require specific protection and conservation measures because they are in at least one of the following circumstances:

- Have a small and decreasing distribution area,
- Most of their natural range Have been destroyed,
- Have suffered a drastic deterioration of its composition, structure or ecological functions in most of its natural distribution area,
- Be at high risk of irreversible transformation in the short or medium term in a significant part of its distribution area.

The marine habitats that are included in this catalog must have in some management instruments or protection figures and have a management and restoration plan, such as the Conservation and Restoration Strategies of marine habitats in danger of disappearance that must include at least a diagnosis of the situation and the first threats, and the actions to be carried out.

In order to ensure territorial cohesion and that the objectives set by the law can be achieved, it establishes the creation of the Fund for Natural Heritage and Biodiversity, the State Commission for Natural Heritage and Biodiversity as a consultative and cooperation body between the Autonomous Communities and the State; and the State Council for Natural Heritage and Biodiversity, as a body for public participation in the field of conservation and sustainable use of natural heritage and biodiversity (Ministerio para la Transición Ecológica y el Reto Demográfico, 2012).

II.4. Main Climate Change adaptations in Spain

Due to Climate Change, the average temperature of Spain has increased by around 1.7°C since pre-industrial time; the rise has been intense especially during the last decade. Other consequences are the lengthening of summers, about 9 days on average per decade, with summer being almost 5 weeks longer than in the early 80s; increase in torrid nights (those in which the minimum temperature is equal to or greater than 25 °C). This phenomenon is ten times more frequent than 40 years ago with an increased duration of heat waves and a decrease in cold spells; decrease in rainfall and changes in its annual distribution; disappearance of glaciers, which are currently present only in the Pyrenees; decrease in average river flow by 1.45 % per year in the period from 1966 to 2005; expansion of the semi-arid climate, whose surface has increased to occupy almost 6% of the surface of Spain; increase in seawater temperature (0.34 °C per decade since the 80s in the Mediterranean, Fig. 3) and sea level, in addition to its acidification, more noticeable in surface waters.

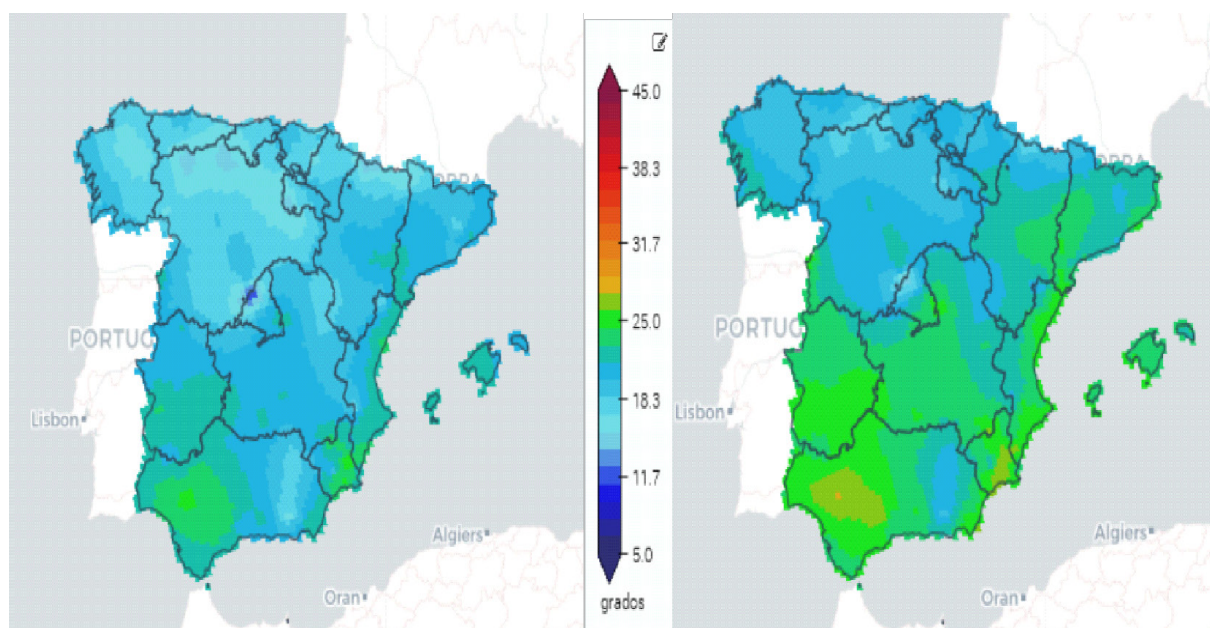


Figure 3. Temperature rises' projection models. On the right, the historical model; on the left, the prediction for the 2041-2070 period(<https://adaptecca.es/> (Oficina Española de Cambio Climático))

From all these changes a series of impacts and risks on ecological systems and economic sectors are derived, such as the decrease in water resources, impact on ecosystems and biota, increased risk of fires and desertification, impacts on human health, impacts on economic sectors such as agriculture and tourism, loss of resources, *etc.* To try to curb the dangers of climate change, different adaptation policies have been developed since 2006 at the national level, while the Autonomous Communities have developed their own adaptation strategies.

