Ecosystem Protection Murcia Scale, Spain











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

Ecosystems protection Murcia Scale, Spain





Union for the Mediterranean Union pour la Méditerranée الاتحاد من أجل المتوسط







OVERVIEW

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REVIEW

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Abstract

This deliverable will provide an analysis of ecosystems protection at Murcia scale. It is developed through the review of existing data at regional scale. The document is structured as follows.

- Section 1 provides an overview of existing strategies and measures facing relevant threats to ecosystems in the touristic coast of Region of Murcia.
- Section 2 focuses on analysis of human pressures on ecosystems in touristic coasts of Region of Murcia.
- Section 3 describes the sustainability of tourism on the touristic coasts of Region of Murcia.



I. Introduction

This document is the deliverable relating to the "Ecosystems protection in Tourist Areas in Murcia" which is part of the project of the Analysis of Natural Ecosystems evolution in relation to Threats and Enabling Factors for maritime development and coastal tourism on a national scale.

In accordance with the TDRs, the objective of this deliverable is:

- Provide an overview of existing strategies and measures facing relevant threats to ecosystems in touristic Murcia.
- Describe the analysis of human pressures on ecosystems in touristic region of Murcia coasts.

The coast in the Region of Murcia is characterized by its high diversity since it constitutes a border zone, the limit of the Atlantic influence in the interior of the Mediterranean. On the coast, the coastal reliefs force the sea wind to rise and condense the moisture they carry on the northern slopes, where groves of junipers and pine forests develop, in contrast to the salt marshes and arid beaches exposed to the sea.

Numerous islands, great depths close to the coast and a well-developed continental shelf in front of La Manga allow the development of different marine communities: *Posidonia oceanica* meadows, corals and gorgonians, rocky bottoms, sand, veriles and submarine cliffs. Several research discovers the decisive importance of the waters of Murcia and Andalusia for the conservation of turtles and cetaceans, and the need to create a World Marine Sanctuary in this vital enclave of the Mediterranean. The Regional Park of Calblanque, Monte de las Cenizas and Peña del Águila -in La Unión and Cartagena- has been proposed for inclusion in the World Network of Biosphere Reserves.

The biological wealth of Murcia is evident in the important representation that this region has in the European ecological network Natura 2000, within which are designated 50 Sites of Community Importance (SCI), which "dot" throughout its geography. On the terrestrial environment there are 47 of these SCIs, 164,066 hectares, which represent 14.50% of the regional surface, while the marine environment is home to the remaining three areas over an area of 185,280 hectares. In addition to these SCIs, an area of some 200,000 hectares, 18% of the region, is included in Natura 2000, with 22 Special Protection Areas for Birds. Among these areas, the coastal lagoon of the Mar Menor, a Wetland of International Importance by the Ramsar Convention due to its high natural values and its waterfowl populations, for the pairs of four regular nesting species: stilt, avocet, Kentish plover, and little tern, stands out for its international interest and uniqueness. This wetland has also been included since 2001 in the list of Specially Protected Areas of Mediterranean Importance (SPAMI) and is part of the Coastal Area Management Programs (CAMP), part of the Mediterranean Action Plan (MAP) of the United Nations Environment Program (UNEP), which have been developed since 1989 in different Mediterranean countries. The main objective of these programs is the



implementation of practical projects for the management of Mediterranean coastal areas based on the principles of sustainable development and in response to environmental problems, using Integrated Coastal Zone Management (ICZM) as a basic tool (Brugarolas Molina, 2003) (Fig. 1).



Figure 1. Map of Protected Natural areas in Region de Murcia (Dirección General de Medio Natural. Comunidad Autónoma de la Región de Murcia. <u>https://murcianatural.</u> <u>carm.es</u>)



II. Strategies and Measures Addressing Ecosystem Threats in Touristic Areas of Murcia

The Strategic Plan of the Region of Murcia 2014-2020, included in its lines of action the Territorial Planning and Environmental Sustainability, being some of the proposed actions:

