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Balearic Sea Report

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Balearic Sea Report

PREFACE

Improving the conservation status of the Balearic Sea is a goal our society shares. A collective desire reflected in many different commitments and legal frameworks. Progressing towards conservation requires a precise definition of what we mean by "status", performing an initial diagnosis to determine the state of our sea and being able to monitor its evolution over time. The BALEARIC SEA REPORT is the result of this need.

Assessing the status and variability of the Balearic Sea is no easy task. The sea is a complex, three-dimensional space, which varies greatly in space and time, in which many environmental economic and social aspects converge. The solution involves developing indicators that help us describe this situation and combining the efforts of all public and private institutions that have been studying and accumulating information about our sea for many years.

In order to tackle this challenge, at the end of 2018, Fundación Marilles proposed that the main scientific institutions in the Balearic Islands should work together towards a common goal: producing a report describing the status of the marine environment around the Balearic Islands, the pressures it is under and our responses as a society. An objective report, based on scientific grounds, intended to be expanded and updated regularly, which contains indicators that allow us to monitor the evolution of the Balearic Sea's status over time.

The response was positive and, in December 2018, we held the first meeting to make a project that began with the publication of this first version of the BALEARIC SEA REPORT a reality. A document that compiles a great deal of information that hitherto has not been widely available, which makes our shared heritage available to the public and gives visibility to the potential for collaboration between institutions.

A vast amount of work has gone into this publication. We would like to take the opportunity to express our gratitude for the efforts of dozens of researchers and technical staff who have shared information and selflessly devoted their time to this project. The Annex describes all of the indicators for which information is available but that we were unable to include in this first edition due to time constraints.

In spite of all of the information gathered, we are still far from being able to conduct a diagnosis of the status of the Balearic Sea. This report is the beginning of a long-term project, a snapshot of part of the information we have been able to gather to date, but not necessarily what we need. Over the coming months and years, we will continue to work to drive this collective project forward, bring new institutions on board and forming new collaborations. Over time, we will perfect this project together and refine the report's contents.

The BALEARIC SEA REPORT must not only make use of the available information, but also highlight the main gaps in data and the challenges involved in filling them, and clearly present the information to society. Its value lies not only in the data it presents, but also in the collaboration being forged between all of the participating institutions. We hope that this will be the first of many reports because if we do not have scientific data and verified information, it will be very difficult to progress towards better management and conservation of the Balearic Sea and coast with the many benefits that will provide.

INTRODUCTION

What is an indicator?

An indicator is a quantitative or qualitative measure that helps us easily understand how a variable changes over time. The main functions it must perform are: conveying, quantifying and simplifying information. A good indicator allows us to convert complicated phenomena into quantifiable data so they can be easily interpreted by specialist and non-specialist readers.[1]

Much has been written about the characteristics that an indicator should ideally have[2-6] and they are summarised below. Although it is not always possible to meet all of the requirements, they are the framework of reference for the selection of indicators for the BALEARIC SEA REPORT.

- → Specific, concrete and quantifiable
- → Easy for non-expert readers to understand
- → Relevant to society
- → Easy to measure and using a robust methodology
- → Measurable over time to show trends
- → Sensitive to change
- → Comparable in time and space
- → Scientifically robust and statistically valid
- → Economically feasible
- → Useful for visualising future decision-making scenarios
- → Relevant at regulatory and legal level
- → Relevant in terms of management targets
- → Agreed on by consensus between the stakeholders involved

REGULATORY FRAMEWORK

Particular attention has been paid to the existing legislative framework in selecting the indicators for this first version of the BALEARIC SEA REPORT. To a large extent, this framework already sets clear objectives for the improvement of the marine and coastal environment. The Marine Strategy Framework Directive, a European directive through which Member States have undertaken to achieve good environmental status in the marine environment by 2025, should be highlighted. This directive contains agreed descriptors and indicators that each State must collect and analyse. The BALEARIC SEA REPORTincludes some of these indicators, as collected within the framework of the directive.

Below we present the list of legal frameworks at European, national and regional level, as well as international conventions that have been taken into account in the report. Each of the indicators in the BALEARIC SEA REPORT is relevant for one or more of these legal frameworks.

1) Regional, national and European legal and institutional framework:

- → Marine Strategy Framework Directive
- → Habitats Directive
- → Water Framework Directive
- → Bathing Water Quality Directive
- → Spanish Natural Heritage and Biodiversity Act [*Ley del patrimonio natural y la biodiversity*]
- → Spanish Marine Environment Protection Act [*Ley de protección del medio marino*]
- → Royal Decree developing the list of specially protected wild species and the Spanish catalogue of endangered species [*Real Decreto para el desarrollo del Listado de especies silvestres en régimen de protección especial y del Catálogo español de especies amenazadas*]
- → Decree creating the Balearic catalogue of endangered and specially protected species [*Decreto por el que se crea el Catálogo balear de especies amenazadas y de especial protección*]

- Regulation of the European Parliament and of the Council on the Common Fisheries Policy
- Royal Decree approving the Hydrological Planning Regulations [*Real Decreto por el que se aprueba el Reglamento de la Planificación Hidrológica*]
- Decree-Law approving the Hydrological Planning Instruction for the intra-community hydrographic demarcation of the Balearic Islands [*Decreto Ley por el que se aprueba la Instrucción de Planificación Hidrológica para la demarcación hidrográfica intracomunitaria de las Islas Baleares*]
- Royal Decree establishing the criteria for monitoring and evaluation of the status of surface water and environmental quality standards [*Real Decreto por el que se establecen los criterios de seguimiento y evaluación del status de las aguas superficiales y las normas de calidad ambiental*]
- Council Regulation (EC) concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea
- Decree regulating sport and recreational fishing in the internal waters of the Balearic Islands [*Decreto por el que se regula la pesca deportiva y recreativa en las aguas interiores de las Islas Baleares*]
- Decree on the conservation of Posidonia oceanica in the Balearic Islands [*Decreto sobre la conservación de la Posidonia oceanica en las Islas Baleares*].
- Decision of the European Parliament and of the Council establishing the list of priority substances in the field of water policy
- Commission Decision on criteria and methodological standards on good environmental status of marine waters
- Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy

2) International conventions:

- Barcelona Convention for the protection of the Mediterranean (Barcelona Convention)
- Convention on Biological Diversity
- Convention on the Conservation of European Wildlife and Natural Habitats (Berne Convention)
- Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets

PRIOR WORK

In recent years, similar initiatives or objectives to those of the BALEARIC SEA REPORT have been promoted. The work and participative process led by IMEDEA (CSIC-UIB) and the Economic and Social Council should be highlighted. This culminated in 2007 with the identification and prioritisation of indicators for Integrated Coastal Zone Management (*Gestión Integrada de Zonas Costeras GIZC*) in the Balearic Islands, as well as other studies, campaigns and reports that are relevant at Balearic, Spanish and Mediterranean level. All of these, together with numerous scientific publications, have been consulted in order to provide content and inspire ideas for the configuration of the Balearic Sea Report."Gestión Integrada de la Zona Costera (GIZC) de las Islas Baleares" (2007) (CES, IMEDEA (UIB-CSIC), Govern de les Illes Balears) y publicaciones internacionales relacionadas.

- "Gestión Integrada de la Zona Costera (GIZC) de las Islas Baleares" (2007) (CES, IMEDEA (UIB-CSIC), Govern de les Illes Balears) and related international publications.
- "Estudio sobre la prospectiva económica, social y medioambiental de las sociedades de las Islas Baleares en el horizonte 2030 (H2030)" (CES, UIB).
- "Indicadores de sostenibilidad socioecológica de las Islas Baleares" (Observatorio de Sostenibilidad y Territorio).
- Reports by the General Fisheries Commission for the Mediterranean (GFCM-FAO).
- Reports by the Scientific, Technical and Economic
- Committee for Fisheries (STECF).
- Annual reports of the MEDITS campaign (IEO).
- Monitoring reports on fish in marine reserves of fishing interest (Direcció General de Pesca i Medi Marí, Govern de les Illes Balears).

- "Canal de Menorca. Áreas de estudio del proyecto LIFE+ INDEMARES" report with monitoring information about the Balearic Sea.
- Indicator reports by Observatori Socioambiental de Menorca (OBSAM).
- European reports on the blue growth strategy.
- Report on the General Ports Plan for the Balearic Islands 2018-2033.
- Annual Reports by Centro de Coordinación de Limpieza del Litoral (ABAQUA) on the collection of debris and the Direcció General Salut Pública i Participació on health monitoring of bathing water in the Balearic Islands.

STRUCTURE OF THE REPORT

The description of each indicator justifies why it was important to include it in the report, the regulations to which it is subject and, when applicable, the optimal or desirable range of values. The methodology used to obtain and analyse the data is also described and the main results for each indicator are presented. Finally, each indicator is accompanied with a summary sheet showing the information presented in a more graphical format.

Data for 101 indicators have been included, classified in 4 categories: Status, Pressure, Response and Socioeconomic (Figure 1). The Status-Pressure-Response structure has been widely used and accepted since it was established at the beginning of the 1990s.[7]

i) Status ==> What is the current situation and how is the status of the sea evolving over time?

These indicators provide information about the health of the marine ecosystem and reflect trends concerning physicochemical variables, habitats and species. The majority are stipulated in directives or European or national legislation. In many cases these define a reference system to be able to interpret the indicator's results. While the optimal values for a particular indicator for the Balearic Sea are often unknown, the "status" category is the longest section in this report.

ii) Pressure ==> What pressures are on the Balearic Sea and how are they evolving?

Anthropogenic stressors that threaten the health of the marine environment (pollution, fishing pressure, human and tourism pressure, non-indigenous or invasive species, and climate change). There are clear gaps in information in this section and we hope to expand it with new indicators in future versions.

iii) Response ==> What are our responses, as a society, to alleviate an impact or problem?

This measures the effectiveness and performance of management to mitigate pressure on the marine environment and the quality of governance. The main aim is to achieve appropriate and successful management.

iv) Socioeconomic ==> How do the economy and Balearic society interact with the marine and coastal environment?

This describes indicators of economic and social activities related to the marine environment. Indicators for extraction and marketing of species (fish landings and aquaculture production) are included, as well as companies and jobs directly related to the sea.

SHEET LEGEND

Colour on the islands

Balearic Islands data.

Colour in the sea

Balearic Sea data.

Colour around the coast

Balearic coastal data.

Coloured points or areas

Local or regional data.

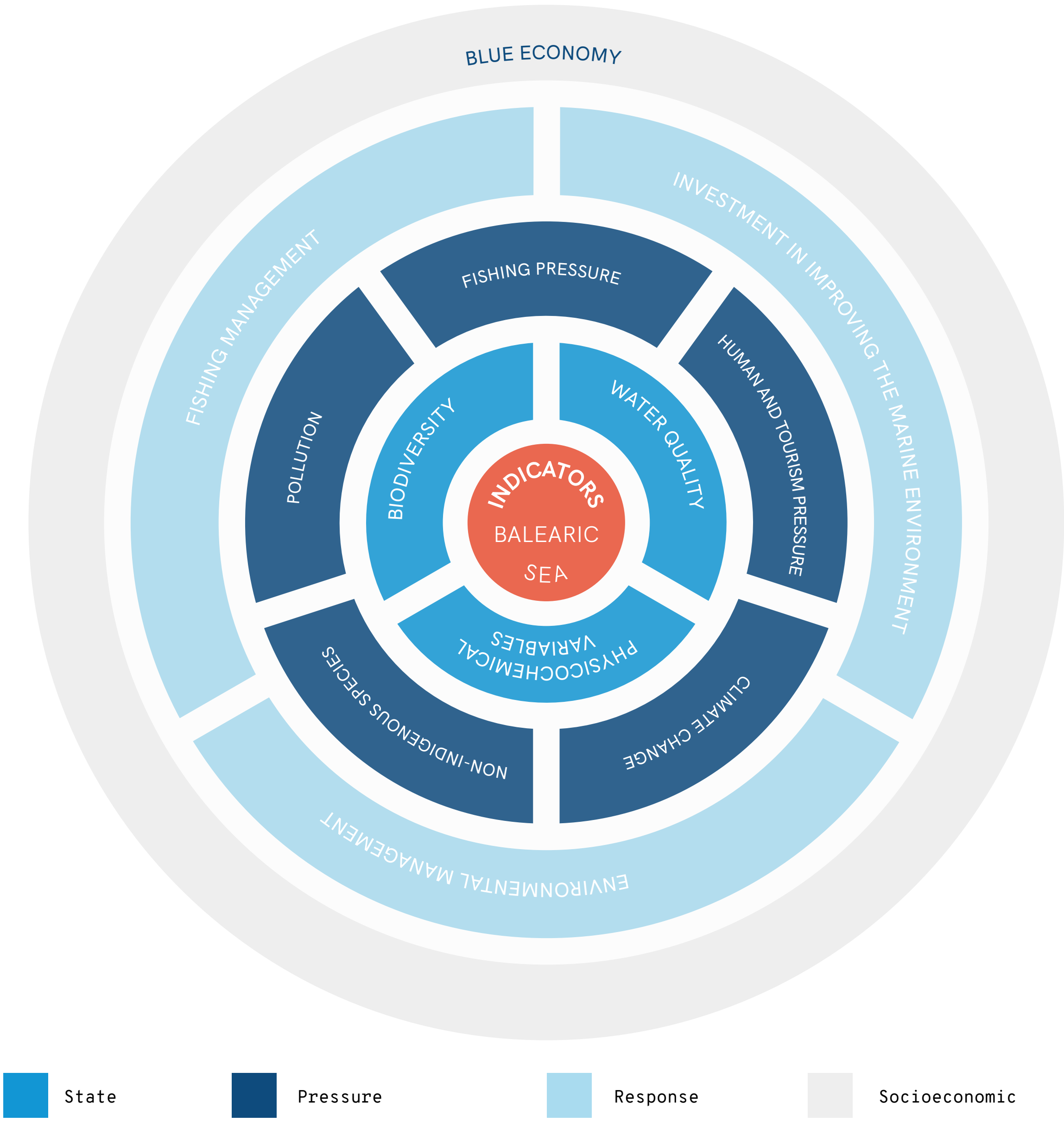

Figure 1. Conceptual chart displaying the structure of the Balearic Sea Report (2020), showing the 12 chapters attributed in the four categories of indicators that have been considered (Status – Pressure – Response – Socioeconomic).

REFERENCES

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[6] Jones-Walters, L. *et al.* (2012). "Streamlining European biodiversity indicators 2020: Building a future on lessons learnt from the SEBI 2010 process". *European Environmental Agency, Technical Report*, 11. Luxembourg: Publications Office of the European Union.

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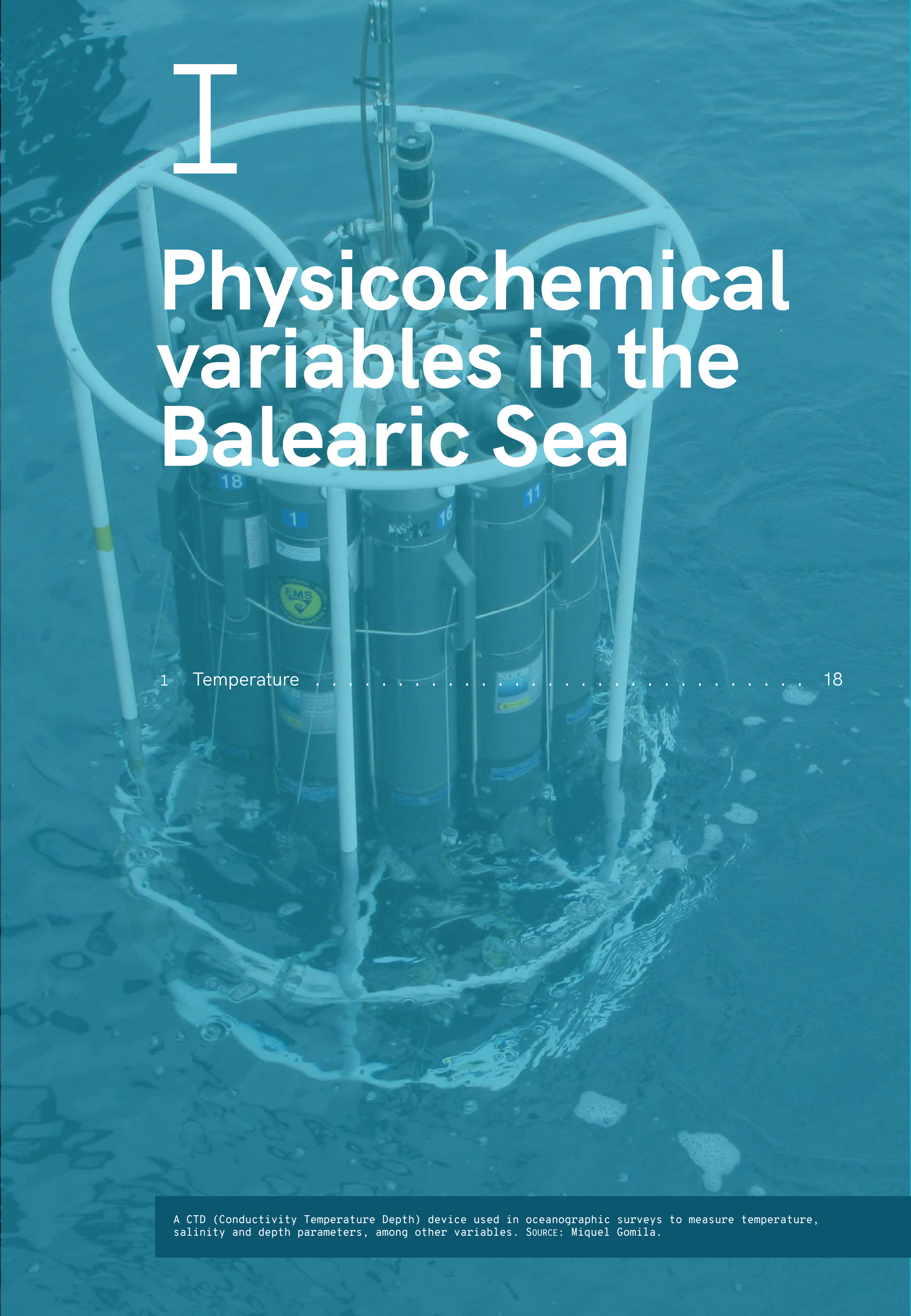
Status

Rocks near the shore on Cala Agulla beach, Mallorca. SOURCE: Sebastià Torrens.

I

Physicochemical variables in the Balearic Sea



A CTD (Conductivity Temperature Depth) device used in oceanographic surveys to measure temperature, salinity and depth parameters, among other variables. SOURCE: Miquel Gomila.

WHAT IS IT?

Temperature is an oceanic variable of great importance in the ecosystem. It conditions the survival, distribution and metabolism of species, ocean currents, the nutrients provided, the sea level and the exchange of gases with the atmosphere (which controls the acidification and oxygenation of the water). In addition, analysis of ocean temperature over time is a climate indicator since the ocean absorbs and stores large amounts of heat.

WHY?

Knowing and predicting changes in ocean temperature is crucial, as it can have a knock-on effect on the ecological status of the sea and the socioeconomic structure of the islands. The information provided by long time series of temperature contributes to defining adaptation strategies and mitigating risks.

METHODOLOGY

Temperature data is collected through various methods:

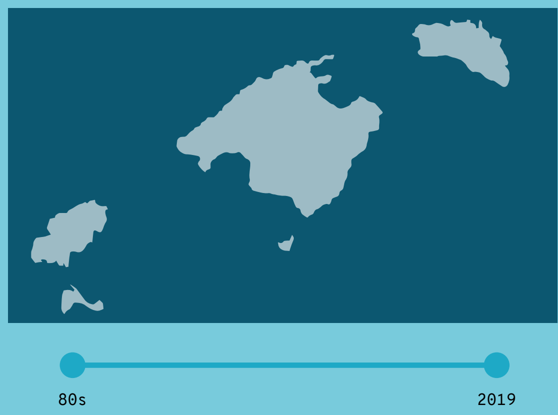
→ Satellite data (measures the sea surface temperature)

→ In situ measurements (measures the temperature on the surface and at depth):

  → Oceanographic surveys in which CTD (Conductivity Temperature Depth) devices are used.

  → Oceanographic buoys (fixed or mobile) that can transmit data by satellite.

LOCATION



RESULTS

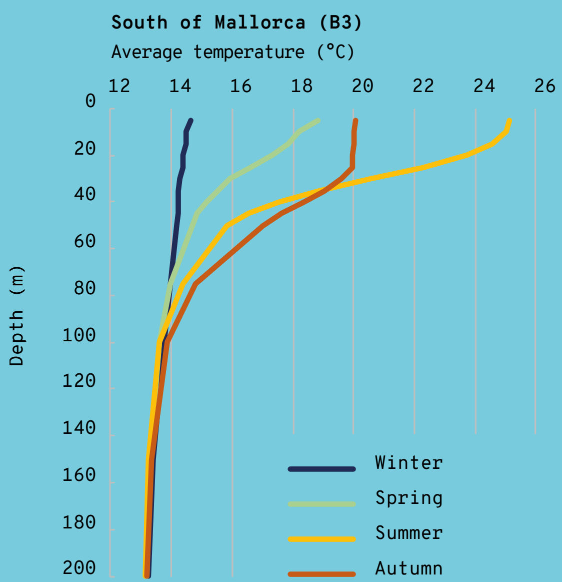
Over the last 37 years, satellite data have shown a 0.036 ± 0.006 °C/year increase in sea surface temperatures of the Western Mediterranean (Pisano *et al.*, 2020).

The average summer sea surface temperature reaches approximately 25 °C with a maximum of > 27 °C (Gomis *et al.*, 2020).

The winter-summer seasonal variation in sea surface temperature tends to be approximately 10-15 °C.

The temperature at depth in the various seasons converges towards the same value from 100 m water depth.

A



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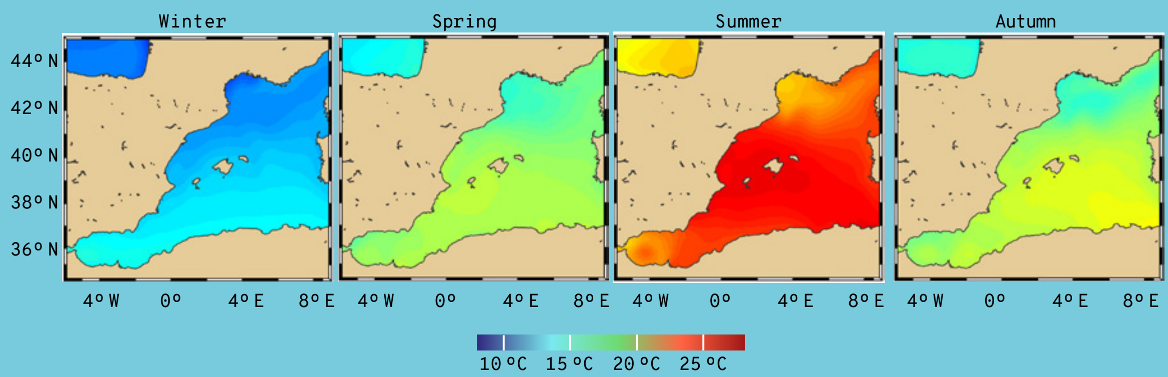
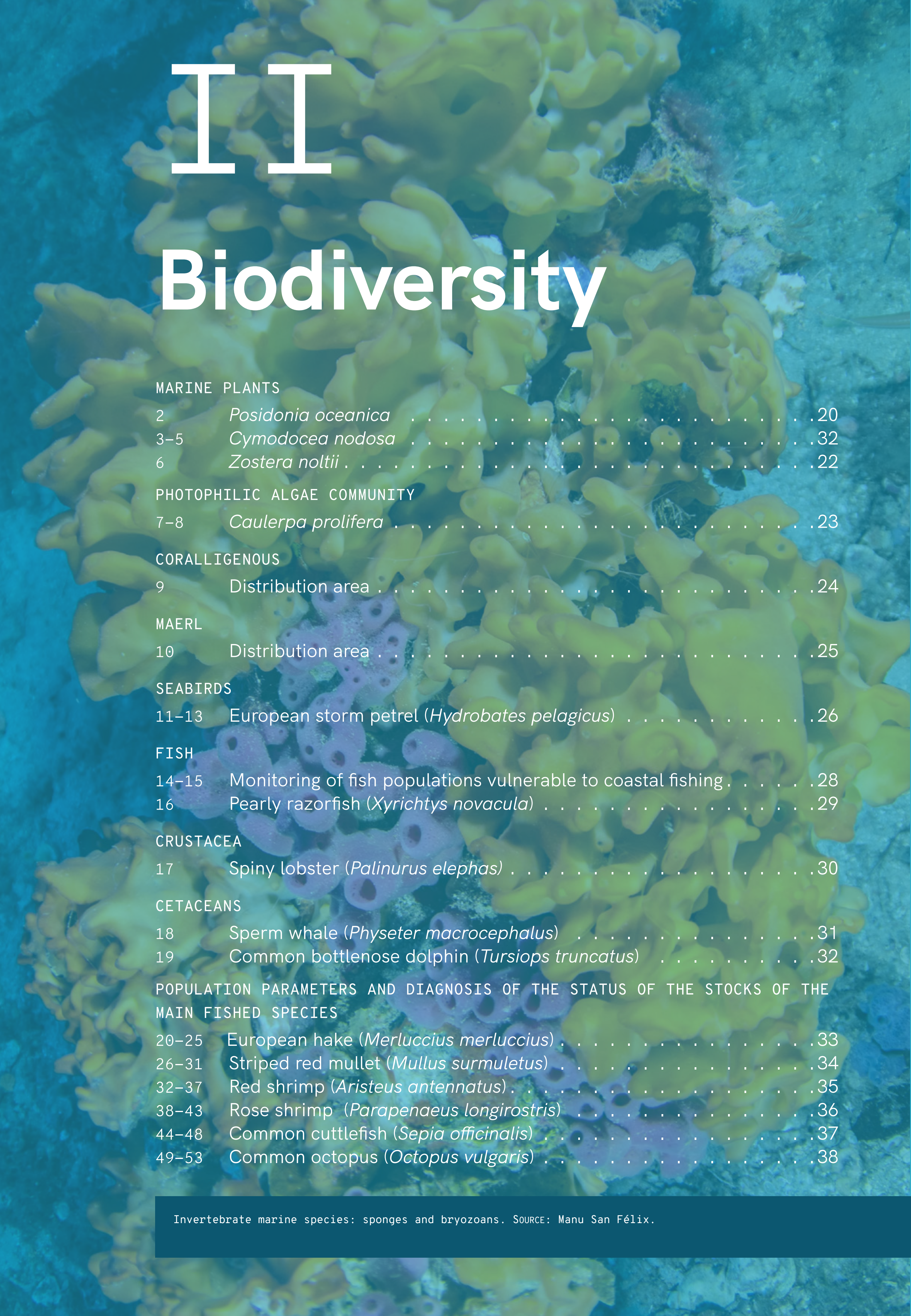


Panel A: temperature profile and depth measured by the RADMED B3 station to the south of Mallorca between 1994 and 2006 Source: Vargas-Yáñez *et al.* (2019). **Panel B:** satellite data showing the average seasonal surface temperature between 1985 and 2016. Source: Gomis *et al.* (2020).

II

Biodiversity



Invertebrate marine species: sponges and bryozoans. SOURCE: Manu San Félix.

Posidonia oceanica distribution area

WHAT IS IT?

The marine plant *Posidonia oceanica* is an endemic species of the Mediterranean Sea. It forms dense meadows in areas up to 40 metres deep. It provides a wide variety of ecological services (it acts as an important carbon sink, oxygenates the water, forms highly biodiverse habitats, produces sand and protects the coast).

WHY?

Posidonia meadows are declining. The Balearic Islands contain the 50 % of the total posidonia meadow area in Spain. It is currently protected as a species and as a habitat at European and national level. Knowing the total area covered by this plant is essential to ensure its conservation.

METHODOLOGY

The mapping compiled, unified and standardised by Julià *et al.* (2019) is presented here.

The results presented are based on the total area mapped in that study (4,395.95 km^2) and the total area covered by marine plants.

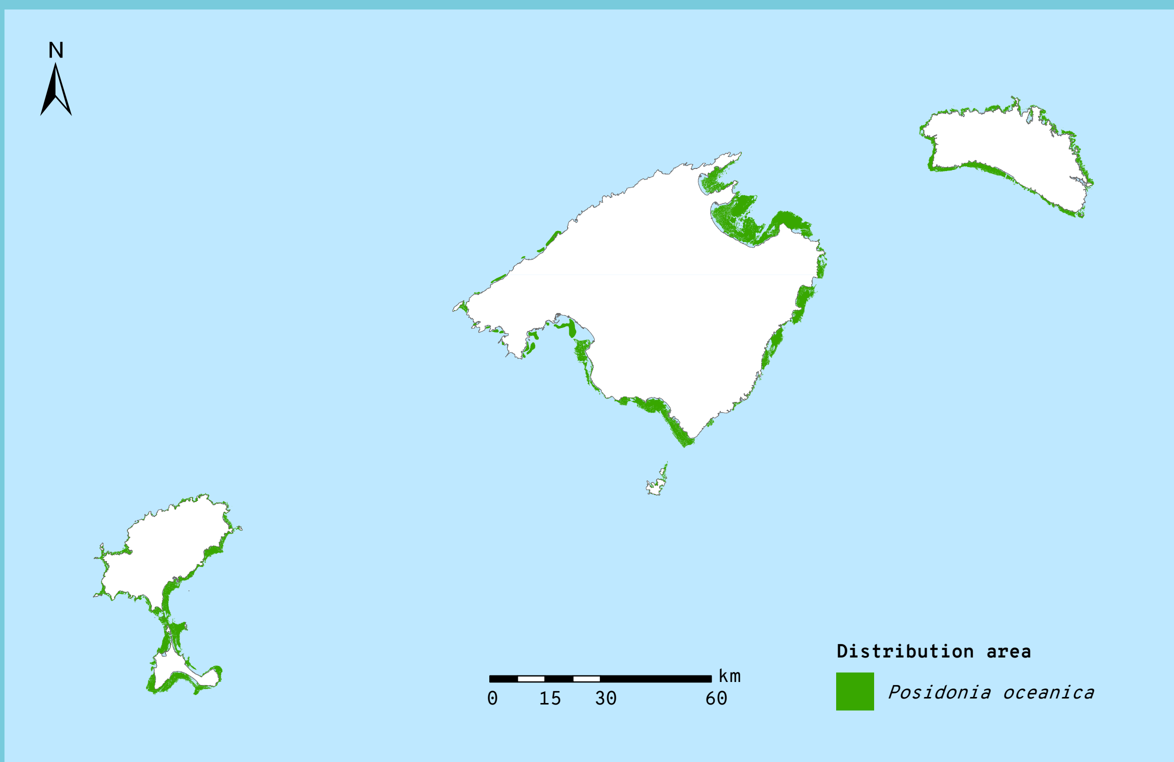
LOCATION

RESULTS

The total mapped area is approximately 459.8 km^2, representing the 10.5 % of the total mapped area.

In areas where posidonia coexists with other habitats, the mapped area covers a surface area of 602.6 km^2, equivalent to 13.7 % of the total mapped area.

Posidonia is present in 97.4 % of the total mapped habitats with marine plants.



Distribution area of *Posidonia oceanica* in the Balearic Islands. Source: Julià *et al.* (2019).

WHAT IS IT?