In order to develop the National Plan for Adaptation to Climate Change (NPACC) 2021-2030, the Ministry of Ecological Transition and Demographic Challenge (MITRED) has developed an evaluation of adaptation policies since its inception in 2006, which has allowed to indicate the objectives to be set for the NPACC 2021-2030.

The main one being to promote coordinated and coherent action against the effects of Climate Change in order to reduce the damages derived from it and build a more resilient economy and society. Specific objectives are also established (Plan de Adaptación al Cambio Climático 2021-2030, 2020):

- Reinforce the systematic observation of climate, the elaboration and updating of regionalized climate change projections for Spain and the development of climate services.
- Promote a continuous and cumulative process of knowledge generation on impacts, risks and adaptation in Spain; and facilitate its transfer to society, reinforcing the development of methodologies and tools to analyze the potential impacts of climate change.

- Encourage the acquisition and strengthening of capacities for adaptation.
- Identify the main risks of climate change for Spain, considering its nature, urgency and magnitude, and promote and support the definition and application of the corresponding adaptation measures.
- Integrate adaptation into public policies.
- Promote the participation of all stakeholders so that they actively contribute to the construction of responses to the risks derived from Climate Change.
- Ensure administrative coordination and strengthen adaptation governance.
- Comply with and develop the commitments acquired at European and international level.
- Promote monitoring and evaluation of adaptation policies and measures.

On the other hand, on March 19th, 2020, a Climate Change and Energy Adaptation Bill was presented in the Courts, which establishes that Spain's emissions by 2030 must be reduced by at least 20% compared to those of 1990 and reach climate neutrality by 2050. Likewise, it establishes that by 2030, at least 70% of the energy consumed in the country must be of renewable origin and improve energy efficiency by reducing primary energy consumption by at least 35% compared to the baseline according to Community regulations. This law also includes planning instruments to address the energy transition of the Integrated National Energy and Climate Plans and the Decarbonisation Strategy to 2050 of the Spanish Economy (*Proyecto de Ley de Cambio Climático y Transición Energética*, 2020).

Regarding the adaptation of the coast to Climate Change, in 2016, an Adaptation Strategy was approved and developed due to the Climate Change Adaptation Plan 2014-2020, and whose general objectives are based on the environmental objectives set out in Law 22/1988 on Coasts, structured in the following statements:

- Increase the resilience of the Spanish coast to climate change and climate variability.
- Integrate adaptation to climate change in the planning and management of the Spanish coast.

In addition to these two general objectives, the strategy establishes specific objectives related to the diagnosis of the state of the coast, public participation, training and awareness, adaptation and coordination measures, monitoring and evaluation, and, finally, research.

Likewise, a series of general guidelines were established to guide and limit the scope of the Strategy in which the systems on which the effects of climate change are considered, the factors of change to be considered in the diagnoses, determination of scenarios and projections, including impacts and the level of risk and its consequences were set.

The measures proposed to achieve the objectives set by the strategy have been selected prioritizing their flexibility and robustness to face as many scenarios as possible. The measures would be the diagnosis and analysis of risks, the systematic monitoring of the coast, the introduction of early warning systems and assessment protocols, regeneration of beaches and dune systems, the creation of artificial beaches and dunes, the conservation and restoration of wetlands and marshes, sediment management, the construction of new protective structures (such as walls or promenades), construction of new structures or artificial elements to maintain the coastline (dikes, breakwaters, geotextiles, *etc.*), functional and structural adaptation of existing infrastructures and buildings, regulations and codes of adequacy, introduction of insurance and specific premiums, realignment of existing structures on the coastline and in estuaries and mouths, acquisition of land, changes in land uses, promote inland migration of wetlands and marshes and the creation of new intertidal areas, training and awareness, integration into decision-making, research, evaluation of services provided by coastal ecosystems, concession management, creation of protected areas and finally, integrated coastal zone management (Table 1).

Each of the measures implemented will have its own monitoring plan (*Estrategia de Adaptación al Cambio Climático de la Costa Española*, 2016).

