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BLUE GROWTH IN THE MEDITERRANEAN SEA: THE CHALLENGE OF GOOD ENVIRONMENTAL STATUS

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BLUE GROWTH IN THE MEDITERRANEAN SEA: THE CHALLENGE OF GOOD ENVIRONMENTAL STATUS

Catherine Piante and Denis Ody, WWF-France

With the contribution of Adriana Raveau, Florence Krowicki, Pierre Stroesser from ACTeon and the maps of Matthieu Le Tixerant from Terra Maris

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TABLE OF ABBREVIATIONS

ACCOBAMS Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area

AIS Automatic Identification System

BOD Bio-chemical Oxygen Demand

CBD Convention on Biological Diversity

COP Conference of Parties

CFP Common Fisheries Policy

DPSIR Drivers, Pressures, State, Impacts, Responses

EBSA Ecologically and Biologically Significant Areas

EC European Commission

EEA European Environment Agency

EEZ Exclusive Economic Zone

EU European Union

EUSAIR European Union Strategy for the Adriatic-Ionian Region (macro-region)

EWEA European Wind Energy Association

FIFO Fish In Fish Out

GEBCO General Bathymetric Chart of the Oceans

GES Good Environmental Status

GFCM General Fisheries Commission for the Mediterranean

GDP Gross Domestic Product

GIS Geographic Information System

GVA Gross Value Added

ICCAT International Commission for the Conservation of Atlantic Tunas

ICZM Integrated Coastal Zone Management

IMO International Maritime Organisation

IMP Integrated Maritime Policy

IUCN International Union for Conservation of Nature

LNG Liquid Natural Gas

MAP Mediterranean Action Plan

MARPOL Marine Pollution (international convention for the prevention of pollution at sea)

MEDPOL The marine pollution assessment and control component of MAP

MPA Marine Protected Area

MSFD Marine Strategic Framework Directive

MSP Maritime Spatial Planning

MSPD Maritime Spatial Planning Directive

MSSD Mediterranean Strategy for Sustainable Development

NatCap Natural Capital Initiative

ODEMM Options for Delivering Ecosystem-Based Marine Management

PAH Polycyclic Aromatic Hydrocarbons

POP Persistent Organic Pollutant

RAC/SPA Regional Activity Centre for Specially Protected Areas

REE Rare Earth Element

SECA Sulphur Emission Control Area

SPA/BD protocol Protocol concerning Specially Protected Areas and Biodiversity in the Mediterranean

SPAMI Specially Protected Areas of Mediterranean Importance

TEU Twenty-foot equivalent unit

TEN-T Trans-European Networks

UNEP United Nations Environment Programme

UWWTD Urban Wastewater Treatment Directive

VME Vulnerable Marine Ecosystem

WTD Water Framework Directive

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CHAPTER 1:

EXECUTIVE SUMMARY

> In 2007, the European Commission adopted the "Blue Book" for an Integrated Maritime Policy (IMP) in the European Union, aiming to provide a more coherent approach to maritime issues with increased coordination between different policy areas. The Marine Spatial Planning Directive (MSPD), adopted on 23 July 2014, is the key instrument guiding the implementation of IMP to ensure the best use of marine spaces and promote economic development. The MSPD goes along with the Marine Strategy Framework Directive (MSFD), the environmental pillar of the IMP adopted on 17 June 2008, which aims to achieve Good Environmental Status for all EU marine waters by 2020.

> **In this context, the Mediterranean Sea is currently facing a Blue Gold Rush** driven by:

- The growth of trade between Europe and Asia, which drives the growth of international maritime traffic in the Mediterranean Sea.
- The development of a middle class worldwide, correlated to the growth of international tourism, in particular in the Mediterranean Sea region being the first tourist destination in the world.
- Energy demand reflected by an extremely fast development of the number of offshore oil and gas exploration contracts, covering today more than 20% of the Mediterranean Sea, with potential new contracts covering another 20% of the basin.
- The EU Blue Growth Strategy which aims at supporting sustainable growth in all marine and maritime sectors. Five sectors are highlighted as potential drivers of blue growth: aquaculture, marine and coastal tourism (including cruise and recreational boating), marine biotechnology and marine mineral mining.

> Except for professional fisheries, all traditional sectors of Mediterranean maritime economy such as tourism, shipping, aquaculture and offshore oil and gas are expected to keep growing during the coming 15 years. Comparatively new or emerging sectors such as renewable energy, seabed mining and biotechnology are expected to grow even faster, although there is greater uncertainty concerning these developments and their expected impacts on marine ecosystems.

Future trends of maritime sectors

Sector	Expected development trend of sector	Estimations
Oil and gas exploration and extraction	↗	• **Offshore oil production could increase by 60% between 2010 and 2020** at the Mediterranean regional level, rising from 0.7 mbd to 1.12 mbd. • **Offshore gas production could increase five-fold from 2010 to 2030,** from 55 Mtoe/year to 250 Mtoe/year at the Mediterranean regional level.
Maritime transport and ports	↗	**4% per annum growth rate in global trade over the next decade** can be anticipated and will be reflected in international maritime traffic routes at the Mediterranean regional level (Suez-Gibraltar axis, Aegean Sea, Adriatic Sea, and to a lesser extent the northwestern Mediterranean)
Professional fishing	↘	A **downward trend** is expected at an uncertain rate at the Mediterranean regional level.
Recreational fishing	↗	An **upward trend** is expected at an uncertain rate in the Mediterranean countries of the EU.
Marine aquaculture	↗	Forecast of fish aquaculture production in the Mediterranean countries of the EU anticipates a **112% increase between 2010 and 2030**. Production could jump from 280,000 tonnes to nearly 600,000 tonnes.
Tourism (coastal tourism, cruise tourism, recreational boating)	↗	**International tourist arrivals in the Mediterranean should increase by 60% between 2015 and 2030 to reach 500 million arrivals in 2030** at the Mediterranean regional level. France, Italy and Spain will remain the three biggest destinations.
Renewable energy	↗	While no marine renewable energy was produced in 2014, predicted production of electricity by offshore wind farms could reach **12 gigawatts (GW) in 2030** in the Mediterranean countries of the EU.
Marine mining	↗	**An upward trend** is expected at an uncertain rate in the mid-term, mainly in the Mediterranean countries of the EU
Coastal development	↗	**5,000 km of additional coastline will be artificialised by 2025 as compared to the 2005** situation at the Mediterranean regional level.
Land-based pollution sources	↗ ↘	In the Mediterranean countries of the EU: • Pollution from wastewater is expected to keep decreasing over the next 15 years. • Persistent Organic Pollutants (POPs) are expected to slowly decline. • An upward trend in heavy metal pollution can be observed for mercury and lead. • Nutrient discharges are expected to increase slightly over the next 15 years.

> The growing development of maritime sectors will lead to potential conflicts:

- C**onflicts for the use of space will grow in coastal areas** due to the development of marine aquaculture, coastal and marine tourism, marine renewable energy, recreational fisheries;
- **The oil and gas industry is clearly looking at offshore developments,** leading to potential interactions with the maritime transport sector. Sea-mining is, in the longer term, another sector that may consider offshore development in the Mediterranean.
- **Professional fishing is the sector most affected by the growing development of the maritime economy.** Fishing zones will be reduced in particular along coastal areas due to the increasing development of coastal activities. Pressures exerted by other sectors on marine ecosystems (e.g. additional fish catch from recreational fisheries, some land-based pollution types, underwater noise generated by ships and by oil and gas activities) are growing and may impact fish stocks directly or indirectly.

> It is difficult to determine the whole range of interactions between these activities and the cumulative impacts of their pressures on the state of marine ecosystems. However, the expected growth in the maritime economy clearly represents a potential additional threat to the health of already-stressed Mediterranean ecosystems. **It is likely that some pressures and, more importantly, cumulative impacts on marine ecosystems generated by the increasing exploitation of the sea will grow at a faster rate than the solutions developed and implemented to mitigate them**.

> This is particularly relevant for sectors such as maritime transport and offshore industries. These sectors do not rely on ecosystem services but on the natural infrastructure that the sea represents and thus have no interest in limiting their externalities. Besides, the internationalization and the strategic weight of these sectors mean that their activities are difficult to regulate.

> **Consequently, there is a high risk of failing to achieve Good Environmental Status in the Mediterranean Sea by 2020 for 7 out of 11 of the descriptors of the Marine Strategy Framework Directive (MSFD).**

> The growth of maritime sectors also increases the challenge faced by the EU to meet the Convention on Biological Diversity (CBD) Aichi Target 11, which requires **at least 10% of EU waters to be within MPAs or other effective area-based management measures by 2020. In the Mediterranean Sea, MPA coverage grew from 1.08% in 2012 to 3.27% of the total surface in 2015, representing significant progress towards the CBD target. However, this rate of progression is insufficient to fill the gap over the next 5 years.**

> **Large-scale areas of high interaction between Blue Growth and sites of conservation interest in EU Mediterranean countries** include the Gulf of Cadiz, the Alboran Sea, the Balearics islands, the Ebro Delta, the Catalunya Coast, the Gulf of Lion, the Northern Adriatic Sea, the Strait of Otranto, the Strait of Sicily and more generally the area located south of Sicily, the northern Aegean Sea, the Central Aegean Sea and the Ionian coast of Greece up to the southwestern part of Greece.

> **Preventing or reducing environmental damage and achieving sustainable use of the marine environment thus remain a significant challenge for the Mediterranean Sea.**

> However, guidance on what a "Sustainable Blue Economy" or "Sustainable Blue Growth" looks like, in practice, is missing right now. **The current development of key economic sectors in the Mediterranean Sea is happening against a background of vague concepts and relatively weak formulation** on what needs to be done to ensure that the Blue Economy is truly sustainable.

SO WHAT SHOULD BE DONE?

> **The implementation of the MSP Directive requires that ambitious shared prospective visions for the future of the Mediterranean maritime space be built at different spatial scales and include biodiversity and ecosystems protection and restoration objectives.**

> **Building shared prospective visions for an integrated sea management requires agreeing on underlying principles** for a Sustainable Blue Economy to ensure that the economic development of the ocean contributes to true prosperity and resilience, today and in the future, building in particular on the following principles:

- Give priority to EU policy visions of establishing a **circular green economy**.
- As far as strategic energy development infrastructures are concerned, **give preference to transition to renewable energies and define a clear contribution to climate change mitigation strategies**. In the face of the unprecedented development of offshore oil and gas exploration in the Mediterranean Sea, **WWF is favoring a strict no-go position for new oil and gas offshore developments**.
- **Implementing the MSFD ecosystem-based approach** as a prerequisite to the management of human activities and the pillar of the implementation of the MSP directive;
- **Considering that fisheries are contributing to food sovereignty,** give priority to the **restoration** of fish stocks and of their ecosystems through support to responsible and sustainable fishing;
- **Apply the precautionary principle.**

> **As regards marine spatial planning implementation processes, clear governance mechanisms for decision-making that make trade-offs explicit among sectors and also between sectors and conservation objectives** need to be established and a participatory approach implemented. **The practical modalities of the implementation of an MSFD ecosystem-based approach need to be clarified** and shared at the transnational Mediterranean level. **The value of ecosystem services and risk to habitats should be integrated as elements of planning** in ocean management scenarios.

> To date, the area beyond states' territorial waters, including EEZ and open seas, has been granted few protection measures (mainly by GFCM) in the Mediterranean Sea. **WWF believes that economical activities in this area should not be initiated before measures to protect deep-sea ecosystems from adverse impacts are in place.**

> **Regarding maritime traffic,** it should be noted that:

- The regulation of maritime traffic in the **Aegean Sea**, a hotspot for ship accidents, should be given special consideration in the future.
- The development of maritime sectors in the **Adriatic Sea** suggests that maritime traffic authorities should seek to foresee increased risks associated with maritime traffic and act accordingly.
- A significant share of maritime traffic overlaps with priority areas for conservation, in particular those concerning marine mammals, especially in the **Straits of Sicily and the Alboran Sea.** The interactions between this sector and conservation issues should be more thoroughly assessed in these two areas and potentially addressed at the with the International Maritime Organization level.

> **As regards professional fisheries, the implementation of effective ecosystem-based resource management throughout the Mediterranean is required,** and to achieve this, the following is needed:

- **The reformed Common Fisheries Policy effectively delivers on an ecosystem approach to fisheries** through sustainable fishery-specific management plans;
- **GFCM delivers on ecosystem-based management of shared** stocks through regional management plans and other technical measures and provides a framework for national fisheries policies;

- **ICCAT sticks to a science-based management plan for bluefin tuna** ensuring enforcement of the implemented measures. Moreover, ICCAT develops a comprehensive recovery plan for Mediterranean swordfish.

> Large-scale areas of high interaction between Blue Growth and sites of conservation interest in EU Mediterranean countries **require urgent planning and implementation of integrated ocean management measures to address cumulative impacts in these areas.**

> Additional efforts are needed to achieve ecologically coherent and effectively managed MPA networks in European seas as required by the MSFD. **The establishment of high seas and deep seas MPAs in the Mediterranean areas identified as priorities for biodiversity conservation is crucial,** whether in Member States EEZ or in the remaining Mediterranean open sea.

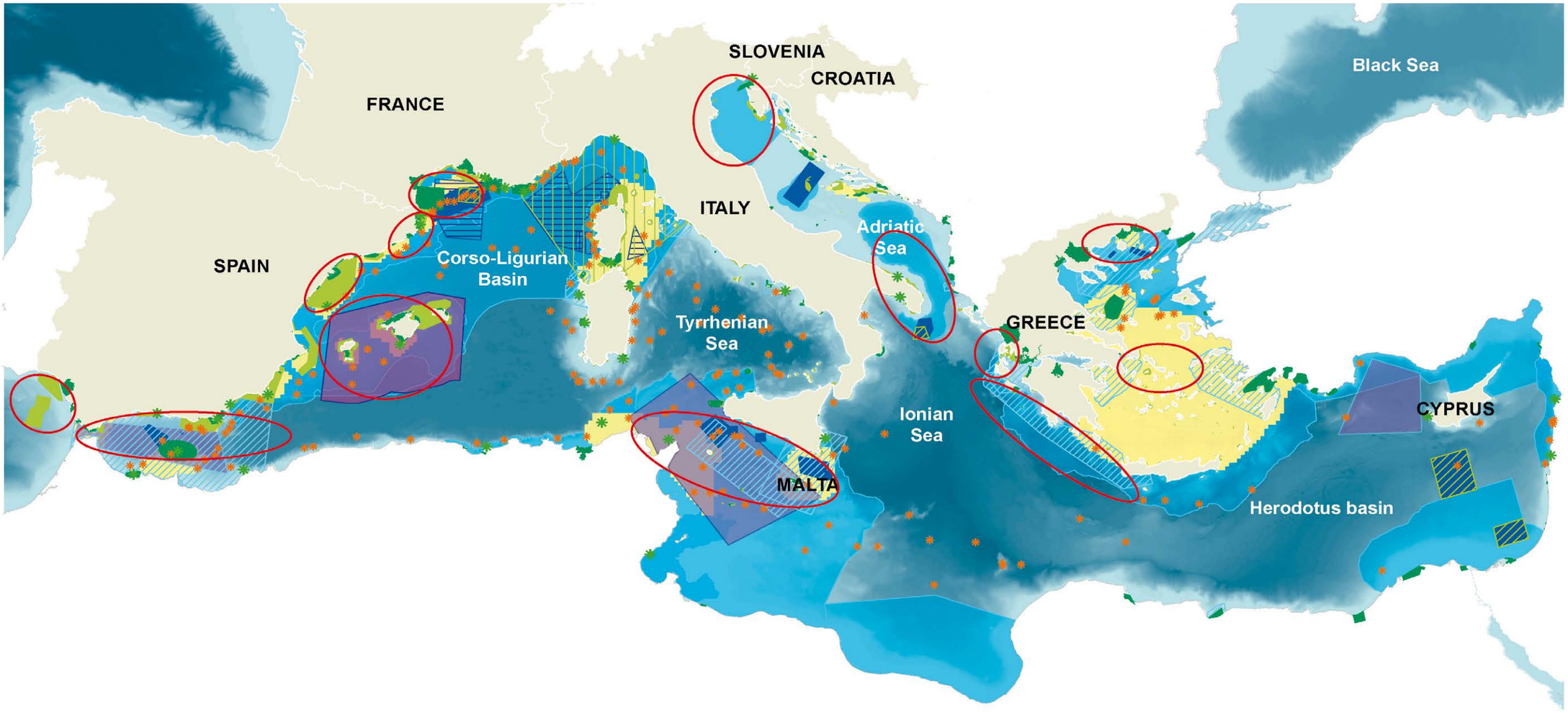

Figure 1. Large-scale areas of high interactions between Blue Growth and sites of conservation interest in EU Mediterranean countries.

CHAPTER 2:

INTRODUCTION

The Mediterranean Sea: from an area of freedom in the past to an area for economic development

For thousands of years and until the middle of the 20th century, the seas and oceans have represented infinite space, giving the illusion that humanity might be free of constraints and limitations. The degradation of fish stocks resulting from the growing intensification of fishing activities was among the first signs of the limits of marine resources, underlining the need for regulated fishing activities to maintain marine resources.

More recently, many activities have developed in coastal areas and in the open sea competing for the same resources or the same space. Seas and oceans have become new areas for economic development. Activities such as shipping have rapidly intensified. Cruise tourism has steadily grown. More recently, offshore oil and gas exploitation have extended the limits of the human footprint to the depths of the oceans. In addition, new sectors such as offshore wind energy and marine mining have developed in the Mediterranean.

The idea of the infinite space of the sea is thus behind us and to respond to increasing pressures on marine ecosystems, it has been recently proposed that maritime spaces be organized and spatially planned so that marine resources are used in a more sustainable manner. Or - and this is the reason for the MedTrends project - isn't marine spatial planning proposed mainly to encourage investments and development by instilling predictability, transparency and clearer rules ?

The Mediterranean Sea is an interesting case study for marine spatial planning as it combines strong demographic pressures, numerous maritime activities, and the oceanographic conditions of a semi-enclosed sea (Mediterranean comes from Latin "*mare medi terra*" or "sea surrounded by land") which accentuates the responsiveness of marine ecosystems to human pressures.

The Mediterranean Sea is experiencing an unprecedented "Blue Gold Rush" under the combined effects of several key factors, including: the "Blue Growth" strategy of the European Commission which aims to support the sustainable growth of maritime sectors; trade development between Europe and Asia which leads to growing international maritime traffic; the fast development and multiplication of offshore oil and gas contracts; and, the growing middle-class underpinning global tourism growth.

The legal and political background

In 2007, the European Commission adopted the "Blue Book" for an Integrated Maritime Policy (IMP) in the European Union, aiming to provide a more coherent approach to maritime issues with increased coordination between different policy areas. The Marine Spatial Planning Directive (MSPD), adopted on 23 July 2014, is the key instrument guiding the implementation of IMP to ensure the best use of marine spaces and promote economic development.

The MSPD goes along with the Marine Strategy Framework Directive (MSFD), the environmental pillar of the IMP adopted on 17 June 2008, which aims to achieve Good Environmental Status for all EU marine waters by 2020.

As a complement to these policies, the European Commission developed a "Blue Growth" strategy (adopted on 23 July 2014) to support sustainable growth in five key areas: aquaculture, coastal tourism (including cruise and yachting), marine biotechnologies, marine energies and marine mining, whilst also supporting the development of other marine sectors. Ensuring the coherence between Blue Growth and the protection of marine ecosystems in line with the objectives set by the MSFD is one of the key challenges for all European seas and for the Mediterranean Sea in particular. This is also the focus of the MedTrends project.

Objectives and positioning of the MedTrends project

Despite incentives to support Blue Growth in the Mediterranean Sea, there is little information on the future trends of maritime sectors in the Mediterranean basin, and how these trends might affect, positively or negatively, marine ecosystems and the achievement of the objectives of the MSFD.

The MedTrends project combines the collection and analysis of geo-localised socio-economic and environmental information on 10 key maritime sectors with a wider spatial analysis that helps identify interactions and conflicts between sector development and the protection of marine ecosystems. It investigates these interactions at the Mediterranean regional or sub-regional scales and more specifically at the level of the 8 EU Mediterranean countries (Croatia, Cyprus, Spain, France, Greece, Italy, Malta and Slovenia). Furthermore, it looks into today's situation along with future developments up to 2030.

In view of the future negotiations associated with the process of marine spiatial planning, MedTrends clearly defends the point of view of the environment and natural resources. The multisectoral foresight analysis proposed by MedTrends helps identify key issues for achieving Good Environmental Status and establishing a network of Marine Protected Areas (MPAs) covering 10% of the Mediterranean basin by 2020 in the context of the expected Blue Growth. The multi-criteria mapping analysis developed helps identify favourable areas that could complement the current network of MPAs. Sectoral and cross-cutting recommendations are given to support the implementation of the MSPD and meet the MSFD commitments.

The MedTrends project was implemented on the basis of a meaningful dialogue with national and supranational public institutions, through its Advisory Committees organised twice during the project. The results and recommendations of the MedTrends project will be shared with stakeholders, policy makers and the general public through various communication tools (reports, summaries, online viewer), building in particular on the large set of regional and national maps developed by MedTrends that facilitate the understanding of the main challenges faced by EU Mediterranean countries.

Overall, the project addresses the issues of promoting maritime economic development in a sustainable manner and stresses the risk of conflicts between the implementation of the Blue Growth Strategy and the protection of natural resources and ecosystems.

CHAPTER 3:

MATERIALS AND METHODS

A. STUDY AREA OF THE MEDTRENDS PROJECT

The MedTrends project covers the Mediterranean marine waters under the jurisdiction of the eight Mediterranean countries of the European Union: Croatia, Cyprus, France, Greece, Italy, Malta, Slovenia, Spain.

When available, data from outside the study area was also collected and displayed on maps.

B. METHODOLOGICAL APPROACH

The conceptual approach of the project is based on the DPSIR framework (Drivers, Pressures, State, Impacts, Responses) which makes it possible to describe the links between human activities and the state of the Mediterranean[1].

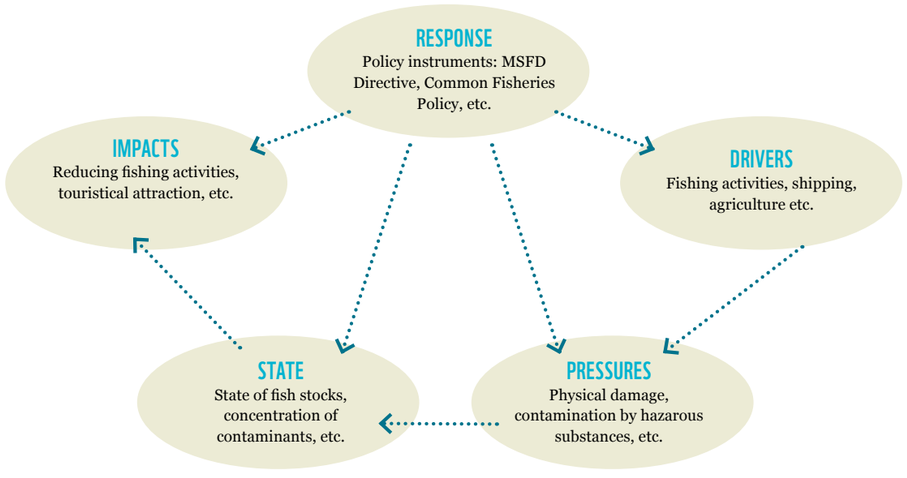

Figure 1. The DPSIR framework applied to the MedTrends project. Drivers: human activities; Pressures: mechanism through whicn an activity has an effect on any part of the ecosystem ; State: level of health of the Mediterranean marine ecosystems (a combination of physical, chemical and biological conditions) affected by human activites ; Impacts: conséquences of the changes in ecosystems health on human activities and the welfare of human beings; Responses: measures undertaken to prevent, compensate or mitigate negative impacts of human activites on the ecosystems state.

Chapter 4 describes the context in which human activities impacting the Mediterranean Sea evolve. It includes:

- A brief summary of the ecological status of the Mediterranean Sea and the pressures exerted by human activities, including climate change ;
- The main overarching drivers of changes that affect economic sectors in the Mediterranean, including production and consumption patterns, financial flows and governance;
- The state of play of existing spatial conservation efforts for protecting Mediterranean marine biodiversity and ecosystems, including the current MPA network, the Pelagos Sanctuary and other spatial conservation measures under GFCM. As the location of future MPAs is not known, priority areas for conservation identified by several global or regional organisations (CBD, RAC/SPA, ACCOBAMS, GEBCO) were mapped.

Chapter 5 presents the current situation and future trends of the main anthropogenic activities, including economic sectors, affecting the Mediterranean Sea.

Anthropogenic activities considered within the MedTrends project

Based on a literature review of the main pressures affecting the Mediterranean Sea, 10 sectors have been identified.

Table 1. Sectors considered within the MedTrends project

Theme	Sector
Extraction of living resources	**Professional fisheries (trawling, other industrial fishing, small scale fishing)**
	Recreational fisheries
	Marine aquaculture
Extraction of non-living resources	**Marine mining**
Energy production	**Marine renewable energy**
	Oil and gas exploration and extraction
Land-based activities	**Land-based pollution sources**
	Coastal development
Transport	**Maritime transport and ports (freight and passenger transport)**
Tourism	**Tourism (coastal tourism, recreational boating, cruise tourism)**

Assessments of the future trends of these sectors were based on a single business-as-usual scenario (BAU). Starting from present data, the BAU scenario analyses the evolution of indicators for each sector until 2030, under the hypothesis of continuing current trends in population, economy, technology and human behaviour, without the implementation of an integrated maritime policy.

For each sector, the main drivers of change and the way they would potentially affect each sector, were specified and the future trends of pressures were assessed with regards to each MSFD descriptor.

Table 1. The 11 MSFD descriptors

MSFD Descriptor	Definition
D1	Biological diversity is maintained.
D2	Non-indigenous species do not adversely alter the ecosystem.
D3	Populations of commercially exploited fish and shellfish are within safe biological limits
D4	All elements of the marine food webs occur at normal abundance and diversity
D5	Human-induced eutrophication is minimised
D6	Sea-floor integrity is at level that ensure that the structure and functions of the ecosystems are safeguarded
D7	Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.
D8	Concentrations of contaminants are at levels not giving rise to pollution effects.
D9	Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.
D10	Properties and quantities of marine litter do not cause harm to the coastal and marine environment.
D11	Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

Data gathering

In order to assess future trends by 2030, we used:

- Available literature (research reports, prospective studies, industry development plans, etc.);
- Extrapolation of past trends, when appropriate;
- Expert opinion in various fields.

For each sector, two types of information were collected for prospective analyses:

- Quantitative and qualitative data including indicators of the importance of the sector and the pressures that they exert, as well as their future trends;
- Geo-localised data on sectors and, depending on the availability of data, on the pressures that they exert.

The short duration of the project (one year) did not allow us to consider developing new datasets. We had to limit ourselves to available datasets that could be directly integrated into a Geographic Information System (GIS). Most of the data used can be accessed freely on online databases (Atlas of the Sea, GEBCO, Eurostat, GFCM) or were kindly provided by scientific partners. We additionally bought three datasets that were crucial for the project:

- Data on the exploration and the exploitation of offshore oil and gas, completed with information gathered at national level by the project partners;
- Automatic Identification System (AIS)data for maritime transport and fisheries;
- Data on existing and planned projects of wind farms.

Map production

Maps were developed using ArcMap, the main component of Esri's ArcGIS.

Geo-localised maps regarding maritime traffic and fisheries were developed based on AIS (Automatic Identification System) data. The Automatic Identification System (AIS) is an autonomous and continuous vessel identification and monitoring system used for maritime safety and security. Today most vessels are equipped with this system, except small leisure and fisheries crafts. The spatial coverage of this system has been significantly improved over the last two years providing a better representation of global maritime traffic. Each AIS signal contains information that identifies the type of vessel and a number of parameters regarding navigation (speed, course, etc.)

Based on these data, we developed maps that show the density of AIS signals compiled over a year and projected on a grid in which each pixel is approximately 1square km (exactly 0.01° in longitude and latitude, which makes 1.1 km on an east-west axis and 0.9 km on a north-south axis). Different algorithms for data processing exist, according to the desired objectives. If we simply combine the signals collected in each pixel, bias can exist because the frequency of the signal transmission is not always even between ships (from every 2 seconds to every 10 minutes).

For that reason, we used an algorithm that performs an interpolation between signals, connecting the preceding with the following, and turns them into a track associated with a ship. This is thus track density that is represented on maps and not signal density, which is more representative of the number of vessels that passed through a pixel and hence of the intensity of maritime traffic.

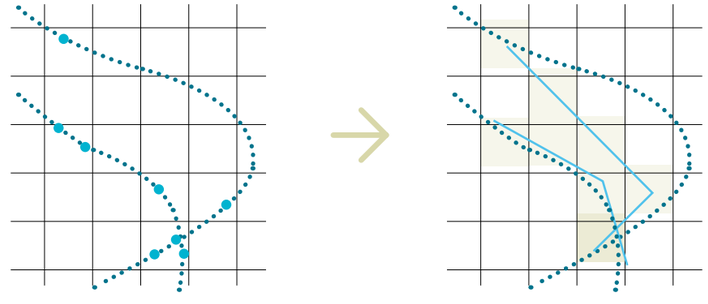

Figure 2 – Illustration of linear interpolation (Each AIS signal is connected to the next to represent the track of ships passing through the pixel. Each track corresponds to a ship)

The result of this processing is a matrix associating a number of tracks, that is to say a density value, for each pixel of 1 km2. Mapping also required a choice between different options. There are only 255 possibilities to represent on the same map track densities that correspond to pixels with a density value of 1 and pixels with a density value of several tens of thousands. The thresholds chosen for establishing the correspondence between the 255 levels available and the thousands of density values significantly modifies the resulting maps. We chose a logarithmic scale that allows the representation of extreme values, which correspond to the characteristics of Mediterranean traffic.

Chapter 6 presents cross-cutting analyses that aim to answer the following questions:

- How will interaction between the various marine sectors evolve within the next 15 years?
- Will growing maritime activities potentially conflict with Marine Protected Areas (MPA)? How can the 10%-target of MPA coverage be achieved by 2020 under such conditions?
- How will the main pressures exerted in the Mediterranean evolve? Are there any new pressures anticipated as compared to the existing ones? What are the risks of not achieving Good Environmental Status (GES) as defined by the Marine Strategy Framework Directive (MSFD) by 2020?

Assessing evolutions of the interactions between sectors

The evolution of the interactions between sectors were analyzed by:

- Overlapping the future location of activities when information was available ;
- Summarizing through a matrix potential levels of interaction (high, medium, low interactions) and the type of conflicts between sectors (conflicts of use of space, negative impacts, competing interests)

Analysis of future maritime sectors development trends versus MPAs and priority areas for conservation

Due to the uncertainty of the location of future MPAs in the Mediterranean, we decided to overlap MPAs and priority areas for conservation with the spatial data collected for each sector, to visualize the location of areas with conflicting interests between Blue Growth and conservation priorities.

Risks of failing to achieve Good Environmental Status (GES) by 2020

This assessment was based on the results of the ODEMM project (Options for Delivering Ecosystem-Based Marine Management) run between 2010 and 2014 by the University of Liverpool which studied the risk of failing to achieve GES by 2020 in European Seas, including at the Mediterranean regional scale. Additional information based on the assessment of each sector made in Chapter 5 was added to the ODEMM risk assessment.

Finally, large-scale areas of high interactions between Blue Growth and sites of conservation interest were identified by the MedTrends national experts in EU Mediterranean countries based on the following criteria: at least two sectors exerting major pressures overlapping with three conservation areas or priority areas for conservation or EBSAs.

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Available at: http://www.liv.ac.uk/media/livacuk/odemm/docs/ODEMM,Deliverable,1.pdf

CHAPTER 4:

THE MEDITERRANEAN SEA, DRIVERS OF CHANGE AND CONSERVATION EFFORTS

The Mediterranean Sea is the largest semi-enclosed sea in the world with 46,000 km of coastline. It is connected to the Atlantic Ocean through the narrow Strait of Gibraltar, to the Red Sea by the man-made Suez Canal and to the Black Sea via the Bosphorus Strait. It includes 21 countries and territories from Europe, Africa and the Middle East.

A. THE MEDITERRANEAN, A SEA SURROUNDED BY LAND

The Mediterranean Sea is home to rare and important marine habitats, extensive endemism and a number of critically endangered species.

The Mediterranean is recognized as one of the world's 25 top biodiversity hotspots. Its biodiversity represents between 4% and 18% of the world's known marine species, in an area covering less than 1% of the world's oceans[1].

Its coastal rocky reefs and seagrass meadows are particularly important habitats that support enormous biodiversity. Seagrass meadows provide breeding, feeding, and resting areas for numerous marine species, particularly fish, crustaceans, and marine turtles. They produce more than 80% of the annual fish yield of the Mediterranean Sea. They stabilise the seashore, maintaining its water quality in particular through oxygen production, and they contribute to trap CO2. The rocky reef ecosystems provide habitat for several endemic fish species and invertebrates as well as for the monk seal (*Monachus monachus*).

In the pelagic realm, the circulation of Mediterranean currents create a landscape of dynamic and permanent habitats, including sub-basin scale cyclonic and anticyclonic gyres, ocean fronts, upwelling areas, and mesoscale eddies. All these hydrographical structures are associated with **various transition domains of particular biological and ecological importance, being breeding and nursery grounds for a wide range of organisms.** They are also associated with a high and predictable primary production, making them important foraging areas with high prey aggregation, and with changes in type and abundance of marine organisms. These structures also serve as migration routes for highly mobile species such as marine mammals and other top predators[2].

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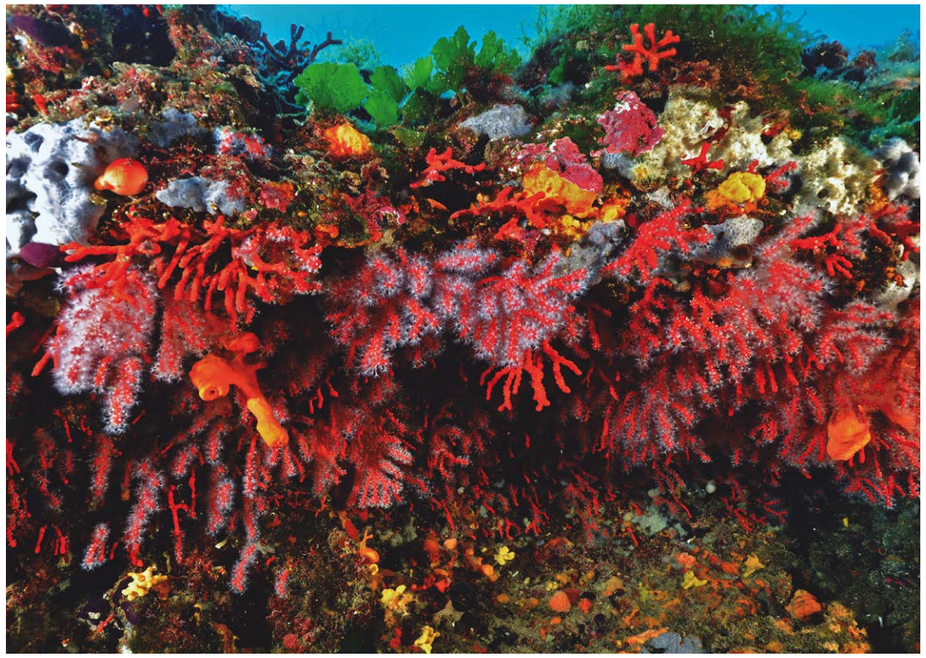

© ALDO FERRUCCI

• *Loggerhead turtle swimming in Lagana Bay, Zákinthos, Greece*
• *Mediterranean Coralligenous Assemblage*

©PARC NATIONAL DES CALANQUES

© BRIAN J. SKERRY NATIONAL GEOGRAPHIC STOCK WWF

• Scopoli's shearwater
• Northern bluefin tuna migration, Mediterranean Sea

Unique areas of special ecological significance are also found in deep-waters, such as cold-seeps, seamounts, coral reefs and brine pools. Other interesting areas recognized for their ecological importance are submarine canyons and the bathyal domain below 1000m depth.

Emblematic species of global conservation concern.

19 species of cetaceans can be encountered in the Mediterranean and 8 of them are considered common (the fin whale *Balaenoptera physalus*, the sperm whale *Physeter macrocephalus*, the striped dolphin *Stenella coeruleoalba*, Risso's dolphin *Grampus griseus*, the long finned pilot whale *Globicephala melas*, the bottlenose dolphin *Tursiops truncatus*, the common dolphin *Delphinus delphis*, Cuvier's beaked whale *Ziphius cavirostris*). Other emblematic species are **the endangered Mediterranean monk seal** (*Monachus monachus*), **loggerhead sea turtles** (*Caretta caretta*), **green sea turtles** (*Chelonia mydas*), and leatherback sea turtles (*Dermochelys coriacea*).Among fish species, **the Atlantic bluefin tuna** is with no doubt the iconic fish of the Mediterranean Sea.

Marine biodiversity is still very poorly known. Data are lacking to evaluate the conservation status of about one third of the species assessed so far. However, the IUCN's Red List for the Mediterranean Sea includes a large number of marine species. For instance, **sharks are seriously threatened** and their decline is much faster in the region than elsewhere. Among marine mammals, six species are now listed as threatened with extinction (Critically Endangered, Endangered and Vulnerable). **The most critically endangered of all the Mediterranean resident species (both regionally and globally) is the Mediterranean Monk Seal, *Monachus monachus.***

Emblematic habitats of global conservation concern

Mediterranean sensitive habitats include seagrass beds, coralligenous habitats and mäerl beds. Located in shallow waters, sea grass beds is an extraordinary habitat that has been regressing and fragmenting due to various coastal human activities, including marine works, beach nourishment, anchoring, placement of submarine cables and pipelines among others. This affects in return the composition of the benthic communities who live in it. Coralligenous, maerl beds and the species that depend on them are affected by mechanical disturbance, sedimentation increase, species invasion, temperature increase and water degradation.

B. THREATS TO THE MEDITERRANEAN MARINE ECOSYSTEMS

In the Mediterranean Sea, marine life is heavily threatened by habitat degradation and biodiversity loss. This is mostly due to human activities, such as fisheries, ship traffic, water pollution, coastal development and offshore oil and gas development. Today, 150 million people live along the Mediterranean coasts of the 21 countries that share the Sea. And millions of tourists visit Mediterranean coasts every year[1].

Table 1 synthesizes the main pressures exerted by human activities on Mediterranean marine ecosystems.

Table 1. Sectors and their pressures on the Mediterranean marine ecosystems

Activity	Sector	Main pressures
Extraction of living resources	Professional fisheries	Selective extraction of species Physical damage (changes in siltation, abrasion) Marine litter
	Recreational fisheries	Selective extraction of species
	Marine aquaculture	Inputs of organic matter Introduction of non-indigenous species and translocation Selective extraction of species (juvenile capture)
Extraction of non-living resources	Marine mining	Physical damage (abrasion, changes in siltation)
Energy production	Marine renewable energy	Sealing, underwater noise
	Oil and gas exploration and extraction	Physical loss (smothering, sealing) Introduction of other substances, whether solid, liquid or gas
Land-based activities	Land-based pollution sources	Contamination of hazardous substances Nutrient and organic matter enrichment
	Coastal development	Physical damage (smothering, sealing) Introduction of microbial pathogens (sewage effluent)
Transport	Maritime transport and ports (freight and passenger transport)	Underwater noise Introduction of non-indigenous species and translocations Introduction of synthetic compounds and non-synthetic compounds Introduction of microbial pathogens (ship waste disposal)
Tourism	Tourism (coastal tourism, recreational boating, cruise tourism)	Physical damage Introduction of synthetic and non-synthetic compounds Introduction of organic matter Underwater noise Introduction of microbial pathogens (ship waste disposal)

The Mediterranean Sea is a hotspot for climate change. Sea warming is identified by the European Environment Agency as a key climate-change related pressure on the Mediterranean Sea. A ten year average increase of 0.74°C is expected between 2000-2010 and 2030-2040 at the basin scale. It could reach 1.5°C in the most impacted areas, such as the north of the Balearic Islands (Figure 1)[3]. There is increasing evidence to suggest that many marine ecosystems in the Mediterranean Sea are already affected by rising sea temperature. Fish and plankton are expanding their geographical distribution further north in response to increasing temperatures. The majority of alien species in the Mediterranean originates from warm waters and the increasing sea temperature is favouring their rapid spread toward the north and west of the Mediterranean Sea. Mass-mortality events of coralligenous formations have also been observed in the Mediterranean Sea over the last 20 years.

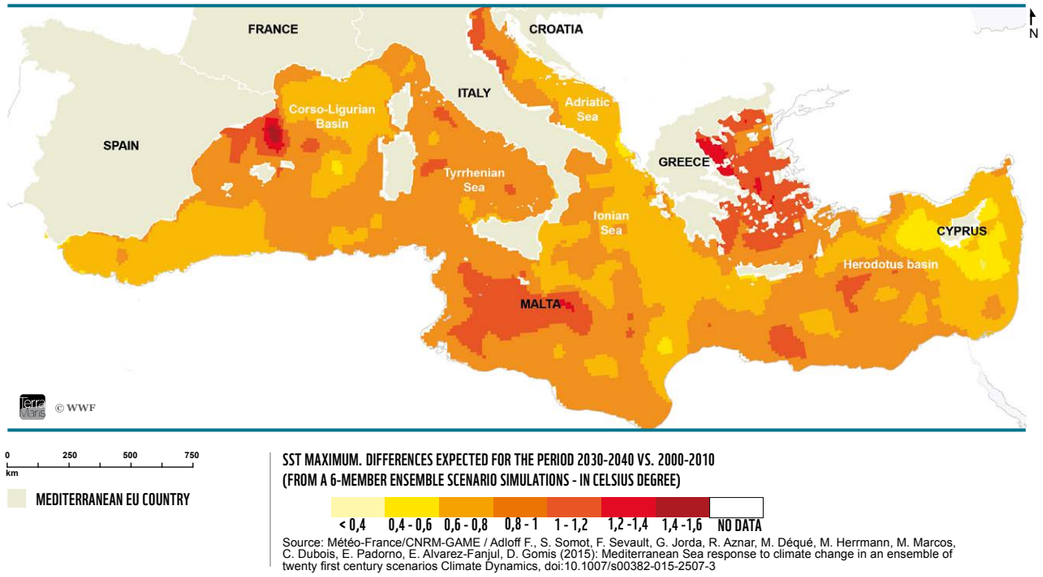

Figure 1. Maximum differences of sea surface temperature between 2000-2010 and 2030-2040.

Ocean acidification is the second significant pressure related to climate change (Figure 2). The progressive increase in the acidity of the ocean is caused by the uptake of carbon dioxide (CO_2) from the atmosphere and fossil fuel burning that dissolves in seawater to alter seawater chemistry.

The Mediterranean Sea acidification is potentially amplified by other environmental stressors such as heat waves and eutrophication. If we continue to emit CO_2 at today's rate, acidity will increase by 30% by 2050 and by 150% by 2100. Acidification can be more pronounced in areas where human impacts, such as agricultural runoff and maritime traffic routing, further alter water chemistry.

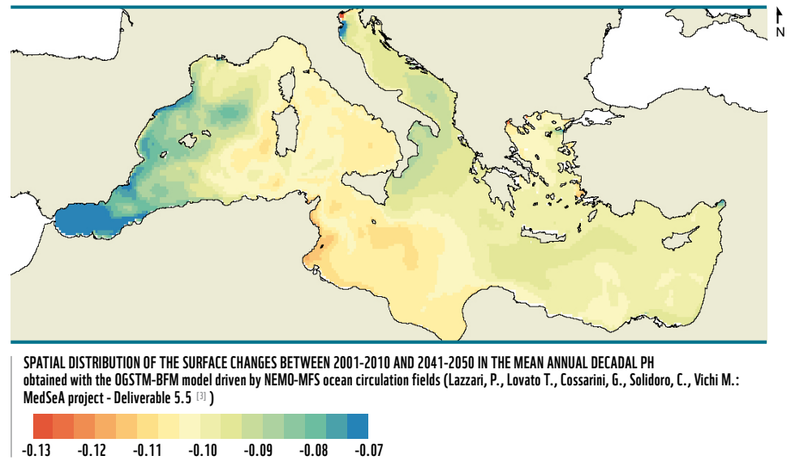

Figure 2. Spatial distribution of the surface changes between 2001-2010 and 2041-2050 in the mean annual decadal PH

In turn, this can be detrimental to several endemic species, including commercially important ones, as many shell-forming marine organisms are sensitive to changes in pH and carbonate chemistry. Corals (such as red coral), pteropods (free-swimming snails), bivalves (such as mussels, oysters and clams), and phytoplankton species fall into this group. But other marine organisms are also stressed by the higher CO_2 and lower pH and carbonate ion levels associated with ocean acidification.

Ocean acidification will lead to changes in the number and abundance of marine organisms. Ocean acidification thus represents another stress on marine environments that can endanger the flow of goods and services it provides to marine-dependent communities, such as the provision of shellfish or fisheries resources.