The marine plant *Cymodocea nodosa* is the second most important marine phanerogam in the Mediterranean—just behind *Posidonia oceanica*— due to both its size and the area covered by its meadows

RESULTS

This plant has a very dynamic distribution. In Mallorca, it is present in the bays of Alcúdia and Pollença, in the Palma Bay Marine Reserve and Portocolom Bay; in various places in Cabrera; in Menorca, in various places to the south of the island, as well as the bays of Fornells and Addaia, in Maó Port and in some areas to the east of the island, and in the Pitiüses, in Formentera and Es Freus, which separates the two islands, as well as in Cala Vedella and Talamanca.

Its area and distribution are underestimated. Improving its existing mapping and the precision of the mapped areas is necessary, as not all of its area of distribution has been mapped.

According to the data in Julià *et al.* (2019), the total area covered by this plant in the Balearic Sea in the form of single-species meadows is 3.32 km^2 (0.20 %) and 16.12 km^2 (0.96 %) when all of the habitats where it is present are considered.

Cymodocea nodosa meadow coverage in the areas studied in Menorca varied between 21.1 % in the Es Grau area and 68.9 % in Addaia Bay, while the average for all of the studied stations was 47.0 ± 3.1 %. The highest and lowest densities of Cymodocea nodosa were found in Menorca: 1,977.8 ± 325.4 plants/m^2 in S'Estany and 340.9 plants/m^2 in S'Arenal d'en Castell, both measured in summer 2006.

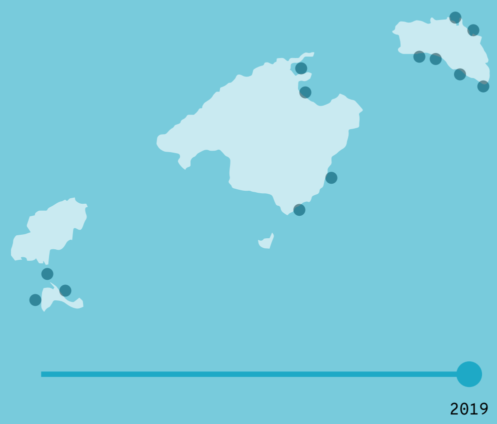
Cymodocea nodosa could expand its area of distribution, as it is a species very tolerant to high temperatures and thus global warming could benefit it.

WHY?

It is a species protected by Decree 139/2011 and the Barcelona Convention and its conservation must be ensured.

Global warming may increase its distribution, as it is resistant to increases in temperature.

LOCATION

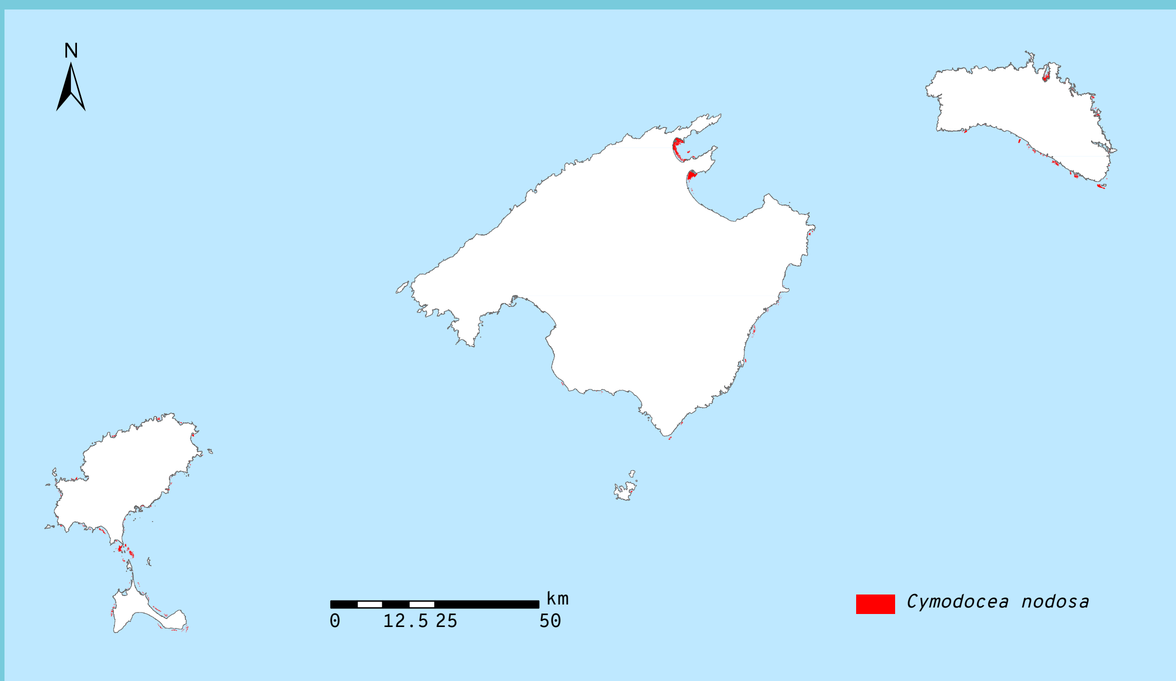


METHODOLOGY

Its area of distribution has been estimated using the unified mapping by Julià *et al.* (2019).

A study of its coverage in the north and northeast areas of Menorca was conducted in 2006 (Pons-Fàbregas, 2007).

Various studies have measured its density in Mallorca, Cabrera and Menorca (Fiona Tomàs [unpublished], Pons-Fàbregas, 2007 and Pérez *et al.*, 1997).



Distribution area of *Cymodocea nodosa* in the Balearic Islands. SOURCE: Julià *et al.* (2019).

Zostera noltii distribution area

WHAT IS IT?

The marine plant *Zostera noltii* is one of the five marine phanerogamae species distributed around the Western Mediterranean.

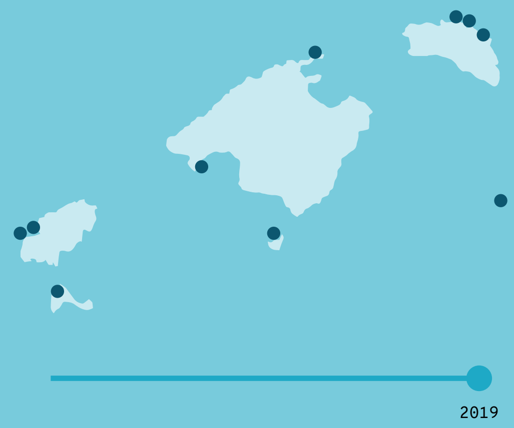
WHY?

It is a species protected by Decree 139/2011 and the Barcelona Convention and its conservation must be ensured.

METHODOLOGY

Zostera noltii distribution area has been estimated based on the unified mapping by Julià *et al.* (2019).

LOCATION

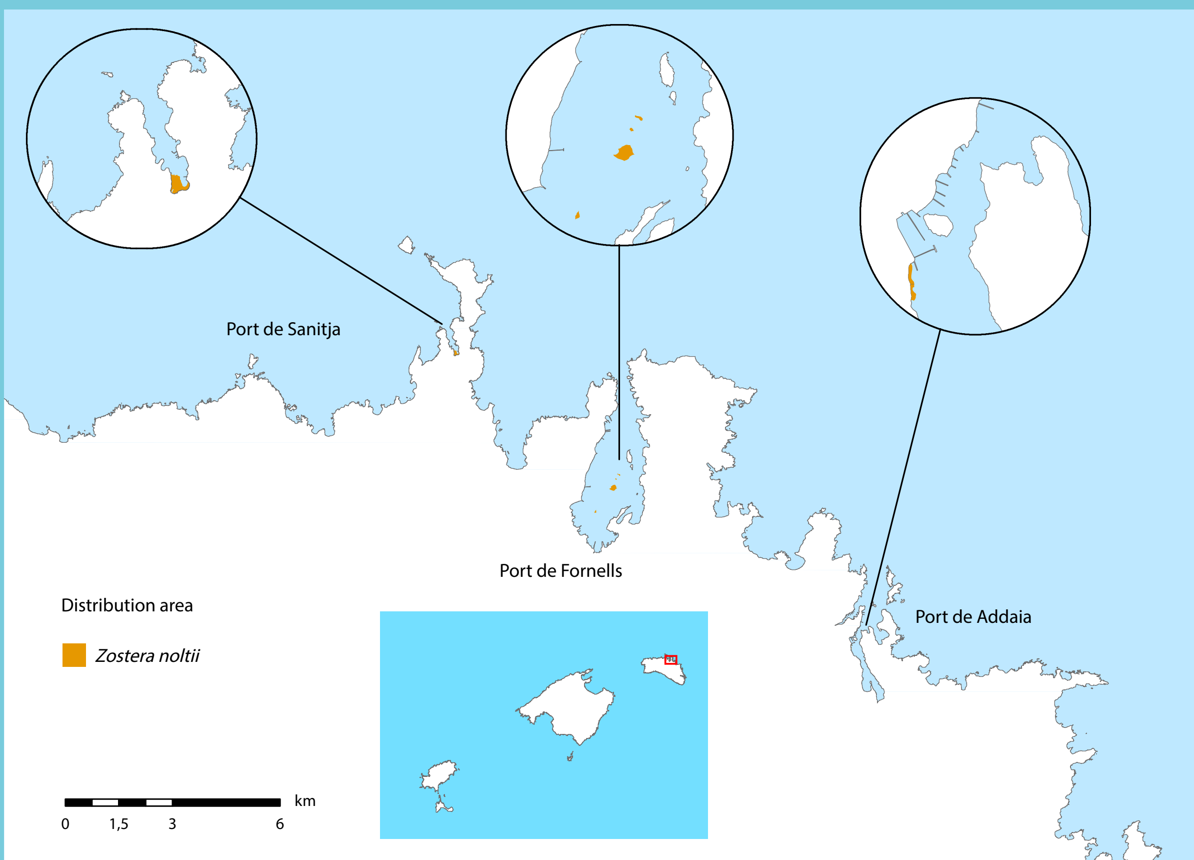


RESULTS

Zostera noltii is a plant resistant to changes in salinity and temperature. It is mainly found on muddy sand or in muddy shallow bottoms (0-5 m). In Menorca it has been recorded in the Fornells bay and the ports of Sanitja and Maó, and in Mallorca in Portals Vells and the Formentor area. It has also been found in Cabrera and Eivissa.

The area it covers and its distribution are underestimated. It is necessary to improve the existing mapping, since not all of its area of distribution has been mapped and an improved precision of the mapped areas is required.

Taking into account the data from the study by Julià *et al.* (2019), the total area covered by this plant in the Balearic Sea in the form of single-species meadows is 0.01 km^2, representing 0.0002 % of the total mapped area and 0.002 % of the area occupied by marine phanerogamae. When all the habitats where it is present (single-species meadows and mixed meadows with both *Cymodocea nodosa* and *Caulerpa prolifera*) are considered, the surface area it covers is 0.07 km^2, 0.0016% of the total mapped area and 0.01 % of the surface area occupied by marine phanerogamae meadows.



Distribution area of *Zostera noltii* in the Balearic Islands. Source: Julià *et al.* (2019).

WHAT IS IT?

The macroalga *Caulerpa prolifera* is an opportunistic green alga native to the Mediterranean, where it is extensively distributed except in cold areas such as the Gulf of Leon and the Adriatic Sea.

WHY?

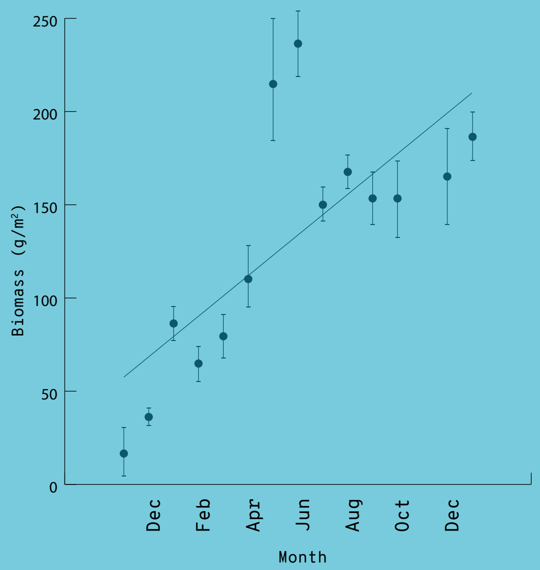
It is a species protected by Decree 139/2011 and its conservation must be ensured.

Global warming and increases of nutrients and organic inputs matter may increase its distribution.

METHODOLOGY

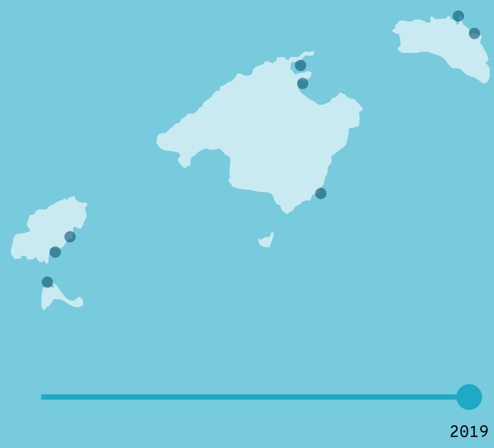
Its area of distribution has been estimated using the unified mapping by Julià *et al.* (2019).

The evolution of its biomass in the Portocolom Bay area was monitored between November 2008 and January 2010 (Ruiz-Halpern *et al.*, 2014; Vaquer-Sunyer *et al.*, 2012).



Evolution of *Caulerpa prolifera* biomass in Sa Bassa Nova de Portocolom between November 2008 and January 2010 (Sources: Ruiz-Halpern *et al.*, 2014; Vaquer-Sunyer *et al.*, 2012).

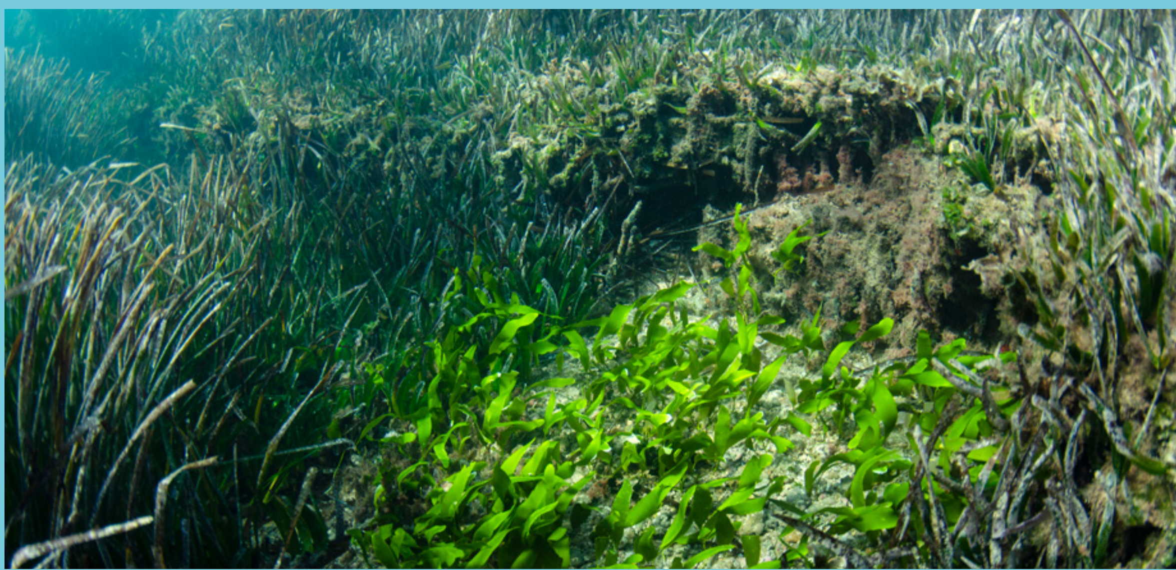
LOCATION



RESULTS

It grows particularly well in areas with high nutrients and organic matter loading, as shown by its distribution. It is present in the bays of Pollença, Alcúdia, Portocolom, Fornells, Addaia, Talamanca and Estany des Peix.

In Portocolom Bay, between 2008 and 2010, the biomass of this macroalga increased at a rate of 10.6 g/m^2 per month with maximums in May and June, when increases in daylight hours and temperature occur.



Caulerpa prolifera meadow. Source: Xavi Mas.

Coralligenous distribution area

WHAT IS IT?

A hard-substrate marine habitat characteristic of the continental shelf area, especially common between 50-100 m. It is formed of hard organic structures produced by calcareous algae that cohabit with a wide range of fauna (sponges, anemones, gorgonias, bryozoans and ascidias).

WHY?

The coralligenous habitat has great ecological value and provides shelter for species of high commercial value such as the spiny lobster. It grows slowly and is considered a non-renewable habitat that recovers with difficulty. Therefore, it is highly vulnerable to its main threat, trawling. Knowing its area of distribution is highly important in order to ensure its protection.

METHODOLOGY

The mapping compilation produced by Julià et al. (2019) has been used with coralligenous cartographic data from various projects (IEO LIFE+ INDEMARES Project Report, DRAGONSAL, LIC Llevant, Areaof LIC Es Trenc, LIC Cabrera, LIC Sa Dragonera).

The following habitats are described as coralligenous:

→ Coralligenous with dominance of invertebrates

→ Coralligenous shelf dominated by algae or invertebrates

→ Coralligenous and circalittoral rock dominated by algae

The data are described based on the total mapped area (4,395.95 km^2). This area must be considered underestimated due to both the lack of existing maps and the lack of survey areas in the Balearic Sea.

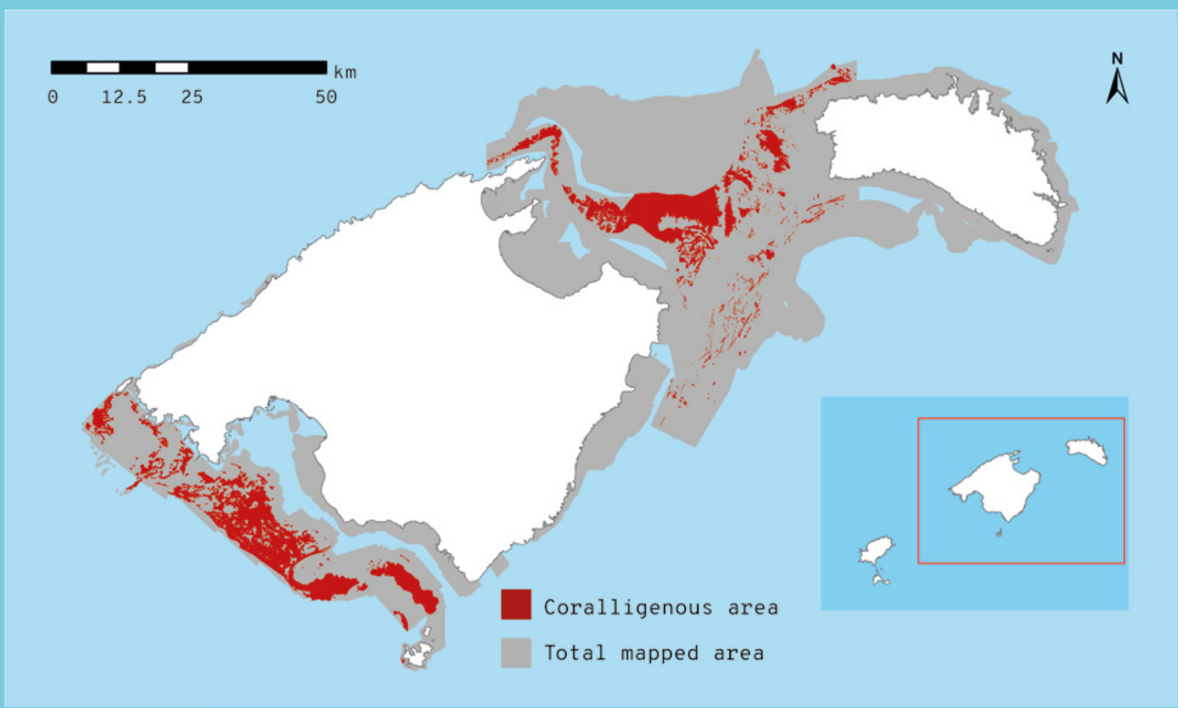
LOCATION

RESULTS

→ Coralligenous mapping has been compiled on the continental shelf in the Menorca Channel and to the southwest of Mallorca, mainly at 50-100 m.

→ The total coralligenous area is 999.7 km^2 of the 4,395.95 km^2 total mapped area of the Balearic Sea.

→ Greater effort must be invested in compiling and surveying the coralligenous habitat, since, for example, there are no data regarding this habitat on the continental shelf of the Pitiüses.



Distribution area of coralligeneous in the Balearic Islands. SOURCE: Julià *et al.* (2019).

Maerl distribution area

WHAT IS IT?

A marine sedimentary habitat of circalittoral bottoms on the continental shelf (0-90 m). It is made of rhodoliths, concretions of free-living calcareous red algae, which are rolled by the ocean currents or bioturbation processes. Many sessile and mobile species coexist in maerl (molluscs, crustaceans, amphipods, annelids, echinoderms and fish). It contains species of high commercial value such as the red scorpionfish and the spiny lobster.

WHY?

It is a habitat of great ecological importance (it sustains high biodiversity) that is slow-growing (considered non-renewable), so it is necessary to know its distribution area for its protection and conservation.

METHODOLOGY

The unified mapping compiled and published in Julià *et al.* (2019) has been used. This study collects maerl data from various reports: LIFE+ INDEMARES Project, DRAGONSAL, Ecocartográfico, LIC Artà, Carto-Cabrera and LIC Sa Dragonera. The habitats selected as maerl are:

→ Coastal detritic with maerl enclaves

→ Coastal detritic with enclaves of maerl and *Osmundaria volubilis*

→ Maerl bottoms in which *Peyssonnelia* spp. predominates.

→ Maerl or rhodolith bottoms

→ Infralittoral and circalittoral rhodolith and gravel bottoms in which invertebrates, in particular sponges, predominate

Only 4,395.95 km^2 of the Balearic Sea have been compiled in this cartographic study. Therefore, the results for the area of distribution of maerl are underestimated.

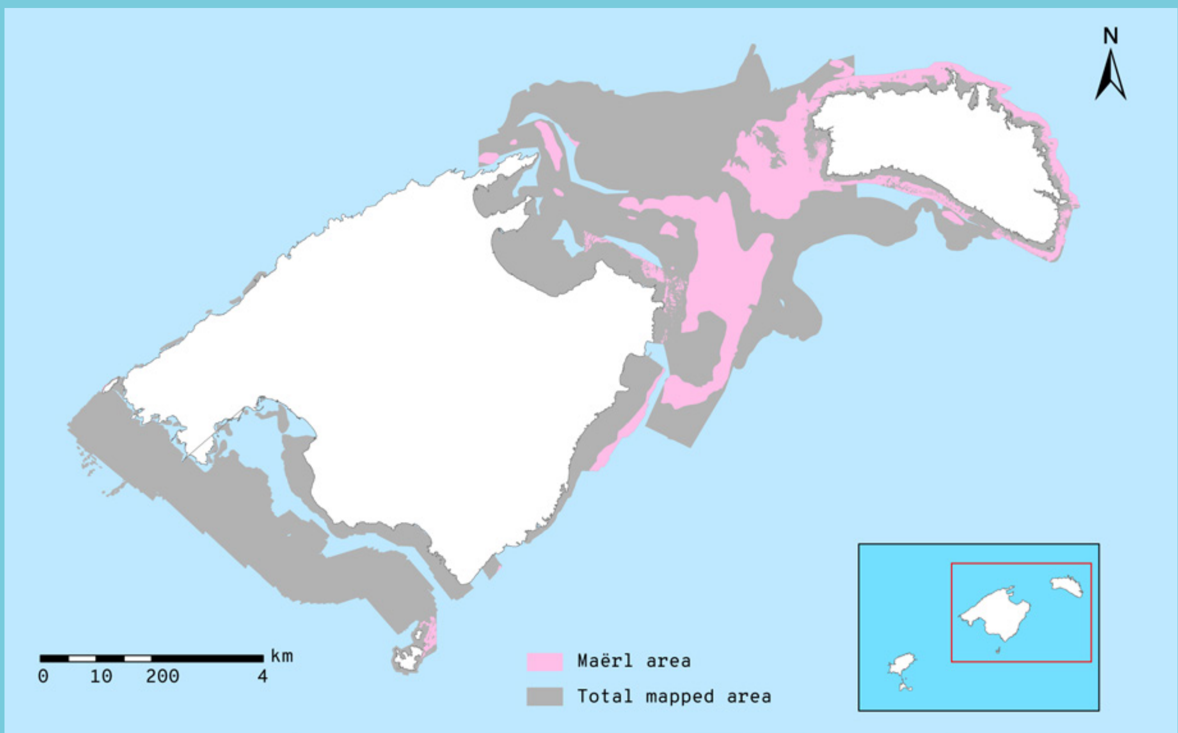
LOCATION

RESULTS

→ The maerl mapped to date is one of the most abundant habitats in the continental shelf area of the Balearic Sea.

→ In the Menorca Channel and around the Menorcan coast it is found at depths of 35-90 m.

→ The area of distribution has an extent of 839.2 km^2 (19% of the total mapped area). This figure is lower than the real extent of this habitat in the Balearic Sea since the full extent of this habitat has not yet been surveyed. For example, there are currently no data for the Pitiüses continental shelf area.

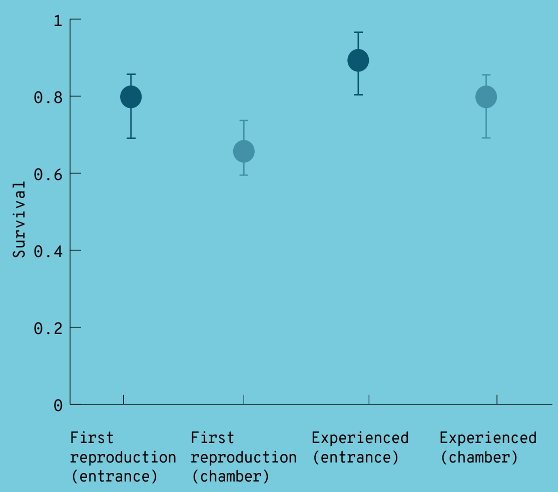


Distribution area of maerl in the Balearic Islands. SOURCE: Julià *et al.* (2019).

European storm petrel (*Hydrobates pelagicus*)

WHAT IS IT?

The European storm petrel is a small seabird also known in the Balearic Islands by the common names of *noneta*, *fumarell*, *paio*, *marineret*, *escateret* and *ocell de tempesta*. It is a small seabird, 14 to 18 cm long, with a wingspan more than twice the length of its body and an average weight of 28 grams during the reproductive season. European storm petrels are the smallest members of the order Procellariiformes, which includes petrels, albatrosses and shearwaters. They have a low fertility rate: they lay a single egg per year during spring-summer, which is incubated by both parents. They nest in colonies on islets, in caves or under rocks, always in places without mammal predators (rats). They have great longevity: the longest-lived individual recorded to date is more than 33 years old. They have long periods of incubation and chick care, around 40 and 60 days respectively. They live at sea and only come on land to reproduce.



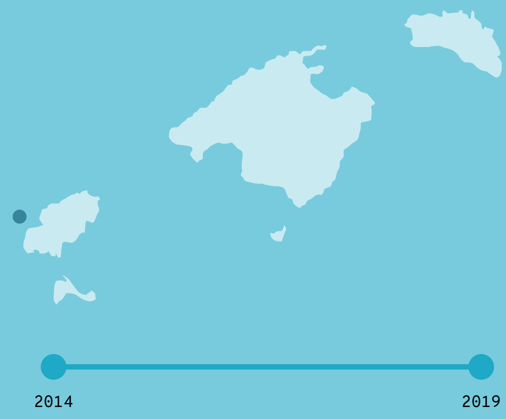
Survival probability of European storm petrels in the various areas of the S'Espartar colony between 2014 and 2019. SOURCE: Picorelli *et al.* (2019).

WHY?

It is one of the most iconic birds on marine islets and at the same time it is also one of the least known to the public.

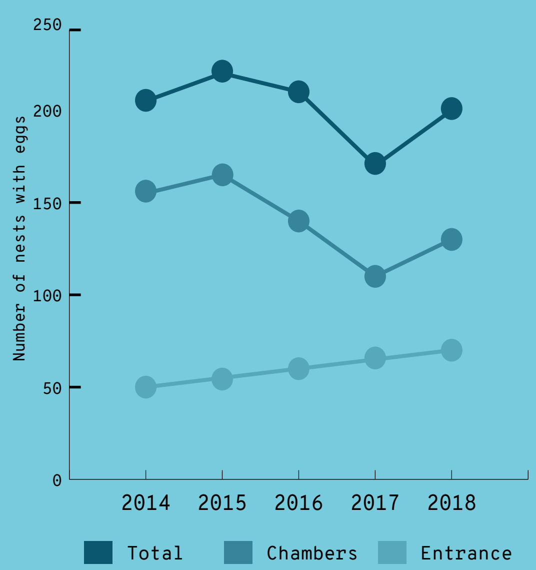
The European storm petrel is classified as a species of special interest in the Spanish Catalogue of Endangered Species (Royal Decree 439/1990) and as a vulnerable species in the Red Book of Spanish Birds.

LOCATION

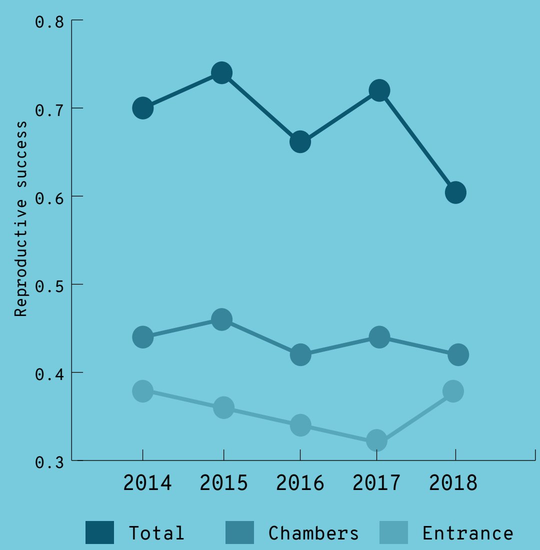


METHODOLOGY

The data shown here come from the monitoring performed with the scientific collaboration of the researcher Ana Sanz-Aguilar from Universitat de les Illes Balears and Institut Mediterrani d'Estudis Avançats (IMEDEA); Virginia Picorelli, a technician at the reserves of Es Vedrà, Es Vedranell and the islets of Ponent; Mariana Viñas, a technician at Conselleria de Medi Ambient del Govern de les Illes Balears, and Esteban Cardona and Oliver Martínez, environmental agents, on the island of S'Espartar since 2014.



Number of nests with eggs in the S'Espartar study area. The total number of nests is marked in black, while the chamber area is marked in dark blue and the cave entrance area is marked in light blue. SOURCE: Picorelli *et al.* (2019).



Annual reproductive success of the European storm petrel on the island of S'Espartar during the years of the study. SOURCE: Picorelli *et al.* (2019).

Photograph of a young European storm petrel (*Hydrobates pelagicus*). SOURCE: Miquel Gomila.