Table 1. Natural systems and their change indicators of Global Warming(Estrategia de Adaptación al Cambio Climático de la Costa Española (2016))

Natural Systems	Characteristic Indicators
Cliffs	-Km with problems of landslides and erosion
Rocky low coasts	-Km with landslide problems
Beaches	-Total number of beaches -Km affected by erosion -M of average annual decline -M projected maximum retracement -M change in flood level -M³ change in potential transport
Dunes	-Km affected by erosion -M average annual decline -M projected maximum retracement -Variation of potential sand transport
Wetlands and marshes Lagoons Deltas	-New flooded area/year -New desiccated or desecrated surface/year -Number of surface and groundwater bodies with saline intrusion problems -Km variation of the extension of the saline wedge
Estuaries	-New flooded area/year -New desecrated surface/year -Number of surface and groundwater bodies with saline intrusion problems -Km variation of the extension of the saline wedge -M³ variation of sand volume in the interior lows or tidal plains -M² variation of the equilibrium section of the mouth of the mouth -M³ variation of the equilibrium volume of the volume of the low exterior -Variation of the dimensionless number of stratifications
Macroalgae meadows Posidonia meadows and other coastal habitats	-N° of meadows or habitats -M³ of occupied area with three-year monitoring

III. Analysis of human pressures on ecosystems

Although human well-being depends directly on the good state of the natural environment, most human activities generate a negative impact on it, leading to biodiversity loss. According to IPBES (2019) it is estimated that one million species would become extinct in a span of decades if pressures continue at the current level, finding us in the sixth mass extinction.

In order of relevance, main factors that cause the biodiversity loss are changes in land and sea uses, species overexploitation, climate change, pollution and invasive exotic species.

At the global level, the most relevant land use transformation is the conversion of wild territory into crops. In Spain, there are other changes in land use to highlight such as agricultural and livestock intensification or the abandonment of these activities, urbanization and fires. There is a trend of decreasing area allocated to crops and increasing forest area: between 1975 and 2015, crops lost 6.5% of the national area, while forests increased by about 9%.

In addition, the area devoted to settlements increased, from 1.2 million ha in 2000 to 1.7 million ha in 2015; which would be an increase of 1.8% of the national area (Fig. 4).

The changes between these large types of ecosystems have been minor within the network of protected areas, which has acted as a stabilizing element of changes in land occupation. Derived from this problem, together with provoked forest fires, the phenomenon of fragmentation appeared which in addition to the occupation of the territory produced disconnection between ecosystems. This phenomenon is also caused by floods, whose effects increased by river channeling actions, as well as canals, reservoirs and their dams, urban development and linear transport infrastructure that section aquatic and terrestrial means.

Despite the great effect it causes, there is currently not enough global information in Spain to characterize and study the evolution of the process.

The problem of desertification acquires enormous importance in Spain, being the EU country where this risk is greatest, with 18% of the total territory at high or very high risk of desertification, being the main cause of erosion. The National Inventory of Soil Erosion includes the study of the main erosion processes that affect the territory (Fig. 5). This inventory has the objectives of locating, mapping, quantifying and analyzing the evolution of erosive phenomena in order to delimit the priority areas of action and coordinate soil conservation policies.

Regarding the exploitation of species, the negative effects of the illegal trade in species stand out, for which in Spain the Spanish Action Plan against illegal trafficking and international poaching of wild species (Plan TIFIES) was launched in 2018. In the marine environment, the objective of maximum sustainable yield for fisheries in the Atlantic has

been achieved and work is being done to move towards sustainable management in the Mediterranean by setting targets for the exploitation of resources at the mortality level that allow for maximum sustainable long-term yield. To work on the prevention of accidental deaths, the SAFE plan (Stop Atropellos de Fauna Española) is being developed, which will be developed by the Doñana Biological Station (EBD-CSIC) together with the main scientific societies in the country that work with affected fauna groups.