- Integrated management of coastal areas in the Mar Menor and its surroundings, to improve the quality of the waters of the Mar Menor and its ecosystem, achieving a balance between the conservation of the coastline and its tourist development.
- Conservation and sustainable use of biodiversity and protected natural areas.
- Generation and management of knowledge for adaptation to climate change.
- The Strategic Plan 2021-2027 is currently undergoing a participatory process. This Plan will reflect on the economic, social and sustainability areas.
- The strategy of Integrated Management of coastal areas in the Mar Menor and its surroundings includes, among others, the following plans:
 - Integrated Management Plan for Protected Areas of the Mar Menor and the Mediterranean Coastal Strip of the Region of Murcia.
 - Plan for the management, promotion and control of facilities and activities in the Mar Menor.
 - Land Management Plan of the Mar Menor watershed (art. 15 L1/2020, RPMM).
 - Landscape, tourism, and cultural heritage program.
 - Hydrological Plan of the Segura River Basin in the Mar Menor River Basin area.

II.1. Main initiatives and guidelines at European level

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

The Region of Murcia has a surface area of 1,131,193 ha. Of this surface area, 24% is within the Natura 2000 Network, while 76% is outside this protected territory. The Natura 2 000 Network in the Region of Murcia is made up of 24 SPAs and 49 SCIs, which in some cases overlap in the territory (266,681 ha of land and 27,502 ha of



marine area). It should be noted that the SCI "Marine Environment" was also designated, which owes its competences to the Ministry for Ecological Transition, which has designated it as a Special Area of Conservation (SAC) "Submerged valleys of the Mazarrón escarpment" and approved its management plan.

The SCIs were proposed by the Region of Murcia and designated in the Resolution of July 28, 2000, and the initial list was adopted by the European Commission in the Decision of July 19, 2006, and included in the successive updates.

Similarly, in compliance with the Birds Directive, several Resolutions have declared 24 SPAs in the Region of Murcia. Given the territorial overlap between the different Natura 2 000 Network protection figures (SCIs and SPAs) and other protected natural spaces, 14 Integrated Planning Areas (IPAs) have been defined so that the different planning instruments are configured in integrated documents (integrated management plans, PGI) which are the result of coherently coordinating their respective legal regimes.

The Habitats Directive includes a wide range of habitats and species. The Region of Murcia is home to 5 types of marine and coastal habitats of Community interest, two of them priority habitats, which require active and permanent management to ensure the maintenance of their favorable conservation status in the long term (Table 1).

The 5 marine and coastal habitats are in 2 Special Protection Areas (SPA) specifically designated for their conservation: "Submerged Coastal Strip of the Region of Murcia" (ES6200029) and "Mar Menor" (ES6200030). Thus, the contribution of these Natura 2,000 sites is essential, as they include the entire 1150* habitat (coastal lagoons) and approximately 80% of the mapped surface area in the Region of types 1110 (sandbanks permanently covered by shallow seawater) and 1120* (Posidonia meadows), as well as 55% of type 1170 (reefs). Both SACs have a recently approved management plan (Comprehensive Management Plan for the protected areas of the Mar Menor and the Mediterranean Coastal Strip of the Region of Murcia) by the Government Council of the Region of Murcia (Supplement no. 7, BORM no. 242 of 19/10/2019), with specific conservation and management objectives and measures for these habitats. Due to the limited environmental situation of the Mar Menor in recent years have intensified protection actions and the number of research projects both inside and outside the Natura 2000 area. In this sense, Law 1/2018, of February 7, on urgent measures to guarantee the environmental sustainability of the environment of the Mar Menor has been approved, whose main objective is the adoption of urgent measures for the management and sustainable use of agricultural activities in the environment of the Mar Menor.



Table 1. Total area of marine habitats of community interest in the Region of Murciaand area of habitats inside and outside the Natura 2 000 Network (CARM)

Region de Murcia						
Habitat	Surface (ha)	Inside Red Natura 2000 (ha - %)		Outside Red Natura 2000 (ha - %)		
1,110	16,586	15,662	94.4%	924	5.6%	
1,120*	11,631	9,709	83.5%	1,922	16.5%	
1,150*	13,823	13,823	100%	-	-	
1,170	1,572	1,161	73.8%	411.2	26.2	
8,330	395	226	57.2%	169	42.8%	
1,310	79	42	54.0%	37	46.0%	
(*) Priority						