RESULTS

- The number of nests with eggs in the study area on the islet of S'Espartar varied between 173 nests in 2017 and 218 nests in 2015 during the six years of the study. The area with the highest number of nests is in the chambers, while the number in the entrance is lower.
- There are only continuous data for a single colony on the islet of S'Espartar, the largest colony in terms of the number of individuals detected in the Balearic Islands. It would be helpful to expand the study area to other colonies, since in the case of this species the dynamics may vary enormously from one place to another.
- Reproductive success and survival are lower in the chamber area than in the cave entrance area.
- The 2018 results confirm the negative effects of ticks on the reproductive parameters (chick mortality) of the European storm petrels in the S'Espartar colony.
- In spite of the high chick mortality rates detected in recent years in S'Espartar, in 2019 colony growth was observed.
- The survival of adults in the entrance is higher than in the chambers: 0.79 vs. 0.68 for individuals reproducing for the first time, and 0.87 vs. 0.78 for experienced individuals.
- The areas in which the species feeds in the marine environment are currently unknown. This information may be compiled using new GPS tracking technologies (as has been done in Benidorm), which would be highly useful in demarcating the priority conservation areas at sea.

Monitoring of fish populations vulnerable to coastal fishing (species richness, total biomass)

WHAT IS IT?

The richness of species vulnerable to fishing represents the average number of species observed in 250 m², while total biomass represents total weight of fishes in 250 m². Both indicators are used to show the extent of the effect of fishing on fish populations and provide knowledge about how the marine protected areas (MPAs) are operating.

METHODOLOGY

Species richness is determined by conducting visual surveys of transects 50 m long x 5 m wide (Area = 250 m²). The study areas are 9 marine reserves of fishing interest (Palma Bay, Migjorn de Mallorca, Isla del Toro, Islas Malgrats, Llevant de Mallorca, Freu de sa Dragonera, Norte de Menorca, Illa de l'Aire, Es Freus in Eivissa and Formentera) and 1 nature reserve (S'Albufera des Grau). Monitoring of different areas in each MPA is conducted: (i) partial reserve (trawling is prohibited and artisanal/recreational fishing is regulated), (ii) control area, outside the reserve (no fishing prohibitions and similar habitats), and (iii) no-take zone (all fishing activities prohibited).

The monitoring has been performed since 2000 by Direcció General de Pesca i Medi Marí, Govern de les Illes Balears through the public company Tragsasec. In Illa de l'Aire Marine Reserve and S'Albufera des Grau Nature Reserve, the institution responsible for monitoring is Observatori Socioambiental de Menorca (OBSAM), together with Instituto Español de Oceanografía (COB-IEO) through the Research Station "Jaume Ferrer"(La Mola, Menorca).

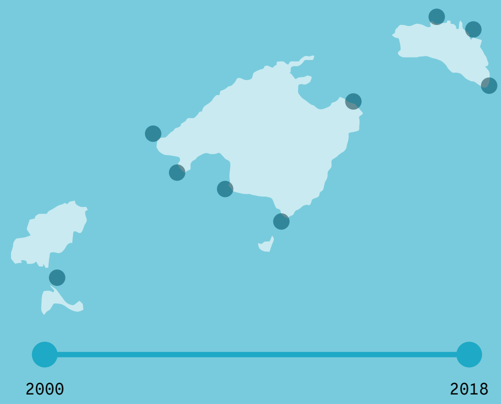
Here we show the total biomass and species richness data for marine reserves of fishing interest in surface water areas of the partial reserve, which have been monitored for more than ten years.

To interpret the reserve effect in each area, these results must be supplemented with information about fishing intensity and the intrinsic natural characteristics of each area.

WHY?

These indicators respond to fishing activities and give information on the status of fish communities vulnerable to fishing in each MPA. This information is of great importance as it helps to improve MPA management to attain optimal results for conservation and regeneration of fishing resources.

LOCATION



RESULTS

→ The highest total biomass was observed in 2018 in the Isla del Toro Marine Reserve (15 kg/250 m²), followed by Es Freus in Eivissa and Formentera (10 kg/250 m²).

→ The largest number of species recorded was in Es Freus in Eivissa and Formentera in 2016 (5.5 species/250 m²), followed by Isla del Toro and Llevant de Mallorca in 2018, with 4.9 and 4.6 species/250 m² respectively.

Total biomass and species richness in marine reserves of fishing interest (partial reserve area in surface waters 3-15 m deep) in all of the Balearic Islands, monitored for more than ten years. SOURCE: Direcció General de Pesca i Medi Marí, Govern de les Illes Balears

Abundance of pearly razorfish (*Xyrichtys novacula*)

WHAT IS IT?

The pearly razorfish (*Xyrichtys novacula*), also known locally as the *raor*, *galán* or *lorito*, belongs to the Labridae family. It is widely distributed in shallow sandy habitats in temperate areas.

WHY?

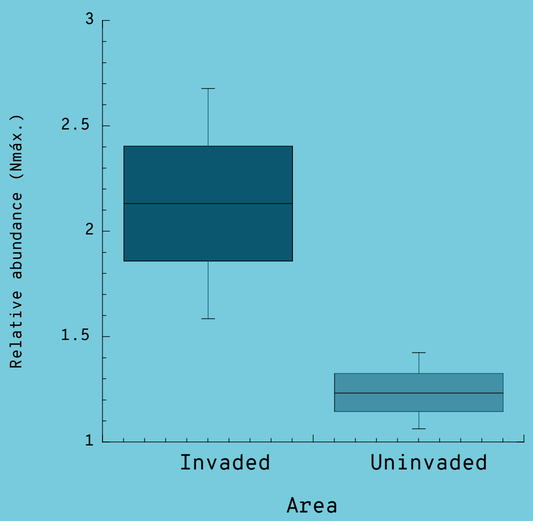
This fish is highly valued in recreational fishing. This fact could cause a decrease in its populations in the absence of tools aimed at ensuring its conservation, such as a seasonal closure and a daily bag limitation.

METHODOLOGY

Researchers from Institut Mediterrani d'Estudis Avançats (IMEDEA) monitored the population of pearly razorfish in the Palma Bay Marine Reserve between 2011 and 2018, concurrent with the monitoring of the presence or absence of the invasive macroalgae *Halimeda incrassata*, which could affect the population of pearly razorfish.

Underwater cameras were anchored at various random geographical points in a 6.4 km^2 study area. These videos were analysed to determine the presence or absence of pearly razorfish and the number of fish of this species that appeared simultaneously in a frame ($N_{max.}$). The presence or absence of the invasive macroalgae *Halimeda incrassata* in each geographical point assessed was also determined.

LOCATION



Box plot showing the distribution of relative abundances of pearly razorfish in the area invaded by *Halimeda incrassata* and in the uninvaded area of the Palma Bay Marine Reserve between 2011 and 2018. Source: IMEDEA.

RESULTS

The abundance of pearly razorfish in the Palma Bay Marine Reserve shows a small upward trend or stability throughout the eight years of monitoring. This indicates that the population is not decreasing even though it has been subject to high recreational fishing pressure.

The relative abundance of the pearly razorfish population in the study area varied between 1.26 and 1.91 and was higher in the areas invaded by the invasive macroalga *Halimeda incrassata*, which varied between 1.59 and 2.68; while in uninvaded areas it varied between 1.06 and 1.42.

In areas colonised by the invasive macroalga *Halimeda incrassata* there are higher relative abundances of pearly razorfish. The attraction of the pearly razorfish to these invaded areas may be due to the fact that they create a new habitat and promote an increase in various crustacean species that they feed on.

Photograph of a pearly razorfish (*Xyrichtys novacula*). Source: Miquel Gomila.

Spiny lobster (*Palinurus elephas*)

WHAT IS IT?

The spiny lobster (*Palinurus elephas*) is a crustacean of great ecological importance and a fishing resource with a high economic value for Balearic society. Its settlement indices refer to the counting of larvae on the sea bottom, used to estimate its current and future population.

WHY?

The recruitment indices are used as measurements to manage local fishing of the species in the future, as it takes 4-6 years for spiny lobsters to reach commercial size. The main objective is to establish the basis for more sustainable fishing. They are also used to provide information about its status and ecological behaviour.

METHODOLOGY

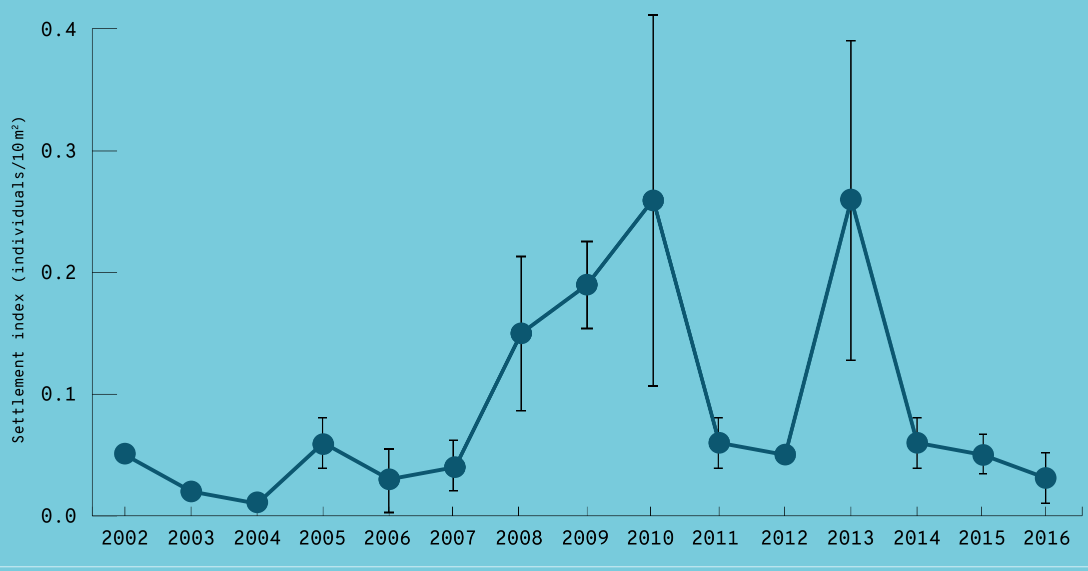
Spiny lobster benthic young were counted by visual censuses in 10 m^2 in 3 study areas around Mallorca and 1 in Cabrera for 15 years (2002-2016). The results show the average values from the 4 stations.

LOCATION

2002 — 2016

RESULTS

Settlement ranged between 0.01 and 0.28 individuals/10 m^2, mainly due to the environmental conditions intrinsic to each year. Low settlement indices could imply a lower capture yield after 4 to 6 years.



Average settlement of the spiny lobster (*Palinurus elephas*, individuals/10 m^2) in the 4 study stations (Mallorca and Cabrera) from 2002 to 2016. SOURCE: COB-IEO

Spiny lobster (*Palinurus elephas*). SOURCE: Xavi Mas.

Sperm whale (*Physeter macrocephalus*)

WHAT IS IT?

The sperm whale is a species of cetacean with an average length of 16 m, which is common and of great importance in the Balearic Sea. This sea plays a very important role in providing the species with food and reproduction area.

The sperm whale encounter rate provides information about the species' presence in the Balearic Sea over the years. It is defined as the number of encounters per kilometre sailed.

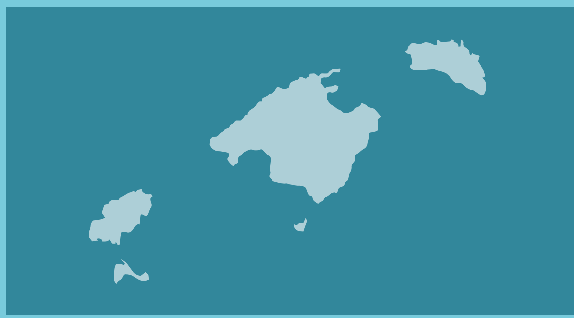
WHY?

The IUCN considers this species to be endangered in the Mediterranean and it is protected by numerous international, European, national and regional regulations.

METHODOLOGY

Expeditions of scientific vessels in the Balearic Sperm Whale Project (Asociación Tursiops and the University of Saint Andrews) monitored this species. The methodology is described in Rendell *et al.* (2014).

LOCATION



Observation of a sperm whale. SOURCE: Asociación Tursiops.

RESULTS

→ Optimum values have not been recorded since 2003.

→ The highest encounter rate (0.022) was observed in 2014. Since then, there has been a gradual decrease in the value to 0.0097 in 2018.

→ There were gaps in 2009, 2010 and 2011 due to lack of research.

Encounter rate of the sperm whale (*Physeter macrocephalus*) between the years 2003-2018. SOURCE: Asociación Tursiops.

Common bottlenose dolphin (*Tursiops truncatus*)

WHAT IS IT?

The common bottlenose dolphin is a species of cetacean, 2.5-3.5 m in length, which lives in coastal waters of the Mediterranean. It whistles to communicate and emits high-frequency clicks to feed. The percentage of Deployment Positive Hours (DPH) is used to measure the presence of the common bottlenose dolphin at a particular point on the coastline based on the sounds detected. The indicator is standardised based on the total number of hours sampled.

WHY?

Due to the number of stressors that affect the health and ecology of this species (accidental capture, resource depletion, oceanographic and climate change, noise and chemical pollution), its presence is a good indicator of the sea's good status. It is considered to be an endangered species in the Mediterranean by the IUCN.

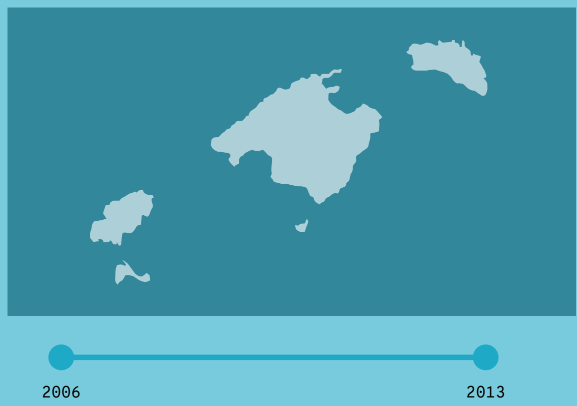
METHODOLOGY

We present data from Castellote *et al.* (2015), which used the passive acoustic method to measure the clicks produced by the common bottlenose dolphin.

Acoustic censuses are performed with hydrophones, submerged instruments that send the sounds emitted to the vessels' computers.

Studies were performed in three marine protected areas (MPA) in the Balearic Islands: Es Freus in Eivissa and Formentera, Migjorn and Llevant in Mallorca. There are currently 3 hydrophones in operation.

LOCATION



RESULTS

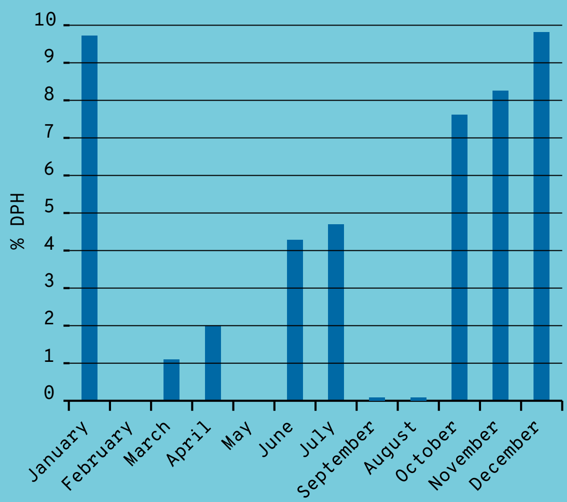
→ The DPH percentages vary from 10 to 0.2%.

→ The highest values were recorded in Es Freus in Eivissa and Formentera.

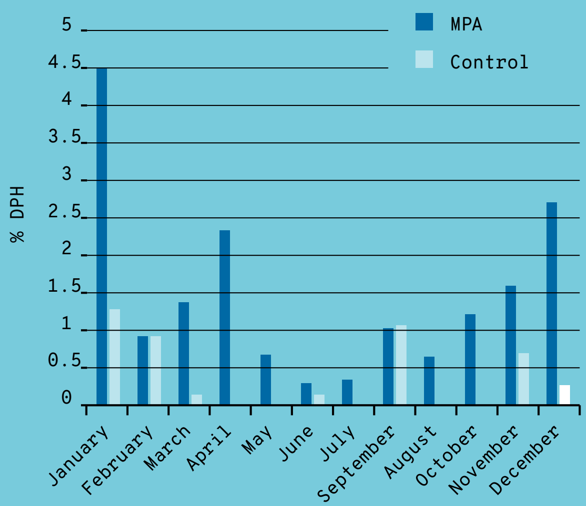
→ A higher presence of dolphins in the winter than in the summer was detected in the three MPA.

→ More exhaustive monitoring of this indicator is necessary to be able to observe the long-term trends in the different areas of the Balearic Sea.

A



B



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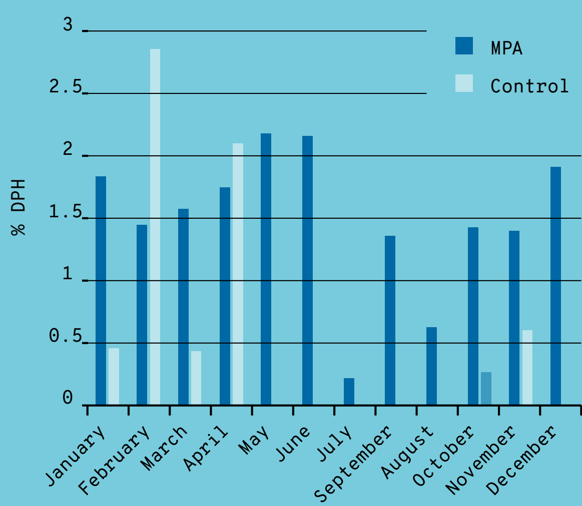


Percentage of Deployment Positive Hours (DPH) for the common bottlenose dolphin inside the MPA of Es Freus of Eivissa and Formentera (A), Migjorn (B) and Llevant (C). Source: Castellote *et al.* (2015).

20–25
Stock assessment of the European hake (*Merluccius merluccius*)

WHAT IS IT?

The European hake is a demersal fish that lives on the soft bottoms of the continental shelf and slope at a depth between 50 and 370 metres. Its geographical distribution covers the Mediterranean Sea and the East Atlantic (from Norway and Iceland to Mauritania).

WHY?

It has great commercial importance. In the Mediterranean it is captured by the bottom trawl fleet and, to a lesser extent, by the small-scale fleet using longlines. In the Balearic Islands it is one of the main species targeted by the trawl fleet.

METHODOLOGY

One of the standard international population assessment methodologies has been used, virtual population analysis (VPA), with two main data sources: catch and effort according to the official fishery statistics, and scientific research surveys in the Balearic Islands. The results of this assessment are regularly presented to the GFCM's Working Group on Stock Assessment of Demersal Species. For a detailed description of the methodology see the report (GFCM-SAC-2018). [http://www.fao.org/gfcm/meetings/info/en/c/1157179/]

RESULTS

Although the abundance and biomass of the population oscillates significantly between years, there is no clear trend over the time series analysed (1980-2017). The average biomass during this period was 279 tonnes with a minimum of 155 tonnes in 1999 and a maximum of 531 tonnes in 1991. Mortality due to fishing by the current fishing fleet (F_c/$F_{0.1}$ = 7.44) is more than seven times higher than the reference point obtained for the species ($F_{0.1}$ = 0.18).

Biomass (weight) and abundance (number of individuals) of the European hake population between 1980 and 2017. SOURCE: COB-IEO.

26-31 Stock assessment of the striped red mullet (*Mullus surmuletus*)

WHAT IS IT?

The striped red mullet is a demersal fish that lives on mixed sand and rock bottoms, mainly on the continental shelf, more than 100 metres deep. Its geographical distribution covers the Mediterranean Sea and the East Atlantic (from the south of Norway to Senegal).

WHY?

It has great commercial interest. In the Balearic Islands, as in the rest of the Mediterranean, it is one of the main species targeted by the bottom trawl and the small-scale fleets .

METHODOLOGY

One of the standard international population assessment methodologies has been used, virtual population analysis (VPA), with two main data sources: catch and effort according to the official fishery statistics, and scientific research surveys in the Balearic Islands. The results of this assessment are regularly presented to the GFCM's Working Group on Stock Assessment of Demersal Species. For a detailed description of the methodology see the report (GFCM-SAC-2017). [http://www.fao.org/gfcm/meetings/info/en/c/1040665/]

RESULTS

Between 2000 and 2014, the abundance and biomass of the striped red mullet showed a clear descending trend, although in the last two years (2015-2016) this trend appears to have reversed. The average biomass during this period was 376 tonnes with a minimum of 227 tonnes in 2014 and a maximum of 527 tonnes in 2001. Mortality due to fishing by the current fishing fleet ($F_c/F_{0.1}$ = 2.55) is 2.5 times higher than the reference point obtained for the species ($F_{0.1}$ = 0.42).

Biomass (weight) and abundance (number of individuals) of the striped red mullet population between 2000 and 2016. SOURCE: COB-IEO.

32–37
Stock assessment of the red shrimp (*Aristeus antennatus*)

WHAT IS IT?

The red shrimp is a demersal crustacean that lives on muddy bottoms of the continental slope at a depth of 100 to 3,000 metres. Its geographical distribution covers the Mediterranean Sea and the East Atlantic (from the north of Portugal to Cape Verde).

WHY?

It is one of the highest-value fishing resources in the Mediterranean, where it is caught exclusively by the trawl fleet. In the Balearic Islands, it is the species targeted by this fleet when it works at a depth of 500 to 800 metres.

METHODOLOGY

One of the standard international population assessment methodologies has been used, virtual population analysis (VPA), with two main data sources: catch and effort according to the official fishery statistics, and scientific research surveys in the Balearic Islands. The results of this assessment are regularly presented to the GFCM's Working Group on Stock Assessment of Demersal Species. The report can be viewed for a detailed description of the methodology (GFCM-SAC-2017).[http://www.fao.org/gfcm/meetings/info/en/c/1040665/]

RESULTS

The abundance and biomass of the total red shrimp population decreased significantly between 2005 (774 tonnes) and 2014 (413 tonnes). The average biomass during the 1997-2016 period was 566 tonnes. Mortality due to fishing by the current fishing fleet ($F_c/F_{0.1}$ = 2.00) is more than twice as high as the reference point obtained for the species ($F_{0.1}$ = 0.31).

Biomass (weight) and abundance (number of individuals) of the red shrimp population between 1997 and 2016.
SOURCE: COB-IEO.

38–43
Stock assessment of the rose shrimp (*Parapenaus longirostris*)

WHAT IS IT?

The rose shrimp is a demersal species that lives mainly on muddy bottoms of the deep continental shelf and the continental slope at a depth of 100 to 300 metres. Its geographical distribution covers the Mediterranean Sea and the East Atlantic (from Portugal to Angola).

WHY?

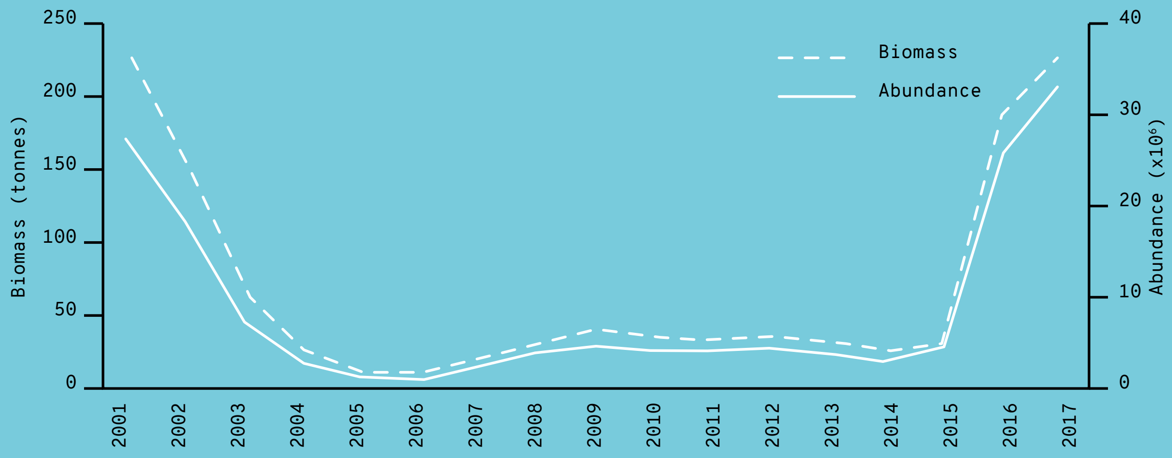
It is a high-value fishing resource for the Mediterranean trawl fleet. In the Balearic Islands, populations undergo major year-on-year fluctuations, as shown by extremely low catches between 2005 and 2015.

METHODOLOGY

One of the standard international population assessment methodologies has been used, virtual population analysis (VPA), with two main data sources: catch and effort according to the official fishery statistics, and scientific research surveys in the Balearic Islands. The results of this assessment are regularly presented to the GFCM's Working Group on Stock Assessment of Demersal Species. For a detailed description of the methodology see the report (GFCM-SAC-2018). [http://www.fao.org/gfcm/meetings/info/en/c/1157179/]

RESULTS

The abundance and biomass of the population fell drastically from 2001 to 2006 (from 227 to 8 tonnes). It remained at very low levels until 2015 (19-36 tonnes) and subsequently increased again very rapidly to 230 tonnes in 2017. Mortality of the rose shrimp due to fishing by the current fishing fleet ($F_c/F_{0.1}$ = 1.23) is close to the reference point obtained for the species ($F_{0.1}$ = 0.77).



Biomass (weight) and abundance (number of individuals) of the rose shrimp population between 2001 and 2017.
SOURCE: COB-IEO.

44–48
Stock assessment of the common cuttlefish (*Sepia officinalis*)

WHAT IS IT?

The common cuttlefish is a demersal cephalopod that lives on soft bottoms on the continental shelf from the littoral zone to a depth of 200 metres. Its geographical distribution covers the Mediterranean Sea and the East Atlantic (from the south of Norway to Angola).

WHY?

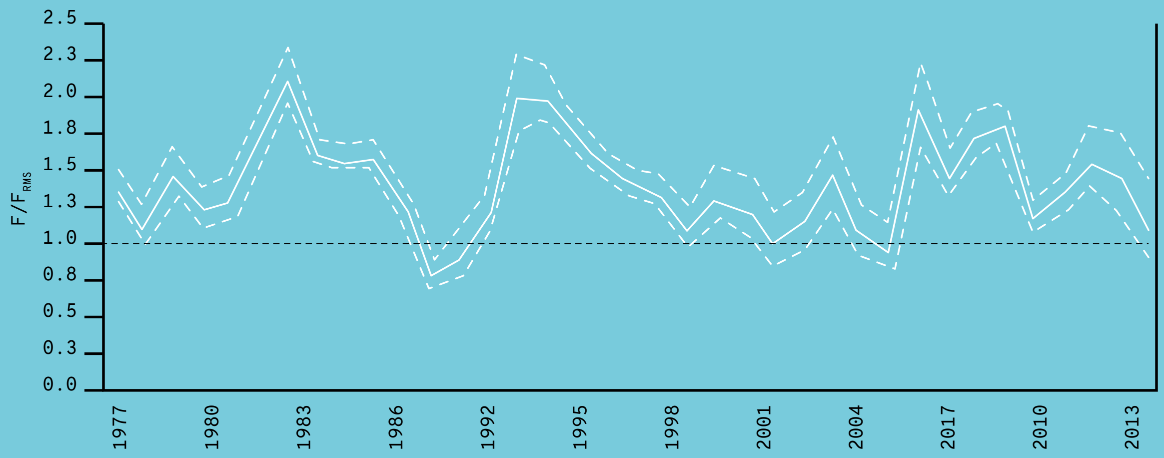
It is a species of great commercial interest. In the Balearic Islands, as in the rest of the Mediterranean, it is a species targeted by significant seasonal fishing by the fleet using small-scale equipment. It is also fished as a bycatch of the bottom trawl fleet throughout the year.

METHODOLOGY

One of the standard international population assessment methodologies has been used, a global or production model, using catch and effort by the fishing fleet from 1977 to 2013. For more details about the methodology, see the paper by Quetglas *et al.* (2015).

RESULTS

The results of the assessment show that the common cuttlefish has generally remained in a status of over-exploitation (F/F_{RMS} > 1) throughout the historical series analysed (1977-2013). However, in recent years the species has been close to the optimal exploitation level (F/F_{RMS} ~ 1) or slightly below the over-exploitation level (F/F_{RMS} < 1: 1988, 1989, 2000 and 2004). The average value of this indicator during the period analysed was 1.38; with a minimum and a maximum of 0.75 and 2.10, respectively.



F/F_{RMS} of the common cuttlefish population between 1977 and 2013. Source: COB-IEO.

49–53
Stock assessment of the common octopus (*Octopus vulgaris*)

WHAT IS IT?

The common octopus is a demersal cephalopod that inhabits the area between the coast to the edge of the continental shelf (approximately 200 metres deep). It is a species with a cosmopolitan distribution in tropical, subtropical and temperate waters.

WHY?

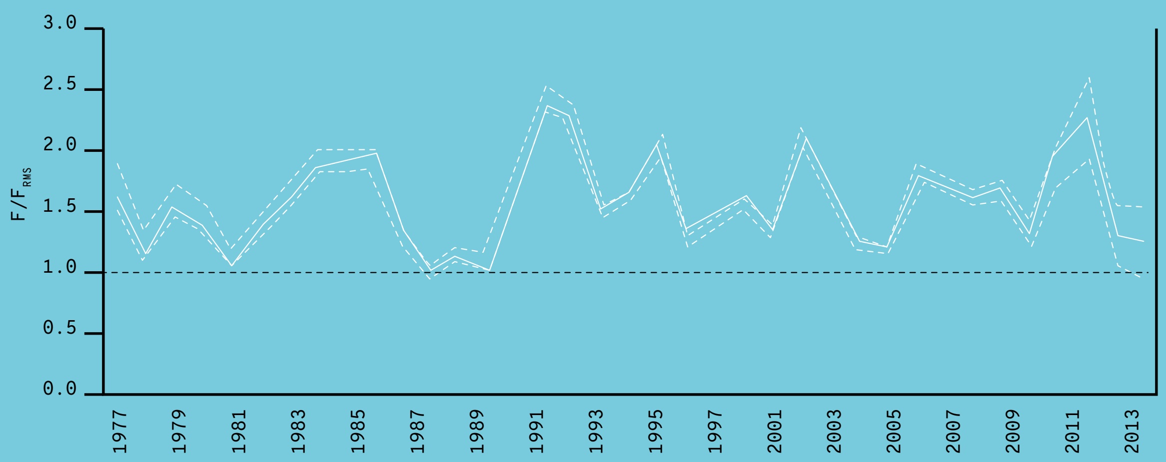
It is a species of great commercial interest all around the world, which is caught with different fishing methods (trawlers, traps, pots and gillnetting). In the Balearic Islands, approximately 90% of the catch comes from the bottom trawl fleet.

METHODOLOGY

One of the standard international population assessment methodologies has been used, a global or production model, using catch and effort by the fishing fleet from 1977 to 2013. For more details about the methodology, see the paper by Quetglas *et al.* (2015).

RESULTS

The results of the assessment show that the common octopus has remained in a status of over-exploitation ($F/F_{RMS} > 1$) throughout the historical series analysed (1977-2013). Only in some specific years has the species been close to the optimal exploitation level ($F/F_{RMS} \sim 1$). The average value of this indicator during the period analysed was 1.54; with a minimum of 0.97 and a maximum of 2.35 in 1992.



F/F_{RMS} of the common octopus population between 1977 and 2013. SOURCE: COB-IEO.

III

Water quality

QUALITY OF BATHING WATER AND COASTAL WATER BODIES

Blue flag on Can Picafort beach, Mallorca. SOURCE: Sebastià Torrens.