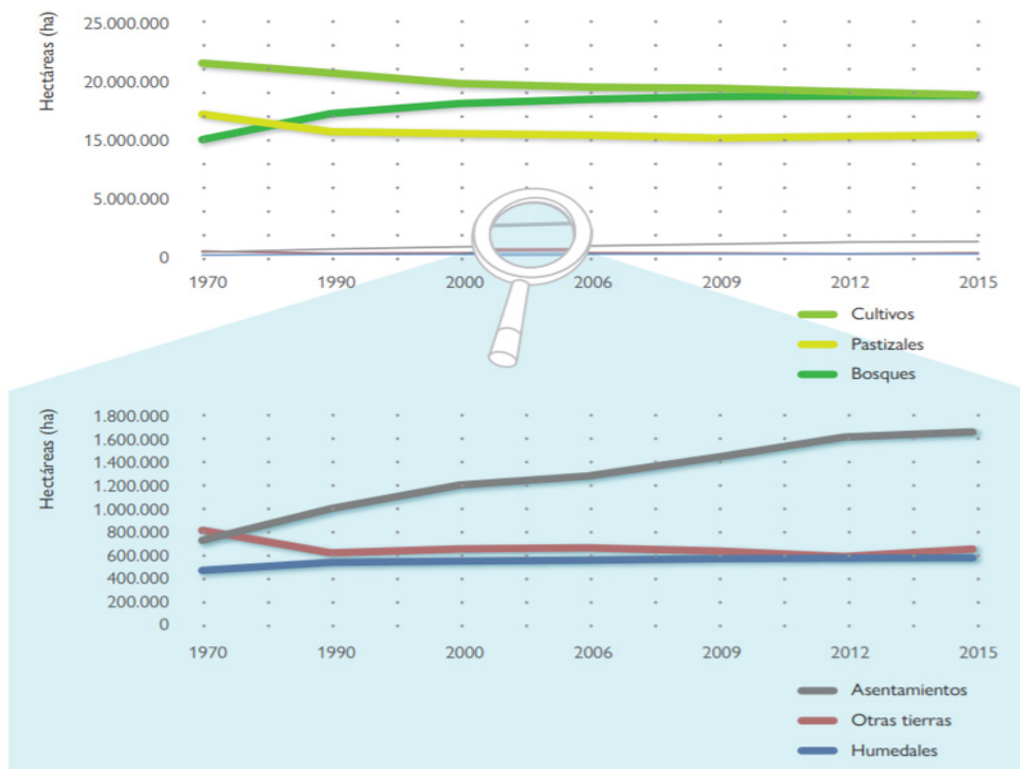


Figure 4. Evolution of occupied area categories between 1975 and 2015 (Informe sobre el estado del Patrimonio Natural y de la Biodiversidad en España a 2020)

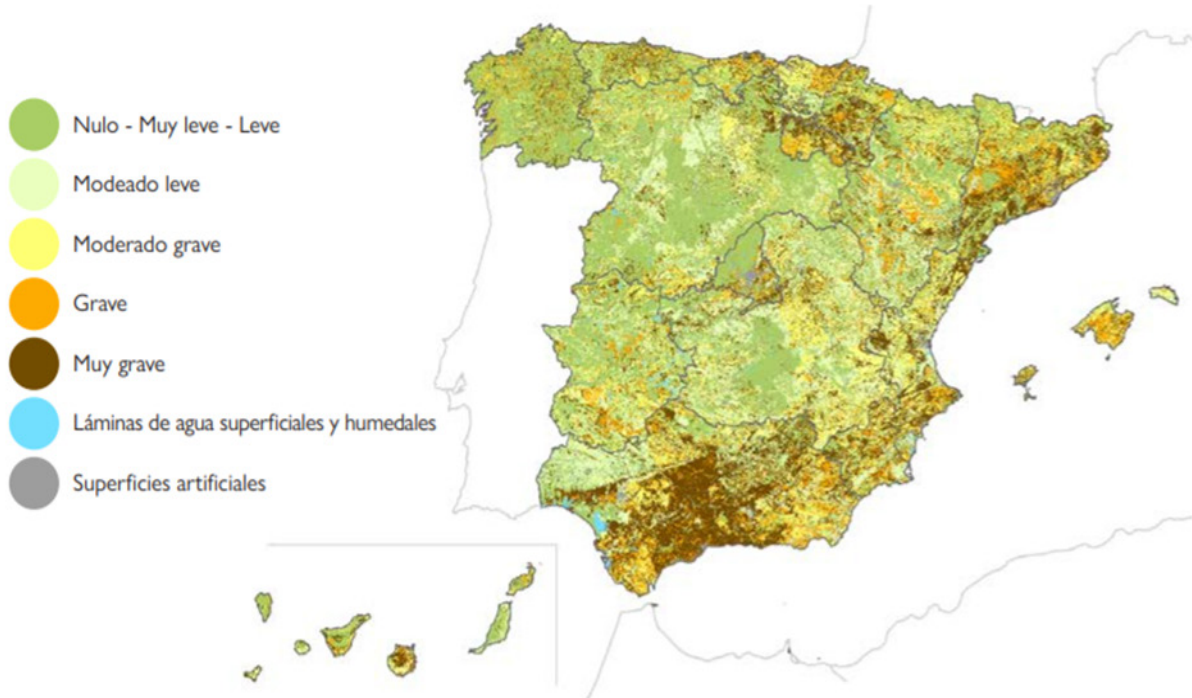


Figure 5. Erosion level distribution (Informe sobre el estado del Patrimonio Natural y de la Biodiversidad en España a 2020)

Invasive exotic species are a growing problem, both in the marine and terrestrial environments. The first modification of the Spanish Catalog of Invasive Exotic Species took place in 2019: four new species of fauna have been included and the scope of application of two plant taxa has been extended to the Canary Islands (Fig. 6). In 2020, three new species were attached to the Catalog: *Rugulopteryxokamurae*, *Acaciamelanoxylon* and *Reticulitermesflavipes*. Six strategies have been adopted that focus on management, control and possible eradication guidelines for the fight against exotic species that pose a greater risk to the natural environment and biodiversity. As future lines of work, they want to prioritize the development of strategies or transversal plans, which cover several invasive exotic species, such as the Action Plan on the ways of introduction and propagation of invasive alien species in Spain. It is also necessary to strengthen the knowledge about these species' behavior in the context of climate change to improve decision-making.

