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MEDTRENDS

BLUE GROWTH TRENDS IN THE ADRIATIC SEA:

THE CHALLENGE OF ENVIRONMENTAL PROTECTION

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MEDTRENDS

BLUE GROWTH TRENDS IN THE ADRIATIC SEA:

THE CHALLENGE OF ENVIRONMENTAL PROTECTION

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ACRONYMS

ADRION Adriatic Ionian Programme

AIS Automatic Identification System

BWMC Ballast Water Management Convention

CBD Convention on Biological Diversity

CFP Common Fishery Policy

CISE Common Information Sharing Environment

CPUE Catch Per Unit Effort

DPSIR Driver Pressure State Response

E&P Exploration and Production

EBSAs Ecologically and Biologically Significant Areas

EC European Community

EU European Union

EUSAIR European Union Strategy for the Adriatic and Ionian Region

FAO Food and Agriculture Organization

FCR Feeding Conversion Rates

FRAs Fisheries Restricted Areas

GDP Gross Domestic Product

GES Good Environmental Status

GFCM General Fisheries Commission for the Mediterranean

GT Gross Tonnage

GVA Gross Value Added

ICCAT International Commission for the Conservation of Atlantic Tunas

ICZM Integrated Coastal Zone Management

IEA International Energy Agency

IMO International Maritime Organization

ISPRA Istituto Superiore per la Protezione Ambientale

LNG Liquefied Natural Gas

MPA Marine Protected Areas

MS Member States

MSP Maritime Spatial Planning

NAPA North Adriatic Port Association

NATO North Atlantic Treaty Organization

NREAP National Renewable Energy Action Plan

NUTS Nomenclature of Territorial Units of Statistics

O&G Oil and gas

ODEMM Options for Delivering Ecosystem-Based Marine Management

RAC/SPA Regional Activity Centre for Specially Protected Areas

REMPEC Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea

RES Renewable Energy Sector

SPAMIs Specially Protected Areas of Mediterranean Importance

TEU Twenty-foot equivalent units