C. DRIVERS OF CHANGES

A driver is a factor, force or condition, or a fundamental process in society that leads to a direct impact on the environment through a change in the state of biodiversity and/or the human footprint [4]. **WWF has identified production and natural resource use, consumption, governance, and global finance systems as the four key global drivers that are critical to determining humanity's future on this planet.**

Production: This driver includes the overharvesting of fisheries and wildlife that is often carried out by commercial operators. Production systems globally face the challenges of increased food supply chain efficiencies, increased water and energy efficiency, and maximum recycling and recovery. They need to reduce their dependence on fossil fuel-based energy systems and greenhouse gas emissions.

Consumption: The current system of economic growth is unsustainable because it is based on increasing consumption, combined with a growing human population and poor overall management and governance of natural resources. Many countries and populations already face a number of risks from biodiversity loss, degraded ecosystem services and climate change impacts.

These risks include food, water and energy scarcity; increased vulnerability to natural disasters; health problems; population movements; and resource-driven conflicts.

Governance: The governance systems include laws, treaties, policies, transparency and corporate behaviour and are responsible for the distribution of costs and benefits derived from natural resources use.

Global finance systems: Financial institutions play a critical role in addressing the environmental challenges externalities and risks that are not now properly integrated into policies and decision-making processes and regulations. through investments, loans, guaranties, etc.

Table 2 identifies how these drivers will affect maritime sectors in the Mediterranean in the future.

Table 2. Drivers of change per sector

Sector	Drivers
Exploration and extraction of oil and gas	National energy demand, global energy demand, international oil prices, global oil and gas supply, technology development, financial institutions investments
Offshore wind farms	National renewable energy demand, EU renewable energy standards, climate change, international oil prices
Maritime traffic	Asia-EU maritime route, opening of the Arctic route, global consumption patterns; freight costs, prices, logistic structures, supply chains, and comparative advantages; global trade in manufactured goods, parts and components; increasing container ship sizes; reduction in the number of carriers per country; tourism development; IMO governance
Professional fisheries	Climate change, EU population growth and fish demand, increased competition for space, EU regulation (CFP reform), GFCM governance
Marine aquaculture	EU fish demand, EU policy
Tourism	Global population growth and global increase of living standards, climate change, competing destinations
Land-based pollution sources	EU population growth and regional tourism development, agricultural activities, manufacturing, aquaculture, coastal development, etc.
Coastal development	EU population growth, tourism development, attractiveness of coastal areas

Coast of Bonifacio in bloom, Mediterranean sea, Corsica, France

D. CONSERVATION EFFORTS

Among the strategies identified to reverse the degradation of the world's oceans, the Convention on Biological Diversity has set the objective of reaching 10% of coastal and marine areas conserved through Marine Protected Areas (MPA) by 2020 (Aichi objective n°11). This might be considered as a minimum for a biodiversity hotspot like the Mediterranean. According to the 2012 Status of Marine Protected Areas in the Mediterranean Sea published by the MedPAN association, Mediterranean MPAs, including Natura 2000 sites designated under the EU Habitats and Birds Directive, covered 1.08% of the Mediterranean Sea in 2012[5].

Beside, in addition to the decision of prohibiting bottom-trawling activities in waters deeper than 1000 taken in 2005 by the General Fisheries Commission for the Mediterranean (GFCM), **four Fisheries Restricted Areas (FRAs) were established in 2006 and 2009 to ensure the protection of deep sea sensitive habitats.**

Even though significant efforts have been made in the last few years by Mediterranean riparian countries to designate new MPAs, there is still a heterogeneous geographical distribution of MPAs between the southern, eastern and northern shores of the Mediterranean as illustrated in Figure 3. And MPAs are still located mainly on the coast, with a high variable representativeness of ecological sub-regions, habitats and species. While the ecological coherence of the MPA network has improved in the western part of the Mediterranean Sea, it is still low at the Mediterranean scale.

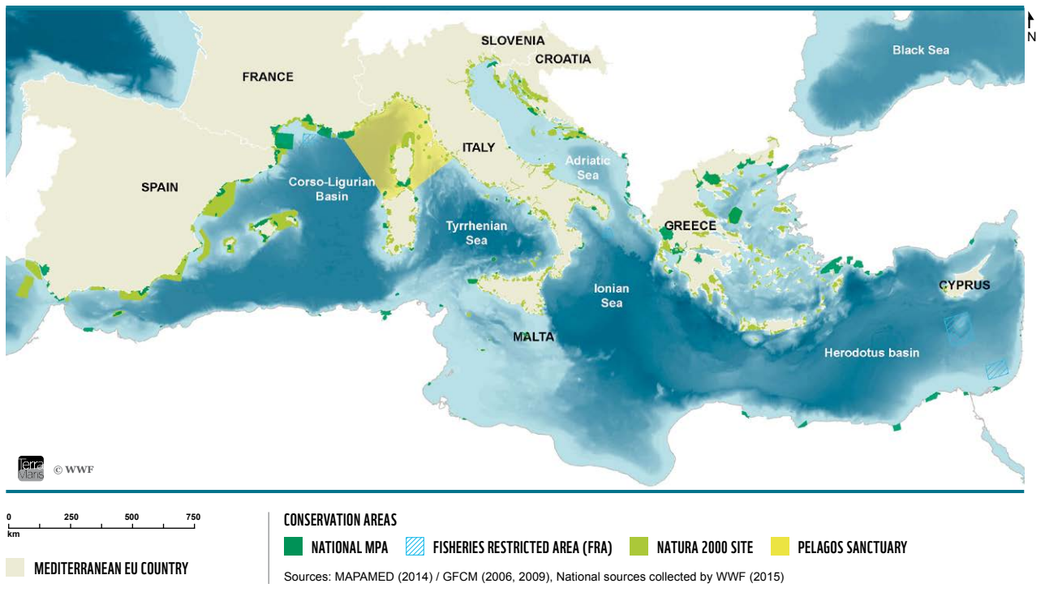

Figure 3. Marine Conservation Areas in the Mediterranean

Considering the lack of protection of the open and deep seas globally, the ninth Meeting of the Conference of the Parties to the Convention on Biological Diversity (COP 9) held in 2008 adopted the scientific criteria for identifying ecologically or biologically significant marine areas (EBSAs) in open-ocean waters and deep-sea habitats that would require specific protection[6]. **EBSAs are special ocean areas that are essential to the healthy functioning of the ocean and to the delivery of the many services it provides.** 15 Mediterranean areas meeting the EBSAs criteria have been identified[7] and endorsed in 2014 by the Executive Secretary of the CBD.

CBD scientific criteria for Ecologically or Biologically Significant Areas (EBSAs)

1. Uniqueness or Rarity
2. Special importance for life history stages of species
3. Importance for threatened, endangered or declining species and/or habitats
4. Vulnerability, Fragility, Sensitivity, or Slow recovery
5. Biological Productivity
6. Biological Diversity
7. Naturalness

Other international organisations have also identified areas of importance for conservation which are mapped in Figure 4 and which are logically mostly overlapping with the designated EBSAs.

These include:

- **Priority areas for conservation of cetaceans,** as identified under the Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS)[8]. Today, the Pelagos Sanctuary is the only designated area for the conservation of Mediterranean marine mammals;
- **Areas of high conservation value for Mediterranean seabirds,** as identified by UNEP/MAP RAC/SPA[9];
- **Priority areas for the conservation of demersal and pelagic fisheries,** as identified by UNEP/MAP RAC/SPA[10].
- **Undersea features:** the Mediterranean deep sea is host to undersea features such as seamounts, hills, canyons, trenches, banks and mud volcanoes which are home to many species. Some are hotspots of demersal biodiversity. The GEBCO Sub-Committee on Undersea Feature Names (SCUFN) maintains and makes available a digital gazetteer of the names, generic feature type and geographic position of features on the sea floor[11].

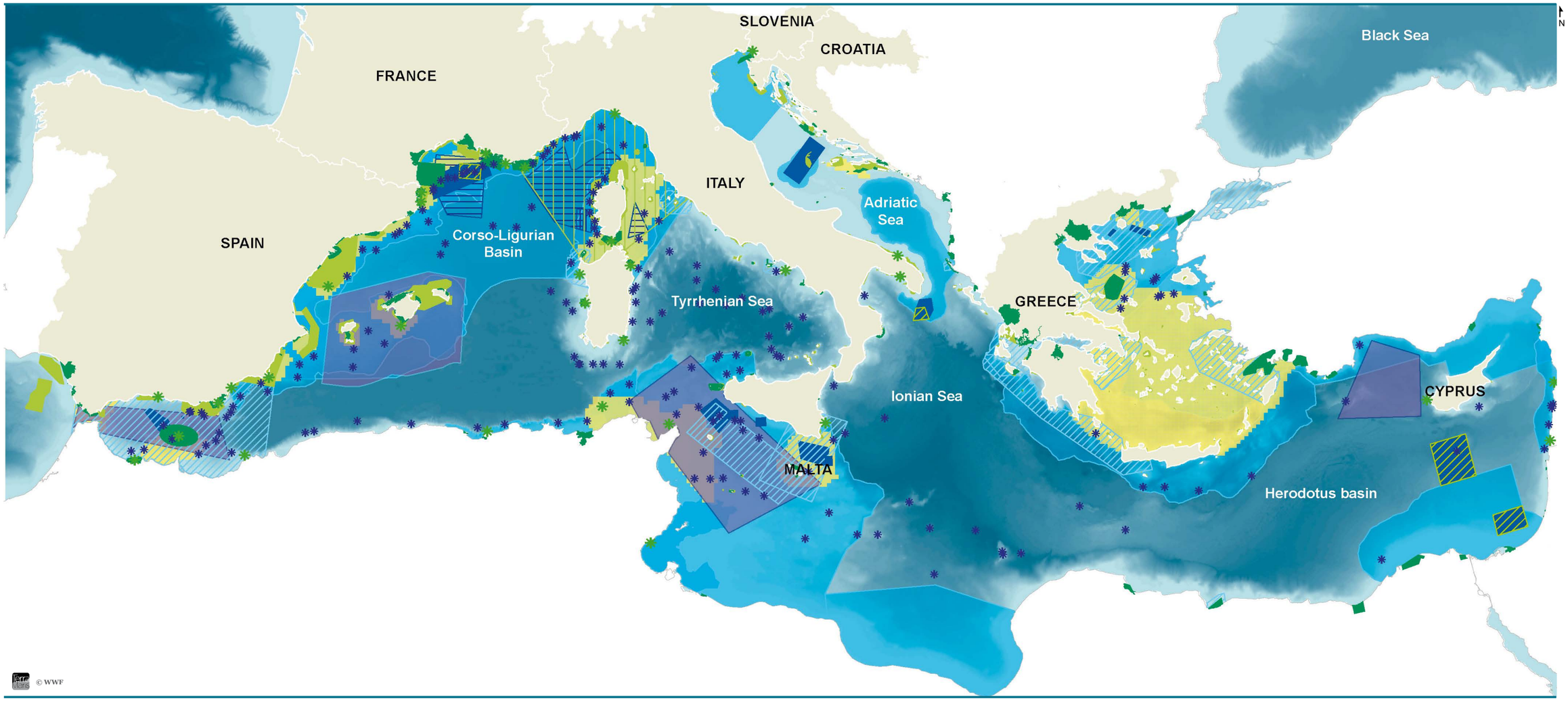

Figure 4. MPAs and priority areas for conservation

© F. BASSEMAYOUSSE

Pilot whales

Through the SPA/BD Protocol, the Contracting Parties to the Barcelona Convention have established a list of **Specially Protected Areas of Mediterranean Importance (SPAMI) that are representative of species or ecosystems at the Mediterranean regional level.** The SPAMI list has already given international recognition to 33 sites, including the Pelagos Sanctuary for marine mammals (Figure 4).

Governments are expected in the future to adopt appropriate measures for conservation and sustainable use in relation to EBSAs, in particular by establishing representative networks of marine protected areas.

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OFFSHORE OIL AND GAS EXPLORATION AND EXTRACTION

GAS AND OIL RIG PLATFORM IN THE MEDITERRANEAN © ANDRIY MARKOV

Offshore oil and gas exploration contracts have mushroomed in recent years in the Mediterranean region, covering nearly half of the basin in April 2015. The growing number of offshore oil and gas operations increases the probability of oil spill accidents. Risks are real as the Mediterranean Sea is a semi-enclosed sea with significant seismic activity. Political concern in the region and at EU level has been growing following the 2010 Deepwater Horizon disaster in the Gulf of Mexico.

1. BACKGROUND AND CURRENT SITUATION

The Mediterranean region has so far been a relatively small producer of offshore oil and gas as compared to the world production. In 2011, total offshore oil and gas production in the Mediterranean region was estimated at 87 million toe (Tonne of Oil Equivalent) with 19 million toe crude oil, 68 million toe natural gas. **However, Mediterranean oil reserves represent 9,400 million toe, equivalent to 4.6% of world oil reserves[1].**

The turnover of the oil and gas sector is highly dependent on oil prices. It can therefore be quite variable from one year to the other. Oil and gas production value has been estimated at 32,067 million Euros in the Mediterranean region in 2011, with a GVA of 22,679 million Euros[1]. Total employment has been estimated at 398,510 in 2011, on the basis of UK industry ratios applied to the Mediterranean context.

In 2011, 94% of Mediterranean offshore oil reserves were held by Libya, Algeria and Egypt[1]. The share of oil reserves in EU Mediterranean countries is very limited compared to the rest of the region. Current offshore oil and gas production in these countries takes place mainly in Italy and to a lesser extent in Spain[1]. Italy operates approximately 100 offshore installations, mainly for gas extraction and exploration. These facilities are located in the Adriatic Sea, in the Ionian Sea and in the Sicily Channel. Spain also has two installations in the Mediterranean Sea. No active offshore installations are reported by the Cypriot, French, Maltese and Slovenian sectors. But some of these countries have had drilling activities in the past (France, Cyprus) and/or plan to start drilling activities in the near future (Cyprus and Malta). Croatia also has some offshore installations, as does Greece.

In addition to Libya, Algeria and Egypt, offshore oil and gas activities also take place in the waters of other North African states and non-EU Member States around the Mediterranean Sea, such as Israel and Tunisia[2]. In March 2013, production started at the Israeli offshore Tamar gas field, the first ultra-deep field (below 1500m depth) in the Mediterranean.

In the last ten years, oil production has remained relatively stable, whereas gas production has steadily increased with a doubling of gas production in the Mediterranean region between 2000 and 2009[3] (Figure).

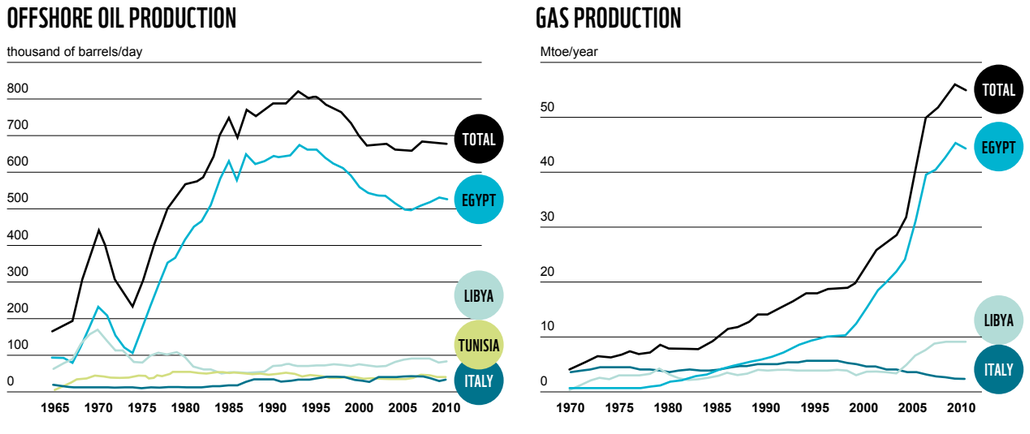

Figure 1. Evolution of oil and gas production in the Mediterranean region [3]

Figure 2 shows the location of current offshore oil and gas development and production contracts in the Mediterranean. Due to the difficulty of accessing industry information, some production sites are missing as for instance in Libya.

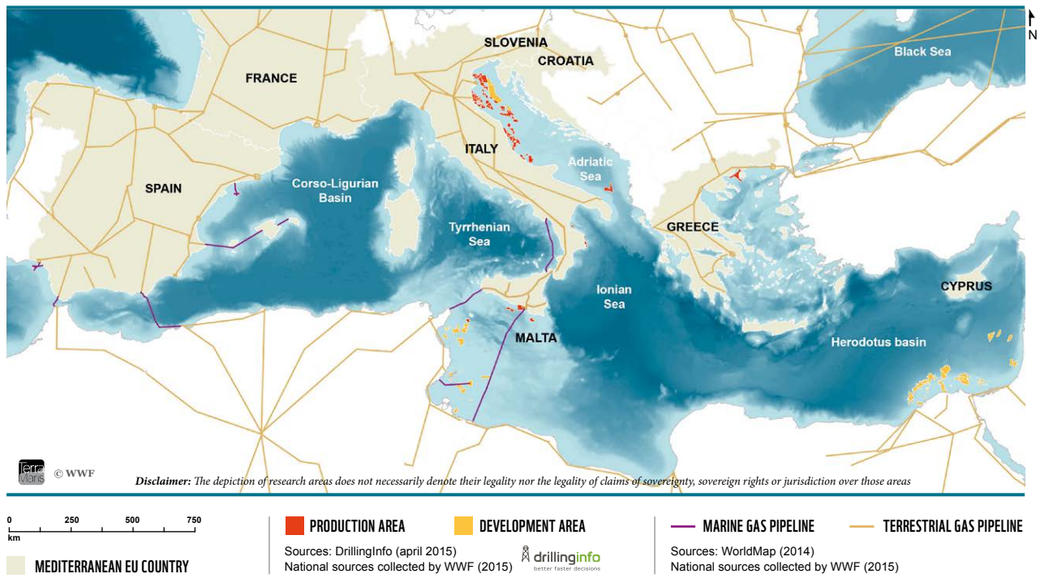

Figure 2. Current offshore oil and gas production contracts, and natural gas pipelines.

Pipelines

EU Mediterranean countries are an important zone of transit for oil and gas, linking African supply to European demand[4]. While oil is mainly transported by tankers, several gas pipelines are operational in the Mediterranean Sea (Figure 2).

2. FUTURE TRENDS

Three major factors will strongly influence future production in the Mediterranean region:

- The global energy demand and price;
- The outcomes of ongoing and future offshore explorations;
- The regulatory framework put in place for offshore activities.

Global energy demand worldwide is expected to keep growing towards 2040 but at a slower pace as compared to today's trends[5]. This slowdown results from energy efficiency gains combined with structural changes in the global economy in favour of less energy-intensive activities. Natural gas consumption is expected to grow, partly replacing oil consumption. European gas and oil production is not expected to grow as much as in other major regions.

However, hydrocarbon exploration projects and associated drilling activity have mushroomed all around the Mediterranean in recent years, including under extreme physical conditions in the deep-sea floor.

However, hydrocarbon exploration projects and associated drilling activity have mushroomed all around the Mediterranean in recent years, including under extreme physical conditions in the deep-sea floor. Advances in seismic research and drilling technology, the increase in global hydrocarbon demand, the long-term rising of oil and energy prices and the global economic crisis which has particularly hit the region, have led to an exploration boom and consequent significant findings of oil and especially natural gas offshore.

While exploration activities are taking place at a large scale in the southern and eastern regions of the Mediterranean Sea, exploration areas have also been recently granted in all EU Mediterranean countries, except Slovenia. Offshore exploration off the Levantine coasts (Greece and Cyprus) seems particularly promising for the future[1].

Figure 3 shows ongoing exploration activities (2015) in the Mediterranean Sea. Current production and development contracts cover 1% of the Mediterranean area. Exploration contracts currently cover 23% of the total area of the Mediterranean surface while areas designated by governments for potential offshore oil and gas development (open areas) and areas for which call for tenders are ongoing (bid blocks) cover an additional 21%.

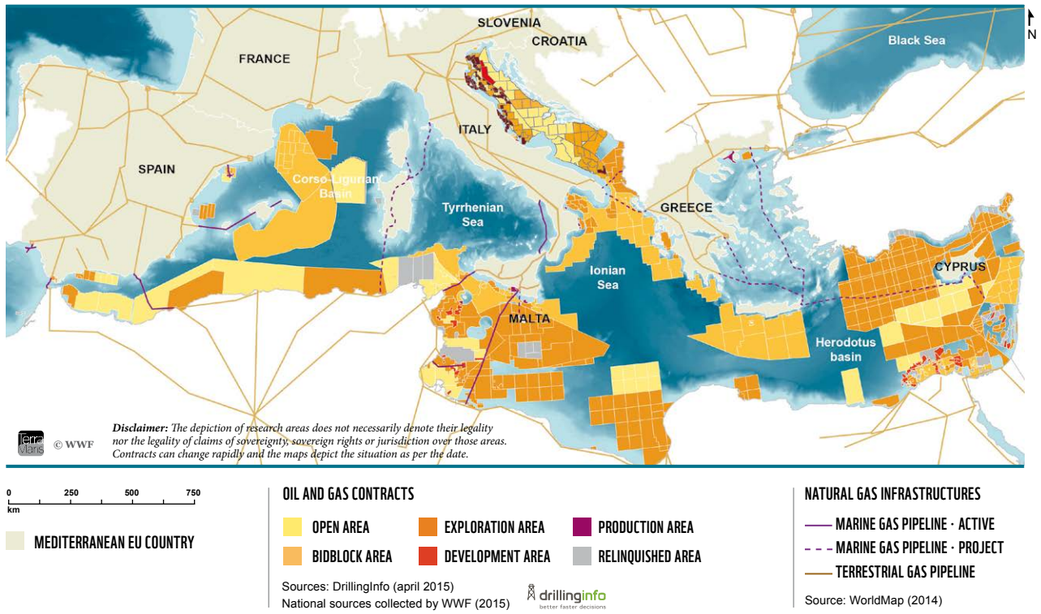

Figure 3. Current offshore oil and gas exploration and production contracts in the Mediterranean Sea, and active and projected gas pipelines

Not all exploration activities will lead to production. Environmental constraints, territorial conflicts, the seismic context or the ultra-depth (leading to high extraction costs) could hinder production development in new oil and gas reserves, especially in the western European countries (Spain and France[1]).

Overall, according to Clarkson Research Services, oil production in the Mediterranean could increase by 60% between 2010 and 2020 as shown in the graph below[6] (Figure 4).

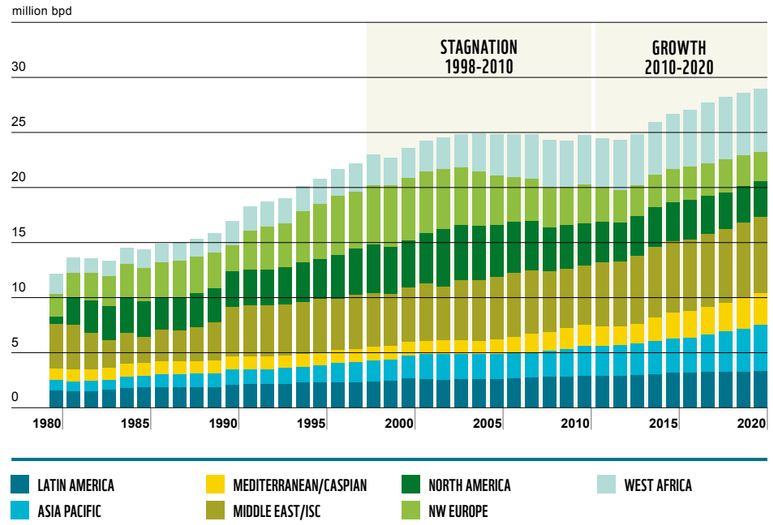

Figure 4. Offshore oil production forecast in the Mediterranean Sea (million barrel per day) [6]

Trends for gas production at the Mediterranean level have been established based on past trends and expected future demand and our estimates show that gas production could increase five-fold from 2010 to 2030.

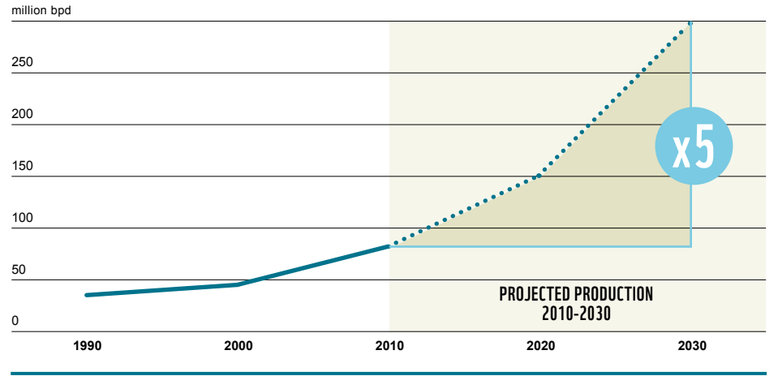

Figure 5. Gas production forecast in the Mediterranean Sea, based on past trends (in Million tonnes of oil equivalent). Projection of past trends[3]

Pipelines

Several new gas pipelines, such as the Trans-Adriatic Pipeline or the projected pipeline between Cyprus and Greece, are planned in the Mediterranean to respond to the need for an increased gas supply to Europe.

The current political context of offshore oil and gas operations

The recent blowout at the Deepwater Horizon drilling rig, also known as the Macondo incident, attracted considerable public attention. It raised awareness of the threats of offshore exploration activities, and the need for better prevention and response mechanisms. Significant progress has been made in the last few years regarding the regulatory framework of oil and gas exploration and exploitation in the Mediterranean Sea. Under the Barcelona Convention, the Protocol for the Protection of the Mediterranean Sea against Pollution resulting from Exploration and Exploitation of the Continental shelf and the seabed and its subsoil, was adopted in 1994 and entered into force in March 2011. **The Offshore Protocol has been signed by most EU Mediterranean countries (i.e., Cyprus, Greece, Italy, Malta, Slovenia and Spain). But, apart from Cyprus, no other EU country has ratified this legal instrument yet.** In addition, the EU Directive on Safety of Offshore Oil and Gas Prospection, Exploration and Production Activities was initiated right after the Deepwater Horizon accident and was adopted in 2013. While strong political will was expressed at the beginning of the legislative process to strengthen the regulation of offshore operations in a strict manner, the Directive neither really constrains industry practices nor really uses the EU dimension to level the playing field and enhance environmental cooperation[7][8]. At this stage, it is difficult to say whether this regulatory framework will secure oil and gas exploration and exploitation in the Mediterranean Sea.

3. IMPACTS AND RISKS ON GES

Offshore oil and gas exploration and production may produce two main categories of impacts on ecosystems:

- those resulting from the drilling and production infrastructures and associated waste;
- those resulting from accidental or operational oil spills[1].

Offshore structures and waste streams can affect marine species and the entire food web through intrusive noise and the possible introduction of non-indigenous species. Explosions and drilling can also cause seafloor and geological disturbances. This impact increases as offshore exploration activities go deeper, a trend that is observed worldwide and in the Mediterranean Sea. Oil and gas exploration and production also lead to risks of bioaccumulation and biomagnifications through the continuous use of chemicals and the release of polluted water.

Potential oil spills can originate from different sources of oil pollution caused by offshore installations, including: well blowouts, acute or slow releases from sub-sea equipment and pipelines, structural failure or damage to production or pumping platforms, platform-tanker loading activities and other accidental spillage[2].

The large majority of spills from offshore oil and gas production and exploration have only been a minor source of oil pollution as compared to other sectors like shipping [1]. Spills from offshore oil production are mostly small (<7t) or medium (<700t). And they occur mainly during loading and discharging operations in ports and oil terminals[1].

However, hazardous accidents relating to oil operations regularly occurred between 1970 and 2009 in the Mediterranean region as indicated in Figure 6. Italy records the largest number of accidents, although data are missing for several southern Mediterranean countries.

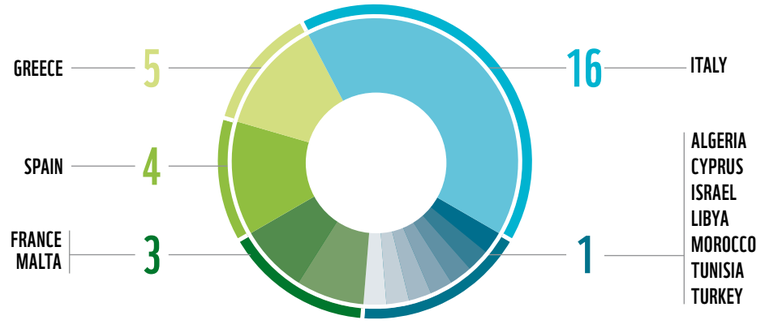

Figure 6. Accidents resulting from oil and gas operations in the Mediterranean Sea from 1970 to 2009. World Offshore Accidents Database [9]

In May 2011, exploratory drilling in the Leviathan gas well (Israel) caused a major leak of brine (12–14 thousand barrels per day). Fortunately, this was not a hydrocarbon leak. Nevertheless, this event demonstrates the technical and engineering difficulties associated with deep drilling[10].

A review of accidents worldwide over the past 50 years has shown that the majority of well blowouts have occurred during exploratory drilling operations[2]. As the number of offshore explorations and installations is increasing across a range of geographical locations in the Mediterranean region, this increases the likelihood that oil spills can occur. It should be emphasized that several current exploration contracts or bid blocks are located in seismic areas (Figure 7), thus significantly increasing the risk of accidents.

Gas and oil rig platform in the Mediterranean

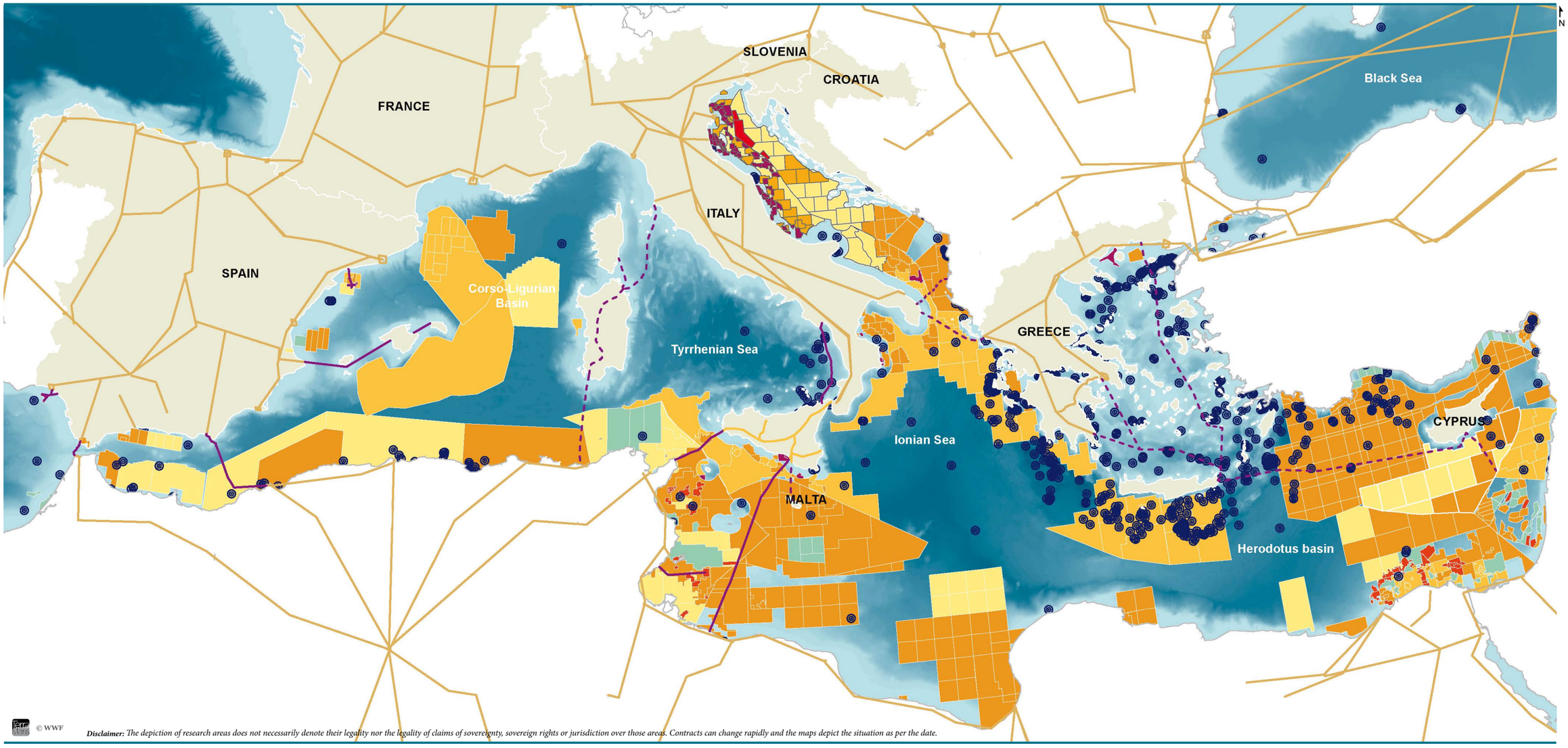

Figure 7. Map of seismic events of magnitude > 4 overlapped with oil and gas contracts map

0 250 500
km

MEDITERRANEAN EU COUNTRY

OIL AND GAS CONTRACTS

OPEN AREA
EXPLORATION AREA
PRODUCTION AREA
BIDBLOCK AREA
DEVELOPMENT AREA
RELINQUISHED AREA

Sources: DrillingInfo (april 2015)
National sources collected by WWF (2015)

drillinginfo
better faster decisions

NATURAL GAS INFRASTRUCTURES

MARINE GAS PIPELINE · ACTIVE
MARINE GAS PIPELINE · PROJECT
TERRESTRIAL GAS PIPELINE

Source: WorldMap (2014)

SEISMIC EVENT SINCE 2006 (MAGNITUDE > 4)

Source: *Orfeus* (2014)

Given the enclosed nature of its marine environment, an oil spill in the Mediterranean Sea would have dramatic consequences on the entire region. Impact on the environment is likely to be higher in areas with lower temperatures or shallow waters[2]. According to a Brief of the EU DG Environment[11], there is limited scientific understanding of the effects of oil on marine organisms and biological systems and processes, but direct impacts could include:

- Death of a wide variety of marine species;
- Behavioural disturbances, including changes in feeding, reproduction and migration;
- Airborne emissions of chemicals from controlled burns;
- Microbial blooms;
- Hypoxia – lowering of oxygen concentrations in water;
- Toxic effects of chemicals used to disperse oil.

Coastal areas, including wetlands and salt marshes are particularly vulnerable as oil washes ashore with the tide but then becomes stuck. Impacts would also be expected on species that inhabit deeper regions of the ocean. However, there is very limited knowledge on the impact of oil on these deep ecosystems.

Another impact of oil and gas production on the global marine environment is linked to its contribution to climate change.

The Brief further emphasizes that despite limited evidence, any spill of a magnitude similar to the spill experienced by the Deepwater Horizon platform in the Gulf of Mexico, would have far-reaching consequences for the Mediterranean marine environment. The interconnectedness of food webs and nutrient cycles implies that any large spill would affect more than just the local environment and its inhabitants, potentially for years following the incident[11].

Table 1. Impacts of the offshore oil and gas exploration and extraction sector on GES

MSFD Descriptor	Pressures exerted by Oil and gas exploration and extraction	Future trends
D1 Biodiversity	Smothering, sealing, Introduction of other substances, whether solid, liquid or gas	↗
D2 Non-indigenous species	Introduction of non-indigenous species and translocations	↗
D3 Commercial species	Potential impacts through contaminants and released polluted water	↗
D4 Foodwebs	Potential impacts through contaminants and released polluted water	↗
D5 Eutrophication		
D6 Sea-floor integrity	Physical damages	
D7 Hydrographical conditions	–	↗
D8 Contaminants	Introduction of other substances, whether solid, liquid or gas	
D9 Contaminants in seafood	–	↗
D10 Marine litter	–	
D11 Energy	Underwater noise	↗

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A night view of the oil drilling platform lit up on the coast of Limassol, in Cyprus

Another impact of oil and gas production on the global marine environment is linked to its contribution to climate change.

4. INTERACTIONS WITH OTHER SECTORS

The short-term prospect is that the oil and gas sector may become a prevalent maritime industry in the region, overshadowing traditional activities that – unlike hydrocarbon exploitation – rely on healthy and functional ecosystems such as fishing, aquaculture and tourism.

Should accidental oil spills occur, the rest of the maritime economy would be impacted. Coastal tourism and fisheries could, among others, bear significant costs. As an illustration of the magnitude of potential costs, British Petroleum has paid more than 6.5 billion US dollars to compensate individuals and businesses who suffered from the Deepwater Horizon accident [12] .

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MARITIME TRANSPORT AND PORTS

CONTAINER SHIP AND FINWHALE © F. BASMAYOUSSE

Maritime transport in the Mediterranean Sea has considerably increased during the last two decades[1]. At the interface of three continents (Europe, Africa and Asia through the Suez Canal), the Mediterranean Sea registers a high maritime transport activity of goods, energy products and passengers. Maritime transport in the Mediterranean Sea will increase in the coming years, both in number of routes and in traffic intensity[1]. Associated pressures on the marine and coastal environment will inevitably increase. In fact maritime transport contributes to many disturbances that severely affect marine and coastal habitats and species, including pollution, collision with large cetaceans, marine litter, underwater noise and the introduction of non-indigenous species.

A. MARITIME TRAFFIC IN THE MEDITERRANEAN

1. BACKGROUND AND CURRENT SITUATION

It is generally accepted that more than 90% of global trade is carried by sea. World-wide **exchanges with the EU depend mainly on maritime transport** (75%) and via fixed connections (gas pipelines)[2]. Thus, the Mediterranean Sea is amongst the world's busiest waterways. It offers a route for exchanges of manufactured products between Europe and Asia through the Suez Canal, Asia being EU's chief trade partner, as well as for the supply of energy products to Europe from the Gulf countries, and for the transfer of passengers transfers between and within Mediterranean countries[1].

Intra-Mediterranean fluxes account for less than a quarter of total Mediterranean maritime traffic[3] that is largely dominated by international fluxes. Figure 1 shows the density of AIS (Automatic Identification System) signals of all vessels (including EU fishing vessels over 15m) in 2014. Major traffic routes are dominated by crude oil shipments (that originate from the eastern Black Sea, Northern Egypt, or from the Persian Gulf via the Suez Canal) and by container ship traffic (Figure 1).

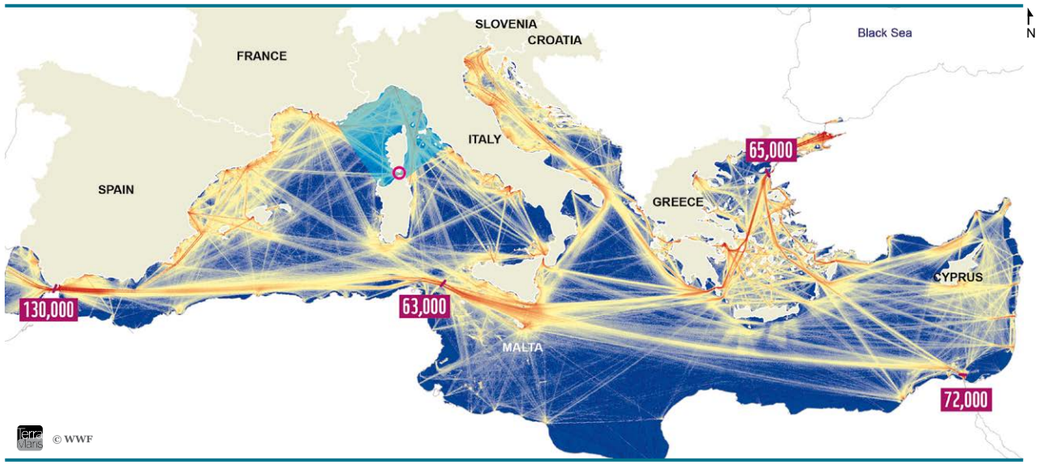


Figure 1. Density of AIS signals from all vessels (including fishing vessels) in 2014

There are more than 600 commercial ports and terminals in the Mediterranean Sea. Almost half of them are located in Greece and Italy[1]. Twenty one ports of the Mediterranean Sea are among the 100 world top ports, in terms of port calls (Barcelona, Leghorn, Genoa, Gibraltar), deadweight tonnage (Gibraltar, Fos, Algeciras, Gioia Tauro), container flows (Valencia, Algeciras, East Port Said, Tanger) or cargo volume (Marseille, Algeciras, Valencia, Genoa, Trieste) (Figure 2).

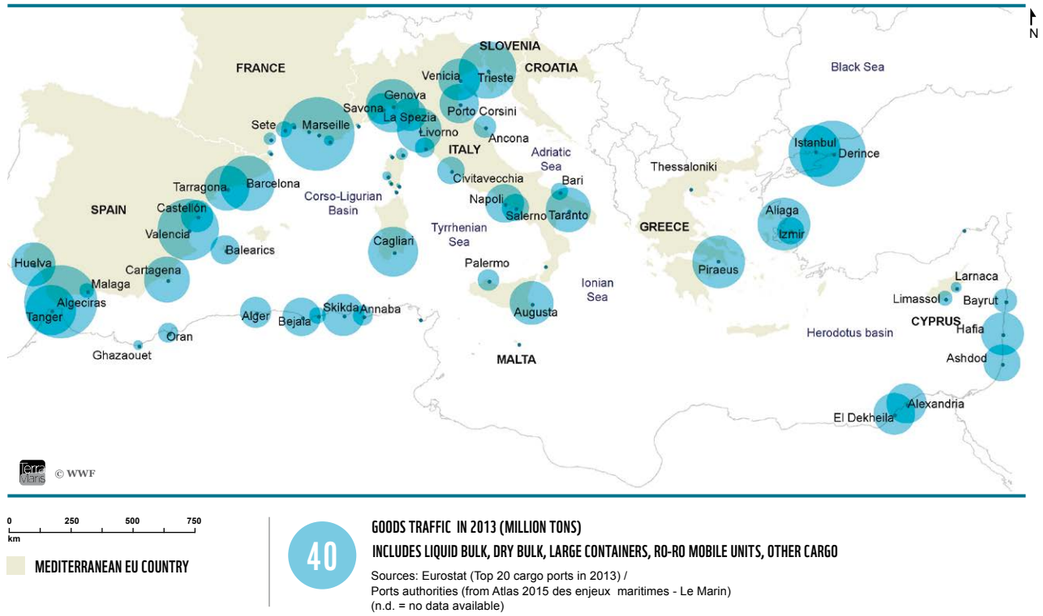


Figure 2. Goods port traffic in the Mediterranean Sea in 2013

Total revenues of maritime transport amount to more than 70 billion Euros in the Mediterranean Sea (5% of the total revenues worldwide), which generate a Gross Value Added (GVA) of 27 billion Euros. Around 550,000 jobs are directly created by the maritime transport sector[1].

2. FUTURE TRENDS

Historically, world seaborne trade expansion has been well correlated to global economic growth. **World seaborne trade had an average per annum growth rate of around 4% between 2002 and 2012**[4].

Similarly, vessel activity in the Mediterranean Sea has been rising steadily since the end of the 1990s. From the mid 1990s to the mid-2000s, the Mediterranean Sea recorded a rise of 58% of transit capacity, combined with an increased size of vessels by 30% since 1997[1]. **Clarckson Research Limited suggests that a 4% per annum growth rate in global trade over the next decade can be anticipated**, backed by continued development of the globalised world economy. Growth in world seaborne trade is likely to be driven by import into China, other Asian economies and developing regions[4].

It is expected that shipping in the Mediterranean basin will **increase in the coming years, both in number of routes and traffic intensity.** Maritime traffic towards and from EU Mediterranean ports will be influenced by the doubling of the Suez canal that will allow a proportional increase of the traffic, but also by key drivers such as weak oil refining capacity outlook for Europe, a changing energy mix, the global demand for Liquified Natural Gas (LNG) as a fuel for maritime shipping, the implementation of Trans European Networks, the potential designation of the

Mediterranean as a Sulphur Emission Control Area (SECA) and a limited renewal rate of the world fleet.

B. FREIGHT TRANSPORT AND PORTS

1. BACKGROUND AND CURRENT SITUATION

The Mediterranean Sea receives all types of goods with a predominance of **energy and non-bulk products (mainly by container shipping)** which account for 24% and 36% of total volumes, respectively[2].

Between 1997 and 2006, maritime transport reported a significant growth with an increase in the deployed transport capacity of over 50%. This rise was due to a 30% increase in the average ship size combined with an increase in ship traffic frequency by around 15%[2].

Liquid bulk

Liquid bulk includes energy products, oil and gas (24%), and to a lesser extent, chemical products (7%). **Oil transport is a significant component of maritime transport in the Mediterranean Sea.** Oil originates in North Africa, the Persian Gulf and the Black Sea. It is conveyed to (northern and southern) Europe and to the USA. The Mediterranean is both a major load and discharge centre for crude oil, accounting for **18% of the global crude oil traffic**[1] (Figure 3).