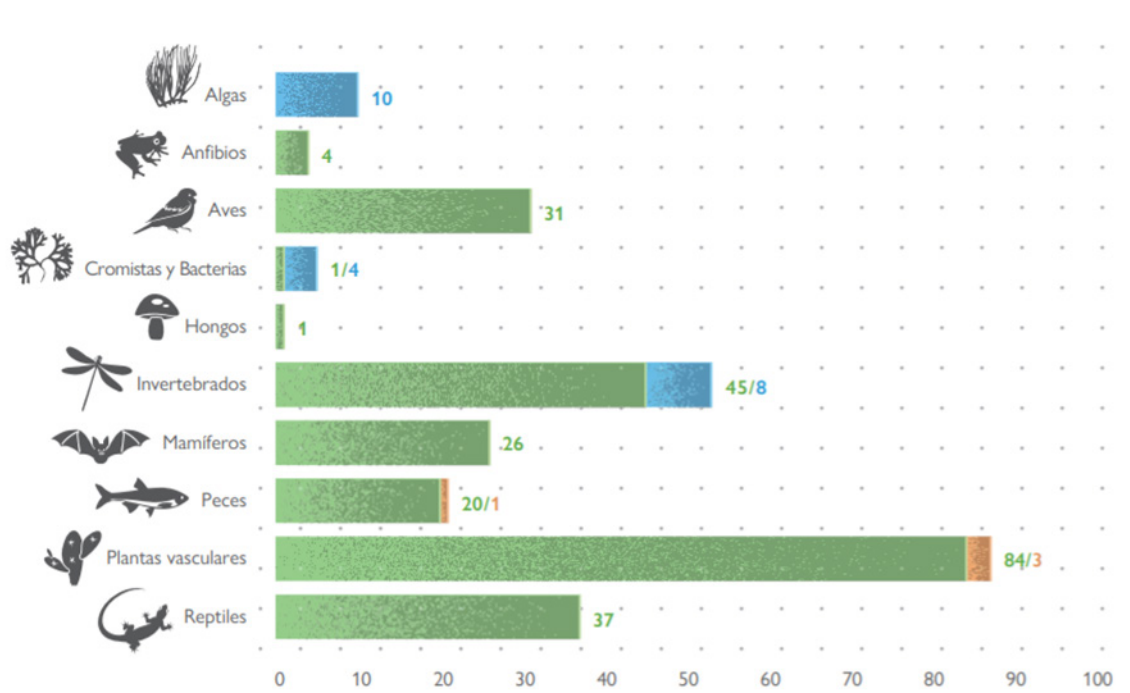


Figure 6. Number of invasive exotic species by taxonomic group (Informe sobre el Estado del Patrimonio Natural y de la Biodiversidad en España a 2020)

Considering pollution, despite progress in reducing water and air pollution during the recent years and the reduction in the use of plastics and the promotion of adaptation to climate change and the circular economy, European pollution levels remain high. In Spain, about 34% of the peninsular surface underwent critical nitrogen inputs, indicating a high risk of eutrophication for those ecosystems located in these areas. The use of herbicide is also a major source of contamination. Air pollution induce pressure on ecosystems and biodiversity because of the direct toxicity on organisms and because of the alteration it can cause to the biogeochemical cycles of ecosystems that can lead to changes in the composition and structure of plant communities, loss of biodiversity and degradation of ecosystem services. Due to the excesses even, critical nitrogen loads in Spain there is a high risk of eutrophication for the country's ecosystems. Nitrate pollution of inland waters, mostly derived from agriculture, affects key places for the conservation of biodiversity such as the Doñana National Park, the Albufera in Valencia or the Mar Menor in Murcia (Rábago et al., 2020). Between 2016 and 2019, 21% of the nitrate vulnerable zones corresponded to protected areas, of which 50.6% were Species Areas for the Protection of Birds. In order to mitigate the risk of using phytosanitary products for plants and animals, especially in the areas of greatest risk due to the presence of endangered species of flora and fauna, protection areas against the use of phytosanitary products have been identified.