In terms of species, these habitats are home to 56 species of community interest, 32 of which are included in Annex II of the Barcelona Convention. 3 species are included in Annex II of the Habitats Directive: Aphanius iberus (fartet), Caretta caretta (loggerhead turtle), a priority species, and Tursiops truncatus (bottlenose dolphin); 10 species (Lithophaga lithophaga, Pinna nobilis, Centrostephanus longispinus, Caretta caretta, Balaenoptera physalus, Delphinus delphis, Globicephala melas, Grampus griseus, Stenella coeruleoalba and Tursiops truncatus) of Community interest requiring strict protection (Annex IV) and 2 (Phymatoliton calcareum and Scyllarides latus) of Annex V of the Habitats Directive.

The Mar Menor and the submerged Mediterranean coastal strip of the Region of Murcia are essential for the conservation of many aquatic and marine birds as their main nesting, wintering, and migration sites. Fifty-one species of Annex I of the Birds Directive have been cited, including the Mediterranean shag (*Phalacrocorax aristotelis desmarestii*), the European storm petrel (*Hydrobates pelagicus*), the Cory's shearwater (*Calonectris diomedea*) and Audouin's gull (*Ichthyaetus audouinii*). Thus, in the marine and coastal area of the Region of Murcia 6 Special Protection Areas for Birds (SPAs) have been designated with a total area of 15,606.58 ha: Mar Menor (ES0000260), Salinas y Arenales de San Pedro del Pinatar (ES0000175), Isla Grosa (ES0000200), Islas Hormigas (ES0000256), Isla de las Palomas (ES0000271) and Isla Cueva de Lobos (ES0000270). There are also two marine SPAs: the Murcia and Almeria Coastal Islets Marine Area (ES0000507) and the Tabarca-Cabo de Palos Marine Area (ES0000508). It is important to mention the overlapping (total and/or partial) of some of the SPAs with other marine protected areas of RN2000.



II.2. Integrated Coastal Zone Management (ICZM) in Murcia

The Autonomous Communities have mainly assumed the role of coastal zone management. The policies used by most of the coastal regions have been to create strategic instruments for the management/protection of the first few hundred meters (normally the distance of 500 meters) from the coastline. For this purpose, instruments of a territorial nature have been used, specifically in the Region of Murcia, the Guidelines and territorial management plan for the coast of the Region of Murcia, which includes among its management tools the Mar Menor ICZM Strategy Proposal.

In 2016, the Integrated Coastal Zone Management Strategy for the Socioecological System of Mar Menor was initiated (Barragán and García-Sanabria, 2016). The main objective pursued is "to achieve a management model in the public sphere of action adapted to the special characteristics of the Mar Menor, in close inter-administrative cooperation, inspired by principles of governance and committed to citizen participation". It is for this reason that the integrated management of this coastal lagoon and its environment is addressed under an ecosystem-based approach. The formal approval process of the PGI by the Governing Council took place in October 2019.

The Integrated Coastal Zone Management Strategy for the Socioecological System of the Mar Menor defines five strategic objectives for integrated management:

- 1. To address the main problems and conflicts affecting the SSEMM by formulating guidelines for an ICZM public policy within a governance framework with goals aimed at the sustainability of human well-being and ecological conservation.
- 2. To focus attention on the management of public and common goods of the SSEMM, strengthening institutional capacity and favoring coordination and cooperation between different territorial scales of public management.
- 3. Involve all social and institutional agents involved or interested in the management of the SSEMM, promoting public awareness of its value to influence social behavior.
- 4. To facilitate dialogue between different disciplines of knowledge, orienting them towards a better integration with decision-making processes in the public and private spheres.
- 5. To provide priority strategic lines for the sustainable development of the different sectors of activity in the Mar Menor and the basin of influence (urban planning, development of large infrastructures, agriculture, management of tourist activity, management of nautical and sporting activities, fishing...).

And four (operational) objectives for action on coastal areas:

6. To act in the SSEMM respecting natural processes with the intention of improving and protecting the structure and functions of coastal marine ecosystems to conserve their services to human well-being.