Bathing water quality based on coliform abundance (*Escherichia coli* and intestinal enterococci)

WHAT IS IT?

Status of bathing water in the Balearic Islands based on the amount of bacteria of faecal origin (*E. coli* and intestinal enterococci).

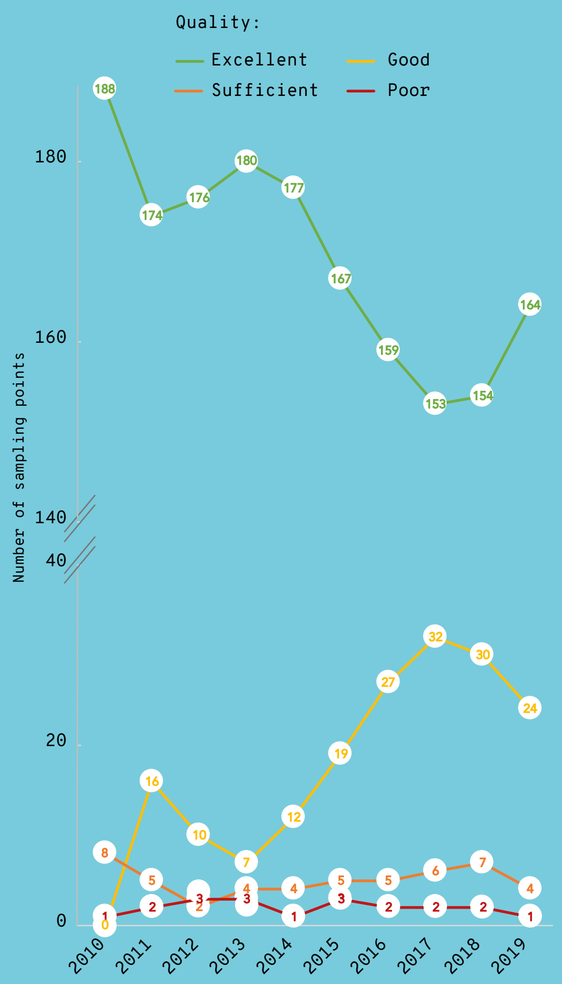
METHODOLOGY

Servei de Salut Ambiental, a service of the Direcció General de Salut Pública i Participació, Conselleria de Salut i Consum, Govern de les Illes Balears, analyses the seawater at 193 points spread around 157 bathing areas in Mallorca, Menorca and the Pitiüses. The reference methods are defined in Royal Decree 1341/2007 on bathing water quality, which describes the abundance ranges of *E. coli* and intestinal enterococci used to estimate water quality.

WHY?

Knowing the quality of bathing areas in the Balearic Islands through microbiological analysis is of great importance as it conditions the status of the ecosystems and human health. This information can be used to inform bathers and public bodies, as well as to decrease risks and improve the management of possible sources of pollution.

LOCATION



Quality of sampling areas throughout the Balearic Islands. N.B.: the Y axis is cut between 40 and 140. SOURCE: Servei de Salut Ambiental (Direcció General de Salut Pública i Participació, Conselleria de Salut i Consum, Govern de les Illes Balears).

RESULTS

→ Since 2010, the sampling points with excellent bathing water quality have decreased from 188 to 164.

→ The decrease in points with excellent quality is due to an increase in the good quality of sampling points, which has risen from 0 (in 2010) to 24 (in 2019).

→ The sampling points with sufficient bathing water quality oscillate between 2 and 8.

→ The number of sampling points with poor bathing water quality tends to range between 1 and 3.

WHAT IS IT?

The Mediterranean Occidental (MEDOCC) index is one of the biotic indexes used to determine the status of coastal water bodies defined by the Water Framework Directive. It uses benthic macroinvertebrate communities to determine water and sediment quality.

METHODOLOGY

The Mediterranean Occidental (MEDOCC) index was developed by a team at Centre d'Estudis Avançats de Blanes (CEAB-CSIC) led by Enric Ballesteros, using data for Catalonia and the Balearic Islands, based on the AMBI index created by researchers led by Ángel Borja from the AZTI research centre. It is developed on the theoretical basis of communities' capacity to respond to variations in environmental conditions caused by humans, more specifically organic matter enrichment in sediments, according to the succession described by Pearson & Rosenberg (1978).

The results presented here are based on two studies produced by the CEAB-CSIC team led by Dr Ballesteros in 2005 and 2007: "Evaluación de la calidad ambiental de las masas de agua costeras utilizando las macroalgas y los invertebrados bentónicos como bioindicadores. Informe final 2009-2010" [Assessment of the environmental quality of coastal water bodies using macroalgae and benthic invertebrates as bioindicators. Final report 2009-2010] and "Implementación de la Directiva marco del agua en las Islas Baleares: evaluación de la calidad ambiental de las masas de agua costeras utilizando las macroalgas y los invertebrados como bioindicadores (mayo 2005 - marzo 2007)" [Implementation of the Water Framework Directive in the Balearic Islands: assessment of the environmental quality of coastal water bodies using macroalgae and invertebrates as bioindicators (May 2005 - March 2007)].

In 2005, a total of 76 stations were sampled and the ecological status was obtained for 42 of them. The rest had coarse sediment and this index is only applicable to soft-bottom areaswith fine sediments. In 2007, a total of 72 stations were sampled and the ecological status was obtained for 40 of them.

The MEDOCC index is calculated using the abundance percentages for each ecological group according to its degree of tolerance to organic matter enrichment. The resulting value is between 0 and 6. Low MEDOCC values indicate good quality and, as the value increases, the environmental quality worsens. The Water Framework Directive (WFD) establishes that the ecological status (EQR) is calculated by comparing the ecological status values obtained in the reference condition. It stipulates that the EQR must have values between 0 and 1. Since the MEDOCC index values vary between 0.5 and 6, they must be processed and converted to the 0-1 scale in which values close to 1 indicate a good ecological status and values close to 0 indicate a poor ecological status.

WHY?

The Water Framework Directive (WFD 2000/60/EC) establishes the basis for the monitoring, protection and improvement of the ecological status of water systems in EU member states. The main objective is to achieve (or maintain) at least a good ecological status in European water bodies by 2015. This directive introduces the compulsory use of bioindicators to assess the ecological status of water systems.

LOCATION

RESULTS

→ A worsening of the ecological status of water bodies in the Balearic Islands between 2005 and 2007 was detected. While in 2005, 51.9% of the sectors analysed had a very good ecological status, in 2007 only 11.5% did. In 2005, only one sector (3.7%) presented a moderate ecological status, while 5 sectors did in 2007 (19.2%).

→ Out of the 26 sectors assessed in 2007, 5 infringed the WFD because they had a moderate ecological status: Serra de Tramuntana, Pollença Bay, Cabrera, Fornells Bay and Maó Port.

Ecological status of coastal sectors sampled in the Balearic Islands in 2007 according to the MEDOCC index. The white stretches show water bodies that were not assessed. Source: Ballesteros *et al.* (2010).

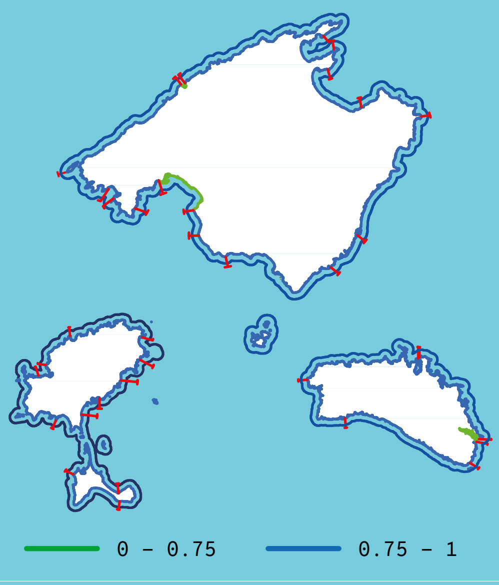
WHAT IS IT?

The CARLIT methodology is based on mapping littoral benthic communities that develop on rocky substrates. It is one of the benthic indices used to determine the status of coastal water bodies defined by the Water Framework Directive (WFD).

METHODOLOGY

The methodology is based on grouping the wide diversity of species present along the coast into a number of categories with an environmental quality value assigned. The category assigned indicates the species that is/are most abundant on the surveyed coast. Assessing them and the coastline they occupy provides an ecological quality value. The EQR (Ecological Quality Ratio) values are obtained by calculating the quotient of the ecological quality value obtained and the value of the reference areas. EQR values are associated with water bodies, which are the environmental management unit in the Water Framework Directive (WFD). This makes it possible to conduct a precise assessment of the ecological status of the coastline through a continuous non-destructive study of the coast and compare changes in algal communities over time and the evolution of the ecological status of the coastal area.

The results presented here are based on two studies produced by the CEAB-CSIC team led by Dr Ballesteros in 2006 and 2009: "Evaluación de la calidad ambiental de las masas de agua costeras utilizando las macroalgas y los invertebrados bentónicos como bioindicadores. Informe final 2009-2010" [Assessment of the environmental quality of coastal water bodies using macroalgae and benthic invertebrates as bioindicators. Final report 2009-2010] and "Implementación de la Directiva marco del agua en las Islas Baleares: evaluación de la calidad ambiental de las masas de agua costeras utilizando las macroalgas y los invertebrados como bioindicadores (mayo 2005 - marzo 2007)" [Implementation of the Water Framework Directive in the Balearic Islands: assessment of the environmental quality of coastal water bodies using macroalgae and invertebrates as bioindicators (May 2005 - March 2007)].



Ecological status of coastal sectors sampled in the Balearic Islands in 2009 according to the CARLIT methodology. SOURCE: Ballesteros *et al.* (2010).

WHY?

The main objective of the Water Framework Directive (WFD 2000/60/EC) is to achieve (or maintain) at least a good ecological status in European water bodies. This directive introduces the compulsory use of bioindicators to assess the ecological status of water systems. Macroalgae communities on infralittoral rocky substrates are good indicators of water quality. In particular, *Cystoseira* communities are good indicators of marine eutrophication, as they are very sensitive to such pressure.

LOCATION

RESULTS

→ Applying the CARLIT methodology, 91.7% of the Balearic coastline has a very good ecological status (33 sectors out of a total of 36) and 8.3% (3 sectors) have a good ecological status.

→ The three water bodies with a good ecological status are: Sóller Bay (MA-4), Palma Bay (MA-15) and Maó Port (ME-3). In Palma Bay and Maó Port, the replacement of *Cystoseira amentacea* with *Corallina-Haliptilon* appears to be related to anthropic pressure.

→ A decrease in the ecological status was detected in Sóller Bay (MA-4). It changed from very good in 2006 (with an EQR of 0.86) to good in 2009 (EQR of 0.71), a 17.4% decrease in the EQR.

→ In Maó Port there is a body of water that has been greatly modified (ME-3) with 78% highly modified (interior of the port and other artificial structures), which was not assessed. Therefore, the good status assessment is not representative of the entire water body. In Cala Sant Esteve, the community was dominated by *Cystoseira amentacea*, which indicates a very good status. The southern boundary of this water body (ME-1C) could be redefined to improve management needs.

→ None of the coastal sectors studied in Mallorca have a high percentage of very abundant *Cystoseira amentacea* occupation. In the rest of the islands this category has very high values, but it does not predominate in any of the coastal sectors.

Pressure

Aerial view of Alcúdia Port, Mallorca. SOURCE: Sebastià Torrens.

IV

Non-indigenous species

Sally lightfoot crab (*Percnon gibbesi*), considered to be an invasive species. SOURCE: Xavier Salvador.

Callinectes sapidus Rathbun, 1896

STATUS

Commercial species (List of commercial names of fishing and aquaculture species allowed in Spain, BOE-A-2016-3357).

EASIN STATUS

Exotic species.

BIOGEOGRAPHIC DISTRIBUTION

A West Atlantic species that naturally lives on the east coast of the Americas from Nova Scotia and Canada to the north of Argentina (Williams, 1984).

POSSIBLE MEANS OF INTRODUCTION AND EXPANSION

Maritime transport in ballast water through dispersion of larvae (Galil *et al.*, 2002).

SPATIAL DISTRIBUTION

The blue crab (*C. sapidus*) was recorded for the first time in the Eastern Mediterranean in 1935 (Giordani-Soika, 1951). In 2005, two megalopae were found in the oceanic waters of the Balearic Sea (Carbonell et al., 2014), but it was not until 2015 that adult individuals were identified in Eivissa (Santa Eulària des Riu, Ses Salines de Eivissa and Formentera). Adult individuals of the species were later recorded in the various islands: 19 in Mallorca (S'Albufera and Pollença Port) and 3 in Menorca (Torrent de Cala Galdana and Albufera des Grau (García *et al.*, 2008). Since then, the species has expanded in fresh and brackish water, with few records in the marine environment (*A. Cabonell, personal communication.*).

Figure 1. Locations of *C. sapidus* presence in the Balearic Islands. SOURCE: citizen science (adults) and Carbonell et al. (2014) (larvae).

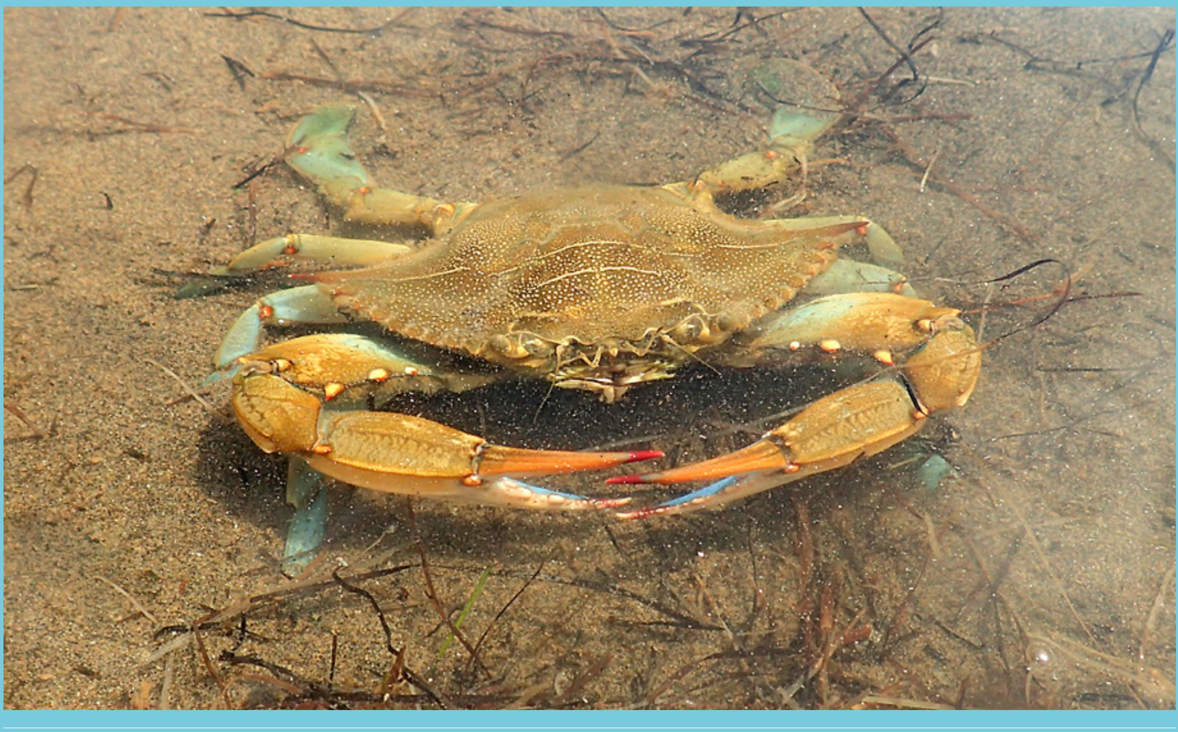


Figure 2. Picture of *C. Sapidus*. SOURCE: Enric Ballesteros.

Lophocladia lallemandii (Montagne) F. Schmitz, 1893

STATUS

Invasive exotic species (Spanish catalogue of invasive exotic species. Royal Decree 630/2013 of 2 August).

EASIN STATUS

Exotic species.

BIOGEOGRAPHIC DISTRIBUTION AND EXPANSION

Algae originating from the Red Sea and the Indo-Pacific.

POSIBLES VÍAS DE INTRODUCCIÓN

Suez Canal.

SPATIAL DISTRIBUTION

Lophocladia lallemandii was detected for the first time in 1998 in Eivissa and, since then, it has expanded rapidly around the islands of Formentera, Mallorca and Menorca.

RESULTS

Until 2014 there was abundant coverage per transect of over 50% to the west of Menorca and 1% to 5% to the north and east (Massutí *et al.*, 2015). However, in recent years it has been observed that its distribution has spread south and east of the island (Figure 1). Nevertheless, its average abundance has diminished since the initial years and it currently covers less than 25% per transect (Cefalì *et al.*, 2018). At depth, its maximum coverage is between 5 and 25 metres, with practically no presence at greater depth. There was an exception in 2016, when its population moved to deeper levels, but in 2018 it returned to shallower depths (Figure 2).

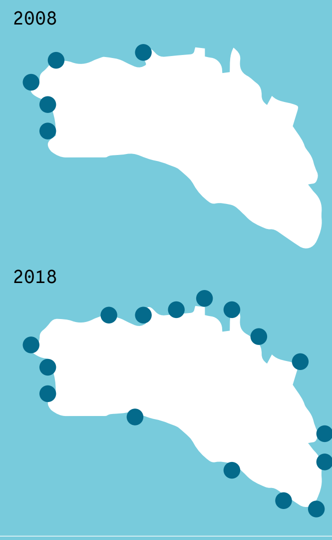


Figure 1. Locations of *L. lallemandii* from the network of monitoring stations in 2008 (a) and in 2018 (b). SOURCE: EIJF / COB-IEO.

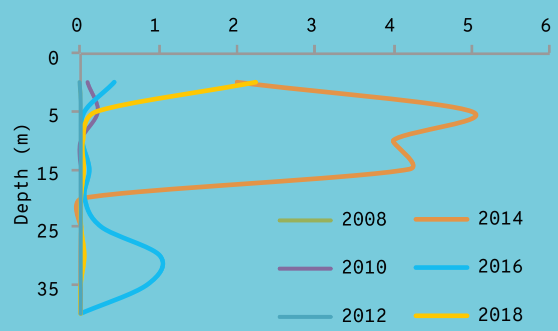


Figure 2. Average percentage (%) coverage of *L. lallemandii* at a depth of between 0 and 50 m from 2008 to 2018. SOURCE: EIJF / COB-IEO.

Figure 3. Locations of *L. lallemandii* in the sampling station network in the rocky infralittoral area of the Balearic Islands. SOURCE: EIJF / COB-IEO.

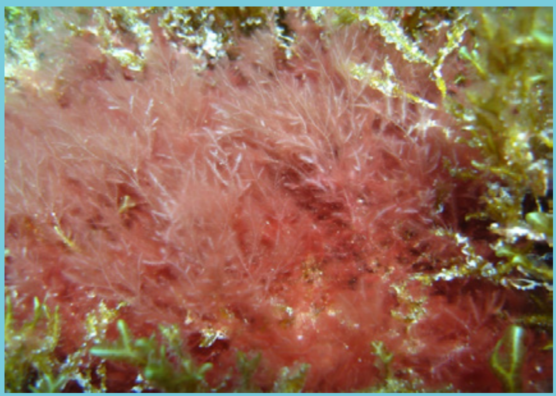


Figure 4. Invasive algae *L. lallemandii* (red) SOURCE: Enric Ballesteros.

Caulerpa cylindracea Sonder, 1845

STATUS

Invasive exotic species (Spanish catalogue of invasive exotic species. Royal Decree 630/2013 of 2 August).

EASIN STATUS

Exotic species.

BIOGEOGRAPHIC DISTRIBUTION

A species of Australian origin, specifically from the southwest of Australia.

SPATIAL DISTRIBUTION

C. cylindracea (formerly known as *C. racemosa*) is found on all kinds of bottoms at a depth of 0 to 70 metres. It has considerably expanded in the Balearic Islands and in certain areas there is a high abundance (Vázquez-Luis *et al.*, 2018).

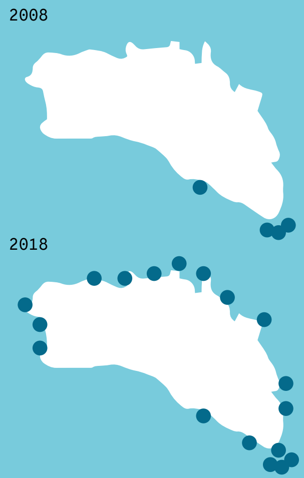


Figure 1. Locations of *C. cylindracea* from the network of monitoring stations in 2008 (a) and in 2018 (b). Source: COB-IEO.

POSSIBLE MEANS OF INTRODUCTION AND EXPANSION

Maritime transport (ballast water and biofouling) and fishkeeping.

RESULTS

From 2008 to 2018, it progressively expanded from Illa de l'Aire throughout Menorca (Massutí *et al.*, 2015). However, in the last two years of sampling (2016 and 2018), a decrease in its abundance was observed. In 2018, it did not exceed 5% coverage on average. The highest abundance values were found to the west in the Ciutadella area; to the east in Illa de l'Aire and La Mola; and to the north in Cavalleria and Mola de Fornells (Cefalì *et al.*, 2018). Analysis of the time series shows that the species has increased its coverage since 2010, especially in deep areas, and to a lesser extent in the first 10 metres. The maximum coverage values were detected in 2014 at 25 metres. In 2016 and 2018, it was practically absent in the first 25 metres, and its maximum coverage was between 40 and 45 metres depth (Figure 2).

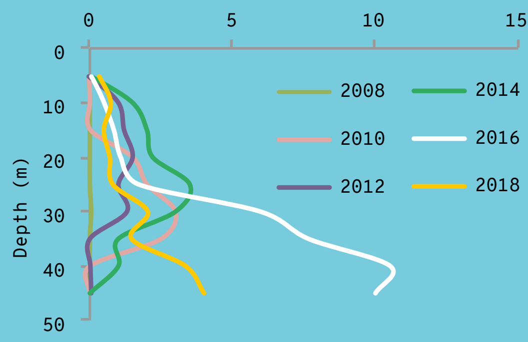


Figure 2. Average percentage (%) coverage of *C. cylindracea* at a depth of between 0 and 50 m from 2008 to 2018. Source: EIJF / COB-IEO.

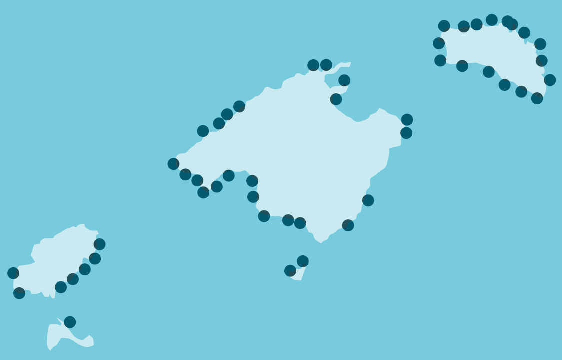


Figure 3. Locations of *C. cylindracea* in the sampling station network in the rocky infralittoral area of the Balearic archipelago. Source: EIJF / COB-IEO.

Figure 4. Picture of *C. cylindracea*. Source: Enric Ballesteros.

Womersleyella setacea (Hollenberg) R. E. Norris, 1992

STATUS

Invasive exotic species (Spanish catalogue of invasive exotic species. Royal Decree 630/2013 of 2 August).

EASIN STATUS

Exotic.

BIOGEOGRAPHIC DISTRIBUTION

Originally described in the Hawaiian Islands and subsequently in tropical regions of the Pacific and Atlantic.

POSSIBLE MEANS OF INTRODUCTION AND EXPANSION

Maritime transport (ballast water) and dispersal from fishing nets.

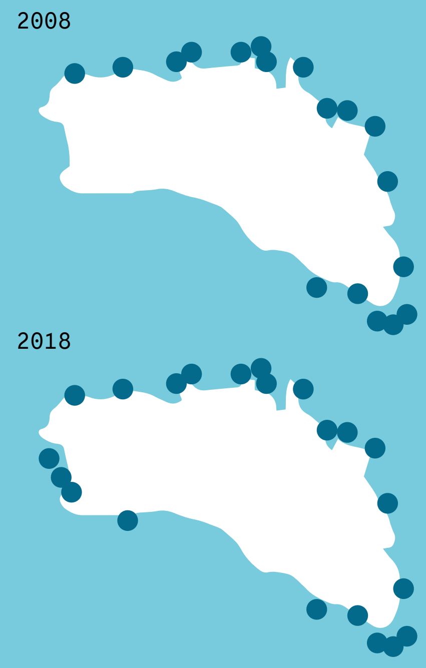


Figure 1. Locations of *W. setacea* from the network of monitoring stations in 2008 (a) and in 2018 (b). SOURCE: EIJF / COB-IEO.

SPATIAL DISTRIBUTION

It is found on rocky, sciaphilous (shaded) bottoms, forming thick, resistant mats (Cebrián and Rodríguez-Prieto, 2012). *W. setacea* became established in Menorca a couple of decades ago and is more abundant to the north of the island due to the coast's morphology with deeper bottoms with a steep gradient and coralligenous and hemisciaphilous algae habitats (Massutí *et al.*, 2015).

RESULTS

The data collected from 2008 to 2014 show a trend towards a decrease in abundance throughout Menorca (Massutí *et al.*, 2015). However, in the last two years of sampling, 2016 and 2018, it became abundant again in the north of the island (Cefalì *et al.*, 2018).

Figure 2 shows how *W. setacea* is distributed at a depth of between 25 and 45 m with maximum coverage at 40 m. In 2018, much lower values were recorded at 35 m. This difference was solely due to the decrease observed in some stations to the north of the island (Cefalì *et al.*, 2018).

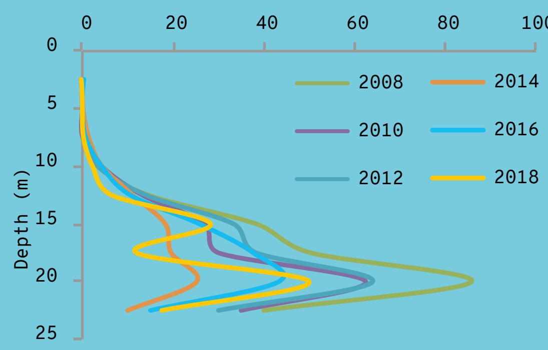


Figure 2. Average percentage (%) coverage of *W. setacea* at a depth of between 0 and 50 m from 2008 to 2018. SOURCE: EIJF / COB-IEO.

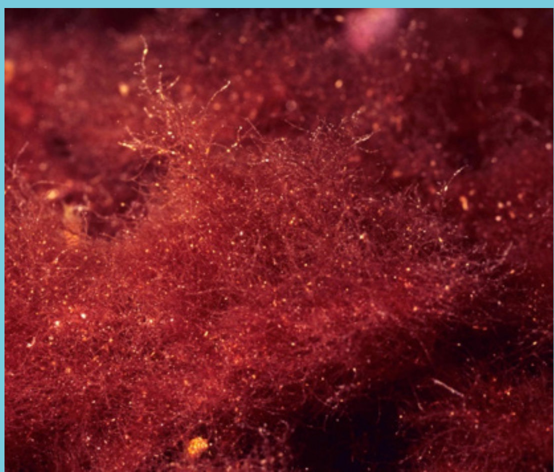


Figure 3. Picture of *W. setacea*. SOURCE: Enric Ballesteros.

Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon, 1845

STATUS

Invasive exotic species (Spanish catalogue of invasive exotic species. Royal Decree 630/2013 of 2 August).

EASIN STATUS

Cryptogenic.

BIOGEOGRAPHIC DISTRIBUTION

Originally from the west of Australia with a very broad distribution in all tropical and subtropical seas.

POSSIBLE MEANS OF INTRODUCTION AND EXPANSION

Maritime transport (ballast water).

RESULTS

As part of the invasive algae monitoring programme, an *A. taxiformis* community was observed at Jaume Ferrer Research Station (Menorca). It is not a dominant species in a community nor is it displacing other species. Therefore, it is not invasive around the island (Cefalì *et al.*, 2018). It is present around all islands in the Balearic archipelago and is now considered an established alga in the Balearic Islands.

SPATIAL DISTRIBUTION

It was recorded for the first time in the Balearic Islands in 1993, specifically in Ciutadella (Menorca) (Ballesteros and Rodríguez, 1996). It has two morphologically differentiated stages in its life-cycle: a sporophytic stage in winter and spring, located in photophilic communities at a shallow depth, and a gametophyte stage, present all year round, although more common in spring and summer in hemisciaphilous communities at a depth of 10 to 30 m (Massutí *et al.*, 2015).

Figure 1. Locations of *A.taxiformis* from the network of monitoring stations of the infralittoral biodiversity program in 2016. SOURCE: EIJF / COB-IEO.

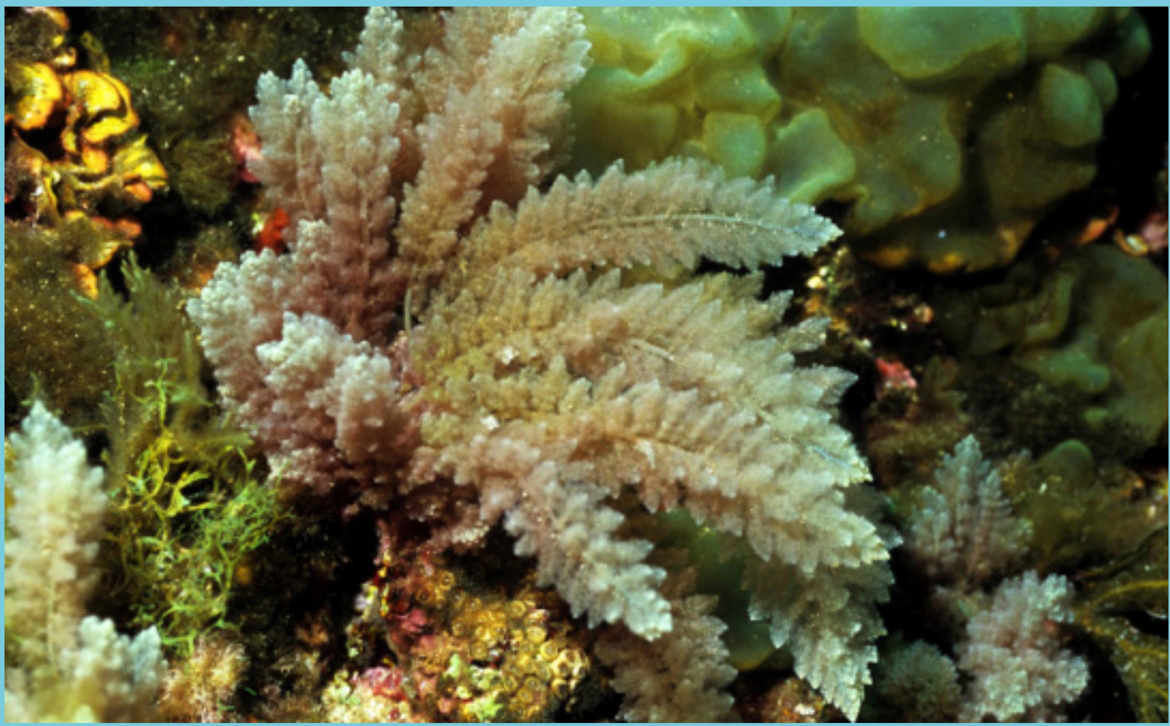


Figure 2. Picture of *A.taxiformis*. SOURCE: Enric Ballesteros.