UNCLOS United Nations Convention on the Law of the Sea

UNDP United Nations Development Programme

UNEP United Nations Environment Programme

VME Vulnerable Marine Ecosystem

WFD Water Framework Directive

WTTC World Travel and Tourism Council

WWF World Wide Fund for Nature

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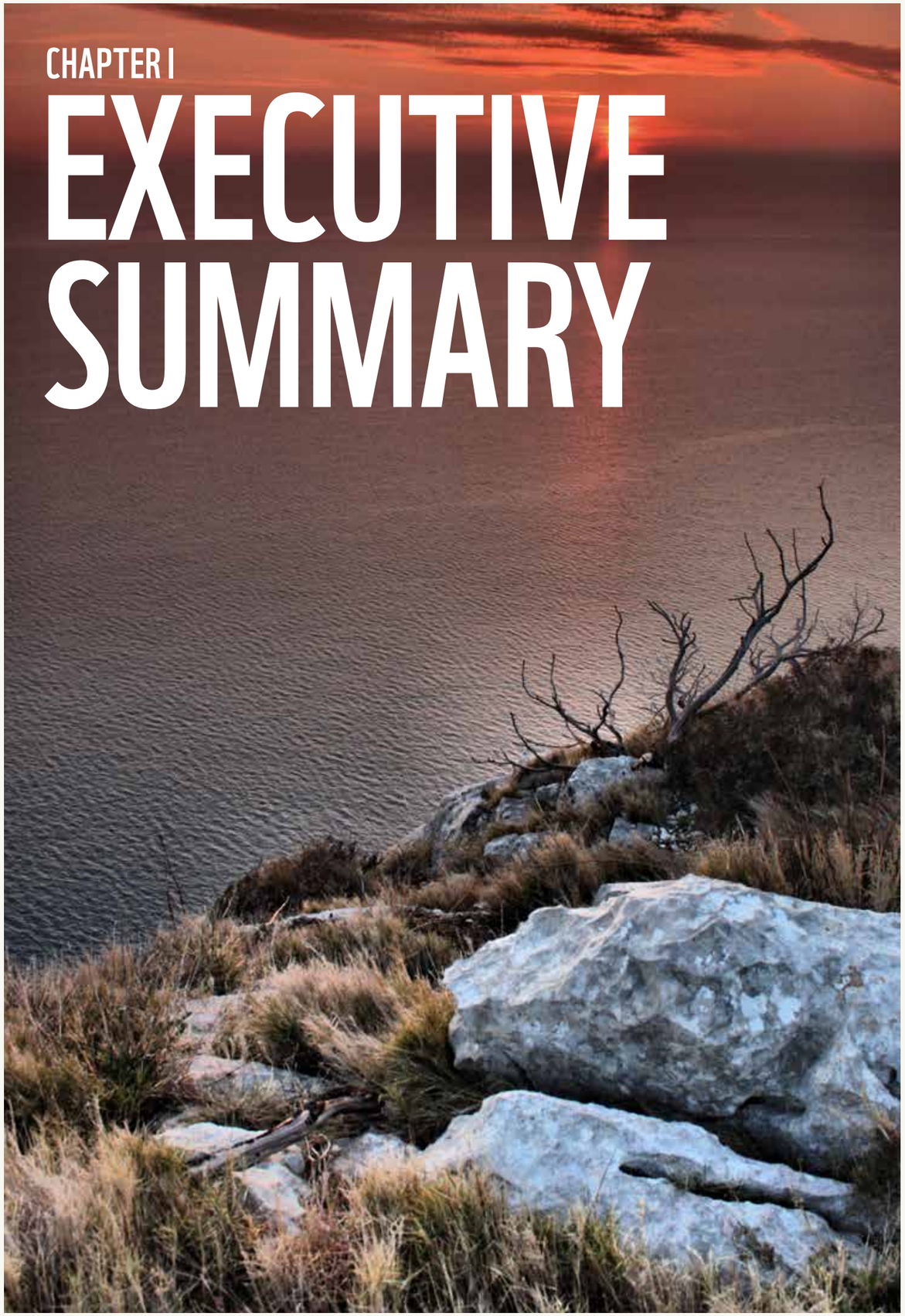

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CHAPTER I

EXECUTIVE SUMMARY

The Adriatic Sea is becoming increasingly crowded with diverse maritime economic activities. Most of these activities are expected to increase substantially over the next 15 years. This increase will lead to a growing demand for space and marine resources, but also to rising conflicts between maritime sectors and, associated with this, potential environmental impacts.

The MedTrends project (Adriatic sub-region) performed an assessment of transnational marine economic growth in Adriatic-EU Member States to assess the capacity of the area to face future environmental pressures and conflicts between economic sectors. The project combined the collection and analysis of geo-localised socio-economic and environmental information on 8 key maritime sectors with a wider spatial analysis aiming to identify interactions between the sectors and potential effects on the marine and coastal environment.

FUTURE TRENDS

According to the sector analysis, with the exception of professional fisheries and military activities, all traditional sectors of the Adriatic maritime economy such as tourism, shipping, aquaculture and offshore oil and gas are expected to grow considerably in the next 15 years. Comparatively new or emerging sectors (such as the renewable energy sector) are also expected to grow, although there is greater uncertainty regarding their developments and potential impacts on marine ecosystems. The main trends that have emerged from the analysis are summarized in the following table, including the key indicators used for the assessment.