- 7. To achieve the quality of the lagoon and aquifer waters required by the Framework Directive.
- 8. To recover the attractiveness of the SSEMM, with special emphasis on the urban contour of the lagoon and its natural and cultural heritage, so that it becomes an attractive place to live and economically competitive.
- 9. To reduce maintenance costs through the recovery of the services provided by the socio-ecological system, promoting an equitable distribution of costs and benefits among the activities developed in the SSEMM.

To achieve these objectives, actions, instruments, and sectorial and operational plans (planned for the coming years) have been established with guidelines and connections of special interest for the Strategy.

For its part, Plan de Gestión Integral de los Espacios Protegidos del Mar Menor y la Franja Litoral Mediterránea de la Región de Murcia, approved in October 2019 is the planning instrument for the Natura 2000 areas (Picazo et al., 2021). It establishes a zoning of the scope of the plan and a set of management measures applicable to the uses and activities in these areas, through a series of guidelines and concrete actions, both general and specific. conservation and management of protected areas.

II.3. Main natural heritage and biodiversity regulations in Murcia

The main regulation in relation to the protection of the territory in Murcia is Law 4/1992 on Territorial Planning and Protection of the Region of Murcia, which in its third additional provision and in accordance with the provisions of Title III of Law 4/1989, of March 27, on the conservation of natural spaces and wild flora and fauna, and in accordance with Title VI of the aforementioned Law, declares the protected natural spaces of the Region of Murcia. (7 Regional Parks / 7 Protected Landscapes / 1 Natural Reserve / 2 Natural Monuments / 5 ENP without protection figure).

This law provides the bases and competences for the development of the natural resources management plans, which are the main instrument for the planning and management of these resources in the Region of Murcia, and of its natural spaces. As regards the current situation of the planning and management of the protected areas included in the Network of Protected Natural Spaces (Natural Resources Management Plans, PORN, and Master Plans for Use and Management, PRUG), 6 of them are still being processed, and 4 have been initially approved. The progress made in the planning of these protected areas in the Region of Murcia has been insufficient since the publication of Law 4/1992 on the Management and Protection of the Territory of the Region of Murcia. Furthermore, even in the case of definitively approved PORNs, the instruments foreseen in them, such as the Master Plans for Use and Management (PRUG), have not been developed. To date, only the PRUG of the Regional Park of the Salinas de San Pedro has been approved, an approval made in Decree No. 259/2019, declaring the ZECs of the Mar Menor and approving its Integral Management Plan (Picazo et al., 2021).



This law incorporates among its protected coastal areas such as the "Regional Park of Calnegre and Cabo Cope", the "Regional Park of Salinas and Arenales de San Pedro del Pinatar", the protected landscapes "Open spaces and islands of the Mar Menor", "Cuatro Calas", "Open spaces and islands of the Mar Menor", which also have the additional figures of protection provided by European and international standards (European Ecological Network Natura 2000, RAMSA, ZEPIM).

At the regional level, the conservation of flora is governed by Decree 50/2003 of May 30, 2003, which establishes the Regional Catalogue of Protected Wild Flora and establishes rules for the use of various forest species, one of its objectives being to graduate the protection effort of endangered species in the Region through the use of the categories used in the National Catalogue: "In danger of extinction", "Vulnerable" and "Of special interest", in attention to the relative importance of the risks affecting their respective populations and, consequently to the priority in the elaboration of recovery, conservation, or management plans for said species., no marine species are indicated in this catalogue.

Regarding Fauna, Article 17 of Law 7/1995 on Wild Fauna lists the species considered endangered in the Region of Murcia. Within this catalogue, the marine species *Aphanius iberus* (Fartet) is found within the category "in danger of extinction", which has an approved Recovery Plan (Decree n° 59/2016) in compliance with Article 18 of said Law which establishes that the species, subspecies, or populations that are in the category "in danger of extinction" must have a Recovery Plan.

II.4. Murcia policy for the control and monitoring of climate change

The possible effects of global warming on the economy, society and ecosystems are diverse. In the case of the Region of Murcia, those derived from the rise in temperature and alteration of the seasons, those derived from extreme climatological phenomena such as torrential rainfall, the effects on health, the rise in sea level and the alteration in the amount and distribution of rainfall are being considered of special interest. The Region of Murcia has a behavior like that of the rest of the territories in the Mediterranean area, with a constant increase in the average annual temperature.