Acrothamnion preissii E. N. Wollaston, 1968

STATUS

Invasive exotic species (Spanish catalogue of invasive exotic species. Royal Decree 630/2013 of 2 August).

EASIN STATUS

Exotic species.

BIOGEOGRAPHIC DISTRIBUTION

Originally from the Indo-Pacific, native to the west of Australia, New Zealand, South Africa and Japan.

POSSIBLE MEANS OF INTRODUCTION AND EXPANSION

Maritime transport, incrustations on ships' hulls (biofouling).

Figure 1. Locations of *A. preissii* in the network of stations in the monitoring programme in 2008 (a) and in 2018 (b). SOURCE: EIJF / COB-IEO.

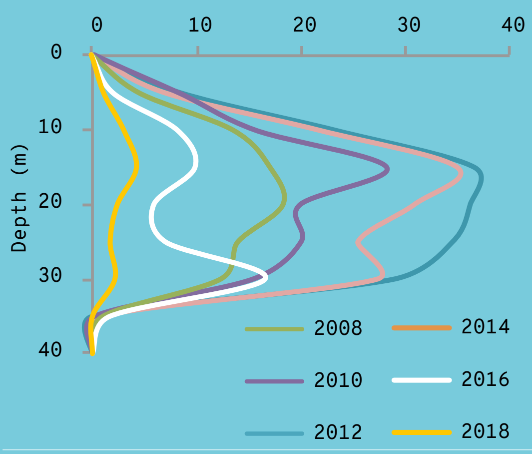


Figure 2. Average percentage (%) coverage of *A. preissii* at a depth of between 0 and 40 m from 2008 to 2018. SOURCE: EIJF / COB-IEO.

SPATIAL DISTRIBUTION

This is a species that grows in locations with dim light at a depth of between 5 and 70 metres. It grows on the rhizomes of *Posidonia oceanica* and sciaphilous algae in the infralittoral zone. It may also form dense mats and displace the flora and fauna in the area. It has settled in the Balearic Islands for more than 20 years and is now considered an established alga (Massutí *et al.*, 2015).

RESULTS

There was a very similar distribution between 2008 and 2016. However, in the last year of monitoring, a decrease in the species was detected compared with the previous years, especially to the north, east and west of the island. This decrease was lower in the south of Menorca, where there was a similar abundance to previous years. This could be explained by greater coverage of *Posidonia oceanica* meadows (Cefalì *et al.*, 2018).

Its maximum coverage is at a depth between 15 and 35 metres with a trend to decrease in abundance throughout the bathymetric range of distribution. In the first years of sampling, the maximum average coverage (almost 40%) was at a depth of 25 metres, which fell to 15% in 2014 and did not exceed 5% in 2018 at any depth (Figure 2).

Figure 3. Pictures of *A. preissii*. SOURCE: Enric Ballesteros.

Percnon gibbesi (H. Milne Edwards, 1853)

STATUS

Invasive exotic species (Spanish catalogue of invasive exotic species. Royal Decree 630/2013 of 2 August).

EASIN STATUS

Exotic species.

BIOGEOGRAPHIC DISTRIBUTION

It is naturally distributed in the Pacific Ocean from Chile to California and in the Atlantic from Brazil to Florida and from the Gulf of Guinea to Madeira.

POSSIBLE MEANS OF INTRODUCTION AND EXPANSION

Maritime transport (ballast water and/or incrustations) and through transport of larvae on currents.

SPATIAL DISTRIBUTION

Percnon gibbesi was recorded in the Mediterranean for the first time in 1999, specifically around the Italian island of Linosa (Relini *et al.*, 2000). That same year, it was recorded in Mallorca, Menorca (García and Reviriego, 2000) and Eivissa (Müller, 2001). It has subsequently expanded rapidly throughout the Mediterranean. The species now has established, stable populations in the Balearic archipelago, which makes it difficult to eradicate. It lives in rocky habitats on in the infralittoral zone at a depth of between 0.5 and 8 metres in fissures, ports and marinas, with maximum abundance at 1 m water depth (Deudero *et al.*, 2005).

Figure 1. Locations of *P. gibbesi* presence in the Balearic Islands obtained from various sources. SOURCE: Citizen science.

Figure 2. Picture of *P. gibbesi*. SOURCE: Salud Deudero.

Caulerpa taxifolia (M. Vahl) C. Agardh, 1817

STATUS

Invasive exotic species (Spanish catalogue of invasive exotic species. Royal Decree 630/2013 of 2 August).

EASIN STATUS

Exotic species.

BIOGEOGRAPHIC DISTRIBUTION

A species from tropical and subtropical areas of the Caribbean Sea and the South Atlantic and Pacific oceans.

MEAN OF INTRODUCTION

It was accidentally introduced to the Western Mediterranean by a water leak from the Oceanographic Museum of Monaco containing propagules in 1984 (Meinesz and Hesse, 1991).

SPATIAL DISTRIBUTION

It was recorded for the first time in Cala d'Or (Mallorca) in 1992 (Pou *et al.*, 1993). After its expansion stage in the Balearic archipelago, the species is currently regressing and is only found to the southeast of Mallorca.

Figure 1. Locations of *C. taxifolia* presence in the Balearic Islands. SOURCE: Citizen science.

Figure 2. Picture of *C. taxifolia*. SOURCE: Enric Ballesteros.

Halimeda incrassata (J. Ellis) J. V. Lamouroux, 1816

STATUS

Exotic species.

EASIN STATUS

Exotic species.

BIOGEOGRAPHIC DISTRIBUTION

It is naturally distributed in the tropical Atlantic Ocean and the Indo-Pacific Ocean (Guiry and Guiry, 2016).

POSSIBLE MEANS OF INTRODUCTION AND EXPANSION

Aquaculture and maritime transport (incrustations on anchors and yachts) (Alós *et al.*, 2016).

SPATIAL DISTRIBUTION

Halimeda incrassata was recorded in the Mediterranean for the first time in 2011, specifically in Palma Bay Marine Reserve, located along the southwest coast of Mallorca (Alós *et al.*, 2016). In 2014, it was detected in the western part of Palma Bay in Portals Vells (Alós *et al.*, 2016). It is set to be a potentially new invasive species in the Balearic Islands. It grows on sandy bottoms, *Posidonia oceanica* mats and rocky areas, and can form very extensive meadows. It produces organic matter and forms calcium carbonate in sediments (Wefer, 1980; Multer, 1988), has a high growth rate (Wefer, 1980; Van Tussenbroek and Van Dijk, 2007) and interacts with native species (Parker *et al.*, 1999). Consequently, it may threaten the structure and operation of the native ecosystem.

Figure 1. Locations of *H. incrassata* presence in the Balearic Islands. SOURCE: Citizen science.

Figure 2. Picture of *H. incrassata*. SOURCE: Enric Ballesteros.

Area colonised by the invasive alga *Halimeda incrassata*

WHAT IS IT?

The macroalga *Halimeda incrassata (Bryopsidales, Chlorophyta)* is a tropical calcareous green alga. It was recorded for the first time in 2011 inside Palma Bay Marine Reserve.

WHY?

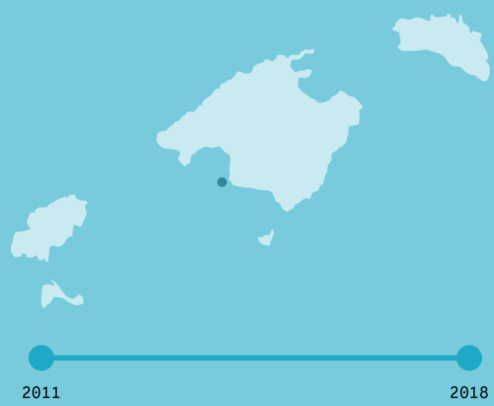
Global warming is contributing to the colonisation of the Mediterranean Sea by tropical and subtropical species. This phenomenon is known as the tropicalisation of the Mediterranean. Tropicalisation is associated to changes in species distribution, biodiversity and ecosystem functioning.

Monitoring its distribution change is essential to elucidate its invasive status and possible effects on diversity and ecosystem functions in the areas that colonises.

METHODOLOGY

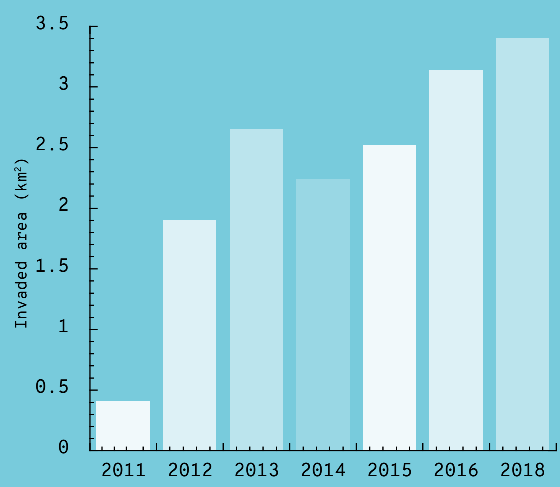
A group of researchers from Institut Mediterrani d'Estudis Avançats has been monitoring it since it was identified in Palma Bay Marine Reserve (Alós *et al.*, 2016). This monitoring has been carried out with underwater video cameras in a 6.4 km^2 study area, which were anchored each August from 2011 to 2018. The videos were analysed and the presence or absence of the invasive macroalga *H. incrassata* at each assessed geographical point assessed was determined. Its distribution and colonised area were estimated with spatial analysis tools, using conventional linear interpolation based on a 50 x 50 m cell mesh to predict its presence or absence in the study area.

LOCATION



RESULTS

The invasive macroalga *Halimeda incrassata* is rapidly colonising the sandy area in the Palma Bay Marine Reserve. In 2011, the colonised area was 0.41 km^2. This figure represented 6.25% of the study area, while in 2018 it was already 3.4 km^2 in size (52.5% of the assessed area), representing an 8-fold increase in 7 years.



Area colonised by the invasive macroalga *Halimeda incrassata* in Palma Bay Marine Reserve between 2011 and 2018. Source: IMEDEA

V

Pollution

Plastic and other debris floating in the sea. SOURCE: Xavi Mas.

Number of coastal cleaning vessels and abundance of floating debris collected at sea

WHAT IS IT?

The floating debris collection vessel service is a pioneering plan for the Balearic coastline, which weighs and classifies the materials found during summer. The debris is weighed and classified into the following substances: plastic, wood, vegetation, organic matter and others.

METHODOLOGY

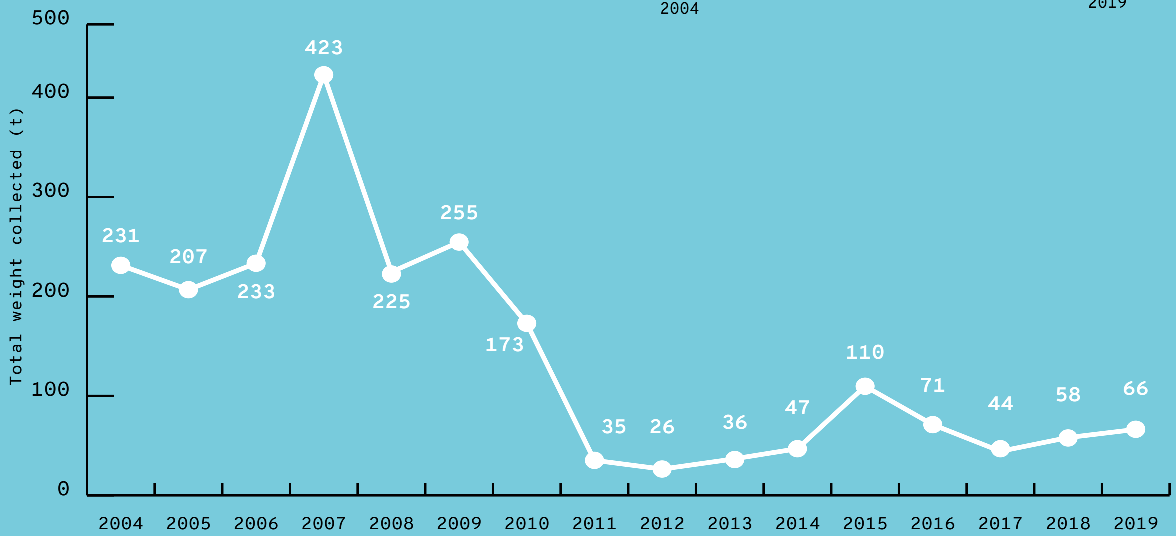
Since 2004, Coordinació de Neteja de Litoral (CNL), a service of the public body ABAQUA (Agència Balear de l'Aigua i la Qualitat Ambiental) has collected floating debris on the Balearic coastline between May and September.

The service uses different vessel types based on their collection capacity (from higher to lower: coastal, semi-coastal and beach), which determines the total amount of debris that can be collected. In 2019, there were 26 beach type vessels in the Balearic Islands (which collect debris next to the shore) and 4 semi-coastal vessels (which are faster than beach vessels).

WHY?

The information about the number of coastal cleaning vessels and the weight and type of material collected allows us to monitor the marine debris in the Balearic Sea. Removing such debris is of great importance as it has negative environmental and economic impacts (especially on fishing and tourism). These data contribute to defining improvements in the management of marine debris and provide better knowledge of the models of debris distribution on the Balearic coastline.

LOCATION

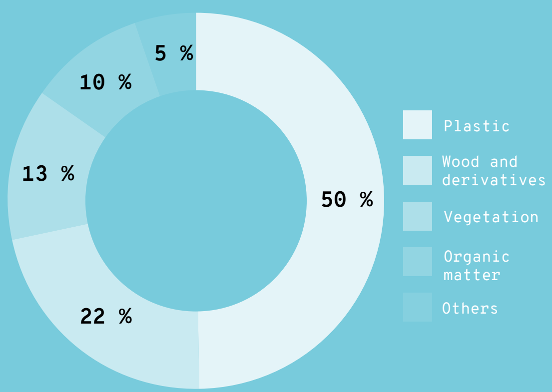


Evolution of the amount of floating debris collected around all Balearic Islands by coastal cleaning vessels over time. Source: CNL (ABAQUA).

RESULTS

From 2004 to 2019, the CNL service collected 2,240 t of debris, which is an average of 140 t per year. These amounts collected are not homogeneous throughout the years, as the amount decreased considerably from 2011 (≤ 110 t) due to the withdrawal of beach type vessels.

In the 2019 season, 30 cleaning vessels collected a total of 66 t of floating debris: 42 t in Mallorca, 13 t in Menorca, 10 t in Eivissa and 2 t in Formentera. Half of the amount collected by weight on the Balearic coastline is plastic. This is followed by wood and derivatives (22%), vegetation (13%), organic matter (10%) and others. No significant amounts of oil spillages were collected (0.1%).



Weight percentage of debris collected on the Balearic coastline by the 30 vessels operating in 2019. Source: CNL (ABAQUA).

WHAT IS IT?

Noise in the ocean may be produced naturally (by organisms and the environment) or by humans (for approximately the last 100 years). Anthropogenic noise is a form of noise pollution produced in large areas of the sea and uses frequencies that compete with natural sounds, such as those made by cetaceans to communicate. This indicator provides information about the amount of human activity in a particular marine area. It is now a descriptor of good marine environmental status.

WHY?

Although we are still generally ignorant of the use of sound by marine fauna, there is evidence that noise pollution affects certain vital functions of mammals, fish and invertebrates. There are national and international regulations and conventions but improved monitoring to mitigate this impact remains an urgent need.

METHODOLOGY

Ocean noise data have been collected in the projects performed by Asociación Tursiops: Els nostres Dofins, CALMA and CALMADOS (the latter two with the support of Fundación Biodiversidad).

Acoustic censuses are performed with hydrophones deployed from vessels. The results show the recordings of anthropogenic noise in Es Freus Marine Reserve in Eivissa and Formentera in 2018. Different frequency bands are studied on a monthly basis.

LOCATION

2018

RESULTS

The noise detected in Es Freus in Eivissa and Formentera is associated with shipping.

The amount of acoustic energy is higher in summer (>15 dB).

In the summer months, the presence of fast-moving vessels increases the energy in the high-frequency zone.

Generalized Additive Model (GAM) per day at the (A) 63 Hz and (B) 4,000 Hz bands. SOURCE: Associació Tursiops.

WHAT IS IT?

Sediments accumulate a large amount of pollutants that are harmful to the environment and toxic to marine organisms and human health.

We show the concentration results of various pollutants in sediments:
(61) heavy metals
(62) polychlorinated biphenyls (PCBs)
(63) polycyclic aromatic hydrocarbons (PAHs)
(64) volatile organic compounds (VOCs) and
(65) organochlorine pesticides.

WHY?

Human activity has increased the amount and distribution of pollutants in the atmosphere, soil, rivers, lakes and seas. A large proportion of these substances accumulate in sediments. These pollutants may bioaccumulate in marine organisms and enter the food cycle, with predators receiving higher doses, which may result in harmful effects for humans.

Many of these compounds are included in the list of priority substances in the Directive on Environmental Quality Standards. European legislation stipulates the need to control and eliminate the discharges of these substances into the aquatic environment in order to prevent pollution and possible effects on the environment and marine organisms.

METHODOLOGY

We present results from the study performed in 2009 by technicians from the Technical Scientific Services at Universitat de les Illes Balears for Direcció General de Recursos Hídrics (Albertí *et al.*, 2010). Samples were taken in 44 different locations around the islands: 27 in Mallorca, 2 in Cabrera, 7 in Eivissa, 3 in Formentera and 5 in Menorca.

For the three metals included in the list of priority substances in the Directive on Environmental Quality Standards, we also present the results of a study conducted in 2005 (Ballesteros *et al.*, 2007).

There are no concentration baseline values of these pollutants in the Balearic Islands that could be used to determine whether the concentration is natural or due to pollution. Therefore, it is necessary to use cut-off values based on the concentrations measured (in this case, the sum of the mean and the standard deviation).

LOCATION

RESULTS

The areas polluted with heavy metals in sediments according to the study produced in 2009 are Sóller Port (Mallorca) and Maó Port (Menorca). If we also consider the results of the study performed in 2005, Fornells Bay (Menorca) and Ses Roquetes (Eivissa) should also be included in the list of areas highly contaminated by heavy metals.

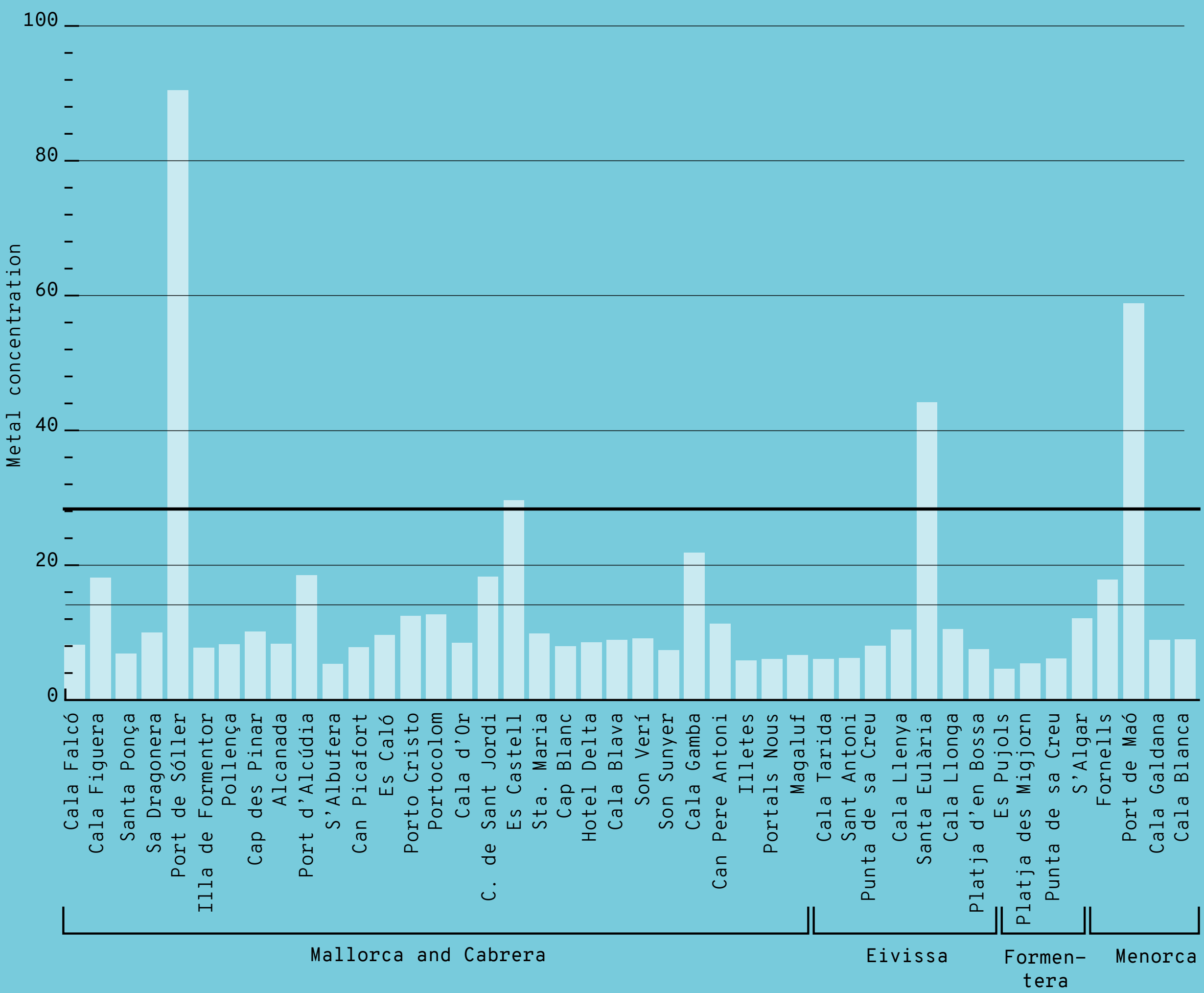
PCB pollution was detected in two places in the study: Sant Antoni (Eivissa) and S'Algar (Menorca).

There are three places where pollution with polycyclic aromatic hydrocarbons (PAHs) was detected: Cala Figuera, Cala Gamba and Maó Port.

Volatile organic compounds (VOCs) pollution was detected in two places: Cala Figuera and Alcúdia Port.

Organochlorine pesticides pollution was detected in Sant Antoni (Eivissa), Cala Blanca (Menorca), Cala Gamba (Mallorca) and S'Algar (Menorca) when the sum of all of the organochlorine pesticides measured in the study is considered, and in Cala Blanca when only the compounds included in the list of priority substances in the Directive on Environmental Quality Standards are considered.

The data for pollutants in sediments in the Balearic Islands belong to a single study conducted in 2009. In the case of some metals, an additional study was conducted in 2005, and they may have varied over time. It would be recommendable to update these data with new studies to assess the evolution of pollutant concentrations in sediments.



Sum of the metal concentrations included in the list of priority substances in the Directive on Environmental Quality Standards (cadmium, lead, mercury and nickel) in mg of metal per kg of sediment for the various places where it was measured in 2009. The black line shows the mean plus the standard deviation of all of the measurements. SOURCE: Albertí *et al.* (2010).

VI

Fishing pressure

Fisherman in Alcúdia Port, Mallorca. SOURCE: Sebastià Torrens.

Number of valid recreational maritime fishing licences

WHAT IS IT?

The number of valid licences each year for recreational maritime fishing for individuals (from land or floating structures), vessels (one licence covers all the people), spearfishing and sport (from land during training and competitions).

WHY?

Recreational maritime fishing activities are increasing in the Balearic Islands. Valid recreational fishing licences provide guideline information about the fishing effort by this sector each year on the Balearic coastline, as there are no control measures to record the catch.

METHODOLOGY

The validity of each type of fishing licence has a set time limit. Currently, individual and vessel licences are valid for 3 years, while sport fishing licences last 1 calendar year and spearfishing licences have an annual validity. Prior to 2014, individual fishing licences were valid for 2 years. Vessel licences did not exist before 2007 (as they were included in individual licenses). Since 2011 they have been issued every 3 years for exterior waters and since 2014 for interior waters. Therefore, in order to calculate how many licenses are operational each year, it is necessary to standardise the data concerning licences issued based on this information.

LOCATION

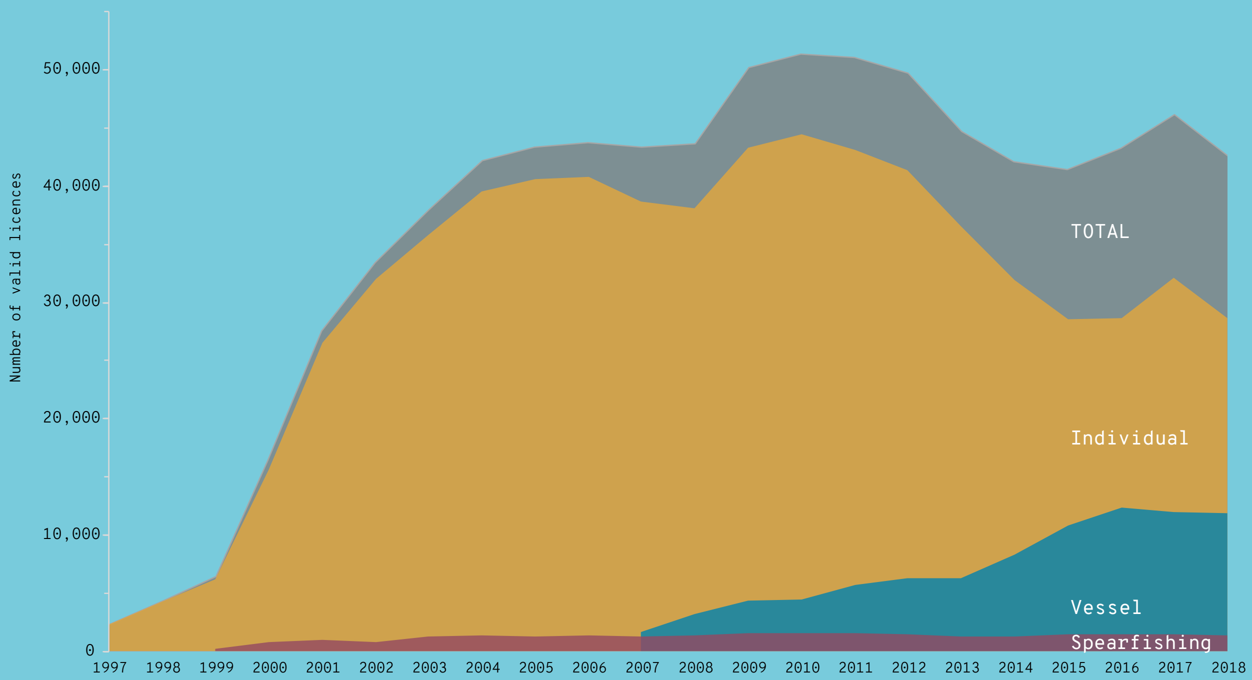
RESULTS

In 2018, the type of recreational licence most applied for in the Balearic Islands was for individual fishing (67%), followed by licences for vessels (28%), spearfishing (3%) and sport (2%).

The increase in individual fishing licences from 1997 to 2004 is due to changes to national and regional regulations. The maximum was reached in 2010 (approximately 45,000 licences), when the economic crisis took place.

The vessel fishing regulations were implemented in different years: 2011 for external waters and 2014 for internal waters. This caused fluctuations in the results, which stabilised from 2016 with approximately 12,000 licences up to the present.

Spearfishing licences are those that fluctuate least over time (approximately 1,400 licences).



Number of valid recreational fishing licences in the Balearic Islands from 1997 to 2018. Three types of licences are shown: spearfishing, individual and vessels. SOURCE: Direcció General de Pesca i Medi Marí, Govern de les Illes Balears.

Evolution of the number of vessels in the professional and recreational fishing fleet

WHAT IS IT?

Number of vessels used for professional and recreational fishing. Professional and recreational fishing provides economic benefits, food, well-being and leisure for society.

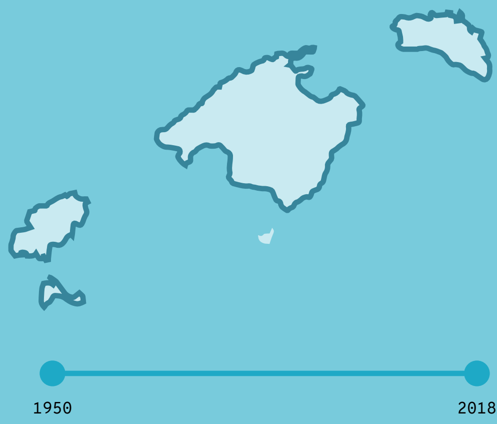
WHY?

Knowing the evolution of both the professional and recreational fleet is necessary in order to improve sustainability and management of local fishing resources.

METHODOLOGY

Historical data concerning the professional fishing fleet collected by Federació Balear de Confraries de Pescadors (FBCP) are shown together with approximate values of the recreational vessels based on the valid licences in 2018, issued by Direcció General de Pesca i Recursos Marins, Govern de les Illes Balears.

LOCATION

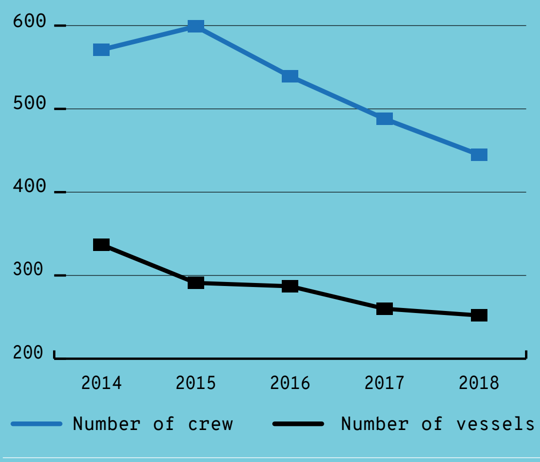


RESULTS

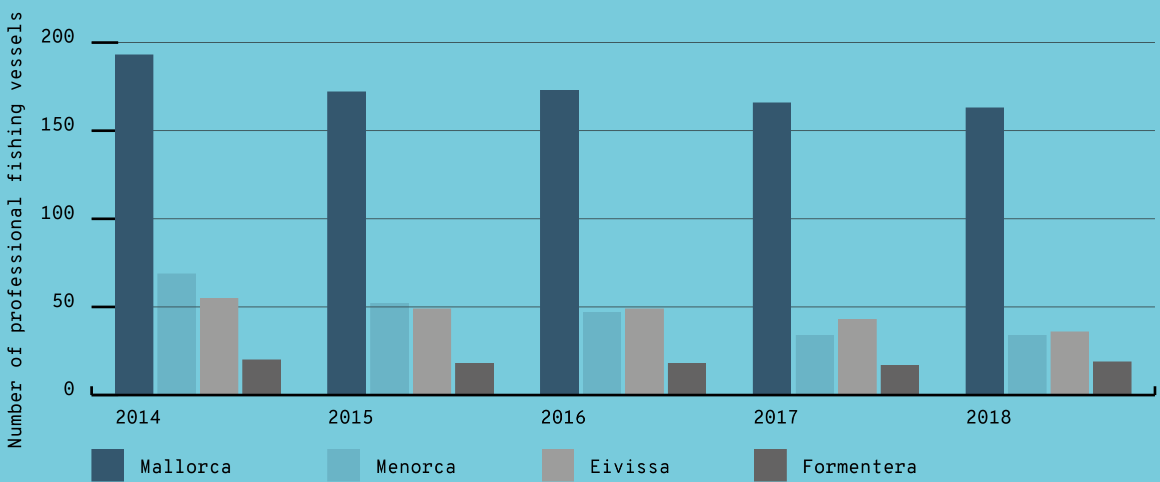
→ The professional fishing sector in the Balearic Islands is in recession.