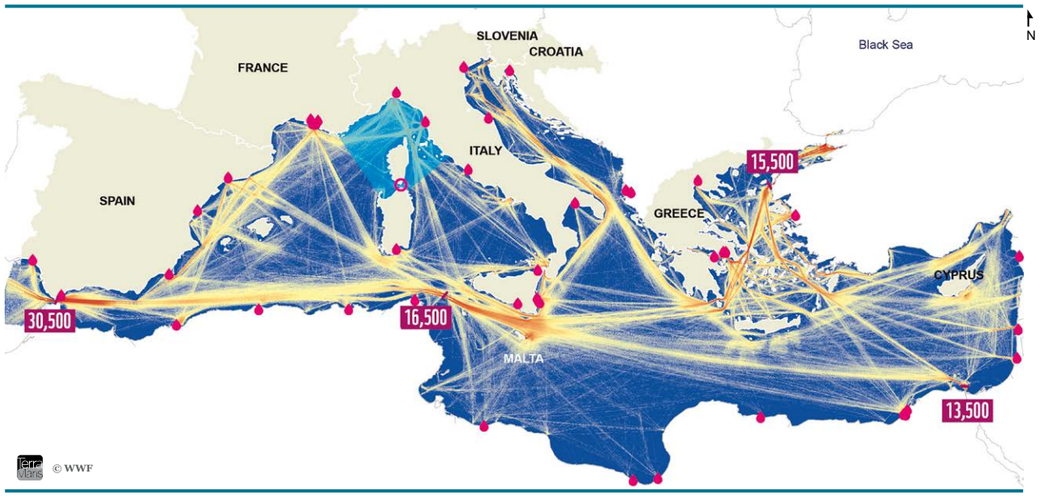


Figure 3. Density of AIS signals from oil tankers in 2014

Between 1997 and 2006, the increase in oil transport was of around 7% per year, up to 500 Mt of oil transport in 2005/2006[5]. This growth led countries to envision larger-scale portinfrastructures as well as deeper ports[2].

Dry bulk

Dry bulk recorded a moderate increase (3% per year) over the 1997-2006 period. This is dedicated transport (minerals, cereals) which increases at a slower pace than the transport of other goods[2].

Non-bulk transport

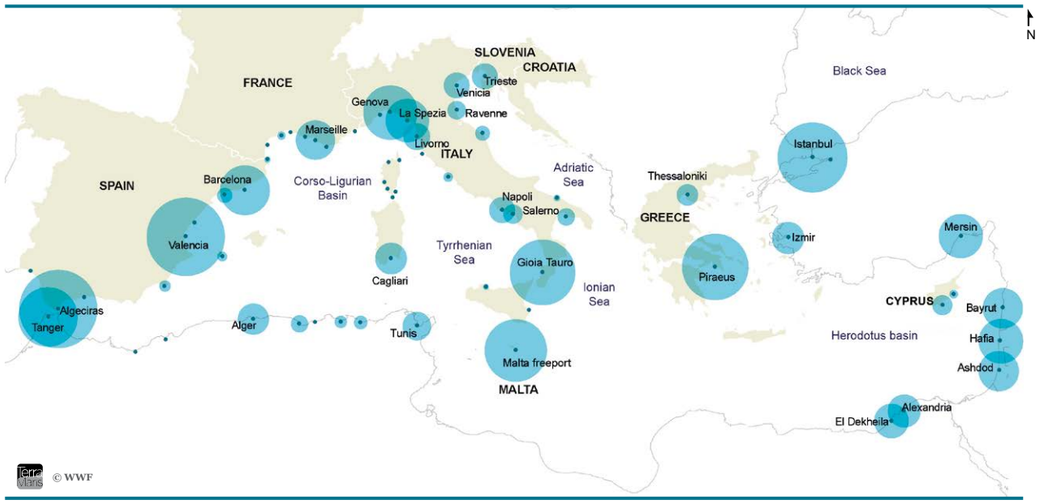
Non-bulk transport, deploying two types of vessel (Ro-Ro ships and container ships) reported the highest growth (+8% per year) in the 1997-2006 period. Ro-Ro routes are intra-Mediterranean and follow a North-South direction (Algeria-France or Morocco-Spain), but also an East-West direction between Greece, Italy and Turkey, and more recently France and Turkey. Large container ships follow mainly an East-West direction, starting in Asia, heading towards North-European ports and undertaking transhipment with smaller units to the Mediterranean Sea[2] (Figure 4).

Figure 4. Density of AIS signals from cargos in 2014

Ro-Ro transport has reported a 5% annual growth over the last 10 years, due to a 33% rise in frequency and a 31% increase in average ship size.

Container ship transport reported a 10% annual growth over the same period, due to increased port traffic (+71%) and ship size (+55%). Yet, container ships continue to preferentially use North-European ports (such as Hamburg and Rotterdam).

Container ship traffic is highly concentrated in the northern part of the Mediterranean Sea and less so in its eastern part, while it is almost absent in its southern part (Figure 5).



2 **CONTAINER TRAFFIC IN 2013 (MILLION EVP / > 0.2 M EVP)**

Sources: Ports authorities (from Atlas 2015 des enjeux maritimes - Le Marin) / Note: ports with container trafic > 0.2 M EVP

Figure 5. Container port traffic in 2013

Container ships follow a transhipment logic in hubs that are often without a hinterland. Larger container ships are supplied and downloaded by smaller feeders which ensure links with Mediterranean ports. These hubs are located along the direct maritime route between the Suez Canal and Gibraltar, at the exit of the Suez Canal, at the centre of the Mediterranean (Malta, Southern Italy) and in its western zone (Tangiers and Algeciras)[2].

The maritime transport of goods is concentrated mainly in the Western Mediterranean Sea and in the Aegean-Levantine Sea. Goods transport in these regions account for around 40% and 35% respectively of overall Mediterranean goods transport[1].

2. FUTURE TRENDS

Liquid bulk

A significant increase in tanker traffic is expected in the Eastern Mediterranean Sea due to new export routes for crude oil from the Caspian region, the development

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Shipping containers, Salento, Italy (2006)

of new pipelines bypassing the Bosphorus, and the expansion of current pipeline capacity[1]. **Oil transport is set to rise to 750 Mt by 2025, with 6,700 tankers/year likely to navigate,** unless the implementation of renewable energy policies succeeds in scaling down this scenario[5]. This growth would result in an annual increase of the tonnage transported by 2.1%. Moreover, northern European demand for energy is expected to be met by an increase in LNG supply.

Non-bulk/containers traffic

The significant growth of non-bulk traffic is connected with non-transport-related factors, such as economic growth, opening up of markets and urban concentration to which ports give access, along with transport-related factors such as its costs (including time value and operation costs), themselves sensitive to energy prices. World seaborne trade expansion estimates, combined with scenario 2 of Plan Bleu based on a steady growth of traffic[2], would lead to an increase in **Europe-Asia exchanges by 6.3% per year**. This Europe-Asia relation would then account for 38% (500 Mt) of the Mediterranean flow of goods in 2025. Plans for the extension of the Suez Canal, with a new waterway being built today that will run parallel to the existing one, anticipate this growth. It will raise the current capacity from 49 passing ships a day to 97 passing ships a day by 2023.

Within EU waters, the Trans-European Networks (TEN-T) initiative "Motorways of the Sea" addresses the challenge of the interconnection and mobility of the internal market to accommodate large trade flows from Asia. It ultimately aims at the increase of cargo flows to be carried by maritime traffic.

Figure 6. Planned Motorways of the Sea in the Mediterranean

Commercial ports

As a follow up of the EU2020 Strategy, the Commission adopted on 28 March 2011 a White Paper on the future of transport[6] which underlined the huge potential that EU ports have for sustaining Europe's economic recovery and contributing to the long term competitiveness of European industries. The review of the TEN-T foresees the inclusion of 82 major EU sea-ports in the core network of infrastructure to be implemented as a priority by 2030. Ports are both key entry gates for TEN-T and an essential part of European corridors. Significant EU funding will be made available in the future towards improving their efficiency and the quality of the services they offer.

In this context, Southern European ports will be able to take advantage of the congested situation at the ports of Rotterdam and Antwerp to expand hinterlands and increase their traffic. Four corridors could strengthen the position of EU Mediterranean ports: from Algeciras to Hungary; from Palermo to Finland; from Genoa to Rotterdam; and from Marseille to Scotland and Ireland. In total, 15 Western Mediterranean ports are likely to benefit from these developments.

Evidence suggests that the region's 98 container terminals located in 42 ports with an annual capacity of 70 million TEU in 2012 **will increase their capacity to 114 million TEU by 2030**[7] (annual increase 2.75%). Non-EU ports are developing, or plan to develop, their port capacity to grab their share of this traffic, as illustrated by developments in Tangier-Med (Morocco), Algiers, Djen Djen and Cap 2015 (Algeria), Mersin, Iskenderun, and Çandarlı (Turkey), East Port Said Port (Egypt) and Enfidha (Tunisia).

C. PASSENGER TRANSPORT AND PORTS

1. BACKGROUND AND CURRENT SITUATION

Together with the South-East Asia region, the Mediterranean Sea is one of the busiest regions in the world in terms of passenger transport. In 2009, 212.4 million passengers embarked or disembarked in an EU Mediterranean port, accounting for more than half (53 %) of the total EU passenger seaborne traffic. The main ports where passengers embark and disembark are in Greece (42 % of total passengers) and in Italy (43.0 % of total passengers)[8] (Figure 7).

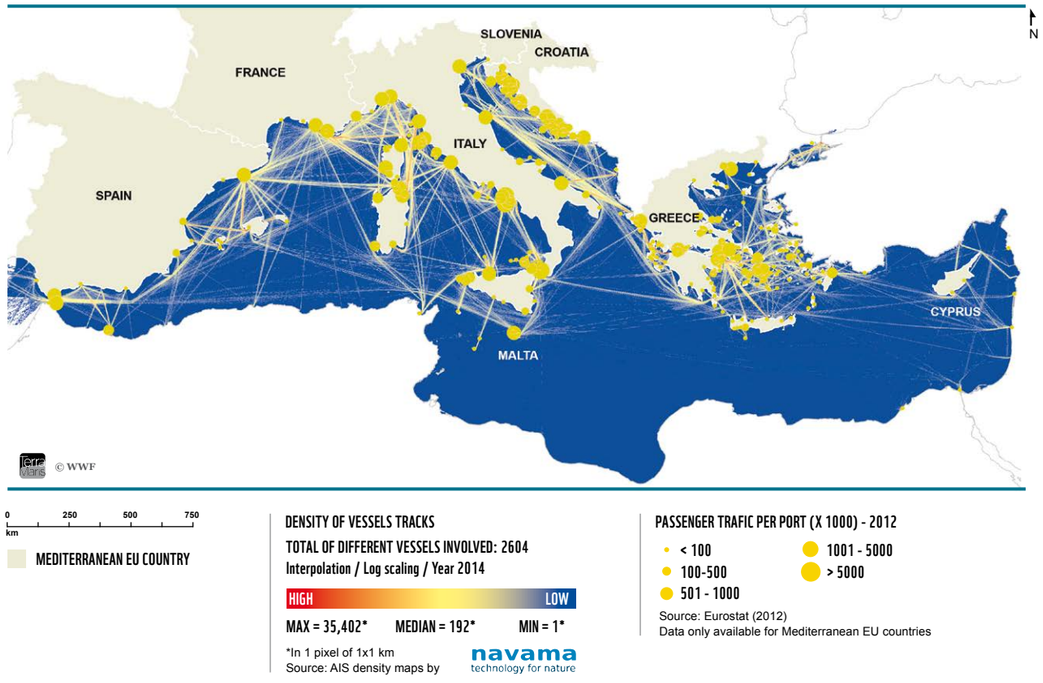

Figure 7. Density of AIS signals from passenger vessels in 2014 and passenger traffic per port in 2012

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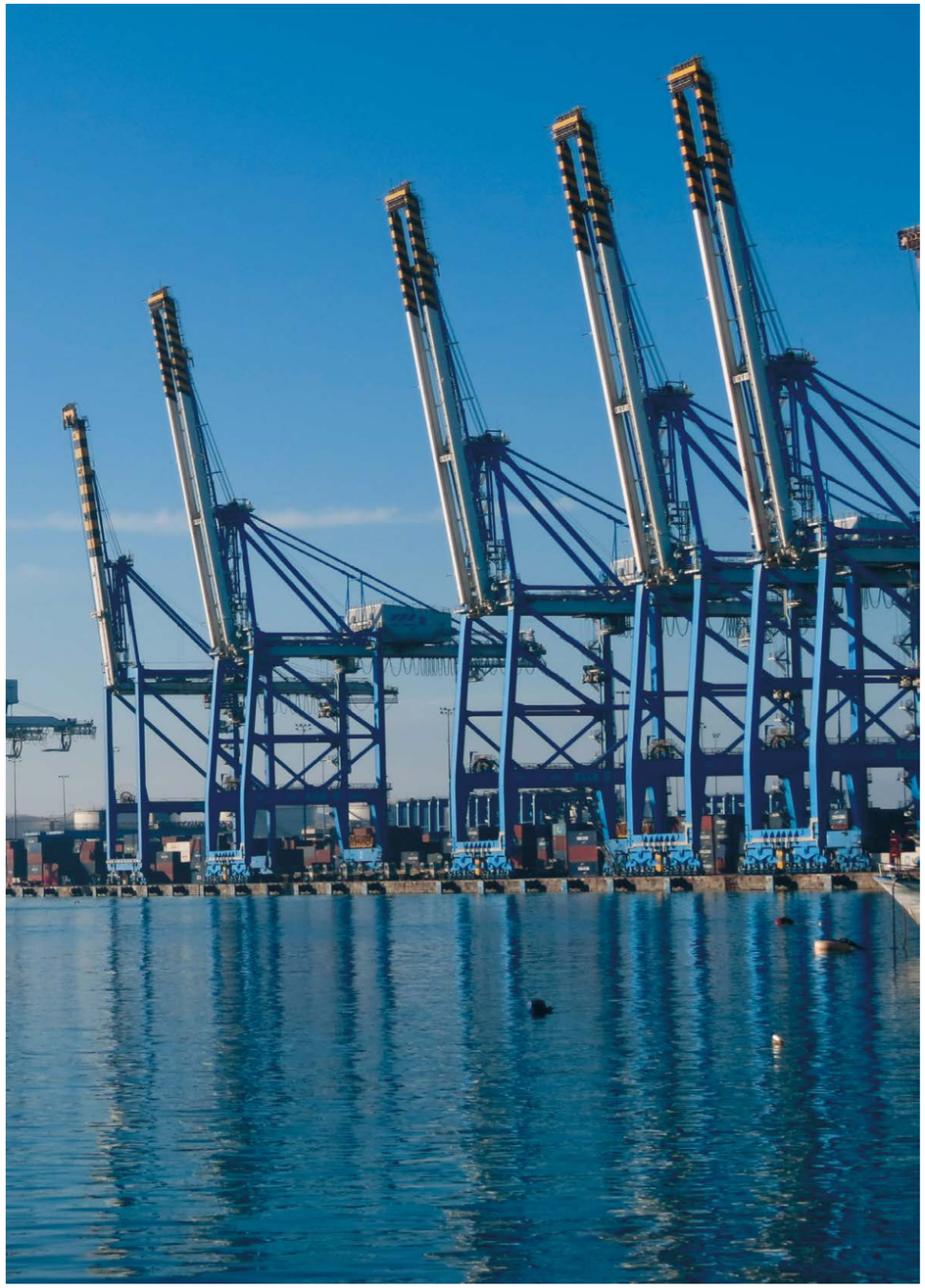

Malta Freeport

Cruise sector

The Mediterranean Sea is the second largest world cruising zone after the Caribbean, with 27 million cruise passengers per year. In 2009, these cruise passengers accounted for approximately 3% of passenger traffic in Europe's Mediterranean ports but their relative significance varied considerably, accounting for 100% and 13% of passenger traffic in Cyprus and Slovenia, respectively, to around 1.0% and 0.4% in Greece and Malta, respectively. In 2009, 60%, 27% and 8% of cruise passengers departed from, or arrived in, Italy, Spain and Greece, respectively. The main ports of departure and destination for cruises in the Mediterranean Sea are: Barcelona (Spain), Napoli (Italy) and Genoa (Italy)[8]. Total expenditures of cruise passengers in Mediterranean termini is estimated at up to 1.7 billion Euros, representing an added value of around 750 million Euros.

2. FUTURE TRENDS

The maritime passenger transport sector in the Mediterranean Sea recorded an annual growth of 10% between 2005 and 2010, the world economic crisis having had a limited impact on embarkations since 2009. It is expected that passenger transport will continue to grow, driven by trends in tourism development.

Cruise sector

Fast growth rates have been observed in the cruise sector in recent years. Indeed, the share of the Mediterranean Sea as a global destination for cruise tourism grew from 17.6% in 2008 to 21.7% in 2011. The main Mediterranean ports experienced a cruise traffic growth of 10% in 2013, as compared to the average growth of Mediterranean ports between 2009 and 2013 which was between 4% and 24%[9]. Cruise tourism is likely to continue to increase significantly in the future, driven by a growing European market demand.

D. IMPACTS ON GES

Maritime transport pressures and impacts are due to ship pollution and emissions, collisions and noise, grounding and anchor damage, and transportation of non-indigenous species[10].

Marine pollution

Seventy percent of marine pollution at sea is caused by maritime transport through emissions and leaks of hazardous substances. The Mediterranean Sea is more polluted by oil than any other sea in the world[10]. Around 360 million tons of oil and refined oil products cross the Mediterranean Sea every year. Of these, 400,000 tons are deliberately dumped into the sea every year as a result of routine ship operations.

These represent the main source of oil pollution in the Mediterranean Sea, even though discharges are strictly regulated in areas designated as 'Special Areas' by IMO (MARPOL Annex 1) such as the Mediterranean Sea. In these areas, ships are expected to store waste in slop tanks, and dispose of it in Port Reception Facilities when they arrive in ports.

Accidental pollution is also likely to occur. Together with the South China Sea and the Black Sea, the East Mediterranean Sea is among the world's most risky seas for accidents involving ships. Sinking due to rough weather, leaks or ships breaking into two parts causes 50% of all annual ship losses (Figure 8).

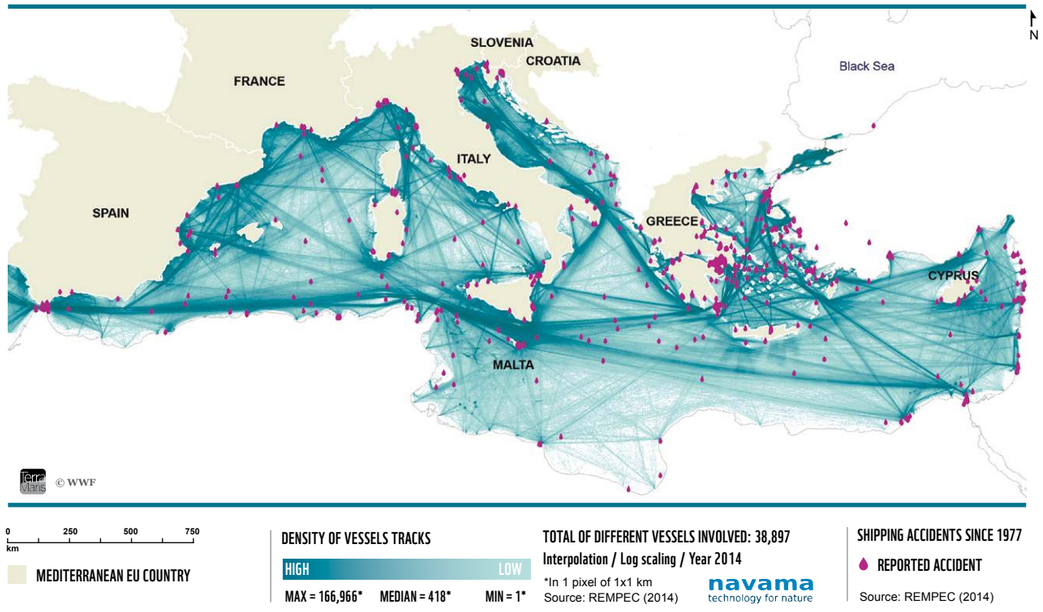

Figure 8. Shipping accidents in the Mediterranean since 1977

To mitigate the risk of accidents, the Strait of Bonifacio has become the first Particularly Sensitive Sea Area under IMO in the Mediterranean in 2012.

Marine noise

Cetaceans, seals and many fish species are affected by chemical pollution and by noise, particularly in areas of heavy maritime traffic and along developed coasts[1]. Noise pollution can cause marine mammals to abandon their habitat and/or alter their behavior[10]. Several major maritime routes in the Mediterranean Sea cross priority areas for the conservation of marine mammals such as the Sicily straights or the Alboran Sea.

Collisions between ships and whales

Collisions between ships and whales are regularly reported in the Mediterranean Sea. The Pelagos Sanctuary for marine mammals was recently proposed as a Particularly Sensitive Sea Area to mitigate risks of collision between vessels and marine mammals.

Non-indigenous species

Maritime transport, and the discharge of ballast water into the sea, is the main driver for the introduction of non-indigenous species in the sea. It is estimated that more than 7,000 species are being carried in ballast tanks around the world[1]. The likely entry into force of the IMO's Ballast Water Management Convention in 2015 is expected to play a key role in controlling the introduction of non-indigenous species. For many ships, the most practical way to comply with the new regulations will be to install a ballast water treatment system.

Air pollution

Air pollution emissions from ships (sulphur dioxide (SO_2), nitrogen dioxide (NOx), and particulate matter (PM), are continuously growing, while land-based emissions are gradually being reduced. By 2020, shipping is expected to become the largest single emitter of air pollution in Europe with polluted air emissions higher than all land-based sources combined[11]. Under the current EU regulations transposed from IMO Annex VI, ship sailing in the SECAs cannot use fuel with more than 0.1% of sulphur from 2015 on. European SECAs currently include the Baltic Sea, the North Sea and the English Channel. Globally, ships will have to cut their fuel's sulphur content to a maximum of 0.5% in 2020. While the latter limit will be subject to IMO review in 2018, the EU decided to firmly stick to the 2020 deadline for this limit. As the Mediterranean Sea is a maritime traffic hotspot, work has been ongoing for many years on the feasibility of its designation as a Sulphur Emission Control Area SECA under MARPOL.

Ports impacts

Dredging and piling activities induce movements of sediments that can be polluted and thus spread dangerous substances into marine waters. Moreover, different types of pollutants may be found in ports, such as toxic pollutants from anti-fouling paints, marine litter and oil. For 40 years, Tributyltin (TBT) commonly known as bottom paint and applied to the hulls of ocean going vessels was used as a biocide in anti-fouling paint. TBT contamination in the Mediterranean Sea, including in the immediate vicinity of nature protection zones away from maritime shipping lanes, far exceeds the concentration limits required to protect the biota from chronic effects. And concentration levels in or near numerous ports and marinas are hundreds or thousands of times higher than these limits. Pollution may stem from the use of antifouling paints on large vessels (including hosed and scraped paint fragments), the illegal use of organotin-based paints on recreational vessels, and the dredging of TBT-rich harbour sediments.

The table below presents the main impacts of maritime transport on marine ecosystems and their future trends.

Table 1. Impacts of maritime transport on GES

MSFD Descriptor	Impacts on GES	Future trends
D1 Biodiversity	Collisions with marine mammals and turtles, antifouling biocide effects on marine fauna, oil/pollutant toxic effects on marine organisms/top predators, effects of litter in marine organisms	↗
D2 Non-indigenous species	Ballast waters, fouling	↗
D3 Commercial species		
D4 Foodwebs		
D5 Eutrophication	Sewage discharge (non-treated used water)	↗
D6 Sea-floor integrity	Direct physical effects of vessels on benthic habitats and species, abrasion	↗
D7 Hydrographical conditions		
D8 Contaminants	Oil pollution (releases/discharges), eventual or chronic, shipping-derived antifouling biocides	↗
D9 Contaminants in seafood		
D10 Marine litter	Littering, waste discharge	↗
D11 Energy	Shipping noise (damage, disturbance to/of marine mammals and fish	↗

E. INTERACTIONS WITH OTHER SECTORS

Marine pollution from maritime transport seriously affects marine and coastal biodiversity, as well as creating marine noise and introducing invasive species through the discharge of ballast water into the sea. In turn, this can indirectly impact tourism and fishing activities.

Conflicting interests may also occur with the development of offshore energy facilities. Installations of wind farms or oil rigs near maritime routes may increase the risks of accidents.

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PROFESSIONAL FISHERIES

Professional fisheries in the Mediterranean Sea region are an important source of nutrition, employment and income for coastal populations. However, Mediterranean fisheries are subject to the consequences of the overexploitation of fish stocks. Environmental degradation, coastal development and pollution also contribute to the reduction of Mediterranean fish stocks while climate change is modifying the spatial distribution and the productivity of marine species. Professional fishery landings have been declining over the past 20 years. And this downward trend is expected to continue under a business as usual scenario for the Mediterranean Sea region.

PURSE SEINE IN KAVAKA, GREECE © G. PAXIMADIS WWF-GREECE

1. BACKGROUND AND CURRENT SITUATION

The Mediterranean Sea is a semi-enclosed marine area with generally narrow continental shelves. With the exception of the Adriatic Sea, the Gulfs of Lion and Gabes, the level of biological production in most of the Mediterranean Sea is considered low due to oligotrophic conditions[1]. Still, the Mediterranean Sea is characterized by a rich biodiversity and by the absence, excepted Blue Fin Tuna, of large single-species fisheries compared to those inhabiting wide areas of open oceans[2].

Figure 1 presents the Mediterranean continental shelf (up to the 200m isobaths) where Mediterranean professional fisheries are mostly located. It also shows two major spatial regulations adopted by the General Fisheries Commission for the Mediterranean (GFCM) between 2005 and 2009: the deep-sea trawling ban area under 1000m and four Fisheries Restricted Areas.

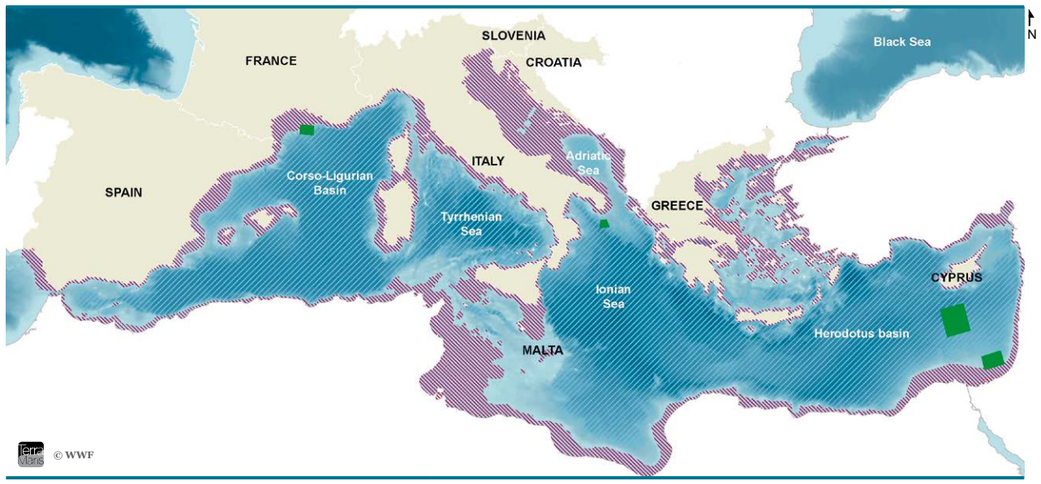

Figure 1. Continental plateau up to the 200m isobath, reflecting major fishing areas in the Mediterranean Sea, and spatial regulations adopted by the GFCM between 2005 and 2009: the deep-sea trawling ban area under 1000m and four Fisheries Restricted Areas

Today, around 73,000 fishing vessels operate in the Mediterranean Sea[2]. **Small-scale artisanal vessels clearly predominate, accounting for 80% of total fishing boats in the Mediterranean Sea.**

Using the boat tonnage as a proxy of fishing capacity, small-scale artisanal fishing boats account for 62% of the total fishing capacity, with industrial fishing vessels (i.e. bottom trawlers and dredgers and other industrial vessels such as seiners and polyvalent vessels over 12 meters that represent 18% of total fishing vessels) account for the remaining 38% (Table 1).

Table 1. Main characteristics of different groups of fishing arts in the Mediterranean sea [2] from [3] [4] [5]

	Small-scale fishing (< 12m)	Trawlers and dredgers	Other industrial vessels	Total
Number of fishing vessels	57,936	7,889	6,995	72,780
As a % of total fishing vessels	80%	11%	9%	100%
Vessel tonnage	3,853,013	260,407	2,800,042	6,193,463
As a % of total vessel tonnage	62%	4%	34%	100%

EU fishing vessels have over the last few years gradually been equipped with AIS (Automatic Identification System) transmitters:

- As from 31 May 2012: all vessels above 24m
- As from 31 May 2013: all vessels above 18m
- As from 31 May 2014: all vessels above 15m.

It is possible since 2013 to visualize more precisely the fishing areas of the Mediterranean AIS-equipped fisheries fleet, as presented in Figure 2. The map mainly reflects the fishing grounds of the EU industrial fisheries fleet but signals of some Turkish and Israeli AIS-equipped fishing vessels are also visible on the map.

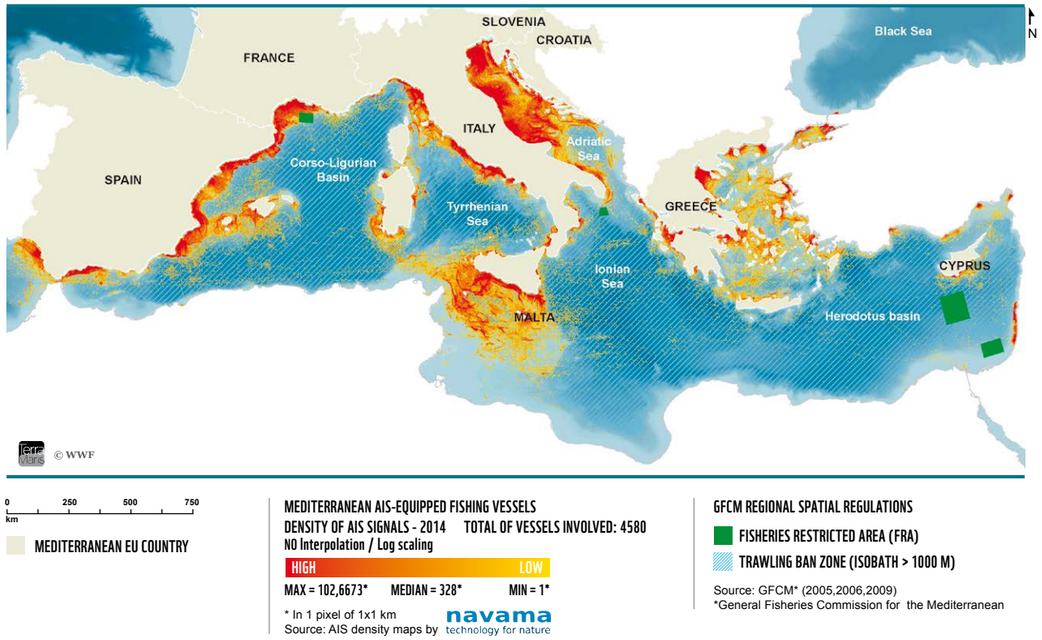

Figure 2. Density of AIS signals from Mediterranean AIS-equipped fishing vessels

It is important to emphasize that the **fishing areas of the small-scale artisan fishing fleet are not represented on this map, as small-scale vessels are not required to be equipped with AIS transmitters.** Improving the spatial knowledge of small-scale fishing areas in the Mediterranean is key to ensuring the sustainable development of the professional fishery sector in the future.

Distribution of fishing vessels in the Mediterranean Sea

Figure 3 shows the number of fishing vessels per GFCM sub-area, along with the breakdown of fishing vessels by fishing practice groups for individual Mediterranean countries. The Aegean-Levantine Sea, the Northern Adriatic Sea, and the Tunisian Plateau score large numbers of small-scale artisanal fishing vessels.

Half of the vessels that fish in the Mediterranean Sea are from EU countries. Greece and Italy account together for more than one third of the fishing vessels operative in the Mediterranean Sea[5]. Greece has the largest fishing fleet (more than 20% of the total number of vessels in the Mediterranean Sea) which includes a majority of artisanal fishing vessels fishing mainly in the Aegan Sea. Most of the industrial vessels (61%) are from EU countries, with Italy hosting the largest fleet of trawlers and dredgers.

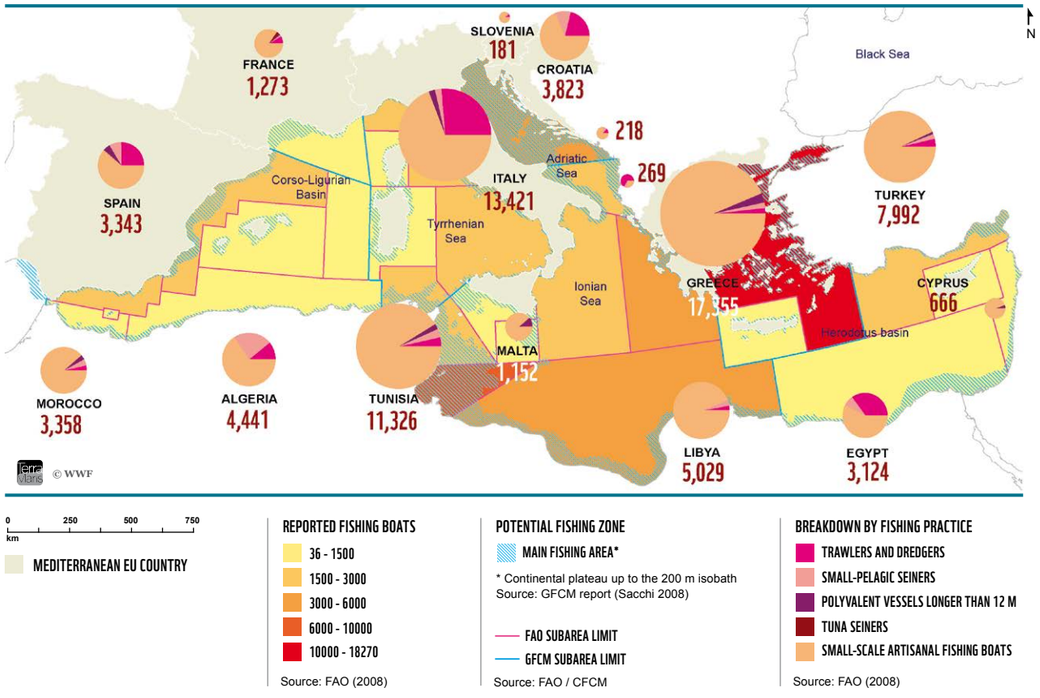

Figure 3. Number of fishing vessels in GFCM sub-areas and breakdown of fishing vessels by fishing practice group and country

Distribution of fish stocks, captures and landings

An important part of the assessed fish stocks in all Mediterranean sub-seas is outside safe biological limits (Figure 4). The latest estimation of Mediterranean stocks by the GFCM Scientific Advisory Committee concluded that over 90% of the assessed stocks are “under overexploitation, being overexploited or ecologically unbalanced”.

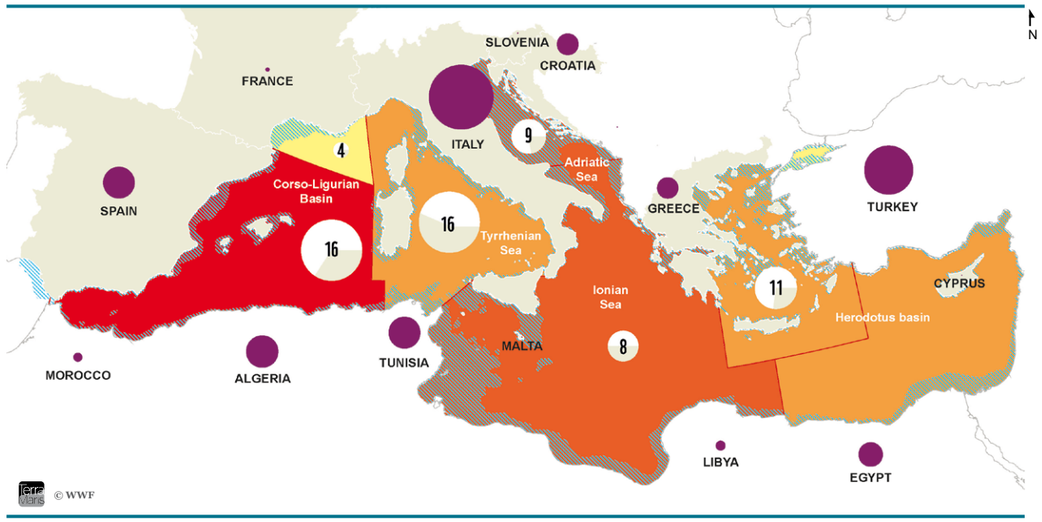

Figure 4. Fish catches by FAO area, proportion of assessed stocks within and outside safe biological limits and annual fish landings per country

Small pelagics (anchovy, sardinella, sprat) and demersal fish together make the bulk of fish catches in the Mediterranean Sea, accounting for more than two thirds of total landings[2] (Figure 5). Large pelagic species, mainly the bluefin tuna and the swordfish, account for less than 10% of total reported landings, but they are of very high economic importance. The Mediterranean Sea holds the main spawning area for the Eastern Atlantic and Mediterranean bluefin tuna stock and its most important fishing grounds.

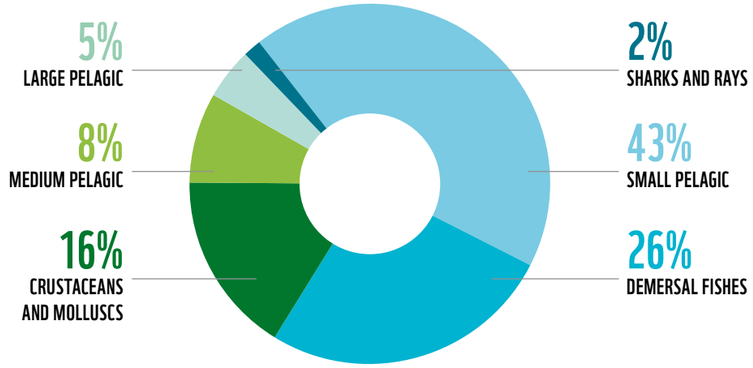

Figure 5. Proportion of landings per group of species in the Mediterranean Sea in 2011[2]

Socio-economic importance of the sector

Fishing plays a fundamental role in the economy of Mediterranean countries. Total fish landings account for more than 3 billion Euros per year in the Mediterranean Sea, with indirect economic impacts of the fishery sector being estimated at around 10 billion Euros per year[5]. The annual Gross Value Added of the professional fishery sector exceeds 2 billion Euros. These values are likely to have been underestimated as an important part of Mediterranean fish catches are not sold through regulated market outlets.

Mediterranean countries import more fishing products than they export, as a result of the increasing demand for seafood. The trade deficit between imports and exports is estimated at around 5.2 billion Euros[2]. Despite being major exporters, France, Spain and Italy are the countries with the highest trade deficits for seafood.

Total employment in the professional fisheries sector has been estimated at around 250,000 jobs in 2008[5]. Small-scale artisanal fisheries provide the largest share of jobs (55%).

2. FUTURE TRENDS

At the end of the last century, fishing pressures increased rapidly in the Mediterranean Sea, shifting from a primarily artisanal and coastal activity to intensive exploitation[2]. Since the 1990s, the Mediterranean Sea has recorded declining fishing catches (Figure 6) due to overexploitation of stocks while demand for seafood has experienced regular growth.

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Artisanal fisheries in Kalymnos, Greece

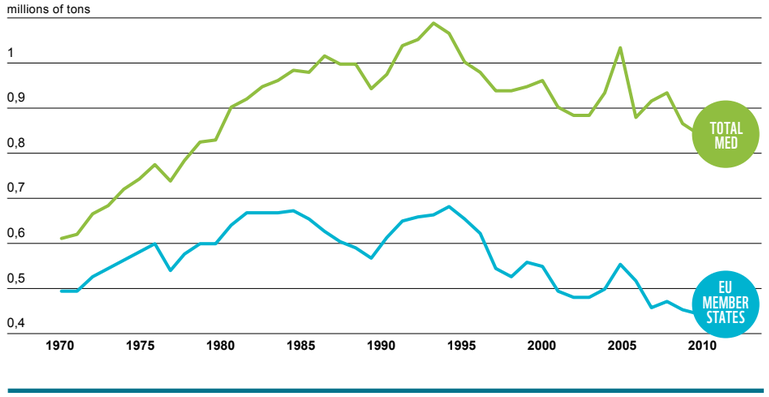

Figure 6. Evolution of Mediterranean landings from 1970 to 2011[6]

Note on the figure: landings shown on the figure do not include illegal catches and by-catches or any other undeclared quantities.

The introduction of the EU Common Fisheries Policy (CFP) in the 1970s and its successive updates aimed at making fishing sustainable—environmentally, economically and socially. However, EU countries have experienced the same downward trend in fish landings as the one observed for the Mediterranean Sea as a whole, as illustrated in Figure 7[6]. Only Croatia recorded an increase in fish catches in recent years, as a result of the adoption of a new fisheries policy and large investments in the fisheries sector.

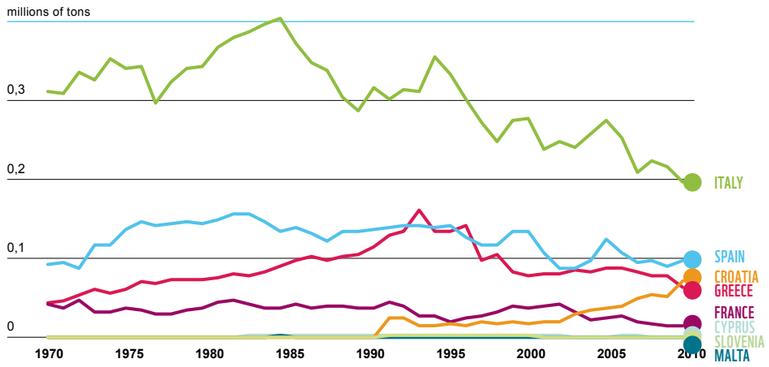

Figure 7. Evolution of Mediterranean landings (tons) from the 8 EU Member States from 1990 to 2011[6]

At the basin level, the total number of vessels in the Mediterranean Sea may increase in the future as a result of the development of fishing activities in the Southern Mediterranean countries[2].

Several Mediterranean stocks will be at risk of critical collapse if fishing effort is not reduced. This entails consequences ranging from the ecosystem and socio-economic impact of declining stocks, strongly affecting trade and the livelihoods of coastal communities.

The reduction in fishing efforts required to stop overexploitation could be very substantial. The estimation of fishing mortality of 6 different Mediterranean stocks of hake, one of the most valuable commercial species in the region, exceeds from 4 to 10 times the scientific recommended level. A 2012 report by the European Commission stresses that **a minimum effort in reduction of fish catches by two-thirds would be required to stop overexploitation in the Mediterranean Sea** (Figure 8)[7].

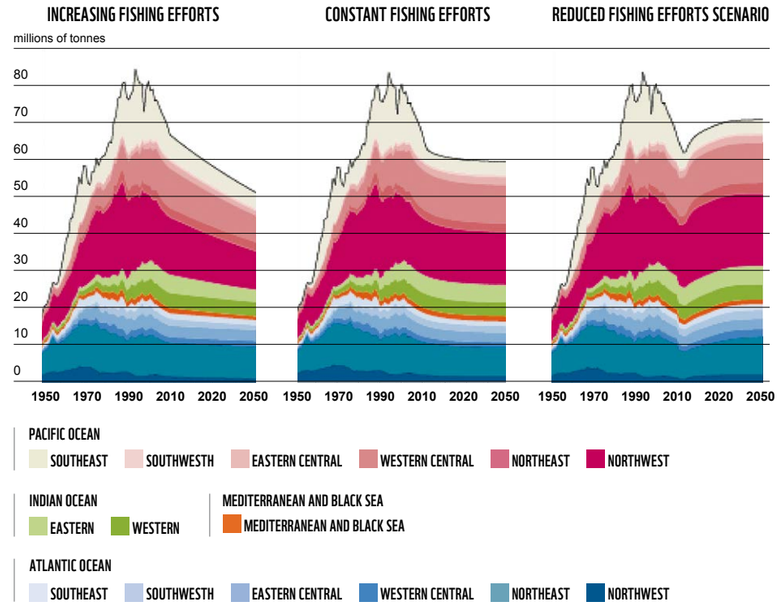

Figure 8. Estimated catch for three fishing efforts scenarios analysed[7]

The recently adopted reformed EU Common Fisheries Policy (CFP) has been effective since January 1, 2014 and stipulates that between **2015 and 2020 catch and effort limitations** should be set at a level able to maintain fish stocks in the long term. The reformed text incorporates a regionalized approach with emphasis on the involvement of stakeholders in order to improve governance of the sector. The CFP also provides measures intended to manage the capacity of the EU fishing fleet to prevent the depletion of fish stocks. As reflected by declining fish stocks, the CFP has not been very effective in controlling fish catches in the past. Thus, the current reform will be critical for the future of fisheries in European seas.