Another consequence of climate change is the rise in sea level. The two main causes of this rise are thermal expansion (warm water occupies more volume than cold water) and the water provided by melting land ice. In the Mediterranean, since the 1990s, sea level has risen at a rate of 2.4-8.7 millimeters/year more than the rest of the world's seas. The information provided by the tide gauges of the State Ports Network shows, at various points in the Mediterranean Sea, a trend in the rise in sea level of about 5 millimeters/year, on average, for 20 years.

In the Region of Murcia, concern is focused on the Manga del Mar Menor and its surroundings, as it has a very flat topography that barely rises 30 or 40 centimeters from the sea in many of its points. One of the main consequences of the rise in sea level is the loss of beaches due to the more aggressive effect of the coastal dynamics. Thus,



storms in winter are more aggressive with each increase in sea level, even if it is millimetric, with the consequent increase in sand loss on the beaches. A sea level rise of 5 millimeters/year, such as those recorded on the Mediterranean coast, requires sand inputs of 1.5 m³/year for each linear meter of beaches.

Also, climate change is causing warming and acidification in the marine environment. Because of the increase in water temperature in the Mediterranean (0.34 degrees Celsius per decade), it has been observed that fishing efforts are moving northward and increasingly farther away to obtain the same resources. Likewise, the presence of fish belonging to thermophilic species, characteristic of warmer water areas such as the Canary Islands, has been detected on the coasts of the Region of Murcia. Climate change will also affect the structure of some marine communities such as the *Posidonia oceanica* meadow, which is very sensitive to increases in temperature and salinity. Seagrass meadows, in general, have an important rate of CO_2 capture, which makes them an important carbon sink.

The Region of Murcia has a Regional Strategy for Mitigation and Adaptation to Climate Change, which was approved in June 2020, and which is structured around two main objectives:

Objective 1: Reduce emissions from diffuse sectors (transport, other industrial activities, commerce, agriculture, waste management, *etc.*) by 26% by 2030.

Objective 2: Achieve a region less vulnerable to climate change.

To achieve these objectives, fifteen major strategic lines of action are developed. Lines 8 and 9 are directly linked to the coast and the conservation of biodiversity and protected areas.

LINE 8. Apply future sea level rise scenarios to urban planning decisions on the coast and initiate the adaptation of urban spaces and infrastructures that are foreseeably affected. Within the framework of this Strategic Line of Action, the goal to be pursued is to identify the coastal areas that will be affected by the rise in mean sea level in the future and to lay the foundations for defining adaptation actions.

LINE 9. Promote adaptation to climate change in the natural environment in aspects related to biodiversity conservation and protected areas. Within this Strategic Line, the Administration responsible for biodiversity and protected areas would develop the following measures:

- Determination of the habitats and species most sensitive to climate change and modeling of possible changes in their structure and composition, in relation to various climate scenarios, especially in protected areas and in highly sensitive environments such as relict forests, habitats associated with the presence of fresh water, high mountain vegetation, marine environment, *etc.*
- Identification of needs for adaptation to change, among which management and management methods should be analyzed, including restoration or conservation actions to maintain a favorable conservation status of plant species and



communities (including habitats of community interest) to increase their capacity to adapt to climate change (resilience).

- Promotion of connectivity between ecosystems to allow species migration, prioritizing the conservation of existing corridors and avoiding habitat fragmentation.
- Control of phenological changes and life cycle, as well as the possible expansion of certain invasive exotic species for the establishment of intervention plans.
- Design of a monitoring network on the status, composition and distribution of habitats and species, with the establishment of indicators and implementation of GIS technology.
- Establishment of coordination with other Autonomous Communities, especially neighboring communities with which we are biogeographically related.
- Elaboration of guidelines for the management and use of species and resources in the natural environment under climate change, as well as the way in which current impacts (overgrazing, water extraction, hunting, *etc.*) may be enhanced or modified.
- Assessment and control of foreseeable impacts on species and natural habitats in a climate change scenario, to avoid negative interactions with changes in land use and to detect activities that may become unsustainable.
- Knowledge of the effect of the land ownership regime of the most vulnerable communities and species on the implementation of adaptation and mitigation actions.
- A program to disseminate information on the problem, making known the needs and modern techniques in restoration and conservation work, transmitting to society the value of plant communities that are adapted to our current and future climate scenario. The main recipients of this dissemination should be those sectors related to the management and handling of forest systems and natural habitats: political authorities, NGOs, forest owners, companies in the sector, public administration technicians, *etc.*