→ The fishing fleet in Mallorca is at least four times larger than the rest of the islands.

→ In 2018 there were 252 valid professional fishing licences compared with 11,313 recreational fishing licences. That means there are 45 recreational fishing vessels for each professional vessel.



Evolution of the professional fishing fleet from 2014 to 2018. Source: FBCP.



Professional fishing fleet in the Balearic Islands by island from 2014 to 2018. Source: FBCP.

VII

Human and tourism pressure

Can Picafort beach, Mallorca. SOURCE: Sebastià Torrens.

Human pressure index (HPI) for the Balearic Islands

WHAT IS IT?

The Human Pressure Indicator (HPI) is intended to show the real daily population of the Balearic Islands.

WHY?

It shows the real population for each day of the year. It gives an idea of the human pressure on the Balearic Islands.

METHODOLOGY

The HPI is calculated each year based on the registered population plus the arrivals and departures of passengers through ports and airports.

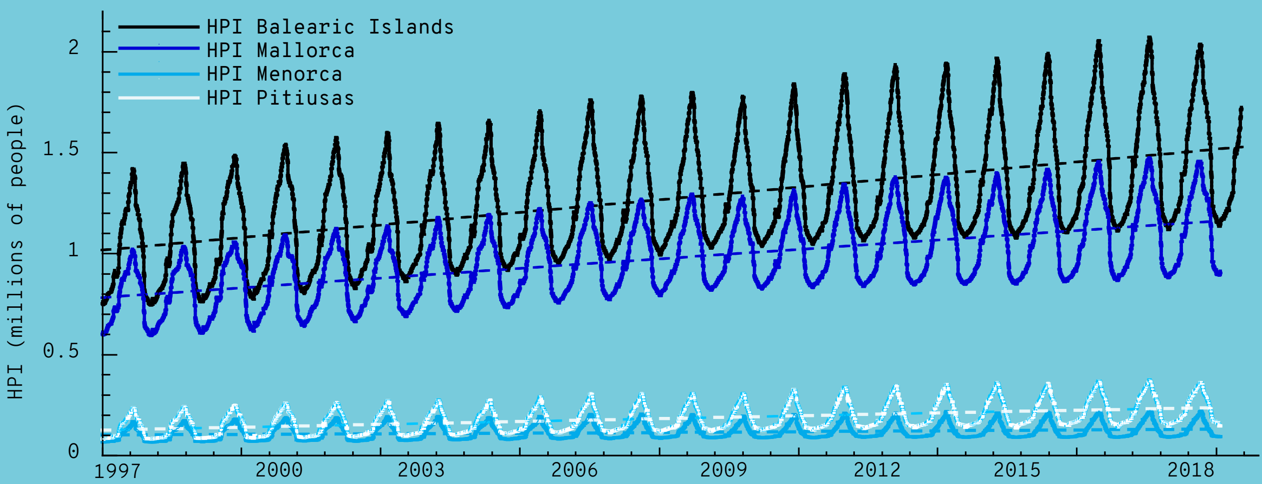
LOCATION

RESULTS

The maximum number of people that have been in the Balearic Islands on the same day is 2,074,004 people. For Mallorca it is 1,476,738 people; for Menorca, 224,004, and the Pitiüses, 376,961. All of these figures were recorded in August 2017.

Since 1997, the resident and visitor population has been on an upward trend, equivalent to 62.5 people per day for the Balearic Islands as a whole, 47.2 for Mallorca; 3.7 for Menorca and 13.9 for the Pitiüses.

In the case of the mean HPI, the increase is 23,411 people per year for the Balearic Islands as a whole, while for Mallorca it is 17,061; 1,288 for Menorca and 5,010 for the Pitiüses.



Evolution of the daily human pressure indicator (HPI) in the Balearic Islands from 1997 to May 2019.
SOURCE: IBESTAT.

WHAT IS IT?

Artificial surface in the first kilometre of the coast.

WHY?

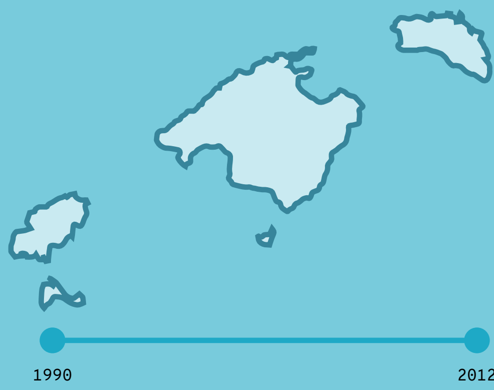
The increase in urbanisation and artificial surfaces is a serious threat to the coast, especially in tourist regions, where it grows at a higher rate than in regions with less intense tourism.

Changes in land occupancy, especially through urbanisation processes, are a good indicator of the loss of ecosystem services in the littoral zone, where natural areas are transformed and covered with buildings and cemented areas.

METHODOLOGY

The data concerning the urbanised coastal area have been obtained from the master's thesis by Jaime Rudolf Rosselló-Beck, directed by Ivan Murray, in 2017 at Universitat de les Illes Balears (UIB).

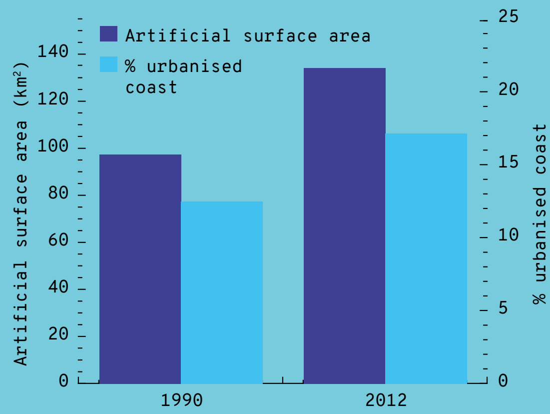
LOCATION



RESULTS

In the last two decades, the presence of artificial surfaces in the first kilometre of the coast has increased by 37.6% with the resulting environmental impacts.

It is necessary to update cartographic information on changes in land occupancy in coastal areas as a management tool to deal with the potential effects of climate change.



Artificial surface area in square kilometres (km²) in the first kilometre of the coast, in dark blue. Source: Rosselló-Beck (2017).

Aerial photograph of Alcanada, Mallorca. Source: Sebastià Torrens.

WHAT IS IT?

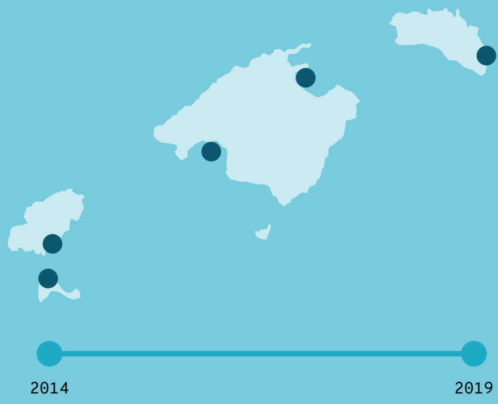
Number of arrivals and departures by vessels in ports managed by the Balearic Port Authority. Different types of vessels are included: warships, cruise ships, ferries, oil tankers, RO-RO, bulk carriers, tugs, gas and liquid tankers, coastal fishing and other vessels.

WHY?

Information about the total number and type of vessels provides a reference framework to understand the environmental pressure on the marine and land environments.

Maó Port, Menorca. SOURCE: David Arquimbau.

LOCATION



METHODOLOGY

Data for arrivals and departures between 2014 and 2019 in the 5 ports managed by Ports de Balears (Balearic Port Authority) are included:

- Mallorca: Palma Port and Alcúdia Port
- Menorca: Maó Port
- Eivissa: Eivissa Port
- Formentera: La Savina Port

The data are published on the internet on the following web page:
www.portsdebalears.com/es/buques-en-puerto

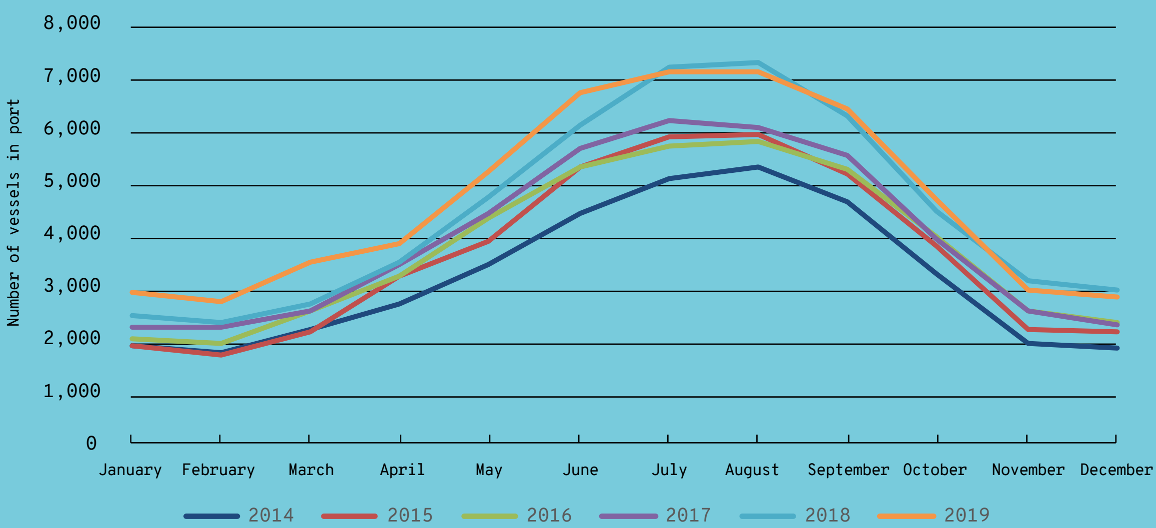
RESULTS

The number of monthly vessels in ports was on a growing trend in the six years of records (2014-2019). Vessels in port have increased since 2014 by 1,000 more per month.

In 2019 approximately 2,600 to 7,000 vessels per month were recorded.

In 2019 arrivals and departures of vessels in ports were higher than in 2018 between January and June; in summer they were higher in 2018 and similar the rest of the year.

The ports of Eivissa and La Savina are those with the highest traffic in the Balearic Islands (an order of magnitude higher). This is due to the large number of ferries that travel between Eivissa and Formentera.



Total vessel transit in all ports in the Balearic Islands (Palma, Alcúdia, Maó, Eivissa and La Savina).
SOURCE: Balearic Port Authority.

Number of marinas and number of moorings

WHAT IS IT?

Moorings are a physical space in the port that may or may not be occupied by a vessel.

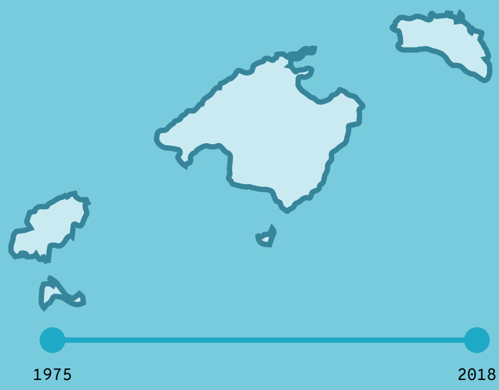
WHY?

The total number of moorings in marinas shows the number of recreational vessels that may use the Balearic coast. This provides information about the possible pressure of the nautical sector on the marine environment.

METHODOLOGY

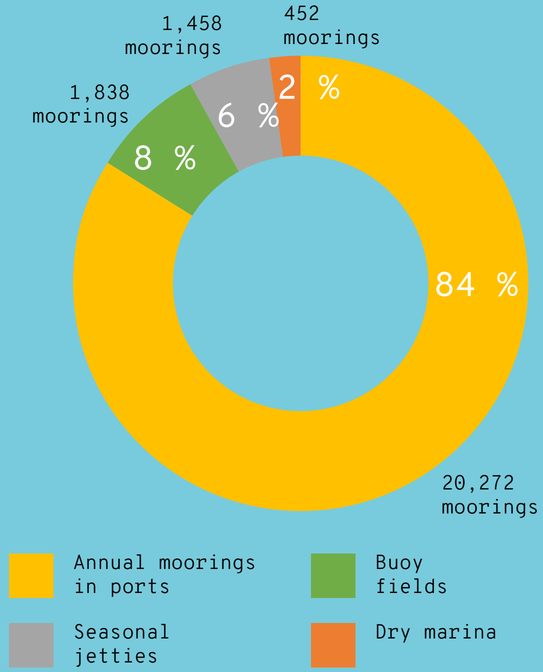
Data from the General Ports Plan for the Balearic Islands (Ports IB) are used. Information from 1975, 1987, 1994, 2000-2008, 2011, 2014 and 2018 is compiled. This sheet presents data concerning the total number of moorings managed by Ports IB in 2018.

LOCATION



RESULTS

In 2018 there were around 24,000 moorings, 86% of which were in marinas, 8% were buoy fields, 6% were in seasonal jetties and 2% in dry marinas. This means that 13% (3,166) are summer mooring facilities.



Total number of moorings managed by Ports IB in 2018. These are located in ports, buoy fields, seasonal jetties and dry marinas. SOURCE: Ports IB.

Annual moorings in ports	Dry marina	Buoy fields				Seasonal jetties		TOTAL
		Annual buoys	Seasonal summer buoys					
		Port	Port	Coast	LIFE Posidonia	Port	Coast	
20,272	452	130	247	1,203	258	519	939	24,020

Number of moorings managed by Ports IB by type (moorings in port, dry marina, buoy fields, summer jetties in port areas or near coasts). SOURCE: Ports IB.

Number and evolution of vessels anchored on beaches

WHAT IS IT?

Maximum number of daily vessels that visit and anchor at beaches in Menorca during summer.

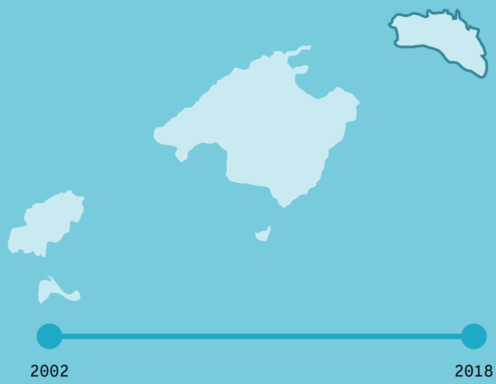
WHY?

This number provides guideline information about the pressure that may be exerted on the coastline by the nautical sector. Knowing this information is fundamental to implement optimal management measures when necessary.

METHODOLOGY

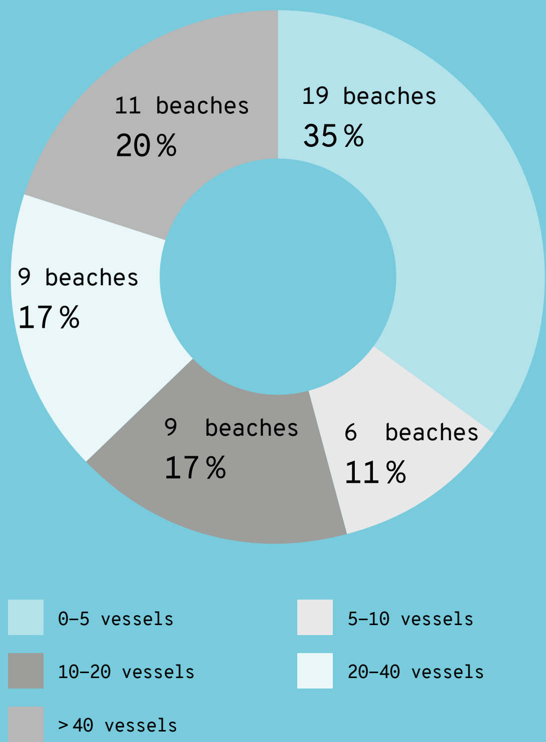
Human teams from Agència Menorca Reserva de Biosfera (Consell Insular de Menorca) and Observatori Socioambiental de Menorca (OBSAM) have counted the anchored vessels. In 2018 they studied 54 beaches spread around the Menorcan coast. The count reports the number of vessels on a beach at three different times (12pm, 2pm and 5pm), and the maximum daily number reached is selected.

LOCATION



RESULTS

The count of anchored vessels in 2018 shows that 19 beaches reach maximum daily values of between 0-5 vessels (35% of the total). This is followed by 11 beaches (20%) that have > 40 vessels anchored simultaneously. The other 24 beaches have values of between 5 and 40 vessels.



Number and percentage of beaches in Menorca with the maximum number of vessels anchored on the same day in summer 2018. Source: Agència Menorca Reserva de Biosfera (Consell Insular de Menorca).

Boats on Binibèquer Beach, Menorca. Source: David Arquimbau.

WHAT IS IT?

The status of the beaches can be measured with the number of users using the following indicators (data are only available for Menorca):

→ Number of users: maximum abundance of users counted in a day.

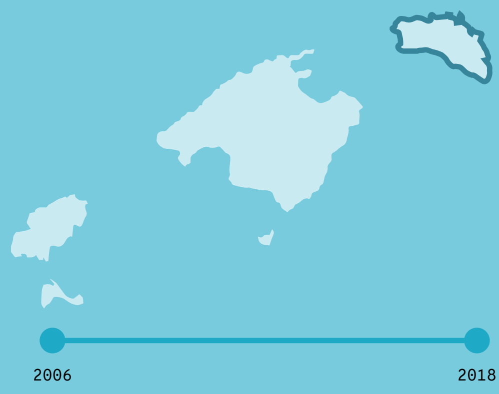
→ User density: land surface area available for each person resting.

→ Carrying capacity: optimal number of people on each beach.

WHY?

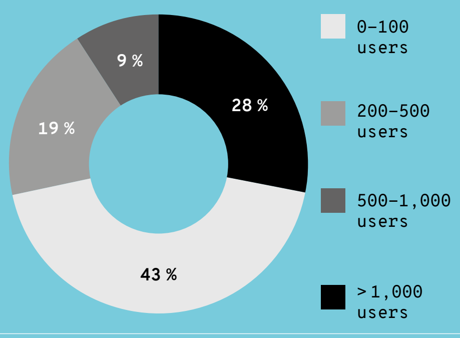
Excessive numbers of users on beaches during the summer may create pressure on these fragile natural systems. Future beach management measures could be based on knowledge of their carrying capacity.

LOCATION



METHODOLOGY

OBSAM (Observatori Socioambiental de Menorca del Institut Menorquí d'Estudis), the lifeguard service of some town councils, Servei de Platges and Agència Menorca Reserva de Biosfera and Consell Insular de Menorca have counted users on 54 beaches in Menorca. The people in the water and on the sand are counted but the people on anchored vessels are not. The land surface area of each beach is measured using orthophoto maps and fieldwork integrated into geographic information systems. Servei de Platges, Consell Insular de Menorca defines the optimal values as 15 m²/ person on virgin beaches and 5 m²/ person on urban beaches.



Number of users of 54 beaches in Menorca in 2018. Source: Agència Menorca Reserva de Biosfera (Consell Insular de Menorca).

RESULTS

Number of users

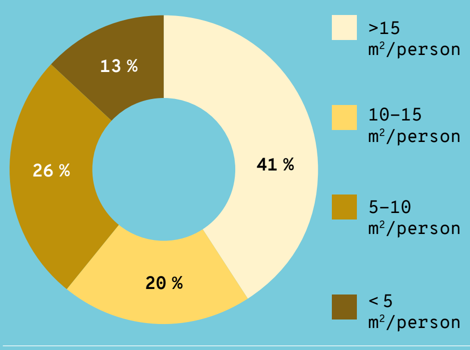
In 2018, 15 of the 54 beaches studied in Menorca had 0-100 users per day (28%). Another 15 beaches had > 500 users in a day (28%); of these 5 beaches had > 1,000 users (9%).

User density

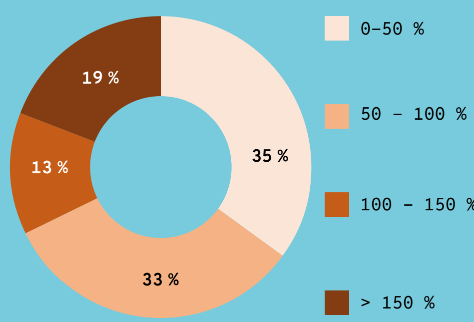
In 2018, the surface area available per person for 7 of the 54 beaches studied (13%) was less than the optimal area (< 5 m²), while 22 beaches had recommendable values (> 15 m²).

Carrying capacity

In 2018, the percentage carrying capacity of 17 beaches was > 100%, while 37 beaches had adequate values of less than 100%.



Surface area available per person on 54 beaches in Menorca in 2018. Source: Agència Menorca Reserva de Biosfera (Consell Insular de Menorca).



Percentage carrying capacity of 54 beaches studied in Menorca in 2018. Source: Agència Menorca Reserva de Biosfera (Consell Insular de Menorca).

Number of tourists and number of tourist beds

WHAT IS IT?

Number of legal tourist beds registered in the Balearic Islands between 1959 and 2019.
Total number of tourists who visited the Balearic Islands between 1959 and 2018.

WHY?

The Balearic Islands are an essentially tourist region. Tourism is the main driving force behind its economy (45% of GDP). This has a great impact on the marine environment.

99.2% of the total tourist beds are concentrated in coastal municipalities.

The number of tourists who arrive each year changes the human pressure indicator (HPI) and alters the demographic burden that the territory can withstand, while having a great influence on the resources consumed and the waste produced.

METHODOLOGY

The data come from Valdivieso & Moranta (2019), based on Murray *et al.* (2017), and updated with data from Agència d'Estratègia Turística de les Illes Balears (AETIB).

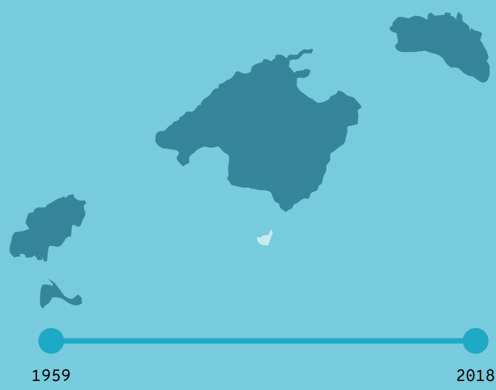
RESULTS

The number of tourists that visit the Balearic Islands each year increased from 320,000 tourists in 1959 to 16.6 million tourists in 2018, an increase of more than 16 million tourists in 59 years. The figure has doubled this century from 8 to 16 million.

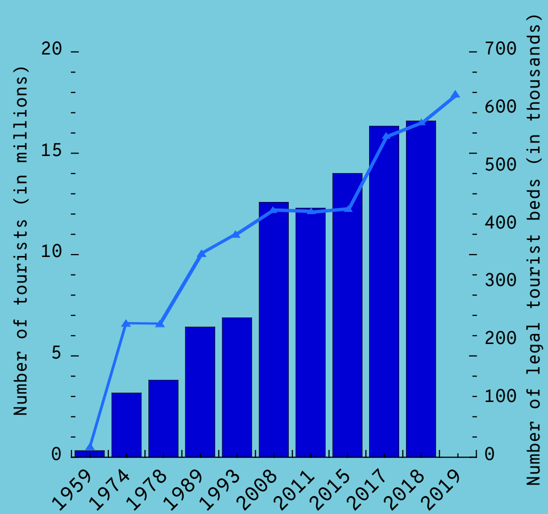
The number of tourist beds has increased from 14,609 in 1959 to 575,196 in 2018, an increase of more than 560,000 tourist beds over 59 years.

The increase in both the number of tourist beds and tourists received by the islands has major consequences for the consumption of resources and waste production.

LOCATION



Parasols and sun loungers on Cala en Porter beach, Menorca. SOURCE: David Arquimbau.



Evolution of the number of tourists (in millions, blue bars) and legal tourist beds (in thousands, light blue triangles) from 1959. SOURCE: Valdivielso & Moranta (2019).

VIII

Climate change

Cala s'Almunia. SOURCE: Sebastià Torrens.

WHAT IS IT?

Sea level is defined here as the height of the sea in relation to the coast. Since this height varies due to surges and tides, the mean level is taken as a reference. Sea level is measured with a tide gauge, a piece of equipment that measures the sea level in relation to the land point on which it is fitted, normally filtering out the effect of waves. Satellites can measure the absolute sea level (with reference to an imaginary surface or reference ellipsoid). In this case, it is also necessary to measure any vertical movements in order to reference it to the coast.

METHODOLOGY

We use sea level data from tide gauges of the Permanent Service for Mean Sea Level (PSMSL: https://www.psmsl.org). We present the annual means from the Marseille station, considered to be representative of the Western Mediterranean.

The data concerning future forecasts of the rising sea level (21st century) are derived from the work by Kopp *et al.* (2014).

RESULTS

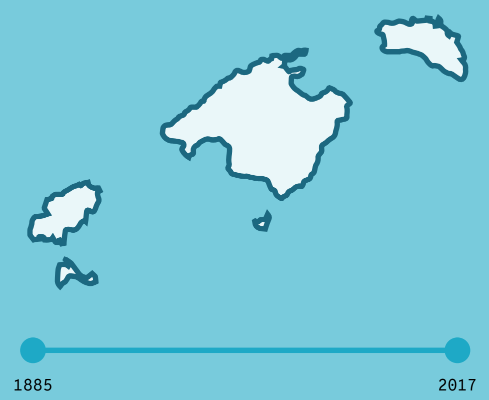
The sea level rise in the Western Mediterranean has accelerated in recent years. It has risen 1.3 mm/year in the last 131 years (a cumulative increase of 17 cm during this period). In the last 36 years the increase has been 3.28 mm/year.

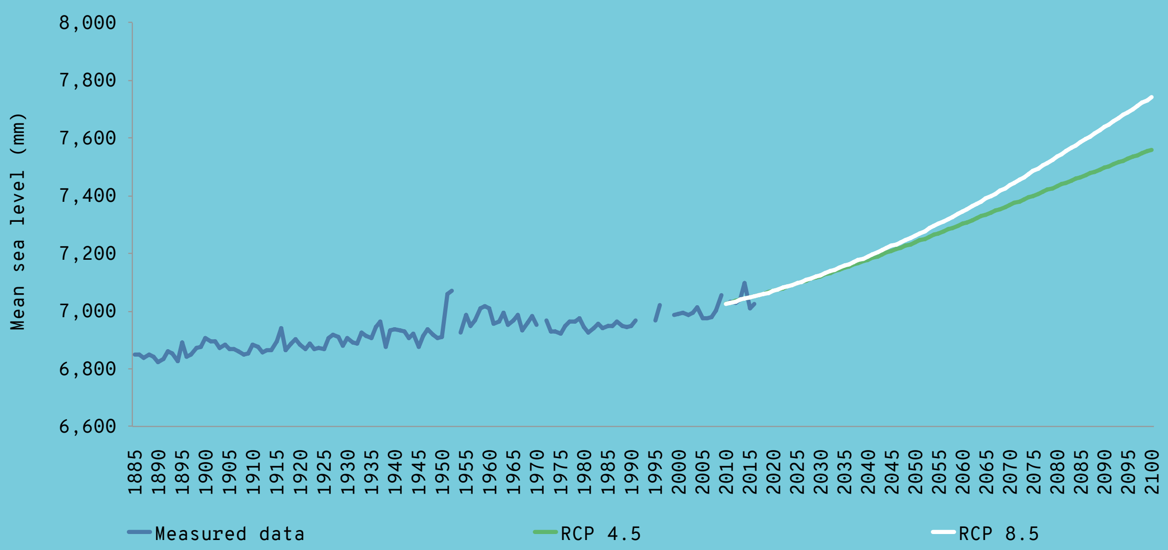
The forecasts for two scenarios of CO_2 emissions show that the sea level could increase by 57 or 75 cm by the end of the century. This would cause the beaches in the Balearic Islands to retreat between 7 to 50 metres.

WHY?

Global warming causes sea level rise due to both ocean thermal expansion and melting of glaciers and polar caps. Locally, sea level also varies due to changes in ocean circulation, atmospheric pressure and winds, but none of these three causes can result in a variation of the global mean. An increase in sea level has both environmental and socioeconomic consequences. A rising sea level and the consequent retreat of the coastline may cause a reduction in or the disappearance of the surface area of beaches and an increase in flooding caused by marine storms. In the Balearic Islands, where the economy is based on sun and beach tourism, a rise in the sea level may have major consequences. It has been observed that this increase in the sea level has accelerated in the last forty years.

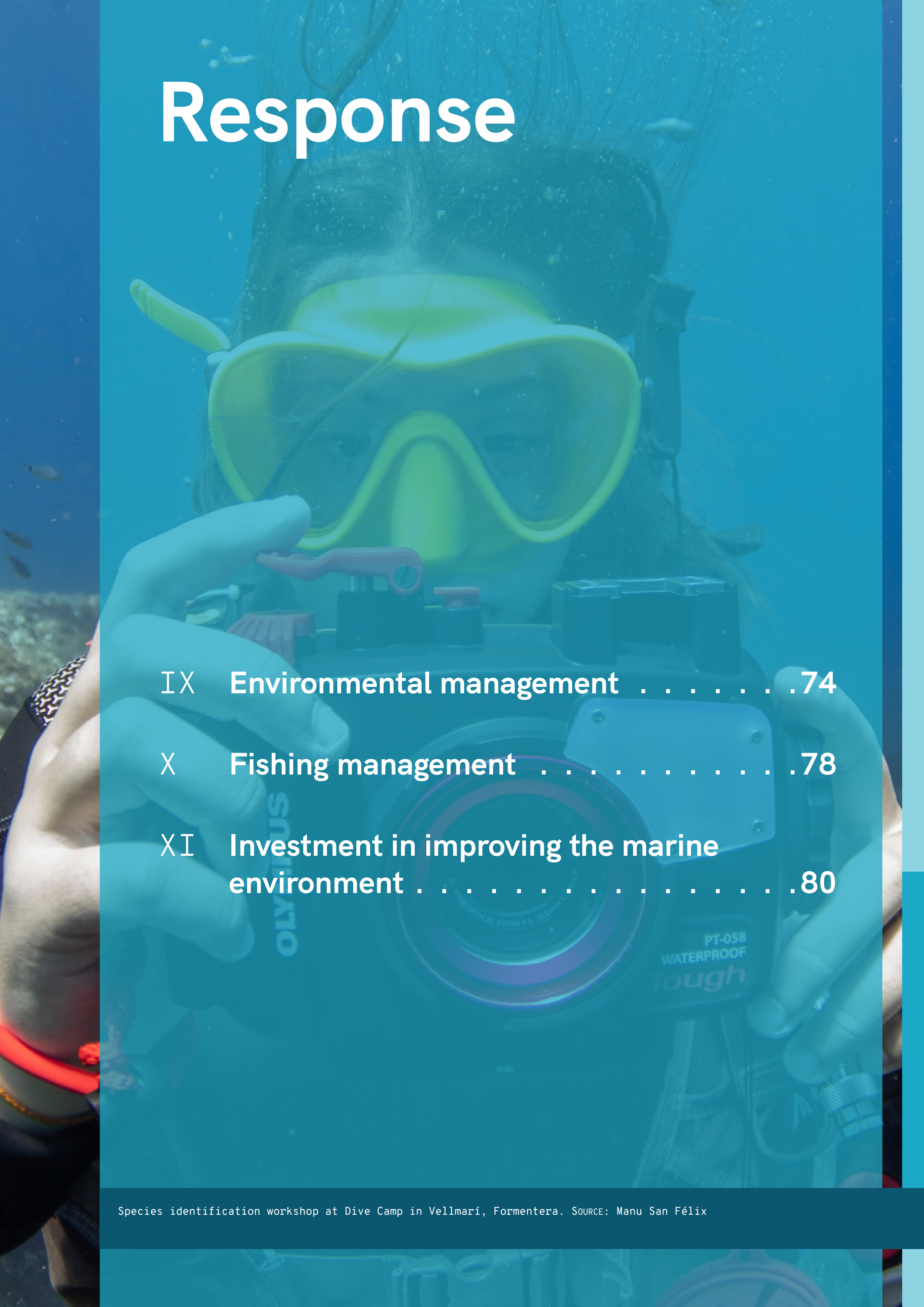
LOCATION





Mean sea level (in millimetres) between 1885 and 2016 in the Western Mediterranean (Marseille station) and projections to the end of the 21st century for two emissions scenarios. SOURCE: www.psmsl.org and Kopp *et al.* (2014).