FIGURE 1 **ADRIATIC ECONOMIC SECTORS TRENDS AND KEY INDICATORS**

SECTOR	TREND	KEY INDICATORS
Oil & gas	↗	• 29 new concessions in Croatian waters • 11 new concessions in Italian waters
Maritime transport and ports	↗	• NAPA ports expected increase in shipping market share by 11.3% by 2030
Fisheries	→	• Low recovery rates of fish stocks • Decreasing trends in the Italian fisheries sector
Marine aquaculture	↗	• Production increased from 20,000 (current) to 32,000 by 2030
Tourism	↗	• Cruise passengers growing to over 11M by 2030
Renewable energy	↗	• 8 new wind farms proposed in the Adriatic + wave and current projects in development
Marine mining	↗	• Increasing market request for dredged sediments and minerals
Military activities	↘	• Reduction plans for the Italian military fleet

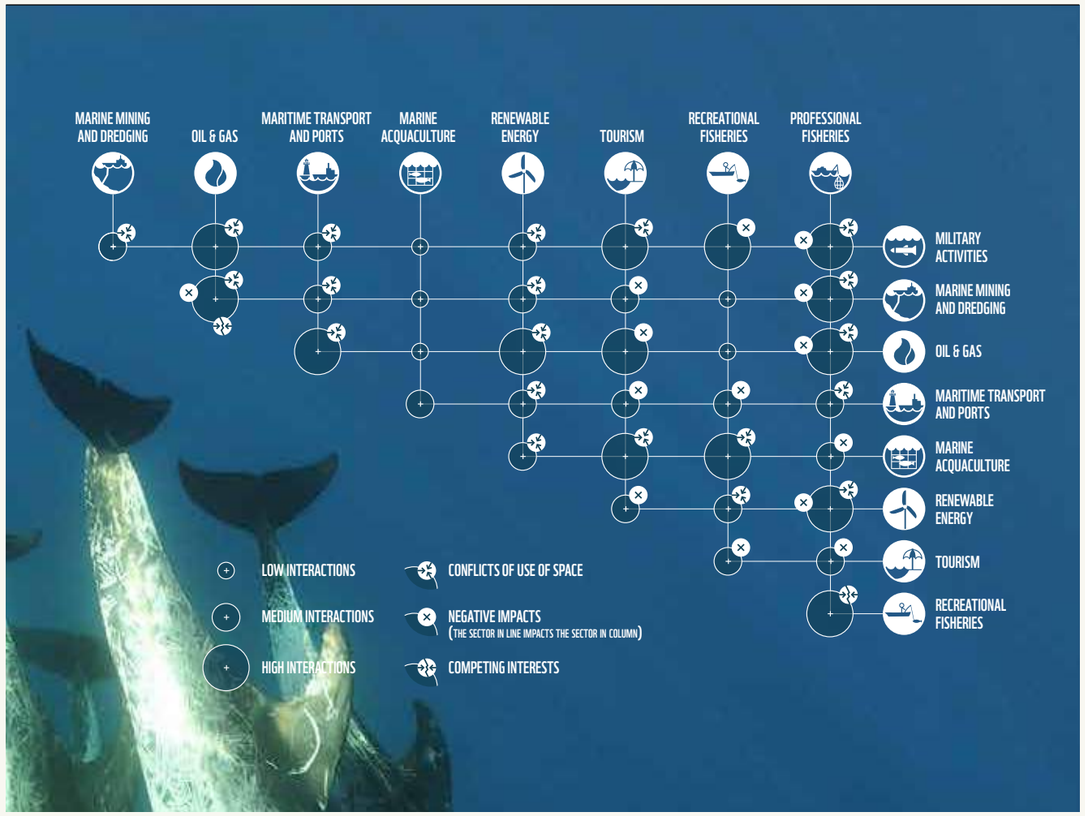
SOURCE: WWF ELABORATION, 2014

CONFLICTS BETWEEN SECTORS

Several potential conflicts in the maritime sectors were identified including:
• Conflicts over the use of the same resources (for instance between the professional and recreational fisheries sector)
• Conflicts over the use of space (for instance between marine aquaculture and tourism)

The main conflicts between the sectors have been summarized in the following table:

FIGURE 2 **MATRIX OF INTERACTIONS BETWEEN ECONOMIC SECTORS IN THE ADRIATIC SEA**



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The analysis shows that the most critical sector in the region is undoubtedly oil and gas, which may enter into conflict with numerous other economic sectors. Other conflicts for the use of space are particularly evident among coastal activities (i.e. aquaculture and tourism, recreational and professional fisheries).