III. Assessment of human pressures on ecosystems in touristic coastal region of Murcia

n accordance with the Marine Strategy Framework Directive (MSFD) and Law 41/2010 on the protection of the marine environment (LPMM) and within the preparatory actions, in 2012 the then Ministry of Agriculture, Food and Environment, proceeded to the publication, after a public consultation process, of the documents for the initial assessment, good environmental status and environmental objectives of the Levantine-Balearic marine demarcation (DM LEBA), within which the Region of Murcia is included.

The DMEM and the LPMM established that the initial assessment to be carried out by the Member States of the marine environment should include the assessment of the environmental status and the impact of human activities on the marine environment of each marine demarcation.

Tourism and leisure activities have a very prominent place in the Region, with sun and beaches being a great attraction. Of the 1,360 beaches located in this demarcation, 400 have a good number of service infrastructures and 290 have none. To curb erosion and improve their conditions, a volume of material of 1,789,604 m³ has been contributed to this demarcation, whose origin is different from the underwater deposits. Surfing and diving activities are practiced in 87 and 148 areas respectively, there being 55,000 licenses for underwater activities in 2016. There are 150 marinas with some 72,000 available moorings and anchoring is practiced on 594 beaches. The average annual number of overnight stays in the provinces of this demarcation is about 180,000,000.

Regarding maritime transport, it should be noted that there are 8 Port Authorities in the Demarcation, with some 153 linear km of docks in 2016, 335,606 vessels called at the Demarcation's ports in the 2011-2016 period, moving 1,227 million tons of goods and transferring 67.1 million passengers. For the maintenance of the drafts or extensions of the infrastructures, port dredging works have been carried out, which have involved an extraction of 6,000,000 m³ of which 3,000,000 m³ have been used in port fillings. Fishing, shell fishing and aquaculture are activities with an important socioeconomic impact in this demarcation. The area devoted to the production of mollusks and other marine invertebrates is 1,957 km², with a production of 5,000 tons. Controlled fish farming and fattening in marine aquaculture facilities contributed 27,000 tons of production in 2016. In this demarcation there is a hydrocarbon extraction area, linked to the Casablanca platform, which extracts some 215,000 tons per year of crude oil. Seawater extraction is another activity to be considered in this demarcation with a maximum authorized extraction flow for desalination plants and cooling water of 280 Hm³/year. Throughout the assessment period, the length of submarine cables laid is estimated at 940 km with 5 new cables in the demarcation.



III.1. Human pressures on Mediterranean marine ecosystems

In the analysis of pressures carried out in the strategy, a distinction is made between physical pressures and pressures due to the input of substances, waste, and energy.

- <u>Physical pressures</u>: physical disturbances of the seabed that are temporary or reversible and physical losses due to a permanent change in the substrate or seabed morphology and the removal of substrate from the seabed are considered.
 - 10. Physical disturbance of the seabed (temporary or reversible) by sediment removal resulting from the installation of buried structures, anchoring of vessels, dumping of dredged material, and trawling. The minimum area of the seabed of the DM LEBA that has suffered some type of disturbance during the 2011-2016 assessment period is 311 km2 which represents 0.13% of the area of the demarcation. In the Region of Murcia, the area with a very high probability of seabed disturbance is in Mazarrón, and no coastal areas with a high probability have been identified. On the other hand, the area with a moderate probability of disturbance is in the port area of Cartagena (Fig. 2).
 - 11. Permanent change of the substrate or the morphology of the seabed and the extraction of substrate from the seabed. The installation of different permanent infrastructures in the marine environment causes the seabed to be sealed. The Region of Murcia has not contributed surface area to this pressure in the evaluated cycle (Fig. 2).