Response



Species identification workshop at Dive Camp in Vellmarí, Formentera. SOURCE: Manu San Félix

IX

Environmental management

Information sign on Sa Punta Prima Beach with Illa de l'Aire Lighthouse in the background, Menorca.
SOURCE: David Arquimbau.

Number of low-impact mooring buoys

WHAT IS IT?

Conselleria de Medi Ambient i Territori, Govern de les Illes Balears has anchoring areas regulated with low ecological impact anchoring buoys in Sites of Community Importance (SCI) (*Lugares de Importancia Comunitaria - LIC*) in the Balearic Islands.

WHY?

Management of these buoys provides an environmental response measure with the aim of making recreational sailing compatible with protection of *Posidonia oceanica* meadows.

METHODOLOGY

The results only include the buoy fields in SCI areas, which are managed by Conselleria de Medi Ambient i Territori (CMAT). CBBA, the company that has currently won the public tender, performs daily management of these buoy fields. The buoys are available to sailors from 1 June to 30 September.

The buoy fields in SCI currently managed by CMAT are:

→ Mallorca (2): Cala Blava and Sant Elm

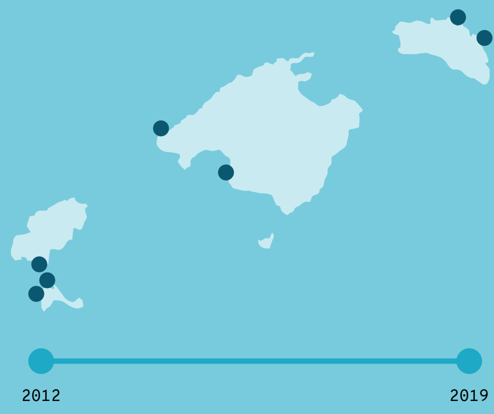
→ Menorca (2): Bahía de Fornells and Illa d'en Colom

→ Eivissa (1): Ses Salines

→ Formentera (2): S'Espalmador and Caló de s'Oli

It is necessary to take into consideration that many different organisations manage buoy fields outside the Balearic Islands SCIs (for example: Ports IB, Fundació Nous Vents, residents' associations, etc.). We aim to attempt to compile all of this information in future versions of the BALEARIC SEA REPORT.

LOCATION

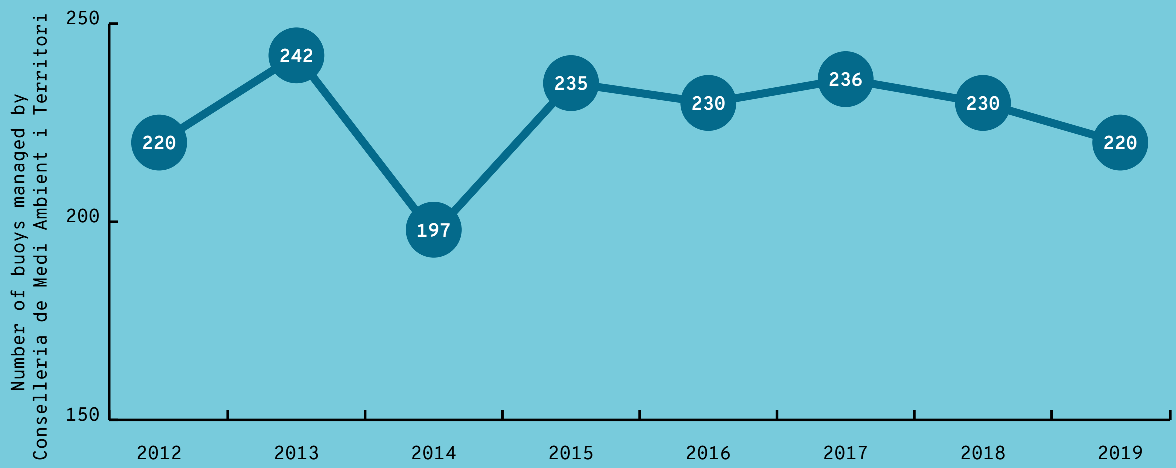


RESULTS

→ The number of buoys managed by CMAT since 2012 has varied between 197 (2014) and 242.

→ The minimum of 197 buoys is explained by the transfer in management of 4 buoy fields.

→ In 2019 CMAT managed 220 buoys in Mallorca, Menorca and the Pitiüses, spread among 7 SCI-areas. If we include the buoys in Cabrera, the number increases to 330 buoys.



Number of buoys in Mallorca, Menorca and the Pitiüses managed between 2012 and 2019 by Conselleria de Medi Ambient i Territori. SOURCE: IBANAT, Conselleria de Medi Ambient i Territori.

WHAT IS IT?

The *Posidonia oceanica* monitoring service is a maritime team that informs, advises and checks anchoring on this protected marine plant. If improperly anchored vessels are found, as stipulated in the regulations (Decree 25/2018), they are moved to permitted anchoring areas without posidonia and fines may be issued.

WHY?

The data concerning the monitoring service allow us to see how society is behaving under the prohibition to anchor on this plant. This response can be used to improve the environmental management of posidonia habitats. The service's action around all the islands, apart from Cabrera, is included.

METHODOLOGY

This service is managed by Conselleria de Medi Ambient i Territori, Govern de les Illes Balears and operates mainly in Sites of Community Importance (*Lugares de Importancia Comunitaria* - LIC) Natura 2000 in the Balearic Islands. An infringement notice can be issued if an Environmental Officer (*Agente de Medio Ambiente* - AMA) is on board the monitoring vessels.

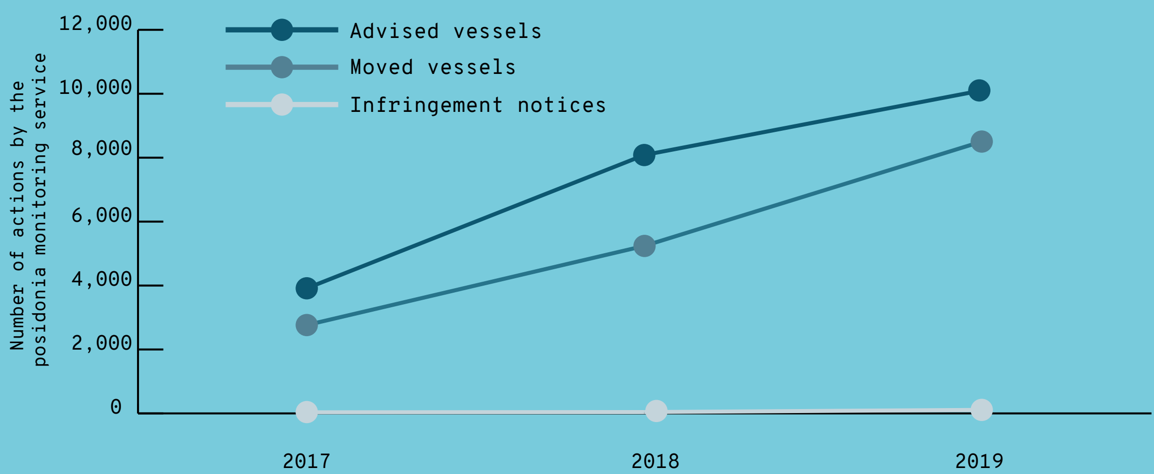
LOCATION

RESULTS

Since the implementation of the service in all of the islands (2017), there has been an increase over time in the number of monitoring vessels, the number of advised and moved vessels, and the number of infringement notices. This is a significant improvement in the management of this service over time.

Posidonia monitoring service

	2017	2018	2019
Number of monitoring vessels	10	15	15
Number of advised vessels	3,914	8,083	10,104
Number of moved vessels	2,764	5,239	8,504
Number of infringement notices	34	42	110



Number of actions (advised vessels, moved vessels and infringement notices) by the posidonia monitoring service between 2017 and 2019. Source: Conselleria de Medi Ambient i Territori and IBANAT.

WHAT IS IT?

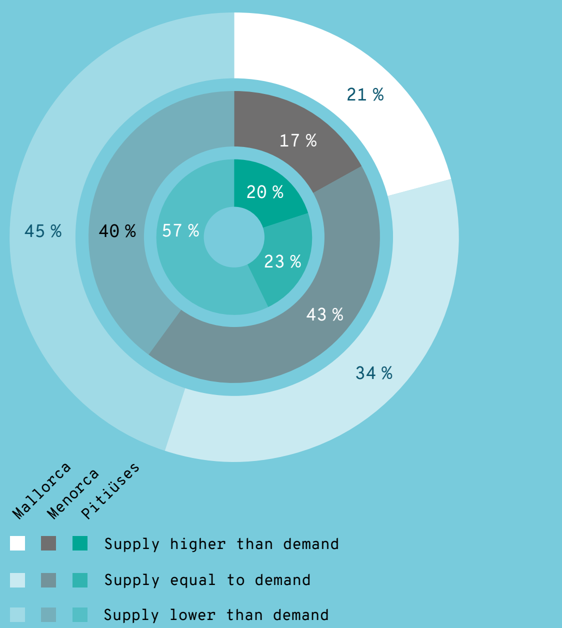
An activity that uses communication, education, information and awareness tools to teach people about the sea. Its main objective is to improve the status of the sea, as it calls people to action to deal with existing problems and social change. These practices can be followed by all sectors of the islands (public, private and third sector).

WHY?

It provides guidance about the response and interest of society in learning about the marine environment in order to promote a good conservation status. It also identifies the main problems that prevent access to marine environmental education.

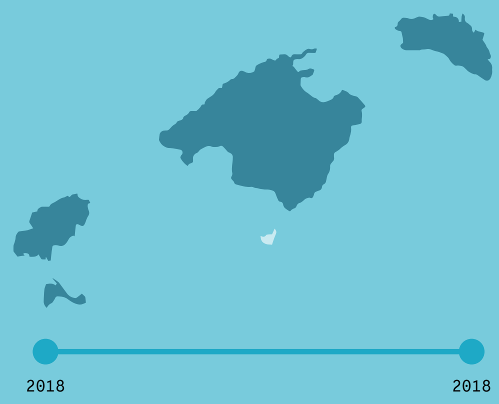
RESULTS

Five sectors involved in marine environmental education in the Balearic Islands have been identified: (1) public institutions, (2) third sector, (3) education centres, (4) private sector and (5) leisure organisations. In general there is a supply of activities in the various sectors. However, demand for activities exceeds supply on all of the islands.



Percentage relationship between supply and demand in marine environmental education activities in all sectors in the Balearic Islands. SOURCES: Ribas-Villalta (2018), Viladomat-Rojo (2018), Pi-Cunningham (2019).

LOCATION



METHODOLOGY

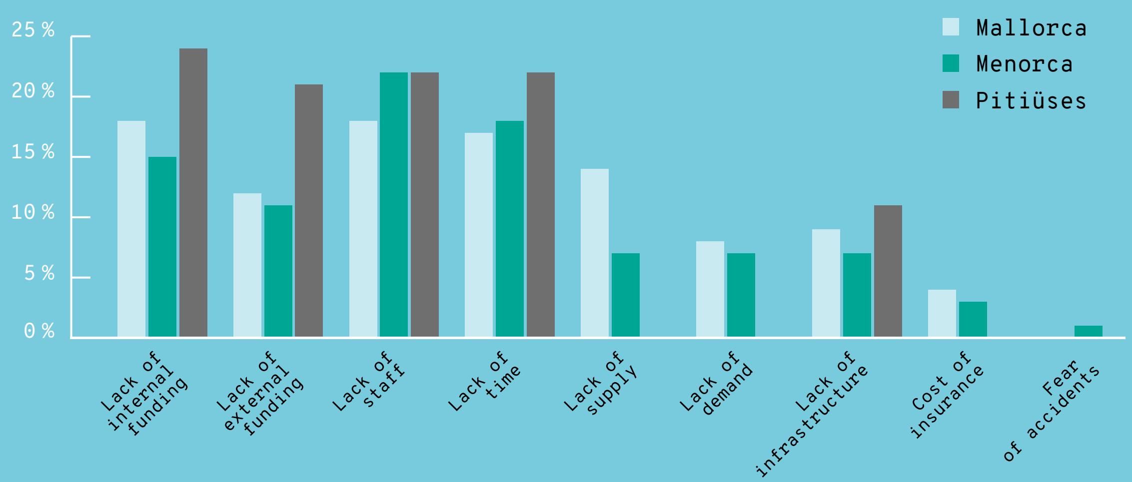
The following questions are analysed through surveys:

→ Which organisations provide marine environmental education or have expressed an interest in doing so?

→ What is the existing supply and demand?

→ What are the limiting barriers of the educational supply?

The main barriers to performing marine environmental education activities are similar in all of the islands. The main barriers stated are: lack of internal and external financial resources, lack of personnel and lack of time.



Percentage of barriers most stated by islands to the performance of marine environmental education activities. SOURCE: Ribas-Villalta (2018), Viladomat-Rojo (2018), Pi-Cunningham (2019).

X

Fishing management

Monitoring vessel in Llevant de Mallorca Marine Reserve. SOURCE: Toni Font.

WHAT IS IT?

Marine fishery reserves are fishing protected areas in which trawling is prohibited and artisanal or recreational fishing activities are regulated. Some marine reserves include no-take zones where fishing is totally prohibited. They are created to regenerate the marine ecosystems of protected areas with a double objective: (1) to increase the productivity of fishing resources and (2) to conserve habitats and species.

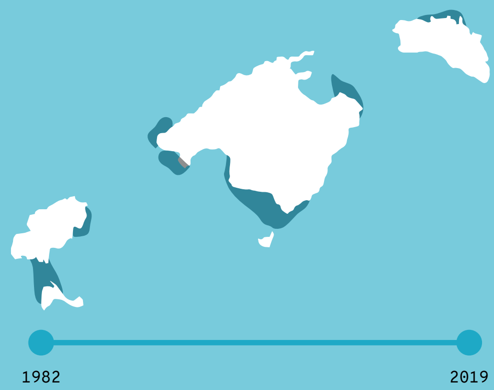
WHY?

This indicator is used as a response measure to improve marine management in terms of regeneration of fishing resources.

METHODOLOGY

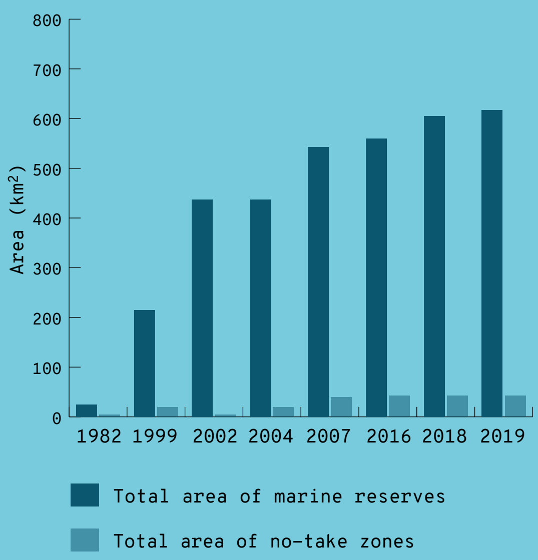
Marine reserve data have been compiled from the web page of Direcció General de Pesca i Medi Marí https://www.caib.es/sites/reservesmarines/es/plano_de_situacion_y_zonificacion-852/. The data are described based on the Balearic Sea area demarcated by the contour line of 1,000 m depth (A = 28,290 km^2).

LOCATION

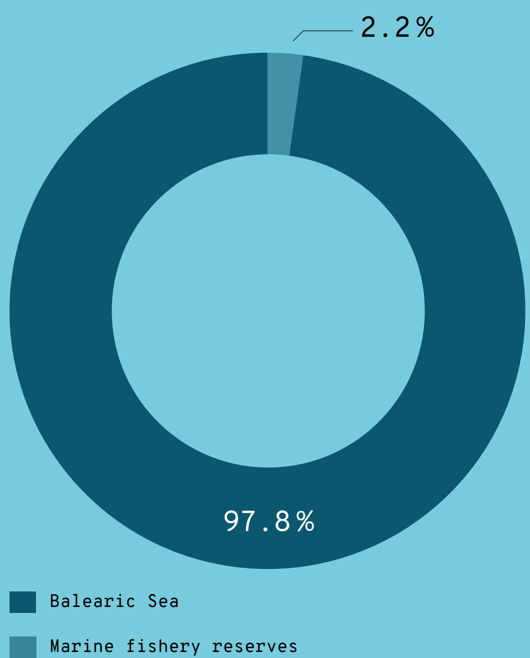


RESULTS

There are 11 marine fishery reserves in the Balearic Islands: 6 in Mallorca, 2 in Menorca and 3 in the Pitiüses. Since they were set up in 1982, the area of marine reserves has gradually increased to a total area of 613.7 km^2. There has not been an increase of the same magnitude in no-take zones, which are only 42.6 km^2 in size.



Evolution of the area of marine fishery reserves in the Balearic Islands and the no-take zones they include. SOURCE: Direcció General de Pesca i Medi Marí.



2.2% of the Balearic Sea is protected by marine fishery reserves, within which 0.9% is completely closed to fishing (no-take zone). SOURCE: Direcció General de Pesca i Medi Marí.

XI

Investment in improving the marine environment

Isla del Toro marine fishery reserve, Mallorca. Source: Sebastià Torrens.

WHAT IS IT?

The creation of marine protected areas (MPAs) promotes the regeneration of the marine resources they contain, which is known as the natural capital of the oceans. A key indicator for the good operation of MPAs is knowing the funding provided for activities related to the marine environment.

WHY?

It makes it possible to know the evolution over time of the expenditure invested in MPAs in the Balearic Islands and how this investment is distributed by type of activity, funding body and type of MPA. This response is a fundamental tool in improving conservation management of the marine environment in the Balearic Islands.

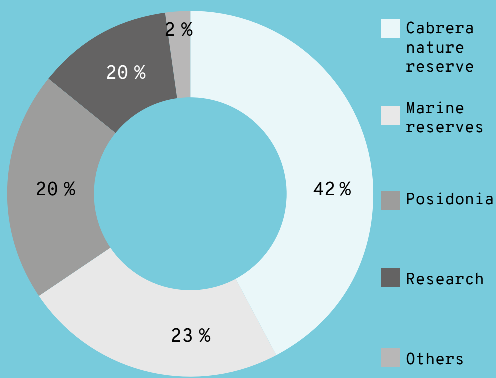
METHODOLOGY

The information comes from a study commissioned by Fundación Marilles from Pandion, an environmental consultancy (Font-Gelabert, 2018), since there was no reliable indicator of this kind. This report compiles information from various bodies (Govern de les Illes Balears, the Spanish Government, island councils, municipalities, research centres and NGOs) over 32 years.

Five-year filtering of the data is performed to reduce the noise produced by annual variability. This method consists of obtaining a value for each year and adding the previous 2 years and the following 2 years and calculating the average over the 5 years. Therefore, the last year for which this method has been used is 2016, since there is less information from 2019.

The main limitation of this indicator is the laborious work involved in obtaining information. There are no data with a high level of detail or homogeneous collection criteria, and long time series do not tend to be kept. Therefore, it is necessary to implement improvements that make it easier to compile data concerning this indicator in the future.

LOCATION

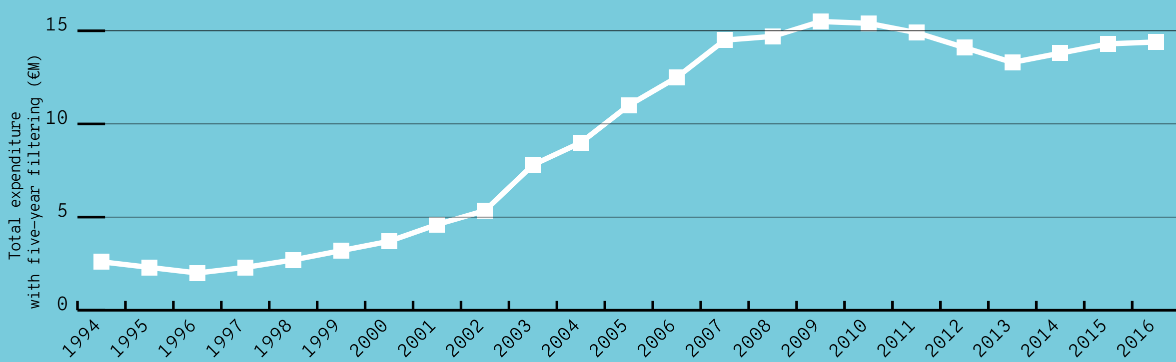


Percentage of total marine conservation expenditure analysed between 1992 and 2024, divided by categories. SOURCE: Font-Gelabert (2018).

RESULTS

The five-year expenditure analysed increased gradually from 1997 to 2007. Subsequently, expenditure was at its highest between 2007-2011, resulting in 14.6 to 15.5 million euros (€M). In 2012 and 2013 it fell to €M13.3 and rose again slightly between 2014 and 2016 to €M14.5.

Of the total amount analysed between 1992 and 2024, > €M55, the Land-Sea National Park of the Cabrera Archipelago is the highest marine conservation expenditure (42.4%), followed by the marine fishery reserves (23.4%), posidonia (buoy fields and monitoring service, 20%), research (12.3%) and others (1.9%).



Average total five-year expenditure on conservation of the marine environment during the years 1994 to 2016. SOURCE: Font-Gelabert (2018).

Socioeconomic aspects

Divers observing a John Dory (*Zeus faber*) in Punta Gavina, Formentera. SOURCE: Manu San Félix.

XII

Blue economy

Group of kayaks at the entrance to Cales Coves, Menorca. SOURCE: David Arquimbau.

WHAT IS IT?

The blue economy is defined as the set of productive activities involving goods and services related to the sea. It includes a wide range of activities related to coastal tourism, fishing and aquaculture, sailing and transport, energy production and mining. Ideally, the blue economy should be measured from the viewpoint of sustainability, considering the long-term balance of the oceans.

WHY?

The Balearic Sea has great economic weight in the islands due to the large number of economic benefits it provides to Balearic society. The blue economy encourages investment, innovation and improved management of marine resources. Therefore, it is vitally important to conduct a detailed analysis of the economic activities performed in relation to the sea and the Balearic coast.

METHODOLOGY

In 2019 Fundació Impulsa Balears published a study that measured 3 main indicators (Gross Value Added- GVA, the number of companies and the number of workers) taking the European economic definition in force as a reference.

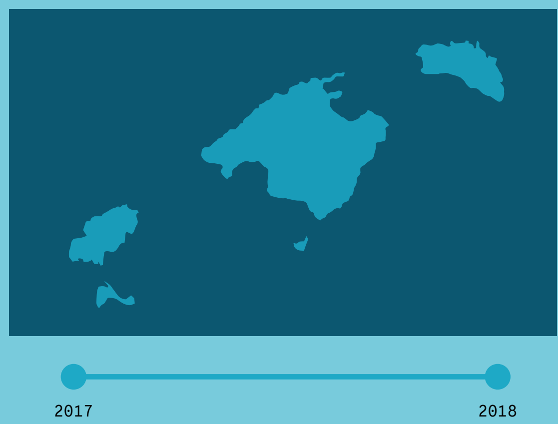
The data concerning the number of companies and workers were obtained from the official records of the business fabric and employment for 2018. The data concerning GVA come from Fundació Impulsa Balears for the year 2017. The activities studied include:

→ Marine resources (living resources and mineral and energy resources).

→ Sailing and transport (port work, construction and repair of vessels and maritime transport).

→ Coastal leisure and tourism (accommodation and other related activities).

LOCATION

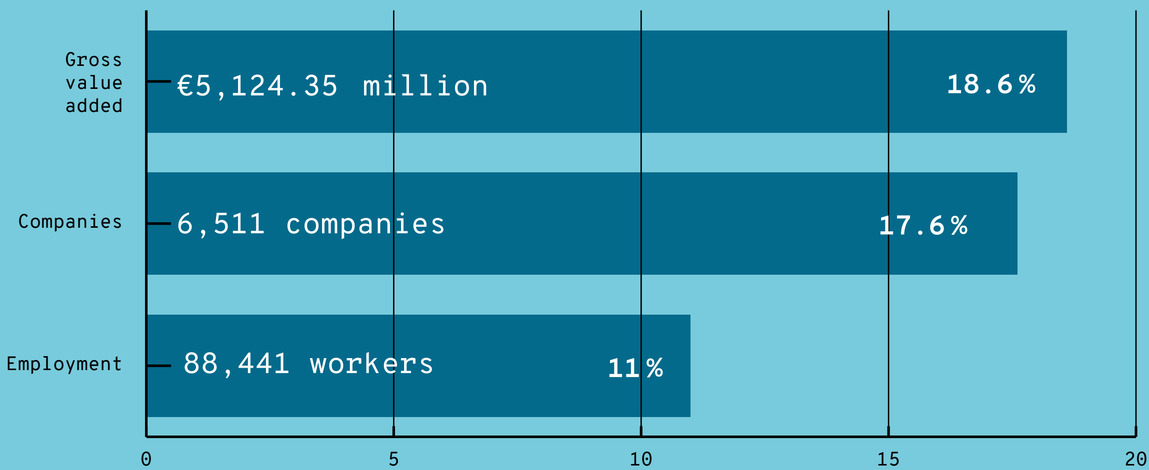


RESULTS

→ Activities related to the blue economy in the Balearic Islands produced GVA of €5,124.4 million (18.6%). That means that 1/5 of the Balearic Islands' GVA is economically dependent on the sea.

→ A total of 6,511 companies related to the Balearic Sea (17.6% of the total for the Balearic Islands) provide employment for 88,441 workers (11% of the total).

→ The blue economy forms a larger proportion of the Balearic Islands' economy than the national and European economy. The analyses should be extended to all activities and resources related to the sea in order to expand the socioeconomic information and implement sustainable management measures.



Characteristics and percentage economic involvement of the 3 blue economy indicators in the Balearic Islands (gross value added, number of companies and number of workers). SOURCE: Fundació IMPULSA Balears

Total volume of professional fishing catches by species and their economic value

WHAT IS IT?

Quantifying the catches of the Balearic professional fishing fleet in tonnes per species and the average annual price in millions of €. The volume of catches provides information about the total landings and about the most fished species in the Balearic Sea. The economic value shows the benefit that catches provide to the Balearic economy.

RESULTS

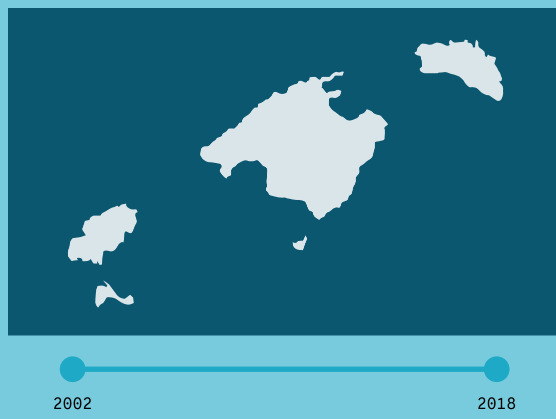
There has been a decrease in catches over time. Fish catches have decreased the most, from 3,900 t in 2002 to 3,000 t in 2018. The species with most catches changed from sardines in 2002 (488 t) to anchovies in 2018 (432 t). This decrease in sardines may be because this species is sensitive to global warming and migrates to higher latitudes when waters heat up. The most caught crustacean is the red shrimp (an average of 186 t), and among molluscs *Octopus vulgaris* (an average of 177 t) stands out.

The crustaceans group, in particular the red shrimp species (*Aristeus antennatus*), provides a higher economic benefit taking total catches into account. In 2018, the ten species whose catches had the highest economic value were: red shrimp, spiny lobster, squid, scorpion fish, anchovy, common octopus, common cuttlefish, striped red mullet, Norway Lobster and dolphinfish.

WHY?

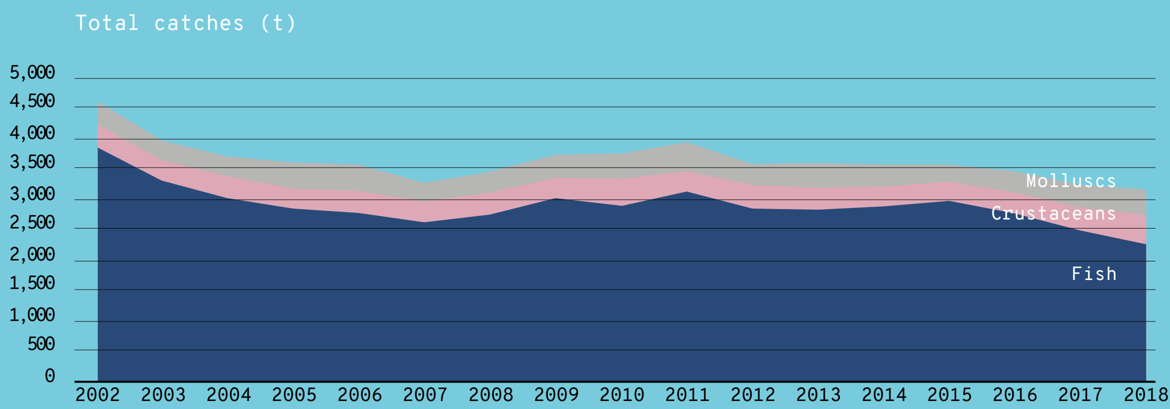
It monitors the most abundant species in the Balearic Sea and those most valued by consumers. It also provides information about the economic evolution of the market for fishing products.