A recent study[8] emphasizes that fish recruitment depends mainly on environmental factors and biotic interactions and not only on parental stock size. The level of control of environmental degradation, coastal development and pollution will strongly influence the future resilience of Mediterranean fisheries. Climate change is already modifying the spatial distribution and the productivity of fish/marine species. It will add considerable uncertainty to the outcome of fisheries management.

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Tuna fisheries in Spain

3. IMPACTS ON GES

Overfishing leads to impoverished marine biodiversity and to the alteration of the marine food web[2].

Professional fisheries are the source of a wide variety of environmental pressures and impacts that depend on several factors, such as the fishing type and gear used, the intensity of fishing and the vulnerability of the ecosystem subject to fishing. Concerning fishing gears, bottom trawling and longlining have been recognized as having the highest (negative) impacts on marine ecosystems throughout the Mediterranean Sea[2]. Pelagic longlining in Mediterranean waters inflicts considerable mortality on elasmobranchs, marine turtles and seabirds taken as bycatch or even (in the case of commercial species) target species[9].

Figure 9 shows the density of the tracks of EU bottom trawlers in the Mediterranean Sea in 2014 based on their AIS signals. As AIS transmitter are not yet required for all non-EU bottom trawlers, the map mainly reflects the fishing area of the EU bottom trawler's fleet.

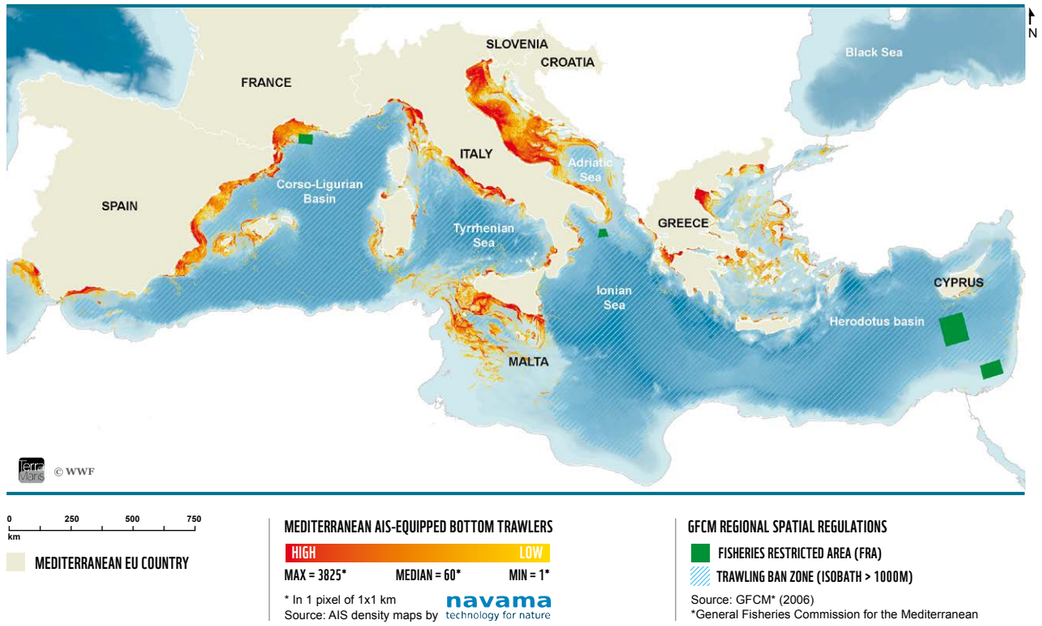

Figure 9. Density of AIS signals from mediterranean AIS-equipped trawlers, GFCM deep-sea trawling ban area and Fisheries Restricted Areas

The table below shows the main pressures and impacts of professional fisheries on marine ecosystems, all types of professional fishing included.

Table 2. Impacts of professional fisheries on GES in the Mediterranean Sea[2]

MSFD Descriptor	Impacts on GES	Future trends
D1 Biodiversity	Habitats such as nursery areas affected, ecosystems affected by poorly selective fisheries, overfishing and depletion, damage to species by entanglement in fishing gears.	↗
D2 Non-indigenous species	The use of fishing gears represents a vector for non-indigenous species in localised areas	↗
D3 Commercial species	Exploited commercial populations outside safe biological limits with altered age and size distribution	↗
D4 Foodwebs	Food webs altered by overfishing and depletion of fish populations.	↗
D5 Eutrophication		
D6 Sea-floor integrity	Impact of fishing gears impacting benthic habitats and altering ecosystems structure and function	↗
D7 Hydrographical conditions		
D8 Contaminants	Vessel oil releases contributing to pollution	↗
D9 Contaminants in seafood		
D10 Marine litter	Fishing nets discharged, abandoned or lost at sea, “domestic” litter from fishermen	↗
D11 Energy	Underwater noise generated by fishing boat engines	↗

4. INTERACTIONS WITH OTHER SECTORS

As a small semi-enclosed area, the Mediterranean Sea is the arena of numerous conflicts over uses and space. Constant additions ot pressures on the Mediterranean Sea through tourism, aquaculture, shipping, oil and gas extraction, or marine mining, and the emergence of new uses of the marine space such as blue energy, is likely to lead to increasingly conflicting interests with professional fishing and to conflicts between small-scale professional fishing and recreational fishing in coastal areas.

Land-based pollution sources, such as agricultural runoff or industrial releases, significantly impact on fish stock sustainability.

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RECREATIONAL FISHERIES

RECREATIONAL FISHERMAN © TONI FONT

Recreational fishing is a popular and fast-growing activity in the Mediterranean for both tourists and local people. Recreational fishing is an important component of coastal culture and, in some countries, the fish caught are a significant source of protein. As a largely unregulated and unstudied activity in the Mediterranean Sea, little data is available concerning the number of recreational fishermen, their catch volume and their total expenditures. As compared to commercial fishing, recreational fishing in the Mediterranean Sea, has been largely underestimated from the point of view of its impact on marine resources or of its socio-economic potential.

1. BACKGROUND AND CURRENT SITUATION

Very few qualitative and quantitative assessments of recreational fishing in terms of its socio-economic importance and environmental impacts have been undertaken in the Mediterranean Sea region[1]. Some studies have investigated the local impacts of recreational fishing (e.g. in France, Portugal and Spain) but no global and integrated meta-vision of this activity exists today for the Mediterranean Sea.

Recreational fishing encompasses "all types of fishing activities including sport fishing activities undertaken by any individual, with or without a boat, for leisure purposes, and does not involve the selling of fish or other aquatic organisms"[2]. There are four types of recreational fishing: "on foot", shore-based, boast-based, and underwater. Each type involves different fishing techniques and practices, each with its own specific socio-economic implications and impact on marine ecosystems.

Despite the lack of data, recreational fishing in the Mediterranean is estimated to account for more than 10% of the total fish catch. An analysis of 15 coastal marine protected areas in Spain, France, Italy and Turkey showed that **total recreational fishing catches in some coastal areas can represent between 10% and 50% of the total catches of small-scale fishing (excluding trawls and seines)**[3].

Recreational fishing has a high economic value, as it represents a non-negligible source of direct and indirect income for various sectors, in particular sectors providing input to recreational fishing (bait, equipment and gear stores) and the tourism sector (linked to services provided by hotels and restaurants).

Figure 1 presents the total number of marinas as a spatial indicator of leisure boating intensity that can be used to estimate recreational boat fishing pressure.

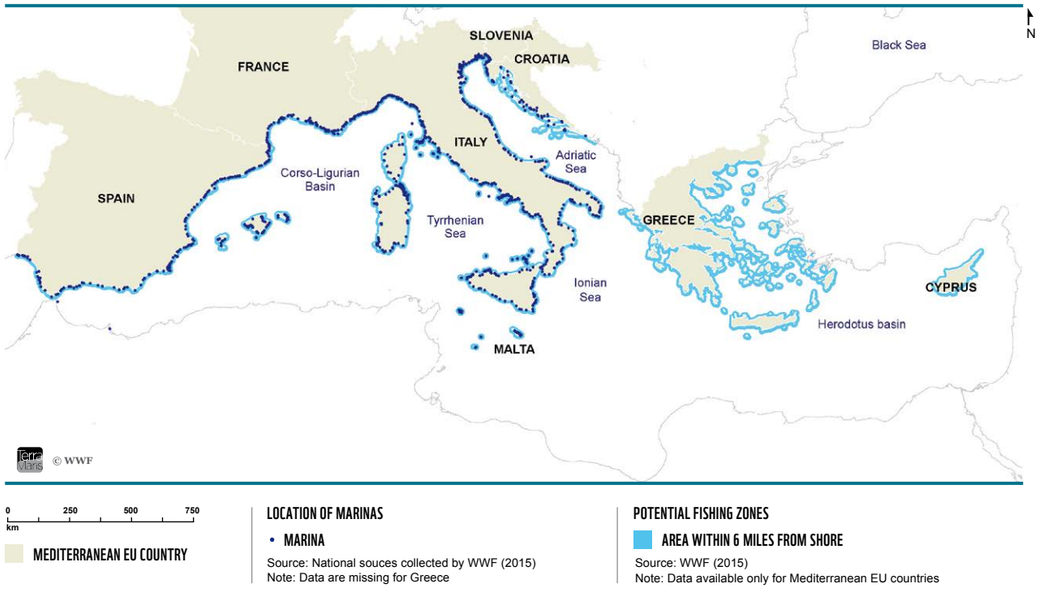

Figure 1. Distribution of marinas and potential recreational fishing zones in the EU countries of the Mediterranean in 2010

The map shows the total number of marinas present in the Mediterranean Sea, with 946 ports active in 2010 mainly in the four EU countries that account for 74% of the total number of ports (Italy: 253 ports; Spain: 191 ports; Greece: 135 ports; and France: 124 ports)[4]. Recreational fishing is practiced all over Greece explaining why the 6-mile area has been represented along the whole Greek coastline.

In 2014, annual expenditure linked to recreational fisheries in Europe was estimated at 25 billion Euros, with anglers alone contributing 8-10 billion Euros. National and local case studies also stress the local importance of recreational fisheries. For example, estimates of the annual expenditures by marine recreational fishermen ranged from approximately 1.2 to 2 billion Euros in France in 2006[5].

Recreational fishermen in the Marine Protected Area (MPA) of Cap de Creus (Spain) were reported to have spent 600 Euros annually per person in 2007, primarily in the village adjacent to the MPA. However, the number of people engaged in this activity remains unknown, making it difficult to estimate total expenditures for this site[6]. In Mallorca, approximately 5.2% of the population (37,265 people) is reported to have participated in recreational fishing in 2004, although the amount spent by the average fisherman was not documented.

2. FUTURE TRENDS

Recreational fishing in the Mediterranean Sea follows an upward trend. Fishing effort is likely to increase in correlation with the expected coastal population increase and the development of the coastal tourism sector.

An increasing number of regulations of the recreational fishing sector will be developed in the near future to respond to this trend, whether at national, local or supra-national scales. At the international (UNCLOS, FAO[7][8]) and EU levels[9], recreational fishing is already mentioned in various regulations. In 2013, recreational fishing was included for the first time in the EU Common Fisheries Policy (CFP) reform. At local level, many marine protected areas increasingly issue specific regulations within their limits to enhance the sustainability of recreational fisheries.

3. IMPACTS ON GES

The analysis of 15 coastal marine protected areas in Spain, France, Italy and Turkey showed that a significant biomass is extracted via recreational fishing in most Mediterranean MPAs, thus confirming the **significance of the pressure recreational fishing imposes on fish resources**[10]. The same study identified 45 vulnerable species as being caught by recreational fishermen, representing about 30% of total fish catches. Boat fishing affects a higher number of species than other fishing types, while spear fishing is the most selective type (i.e., a smaller variety of fish species and fish sizes caught).

The capture of undersized individuals below the Minimum Landing Size (MLS) has an impact on the reproductive potential of species and on fish stocks. In some cases, the MLS does not correspond to the species' actual size at maturity, which may put their sustainability at risk. On the other hand, the fact that spearfishing targets large

individuals is also representative of a risk to their reproduction potential, as larger females are more fecund, have extended more extensive reproduction time, and spawn bigger eggs and larvae with better survival rates[10].

Most species in the Mediterranean Sea are caught for human consumption. *Catch and release* is therefore the exception rather than the rule. Fish are released mainly when specimens caught are considered to be too small or not worth eating, and can be more accurately classified as discards or bycatch, affecting the survival of captured and released fish as some handling techniques can cause great stress and subsequent death.

The use of exotic species as bait, and their subsequent release into aquatic ecosystems, may have an indirect impact on marine resources, with threats to ecosystems, transfers of viruses that can significantly affect stocks of wild fish and risks of unwanted introductions. Moreover, living substrates (such as algae), most likely containing small invertebrates or living organisms used to keep bait alive and moist, are also commonly discarded into the sea by fishermen.

The expansion of recreational fishing activities involves the development of the bait industry and bait collection that has its own environmental consequences. Activities such as bait digging or "pumping" affect not only the harvested species but also the coastal fauna and sediment structure.

Furthermore, the loss or abandonment of fishing gear (e.g., lead weights, lines and hooks) can cause significant damage to the marine ecosystem (e.g., the fauna on the seabed). Anchoring and mooring of boats may disturb marine habitats, particularly *Posidonia oceanica* meadows and coralligenous reefs. Finally, shore fishermen and shellfish collectors walking on Mediterranean rocky areas trample organisms on the rocks and damage erect algae inhabitants, particularly *Cystoseira* assemblages.

Table 1. Impacts of the recreational fishing on GES

MSFD Descriptor	Description of the impacts	Future trends
D1 Biodiversity	Fish reproductive potential, post-release mortality, marine ecosystems and habitats	↗
D2 Non-indigenous species	The use of exotic species as bait	↗
D3 Commercial species	Pressure on commercial species.	↗
D4 Foodwebs	Food supplies affected by overfishing and depletion of food populations,...	↗
D5 Eutrophication		
D6 Sea-floor integrity	Impacts through anchoring and mooring (boat fishing)	↗
D7 Hydrographical conditions		
D8 Contaminants		
D9 Contaminants in seafood		
D10 Marine litter	Fishing gear (e.g., lead weights, lines and hooks) discharged, abandoned or lost at sea, "domestic" litter	↗
D11 Energy	Underwater noise generated by fishing boat engines	↗

4. INTERACTIONS WITH OTHER SECTORS

Conflict between marine recreational and commercial fishing activities frequently arise over fishing grounds as well as some species, in particular migratory species (e.g. bluefin tuna) threatened by overexploitation and prized by both recreational and commercial fisheries, but also coastal demersal species.

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MARINE AQUACULTURE

CAGED NORTHERN BLUEFIN TUNA, SPAIN © BRIAN J. SKERRY NATIONAL GEOGRAPHIC STOCK WWF

Since the 1970s, the aquaculture sector has been developing rapidly in the countries surrounding the Mediterranean Sea with a growth rate of 70% recorded between 1997 and 2007[1]. The aquaculture sector in the Mediterranean region is expected to continue developing and diversifying in parallel to the decline of wild stocks and the increasing demand for fish products for human consumption[2]. Those Mediterranean countries with a small aquaculture sector are predicted to reach their growth potential in the coming years. In countries with an already well-developed aquaculture sector, such as EU Member States, the development of the sector will build on the use of environmentally friendly production techniques. As a result, the Mediterranean aquaculture sector may grow by more than 100% by 2030 in terms of production and value. While this growth will provide extra jobs, it will be associated with environmental challenges.

1. BACKGROUND AND CURRENT SITUATION

In the Mediterranean region, production from capture fisheries stabilized in the early 1990s, and many fish stocks are today considered fully exploited or overexploited. Marine and brackish water aquaculture grew steadily during the last decades (Figure 1), contributing substantially to meeting rising demand for fishery products. About 67 different species comprising fish, molluscs and crustaceans are currently farmed in the Mediterranean Sea and in the Black Sea.

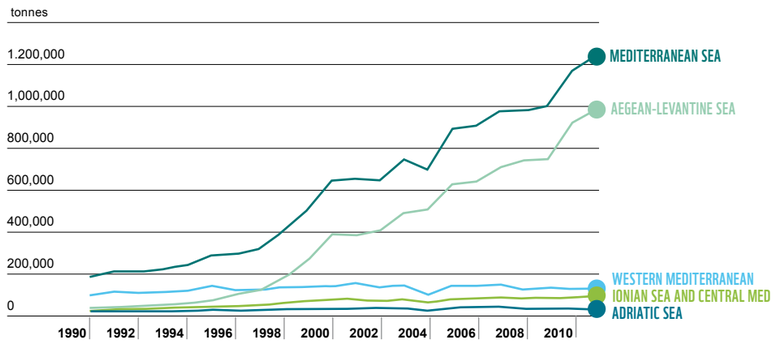

Figure 1. Aquaculture marine and brackish production in the Mediterranean (1990-2011, in tonnes)[1]

Aquaculture accounts for more than 50% of today's total fishery output at the Mediterranean scale. Two thirds of Mediterranean aquaculture production is based on fish farming (including bluefin tuna farming) with mollusc farming representing the remaining 33%[2]. Marine and brackish aquaculture production in Mediterranean waters amounts to 1.2 million tons per year, equivalent to 3% of the world's marine and brackish aquaculture production and almost 75% of the total Mediterranean aquaculture production (freshwater aquaculture included).

Mediterranean aquaculture has traditionally specialised in the production of mollusc species (representing 62% of the total aquaculture production in 1992). More recently, however, the share of fish production has significantly increased (from 37% in 1992 to 53% in 2001), due to significant research efforts the results of which have helped promote the production of high value species (such as turbot, gilthead sea bream, or European sea bass)[1]. Development of the Mediterranean aquaculture sector has been facilitated by its proximity to viable markets in Europe, as well as ideal growth conditions, temperatures and physiochemical parameters. The presence of research institutions specialised in aquaculture was also vital to overcoming early technical problems.

Aquaculture production of the Mediterranean region is mainly concentrated in six countries, namely: Egypt, Greece, Italy, Spain, France and Turkey. These six countries account for the bulk (95%) of the total aquaculture production (freshwater and marine aquaculture combined) of the Mediterranean region. The Aegean-Levantine Sea represents the principal Mediterranean sub-region in terms of the number of aquaculture farms and production[1]. Figure 2 illustrates the distribution of aquaculture fish farms along the Mediterranean coast in 2014, along with the total aquaculture production (in tons) per country for 2011.

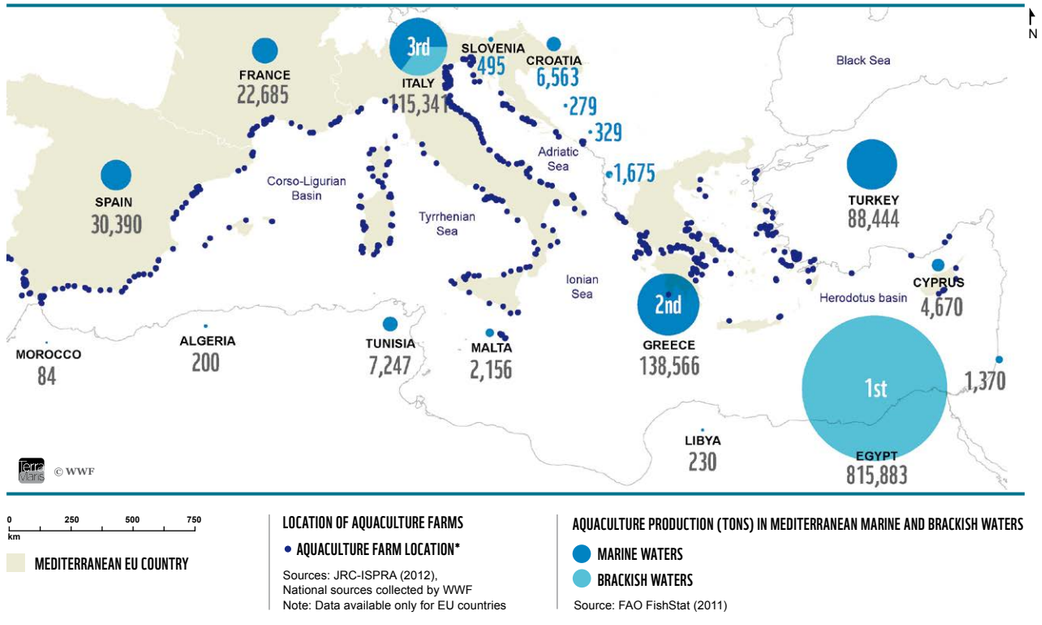

Figure 2. Aquaculture fish farms and total production (tons/year) in the Mediterranean region

Aquaculture plays an important role in coastal communities, as it contributes to their socio-economic development and to employment. The sector represents more than **120,000 direct jobs** in countries of the Mediterranean region. In addition, it provides indirect employment (e.g. in the processing industry, in the transport sector, etc.) equivalent to more then 750,000 jobs[1].

Marine and brackish aquaculture production in the Mediterranean Sea represents a total production value of **2.5 billion Euros**, equivalent to 6% of the world total revenues of marine and brackish aquaculture production, and over 70% of the total aquaculture production of Mediterranean countries (freshwater, brackish, marine species and non-Mediterranean façades included).

2. FUTURE TRENDS

During the last 40 years, the annual growth rate of the aquaculture sector was higher than 8 percent. From 1990 to 2010, and as indicated in Figure 3, the total marine and brackish water aquaculture production of the General Fisheries Commission for the Mediterranean (GFCM) increased from around 540,000 tonnes to 1,400,000 tonnes[3].

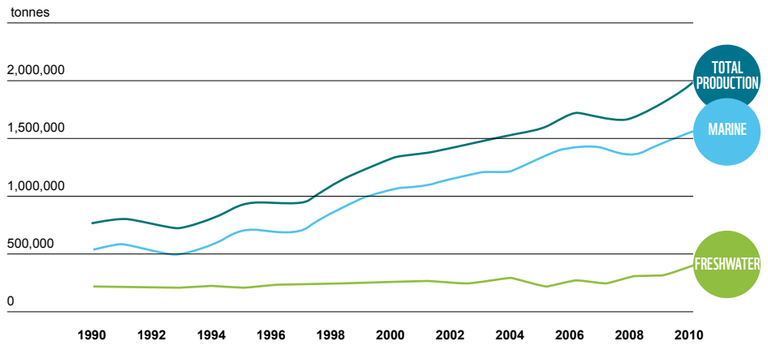

Figure 3. Mediterranean and Black Sea aquaculture production trend (1990–2010, in tonnes)[4]

As a consequence of the decline of wild fish stocks, combined with the increasing demand for seafood, aquaculture in the Mediterranean Sea is expected to continue its growth in coming years. The EU's Blue Growth agenda for economic growth and employment singled out the aquaculture sector as one of its five priority sectors that would steer Blue growth, thanks in particular to the reform of the Common Fisheries Policy and following its recently published Strategic Guidelines[5].

Projections indicate that **European aquaculture in the Mediterranean Sea might grow by more than 100% by 2030** up to a total production exceeding 600,000 tons. This is equivalent to a rise in the sector's total (direct and indirect) value of 5 billion Euros, and the provision of 10,000 additional jobs in Mediterranean European countries[1].

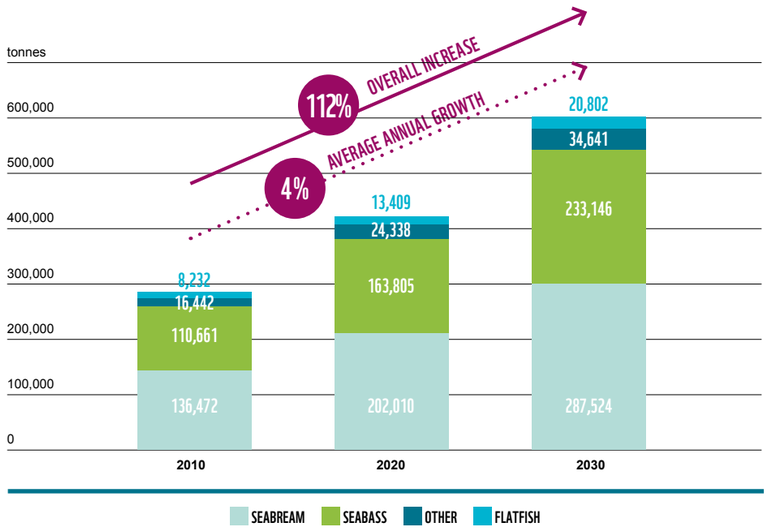

Figure 3. Forecast of fish aquaculture production by species (tonnes) in the Mediterranean up to 2030[6]

Several Mediterranean countries already have large and well-organized aquaculture sectors (in particular Greece, Turkey, Spain, France, Italy, Cyprus, Malta and Egypt). With the exception of Greece, aquaculture production for these countries has stabilised as a result of a lack of suitable new areas for mollusc or fish farming due to geographic and environmental constraints, competition for coastal space with other users or regulations and governance issues. For these countries, opportunities for expansion are likely to be driven by the development and application of **new environmentally friendly production techniques**, as well as by the establishment of rearing cages in the open sea[1].

In contrast, some countries (such as Albania, Algeria, Croatia, Israel, Montenegro, Morocco and Tunisia) have small aquaculture sectors with still significant growth potential for the coming years.

3. IMPACTS ON GES

The aquaculture sector today faces a dual challenge regarding marine fish production: how to alleviate the pressure on fish populations while responding to the increasing demand for sea products in local and international markets without additional environmental problems[1]. Fish farming in the Mediterranean has progressively shifted from producing herbivore fish such as grey mullet to producing predatory species such as sea bass. This 'farming up' the food chain requires a supply of fish caught in the wild to use as feed[7]. The improvement of the Fish In Fish Out (FIFO) ratio, replacing fish oil and meal with vegetable proteins in the diet of aquaculture species is offset by the global increase in aquaculture production. Fish stocks targeted to produce fish meal are already fully exploited and would not support any further increase in fishing pressure.

The major environmental concerns of aquaculture deal with the biological interaction caused by the unintentional release of farmed organisms and the introduction of non indigenous species into the environment. In both cases, these organisms can compete with native species for food and space, and might also transfer diseases and parasites. Many studies have also pointed at overfeeding in fish farms, which may favour some organisms over others, as the cause of changes in benthic community structure[8]. Effluent discharges from aquaculture facilities also pose environmental concerns, as they may contain residues of therapeutic products, antifouling agents or uneaten fish feed. If improperly managed, these discharges can lead to antibiotic pathogen resistance, water eutrophication, oxygen depletion and other problems contributing to environmental damage.

Most of the potential environmental impacts of the aquaculture sector can be managed and minimized through an understanding of processes and responsible management. Therefore, sustainable management guidelines for the aquaculture sector are essential tools for policy makers, administrators, aquaculture producers and other stakeholders[1].

Despite the increasing application of environmental friendly techniques, in particular in European Mediterranean countries, it is expected that the pressures on marine ecosystems from the aquaculture sector will increase at the Mediterranean scale.

Table 1. Impacts of aquaculture on GES in the Mediterranean Sea

MSFD Descriptor	Impacts on GES	Future trends
D1 Biodiversity	Pathogen transfer and effects on local wild marine organisms, therapeutics and antifouling effects on local wild marine organisms, interaction between aquaculture and local fauna and flora, destruction or disturbance of habitats.	↗
D2 Non-indigenous species	Leakage or escaping leading to the introduction of alien marine species (e.g. fish, crustaceans, molluscs, aquatic plants), alien parasites and pathogens.	↗
D3 Commercial species	Capture of wild stocks for aquaculture needs: stock depletion and/or collapse.	↗
D4 Foodwebs	Disequilibrium of prey/predator balance	
D5 Eutrophication	Organic and inorganic nutrient loss through effluents.	↗
D6 Sea-floor integrity	Local benthic impacts such as sediment anoxia, sediment chemical changes or changes in and/or absence of macrofauna, decline and severe effects on Posidonia oceanica meadows in contact with effluents at short, mid and long terms.	↗
D7 Hydrographical conditions	Increase in particulate matter	↗
D8 Contaminants	Release of waste products derived from animal metabolism, antibiotic and biocide releases, antifouling biocides.	↗
D9 Contaminants in seafood	Accumulation of toxic components	↗
D10 Marine litter	Littering, solid waste discharge	↗
D11 Energy		

4. INTERACTIONS WITH OTHER SECTORS

The interactions of the aquaculture sector with other sectors are numerous. And the limited access to space/water and licensing, especially in coastal areas, have been highlighted as a particular challenge for the sector. The presence of aquaculture farms in coastal areas competes with the need for high quality water near beaches, necessary for tourism development but also for professional fishing grounds and other coastal activities. The release of farmed organisms, the introduction of invasive species, and the potential transfer of diseases and parasites, may also affect marine and coastal biodiversity, and thus tourism and fishing activity which rely on a healthy marine environment.

This competition for space is also impacting marine protected areas. The EU Commission has committed to facilitating the development of aquaculture in Natura 2000 sites.

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TOURISM

CALA AGULLA, MALLORCA, SPAIN © JORGE SIERRA, WWF-SPAIN

The Mediterranean Sea is the first tourism destination in the world. Tourism, including coastal tourism, cruise tourism and recreational boating, is an essential economic activity for Mediterranean countries. This sector is extensively developed in France, Italy and Spain while it has significant growth potential in countries like Croatia and Greece. The impacts of the tourism sector on the marine environment are diverse and significant.

The Mediterranean tourism industry is facing increasing global competition, with emerging or developing countries attracting increasing numbers of tourists. Coastal tourism has been identified as one of the five priorities of the EU Blue Growth strategy. It is expected to keep growing in the future, although at a slower pace than in recent years. Cruise tourism and recreational boating are expected to keep growing at a fast rate in the short term.

A. COASTAL TOURISM

1. BACKGROUND AND CURRENT SITUATION

Tourism is an essential economic activity for Mediterranean countries[1]. Climate, cultural heritage and the long tradition of tourism activities in these countries[2] explain the success of the Mediterranean Sea region as the first destination in the world. **International arrivals in the Mediterranean Sea region correspond to one third of the world's international tourism**[3]. Tourism in the Mediterranean Sea region is highly concentrated, both spatially and seasonally, with most visits occurring during the summer months.

Coastal tourism is the largest sea-related economic activity in the Mediterranean region[2]. Nearly 300 million international tourists visited the region in 2012, representing 30% of total world tourists for that year3]. Half of these arrivals were in coastal areas. The tourism sector is extensively developed in Southern EU countries such as Spain, France and Italy and has witnessed an important growth rate in Southern and Eastern Mediterranean countries such as Algeria and Egypt over the last decade. Figure 1 shows the distribution of international arrivals in Mediterranean countries in 2012.

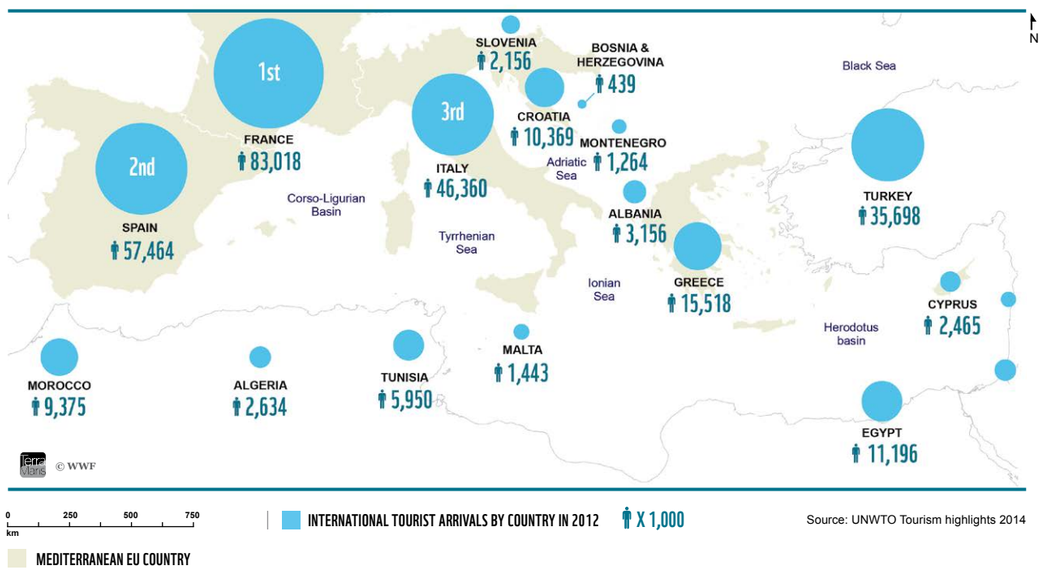


Figure 1 International tourist arrivals in Mediterranean countries in 2012

The direct Gross Value Added (GVA) of coastal tourism in the Mediterranean Sea region in 2012 is estimated at 135 billion Euros or 7% of the direct contribution of the tourism sector worldwide[3]. This confirms the importance of the region in the global tourism economy. Total contributions of this sector to national economies are high. The total income induced by tourism and travel activities in Mediterranean countries was estimated at 774.5 billion Euros or 11.1% of the Gross Domestic Product (GDP) in 2011[4].

Table 1. Total contribution to national GDP (in %) from tourism and travel activities in the Mediterranean Sea region (2011). Adapted from PERSEUS (2013)[4]

Country	2001	2011	Country	2001	2011
Lebanon	15,4	35,1	Egypt	14,1	14,8
Malta	27,4	27,7	Tunisia	19,8	14,2
Croatia	17,8	26,4	Syria	13,3	13,1
Albania	16,8	21,7	Slovenia	11,5	12,8
Morocco	14,8	18,9	Turkey	14,5	10,9
Jordan	18	18,8	France	12,6	9,2
Cyprus	33,1	17,7	Italy	10,6	8,6
Greece	16,9	16,5	Israel	7,7	8
Montenegro	10,2	15,4	Algeria	6,9	7,7
Spain	16,9	14,8	Libya	5,6	3,2

In 2011, contributions of the tourism sector to the GDP in EU Mediterranean countries were most significant for Malta, Croatia and Cyprus, with the sector accounting for around 18.5 million jobs at the regional level, contributing on average to 15.2% of total employment (2011), and reaching 25% of total employment in Lebanon, Croatia and Malta[4]. This economic activity is therefore key to Mediterranean economies.

2. FUTURE TRENDS

Coastal tourism was affected by the recent economic crisis, although it was able to recover[3] and kept growing over the following years[2]. From 1995 to 2010, international tourism around the Mediterranean Sea grew on average by 3.7% annually[5].

The future development of the sector will be influenced by several factors, including the declining competitiveness of some Mediterranean tourism destinations, changes in tourist expectations and needs, cultural and environmental conservation and protection levels and the increasing impacts of climate change.

Despite these uncertainties, Plan Bleu forecasts show that coastal tourism is expected to maintain an upward trend over the next 15 years. While past growth for the tourism sector was concentrated in the north-western Mediterranean Sea, future growth will be experienced throughout the Mediterranean basin with rapid growth forecast for Croatia, Greece, and Morocco, and for areas with a wealth of biodiversity[3].

Figure 2 shows the expected future trends in the number of arrivals of international tourists in the Mediterranean region up to 2030.

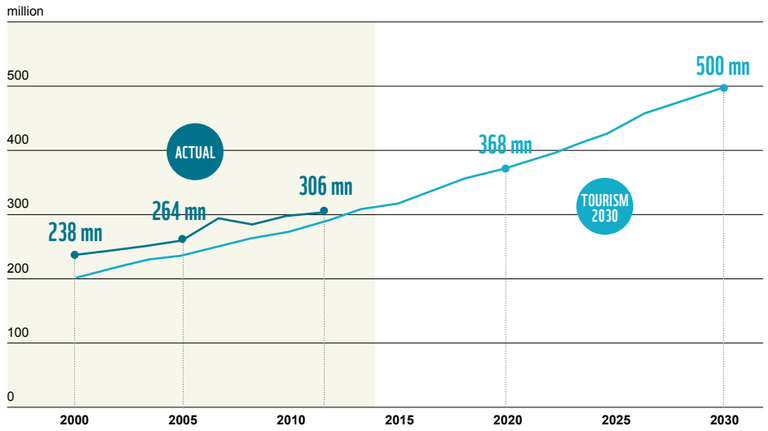


Figure 2. Expected trends of international tourists arrivals in the Mediterranean region, in million[6]

Figure 3 shows past and future trends of international tourists arrivals by Mediterranean country.

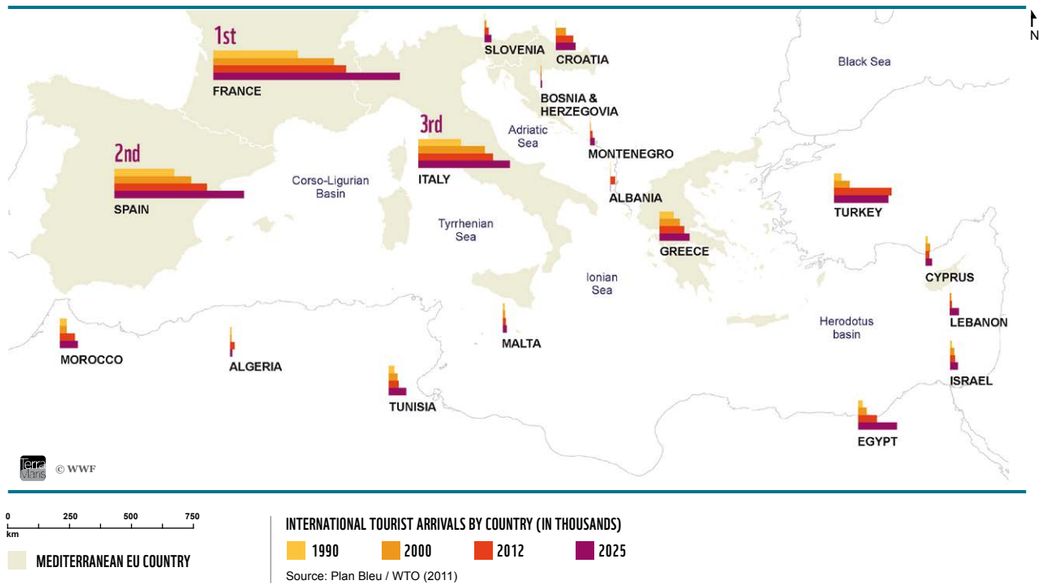


Figure 3. Past and future trends of international tourist arrivals in Mediterranean countries (1990, 2000, 2012 and 2025), in thousands

According to this forecast, total arrivals of international tourists in the Mediterranean region will grow at an average annual rate of 2.6% up to 2030, a growth rate lower than the worldwide expected growth of 3.3%[3] and lower than past trends in the Mediterranean Sea region[5]. However, this expected trend will result in a significant net growth in the total number of tourists.

Similarly, employment linked to the tourism sector should also increase but at a slower pace because of economies of scale (European Commission, 2012). Direct contributions of the tourism sector to national GDPs are expected to slightly grow by 2020[4].

The expected trends of Mediterranean coastal tourism can be illustrated by the estimated growth of the number of nights in tourist accommodation for EU Mediterranean countries up to 2030, as reflected in Figure 4. Future estimates are based on the assumptions of a constant share in the distribution of nights between countries (equal to the share observed in 2013) and a growth rate equal to that estimated for the arrivals of international tourists in the Mediterranean Sea region. These assumptions may result in overestimates for countries such as France and Spain, and underestimates for countries such as Croatia and Greece.

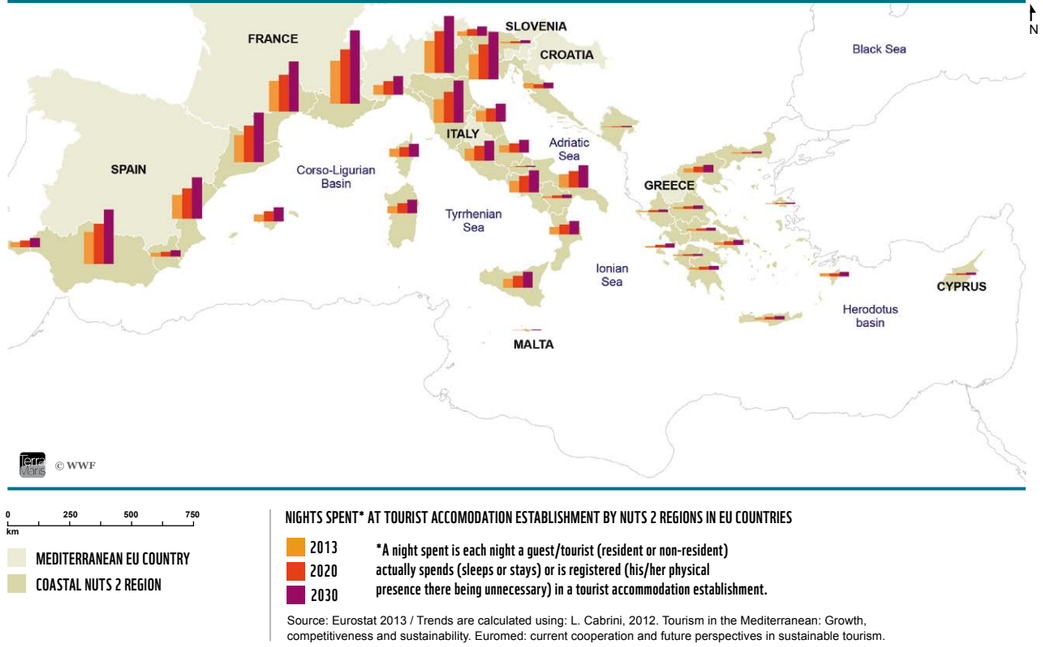


Figure 4. Past and future trends of nights spent at tourist accomodation in EU Mediterranean countries (2013, 2020 and 2030)

B. CRUISE TOURISM

1. BACKGROUND AND CURRENT SITUATION

The Mediterranean Sea is among the most important cruise areas in the world[4]. Around 27 million passengers went through Mediterranean ports in 2013[7]. Cruise tourism is especially developed in Italy and Greece, but is also very promising in several other countries. The 5 Mediterranean ports handling the largest number of cruise passengers in 2009 in the Mediterranean were in Spain (Barcelona), Italy (Civitavecchia) and Greece[4] .

Overall, 75% of Mediterranean ports are located in Italy, Spain, France, Greece, Croatia and Slovenia, with 9% of ports being located in Turkey and Cyprus and only 7% in North Africa[7] .

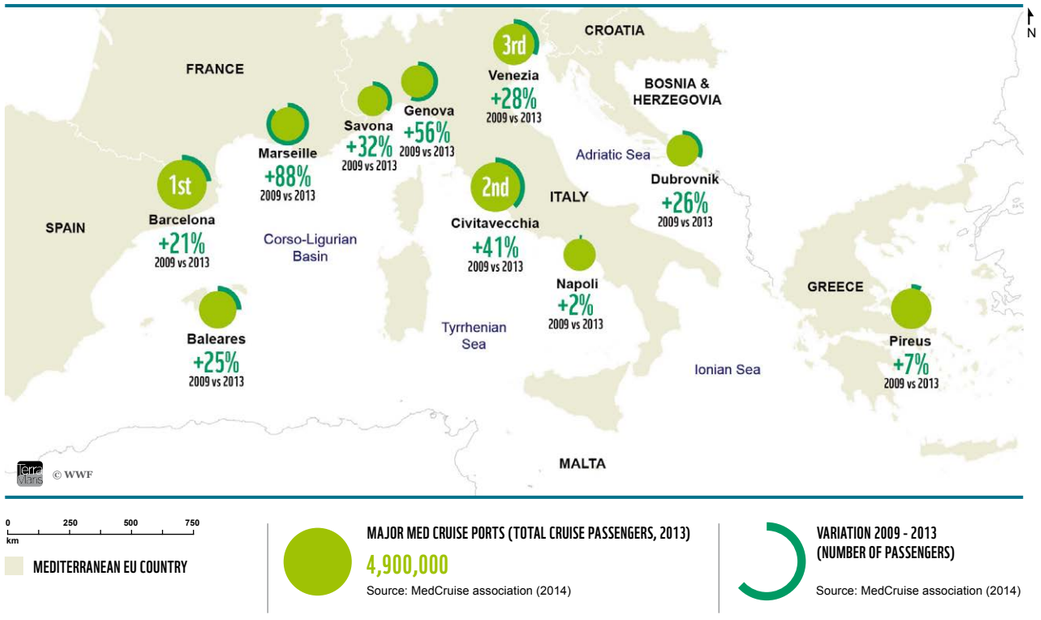


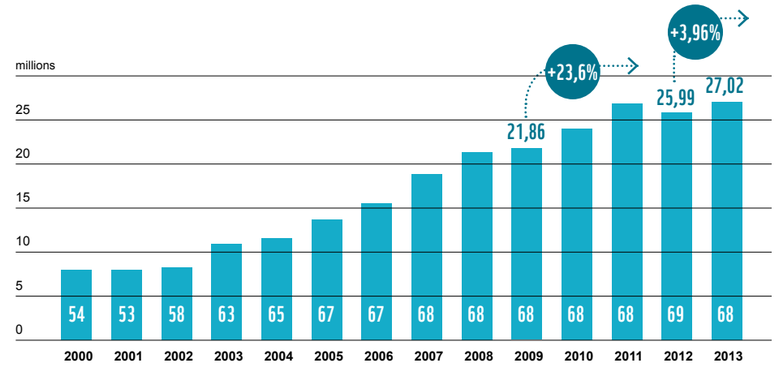
Figure 5. Growth of Med Cruise ports in number of passengers between 2009 and 2013.