As a specific tool to advance in the knowledge of the effects of climate change in the forest field, the "Monitoring of forest species indicating climate change" has been developed since 2005 in the Network of National Parks, which has observed deviations

towards lower precipitation and higher average temperatures, with increasing biotic factors (basically pathogens, hemiparasites perforating insects) in parallel with an appreciable deterioration, even decay, of some species in their current range, where they may not find the ecological requirements necessary for their correct development (Informe sobre el estado del Patrimonio Natural y de la Biodiversidad en España a 2020, 2021).

III.1. Human pressures on Mediterranean marine ecosystems

Spain is considered a maritime country, since it has an extension of coast close to 10,000 km, so the exploitation of marine waters and their resources has a great economic importance (Ministerio para la Transición Ecológica y el Reto Demográfico, 2018).

According to the Marine Strategy of the Levantine-Balearic (2019) demarcation, tourism and leisure activities have a great importance to the environment, due to pleasant climate and the beaches of great attraction. Similarly, fishing, shell fishing and aquaculture have a great socio-economic impact.

In the analysis of pressures carried out in the aforementioned strategy, physical pressures and pressures due to substances, garbage and energy are distinguished.

Physical pressures refer to temporary or reversible physical disturbances of the seafloor that cause damage to the structure, functions and processes of ecosystems and that affect different species. The human activities that cause this pressure are the restructuring of the morphology of the seabed by dredging or depositing materials, the installation of cables for the transport of electricity and communications, fishing and shellfishing (both professional and recreational), marine aquaculture, marine transport, tourism and leisure infrastructures. Within the physical pressures, the loss of the marine substrate or habitats due to the sealing or modification of the bottom profile is also contemplated.

This modification of the profile may be due to the extraction of sediments from the seabed and the creation of artificial beaches, while the sealing is produced by the construction of infrastructures whether they are port, coastal defense (especially transverse ones such as breakwaters), artificial reefs, hydrocarbon exploitation platforms, cemented wind farms and other structures installed offshore. Because of these disturbances, the alteration and destruction of benthic communities could occur. There is also a risk of the resuspension of toxic substances that can pass through the trophic food web.

As for the pressures produced by contributions of substances, garbage and energy, the materials contemplated are nutrients (especially nitrate and phosphate), organic matter and other polluting substances from urban or industrial discharges, from rivers, discharges of dredged material, atmospheric deposition and discharges from ships. These discharges suppose in most cases an increase in the activity of the decomposing organisms that causes the decrease of the available oxygen. Depending on the substance of the spill, it can also lead to the contamination of the ecosystem by toxic substances.

III.2. Measures to respond to pressures on ecosystems

To curb the degradation of ecosystems caused by human pressures, different measures have been created ranging from the adoption of strategies, plans and programs to actions of awareness and environmental education, as well as concrete actions of conservation, restoration and fight against threats.

Conservation strategies are regulated by article 57 of Law 42/2007 on Natural Heritage and Biodiversity and by article 11 of Royal Decree 139/2011, for the development of the List of Wild Species in Special Protection Regime and the Spanish Catalog of Threatened Species. The main objective of these strategies is to define criteria to guide the development of recovery, conservation or threat control plans. For the creation of flora conservation strategies, a multi-specific and focused approach has been followed since groups of threatened flora species have similar pressures and threats. As for the fauna, in the last six years the conservation and management strategies for the Iberian imperial eagle and the Cantabrian brown bear have been approved. On the other hand, work is being done on the conservation of marine species such as turtles, cetaceans and nares in the Mediterranean. In addition, in 2017 the orca conservation plan was approved.

Likewise, management, control and eradication strategies have been promoted for invasive exotic species that pose a greater risk to the natural environment, which also have an indicative character for the competent administrations in the actions to stop the expansion of an invasive alien species.

In recent years, ecosystem restoration has gained strength, being one of the main tools proposed in the Climate Change Adaptation Plan to improve the response capacity of species to Climate Change. Among the ecosystem recovery plans are restoration actions and creation of habitats for amphibians, adaptive forest management actions, wetland restoration, a national river restoration strategy, etc (Informe sobre el estado del Patrimonio Natural y de la Biodiversidad en España a 2020, 2021).

IV. The sustainability of Mediterranean tourism

The Mediterranean is today the most important tourist destination in the world. Its coastal countries receive a third of all international tourist arrivals. The Mediterranean areas of these countries themselves represent a fifth of that total, that is, more than 90 million foreign tourists. In 2002, Mediterranean tourism accounted for 20.4% of the world total. This tourism development has led to a series of environmental impacts, including pollution and destruction of the landscape, wastewater, municipal solid waste and noise pollution, which has placed Spain as one of the noisiest countries in the world. The creation of urbanizations, promenades and ports, as well as the creation of defense breakwaters, in order to promote tourism can end up negatively since it causes the disappearance of the sand from the beaches, which already affects about 70% of the Spanish coast.