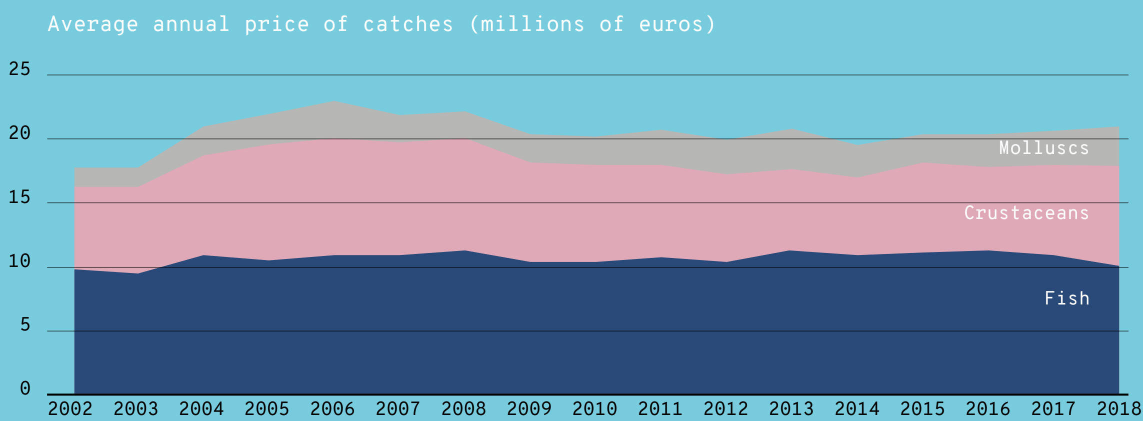
LOCATION



METHODOLOGY

The species caught are identified and weighed at fish markets and the results are reported to Servei de Recursos Marins, Direcció General de Pesca i Medi Marí, Govern de les Illes Balears. The catches are divided into 3 groups: fish, crustaceans and molluscs, and the most abundant species in each group are stated.





Total fish, crustacean and mollusc catches and their average annual price between 2002 and 2018. SOURCE: Servei de Recursos Marins, Direcció General de Pesca i Medi Marí, Govern de les Illes Balears.

WHAT IS IT?

Aquaculture is the farming of freshwater or saltwater species in captivity. In this document we only refer to marine species.

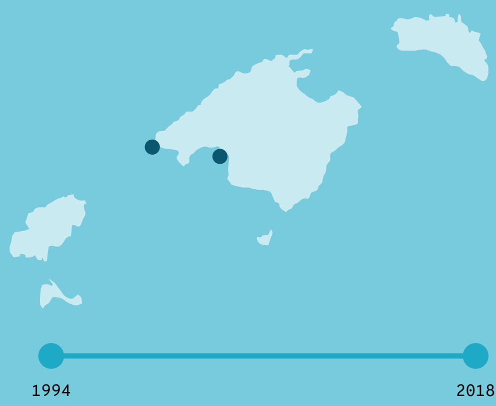
WHY?

Economic importance.
Importance as a food source.

METHODOLOGY

We present data from Direcció General de Pesca i Medi Marí and the Multi-year Strategic Plan for Spanish Aquaculture 2014-2020.

LOCATION



RESULTS

In the Balearic Islands, the production of fish with marine aquaculture ended in 2007 and was replaced with the production of fry, which are subsequently grown in facilities in Peninsular Spain. This production varied between 65.7 t in 2003 and 455 t in 2013, when the fry produced were grown and sold as adults.

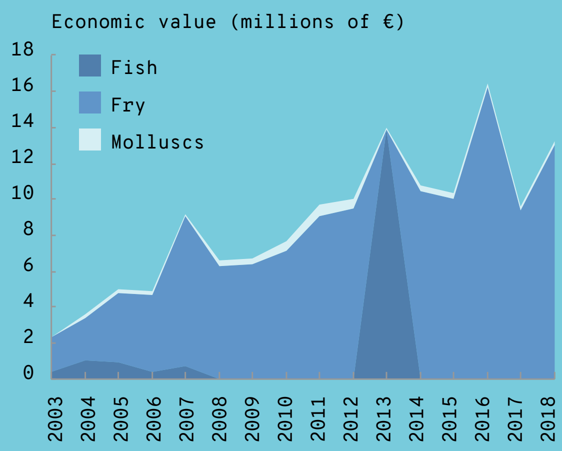
The adult fish sold were mainly gilt-head bream (*Sparus auratus*), while sea bass (*Dicentrarchus labrax*) has always been a minority grown fish. On the other hand, the majority of fry produced are sea bass, which accounted for 89.9% of the units of fry produced in 2018.

The economic value of the fry varied between 1.95 million euros in 2003 and 16.23 million euros in 2016. In 2018 it was 13.2 million euros and seabass fry accounted for 94% of income.

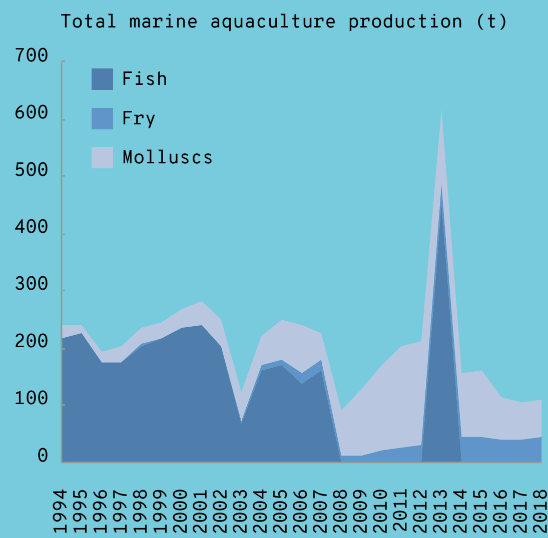
Mollusc aquaculture is only performed in Menorca and is based on the production of mussels (*Mytilus galloprovincialis*) and clams (*Venus verrucosa*), although mussel production is by far the majority by weight (between 98.8% and 94.7%). While clam production is very much the minority in terms of weight, it has a high economic value and accounted for 32% of the total value of mollusc production in 2006 and 0.8% in 2018. Since the 1990s, clam production has fallen drastically from around 5 t to 0.15 t in 2018.

In the Balearic Islands there is only one research centre involved in aquaculture, located in Andratx Port: Laboratori d'Investigacions Marines i Aqüicultura (LIMIA).

The total economic value of marine aquaculture in the Balearic Islands varied between 2.13 million euros in 2003 and 16.4 million euros in 2016.



Evolution of the total marine aquaculture production in the Balearic Islands from 1994 to 2018. SOURCE: Direcció General de Pesca i Medi Marí.



Evolution of the economic value of marine aquaculture production in the Balearic Islands from 2003 to 2018. SOURCE: Direcció General de Pesca i Medi Marí.

Future indicators

For illustration purposes, Table A shows a list of indicators that could be included in future versions of the BALEARIC SEA REPORT (BSR). Those marked with a (✓) have been included in this report. The rest have not been included due to lack of data and/or time. It is not an exhaustive list and their inclusion in future editions of the report will be decided by consensus.

Category	Subcategory		Indicator	BSR 2020
PHYSICOCHEMICAL AND BIOLOGICAL VARIABLES			Temperature	✓
			Salinity	
			Oxygen	
			Chorophyll-a concentration / phytoplankton biomass	
			Phytoplankton composition	
			pH	
			Turbidity	
BIODIVERSITY	Marine plants	*Posidonia oceanica*	Distribution area	✓
			Coverage	
			Density	
			Population dynamics	
		Cymodocea nodosa	Distribution area	✓
			Coverage	✓
			Density	✓
		Zostera noltii	Distribution area	✓
			Coverage	
			Density	
	Photophilic algae community	*Caulerpa prolifera*	Distribution area	✓
			Coverage	
			Density	
			Biomass	✓
		Cystoseira spp.	Distribution area	
			Coverage	
			Density	
			Biomass	
	Protected marine habitats	Coralligenous (0-100 m)	Distribution area	✓
		Deep coralligenous	Distribution area	
		Maerl	Distribution area	✓
	Biodiversity index	Biodiversity indices	Trophic level index	
		Foraminifera	Foram Index	
		Biomarkers of oxidative stress in fish	Oxidative stress indicators	

Category	Subcategory		Indicator	BSR 2020
BIODIVERSITY	Vulnerable species	Elasmobranchs	Giant devil ray (*Mobula mobular*) abundance	
			Spiny butterfly ray (*Gymnura altavela*) abundance	
			Sandy ray (*Leucoraja circularis*) abundance	
			Bottlenose skate (*Rostroraja alba*) abundance	
			Angelshark (*Squatina squatina*) abundance	
			Great hammerhead shark (*Sphyrnidae* Family) abundance	
			Thresher shark (*Alopiidae* Family) abundance	
			Rhinobatos cemiculus abundance	
			Largetooth sawfish (*Pristis pristis*) abundance	
			Angular roughshark (*Oxynotus centrina*) abundance	
			Great white shark (*Carcharodon carcharias*) abundance	
			Basking shark (*Cetorhinus maximus*) abundance	
			School shark (*Galeorhinus galeus*) abundance	
			Shortfin mako shark (*Isurus oxyrinchus*) abundance	
		Cetaceans	Percentage (%) of Deployment Positive Hours (DPH) for the common bottlenose dolphin (*Tursiops truncatus*)	✓
			Common bottlenose dolphin (*Tursiops truncatus*) abundance	
			Sperm whale encounter rate (*Physeter macrocephalus*)	✓
			Sperm whale (*Physeter macrocephalus*) abundance	
		Loggerhead sea turtle (*Caretta caretta*)	Abundance	
		Syngnathids (*Hippocampus ramulosus, Hippocampus hippocampus*)	Population	
		Fan mussel (*Pinna nobilis*)	Population	
		European storm petrel (*Hydrobates pelagicus*)	Number of breeding pairs/number of nests with eggs	✓
			Breeding success	✓
			Adult survival	✓
			Population estimate	
		Balearic shearwater (*Puffinus mauretanicus*)	Number of breeding pairs/number of nests with eggs	
			Breeding success	
			Adult survival	
			Population estimate	

Category	Subcategory		Indicator	BSR 2020
BIODIVERSITY	Vulnerable species	Scopoli's shearwater (*Calonectris diomedea*)	Number of breeding pairs/number of nests with eggs	
			Breeding success	
			Adult survival	
			Population estimate	
		European shag (*Phalacrocorax aristotelis*)	Number of breeding pairs/number of nests with eggs	
			Breeding success	
			Adult survival	
			Population estimate	
		Audouin's gull (*Larus audouinii*)	Number of breeding pairs/number of nests with eggs	
			Breeding success	
			Adult survival	
			Population estimate	
	Monitoring of fish vulnerable to fishing in MPA	*Balistes capriscus, Conger conger, Dentex dentex, Dicentrarchus labrax, Diplodus puntazo, Diplodus sargus, Diplodus vulgaris, Epinephelus costae, Epinephelus marginatus, Labrus merula, Labrus viridis, Muraena helena, Mycteroperca rubra, Pagrus pagrus, Phycis physis, Sciaena umbra, Scorpaena porcus, Scorpaena scrofa, Seriola dumerili, Sparus aurata, Sphyraena spp., Spondyliosoma cantharus*	Biomass	✓
			Species richness	✓
			Number of species	
			Density	
			Size	
	Population and stock of the main fished species	Bluefin tuna	Bluefin tuna larval index (abundance of reproducers)	
			Bluefin tuna larval survival index, used to monitor the environmental effect on recruitment	
		Albacore	Albacore larval index (abundance of reproducers)	
		Included in IMB 2020: European hake (*Merluccius merluccius*), striped red mullet (*Mullus surmuletus*), red shrimp (*Aristeus antennatus*), rose shrimp (*Parapenaeus longirostris*), common cuttlefish (*Sepia officinalis*), common octopus (*Octopus vulgaris*) Not included in IMB 2020: dusky grouper (*Epinephelus marginatus*), common two-banded sea bream (*Diplodus vulgaris*), scorpion fish (*Scorpaena scrofa*), sargo (*Diplodus sargus*), gilt-head bream (*Sparus aurata*), greater amberjack (*Seriola dumerili*), John Dory (*Zeus faber)*, common dentex (*Dentex dentex*), brown meagre (*Sciaena umbra*), shi drum (*Umbrina cirrosa*)	Abundance and population biomass	✓ *
			Abundance and recruit biomass	✓ *
			Abundance and reproducer biomass	✓ *
			Average size and/or population structure	✓ *
			Exploitation status $F_{current}$/ $F_{0.1}$	✓ *
			Mortality due to fishing at maximum sustainable yield (F_{RMS}) o $F_{0.1}$	✓ *

Category	Subcategory		Indicator	BSR 2020
BIODIVERSITY	Population and stock of the main fished species	Spiny lobster (*Palinurus elephas*)	Settlement indices	✓
			Population	
	Fish populations of interest for recreational fishing	Pearly razorfish (*Xyrichtys novacula*)	Relative abundance	✓
WATER QUALTITY	Changes in surface area of the emerged shoreline			
	Water quality		Biological indicator of macroinvertebrates: Mediterranean Occidental (MEDOCC) index	✓
			Macroalgae biological indicator (CARLIT)	✓
			Multivariate *Posidonia oceanica* index (POMI)	
			Chlorophyll-a concentration	
			Coliform abundance	✓
NON-INDIGENOUS SPECIES	*Callinectes sapidus, Lophocladia lallemandii, Caulerpa cylindracea, Womersleyella setacea, Asparagopsis taxiformis, Acrothamnion preissii, Percnon gibbesi, Caulerpa taxifolia, Halimeda incrassata*		Presence locations	✓
			Average percentage (%) coverage	✓
			Area invaded by *Halimeda incrassata*	✓
			Distribution area of other species	
	Other non-indigenous species: algae: *Codium fragile*; fish: *Fistularia commersonii*; sponge: *Paraleucilla magna*		Distribution area	
POLLUTION	Marine debris		Abundance of floating debris collected at sea	✓
			Amount of debris on beaches	
			Total density of marine debris on continental shelf bottoms in the Balearic Sea	
			Spatial distribution of floating debris collected at sea	
			Average ingestion of microplastic in marine species of commercial interest	
	Ocean noise			✓
	Discharges of treated wastewater (flows, flows by type of treatment and evolution over time)			
	Volume of desalinated water and discharges of brine from desalination plants			
	Eutrophication of coastal waters		Average values of nitrate, nitrite, ammonia, total nitrogen, total phosphorus, phosphate, concentration of organic matter (total organic carbon, TOC, and dissolved organic carbon, DOC)	
	Amount of ballast water discharged			

Category	Subcategory	Indicator	BSR 2020
POLLUTION	Concentration of pollutants in sediments	Concentration of heavy metals in sediments	✓
		Polychlorinated biphenyls (PCBs) concentration in sediments	✓
		Polycyclic aromatic hydrocarbons (PAHs) concentration in sediments	✓
		Volatile organic compounds (VOCs) concentration in sediments	✓
		Organochlorine pesticides concentration in sediments	✓
		Concentration of persistent organic pollutants (POPs)	
DEGRADED HABITATS	Ocean deserts		
PHYSICAL IMPACTCS	Impacts and physical losses on the sea bottom	Number of anchorings	
		Dredgings	
		Port construction	
	Impacts on beach dynamics	Addition of sand to beaches, proportion of artificial coast, extracted sediment	
	Impact on the shore	Proportion of artificial coast	
FISHING PRESSURE	Professional trawler fishing	Surface area of lost habitat of *Posidonia oceanica* meadows, estimate of dead plants, area (km^2)	
		Bycatch estimates	
		Number of overexploited fishing stocks	
		Total area affected by trawling	
		Loss of professional fishing equipment (nets, traps)	
	Artisanal fishing	Bycatch estimates	
		Estimates of kilometres of gillnetting and longlines set	
	Recreational fishing and spearfishing	Number of recreational maritime fishing licences by type (individual, vessel, spearfishing and sport)	✓
		Volume of recreational fishing catches	
	Fishing footprint	Human appropriation of net primary production	
		Fossil fuels used by the fishing industry	
	Estimate of illegal, unreported and unregulated (IUU) catches		
	Total volume of catches per species		✓
	Number of recreational maritime fishing licences by type (individual, vessel, spearfishing, group and sport)		✓
	Evolution of the number of vessels in the professional and recreational fishing fleet		✓
HUMAN AND TOURISM PRESSURE	Human pressure index (HPI)		✓
	Urbanised coastal area		✓
	Number of marinas and moorings		✓
	Number of recreational vessels		✓
	Number of nautical rental (charter) companies		

Category	Subcategory	Indicator	BSR 2020
HUMAN AND TOURIST PRESSURE	Total number of nautical companies (taxi boats, party boats, motor launches, waters-kiing, jet skis, etc.)		
	Amount and evolution of tourist demand		
	Water consumption per tourist		
	Beach use	Number of beach users	✓
		Density of beach users	✓
		Percentage of beach carrying capacity	✓
		Number of tourists and number of tourist beds	✓
	Number and evolution of vessels anchored on beaches		✓
	Vessels in port	Total transit of vessels per month, year and port	✓
		Number of cruise ships per month, year and port	✓
		Number of ferries per month, year and port	✓
		Number of oil tankers per month, year and port	✓
		Number of cement carriers per month, year and port	✓
		Number of RO-RO vessels per month, year and port	✓
		Number of marinas and number of moorings	✓
		Number of vessels anchored on beaches	✓
CLIMATE CHANGE	Sea level		✓
	Sea surface temperature (SST) trends		
	Number of extreme events: heatwaves		
	Biodiversity loss (*Posidonia oceanica*, benthic filter communities)		
	Loss of ecosystem functions		
	Migration of organisms following isotherms		
	Carbon dioxide and acidification		
ENVIRONMENTAL MANAGEMENT	Environmental education	Number of schools/students attending marine environmental education activities	
		Attitude and perception of the resident and tourist population concerning the coastal environment	
		Percentage (%) interest of different sectors in marine environmental education activities	✓
		Percentage (%) supply and demand in the various sectors of marine environmental education activities	✓
		Percentage (%) of most-stated barriers	✓
	Number of low-impact mooring buoys		✓
	Sea and beach cleaning routines		
	Surface area of MPA/% of area covered by protected areas		
	Percentage (%) of MPAs managed by Red Natura 2000		
	Percentage of Natura 2000 areas with a management plan		
	Existence, application and contribution of scientific research		
	Local understanding of the rules and regulations of the MPA		
FISHING MANAGEMENT	Recreational fishing fines		
	Number of inspectors and inspection area		
	Evolution of the area and percentage of the Balearic Sea and coastline protected as marine fishery reserves		✓

Category	Subcategory	Indicator	BSR 2020
FISHING MANAGEMENT	No-take zone surface area		✓
	Effectiveness of MPA management		
	Number and variety of monitoring patrols by time and unit of area		
BLUE ECONOMY	Measurement of the blue economy	Gross value added	✓
		Number of companies	✓
		Number of workers	✓
		Total volume of professional fishing catches by species and their economic value	✓
	Marine aquaculture	Production of marine fish by weight (t)	✓
		Economic value of marine fish production	✓
		Fry production by weight (t)	✓
		Economic value of fry production	✓
		Mollusc production by weight (t)	✓
		Economic value of mollusc production	✓
		Number of research centres involved in aquaculture	✓
		Total economic value of aquaculture in the Balearic Islands	✓
	Fishing sector	Number of professional fishing vessels vs. small-scale equipment.	✓
		Total volume of professional fishing catches by species and their economic value	✓
		Value and profitability of catches by unit of effort/fishing fleet	
		Cultural, socioeconomic, gastronomic value, etc. of the loss of the commercial fishing fleet	
		Fishing fleet employment	
		Reproductive biomass	
		Fishing mortality	
		Percentage (%) sale of local vs. imported fish/shellfish	
		Percentage (%) sale of local fish/shellfish vs. aquaculture	
		Indirect employment from recreational fishing	
		Indirect economic production from recreational fishing	
		Satisfaction of recreational fishers (this determines the utility function in bioeconomic models of recreational fishing)	
	Tourism sector	Percentage (%) of tourism attracted to the islands by the quality of the coastal environment	
		Visitor expenditure allocated to the marine environment	
		Percentage (%) of the ecotax allocated to conservation of the marine environment	
	Diving sector	Number of recreational dives in MPA	
		Number of diving centres	

Cate-gory	Subcategory	Indicator	BSR 2020
	ECONOMICS FOR MARINE CONSERVATION	Value and size of the sea and coastal economy	
		Public and private expenditure on involving other sectors in conservation of the marine environment	
		Expenditure by residents allocated to the marine environment	
		Number of jobs related to sea/marine conservation	
		Expenditure and investment in MPA	

Collaborators

The text and figures of the indicators in this report were produced and edited by Raquel Vaquer-Sunyer and Natalia Barrientos with the help of a large number of authors and collaborators (Table B), except for indicators 20-53 and 57, which were produced entirely by scientists from COB-IEO, and indicators 18, 19 and 60, produced by Asociación Tursiops.

Category	Subcategory	Indicator	Name of the collaborating person (organisation) / *(author)
PHYSICOCHEMICAL VARIABLES		1. Temperature	Damià Gomis (UIB)
BIODIVERISTY	*Posidonia oceanica*	2. Distribution area	Nuria Marbà (IMEDEA UIB-CSIC)
	Cymodocea nodosa	3. Distribution area 4. Coverage 5. Density	Nuria Marbà (IMEDEA UIB-CSIC) Fiona Tomàs (IMEDEA UIB-CSIC)* Marc Julià (OBSAM) Eva Marsinyach (OBSAM)
	Zostera noltei	6. Distribution area	Fiona Tomàs (IMEDEA UIB-CSIC)* Núria Marbà (IMEDEA UIB-CSIC) Marc Julià (OBSAM) Eva Marsinyach (OBSAM)
	Caulerpa prolifera	7. Distribution area 8. Biomass	Marc Julià (OBSAM) Eva Marsinyach (OBSAM)
	Coralligenous	9. Distribution area	Joan Moranta (COB-IEO) Enric Ballesteros (CEAB-CSIC) Eva Marsinyach (OBSAM) Marc Julià (OBSAM) Carmen Barberá (CIMAR-Universidad de Alicante)
	Maerl	10. Distribution area	Joan Moranta (COB-IEO) Enric Ballesteros (CEAB-CSIC) Eva Marsinyach (OBSAM) Marc Julià (OBSAM) Carmen Barberá (CIMAR-Universidad de Alicante)
	European storm petrel (*Hydrobates pelagicus*)	11. Number of breeding pairs/number of nests with eggs 12. Reproductive success 13. Adult survival	Ana Sanz-Aguilar (IMEDEA UIB-CSIC)*
	Monitoring of fish populations vulnerable to coastal fishing	14. Total biomass (kg/250 m^2) 15. Species richness (number of species/250 m^2)	Josep Coll (Tragsatec) Eva Marsinyach (OBSAM) Antoni M. Grau (D. G. de Pesca i Medi Marí, GOIB) Oliver Navarro Gil
	Razorfish (*Xyrichtys novacula*)	16. Relative abundance	Josep Alós (IMEDEA UIB-CSIC) Antoni Vivó (IMEDEA UIB-CSIC)
	Spiny lobster (*Palinurus elephas*)	17. Settlement indices	David Díaz (COB-IEO)* Anabel Muñoz Caballero (COB-IEO)*
	Sperm whale (*Physeter macrocephalus*)	18. Encounter rate	Asociación Tursiops*
	Common bottlenose dolphin (*Tursiops truncatus*)	19. Percentage of Deployment Positive Hours (DPH)	

Category	Subcategory	Indicator	Name of the collaborating person (organisation) / *(author)
BIODIVERSITY	European hake (*Merluccius merluccius*)	20. Abundance and population biomass 21. Abundance and recruit biomass 22. Abundance and reproducer biomass 23. Average size and/or population structure 24. Exploitation status $F_{current}/F_{0.1}$ 25. Mortality due to fishing at maximum sustainable yield (F_{RMS}) or $F_{0.1}$	Antoni Quetglas (COB-IEO)* Beatriz Guijarro (COB-IEO)* Aina Carbonell (COB-IEO)* Enric Massutí (COB-IEO)*
	Striped red mullet (*Mullus surmuletus*)	26. Abundance and population biomass 27. Abundance and recruit biomass 28. Abundance and reproducer biomass 29. Average size and/or population structure 30. Exploitation status $F_{current}/F_{0.1}$ 31. Mortality due to fishing at maximum sustainable yield (F_{RMS}) or $F_{0.1}$	Antoni Quetglas (COB-IEO)* Beatriz Guijarro (COB-IEO)* Aina Carbonell (COB-IEO)* Enric Massutí (COB-IEO)*
	Red shrimp (*Aristeus antennatus*)	32. Abundance and population biomass 33. Abundance and recruit biomass 34. Abundance and reproducer biomass 35. Average size and/or population structure 36. Exploitation status $F_{current}/F_{0.1}$ 37. Mortality due to fishing at maximum sustainable yield (F_{RMS}) or $F_{0.1}$	Antoni Quetglas (COB-IEO)* Beatriz Guijarro (COB-IEO)* Aina Carbonell (COB-IEO)* Enric Massutí (COB-IEO)*
	Rose shrimp *(Parapenaeus longirostris)*	38. Abundance and population biomass 39. Abundance and recruit biomass 40. Abundance and reproducer biomass 41. Average size and/or population structure 42. Exploitation status $F_{current}/F_{0.1}$ 43. Mortality due to fishing at maximum sustainable yield (F_{RMS}) or $F_{0.1}$	Antoni Quetglas (COB-IEO)* Beatriz Guijarro (COB-IEO)* Aina Carbonell (COB-IEO)* Enric Massutí (COB-IEO)*
	Common cuttlefish (*Sepia officinalis*)	44. Abundance and population biomass 45. Exploitation status $F_{current}/F_{MSY}$ 46. Average size and/or population structure 47. Evolution of catches 48. Mortality due to fishing at maximum sustainable yield (F_{RMS}) or $F_{0.1}$	Antoni Quetglas (COB-IEO)* Beatriz Guijarro (COB-IEO)* Aina Carbonell (COB-IEO)* Enric Massutí (COB-IEO)*

Category	Subcategory	Indicator	Name of the collaborating person (organisation) / *(author)
BIODIVERSITY	Common octopus (*Octopus vulgaris*)	49. Population biomass 50. Exploitation status $F_{current}/F_{MSY}$ 51. Average size and/or population structure 52. Evolution of catches 53. Mortality due to fishing at maximum sustainable yield (F_{RMS}) or $F_{0.1}$	Antoni Quetglas (COB-IEO)* Beatriz Guijarro (COB-IEO)* Aina Carbonell (COB-IEO)* Enric Massutí (COB-IEO)*
WATER QUALITY	Quality of bathing water and coastal water bodies	54. Coliform abundance (*Escherichia coli* and intestinal enterococci)	Conselleria de Salut i Consum (GOIB)
		55. Biological indicator of macroinvertebrates: Western Mediterranean (MEDOCC) index 56. Macroalgae biological indicator: CARLIT	Enric Ballesteros (CEAB-CSIC) Sergio Martino (D. G. de Recursos Hídrics, GOIB)
NON-INDIGENOUS SPECIES		57. Exotic and invasive species in the Balearic Sea	Núria Zaragoza (COB-IEO)* Lydia Png (COB-IEO)* Maria Elena Cefalì (COB-IEO, EIJF)* Aina Carbonell (COB-IEO)*
		58. Area invaded by *Halimeda incrassata*	Fiona Tomàs (IMEDEA UIB-CSIC)* Antoni Vivó Josep Alós (IMEDEA UIB-CSIC)
POLLUTION		59. Abundance of floating debris collected at sea	Servei de Coordinació de Neteja del Litoral (ABAQUA) Montserrat Compa Ferrer (COB-EIO)* Carme Alomar Mascaró (COB-IEO)* Salud Deudero (COB-IEO)*
		60. Ocean noise	Asociación Tursiops*
	Concentration of pollutants in sediments	61. Concentration of heavy metals in sediments 62. Polychlorinated biphenyls (PCB) in sediments 63. Polycyclic aromatic hydrocarbon (PAH) concentration in sediments 64. Volatile organic compound (VOC) in sediments 65. Concentration of organochlorine pesticides in sediments	Sergio Martino (D. G. de Recursos Hídrics, GOIB) Enric Ballesteros (CEAB-CSIC) Sebastià Albertí (Technical Scientific Services, UIB)* Gabriel Martorell (Technical Scientific Services, UIB)* Josep Pablo (Technical Scientific Services, UIB)* Joan Cifre (Technical Scientific Services, UIB)* José Francisco González (Technical Scientific Services, UIB)* Maribel Cabra (Technical Scientific Services, UIB)* Joan Miquel Cardona (Technical Scientific Services, UIB)* Trinidad García (Technical Scientific Services, UIB)* Esperança Tous (Technical Scientific Services, UIB)* Marc Vidal (Technical Scientific Services, UIB)* Raúl Sánchez (Technical Scientific Services, UIB)*
FISHING PRESSURE		66. Number of recreational maritime fishing licences by type (individual, vessel, spearfishing, group and sport)	Antoni M. Grau (D.G. Pesca i Medi Marí, GOIB) Antoni Mira (D.G. Pesca i Medi Marí, GOIB)* Eva Marsinyach (OBSAM)

Category	Subcategory	Indicator	Name of the collaborating person (organisation) / *(author)
FISHING PRESSURE		67. Evolution of the number of vessels in the professional and recreational fishing fleet	Federació Balear de Confraries de Pescadors Josep Alós (IMEDEA, UIB CSIC) Pere Oliver
HUMAN AND TOURISM PRESSURE		68. Human Pressure Index (HPI)	Ivan Murray (UIB) Macià Blázquez (UIB) IBESTAT
		69. Urbanised coastal area	Ivan Murray (UIB)
		70. Total transit of vessels per month, year and port 71. Number of cruise ships per month, year and port 72. Number of ferries per month, year and port 73. Number of oil tankers per month, year and port 74. Number of cement carriers per month, year and port 75. Number of RO-RO per month, year and port	Ports de Balears (Autoritat Portuària de Balears)
		76. Number of marinas and number of moorings	Ports IB
		77. Number of vessels anchored on beaches 78. Number of beach users 79. Density of beach users 80. Percentage of beach carrying capacity	Eva Marsinyach (OBSAM) David Carreras (OBSAM)
		81. Number of tourists and number of tourist beds	Joan Moranta (COB-IEO) Joaquim Valdivielso (UIB) AETIB
CLIMATE CHANGE		82. Sea level	Marta Marcos (UIB) Damià Gomis (UIB)
ENVIRONMENTAL MANAGEMENT		83. Number of low-impact mooring buoys	Marcial Bardolet (IBANAT) Maria del Carmen de Roque Company (Conselleria de Medi Ambient i Territori, GOIB)
	Posidonia monitoring service	84. Number of monitoring vessels 85. Number of vessels informed/advised/checked / moved 86. Number of improper anchoring infringements	Marcial Bardolet (IBANAT) Nuria Valverde Costa (Conselleria de Medi Ambient i Territori, GOIB)
		87. Marine environmental education: percentages of interest, supply/demand and most stated barriers	Blanca Ribas-Villalta (Consultant)
FISHING MANAGEMENT		88. Evolution of the area and percentage of the Balearic Sea and coastline protected as marine fishery reserves	D. G. de Pesca i Medi Marí (GOIB)
INVESTMENT IN IMPROVING THE MARINE ENVIRONMENT		89. Expenditure and investment in marine protected areas	Antoni Font Gelabert (Pandion Consultoría Ambiental)

Category	Subcategory	Indicator	Name of the collaborating person (organisation) / *(author)
BLUE ECONOMY	Measurement of the blue economy	90. Gross value added 91. Number of companies 92. Number of workers	Fundació IMPULSA Balears
		93. Total volume of professional fishing catches by species and their economic value	Francesc Riera (D. G. de Pesca i Medi Marí, GOIB) Antoni M. Grau (D. G. de Pesca i Medi Marí, GOIB)
	Marine aquaculture	94. Marine fish production by weight (tonnes) 95. Economic value of marine fish production 96. Hatchery production by weight (t) 97. Economic value of hatchery production 98. Mollusc production by weight (t) 99. Economic value of mollusc production 100. Number of research centres involved in aquaculture 101. Total economic value of aquaculture in the Balearic Islands	José María Valencia Cruz (LIMIA)

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