ANALYSIS OF THE POTENTIAL IMPACTS ON GES

According to the MedTrends study, the risk of failing to achieve Good Environmental Status in the Adriatic Sea by 2020 for 8 out of 11 of the descriptors of the Marine Strategy Framework Directive (MSFD) is very high. The analysis also included a 12th descriptor (Landscape), which is not included in the MSFD but was emphasised by the Barcelona Convention. The analysis unveiled that some of the Descriptors, such as Descriptor 6 on Sea Floor Integrity, may be affected by a variety of sectors, such as oil and gas and mining drilling and exploration, but also dredging and trawling. Other Descriptors such as D4 Foodwebs may be directly affected by different sectors such as fisheries (impacting the populations of commercial species) or pollution. The results of the assessment are summarised in Figure 3 below.

FIGURE 3 **MATRIX OF INTERACTIONS BETWEEN ECONOMIC SECTORS IN THE ADRIATIC SEA**

GES DESCRIPTORS	RISKS OF NOT ACHIEVING GES	MAIN SECTORS AT THE ORIGIN OF THE RISK (MEDTRENDS ANALYSIS)
D1 **Biodiversity**	High	
D2 **Non-indigenous species**	High	
D3 **Commercial species**	High	
D4 **Foodwebs**	High	
D5 **Eutrophication**	Moderate	
D6 **Sea-floor integrity**	High	
D7 **Hydrographical conditions**	Not assessed	
D8 **Contaminants**	High	
D9 **Contaminants in seafood**	Moderate	
D10 **Marine litter**	High	
D11 **Energy (underwater noise)**	High	
Marine and coastal landscape	High	

SOURCE: WWF ELABORATION

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BLUE GROWTH TRENDS AND CONSERVATION COMMITMENTS

The analysis also revealed potentially increasing constraints for Adriatic EU Member States to meet the Convention on Biological Diversity (CBD) Aichi Target 11 commitments, which require at least 10% of EU waters to be within MPAs or other effective area-based management measures by 2020 (the current area of Adriatic waters within MPAs is below 1%). Considering the increasing requirements for space of the growing economic sectors in the region, the establishment of large MPAs that would allow the fulfilment of the 10% target seems unlikely.

MAIN CONCLUSIONS AND RECOMMENDATIONS

The context of the future implementation of the EU's Blue Growth Strategy and the Maritime Spatial Planning (MSP) Directive (2014/89/UE), which needs to be transposed by Adriatic Member States at the latest by 18 September 2016, is still complex and very unclear. The findings of the report demonstrate that guidance on "sustainable blue economy" or "sustainable blue growth" is currently missing and efforts should be made to fully adopt an Ecosystem-Based Management approach in MSP and blue growth planning.

It is therefore highly recommended that in MSP processes in the Adriatic, particular attention towards the conservation of natural resources should be given and that new MPAs should be established, to meet conservation targets.

Furthermore it is recommended 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, specifically:

- At a temporal level, development trends scenarios of the maritime economy sectors (what is likely to happen without any interference in the management of the area) need to be established at a minimum scale of 15 to 20 years.