Although approaches to the tourism issue from critical and environmental perspectives exist since the 70s, it took until the beginning of the nineties when sustainability in tourism was raised. Regarding the Mediterranean, it is interesting to highlight the Mediterranean Action Plan) in which the Spanish and Greek delegations presented a proposal for Sustainable Tourism in the Mediterranean Basin. The issue is of vital importance and urgency, considering the environmental conditions of the Mediterranean Sea and that its coasts receive more than 150 million tourists a year, with forecasts of an annual growth of 3% until 2020.

In the horizon of 2025, chosen by the Blue Plan of the Mediterranean, the conclusions of the scenarios must be differentiated to some extent, according to whether the whole of each country is considered, only its coastal regions or the sea itself. At the level of coastal countries and regions, the most worrying threat in the medium term seems to be the inability to cope with the progress of soil erosion; its protection goes through that of forests at the headwaters of river basins. With regard to coastal regions and the sea, the priority should be on coastal protection, conceived as the narrow land and sea band in which direct action can only be local and/or national, but where threats to the environment are most serious, even in the most favorable scenarios (Borrell, 2005).

The Government of Spain is developing a Sustainable Tourism Strategy 2030 that seeks to lay the foundations for the transformation of Spanish tourism towards a more sustainable growth model to improve the competitive capacity and profitability of the industry.

The tourism growth model proposed by this strategy is based on socioeconomic growth, improving the profitability of the activity and the distribution of wealth. Likewise, tourism must be the engine for sustainable development that helps to stop the depopulation of the rural environment and its consequent deterioration through the promotion of sustainable tourism that preserves and recovers environmental values (Secretaria de Estado de Turismo, 2019).

V. Conclusions

The main conclusions are:

- The prevention of Climate Change and its consequences is the main objective of the environmental policies developed in recent years.
- The protection and recovery of coastal areas is fundamental for the fight against Climate Change and the protection of biodiversity.
- Despite the existence of policies to protect and manage the pressures caused by human beings, the degradation of the environment continues since direct and effective actions must be adopted.
- The recovery of ecosystems must be carried out taking into account the adaptation of the environment to Climate Change. Resulting in a wide range of environmental impacts that negatively affect tourism itself.
- To promote tourism, it is necessary to act by seeking the recovery of ecosystems since their state affects the quality of the tourist offer.

VI. References

Andrés M.D., Barragán J.M., Arenas Granados P., García Sanabria J., Onetti García J., 2020. Gestión de las zonas costeras y marinas en España. Costas, 117-132.

Arenas P., 2009. Gestión del litoral y política pública en España. En R. IBERMAR, Manejo costero integrado y política pública en Iberoamérica: un diagnóstico, Necesidad de cambio. (págs. 353-380). CYTED.

Borrell Merlín M.D., 2005. Turismo, medio ambiente y desarrollos sostenibles en el Mediterráneo. Observatorio Medioambiental. (8), 305-330.

Clark J., 1992. Ecosystem Level Conservation. Integrated management of coastal zones (327), 167. Rome: FAO Fisheries Technical Paper.

Coordinación General Ministerio para la Transición Ecológica (Subdirección General para la Protección del Mar), Centro de Estudios y Experimentación de Obras Públicas, Centro de Estudios de Puertos y Costas, 2019. Anexo II. Fichas de análisis de presiones e impactos. In Estrategia marina de la Demarcación levantino-balear. Madrid: Ministerio para la Transición Ecológica (MITECO). Retrieved from: https://www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/anexo%20parte%20i%20fichas%20por%20presion%20dm%20leba_tcm30-498348.pdf

Dirección General de Sostenibilidad de la Costa y el Mar, 2016. Estrategia de Adaptación al Cambio Climático de la Costa Española. Madrid: Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente. Retrieved from: https://www.miteco.gob.es/es/costas/temas/proteccion-costa/estrategia%20adaptacion%20cc%20aprobada_tcm30-420088.pdf

European Commission, 2007. European Commission. Retrieved from Coastal and marine policy: https://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/index_en.htm

European Environmental Agency (EEA), 2020. State of Nature in the EU. Result from reporting under nature directives 2013-2018. Luxembourg: Publications Office of the European Union. Retrieved from: <https://www.eea.europa.eu/publications/state-of-nature-in-the-eu-2020>

Fundación biodiversidad, 2018. Fundación Biodiversidad. Retrieved from: <https://fundacion-biodiversidad.es/es/que-hacemos/biodiversidad-en-espana>

Gobierno de España, 2002. Gestión Integrada de las Zonas Costeras en España. Retrieved Septiembre 16, 2021, from <https://www.upv.es/contenidos/CAMUNISO/info/U0652473.pdf>

IPBES, 2019. Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Bonn: IPBES secretariat.