Cruise tourism contributes to the wider economy through different expenditures (cruise lines, passenger and crew purchases) and shipbuilding. Italy, Spain, France and Greece earned almost 48% of total cruise expenditures in Europe in 2012 (these figures include cruises originating in non-Mediterranean areas).

Unlike coastal tourism, cruise tourism in the Mediterranean kept growing over the period 2008-2010[4] and represents an increasing share of global cruise tourism.

2. FUTURE TRENDS

Fast growth rates have been observed in this sector over the past years (Figure 6). Overall, the share of the Mediterranean Sea as a global destination for cruise tourism grew from 17.6% in 2008 to 21.7% in 2011.



Note: Missing data since 2009: 2013: Egyptian Ports, Lattakia / 2012: Rize / 2011: Egyptian Ports, Rize / 2010: Egyptian Ports, Rize / 2009: Egyptian Ports, Rize

Figure 6. Growth of cruise passenger movements in Med Cruise ports (2000-2013)[7] .

The intense media coverage of the Costa Concordia accident in 2012 had a negative impact on the sector that year although the sector has had a rapid recovery. Growth was especially concentrated in a few ports, with major Med Cruise ports experiencing a cruise traffic growth of 10% in 2013, as compared to the total average growth of Med Cruise ports of around 4% [7]. The growth of cruise tourism is expected to continue over the next few years[7] .

CRUISE SHIP © F. BASMAYOUSSE

C. RECREATIONAL BOATING

1. BACKGROUND AND CURRENT SITUATION

Recreational boating is economically important for France and Greece and is expected to grow quickly in several other countries such as Greece and Montenegro[2]. Marinas or recreational ports are widespread tourism infrastructures along the Mediterranean coast. There were around 940 marinas in the Mediterranean Sea in 2010, of which 253 were located in Italy, 191 in Spain and 124 in France[8] .

The Mediterranean Sea is also a world destination for yachting. Evidence shows that 50% of the global fleet of large yachts spends 8 months out of 12 in Mediterranean waters[8] the Côte d'Azur being the most coveted destination as reflected in Figure 7.

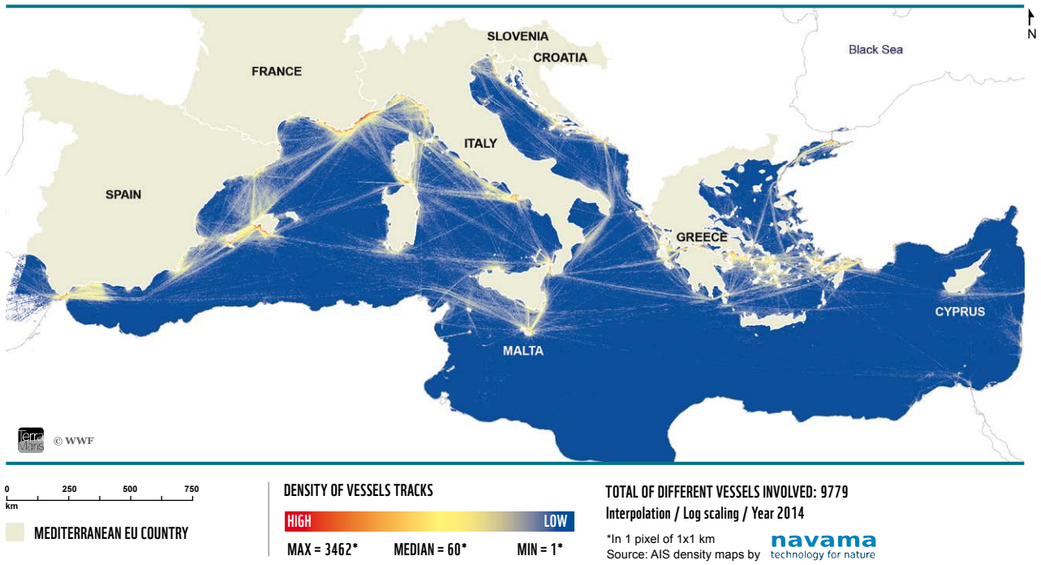


Figure 7. Density of AIS signals from EU pleasure crafts in 2014

2. FUTURE TRENDS

Few data on future trends are available for marinas. And these may only be relevant for some of the EU Mediterranean countries. Many coastal cities with a marina along the French Mediterranean coast report a strong demand for an increased number of berths and plan to expand their berth capacity. The potential for the spatial expansion of marinas is however very limited by the enforcement of current environmental protection legislation. In 2015, many new marina projects were identified in other EU countries: 17 in Greece, 10 in Spain, 1 Malta and several in Italy and the Adriatic (exact number unknown).

LEISURE BOATS IN SPLIT, CROATIA © C. AMICO WWF MEDPO

D. UNCERTAINTIES

The future development of coastal tourism, cruise tourism and recreational boating in the Mediterranean Sea will depend on several factors including: promotion/ communication efforts towards potential clients; the degree of responsiveness to international demand; the innovativeness and the capacity to develop tourism activities during low season[2]; or external factors like the state of the global economy, the evolution of fuel prices and of consumers' preferences[1]. The raising of environmental awareness could also influence future tourism development in the Mediterranean Sea region[1] and current environmental degradation could indeed impact negatively on tourism demand[6]. Last but not least, climate change may also affect the future of the tourism sector in the Mediterranean region.

E. IMPACTS ON GES

As the main tourism destination in the world, **the Mediterranean Sea region is one of the world's main tourism vulnerability hotspots**[5] .

This economic sector generates a wide range of pressures on the environment while it depends strongly on environmental assets.

The artificialisation of coastal areas through urbanisation is a direct impact of tourism and recreational boating[4]. The construction of infrastructure, hotels, marinas can destroy natural communities, change the sedimentation process and modify the beach morphology[4]. The number of tourist beds per square kilometre was used as a visual indicator reflecting the intensity of the pressure exerted by the tourism sector on Mediterranean coastal areas (Figure 8), with hotspots being primarily located in France, and Spain, Italy and Cyprus.

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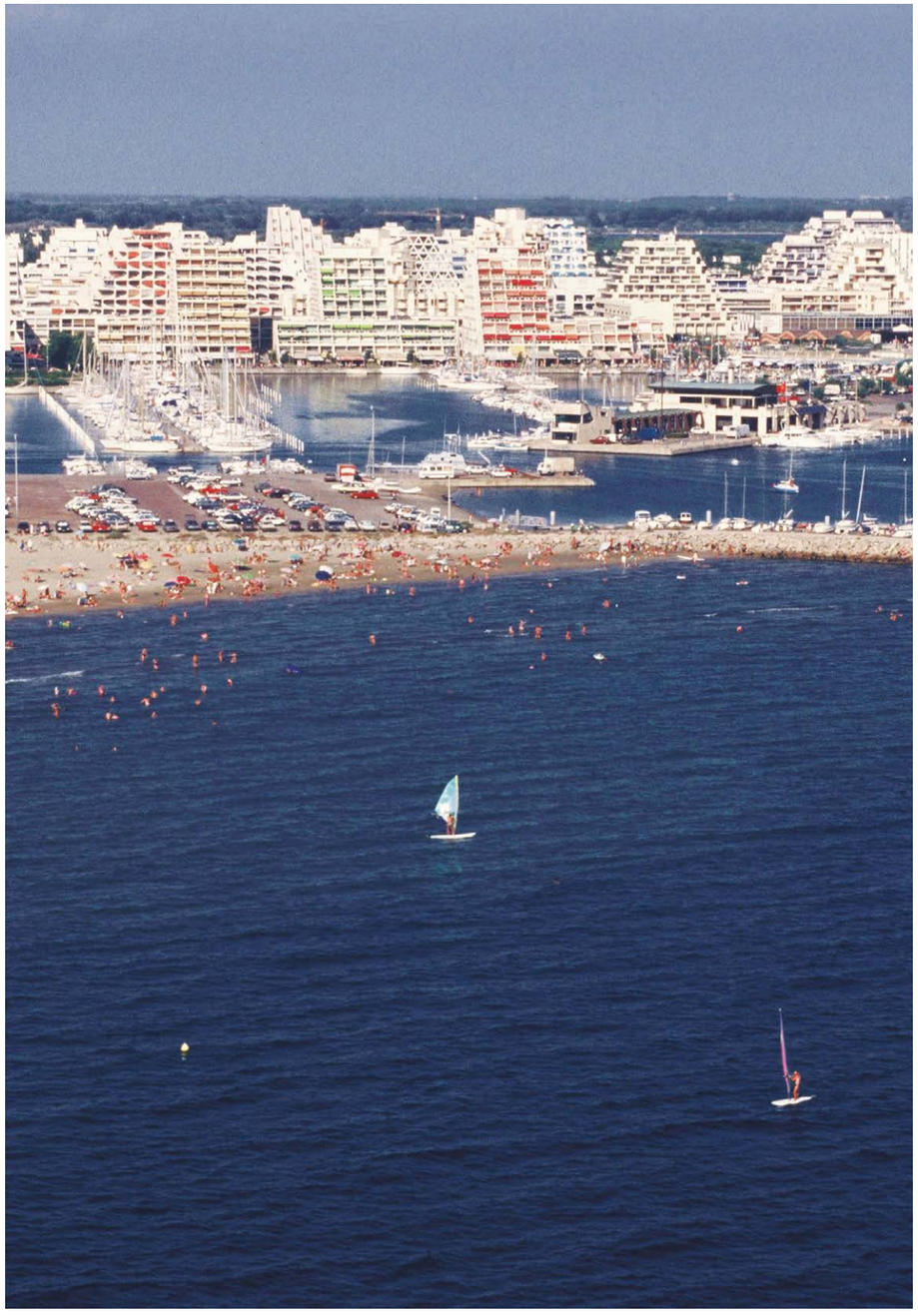

Heavy development of tourism infrastructures, La Grande Motte, France

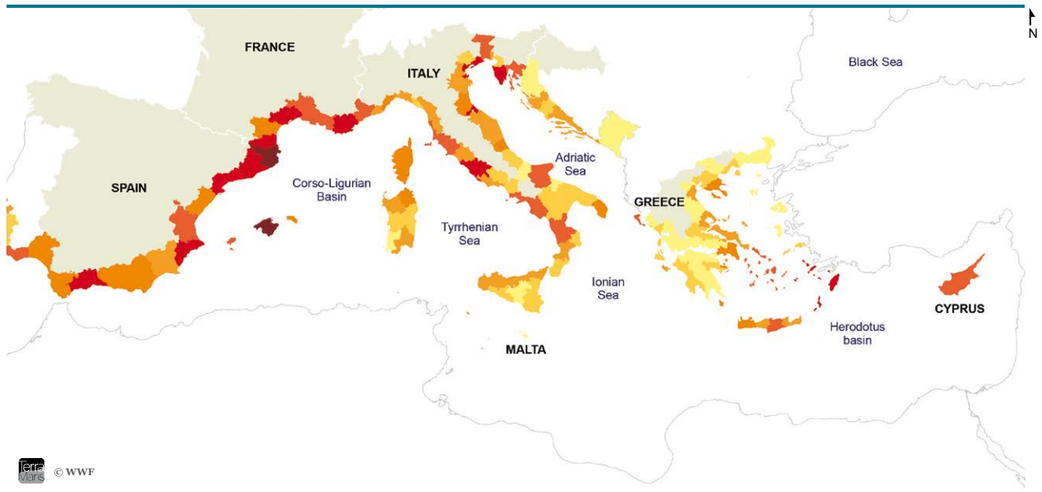

Figure 8. Number of beds in the coastal areas of EU Mediterranean countries in 2011

The artificialisation of shallow marine habitats depends directly on the spatial extensions of ports. The mean distance between ports in the Mediterranean is on average 79km (Table 2), **down to 20 km in Spain, France and Slovenia**[4]. The number of marinas and the mean distance between them indirectly reflects part of the impact recreational boating might have on coastal habitats and natural communities.

Table 2. Number of marinas and mean distance between ports in the Mediterranean Sea[8].

	Number of marinas	Distance (km)
Italy	**253**	29
Spain	**191**	**14**
Greece	**135**	111
France	**124**	**14**
Croatia	81	72
Turkey	37	140
Tunisia	29	45
Algeria	24	50
Libya	15	118
Albania	11	38
Morocco	9	57
Israel	8	22
Egypt	6	159
Malta	6	30
Cyprus	3	261
Lebanon	3	75
Syria	3	61
Slovenia	3	**16**
Montenegro	2	147

Tourism and recreational boating also generate **litter** at sea and on the coast. Cruise ships are significant producers of waste. In 2009, total waste production from cruise ships in the Mediterranean Sea region was estimated at 10 million tons of waste, 75% of which were incinerated[8] .

Pollution from sewage/wastewater and ballast water is also an important pressure from these three sub-sectors. Cruise ships in the Mediterranean produce around 800 million litres of wastewater that can be discharged at sea without treatment[8] . Oil and antifouling substances are other sources of pollution from recreational boating and cruise tourism. Poor collection systems can lead to the introduction of organic matter or the presence of microbial pathogens. There was no improvement to sewage, waste and ballast water collection services in the Mediterranean Sea during the period 2008 to 2010[8].

The introduction of non-indigenous species, the dismantling of out-of-service ships, and underwater noise are other potential pressures from cruise tourism and recreational boating. Given the growth trends of this sector, pressures and related impacts on marine and coastal ecosystems are expected to keep growing.

Table 3. Impacts of coastal tourism, cruise tourism and recreational boating on GES

MSFD Descriptor	Coastal and cruise tourism, and recreational boating	Trends
D1 - Biodiversity	The construction of infrastructures (hotels, ports, marinas) affects marine biodiversity and habitat. Recreational boating cause also damage to species through collisions.	↗
D2 - Non-indigenous species	Cruise tourism and recreational boating can lead to voluntary or non-voluntary introduction of non-indigenous species	↗
D3 - Commercial species	Pollution from tourism and recreational boating can impact seafood	↗
D4 - Foodwebs	Pollution from tourism and destruction of habitat can impact foodwebs	↗
D5 - Eutrophication	Discharges from untreated wastewater	↗
D6 - Sea-floor integrity	Sealing due to coastal urbanisation	↗
D7 - Hydrographical conditions	Development of marinas can cause changes in currents and coastlines	↗
D8 - Contaminants	Release of oil and contaminants	↗
D9 - Contaminants in seafood	Pollution from tourism and recreational boating can impact seafood	↗
D10 - Marine litter	Beach/marine litter	↗
D11 - Energy	Recreational boating creates underwater noise affecting marine species	↗

F. INTERACTIONS WITH OTHER SECTORS

While tourism has a significant impact on the environment, it relies on healthy and pristine marine and coastal ecosystems, and good water quality. It can therefore conflict with aquaculture development, as is currently the case, for example, in Greece.

The development of the energy sector will, in the future, interact with coastal tourism. The recent debate on offshore oil and gas development along the coast of Croatia, reported in the national and international media, highlights the growing antagonism between the two sectors[10]. **Any oil spill would have dramatic effects on the Mediterranean tourism industry.**

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MARINE RENEWABLE ENERGY

REPRESENTATION OF A FLOATING TURBINE WINDFARM © NENUPHAR

Blue energy, including offshore wind, wave, tide-current and thermal gradient energies, is in the early stages of development in the Mediterranean Sea. The offshore wind energy sector is more developed than the wave and tidal energy sectors. Compared to the North Sea and the Atlantic Ocean, the Mediterranean Sea hosts limited blue energy resources that are progressively being tapped.

1. BACKGROUND AND CURRENT SITUATION

The Mediterranean Sea region records limited development in the blue energy sector. Various projects are currently being developed but wind farms are not yet operational in the Mediterranean Sea. Other types of blue energy are still in their infancy.

2. TRENDS

According to the EU Climate and Energy Policy Framework, EU Member States have agreed to produce 27% of the total EU electricity demand from renewable sources by 2030[1].

Wind energy

As a consequence, the offshore wind sector is expected to grow in the coming decades. This will be made possible by new developments in floating platform construction adapted to deep offshore sites which are particularly relevant to the deeper waters of the Mediterranean Sea[2].

The wind resources of the Mediterranean Sea are of lower intensity than Northern European conditions. The sector is, then, less a priority in the short term to medium term[3]. Technical constraints to offshore wind energy development include the (low) mean wind speed and the high bottom depth[4]

As the sector matures and costs fall, there will be increasing opportunities for the sector in the Mediterranean Sea[3]. At present, a limited number of wind farm projects are considered mainly in the EU countries of the Mediterranean region (Figure 1). But only a few projects have obtained all necessary authorisations so far.

The European Wind Energy Association (EWEA) forecasts a 40 GW offshore wind capacity in European waters by 2020, equivalent to a production of 148 TWh, provided that the right conditions are in place[5]. The electricity produced would be sufficient for the equivalent of 39 million households. Up to 2020, most of these developments will take place in the North Sea and Baltic Sea with the Mediterranean Sea region beginning the exploitation of its offshore potential (estimated at 8% of the consented capacity in Europe).

By 2030, EWEA forecasts a 150 GW installed offshore wind capacity in European waters, producing sufficient electricity for energy the equivalent of the electricity demand of 145 million households. By 2050, offshore wind could reach 460 GW, producing 1,813 TWh and contributing up to 50% of the European electricity supply[5].

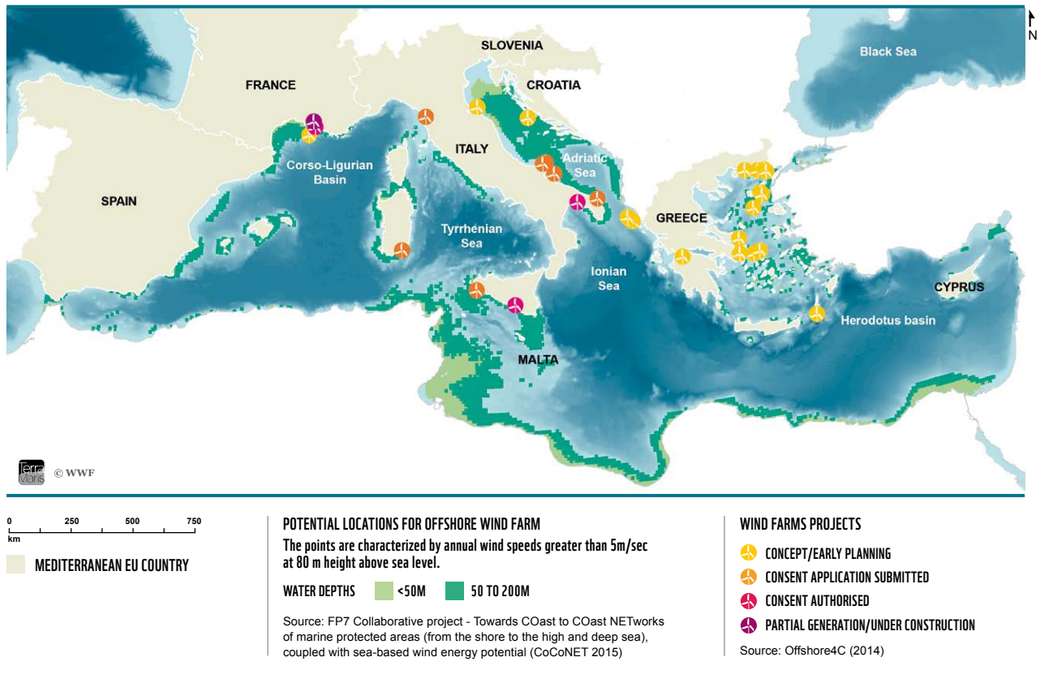

Figure 1. Potential locations for offshore wind farms

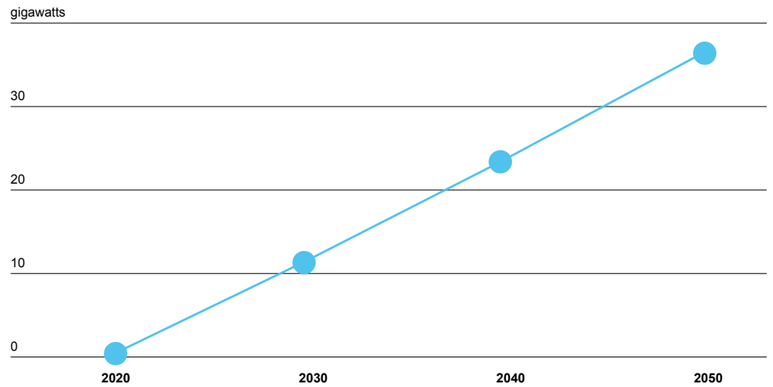

Figure 2. Predicted production of electricity in gigawatts (GW) by offshore wind farms in the Mediterranean sea 2020-2030-2050. Estimates based on EWEA forecasts[5]

© NENUPHAR

Prototype of vertical axis wind turbine, Fos-sur-Mer, France

Wave energy

The Mediterranean Sea has a very low wave energy resource with the highest average wave power in the region being around 6kW/m[3]. Wave energy is still more expensive than offshore wind energy and its technological development is far behind wind turbine technological developments. Underwater grid-connections in the Mediterranean Sea are rarely available[11]. It is expected that the development of wave energy will be slow and limited in the future.

Tides and currents

Tidal stream resources are limited primarily to the Straits of Messina, Bosphorous and Gibraltar[3]. Although the development of underwater turbines is at a mature stage, underwater grid-connections in the Mediterranean Sea are rarely available[11]. It is expected that the development of electricity based on tides and currents will remain limited in the future.

3. IMPACTS ON GES

Wind energy

Wind energy plays an important role in addressing climate change. And it takes less than six months for a wind farm to produce more energy than it will consume in its entire lifetime. The lifecycle emissions (including manufacturing of components, transport to site, construction, operation and decommissioning) from wind farms are about 1% of the emissions generated by thermal energy[9].

Knowledge on the ecological impact of windfarms is still limited. The major environmental concerns related to offshore wind developments are: increased noise levels, risk of collisions, changes to benthic and pelagic habitats, alterations to food webs, and pollution from increased vessel traffic or release of contaminants from seabed sediments[6].

Indirect impacts of offshore windfarm development are related to the potential extension of related port facilities.

As well as potential adverse impacts, there are possible environmental benefits. For example, wind turbine foundations may act as artificial reefs, providing a surface to which animals can fix themselves. And this can positively impact on the number of shellfish and all related animals of their trophic chain (including fish and marine mammals). A second possible benefit is the sheltering effect wind farms can play. A safety buffer zone surrounding the wind turbines may become a de-facto marine reserve, the exclusion of boats within this zone leading to reduced disturbances from shipping. Exclusion of some, or of all, types of fishing activities could also result in local increases in prey abundance for top predators, whilst reducing the risk of bycatch in fishing gear[6].

Table 1. Impacts of the development of marine wind farms on GES[8]

MSFD Descriptor	Impacts on GES	Future trends
D1 Biodiversity	The construction stage leads to negative impacts on marine biodiversity (abrasion, substrate loss, smothering, death or injury by collision, etc.). At the operational stage, possible environmental benefits (artificial reef role, exclusion of some or all types of fishing) might increase biodiversity around wind turbines.	
D2 Non-indigenous species		
D3 Commercial species	At the operational stage, wind farms might act as an artificial reef that could benefit commercial species.	
D4 Foodwebs		
D5 Eutrophication		
D6 Sea-floor integrity	The construction stage affects seafloor integrity and habitats (sealing, laying cables, smothering, substrate loss, changes in siltation, abrasion)	
D7 Hydrographical conditions	Sediment resuspension, change of water flow rate	
D8 Contaminants	The construction of wind farms may lead to the introduction of synthetic and non-synthetic compounds in the sea.	
D9 Contaminants in seafood		
D10 Marine litter		
D11 Energy	Underwater noise mainly at the construction stage.	

4. INTERACTIONS WITH OTHER SECTORS

Wind energy

Large-scale offshore wind farms can conflict with other interests such as shipping, fishery, extraction of sediment, laying of cables and pipelines and military activities.

The aesthetic changes that wind farms bring to the natural landscape may negatively affect Mediterranean tourism and recreational activities. Evidence from the Vectors project shows that an offshore windfarm developed in front of a beach can lead to a 10%-13% decrease in the total number of beach users[10].

In the medium to long term, there may be opportunities to combine offshore wind farms with open ocean aquaculture[6].

Despite the fact that the Mediterranean Sea is not the main priority for the development of the marine renewable energy sector, ports will still need to be developed to facilitate future offshore renewable energy deployments[3].

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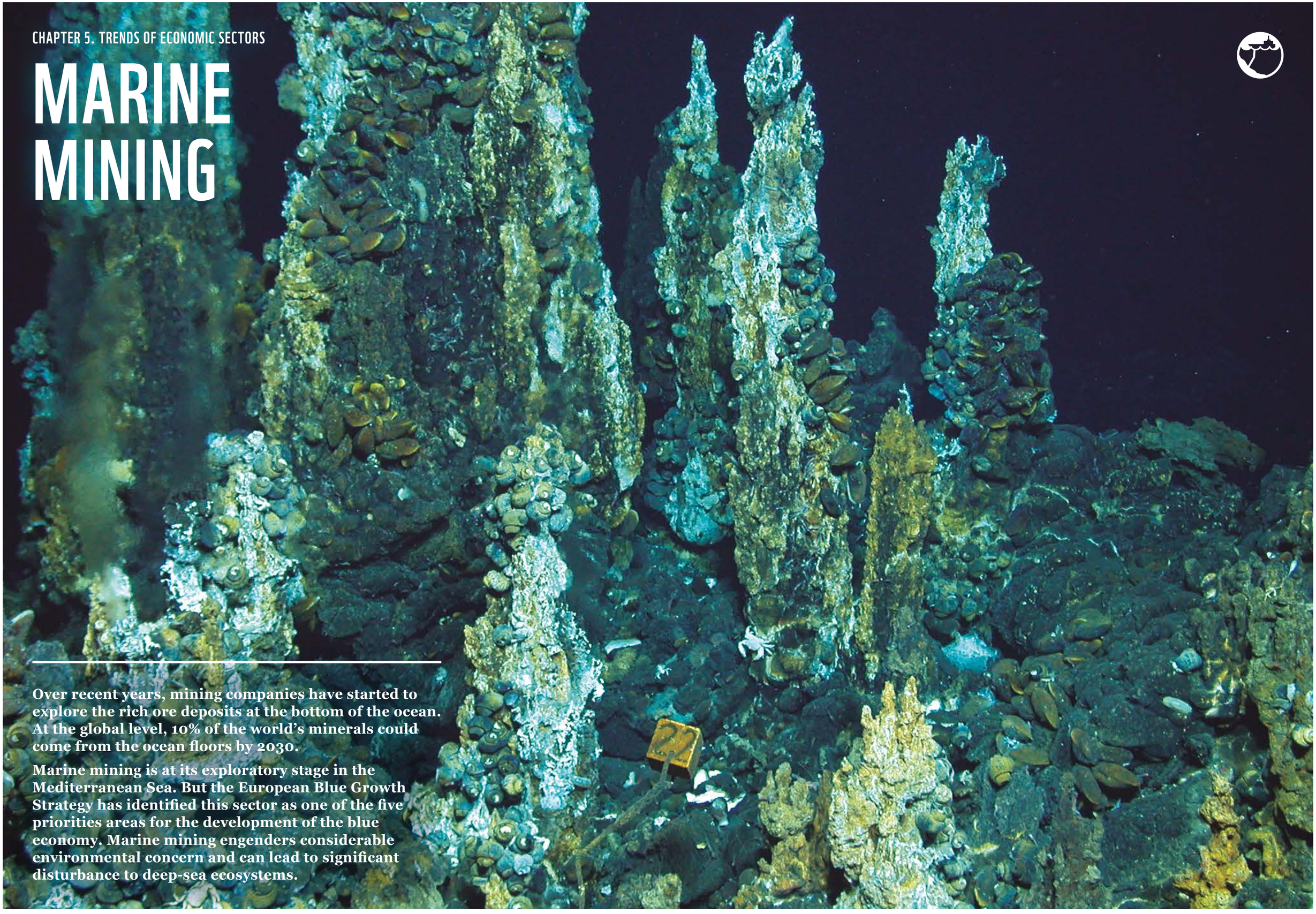
MARINE MINING



SEAFLOOR SULFIDE CHIMNEYS ON THE EASTERN LAU SPREADING CENTER. KINGDOM OF TONGA-WOODS HOLE OCEANOGRAPHIC INSTITUTION AND CHARLES FISHER, PENNSYLVANIA STATE UNIVERSITY

Over recent years, mining companies have started to explore the rich ore deposits at the bottom of the ocean. At the global level, 10% of the world's minerals could come from the ocean floors by 2030.

Marine mining is at its exploratory stage in the Mediterranean Sea. But the European Blue Growth Strategy has identified this sector as one of the five priorities areas for the development of the blue economy. Marine mining engenders considerable environmental concern and can lead to significant disturbance to deep-sea ecosystems.

1. BACKGROUND AND CURRENT SITUATION

Deep sea mineral mining involves the excavation of mineral deposits located in the deep sea (over 1km depth), which requires the installation of mining systems, operating high pressure hoisting pipes and a surface-level mining platform connected to transportation vessels [1].

The most likely target products for deep-sea mining are polymetallic massive sulphides, polymetallic nodules and cobalt-rich ferromanganese crusts. Together, they could supply copper, nickel, lead, zinc, cobalt and a range of precious and trace metals of commercial value. At a longer time scale, Rare Earth Elements (REEs) that are present in deep-sea mud may also become strategic as land-based reserves become progressively less accessible. There is also considerable interest from some countries in the extraction of offshore gas hydrates as a source of hydrocarbons [2].

Mineral exploration activities have already taken place in prospective areas of the ocean beyond national jurisdiction under license from the International Seabed Authority, most notably around the Clarion-Clipperton Zone in the Pacific Ocean, parts of the Indian Ocean and along the Mid-Atlantic Ridge [2]. The Mediterranean Sea is not a priority area and there are currently no ongoing deep-sea mining operations.

2. FUTURE TRENDS

The interest in seabed mining is being driven by the growing global demand for metals and minerals for use in electronic devices such as mobile phones. The prospect of a race for the bottom of the ocean is alarming the scientific community. By 2020, 5% of the world's minerals, including cobalt, copper and zinc, could come from the ocean floors. This could rise to 10% by 2030 [3].

For the EU, the security of metal supplies is an important consideration. In 2012, the European Commission released its Blue Growth strategy, which identified seabed mining as one of the five "priority areas" that could deliver sustainable growth and jobs in the blue economy [3]. Potential areas for seabed mining have been identified in European waters, including in the Mediterranean Sea [4]. In particular, sulphide deposits have been identified along the Italian and Greek coastlines (Figure 1).

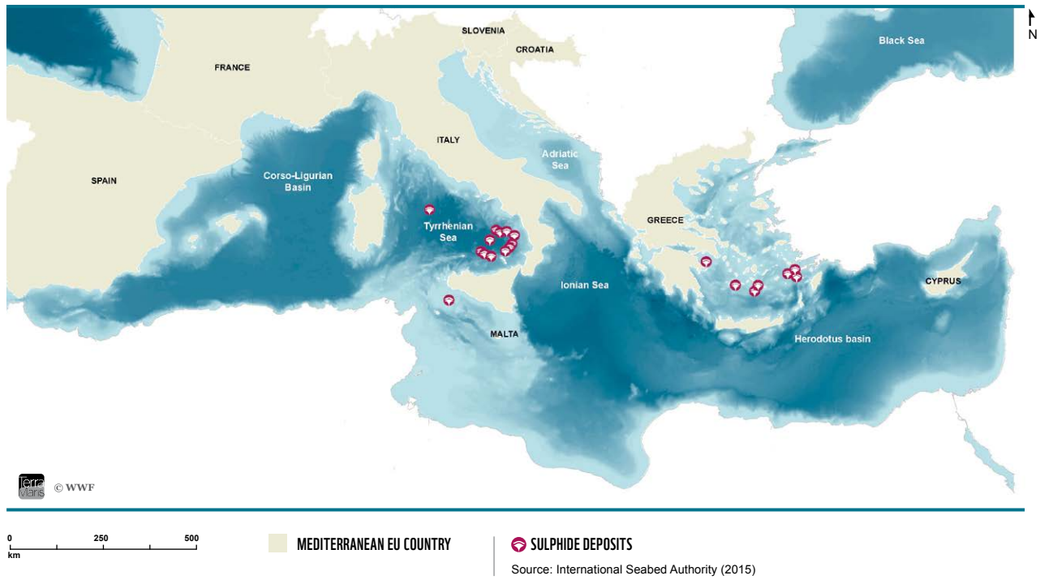


Figure 1. Deep-sea mineral resources in the Mediterranean

While the market for offshore mineral resources is still in its infancy, the economic potential for deep sea mining is considered to be large. It is still uncertain how this potential can be tapped, as technologies allowing cost-effective extract and transport of minerals have not yet been developed[1].

3. IMPACTS ON GES

There is considerable environmental concern regarding the disturbance of deep-sea ecosystems by the extraction of mineral resources. The functioning of deep-sea ecosystems is crucial to global biogeochemical cycles. Operations on the seafloor may destroy unique habitats and disturb deep-sea ecosystems which could entail changes in long-living fish stocks and primary production.

The highest potential impacts are [1]:

- large-scale loss of habitat due to extraction techniques;
- the toxicity of the residual seabed and any talus that might be deposited;
- the impact of sediment plumes on pelagic organisms in terms of particle content and chemical toxicity;
- disrupted behaviour of some organisms e.g. migrating organisms.

The environmental impact of and the risks involved in, exploration of the deep sea environment are significant but highly uncertain, as data on potential impacts is scarce [1]. More research should be conducted into the environmental impacts of this activity.

Table 1. Potential impacts of marine mining on GES

MSFD Descriptor	Pressures exerted by Oil and gas exploration and extraction	Future trends
D1 Biodiversity	Large-scale loss of habitat due to the extraction techniques, disrupted life habits of some organisms, impacts on pelagic organisms	↗
D2 Non-indigenous species		
D3 commercial species		
D4 Foodwebs	Chemical toxicity affecting foodwebs	↗
D5 Eutrophication		
D6 Sea-floor integrity	Disturbance of the largely unknown benthic layer	↗
D7 Hydrographical conditions		
D8 Contaminants	Increasingly toxic water column	↗
D9 Contaminants in seafood		
D10 Marine litter		
D11 Energy	Marine noise caused by extraction activities	↗

4. INTERACTIONS WITH OTHER SECTORS

Today, this activity is at the exploratory stage in the Mediterranean Sea. Its development can lead to space conflicts with other sedentary activities, such as oil and gas exploration and extraction, or the development of wind farms.

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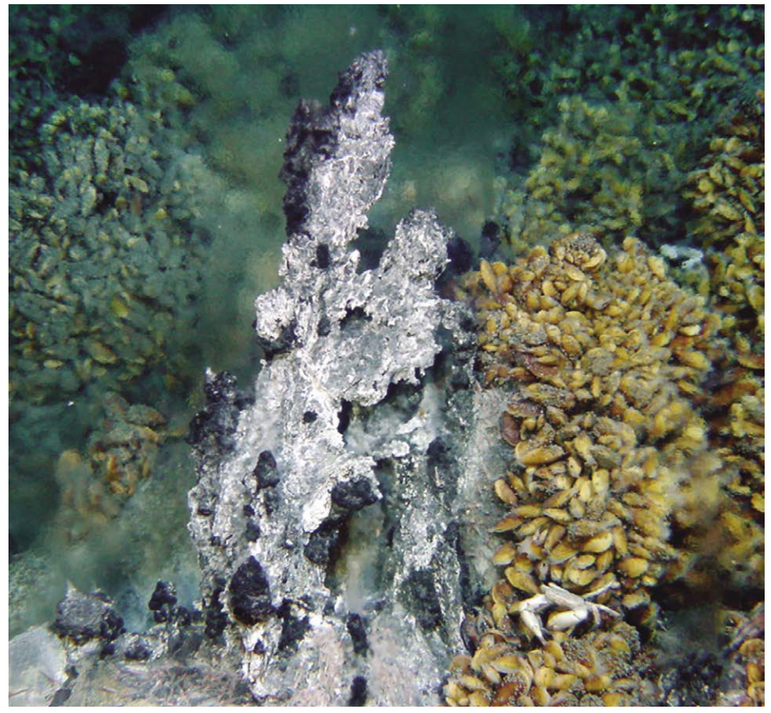

Menez Gwen Hydrothermal Vents, Azores/Portugal

COASTAL DEVELOPMENT

GULF OF LION CORSICA SARDINIA (2014) © NASA EARTH OBSERVATORY

Most Mediterranean countries share the challenge of rapid coastal development that results from growing coastal populations and a high seasonal influx of tourism. Coastal populations will continue to grow in the future, in particular in Southern and Eastern Mediterranean countries. And 500 million international tourists a year are expected to visit the Mediterranean basin by 2030. As a result, an increased rate of artificialisation of the coastline and a reduction in the overall quality of the coastal environmental can be expected.

1. BACKGROUND AND CURRENT SITUATION

Demographic growth, urbanisation and the development of the tourism sector explain the importance of coastal development in the Mediterranean basin (see the section on tourism for further information on this sector). Around 487 million people live in Mediterranean countries (2013 [1]). From 2000 to 2013, the Mediterranean population increased by 17% [1]. Population is more concentrated in Northern and Eastern Mediterranean countries (such as Egypt, Turkey, France, Italy and Spain) that record high population density [2] . As shown in Figure 1, population density is high in coastal areas - around one-third of the population of Mediterranean countries live on the coast.

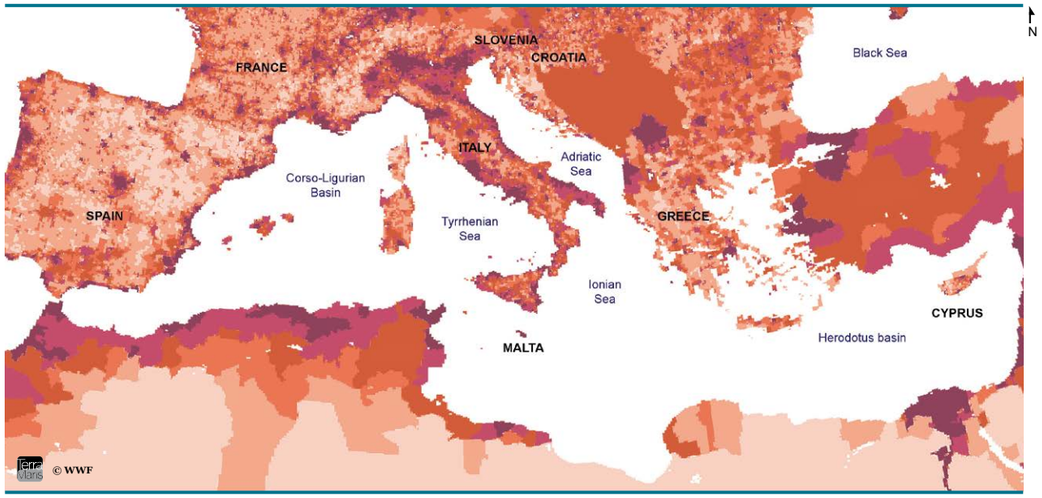

Figure 1. Estimated population density in Mediterranean countries in 2015

The table below shows the distribution of the population living in coastal areas at different distances from the sea, stressing the importance of coastal regions for the majority of Mediterranean countries.

Following worldwide trends, urban development has been very rapid in the Mediterranean region [4]. The number of coastal cities with more than 10,000 inhabitants almost doubled in the Mediterranean basin from 1950 to 1995 [5].

Table 1. Share of population (in % of the total country population) living within coastal strips of different sizes

Country	Within 5 km from the sea	Within 15 km from the sea	Within 50 km from the sea
Malta	98	100	100
Spain	46	69	94
Italy	34	55	94
France	25	40	67
Slovenia	22	34	93
Cyprus	n.a	n.a	100
Croatia	n.a	n.a	n.a
Greece	n.a	n.a	98

(Based on NUTS 2010 and a population grid for 2006 [3]. N.a. = data Not Available. This includes figures of non-Mediterranean coasts)

Adopted in January 2008, and ratified in 2010 [6] by the contracting parties to the Barcelona Convention, the Integrated Coastal Zone Management (ICZM) Protocol is the first supra-State legal instrument aimed at coastal zone management and that addresses the challenges and impacts of coastal development. It has been ratified by 9 countries (Slovenia, France, Albania, Spain, Syria, Montenegro, Morocco, Croatia, Israel) and by the EU [7]. An Action Plan has been defined for supporting the implementation of the Protocol via national planning and regional cooperation.

2. FUTURE TRENDS

The population is expected to grow in most Mediterranean countries in the coming years. Population increase will be greater in Eastern Mediterranean countries (e.g. + 59% is expected between 2010 and 2030 for the State of Palestine, +44% for Jordan [1]). The total national population of EU Mediterranean countries is expected to grow by 5% from 2010 to 2030 [1], which represents a significant increase for areas that are already heavily populated. The coastal density is expected to intensify as well.

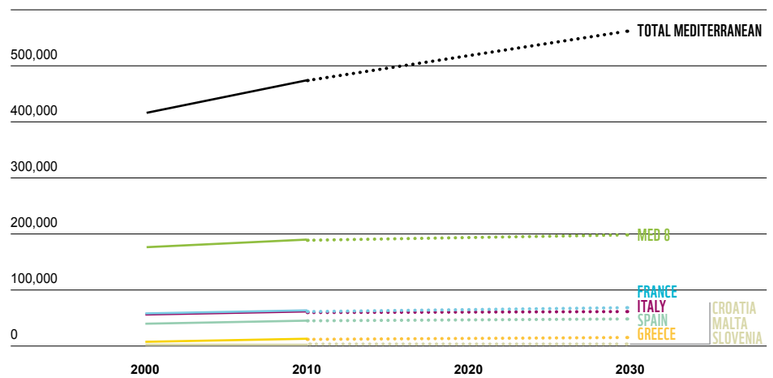

Figure 2. Expected population trends in Mediterranean EU countries (in thousands) [1] (MED8 stands for the sum of the 8 EU Mediterranean countries)

3. IMPACTS ON GES

Artificialisation of the coastal and marine ecosystems is the main impact of coastal development, which leads to habitat fragmentation and deterioration. As shown in Figure 3 artificialisation is especially important on French and Spanish coasts, where more than 15% of the coastline has been artificialised.

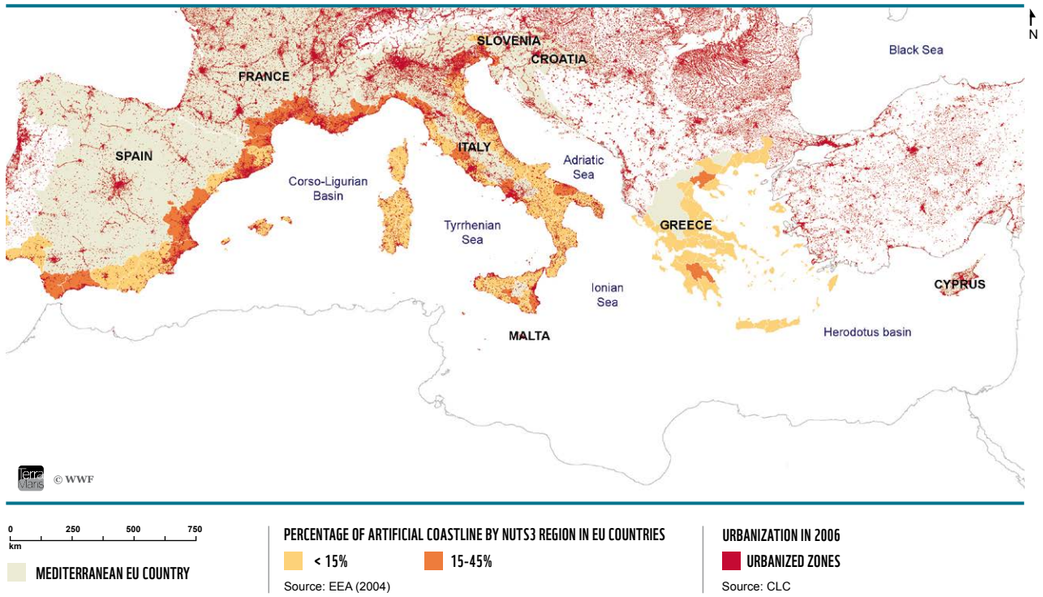

Figure 3. Percentage of arficial coasts in EU countries

At the Mediterranean basin level, Blue Plan estimates that 5,000 km of additional coastline will be artificialised by 2025 as compared to the 2005 situation [8].