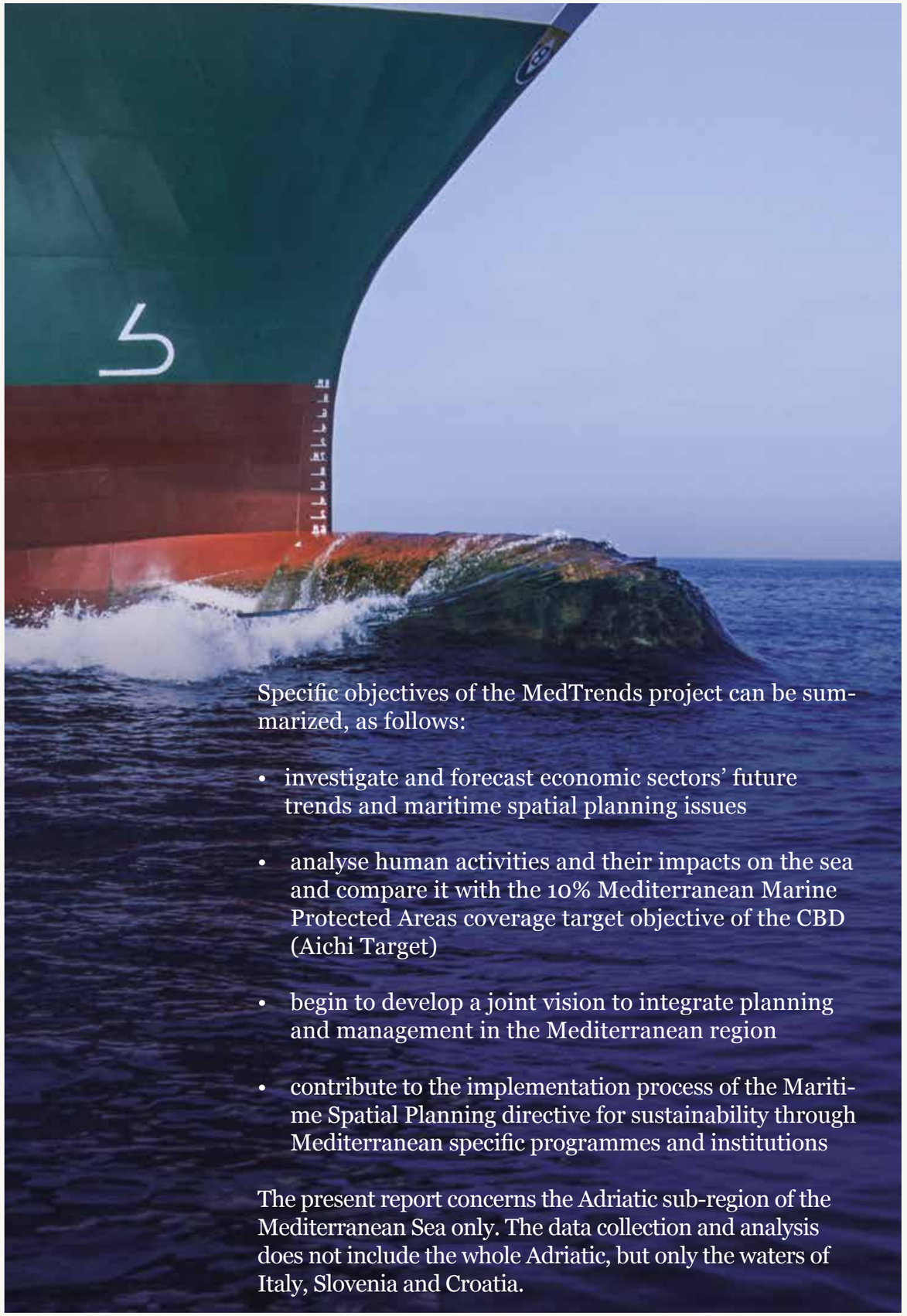
- These trends need to be anticipated at a transnational level. This is especially important in the Adriatic, a semi-enclosed sea, where any national development will have an impact on several neighbouring countries. In this respect, joint efforts between Adriatic Member States should be made in all aspects of maritime spatial planning and management.

WWF believes that existing conservation commitments should be respected by all Adriatic EU Member States, and that further monitoring and enforcement should take place to ensure that these commitments will be met.

CHAPTER II

BACKGROUND AND OBJECTIVES

The MedTrends project takes inspiration from WWF's 2010 report "Future trends in the Baltic Sea" which forecast the expected growth trends of key maritime economic sectors in the Baltic area within the next 20 years and proposed useful tools for facing challenges of the Baltic Sea governance framework .
WWF is increasingly involved in Maritime Spatial Planning (MSP) processes in the Mediterranean Sea, and the present project represents a first attempt to map and describe key economic sectors at regional, sub-regional and national level, in order to establish a baseline to support the implementation of the recently approved MSP Directive.
The scope of the MedTrends project is therefore the illustration and mapping of transnational marine economic growth in Med-EU countries with the final goal to improve the use of the sea and assess its capacity to face future pressures, while promoting transnational cooperation for long term conservation and productivity of marine areas, according to the MSFD objective to reach and maintain a Good Environmental Status (GES) of the sea.