- **Figure 2.** Location of the areas of the seabed disturbed by anchoring according to the probability of disturbance in the southern part of the Levante-Balearic Demarcation (MITECO. Figure prepared by CEDEX from SASEMAR AIS data)
- Substances, waste, and energy: the materials covered are nutrients (especially nitrate and phosphate), organic matter and other pollutants from urban or industrial discharges, rivers, dredged material discharges, atmospheric deposition, and ship discharges. In most cases, these discharges lead to an increase in the activity of decomposing organisms, resulting in a decrease in available oxygen. Depending on the substance of the spill, it can also lead to pollution of the ecosystem by toxic substances. The main sources that contribute nutrients to the coastal waters of the different hydrographic districts that intersect with the Levantine-Balearic marine district are direct discharges (installations) and inputs from rivers.

For the N-total, the number of complexes with annual information is around 30, and the maximum load contributed took place in 2015, when it exceeded 21 kt. Of all the N-total contributed to the period 2011-2016 to Spanish waters by facilities reporting to the PRTR, 51% was in the DM LEBA. The Segura River basin district has a low number of facilities contributing Total N (Fig. 3).





Figure 3. Total N inputs to the Levantine-Balearic coast (MITECO. From PRTR registry data)

The contributions of P-Total by direct discharges are an order of magnitude lower than those of N-Total, with a maximum of 1.89 kt in 2015. For the overall study period, the DM LEBA contributes 45% of the total P-total contributed by complexes reporting to the PRTR. As in the previous case, the Segura River basin district has a low number of facilities that contribute P-Total (Fig. 4).

In the contributions from rivers, of the parameters evaluated only for total nitrogen and total phosphorus, the contributions of the Segura district are higher than those of the other river basin districts or show an upward trend, as shown in the following Figures 5, 6, 7 and 8.



Figure 4. Total P inputs to the Levantine-Balearic coast (MITECO. Figure elaborated by CEDEX from PRTR registry data)





Figure 5. Number of rivers with data and upper estimate of annual nitrogen input in the form of ammonium from rivers (MITECO. Figure prepared by CEDEX based on data supplied by the DGA)



Figure 6. Number of rivers with data and upper estimate of annual nitrogen input in the form of nitrate from rivers (MITECO. Figure of CEDEX based on data supplied by the DGA)





Figure 7. Number of rivers with data and upper estimate of annual nitrogen input in the form of total nitrogen from rivers (MITECO. Figure prepared by CEDEX based on data supplied by the DGA)



Figure 8. Number of rivers with data and upper estimate of annual total phosphorus input from rivers (MITECO. Figure prepared by CEDEX based on data supplied by the DGA)



III.2. Measures to respond to pressures on ecosystems

The marine strategy for the Levantine-Balearic demarcation includes the evaluation of the environmental status of the waters, the determination of the good environmental status, the setting of environmental objectives to be achieved, a monitoring program and a program of measures to achieve these objectives.

The monitoring programs include, among others, measures to respond to pressures on the marine environment. The main aspects of the DMLB MS monitoring program for the cycle (2018-2024) for the human pressures listed in the previous section are summarized below.

- Physical disturbance of the seabed: the intensity and temporal variation of this pressure on the marine environment is assessed to calculate the marine area affected by each of them. The following indicators are used for this assessment: seabed area disturbed by dumping of dredged material (m²), seabed area disturbed by submarine cables (m²), seabed area disturbed by marine aquaculture facilities (m²), seabed area disturbed by anchoring of commercial vessels (m²), seabed area disturbed by anchoring of sport boats (m²), seabed area disturbed by bottom trawling (m²).
- Physical losses: The intensity and spatio-temporal variation of this pressure on the marine environment is evaluated. The following indicators are used for this assessment: seabed area affected by new port infrastructures or by modification of existing ones (m²), seabed area affected by new defense works or by modification of existing ones (m²), seabed area occupied by new artificial reefs (m²), seabed area occupied by new oil and gas extraction infrastructures (m²), seabed area occupied by new offshore wind farms (m²), seabed area occupied by new scientific-technical platforms (m²), seabed area affected by the extraction of sediments from the seabed for beach regeneration (m²), seabed area affected by port dredging (m²), seabed area affected by the creation of artificial beaches (m²).
- <u>Nutrient inputs</u>: The spatio-temporal variation of nutrient inputs to the marine environment by rivers, direct discharges from land and marine aquaculture as well as atmospheric deposition is evaluated. In the specific case of the Mar Menor, the monitoring of diffuse pollution is being reinforced by including in the control network more sampling points of the contribution of the quaternary aquifer that discharges into the lagoon.