Several types of infrastructure lead to the artificialisation of marine areas: harbours, artificial beaches or infrastructure controlling coastal and beach erosion. The development of harbours is a key driver of artificialisation. In France, for example, the development of harbours causes 80% of the artificialisation of shallow marine waters [9].

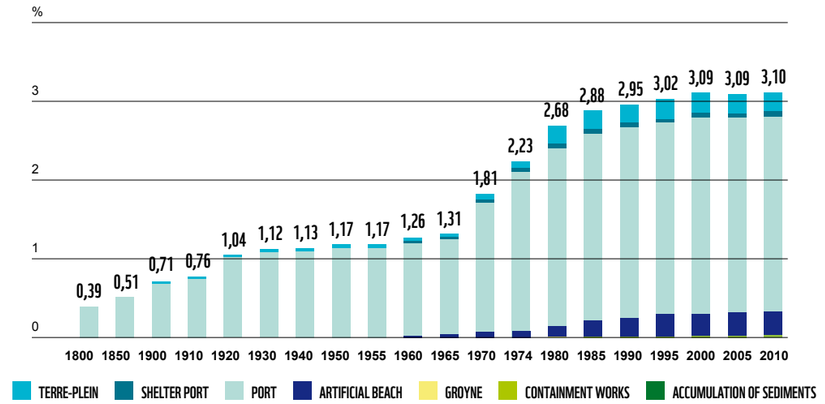

Figure 3 Percentage of artificialised shallow marine habitats (between 0 and 20m) along the French Mediterranean coast (%) [9]

Other major impacts of coastal development, including the discharge of polluted waste water [2] , are treated in the "Land-based Pollution Sources" section.

Table 2. Impacts of the coastal development on GES

MSFD Descriptor	Pressures exerted by coastal development	Future trends
D1 Biodiversity	Smothering, sealing, Introduction of other substances, whether solid, liquid or gas	↗
D2 Non-indigenous species		
D3 Commercial species	Destruction of habitats, Potential impacts through contaminants and released polluted water	↗
D4 Foodwebs	Destruction of habitats, Potential impacts through contaminants and released polluted water	↗
D5 Eutrophication		
D6 Sea-floor integrity	Physical damages	↗
D7 Hydrographical conditions		
D8 Contaminants	Potential impacts through contaminants and released polluted water	↗
D9 Contaminants in seafood	Potential impacts through contaminants and released polluted water	↗
D10 Marine litter	Increasing impacts through introduction of waste	↗
D11 Energy		

4. INTERACTIONS WITH OTHER SECTORS

Coastal development may have an impact on all sectors that rely on ecosystem services, most notably fisheries and tourism.

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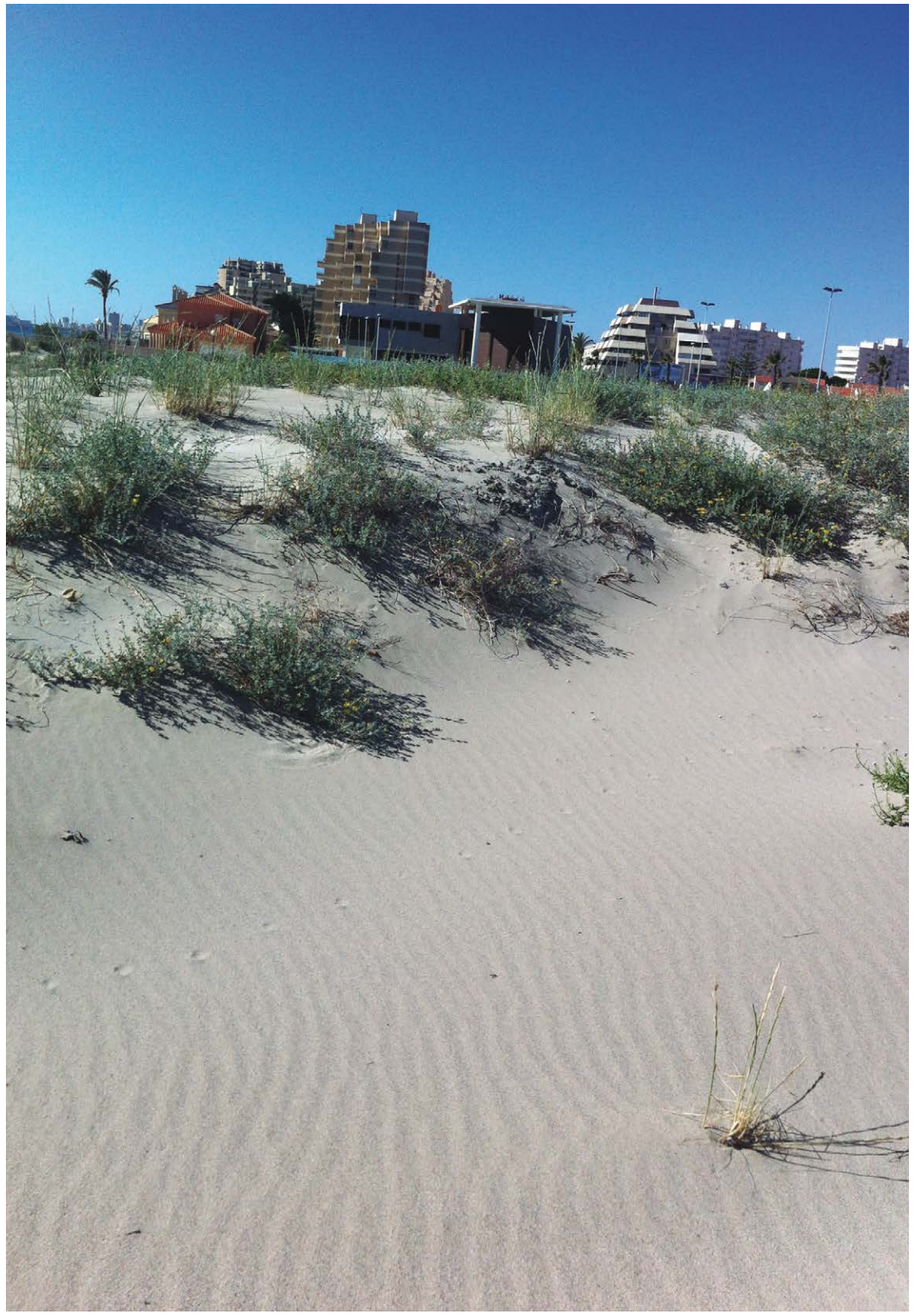

Coastal development in Spain

LAND-BASED POLLUTION SOURCES

ALUMINIUM CAN ON THE BEACH OF ARGELÈS-SUR-MER, FRANCE © EMMANUELLE RIVAS

Eighty percent of marine pollution originates from land-based human activities. Different types of pollutants (e.g. nutrients, heavy metals, Persistent Organic Pollutants, marine litter) affect marine and coastal ecosystems and related economic activities such as fishing or tourism. Due to continuing progress in wastewater treatment, pollution from wastewater is expected to keep decreasing over the next 15 years. For heavy metals, an upward trend in heavy metal pollution can be observed in the Mediterranean Sea for mercury and lead. Persistent Organic Pollutants (POPs) are expected to slowly decline. Nutrient discharges into the Mediterranean Sea are expected to increase slightly over the next 15 years.

A. INTRODUCTION

Marine and coastal pollution affects water, sediments, and biota. Pollutants enter the Mediterranean Sea from the shore through rivers, by atmospheric deposition, or by marine activities[1]. Different kinds of substances are present due to human activities, in particular: organic compounds (e.g. phenols, pesticides, chlorinated hydrocarbons), heavy metals (e.g. cadmium, zinc, nickel, mercury), Persistent Organic Pollutants (POPs), nutrient (Nitrogen, Phosphorus) and marine litter[1].

Eighty percent of marine pollution originates from land-based human activities, mainly from northern Mediterranean countries[2]. Pollution comes from discharge points and dumping grounds (point-source pollution) and from surface fluvial run-off (non-point-source pollution)[3]. The largest freshwater discharge to the Mediterranean Sea is provided by the Rhone River in its North-western part. Together with the Po River which flows into the Adriatic Sea, they provide about 25% of the total continental freshwater discharge to the Mediterranean Sea 4].

In 2005, the Euro-Mediterranean Partners committed themselves through the **"Horizon 2020 Initiative"** (or H2020 Initiative) to increasing efforts to reduce the pollution of the Mediterranean by 2020. This initiative was translated into a 2007-2013 Road Map of actions addressing the main sources of pollution **(municipal waste, urban waste water and industrial pollution)**.

B. DISCHARGED ORGANIC MATTER FROM WASTEWATER

1. BACKGROUND AND CURRENT SITUATION

Organic matter in coastal and marine waters originates mostly from urban/domestic and industrial wastewater, entering marine waters through direct point-source discharges or through rivers.

Organic-matter pollution in industrial wastewater was documented by MEDPOL in 2003 through an inventory of industrial point sources of pollution. The areas with the highest Bio-chemical Oxygen Demand (BOD) are the southern shore of the Western Mediterranean basin, the Eastern coast of the Adriatic, the Aegean and the North-eastern sector of the Levantine basin. In the northern Mediterranean, BOD is mainly released by wastewater treatment plants and by the food industry, while in the Southern and Eastern Mediterranean Sea, other sectors like oil refinery, livestock farming, textiles, paper or fertilisers are important pollution emitters[1] (Figure 3.).

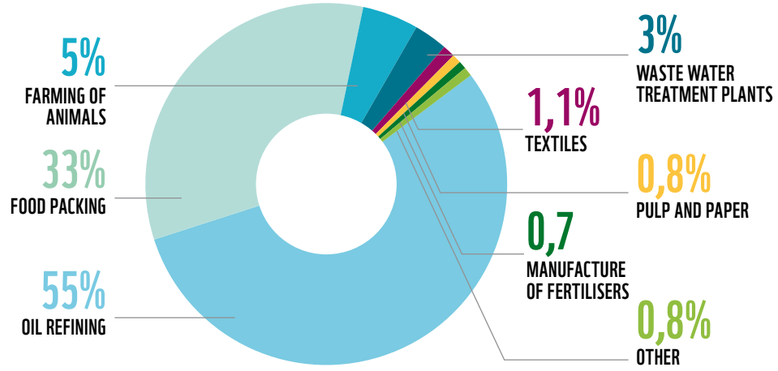

Figure 1. Major point sources of organic water pollutants in the Mediterranean[1]

Important investments in wastewater treatment infrastructure have been made since the launching of the H2020 initiative[5]. EU Member States must implement the EU regulatory framework, in particular the Urban Wastewater Treatment Directive (UWWTD), the Water Framework Directive and, since 2008, the Marine Strategy Framework Directive. The 7th implementation report (2013) for urban wastewater treatment in Europe shows improvements in collection and treatment, although significant differences remain between Member States. The vast majority (91%) of the pollution load from the EU's largest cities benefit from more stringent treatment levels. The graph below shows the compliance level to the UWWTD of each individual Member State. Some EU Mediterranean countries are lagging behind, especially islands (Cyprus and Malta) and Slovenia. France and Greece have reached a high level of compliance for Articles 3, 4 and 5 of the UWWTD.

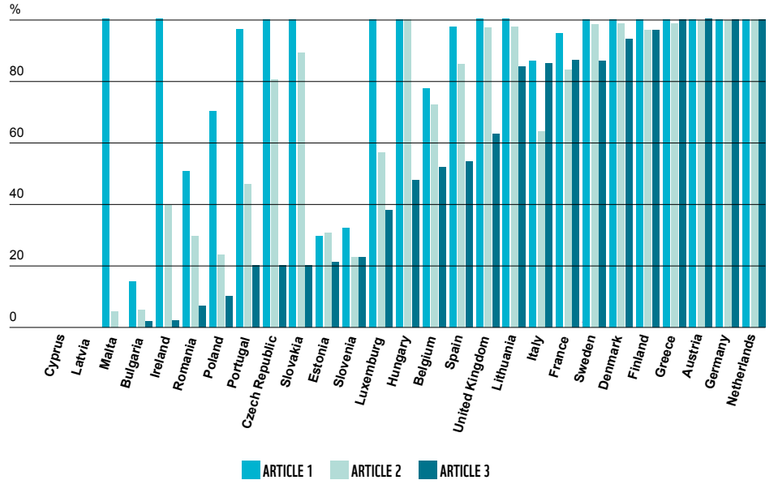

Figure 2. Percentage to which each of the EU27 are compliant with the Wastewater Treatment Directive (2013)[6]

2. FUTURE TRENDS

Due to continuing progress in wastewater treatment, pollution from wastewater should keep on decreasing over the next 15 years.

C. HEAVY METALS

1. BACKGROUND AND CURRENT SITUATION

Heavy metals present in marine and coastal waters mostly originate from the activities of fertiliser industries, metal industries, oil refineries and wastewater treatment plants, and to a lesser extent the energy sector and the chemical industry (Figure 3.). Heavy metals from land-based sources may not only accumulate in coastal zones but may also move through advection into the deeper areas of the continental margin or the deep basin[1].

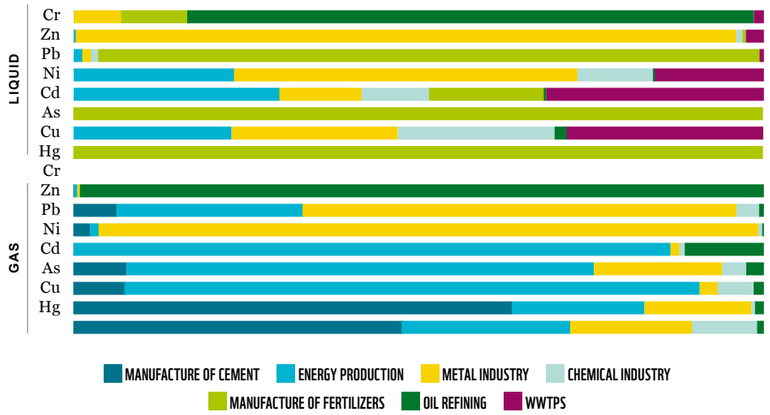

Figure 3. Major industrial sectors emitting heavy metals in the Mediterranean (2008)[1]

2. FUTURE TRENDS

Information regarding heavy metal concentrations in the Mediterranean Sea is scarce. Information on heavy metal concentrations of seawater in Croatia, France and Italy shows that lindane concentration in mussels has reduced over time, while mercury and lead concentrations have increased. Improvement in data collection and reporting is a prerequisite for estimating long-term trends in heavy metal concentrations in the Mediterranean Sea[7].

D. PERSISTENT ORGANIC POLLUTANTS (POPS)

1. BACKGROUND AND CURRENT SITUATION

POPs are organic compounds that are very resistant to natural breakdown processes and can accumulate in human and animal tissue with potentially significant impacts on human health and the environment. Examples of POPs are dioxins and furans, hexachlorobenzene (HCB), PCBs and Polycyclic Aromatic Hydrocarbons (PAHs). **The Northern Mediterranean coast**, and in particular its coastal enclosures (harbours and coastal lagoons), are the **areas of most concern for sediment pollution by POPs** mainly associated with urban/industrial and river discharges[1].

2. FUTURE TRENDS

Very high levels of POPs have been historically measured in the marine environment, especially in top predators and cetaceans. In some cases, concentrations still remain relatively high[1]. Global trends show that the concentrations of POPs are slowly declining in marine mammals around the world. However, it is not clear whether this results from declining use of POPs worldwide or from mammals' dietary changes caused by climate change.

E. NUTRIENTS

1. BACKGROUND AND CURRENT SITUATION

Many Mediterranean coastal areas are threatened by **nutrient over-enrichment** due to coastal and watershed developments. Most of the nutrients come from municipal sewage, animal waste, fertilisers and industrial discharges[1]. Coastal areas suffer particularly from increased influx of dissolved **nitrogen** and **phosphorus.** While agriculture is the largest non-point source of nutrients in the Mediterranean Sea via groundwater and rivers, there are also many point-sources of nitrogen and phosphorous (Figure 4).

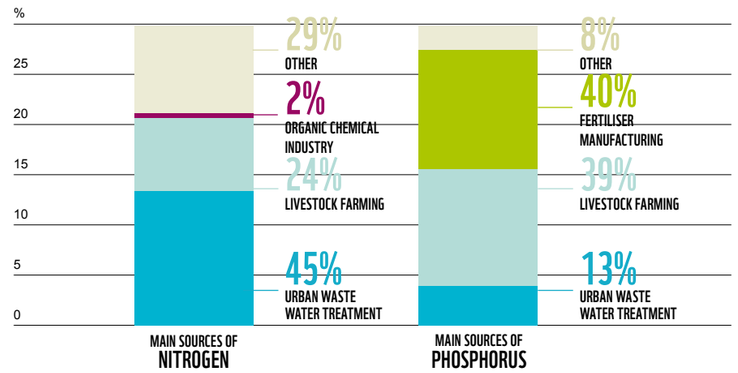

Figure 4. Main sources of nitrogen and phosphorous in the Mediterranean Sea[1]

European countries and Egypt are the major users of fertilisers in the Mediterranean region.

Although the overall inputs of nitrogen and phosphorus are low compared to other regional seas (e.g. the Black Sea), current nutrient loads to the Mediterranean Sea are problematic in coastal areas. The problem of over-enrichment is particularly acute in shallow areas with limited flushing, such as the Adriatic Sea and along the Mediterranean's southern shore[1].

For marine animal and plant communities, oxygen depletion caused by either input of organic matter in wastewater or by human-induced eutrophication (resulting from productivity increasing because of the extra supply of nutrients) may be fatal. Addition of organic matter and eutrophication are often caused by the same sources and act together to deplete oxygen.

Figure 5 presents the main eutrophic and hypoxic hotspots in the Mediterranean Sea, highlighting the challenges faced in the Northern Adriatic Sea.

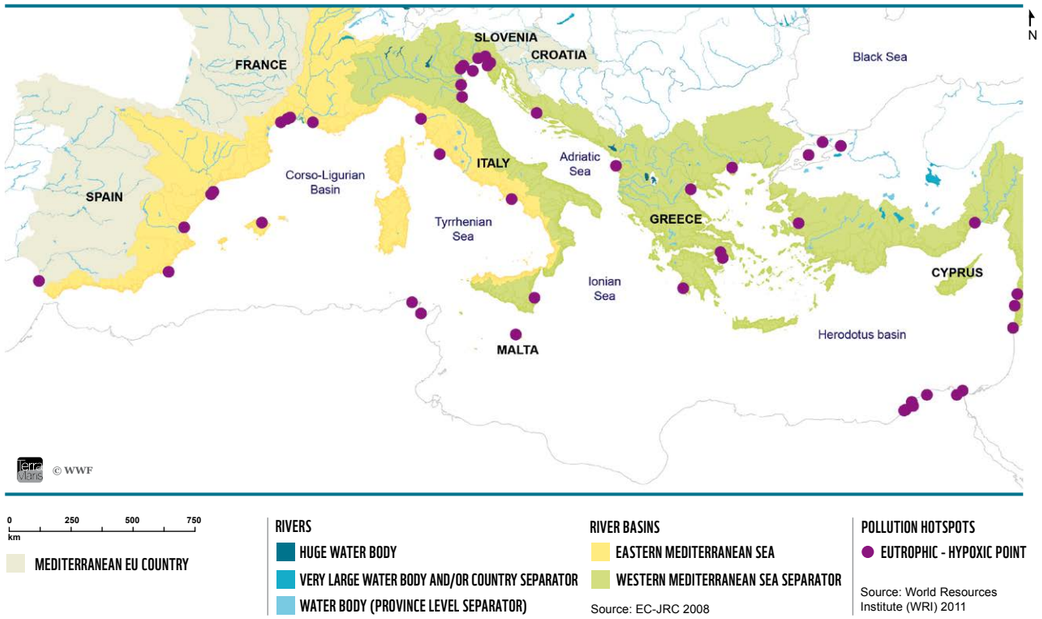

Figure 5. Main eutrophic and hypoxic hotspots along the Mediterranean coastline

2. FUTURE TRENDS

Concentrations of nutrients have been increasing for 20 years, but these have been limited to such zones as the North Adriatic Sea, the Gulf of Lions and the Nile delta[5]. Nutrient discharges into the Mediterranean are projected to continue to increase slightly within the next 15 years (Figure 6).

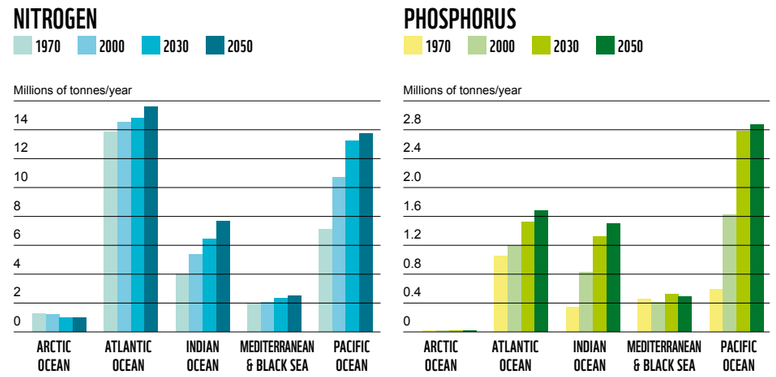

Figure 6. River discharges of nitrogen and phosphorus into the sea, 1970-2050[8]

Eutrophication is a localised phenomenon in the Mediterranean Basin. Better monitoring regimes and analysis of resulting data to determine trends will, in the future, allow robust statements of the effect of eutrophication on the ecology, as well as on fisheries and other valuable ecosystem services[1].

F. MARINE LITTER

1. BACKGROUND AND CURRENT SITUATION

Anthropogenic litter is present in all marine habitats, from beaches to the most remote points in the oceans. On the seafloor, marine litter, particularly plastic, can accumulate in high densities. Yet, because of the high costs associated with sampling the seafloor, no large-scale assessment of distribution patterns is available to date. Figure 7 shows litter densities (kg ha–1) in various locations across the Mediterranean Sea obtained from trawl surveys[9].

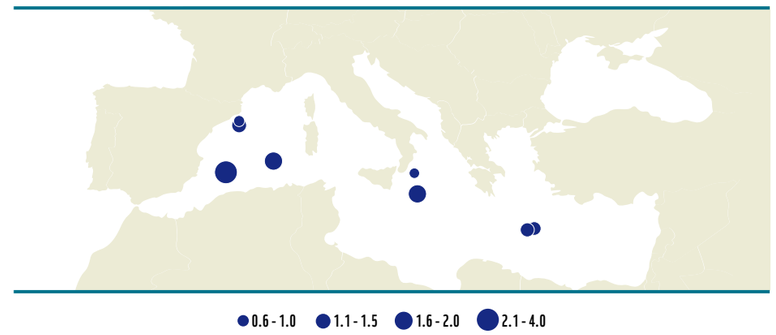

Figure 7. Litter densities (kg ha^{-1}) in different locations across the Mediterranean Sea obtained from trawl surveys[9].

2. FUTURE TRENDS

Litter disposal and accumulation in the marine environment is one of the fastest growing threats for the health of the world's oceans. This upward trend is correlated to population and economic growth. Southern Mediterranean countries produce half as much waste as the EU countries, but in growing quantities[5]. In 2013, the Conference of Parties of the Barcelona Convention adopted a regional plan to manage marine litter. Marine litter is one of the 11 Descriptors set by Europe's Marine Strategy Framework directive.

6. IMPACTS ON GES

These land-based pollutants sources impact on marine and coastal ecosystems in various ways, and with effects that can be cumulative. Figure 8 shows the percentage of classified water bodies in less than Good Environmental Status or potential in coastal and transitional waters [10].

Figure 8. Percentage of water bodies classified as " less than Good Environmental Status or potential" in European coastal and transitional waters (Temporal coverage 2005-2010)

The presence of toxic substances in the marine environment (mercury, cadmium, lead), even at low concentration levels, can lead to biochemical reactions that may cause stress to marine organisms. Concentrations of mercury in Mediterranean fish are twice as high as those found in the same species living in the Atlantic Ocean[1].

POPs modify the reproductive systems of animals, such as the Mediterranean swordfish, which may constitute a threat to the survival of species[1].

Eutrophication can lead to hypoxic and anoxic conditions which can result in the death of marine organisms. Both fish and shellfish kills resulting from eutrophication have been recorded in the Mediterranean Sea[1]. One of the most serious consequences of eutrophication is algal blooms. Although coastal pollution is not the primary cause of algal blooms, they are closely related. Harmful algal blooms can cause human illness and mortality, economic losses to coastal communities and commercial fisheries, and mortality of fish, birds and mammals. At least 57 species of algae are reported to cause algal blooms in the Mediterranean.

More information is required on the impact of marine litter on Mediterranean wildlife. The most significant effects come from entanglement in, or ingestion of marine litter, especially plastics[1]. A recent study showed that endangered Mediterranean seabirds are suffering from ingestion of plastic litter. Overall, 66% of 171 seabirds studied were found to have plastic fragments in their stomachs and the critically endangered Balearic shearwater was among the most affected[11].

Increased attention is being given to the impact of microplastics that can progressively integrate the food web through fragmentation and/or through dissolution of chemicals in the sea water, with negative effects on marine organisms.

Table 1. Impacts of land-based pollution sources on GES in the Mediterranean Sea[1]

MSFD Descriptor	Impacts on GES	Future trends
D1 Biodiversity	Entanglement in or ingestion of marine litter, especially plastics; mortality of fish, birds and mammals caused by harmful alga blooms ; bioaccumulation of toxins; endocrine systems disrupted and reproductive systems of swordfish modified by POPs; ecological stress exacerbated by elevated concentrations of heavy metals; biochemical reactions caused by toxic substances; negative effects of cadmium on top predators; negative effects of lead on predators of shellfish.	↘ ↗
D2 Non-indigenous species		
D3 Commercial species	Red tides may cause damage to fish and mollusc farming	↘
D4 Foodwebs	Shift in phytoplankton species caused by changes in nutrient concentrations and N:P ratios (e.g. Macrophytes such as Cystoseira spp., Dictyota spp. and Halymenia spp. are being replaced by short-lived algal species)	↘
D5 Eutrophication	Fish and shellfish kills have been recorded in the Mediterranean caused by oxygen depletion. Most vulnerable areas to eutrophication are semi-enclosed basins, estuaries and lagoons.	↘
D6 Sea-floor integrity		

MSFD Descriptor	Impacts on GES	Future trends
D7 Hydrographical conditions		
D8 Contaminants	Land-based releases of heavy metals, nutrients, POPs.	↘
D9 Contaminants in seafood	Filter feeders such are vulnerable to toxic elements that they concentrate by filtering. POPs and heavy metals can accumulate in animal tissues which can be toxic for human health and the environment.	↘
D10 Marine litter	Entanglement or ingestion caused by marine litter, especially plastics. More attention is now being given to the impact of microplastics that can have also negative effects on organisms.	↘ ↗
D11 Energy		

H. INTERACTIONS WITH OTHER SECTORS

Together with overfishing and marine habitat degradation, pollution constitutes a major challenge for fisheries in the Mediterranean region. According to IUCN, it affects 7.5% of native marine fish in the Mediterranean.

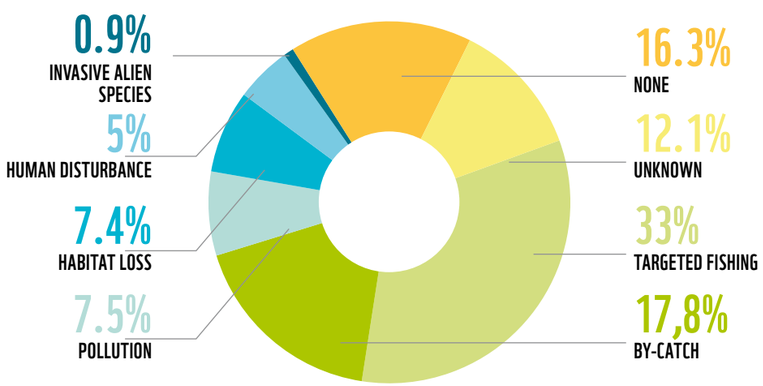

Figure 9. Major threats to native marine fish in the Mediterranean Sea[12]

Pollution also negatively affects the water quality of beaches. Tourism, although it contributes to marine pollution, is very dependent on a healthy marine environment.

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CHAPTER 6:

CROSS-CUTTING ANALYSES

The assessments of future economic developments in the Mediterranean Sea stressed that most key maritime sectors will record a positive growth in the coming decades. While there are efforts made at various levels to reduce the pressures from these sectors, there is a risk that combined positive economic growths lead to competition between sectors and further deterioration of the ecosystems of the Mediterranean Sea.

In this context, this section addresses the following questions:

- How will the interactions between the different maritime sectors evolve within the next 15 years?
- How will the main pressures exerted on the Mediterranean ecosystems evolve?
- What are the risks of not achieving Good Environmental Status (GES) by 2020, as defined by the Marine Strategy Framework Directive (MSFD)?
- How will growing maritime activities potentially interact with Marine Protected Areas (MPAs)? How can the 10%-target of MPA coverage be achieved by 2020?

A. INCREASING INTERACTIONS BETWEEN MARITIME SECTORS

In most of the regions of the world, the Blue Economy is emerging against a background of rapid economic growth in marine sectors. Figure 1 shows rough estimates of the relative sizes of maritime sectors at the global scale and their expected growth to 2030[1]. Despite the uncertainty that can be attached to future estimates, it is expected that **all maritime sectors will significantly grow in the next 15 years except for fisheries** (which will continue to decrease due to continuous high pressures on fish stocks) and land-based pollution sources for which polluting discharges to the sea are expected to decrease in coming years. New maritime sectors, such as offshore renewable energy or seabed mining, will emerge as key maritime sectors. In addition, it is expected that the three biggest sectors, maritime transport, tourism and offshore oil and gas industry will continue to increase in the coming years.

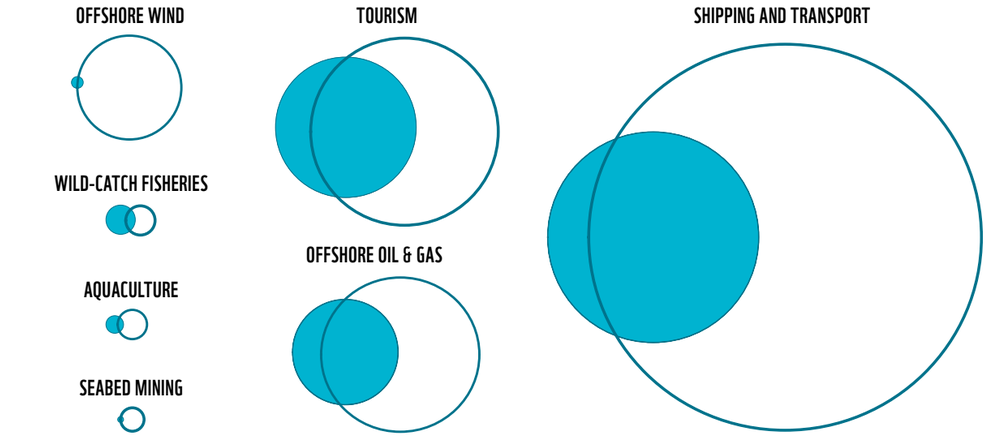


Figure 1. Rough estimates of the relative sizes of maritime sectors at the global scale based on Gross Domestic Products (GDP) figures from 2005[1] and their expected growth to 2030 (projections made by WWF)

For reasons described earlier in the report, **the Mediterranean sea is among the world's marine regions that are and will be most impacted by global drivers of change. For this reason, the development of most maritime sectors in the Mediterranean Sea will most certainly reflect these global trends.** Table 1 summarises the future trends in economic activities.

Table 1. Future trends of maritime sectors

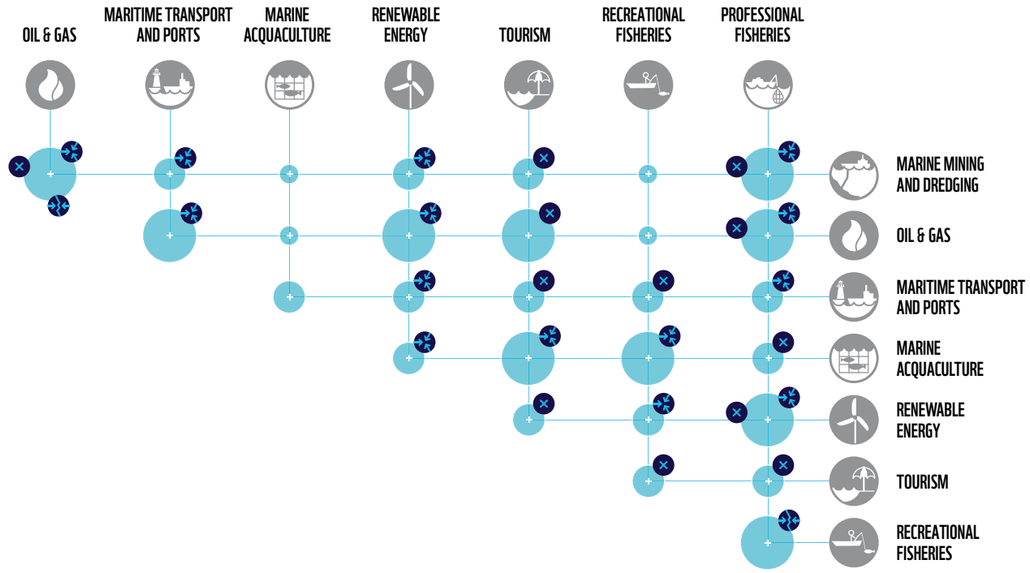
Sector	Expected development trend of sector	Quantified estimates
Oil and gas exploration and extraction	↗	**Offshore oil production could increase by 60% between 2010 and 2020** at the Mediterranean regional level, rising from 0,7 mbd to 1,12 mbd. **Offshore gas production could increase five-fold from 2010 to 2030,** from 55 Mtoe/year to 250 Mtoe/year at the Mediterranean regional level.
Maritime transport and ports	↗	**4% per annum growth rate in global trade over the next decade** can be anticipated and will be reflected on international maritime traffic routes at the Mediterranean regional level (Suez-Gibraltar axis, Aegean Sea, Adriatic Sea, and to a lesser extent the North-Western Mediterranean)
Professional fishing	↘	A **downward trend** is expected at an uncertain rate at the Mediterranean regional level.
Recreational fishing	↗	An **upward trend** is expected at an uncertain rate in the Mediterranean countries of the EU.

Sector	Expected development trend of sector	Quantified estimates
Marine aquaculture	↗	Forecast of fish aquaculture production in the Mediterranean countries of the EU anticipates a **112% increase between 2010 and 2030**. Production should jump from 280 000 tonnes to nearly 600 000 tonnes.
Tourism (coastal tourism, cruise tourism, recreational boating)	↗	**International tourist arrivals in the Mediterranean should increase by 60% between 2015 and 2030** to reach 500 million arrivals in 2030 at the Mediterranean regional level. France, Italy and Spain will remain the three biggest destinations.
Renewable energy	↗	While no marine renewable energy was produced in 2014, predicted production of electricity by offshore wind farms could reach **12 gigawatts (GW) in 2030** in the Mediterranean countries of the EU.
Marine mining	↗	**An upward trend** is expected at an uncertain rate in the mid-term, mainly in the Mediterranean countries of the EU
Coastal development	↗	**5,000 km of additional coastline will be artificialised by 2025 as compared to the 2005** situation at the Mediterranean regional level.
Land-based pollution sources	↗ ↘	In the Mediterranean countries of the EU: • Pollution from wastewater is expected to keep decreasing over the next 15 years. • Persistent Organic Pollutants (POPs) are expected to slowly decline. • An upward trend in heavy metal pollution can be observed for mercury and lead. • Nutrient discharges are expected to increase slightly over the next 15 years.

Table 2 summarises the **potential levels of interaction and risks of conflicts between sectors.** Interactions between sectors vary greatly. For some sectors, interaction might be positive, e.g. the development of offshore wind farms areas providing potential for new aquaculture production sites[2]. On the other hand, the growing development of maritime sectors can lead to potential conflicts, in particular:

- **Conflicts regarding space use** when one sector excludes some or all other sectors from specific areas. This can be the case for coastal activities that develop in already crowded areas. Conflicts may also rise offshore, e.g. between maritime traffic and increasingly developed offshore oil and gas infrastructures;
- **Negative effects** some activities may have on other activities that are highly dependent on healthy ecosystem services (e.g. fishing and tourism);
- **Competing interests** due to the exploitation of the same marine resources. This is the case for professional fishing that competes with the constant increase of recreational fishing.

Table 2. Compatibility between sectors and potential risks of conflicting interests



The overlap of the spatial data from maritime sectors (Figure 2) highlights that:

- **Conflicts for the use of space will grow in coastal areas** due to the development of marine aquaculture, marine tourism, marine renewable energy, recreational fisheries;
- **The oil and gas industry is clearly looking at offshore developments,** leading to potential interaction with the maritime transport sector. Sea-mining is, in the longer term, another sector that may consider offshore development in the Mediterranean.

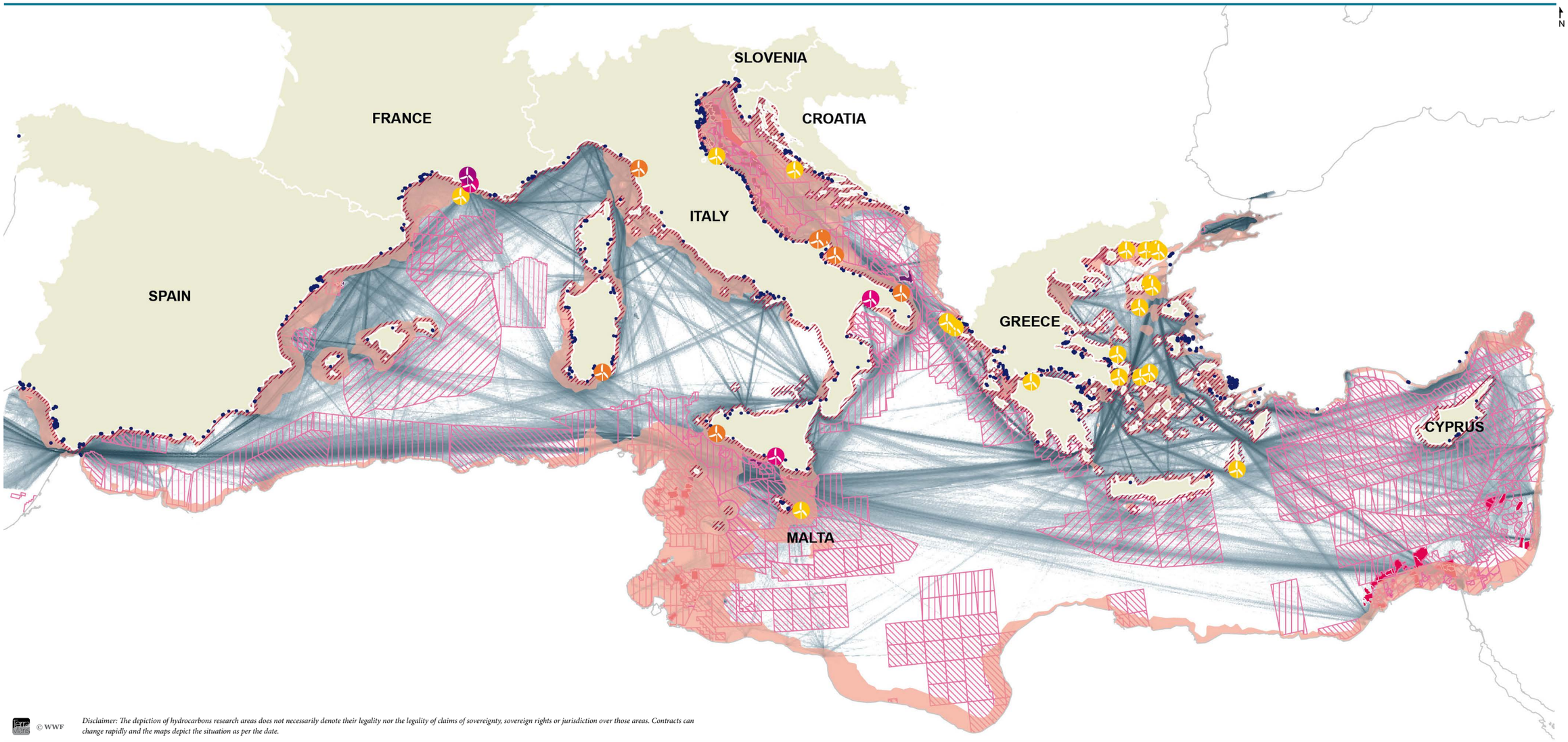
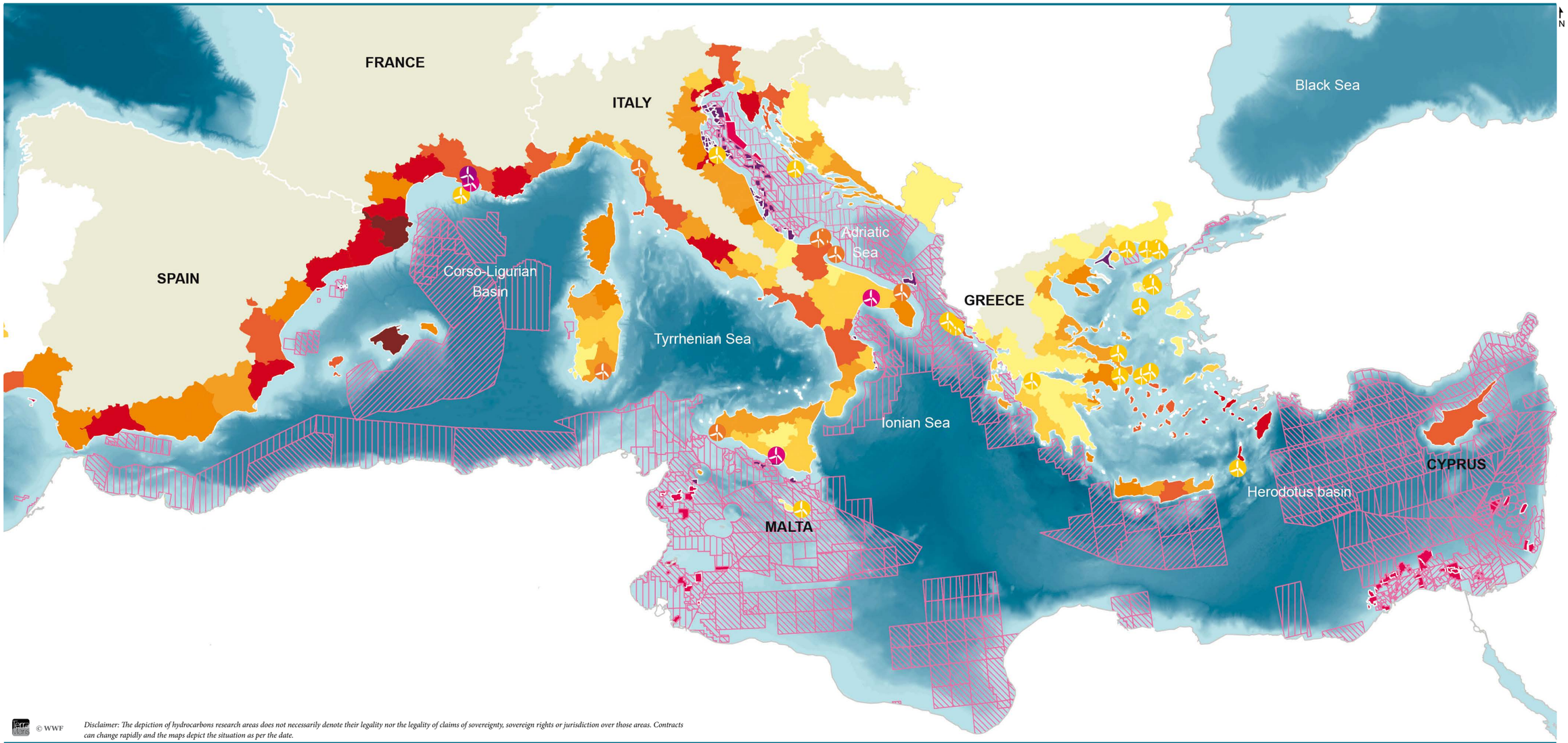


Figure 2. Potential spatial interactions between sectors

Professional fishing is the sector most affected by the growing development of the maritime economy:

- Fishing zones will be reduced in particular along coastal areas due to the increasing development of coastal activities;
- Pressures exerted by other sectors on marine ecosystems (e.g. additional fish catch from recreational fisheries, some land-based pollution types, underwater noise generated by ships and by oil and gas activities) are growing and may impact fish stocks directly or indirectly.



Other conflicts between sectors might emerge, such as between the expected development of the oil and gas industry and coastal tourism due to the potential growing risk of oil spills and the degradation of natural landscape (Figure 3).