IUCN, 2008. IUCN (International Union for Conservation of Nature). Retrieved 09 10, 2021, from https://www.iucn.org/sites/dev/files/import/downloads/el_mediterraneo_un_punto_caliente_de_biodiversidad_amenazado.pdf

Linares, C., 2010. IRBio. Retrieved 09 10, 2021, from <http://www.ub.edu/irbio/biodiversidad-marina-mediterranea-situacion-actual-perspectivas-a-67-ca>

Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO), 2020. Plan de Adaptación al Cambio Climático 2021-2030. Madrid. Retrieved Septiembre 17, 2021, from https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/pnacc-2021-2030_tcm30-512163.pdf

Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO), 2020. Proyecto de Ley de Cambio Climático y Transición Energética. Madrid. Retrieved Septiembre 17, 2021, from https://www.miteco.gob.es/es/ministerio/proyectedeleycambioclimaticoytransicionenergetica_tcm30-509256.pdf

Ministerio para la Transición Ecológica y el Reto Demográfico, 2012. Ministerio para la Transición Ecológica y el Reto Demográfico. Retrieved Septiembre 15, 2021, from <https://www.miteco.gob.es/es/biodiversidad/temas/conservacion-de-la-biodiversidad/conservacion-de-la-biodiversidad-en-espana/default.aspx>

Ministerio para la Transición Ecológica y el Reto Demográfico, 2018. Ministerio para la Transición Ecológica y el Reto Demográfico. Retrieved from Actividades humanas en el mar: <https://www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/actividades-humanas/default.aspx>

Ministerio para la Transición Ecológica y el Reto Demográfico, 2019. Map of protection figures in Spain. Obtenido de https://www.miteco.gob.es/es/biodiversidad/servicios/banco-datos-naturaleza/enpjulio2021_tcm30-195782.pdf

Ministerio para la Transición Ecológica y el Reto Demográfico, 2021. Informe sobre el estado del Patrimonio Natural y de la Biodiversidad en España a 2020. Madrid: Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO). Retrieved from https://www.miteco.gob.es/es/biodiversidad/temas/inventarios-nacionales/iepn20sexenal_tcm30-527047.pdf

Ministerio para la Transición Ecológica y el Reto Demográfico, 2021. Informe sobre el estado del Patrimonio Natural y de la Biodiversidad en España a 2020. Madrid: Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO). Retrieved from https://www.miteco.gob.es/es/biodiversidad/temas/inventarios-nacionales/iepn20sexenal_tcm30-527047.pdf

Munro D.A., 1990. Caring for the world. A strategy for sustainability. IUCN, UNEP, WWF International. Gland: IUCN.

Oficina Española de Cambio Climático. (n.d.). Plataforma sobre Adaptación al Cambio Climático en España. Retrieved from Visor de Escenarios de Cambio Climático: [http://escenarios.adaptecca.es/#&model=EURO-CORDEX-EQM.average&variable=tasmax&scenario=rcp85&temporalFilter=year&layers=AREAS&period=MEDIUM_FUTURE & anomaly=RAW VALUE](http://escenarios.adaptecca.es/#&model=EURO-CORDEX-EQM.average&variable=tasmax&scenario=rcp85&temporalFilter=year&layers=AREAS&period=MEDIUM_FUTURE&anomaly=RAW_VALUE)

PlumedLasarte M., Gómez Bruna D., Martín Duque C., 2018. Planificación turística, promoción y sostenibilidad ambiental: el caso de España. Ciencias de la Administración y Economía 15: 7-18.

Rábago I. García H., 2020. Contaminación Atmosférica. En M. p. Demográfico, Informe sobre el Estado del Patrimonio Natural y de la Biodiversidad en España (págs. 110-111).

Salm R., Clack J., 1984. Marine and Coastal Protected areas: a guide for Planners and Managers. Gland: UICN. Retrieved from: <https://www.iucn.org/content/marine-and-coastal-protected-areas-a-guide-planners-and-managers-0>

Secretaría de Estado de Turismo, 2019. Directrices generales de la estrategia de turismo sostenible de España 2030. Madrid: Ministerio de Industria, Comercio y Turismo. Retrieved from <https://turismo.gob.es/es-es/estrategia-turismo-sostenible/Documents/directrices-estrategia-turismo-sostenible.pdf>

Universidad Autónoma de Barcelona, 2008. Pegaso project. Retrieved Septiembre 15, 2021, from <http://www.vliz.be/projects/pegaso/project-overview.html>

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