The indicators are:

- Nitrogen inputs in the form of ammonium from rivers (kt/year),
- Nitrogen inputs in the form of ammonium by direct discharge (kt/year),
- Total nitrogen inputs from rivers (kt/year),
- Total nitrogen inputs by direct discharge (kt/year),



- Nitrogen inputs in the form of nitrates from rivers (kt/year),
- Nitrogen inputs in the form of nitrates by direct discharges (kt/year),
- Phosphorus inputs in the form of orthophosphate from rivers (kt/year),
- Phosphorus inputs in the form of orthophosphate by direct discharge (kt/ year),
- Total phosphorus inputs from rivers (kt/year),
- Total phosphorus inputs by direct discharge (kt/year),
- Nitrogen inputs in the form of ammonium by coastal or transitional water mass by direct discharge (kt/year),
- Nitrogen inputs in the form of nitrate per coastal or transitional water body by direct discharge (kt/year),
- Total nitrogen inputs per coastal or transitional water body by direct discharge (kt/year),
- Phosphorus inputs in the form of orthophosphate per coastal or transitional water body by direct discharge (kt/year),
- Total phosphorus inputs per coastal or transitional water body by direct discharge (kt/year),
- Mass of oxidized nitrogen deposited from the atmosphere per unit area (mg N/m²/year),
- Mass of reduced nitrogen deposited from the atmosphere per unit area (mg N/m²/year).
- **Organic matter input.** The input to the marine environment of organic matter (evaluated as COD and TOC) from direct discharges from land is evaluated. COD contributed by facilities reporting to the PRTR (kg/year), TOC contributed by facilities reporting to the PRTR (kg/year).



IV. Tourism sustainability

The Region of Murcia participates in the Inherit project "Sustainable tourism strategies to conserve and enhance the Mediterranean coast and maritime cultural heritage". It is an Interreg MED project, financed with European funds, which promotes sustainable tourism through the enhancement of natural heritage areas, identified as "INHERITURA" areas, and the integration of tourism activities to obtain sustainable destinations.

The objective of the project is to strengthen the protection of natural resources to address the problems generated by peak tourism, seasonality, and mass tourism in coastal and maritime tourism destinations in the Mediterranean.

The project is expected to result in:

- Mediterranean-wide protection measures to address the negative effects of intensive tourist flows.
- "INHERITURE areas", i.e., designated areas where human activities coexist with significant natural heritage, subscribe to the INHERIT protection approach and act as models to extend and bring the approach to other areas of the Mediterranean.
- A network and management mechanism for the INHERITURA areas that will assume sustainability and export to other Mediterranean coastal areas after the completion of the project.
- Thematic tourist routes, which will be integrated on a pilot basis in the INHERITURA areas using the enhanced protection of the environment and natural heritage as an asset to increase the tourist attractiveness in a sustainable way.



V. Conclusions

he main conclusions of this work are:

- The biological richness of Murcia is evident in the important representation that this region has in the European ecological network Natura 2000.
- The strategy of integrated management of coastal areas in the Mar Menor and its surroundings, develops plans for the management of the protected areas of the Mar Menor and the Mediterranean Coastal Strip of the Region of Murcia, landscape, tourism, and cultural heritage.
- The Region of Murcia is home to 5 types of marine and coastal habitats of Community interest, included in 2 Special Protection Areas (SPA) specifically designated for their conservation: "Submerged Coastal Strip of the Region of Murcia" (ES6200029) and "Mar Menor" (ES6200030).
- The Region of Murcia has developed a Regional Strategy for Climate Change Mitigation and Adaptation, which has two strategic lines that are directly linked to the coast and the conservation of biodiversity and protected areas.
- The marine strategy for the Levantine-Balearic demarcation, which includes the Region of Murcia, has strategies and monitoring programs based on indicators to measure anthropic pressures on the marine environment.
- The Region of Murcia participates in a European project on sustainable tourism that aims to address the problems of tourism in coastal and maritime tourism destinations in the Mediterranean.



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