Figure 3. Oil and gas development, a new emerging threat for the tourism sector

B. A LIKELY INCREASE OF SOME PRESSURES ON THE MARINE ENVIRONMENT

Most of the pressures imposed by sectors are addressed directly by the EU through its large body of existing policies and legislation. EU policy tools that focus on the marine environment include the Common Fisheries Policy (CFP), the Integrated Maritime Policy (IMP) which covers maritime spatial planning (MSP) and the EU's Blue Growth strategy, the Marine Strategy Framework Directive (MSFD) and its ecosystem approach, the EU Biodiversity Strategy, the EU Strategy on adaptation to climate change which is key to coastal areas and the Water Framework Directive. In addition, the Barcelona Convention protocols provide basin-wide approaches to reach Good Environmental Status for the whole Mediterranean Sea. However, developing synergies between all these policies and ultimately integrating them to enhance their efficiency is far from being achieved today[2]. **Some pressures will increase unless innovative solutions are developed and implemented at a rate that coincides with the increasing exploitation of the seas.**

Table 3 presents the likely trends in pressures for the Mediterranean Sea based on the expected future trends of maritime sectors.

Table 3. Marine pressures and their future trends

Pressures	Main drivers of pressures	Assumption on future trends
Physical loss	Oil and gas exploration and extraction, coastal development, tourism	Damage and loss of marine habitats and species will continue due to the development of maritime activities and the pressures that they exert, mostly on coastal areas through anchoring, dredging, bottom trawling.
Physical damage	Professional fisheries, recreational fisheries, coastal development, tourism	
Other physical disturbance (underwater noise, marine litter)	Professional fisheries, recreation fisheries, marine renewable energy, oil and gas activities, maritime transport, tourism	The increase in maritime traffic, drilling operations, coastal construction works will increase underwater noise and their impacts on marine fauna. Seismic sonar used in the oil and gas industry is the second major source of potential noise impacts on Mediterranean marine mammals, after maritime traffic. Marine litter is one of the fastest growing threats for the health of the world's oceans.
Interference with hydrological processes (significant changes in thermal and salinity regimes)	All sectors	It is expected that ocean warming and salinity will increase over the next 15 years. Ocean acidification will continue along with global warming
Discharge of polluting and hazardous substances	Oil and gas exploration and extraction, maritime transport, land-based pollution sources, maritime transport, marine mining	An increase of toxic compounds is expected along with the increase in oil and gas extraction and the potential development of marine mining. Trend for POPs are expected to be slowly declining.
Nutrient and organic matter enrichment	Marine aquaculture, land-based pollution sources, coastal development, tourism	Organic matter from wastewater should keep on decreasing over the next 15 years. Nutrient discharges into the Mediterranean are projected to continue to increase slightly over the next 15 years. Eutrophication and hypoxia will still be a localised phenomenon.
Biological disturbance (introduction of non-indigenous species, translocations, selective extraction of species)	Professional fisheries, recreational fisheries, marine aquaculture, maritime transport	The enlargement of the Suez Canal and the growing increase of maritime transport will enhance the introduction of invasive species and their translocation. The major part of the assessed fish stocks will certainly continue to be overexploited within the next 15 years.

C. HIGH RISKS OF NOT ACHIEVING GOOD ENVIRONMENTAL STATUS IN 2020

The EU-funded ODEMM project (Options for Delivering Ecosystem-Based Marine Management) has assessed the risk of failing to achieve GES as required under the MSFD for each European Marine Region[3]. Table 4 shows the results of the ODEMM assessment for each of the MSFD descriptors in the Mediterranean Sea at regional level. The assessment also includes species and habitats relevant to the Habitats Directive (92/43/EC). The landscape descriptor is added to the original assessment, since it was identified by the Ecosystem Approach (EcAp) initiative of the Barcelona Convention as being fully relevant for the Mediterranean region.

Table 4. Risks of not achieving the Good Environmental Status by 2020 in the Mediterranean (Source: ODEMM[3], adapted by WWF)

Descriptor/issue		Risk to GES	Risk confidence	Comments
D1 - Biodiversity	1a. Plankton	Moderate	Moderate	Alterations in the dominance of plankton species are ongoing, but no notable or maintained changes are occurring[4]. Mediterranean algal blooms are a localized phenomenon, related to areas of constrained dynamism, such as bays, lagoons, ports, beaches and estuaries.
	1b. Fish	Moderate	Moderate	Trends indicate a decline in the abundance of many species. The greatest threat to fish is from fisheries bycatch, followed by pollution, habitat loss and degradation, and human disturbance. About 73% of bony fish are outside safe biological limits[4] and 42% of cartilaginous fish are considered as threatened[5].

D1 - Biodiversity	1c. Marine mammals and reptiles	High	High	Several species of marine mammal and reptiles are currently threatened with rates of decline in abundance and distributional range suggesting those species may be lost within the next 10 years. The Mediterranean monk seal is now listed as critically endangered on the IUCN's Red List. Threats are increasing with the upward trend of the maritime traffic (noise and risks of collision) and the fast development of offshore oil and gas exploration contracts (noise), including in priority areas for conservation of cetaceans in the Alboran Sea, the Pelagos Sanctuary, the Strait of Sicily and the Aegean Sea (Figure 4). Sea turtles are also very vulnerable to human activities. Contributing to their decline are entanglement in fishing gear, loss of sea grass meadows, degradation of beach nesting habitat due to sand extraction, tourism, light pollution, pollution and plastic waste, and increased ship traffic [4]. The number of nesting female green turtles is declining[4].
	1d. Seabirds	Moderate	Moderate	60% of Annex II SPA-BD species (Barcelona Convention) are listed as threatened or endangered shown by reducing population (breeding) sizes. The increasing loss of suitable disturbance-free habitat along with other pressures will continue to threaten several species of birds typical to the Mediterranean Sea. The likely development of offshore wind farms represents a new threat to seabirds.
	1e. Predominant habitats	Moderate	Moderate	In terms of habitats, nearly all predominant habitat types in the Mediterranean, and in particular the *Posidonia oceanica* sea grass meadows, are declining or exhibiting some degree of degradation with many in poor, endangered or unfavourable status, due to water quality deterioration, anchoring, illegal trawling activities[4] and coastal development.
D2 - Non-indigenous species		High	High	While the Mediterranean Sea has already the largest share of alien species introduction among all European seas[6], introductWWions are expected to keep growing as a result of the expansion of the Suez Canal, increased maritime traffic and growing sea temperature (Figure 5).
D3 - Commercial species		High	High	Over 90% of the total Mediterranean assessed stocks of commercial species are today under overexploitation, being overexploited or ecologically unbalanced. This includes the Mediterranean bluefin tuna, swordfish, albacore tuna[4]. A drastic reduction of fishing effort would be required to stop overexploitation in the Mediterranean Sea. Some priority areas for fisheries conservation such as in the Strait of Sicily and around the Balearic Islands record high levels of fishing activities (Figure 6).
D4 - Foodwebs		High	High	The prevalence of invasive jellyfish species and structure of top predators suggests that the Mediterranean food web is in an advanced state of degradation[3]. Increased pressures on marine mammals and seabirds, overfishing and unintended capture of top-level predators indicates potential further degradation.
D5 - Eutrophication		Moderate	Moderate	Algal blooms, hypoxia, eutrophication hot spots coupled with local oxygen deficiencies are of some concern, but due to low nutrient inputs and given the large area of the basin, eutrophication is a problem limited to sheltered marine waters such as harbours or bays and not expected to be of concern in the next two decades
D6 - Sea-floor integrity		High	High	Bottom trawling operations that can have long-lasting effects on fragile marine ecosystems such as corals or sponge communities, is one of the major contributors to habitat damage in the Mediterranean Sea[4] and in particular in the Western Mediterranean. Offshore constructions, dredging, coastal development, anchoring also contribute to physical damage. Maritime traffic affects both the high seas pelagic habitats and the benthic habitats, as shown by the accumulation of litter on the seabed along the main shipping routes, due to overboard waste dumping[8]. Since these activities are expected to increase over the coming years, increasing impacts on marine seabed are expected.
D7 - Hydrographical conditions		Not assessed	Not assessed	Increases in sea surface and bottom temperatures indicate warming sea in conjunction with continued ocean acidification and increased pCO_2[3]
D8 - Contaminants		Moderate	High	Due to continued progress in wastewater treatment, pollution from wastewater should keep on decreasing over the next 15 years. Regarding heavy metals, an upward trend is seen in the Mediterranean Sea for mercury and lead. Trends for POPs are expected to be slowly declining. Nutrient discharges into the Mediterranean are projected to continue to increase slightly over the next 15 years[9].
D9 - Contaminants in seafood		Low	Moderate	Concentrations of mercury currently exceed benchmark dose limits and concentrations of some heavy metals are high, but they are from heavy metal natural sources[3]. POPs concentrations remain relatively high in some areas[4]. Risks also stem from the effects of cadmium and lead on top predators and on shellfish predators, respectively[4]. Future trends in economic sector development are unlikely however to aggravate the current situation.
D10 - Marine litter		High	High	Marine litter emission, mainly plastics from land-based sources, has significantly increased since the 1930s as a result of the increasing production and consumption of goods. In the last decades, the improvement of waste water treatment plants and sewage collection has reduced macro-waste flows from urban sanitation systems. However shoreline and recreational activities continue to discard large volumes of litter into the marine environment[3]. Marine litter is expected to become a more prominent issue in the future with the increasing knowledge of their impacts on marine wildlife[9].
D11 – Energy (underwater noise)		High	Moderate	Underwater noise from human activities may have deleterious impacts on fish, seabirds, and marine mammals. By drowning out the sounds that the animals rely on for communication, hunt and orientation, impacts may range from physical damage to displacement from an area. For many species, the nature and severity of effects remain uncertain and unproven[10]. But there is a growing concern on the cumulative effects of anthropogenic sound with other existing pressures. All activities generating noise detrimental to marine mammals are expected to increase sharply in the coming years[10] in particular maritime traffic, oil and gas activities, and new activities that imply drilling such as marine mining[8].
Habitats (as defined in the Habitats Directive)		High	High	About two thirds of the habitats listed under the Habitats Directive are in an unfavourable (inadequate or bad) status today, the status of the remaining assessed habitats being reported as unknown[11]. There is considerable uncertainty of the trends of the conservation status of many habitats.
Species (as defined in the Habitats Directive)		High	High	The major part (56%) of the Mediterranean marine species protected under the Habitats Directive (32 species in total) is in an unfavourable (inadequate or bad) status today[11]. Trends in the conservation status of the large majority of these species are uncertain.
Marine and coastal landscape		High		The continuing pressures of urbanisation, industrialisation, and agriculture threaten natural and cultural landscape integrity and diversity of the Mediterranean basin[4]. The past expansion of urbanised and cultivated land and maritime traffic has caused multiple impacts, including habitat loss, reductions in freshwater and sediment discharges by rivers, salinisation of coastal aquifers, soil and coastline erosion. Coastline stability has been in particular affected by the increase in artificial structure [4]. In addition erosion rates are expected to accelerate in the near-future due to sea level rise as a result of climate change. The development of new activities, such as offshore wind energy or oil and gas extraction, will also potentially impact landscapes, with potential negative impacts on tourism.

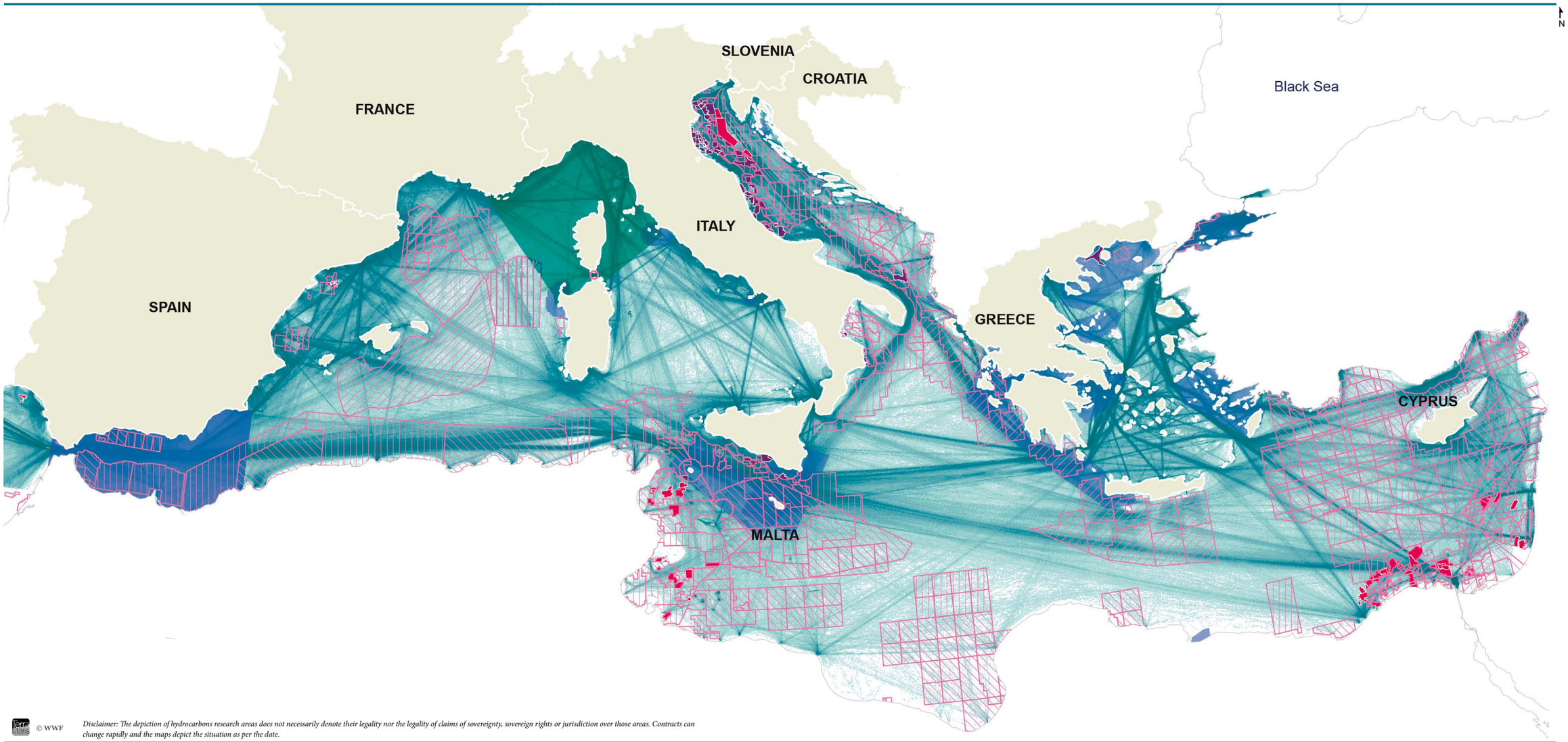
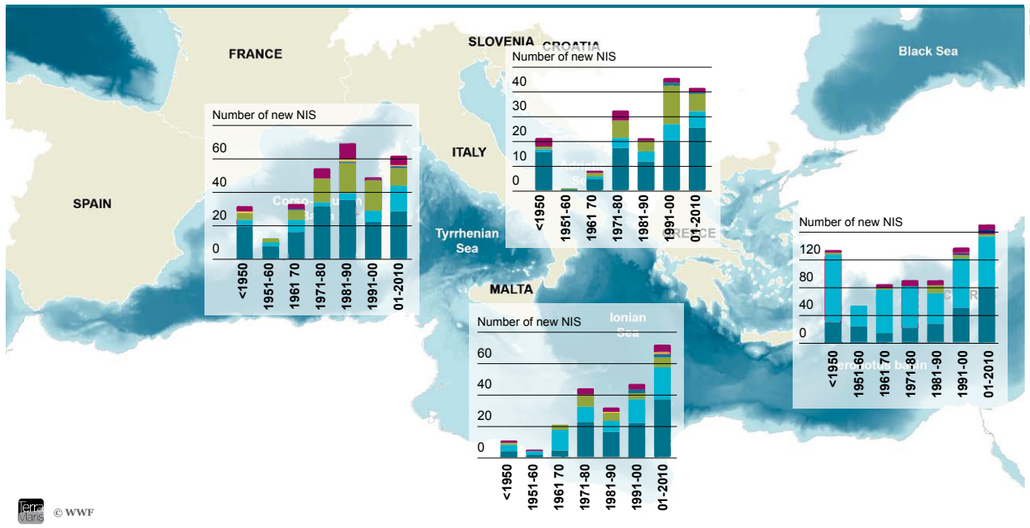


Figure 4. Priority areas for the conservation of cetaceans overlapped with offshore oil and gas exploration and production contracts, and with maritime traffic



MEDITERRANEAN EU COUNTRY

VECTORS OF INTRODUCTION

UNKNOWN OTHER AQUARIUM TRADE AQUACULTURE CORRIDORS SHIPPING

Source: Zenetos A., et al., 2012

Figure 5. Trends in non-indeginous species per decade by MSFD subregion by vectors of introduction[7]

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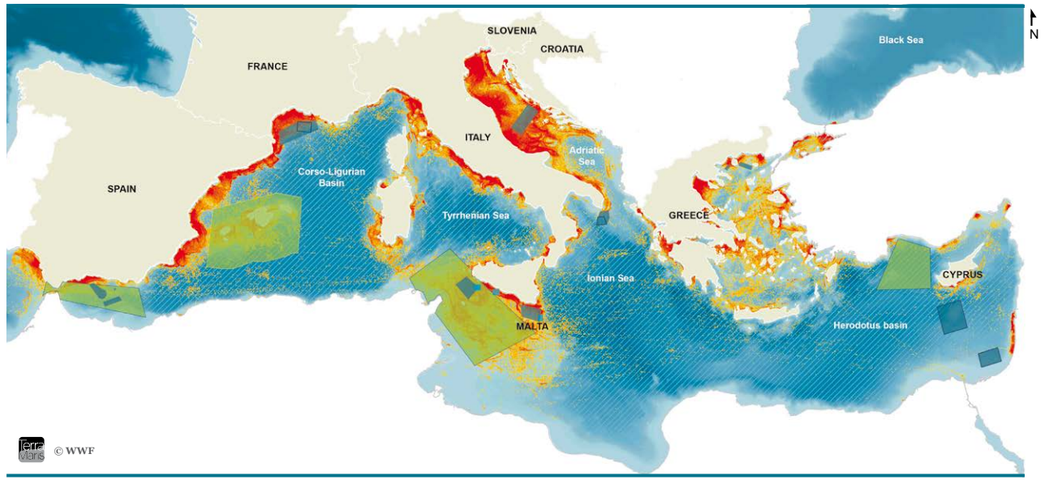
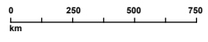
Brijuni National Park





MEDITERRANEAN EU COUNTRY

ALL EU FISHING BOATS (> 15 M)
TOTAL OF VESSELS INVOLVED: 4580
NO Interpolation / Log scaling / Year 2014

HIGH LOW

MAX = 102,673* MEDIAN = 328* MIN = 1*

* In 1 pixel of 1x1 km
Source: AIS density maps by navama technology for nature

PRIORITY AREAS FOR FISHERIES CONSERVATION

FISHERIES RESTRICTED AREA (FRA)
CONTINENTAL PLATEAU UP TO THE 200M ISOBATH
PROPOSED FISHERIES RESTRICTED AREA (FRA)
ESSENTIAL FISH HABITATS FOR DEMERSAL FISHERIES
ESSENTIAL FISH HABITATS FOR PELAGIC FISHERIES
PROPOSED RED TUNA SANCTUARY (BALEARIC SEA)

Source: UNEP-MAP-RAC/SPA (2010) / GFCM (2006 - 2009 - 2015)

Figure 6. EU fishing zones and priority areas for fisheries conservation (Turkey and Israel fishing zones are aslo visible on the map)

D. BLUE GROWTH AND CONSERVATION EFFORTS

1. Interaction between maritime economic sectors and Marine Protected Areas (MPA)

The Convention on Biological Diversity sets the objective of reaching 10% of coastal and marine areas as Marine Protected Areas by 2020 (Aichi objective n°11). As the coverage of the MPA network increases, the competition over space with maritime sectors is likely to increase. Some sectors such as regulated small-scale fisheries or sustainable tourism can be compatible with MPAs, while the development of oil and gas operations is clearly incompatible. Blue Growth will also generate new pressures and risks, especially when activities occur inside or in the vicinity of sites of conservation interest.

Figures 7 to 11 show the potential overlap between offshore oil and gas contracts, maritime traffic, tourism, marine aquaculture and sites of conservation interest. Related issues are described for each figure.

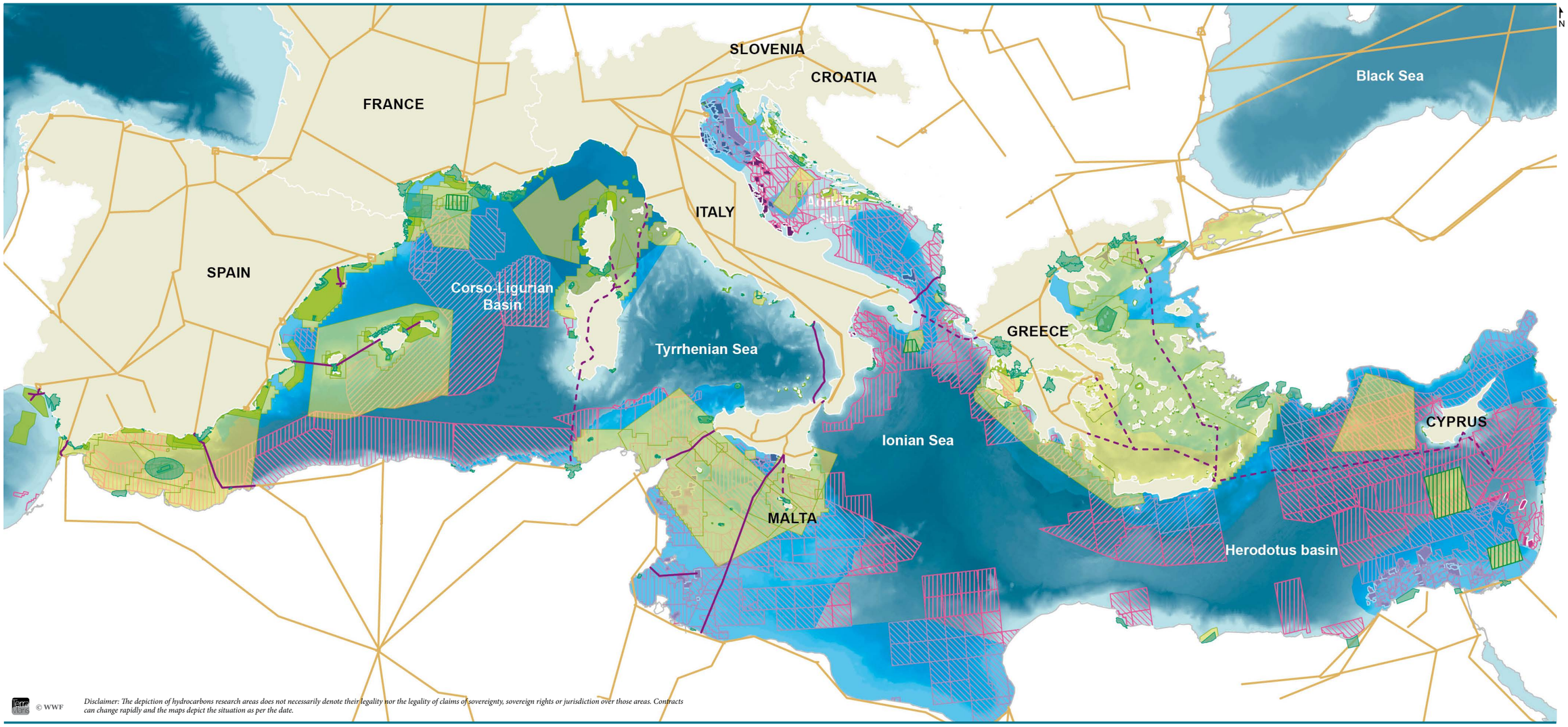


Figure 7. Offshore oil and gas contracts and sites of conservation interest

Key issues:

- Some relatively old oil and gas production sites are located in the vicinity of MPAs (e.g. in the Adriatic Sea) and generate pollution risks;
- Several oil and gas exploration contracts overlap with MPAs (e.g. the Marine Park of the Gulf of Lion in France) which should be absolutely avoided;
- A large number of oil and gas exploration contracts overlap with priority areas for conservation, which have not yet been given protection status, including in highly seismic areas, such as in the Western Hellenic Trench. The interactions between the oil and gas sector and conservation issues should be thoroughly assessed and addressed in a systematic manner at regional scale under an appropriate governance mechanism.

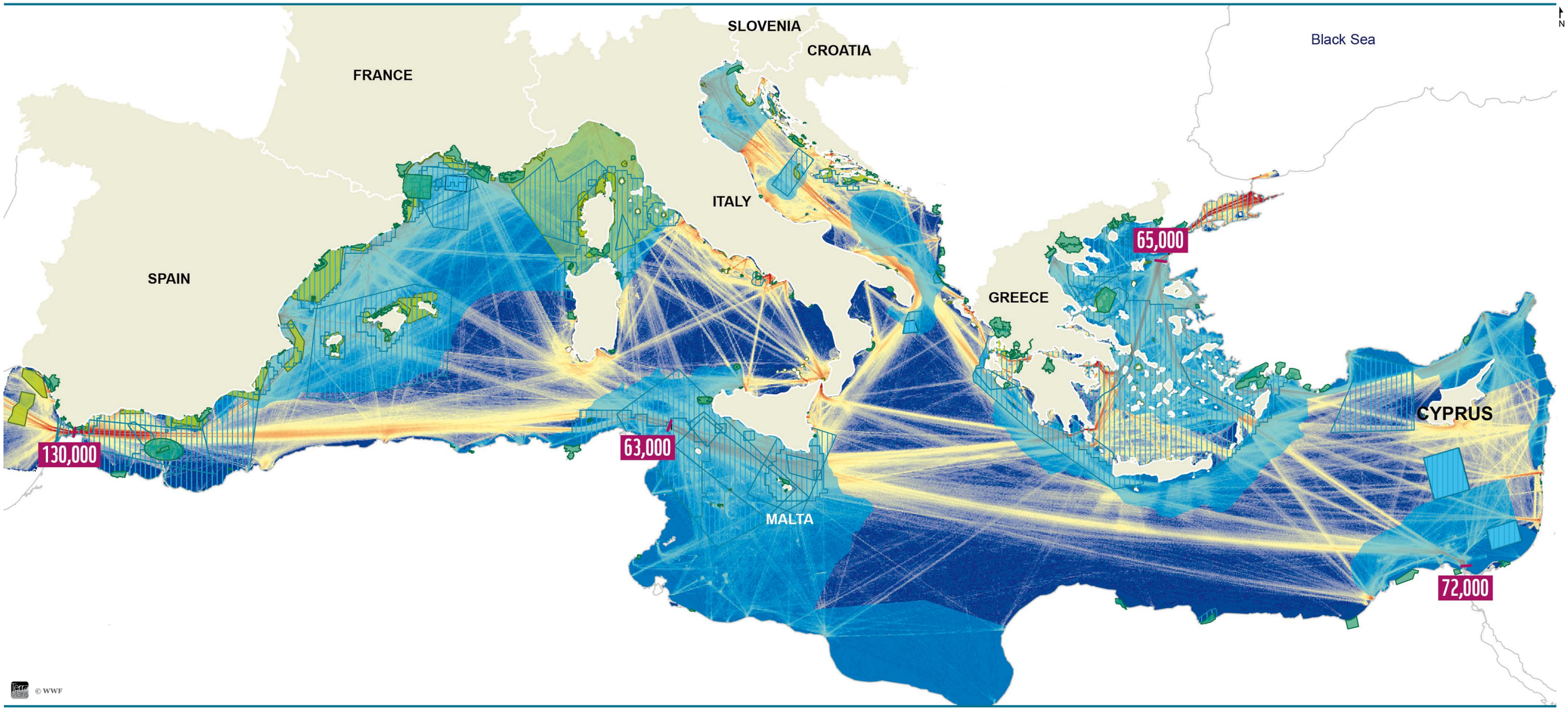


Figure 8. Density of all vessels equipped with AIS transmitters and areas of conservation

Key issues:

- Many MPAs are located in the vicinity of maritime routes and are under the risk of a pollution incident due to maritime traffic. The Aegean Sea is known as a hotspot for ship accidents. As oil tanker traffic is expected to increase in the coming years in that area due to new export routes for crude oil from the Caspian region and the development of pipeline capacity, the regulation of maritime traffic in the Aegean Sea should be given special consideration in the future.
- The development of maritime sectors in the Adriatic Sea suggests that maritime traffic authorities should seek to foresee increased risks associated with maritime traffic and act accordingly.
- A significant share of maritime traffic overlaps with priority areas for conservation, in particular those concerning marine mammals, especially in the Straits of Sicily and the Alboran Sea. The interactions between this sector and conservation issues should be more thoroughly assessed in these two areas and potentially addressed at the with the International Maritime Organization level.

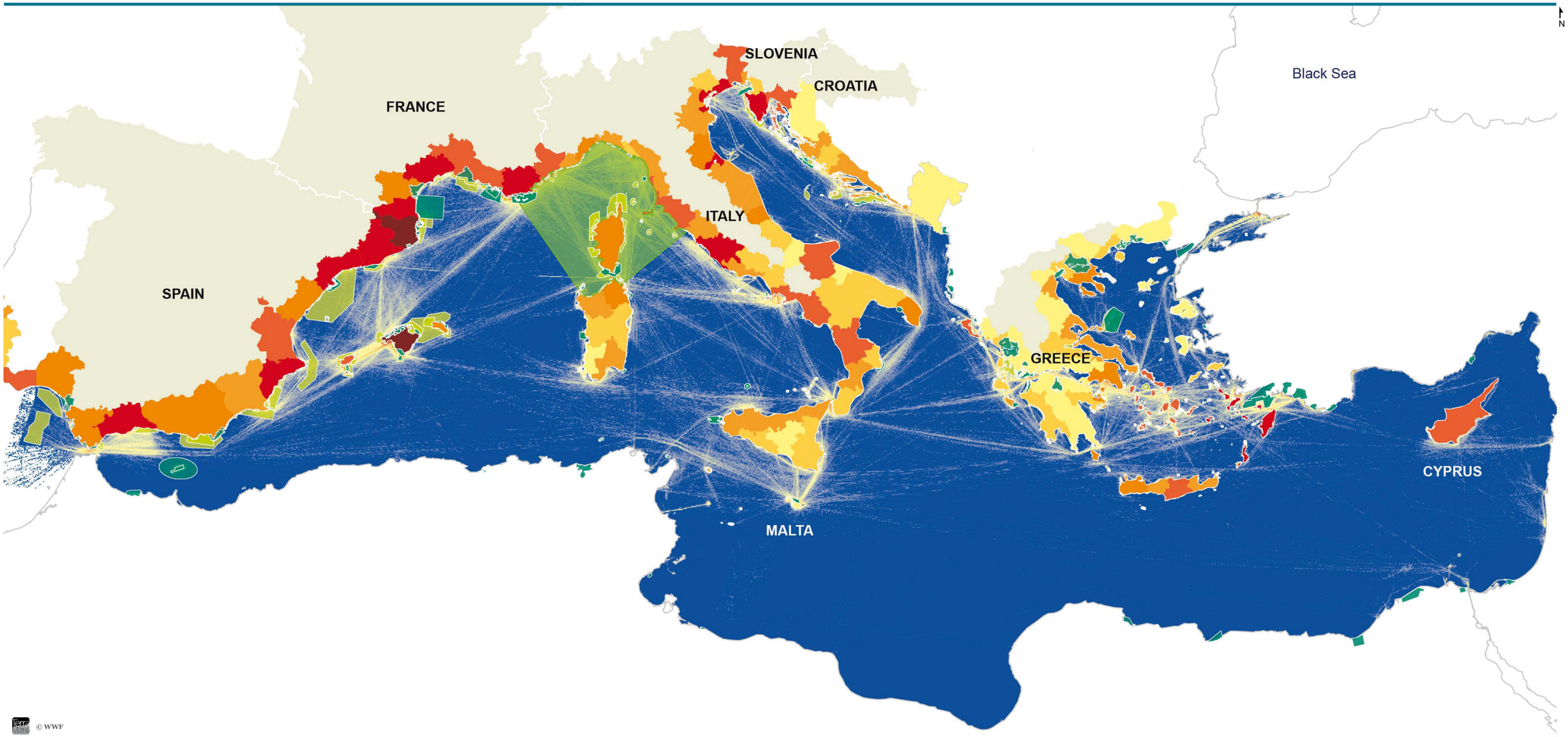


Figure 9. Tourism and MPAs

Key issues:

- The current interactions between tourism and MPAs are high along the northern shore of the Mediterranean. Some MPAs face the cumulative pressures of intensive coastal tourism and leisure crafts, for instance on the French Riviera or in the Balearic islands. The expected growth of tourism in the Mediterranean region may lead to growing pressures on vulnerable areas.

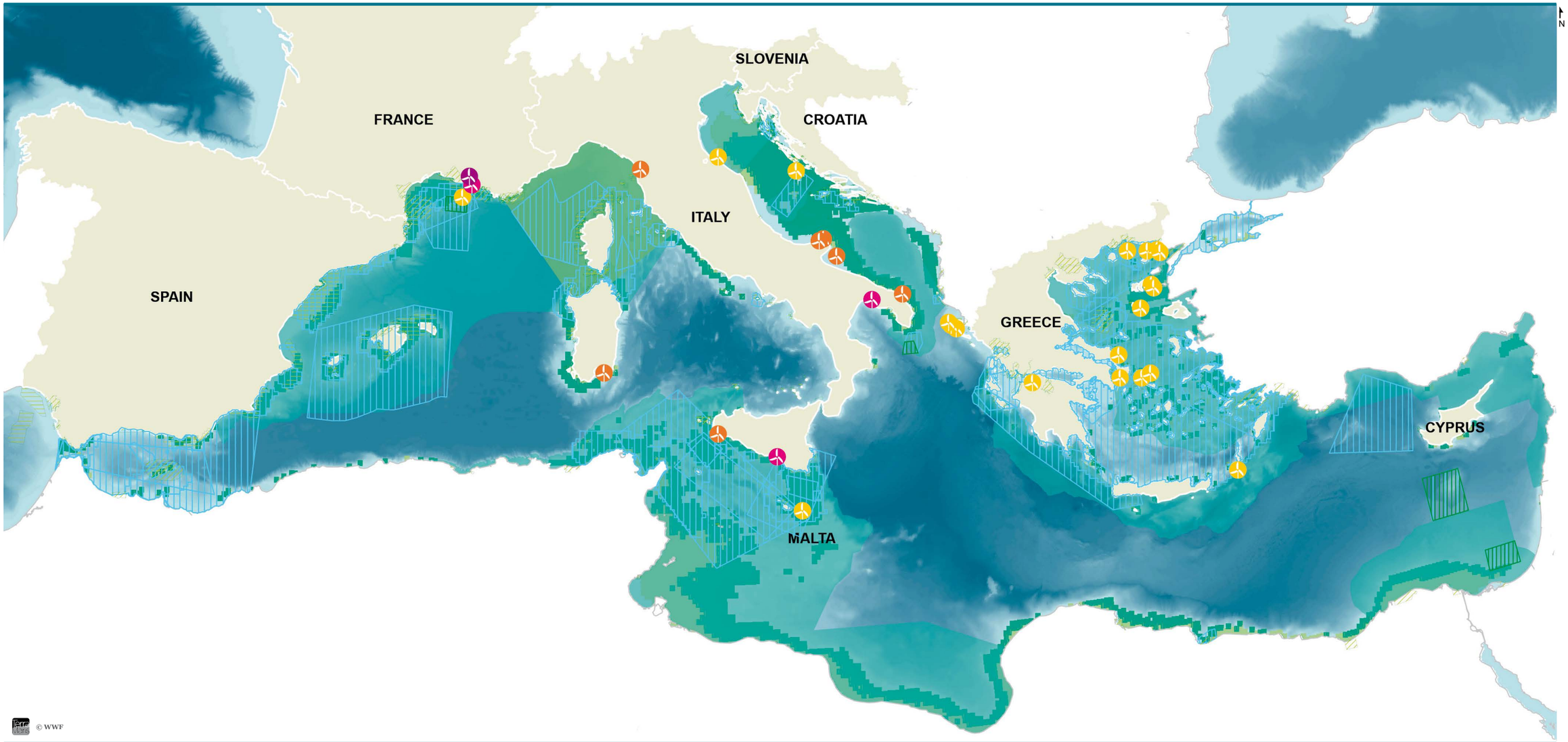


Figure 10. Offshore wind energy development and sites of conservation interest

Key issues:

- Areas suitable for offshore wind energy development are mainly overlapping with EBSAs, except to some extent in the Adriatic Sea.
- The impacts of wind farms on the marine environment need to be better known and the monitoring of the first operating sites will be very important to suggest best practices for future large developments.

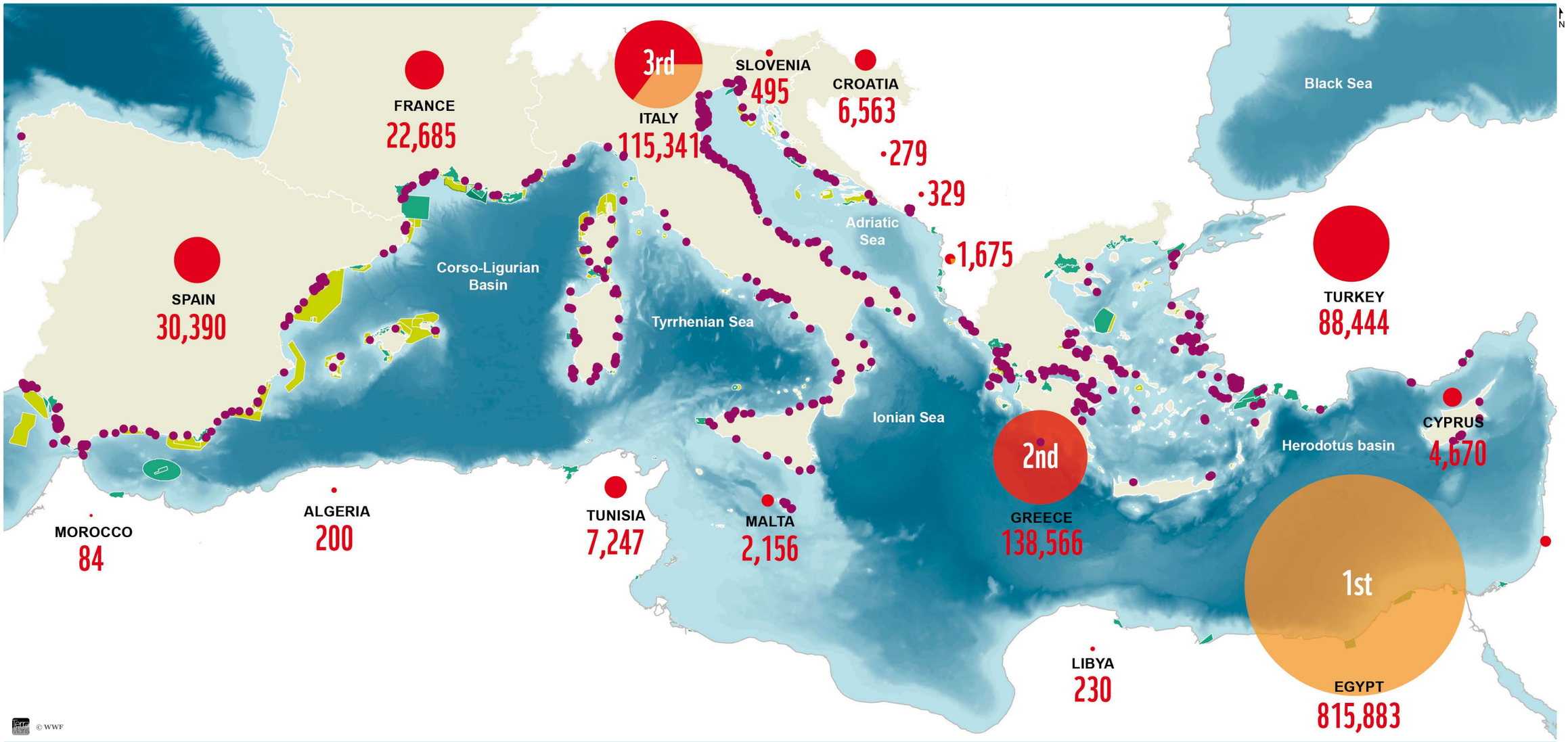


Figure 11. Marine aquaculture and MPAs

Key issues:

- Coastal MPAs may be impacted by pressures exerted by marine aquaculture (e.g. introduction of invasive species, micro-pollution and marine litter).
- As marine aquaculture is expected to grow in coming years, conflicts over space might arise between marine aquaculture and MPAs. The development of aquaculture farming in MPAs should be addressed on a case by case basis.

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• Fisherman in Penisola del Sinis
• Sea breams in the Marine Reserve of Cerbère-Banyuls

2. Will the 2020 target of 10% MPA coverage be achieved?

MPAs in the Mediterranean Sea region accounted for 1.08% of its area in 2010 (Pelagos Sanctuary excluded)[12]. **This area increased to 3.21% according to a 2015 assessment[13], most of the new designated MPAs being located in EU waters.** France contributed to the expansion of the Mediterranean MPAs network with the establishment of large MPAs, including the designation of the Marine Park of the Gulf of Lion in 2011 (4,019 km²), the Calanques National Park in 2012 (1,413 km²) and the enlargement of the Port-Cros National Park in 2012 (1,665 km²). The designation in Spanish waters of large Natura 2000 sites as a result of the implementation of the Habitats and Birds Directives makes the contribution of Spain particularly significant as well. In other countries, the effort was much more limited and progress towards the 10% target is slow. This is especially visible in the Adriatic-Ionian Sea and the Aegean Sea.

To achieve the target, the EEA estimates that the EU Member States should designate over the next 5 years the same area of MPAs as they have already **designated under the marine Natura 2000 network over the last 20 years[2]. It is thus unlikely that the 10% target will be achieved in 2020 at the Mediterranean regional scale.** While the EU will boast the highest level of achievement, very different levels of progress will be occurring between the 8 EU Mediterranean countries.

The recent identification of EBSAs in the Mediterranean is seen as a first step in a longer process that will eventually lead to enhanced protection of EBSAs. **Governments are expected in the future to adopt appropriate measures for conservation and sustainable use in relation to EBSAs, in particular by establishing representative networks of marine protected areas.**

It is highly possible that **the growth in maritime sector activities and the increasing competition over space may slow down or even hinder the designation process of new MPAs.** Figure 12 overlaps spatial data from maritime sectors with sites of conservation interest. This map shows the complexity of the interactions among sectors and between sectors and conservation issues that will need to be addressed in the future. It suggests that further research is needed to better understand the cumulative impacts of human pressures on marine ecosystems in the Mediterranean Sea, and derive sound and sustainable ecosystem-based management.

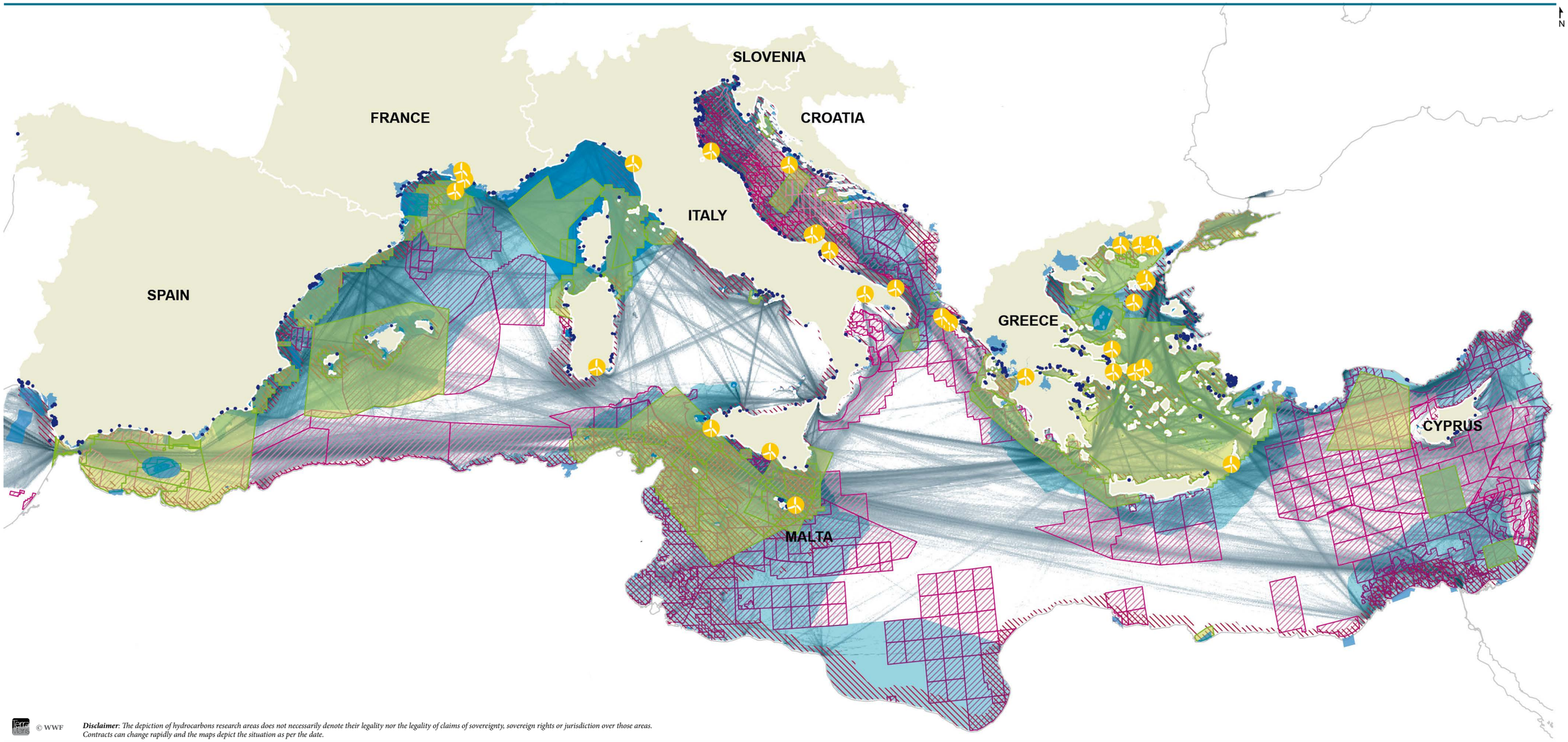

Figure 12. Map overlapping maritime sectors and sites of conservation interest

Large-scale areas of high interaction between Blue Growth and sites of conservation interest in EU Mediterranean countries were identified by the MedTrends national experts based on the following criteria: at least two sectors exerting major pressures overlapping with three conservation areas or priority areas for conservation or EBSAs (Figure 13).

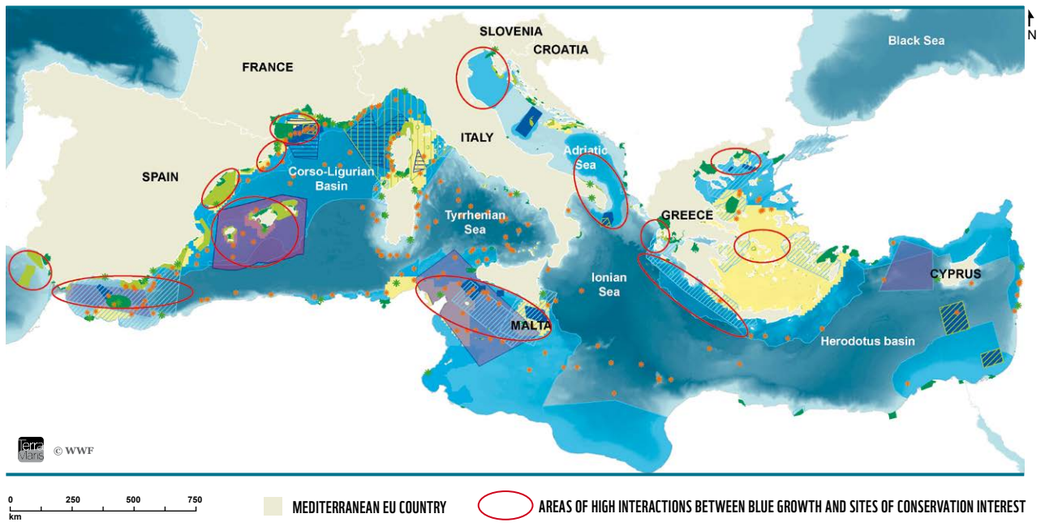

Figure 13. Areas of high interactions between Blue Growth and sites of conservation interest

These areas include:

- The Alboran Sea,
- The Gulf of Cadiz,
- The Balearic islands,
- The Ebro Delta,
- The Catalunya coast,
- The Gulf of Lion,
- The Northern Adriatic Sea,
- The Strait of Otranto,
- The Strait of Sicily and more generally the area located south of Sicily,
- The northern Aegean Sea,
- The central Aegean Sea,
- The Ionian coast of Greece up to the southwestern part of Greece.

The implementation of the MSFD ecosystem approach in these areas will be of particular importance in the future.

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CHAPTER 7:

CONCLUSIONS AND RECOMMENDATIONS

WWF's **Reviving the Ocean Economy report,** released in March 2015[1], outlines that the range of goods and services that flow from coastal and marine environments can be valued conservatively at US$2.5 trillion each year, and the overall value of the ocean as an asset is 10 times that. This is an underestimate, as outputs that are not generated by the ocean – offshore oil and gas, and wind energy, for example – were excluded, as were valuable intangibles such as the ocean's role in climate regulation. Gross marine product is the ocean's annual economic value. More than two-thirds of the gross marine product is dependent on healthy ocean assets.

The marine living planet index shows a global decline of 39% between 1970 and 2010[1].

As natural assets are degraded, the ocean is losing its capacity to feed and provide livelihoods for hundreds of millions of people. The downward trends are steep and reflect major changes in species abundance and diversity, as well as habitat extent, most over a single human lifespan.

A. CONCLUSIONS

> **The Mediterranean Sea is a semi-enclosed, highly anthropized sea that clearly reflects this global deterioration of the state of the ocean, despite the presence of a comprehensive policy framework both at EU and Mediterranean levels.**

> **The Mediterranean Sea is currently facing a blue Gold Rush**[2] driven by:

- The growth of trade between Europe and Asia, which drives the growth of international maritime traffic in the Mediterranean Sea.
- The development of a middle class worldwide, correlated to the growth of international tourism, in particular in the Mediterranean Sea region being the first tourist destination in the world.
- Energy demand reflected by an extremely fast development of the number of offshore oil and gas exploration contracts, covering today more than 20% of the Mediterranean Sea, with potential new contracts covering another 20% of the basin.
- the EU Blue Growth Strategy which aims at supporting sustainable growth in all marine and maritime sectors. Five sectors are highlighted as potential drivers of blue growth: aquaculture, marine and coastal tourism (including cruise and recreational boating), marine biotechnology and marine mineral mining.

> **Except for professional fisheries, all traditional sectors of Mediterranean maritime economy such as tourism, shipping, aquaculture and offshore oil and gas are expected to keep growing during the coming 15 years. Comparatively new or emerging sectors such as renewable energy, seabed mining and biotechnology are expected to grow even faster, although there is greater uncertainty concerning these developments and in their expected impacts on marine ecosystems.**

> **It is difficult to determine the whole range of interactions between these activities and the cumulative impacts of their pressures on the state of marine ecosystems.** However, evidence shows that they have induced large-scale changes on marine ecosystems, including the collapse of fish stocks and loss of biodiversity.Climate change is a significant additional indirect pressure on the marine environment leading to increased sea surface temperature and acidification. The combined effects of these impacts decrease the overall resilience of marine ecosystems[2]. **Consequently, the expected growth in the marine economy represents a potential additional threat to the health of already-stressed Mediterranean ecosystems.**
It is likely that some pressures and, more importantly, cumulative impacts on marine ecosystems generated by the increasing exploitation of the sea will grow at a faster rate than the solutions developed and implemented to mitigate them.

> This is particularly relevant for sectors such as maritime transport and offshore industries. These sectors do not rely on ecosystem services but on the natural infrastructure that the sea represents and thus have no interest in limiting their externalities. Besides, the internationalization and the strategic weight of these sectors mean that their activities are difficult to regulate.

> **The likely future developments in key sectors and their resulting pressures can generate significant conflicts between sectors. This can be the case, for instance, between sectors that rely strongly on marine ecosystem services (marine and coastal tourism, fisheries, aquaculture) and offshore extractive industries or maritime traffic.** The development of the offshore oil and gas sector will impose additional risks on marine ecosystems and on the tourism economy of Mediterranean riparian countries. Professional fisheries are likely to be the sector most affected by all other developments. Loss of fishing grounds, increased pollution likely to affectfish stocks, or competition for fish resources as a result of growing recreational fishing will undermine the productivity (as well as the profitability) of professional fisheries.The contribution of professional fisheries to national food sovereignty can thus be challenged.

> Conflicts between sectors can reflect the incoherence between public policies including those not targeting the marine/maritime sector. For example, supporting the development of offshore oil and gas investments may slow down the shift to renewable energies. **Strategically important energy-related infrastructure developments may not be compatible with the requirements of coastal economies** that rely, as far as tourism is concerned for instance, on environment conservation. Local communities' interests might be potentially incompatible with energy policies at the highest level of States.

[1] The marine Living Planet Index is an indicator of the state of global biological diversity, based on trends in more than 900 marine species of mammals, birds, reptiles and fish.

[2] This expression refers to a speech given by Maria Damanaki, previous European Commissioner for Maritime Affairs and Fisheries, on 8 May 2014 on Blue Innovation, in which she said "I'm acutely aware of the dangers of an uncontrolled 'gold rush' towards the sea riches, so let me be clear: any growth that is not 100% sustainable would be absolutely irresponsible at this point". This sentence was widely commented upon in the press.

> Despite technological progress and stricter environmental legislation, the development of key sectors is likely to increase pressures and impacts on the marine environment. **There is a high risk of failing to achieve Good Environmental Status in the Mediterranean Sea by 2020 for 7 out of 11 of the descriptors of the Marine Strategy Framework Directive(MSFD).**

> While Marine Protected Areas (MPAs) propose innovative approaches to sustainable development, **the growth of maritime sectors also increases the challenge faced by the EU to meet the Convention on Biological Diversity (CBD) Aichi Target 11, which requires at least 10% of EU waters to be within MPAs or other effective area-based management measures by 2020.** This means that in less than 6 years, Europe still needs to designate the same area of MPAs as it has designated under the marine Natura 2000 network over the last 20 years. And additional efforts are needed to achieve ecologically coherent and effectively managed MPA networks in European seas as required by the MSFD[2].

In the Mediterranean Sea, MPA coverage grew from 1.08% in 2012 to 3.27% of the total surface in 2015, representing significant progress towards the CBD target[3]. However, this rate of progression is insufficient to fill the gap over the next 5 years. The geographical distribution of MPAs remains uneven, with 96% of MPAs being located in the northern part of the basin and 86% of the MPAs area being located within the 12 nautical mile zone. As a result, the area beyond the 12 nautical mile zone which represents 74% of the area of the Mediterranean Sea has a protection of less than 3%, with the Pelagos Sanctuary contributing to three quarters of this area[4].

The MedTrends project shows that the growing competition for space between priority areas for conservation and developing economic sectors will make the CBD target more difficult to achieve.

The recent recommendation made at the 2014 IUCN World Parks Congress to increase the target set by the Convention on Biological Diversity up to 30% is thus even more challenging.

> **Preventing or reducing environmental damage and achieving sustainable use of the marine environment thus remain a significant challenge for the Mediterranean Sea.** The European Environment Agency's Environment State and Outlook 2015 emphasizes that "Blue Growth may have great potential, but only if the right balance is given to sustainability challenges. This is especially true given the current levels of marine environmental degradation. The Blue Growth Strategy recognizes the dual challenge of supporting sustainable use of the sea alongside achieving a healthy status for the sea. For example, the need to reduce greenhouse gases has already steered the development of offshore renewable energy installations. However, as many activities are expected to increase significantly over the next decade, it is important to better understand and account for the interactive and cumulative effects from past, present and future human activities acting upon the state of marine ecosystems"[2].

> Despite the efforts implemented at the EU level to ensure the smooth dissemination of marine data among public and private users, it is still difficult to access information and data, particularly fisheries and energy-related data as well as as the results of EU-funded scientific projects and data produced by EU institutions.

> **Guidance on what a "Sustainable Blue Economy" or "Sustainable Blue Growth" looks like, in practice, is missing *right now*.** The current development of key economic sectors in the Mediterranean Sea is happening against a background of vague concepts and relatively weak formulation on what needs to be done to ensure that the Blue Economy is truly sustainable[5]. And the future implementation of the

B. RECOMMENDATIONS

Blue Growth Strategy and the Maritime Spatial Planning Directive (2014/89/UE), which needs to be transposed by EU Member States by 18 September 2016, adds complexity and uncertainty.

However, it should be mentioned that the contracting parties to the Barcelona Convention have undertaken a revision of the Mediterranean Strategy for Sustainable development (MSSD). The new MSSD will aim at six objectives, three thematic, including "ensuring sustainable development in marine and coastal areas, and three transversal, including "transition towards a green and blue economy".

Cross-cutting recommendations

> Most of the pressures imposed by sectors, whether point source or diffuse, are addressed directly by the EU through its large body of existing policies and legislation.EU policy tools that focus on the marine environment include the Common Fisheries Policy (CFP), the Integrated Maritime Policy (IMP) which covers maritime spatial planning (MSP) and the EU's Blue Growth strategy, the Marine Strategy Framework Directive (MSFD) and its ecosystem approach, the EU Biodiversity Strategy, the EU Strategy on adaptation to climate change which is key to coastal areas and the Water Framework Directive. In addition, the Barcelona Convention protocols provide basin-wide approaches to reach Good Environmental Status for the whole Mediterranean Sea. However, developing synergies between all these policies and ultimately integrating them to enhance their efficiency is far from being achieved today. **And sustainability challenges will remain unless smart and innovative solutions are developed and implemented at a rate that coincides with the increasing exploitation of the seas**[2]**.**

The MedTrends project recommends that **the implementation of EU policy tools, in particular the MSFD and the Integrated Maritime Policy, takes into account enlarged temporal and spatial dimensions to better anticipate future sustainability challenges:**

- In terms of the temporal scale, development trends scenarios (what is likely to happen without any additional public interference in the development of sectors) for key maritime sectors need to be established at a minimum of 15 to 20 years scale, and then integrated.
- Future development trends which are currently mostly assessed at national level need to be considered at a transnational level. This is especially important for the Mediterranean Sea, a semi-enclosed sea where any national development may easily impact one or several neighboring countries.

> **Ambitious shared prospective visions for the future of the Mediterranean maritime space need to be built at different spatial scales and include biodiversity and ecosystems protection and restoration objectives.** The current revision of the Mediterranean Strategy for Sustainable Development provides a useful framework at a sea basin-wide level, with a strong Integrated Coastal Zone Management dimension. However, prospective visions need to be built first at the country level to account for specific spatial and emotional identities, and then integrated at the macro-regional level so effective transnational coordination and optimization can take place.

WWF supports the Sustainable Blue Economy[5]**as a marine-based economy that:**

- **Provides social and economic benefits for current and future generations,** by contributing to food security, poverty eradication, livelihoods, income, employment, health, safety, equity, and political stability.
- **Restores, protects and maintains the diversity, productivity, resilience, core functions, and intrinsic value of marine ecosystems,** upon which its prosperity depends.
- **Is based on clean technologies, renewable energy, and circular material flows to secure economic and social stability over time,** while keeping within the limits of one planet.

> **Building shared prospective visions for an integrated sea management requires agreeing on underlying principles** for a Sustainable Blue Economy to ensure that the economic development of the ocean contributes to true prosperity and resilience, today and in the future, building in particular on the following principles:

- **Give priority to EU policy visions of establishing a circular green economy.** For instance, recycling rare metals waste should be maximized before considering deep-sea mining. Basing production as close as possible to demand centers should help reduce the need for maritime transport.
- **As far as strategic energy development infrastructures are concerned, give preference to transition to renewable energy and define a clear contribution to climate change mitigation strategies.** Switching to renewable energy is not just the best choice, it is our only option. According to the International Energy Agency (IEA), more than two thirds of all proven fossil fuel reserves in the ground should be left aside to have only a modest 50% chance to keep the Earth below a 2 degree increase in global average temperature compared to pre-industrial times. **In the face of the unprecedented development of offshore oil and gas exploration in the Mediterranean Sea, WWF is favoring a strict no-go position for new oil and gas offshore developments.**
- **Implementing the MSFD ecosystem-based approach as a prerequisite to the management of human activities and the pillar of the implementation of the MSP directive;**
- **Considering that fisheries are contributing to food sovereignty,** give priority to the restoration of fish stocks and of their ecosystems through support to responsible and sustainable fishing;
- **Apply the precautionary principle** when key data necessary to inform smart decision-making processes are missing.

> **As regards marine spatial planning implementation processes, clear governance mechanisms for decision-making that make trade-offs explicit** among sectors and also between sectors and conservation objectives need to be established and a participatory approach implemented. **The practical modalities of the implementation of an MSFD ecosystem-based approach need to be clarified** and shared at the transnational Mediterranean level. **The value of ecosystem services and risk to habitats should be integrated as elements of planning** in ocean management scenarios.

> Data availability is key to supporting and sharing knowledge on the state of the ocean and on solutions for improving its state. Despite the highly significant efforts made by the EU to support data-sharing, access to data remains challenging in particular for some sectors (e.g. fossil energy or fisheries), pressures and impacts. **WWF calls for the EU to further enhance data accessibility from the private and research sectors at national and regional level.**

> The MSFD, as the environmental pillar of the Integrated Maritime Policy, is the key component of the EU's policy response to achieve healthy, clean and productive seas. **The practical modalities of the implementation of an MSFD ecosystem-based approach need to be clarified and shared at the transnational Mediterranean level.**

Spatial recommendations

> The transboundary nature of drivers of environmental change in the marine environment requires **a coordinated approach** between countries to tackle them effectively. Seas cannot be defined by arbitrary (administrative) lines on a map – as a fish will not stop swimming when it reaches an administrative boundary. This is why the MSFD requires countries to work together to manage the marine environment in a collaborative and collective manner.

> From an environmental perspective, identifying priority areas for intervention at transnational level is crucial. In the Mediterranean Sea, **the identification of Ecologically and Biologically Significant Areas (EBSAs) represents a significant step forward.** EBSA values, and the pressures and stressors exerted on them, should be better known so as to identify priority areas of intervention. The increasing trends of using the Mediterranean Sea increases the chances that specific threats cause more impacts when occurring simultaneously than the cumulative effect of individual pressures (UNEP/MAP, 2012). Consequently, mapping cumulative impacts is crucial to understanding the impacts humans have on the ocean's ecosystems and the areas that are most heavily affected by human activities.

> **Cumulative impacts maps should be overlapped with priority areas for conservation so that priority areas requiring specific and priority action are identified.** This needs to be done at several scales, from the transboundary level, relevant for cetaceans or fisheries habitats to the finer local scale, where local coastal pressures may impact a specific Posidonia meadow. At the regional scale, the MedTrends project helped identify hotspots in Mediterranean EU countries marine waters that require **urgent planning and implementation of integrated ocean management measures to address cumulative impacts in these areas** (Chapter 7, Figure 14).

These areas include:

- The Alboran Sea,
- The Gulf of Cadiz,
- The Balearics islands,
- The Ebro Delta,
- The Catalunya coast
- The Gulf of Lion
- The Northern Adriatic Sea
- The Strait of Otranto
- The Strait of Sicily and more generally the area located south of Sicily,
- The northern Aegean Sea,
- The central Aegean Sea
- The Ionian coast of Greece up to the southwestern part of Greece.

> To date, the area beyond states' territorial waters, including EEZ and open seas, has been granted few protection measures (mainly by GFCM) in the Mediterranean Sea.

WWF believes that economical activities in this area should not be initiated before measures to protect deep-sea ecosystems from adverse impacts are in place. It is essential that the offshore industry and related public institutions respect and align with the measures/designations of other international bodies regarding the protection of the marine environment in all steps of any licensing procedure. This should range from the evaluation of work plans for exploration to the assessments of environmental impacts, including cumulative impacts of mining operations. It needs in particular to include:

- consideration of the CBD scientific criteria for "Ecologically or Biologically Significant marine Areas (EBSAs)";
- the CBD guidance for the design of representative networks of marine protected areas;
- the FAO criteria for the identification of "Vulnerable Marine Ecosystems" (VMEs);
- the criteria adopted by other international organizations for areas to be protected (e.g. the High Sea Marine Protected areas) from adverse human impacts.

> Regarding maritime traffic, it should be noted that:

- Many MPAs are located in the vicinity of maritime routes and are under the risk of a pollution incident due to maritime traffic, The Aegean Sea is known as a hotspot for ship accidents. As oil tanker traffic is expected to increase in the coming years in that area due to new export routes for crude oil from the Caspian region and the development of pipelines capacity, the regulation of maritime traffic in the Aegean Sea should be given special consideration in the future. The development of maritime sectors in the Adriatic Sea suggests that maritime traffic authorities should seek to foresee increased risks associated with maritime traffic and act accordingly.

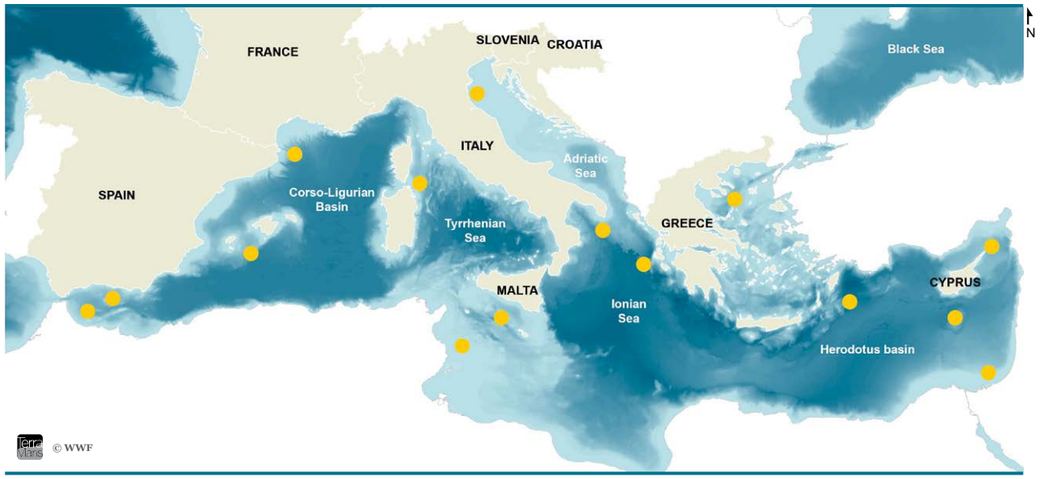

Figure 1.Prospective SPAMI sites identified by UNEP/MAP RAC/SPA.

- The development of maritime sectors in the Adriatic Sea suggests that the anticipation of increased risks on maritime traffic is a must.
- A significant share of maritime traffic overlaps with priority areas for conservation, in particular those concerning marine mammals, especially in the Straits of Sicily and the Alboran Sea. The interactions between this sector and conservation issues should be more thoroughly assessed in these two areas and potentially raised at the IMO level.

> **The establishment of high seas and deep seas MPAs in the Mediterranean areas identified as priorities for biodiversity conservation is crucial, whether in Member States EEZ or in the remaining Mediterranean open sea.** In such (future) high/deep seas MPAs, relevant states and competent bodies should adopt arrangements to introduce relevant sectorial spatial measures. Potential Specially Protected Areas of Mediterranean Importance (SPAMI) sites identified by UNEP/MAP RAC/SPA in the Mediterranean Sea include 15 areas that should be considered a priority[8].

> Historically, countries and maritime sectors have managed their seas and activities in isolation from each other. Strengthening multi-level and territorial cooperation in the Mediterranean Sea region is a pre-requisite to effective decision making. Today, there are very few platforms that offer opportunities for countries and maritime sectors to discuss or exchange information at the transnational scale. **The establishment of transnational cooperation platforms should be encouraged.** Non-statutory cooperation based on common interests and of a non-binding character is likely to represent a first step in enhancing knowledge sharing within the Mediterranean Sea basin.

> Macro-regional strategies represent an innovative coordination mechanism at the transnational level. A 'Macroregional strategy' is an integrated framework that addresses common challenges faced by a defined geographical area shared by Member States and third countries which thereby benefit from strengthened cooperation contributing to achievement of economic, social and territorial cohesion. In the Mediterranean Sea region, the EU Strategy for the Adriatic and Ionian Region (EUSAIR)is at a very advanced stage. And some regional stakeholders have proposed the subsequent development of macro-regional strategies in the Western Mediterranean Sea and in the Eastern Mediterranean. From the environmental perspective, despite the fact that it includes an environmental chapter, EUSAIR is primarily growth-oriented. And **the EU will have to clearly demonstrate its ability to incorporate the MSFD ecosystem-based approach in the future implementation of macro-regional strategies.** Macro-regional strategic processes driven by the EU will also need to establish synergies **with Mediterranean regional institutions, governance bodies or agreements (Barcelona Convention, GFCM, ACCOBAMS).**

> Regarding the implementation of maritime spatial planning, it is recommended to use an evidence-based approach to decision making that ensures policy development is informed by evidence at each stage. This should be applied from the preliminary assessments of an issue to the consideration of all available policy options, development of the most appropriate response and ultimately evaluation of policy effectiveness. **WWF supports the use of appropriate decision-making support tools (including mapping tools) that combine social, economic and environmental data** and highlight possible tradeoffs between sector development and protection of the marine ecosystems. As an example, the Natural Capital Initiative (NatCap)[6], a partnership between Stanford University, the University of Minnesota, WWF and the Nature Conservancy, aims to integrate the values of nature into all major decisions affecting the environment and human well-being. A specialized software, InVEST[7], used in many world regions, helps incorporate the value of ecosystem services in integrated ocean management scenarios.

C) FINAL WORD

According to the report "Mediterranean Ecological Footprint Trends" published by the Global Footprint Network[9], in 2008 every country in the region but one demanded more ecological resources and services than were available within their respective borders. **With the ocean recording rapid development in various sectors, there is the clear risk that these may push many ocean systems beyond their "points of no-return", seriously constraining the options available to our children and for generations to come.** In some cases, such as ocean acidification, it will take tens of thousands of years (or hundreds of generations of people) for the ocean to repair itself. In the case of species extinction, impacts are permanent and there is no going back.

The 2015 EEA State of the Environment Report emphasizes that the key challenge in the coming decade will be **to steer policy expectations for Blue Growth towards the EU policy visions of establishing a circular green economy and living well within the ecological limits of the sea**[2]**.**

WWF calls for this challenge to be addressed so that Mediterranean people fully benefit from the services provided by marine and coastal ecosystems in the future.

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ANNEX 1:

RECOMMENDATIONS FOR SECTORS

Offshore oil and gas

According to the International Energy Agency (IEA), to have a modest 50% chance of keeping the Earth below a 2 degree increase in global average temperature as compared to pre-industrial times more than two thirds of all proven fossil fuel reserves in the ground should be left untouched[13]. Consequently, WWF urges a stop to all new fossil fuel developments in the Mediterranean.

The Mediterranean Sea is at the same time a biodiversity hotspot of global relevance and an extremely vulnerable sea, due to its semi-enclosed nature. Because of intense pressure from multiple uses and stressors, the Mediterranean Sea has been characterized as a sea "under siege".

WWF supports the consideration of the entire Mediterranean Sea as an off-limits region regarding any new offshore oil and gas development, both at the level of exploration and exploitation. Consequently, WWF opposes any new hydrocarbon exploration and exploitation development on both the continental shelf and the deep-sea floor in the Mediterranean

Maritime transport

WWF advocates for the development of sustainable maritime transport in the Mediterranean Sea. In particular:

- It advocates for better prevention of accidents involving ships, with better flag state control and responsibility combined with better port state control and a call to increase the level of preparedness of the sector to deal with the increase of the traffic in safety and environmentally-friendly conditions, in particular for the transport of hazardous and noxious substances. Specifically assigned Ports of Safe Refuge must be listed and equipped with adequate facilities.
- As the socio-economic impacts of alien species in the Mediterranean is significant, WWF calls for all Mediterranean States to ratify the Ballast Water Convention. As biofouling of hulls is also a significant vector for the dissemination of alien species, WWF calls for all Mediterranean States to adhere to the IMO guidelines with a view to future regulation.
- Regarding marine noise, WWF proposes that Mediterranean States adhere to the IMO guidelines with a view to translating these guidelines into specific regulations.

- WWF supports the proposal of the Pelagos Sanctuary designation as a Particularly Sensitive Sea Area.
- It also proposes that the possible implementation of specific measures to mitigate risks on the environment should be assessed in areas with intense and growing maritime traffic, including the Sicily Straights, the Gibraltar Straights and the Aegean Sea.
- WWF supports the designation of the Mediterranean Sea as a Sulphur Emissions Control Area with adequate enforcement procedures.

Ports

Elements of sustainable planning in ports should include:

- Strict limitation of the spatial development of industrial harbours and the optimization of infrastructures of existing ones.
- Strict limitation of the spatial development of marinas and the engagement of the leisure boating industry in circular economy business models.
- Respecting all environmental laws and protected habitats
- Applying ecosystem-based management approach as a rule
- Better Port Waste reception facilities
- New harbour sludge concepts including recycling rather than dumping
- Strict rules for dredging and land fills
- National /European cooperation/ specification instead of competing multimode harbours
- Shore side electricity for ships at berth which lessens emissions.

The Mediterranean Sea needs to translate the existing list of ports into specifically assigned Ports of safe refuge with adequate facilities.

Professional fisheries

The fisheries sector deserves specific attention, as it will be the sector most affected by Blue Growth in the Mediterranean.

The overall objective for this sector is to contribute to food security and livelihoods in a healthy marine ecosystem through effective ecosystem-based resource management throughout the Mediterranean, for which the following is needed:

- The reformed Common Fisheries Policy effectively delivers on an ecosystem approach to fisheries through sustainable fishery-specific management plans;
- GFCM delivers on ecosystem-based management of shared stocks through regional management plans and other technical measures and provides a framework for national fisheries policies;
- ICCAT sticks to a science-based management plan for bluefin tuna ensuring enforcement of the implemented measures. Moreover, ICCAT develops a comprehensive recovery plan for Mediterranean swordfish.

Particular emphasis should be given to:

- the implementation of co-management approaches applied to fisheries, including in MPAs;
- a reduction of fishing mortality to the recommended levels through a combination of measures including spatial management measures (time/area closures);
- support to sustainable artisanal fisheries - improving the spatial knowledge of small-scale fishing areas in the Mediterranean is key in the face of the blue growth anticipated by all other maritime economic sectors.

WWF also recommends the establishment of a Mediterranean Fisheries Forum to enable dialogue and joint action between civil society organizations, scientific organizations and the fishing industry.

Recreational fisheries

The overall impacts of recreational fishing and its total catches are grossly underestimated in the Mediterranean. WWF recommends that:

- More research and regular monitoring are required to better understand this fast-growing activity. On the basis of the above, new regulations may be needed for minimum landing sizes, gears and catch limitations and effectively enforced. Consequently, recreational fishing effort needs to be included in all fisheries resource management schemes.
- As regards competition with professional fisheries on fishing grounds and resources, priority should be given to professional fisheries as key to national food security and sovereignty.

Marine aquaculture

WWF holds that the impacts of aquaculture on the Mediterranean marine environment should be minimized through responsible aquaculture practices regarding the following issues:

Site selection

- As a general rule, the settlement of cages in deeper waters (offshore) when feasible should be encouraged.
- Only marine aquaculture farms without a detrimental effect on the designated protected area should be permitted in Natura 2000 areas protected under the EU Birds and Habitats Directives or other marine protected areas and this on a case by case basis.
- Cage settlement in areas with significant communities of seagrass meadows and coralligenous formations and/or important fish habitats, spawning grounds and nursery areas should not be allowed.
- An on-going state-of-the-art environmental monitoring programme needs to be realized by aquaculture operations.

Nutrient release

- Rotating production between several sites (“fallowing”) should be encouraged.
- Responsible feeding practices and feed management plan in order to reduce the nutrient input (including regular monitoring of Feed Conversion Rates and assessment of whether feeding protocols are effective and FCR’s are reduced).

Escapes

- Farms should set up all necessary preventative measures and an escape prevention management plan, including a contingency plan and an annual monitoring plan in case of escapes.

Antifoulingchemicals

- Stop the use of copper as an anti-fouling substance.
- Use eco-friendly antifouling coatings and products.
- When using copper-treated nets, cleaning should take place on land with effluent treatment as a prerequisite.

Fish health

- Minimise the use of antibiotics.
- Implement a robust fish health management plan for the identification and monitoring of fish diseases and parasites.

Interaction with wildlife

- Use of anti-predator nets and implement regular inspections
- Acoustic deterrent devices (ADDs) or acoustic harassment devices (AHDs) should not be used.

Non-biological wastes

- Presence and evidence of a functioning policy for proper and responsible treatment of waste from production (either disposed of properly or recycled)

Sourcing of feed

- Demonstration of third party verified chain of custody and traceability for feed.
- Fishmeal and fish oil must come from well managed and sustainable fisheries (verified by organizations such as the International Fishmeal and Fish Oil Organization)
- No use of genetically modified organisms.

Furthermore, there is need for more research on the impacts of aquaculture on the marine environment. Public funding towards aquaculture should be directed towards environmentally responsible practices. Finally, more emphasis should be given to organic aquaculture, as well to the development of standards relevant to the Mediterranean and the implementation of certification schemes such as the Aquaculture Stewardship Council.

Tourism

WWF supports the Objectives of the Mediterranean Strategy for Sustainable Development related to sustainable tourism, i.e.:

- To promote sustainable tourism, which in turn reinforces social cohesion and cultural and economic development, enhances Mediterranean diversity and specificities, and strengthens synergies with other economic sectors, especially agriculture.
- To reduce the adverse territorial and environmental impacts of tourism, especially in existing coastal tourist areas.
- To increase the added value of tourism for local communities and for actors in developing countries.
- To improve governance for sustainable tourism.

More specific measures include:

- the evaluation of the carrying capacity of territories
- the reduction of impacts of mass tourism: limits to the artificialization of the coast, development of sustainable practices (recycling, water use, etc.).
- the reduction of impacts of sub-sectors, such as cruise tourism, recreational boating, diving and new tourism uses.

Regarding the cruise sector specifically:

Monitoring and mitigation of environmental impacts from cruise tourism should become a policy priority in all cruise destinations. Developing an effective monitoring system should be initiated via local decision-makers that should formally commit to environmental quality and ensure effective protection. Monitored parameters should include toxic substances presence in the sea and air and changes in biodiversity, but also noise pollution, metal contents in sediment and DNA changes in shells and mussels in harbours[3].

Specific recommendations to reduce the environmental impacts of the cruise sector are the following[4]:

- Cruise ships should shut down engines while in port, connecting to the local energy supply instead.
- All cruise companies should switch to modern engines that lower emissions and eliminate haze.
- Ships should adopt mechanism of ballast water control according to the Ballast Water Management Convention (BWMC)
- Designated mooring locations should be adopted to avoid anchoring damage to the sea floor and disruption of benthic organisms habitats.
- Recycling programmes, waste separation and plastics use reduction should be adopted on board of ships.
- Bilge water should be filtered through OWS (oily water separator) devices to remove and secure the oil before the water is pumped out to sea. The separated oil can be reused, or disposed of on shore. All cruise lines should maintain log books of oily bilge water disposal.
- Sewage should be treated before discharge within 4-10 miles of land. The sewage discharge ban 4 miles from land should be enforced.
- Cruisers burn so called Bunker or No. 6 Heavy Fuel Oil. This is probably the dirtiest fuel available with confirmed serious environmental impacts such as acidification and health-respiratory impacts such as asthma and increased risks of lung cancer. Cleaner solutions here can be found by switching to the low sulphur fuel that can be conducted quickly and with reasonable economic costs to the cruise operations.

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WWF has a vision of a world that is powered by 100 per cent renewable energy sources by the middle of this century

Marine renewable energy

Switching to renewable energy is not just the best choice for energy supply. It remains our only option that needs to be supported by strong energy efficiency efforts to shift today's world energy production and use to a more sustainable path. Offshore wind power, and other types of blue energy, is a valuable source of renewable energy that can help reduce carbon emissions. To achieve WWF's vision of a world that is powered by 100 per cent renewable energy sources by the middle of this century, and to avoid predicted escalating impacts of climate change, a drastic change in energy production and use practices is required[1].

Global environment benefits of reduced greenhouse gas emissions need to be balanced against local environmental risks and opportunities. For most marine-based renewable energy types, the greatest negative impacts on biodiversity occur most likely during

the construction and decommissioning phases as a result of noise and habitat disturbances. This implies that ecologically sensitive sites need to be avoided and best practice systematically applied. As relatively little is known about more recent technologies, new developments need to be accompanied by appropriate knowledge development combined with sound monitoring and evaluation in the context of environmental impact assessment procedures[11].

The development of the sector also has to be done in the framework of marine spatial planning to take into account potential adverse effects on other sectors such as tourism and fisheries.

Seabed mining

Intrinsically linked to the exploitation of finite non-renewable resources, deep sea mining is at odds with the EU strategy for resource efficiency and its aspiration for a circular economy based on renewable resources. Many of the materials present in seafloor polymetallic nodules, massive sulphide deposits around vents and mineral crusts on seamounts are still largely not reused or recycled, neither globally nor in the EU. While the growing demand for electronic devices is used as an argument for justifying seabed mining, only 19% of electronic devices are currently recycled in Europe[12].

The exploration for, and exploitation of minerals from deep-sea deposits in water depths greater than 300 m will increase the human footprint on previously largely untouched, unknown and vulnerable ecosystems.

WWF believes that deep-sea mining activities should not commence before measures are in place to protect deep-sea ecosystems from adverse impacts. It is essential that the deep-sea mining industry and related public institutions respect and align with the measures/designations of other international bodies regarding the protection of the marine environment in all steps of the licensing procedure. This should range from the evaluation of work plans for exploration to the assessments of environmental impacts, including cumulative impacts of mining operations and further include:

- consideration of the CBD scientific criteria for “Ecologically or Biologically Significant marine Areas (EBSAs)”;
- the CBD guidance for the design of representative networks of marine protected areas;
- the FAO criteria for the identification of “Vulnerable Marine Ecosystems“ (VMEs);
- the criteria adopted by other international organizations for areas to be protected from adverse human impacts, including High Seas Marine Protected Areas.

WWF supports the position of Seas At Risk requesting that a moratorium on deep-sea mining be put in place by the European Commission until: more sustainable alternatives are fully investigated; further research on the impacts of mining on the marine environment is conducted; a comprehensive legal framework is put in place; and a network of marine protected areas for deep sea ecosystems and biodiversity is complete[12].

Coastal development

The effective implementation of the Integrated and Coastal Zone Management Protocol under the Barcelona Convention is the real challenge of coastal development.

Coastal and marine ecosystems need to be further protected from coastal development, which includes avoiding any further artificialization including land reclamation and an accelerated implementation of land-based pollution reduction policies. The development, adoption and application of spatial and urban plans that account for the specificities and protection of coastal ecosystems, are key instruments that can help reduce the negative impacts of coastal development.

Adaptation to climate change impacts, e.g. coastal erosion, should be dealt with through comprehensive national adaptation plans based on an ecosystem-approach, including:

- Conserving, maintaining and restoring natural key ecosystems (dunes, marshes, coastal lagoons), as well as the goods and services they provide.
- Maintenance and improvement of ecosystem services: especially those that are vital (e.g., access and quality of water)
- Conservation of natural “infrastructure”, improvement of connectivity and resilience: maintenance of coastal barriers and natural flood control mechanisms, cushioning against storms, pollution reduction and water purification,

Land-based pollution sources

EU policies such as the Integrated Pollution Prevention and Control (IPPC) Directive (EU, 2008) and related directives have played an important role in limiting the adverse environmental effects of industrial activities in recent decades. More recently, the obligations on industry have been brought together in the Industrial Emissions Directive (EU, 2010), which sets out requirements for some 50,000 large industrial installations to avoid or minimize emissions and waste. Other factors contributing to emissions reductions include energy efficiency, changes in the energy mix, end-of-pipe pollutant abatement technologies, a shift in Europe away from certain heavy and more polluting types of manufacture, and company participation in voluntary schemes to reduce environmental impacts[2].

Looking ahead, further implementation of the above-mentioned Directives is strongly needed to help further reduce impacts.

Due to continued progress in wastewater treatment, pollution from wastewater should keep on decreasing over the next 15 years. The full implementation of the Urban Waste Water Directive, and its revision, are needed.

Focus on solid waste

Regarding the issue of solid waste in the marine environment, WWF is advocating for specific policy goals, including:

- High recycling targets in order to drive recovery of materials, including dedicated reduction targets for plastic packaging.
- A legally binding, 50% reduction target for marine litter to drive ambitious measures and further policy changes.
- End single-use plastic products wherever possible.
- Strong implementation of the Marine Strategy Framework Directive by Member States, including ambitious programmes of measures and quantitative targets.
- Implementation of economic incentives to move Europe towards a circular waste-free economy.
- Ban on plastic microbeads in cosmetics and personal care products.
- Ban on plastics to landfills and recyclables to incinerators.
- European-wide Extended Producer Responsibility (EPR) schemes.
- Compulsory marking of fishing gear and specific Extended Producer Responsibility schemes in harbours, to minimize ghost nets.

ANNEX 2:

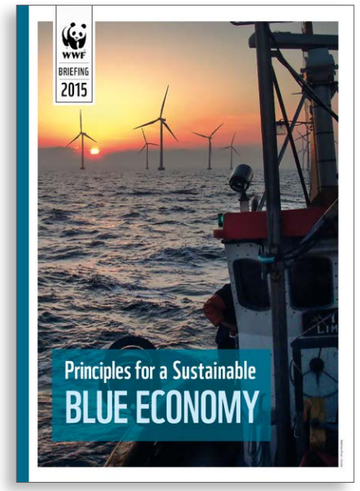
WWF PRINCIPLES FOR A SUSTAINABLE ECONOMY

A Sustainable Blue Economy[5] is governed by public and private processes that are ...

- **Inclusive.** A Sustainable Blue Economy is based on active and effective stakeholder engagement and participation.
- **Well-informed, precautionary and adaptive.** Decisions are based on scientifically sound information to avoid harmful effects that undermine long-term sustainability. When adequate information and knowledge are missing, actors take a precautionary approach, actively seek to develop such knowledge, and refrain from undertaking activities that could potentially lead to harmful effects. As new knowledge of risks and sustainable opportunities is gained, actors adapt their decisions and activities.
- **Accountable and transparent.** Actors take responsibility for the impacts of their activities, as well as are transparent about their impacts so that stakeholders are well-informed and can exert their influence.
- **Holistic, cross-sectoral and long-term.** Decisions are based on an assessment of their economic, social and environmental benefits and costs to society, as well as their impacts on other activities and across borders, now and in the future.
- **Innovative and proactive.** All actors in a Sustainable Blue Economy are constantly looking for the most effective and efficient ways to meet the needs of present and future generations without undermining the capacity of nature to support human economic activities and wellbeing.

To create a Sustainable Blue Economy, public and private actors must ...

- **Set clear, measurable, and internally consistent goals and targets for a Sustainable Blue Economy.** Governments, economic sectors, individual businesses and other actors must all set relevant and measurable goals and targets for a Sustainable Blue Economy to provide their planning, management and activities with a clear direction. Goals and targets for different economic, social and ecological areas — as well as related policies and activities — must be made as integrated and coherent as possible, to avoid conflicts and contradictions.
- **Assess and communicate their performance on these goals and targets.** The goals and targets for a Sustainable Blue Economy must be regularly monitored and progress communicated to all stakeholders, including the general public, in a transparent and accessible way.
- **Create a level economic and legislative playing field that provides the Blue Economy with adequate incentives and rules.** Economic instruments such as taxes, subsidies and fees should be aimed at internalizing environmental and social benefits, costs and risks to society. International and national laws and agreements, including private agreements, should be framed, implemented, enforced, and continuously improved in ways that support a Sustainable Blue Economy.
- **Plan, manage and effectively govern the use of marine space and resources, applying inclusive methods and the ecosystem approach.** All relevant uses of marine space and resources must be planned, managed and governed through forward-looking, precautionary, adaptive and integrated processes that ensure the long term health and sustainable use of the sea, while also taking into account human activities on land. Such processes must be participatory, consensus-oriented, accountable, transparent, equitable and inclusive, in order to be responsive to present and future human uses and needs, including the needs of minorities and the most vulnerable groups in society. To make informed trade-offs, such processes should also use appropriate tools and methods to capture the range of benefits that ecosystem goods and services can bring to different stakeholders.



- **Develop and apply standards, guidelines and best practices that support a Sustainable Blue Economy.** All actors — including governments, businesses, non-profit enterprises, investors and consumers — must develop or apply the global sustainability standards, guidelines, best practices, or other behaviors that are relevant to them. For organizations, application of such standards should not only ensure that their activities are conducted in a responsible way, but also improve their own performance and competitiveness, today and in the future.
- **Recognize that the maritime and land-based economies are interlinked and that many of the threats facing marine environments originate on land.** To a achieve a Sustainable Blue Economy in the seas and coastal regions, land-based impacts to marine ecosystems must be addressed and actors must also work to promote the development of a sustainable green economy on land.
- **Actively cooperate, sharing information, knowledge, perspectives, and ideas, to realize a sustainable and prosperous future for all.** All actors in a Sustainable Blue Economy have a responsibility to participate in the process of implementation, and to reach out across national, regional, sectoral, organizational, and other borders, to ensure collective stewardship of our common marine heritage.

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