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Specific objectives of the MedTrends project can be summarized, as follows:

- investigate and forecast economic sectors' future trends and maritime spatial planning issues
- analyse human activities and their impacts on the sea and compare it with the 10% Mediterranean Marine Protected Areas coverage target objective of the CBD (Aichi Target)
- begin to develop a joint vision to integrate planning and management in the Mediterranean region
- contribute to the implementation process of the Maritime Spatial Planning directive for sustainability through Mediterranean specific programmes and institutions

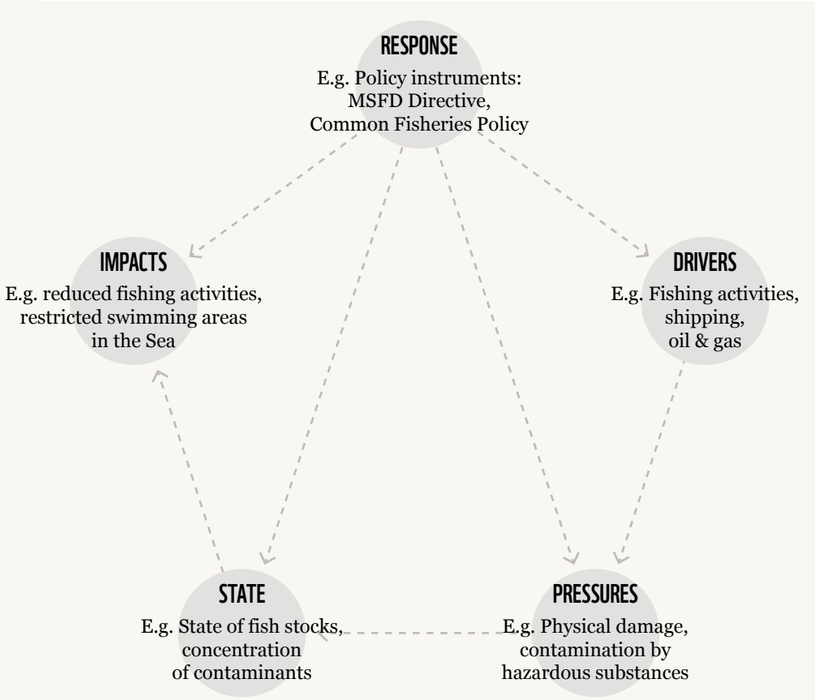
The present report concerns the Adriatic sub-region of the Mediterranean Sea only. The data collection and analysis does not include the whole Adriatic, but only the waters of Italy, Slovenia and Croatia.

CHAPTER III

METHODOLOGY

The general conceptual approach of the MedTrends project is based on the DPSIR framework (Drivers, Pressures, State, Impacts, Response), which allowed to define and assess the links between human activities and state of the sea, as illustrated in Figure 4 below.

FIGURE 4 **THE DPSIR FRAMEWORK APPLIED TO THE MEDTRENDS PROJECT**



[2] Drivers: human activities; Pressures : mechanism through which 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 activities; Impacts: consequences 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 activities on the ecosystems state.

The methodology applied to the MedTrends project in the Adriatic sub-region consists in the following main steps:

1. Description of the current state of the Adriatic Sea and identification of the key global drivers affecting the economic sectors in the sub-region.
2. Mapping and quantitative description of the current status and future trends (where possible) of the key economic sectors in the sub-region.
3. Evaluation of each sector's potential impacts on the achievement of GES
4. Evaluation of potential conflicts with other economic sectors in the region
5. Cross cutting analysis

These are described in detail in the following paragraphs.

1. DESCRIPTION OF THE CURRENT STATE OF THE ADRIATIC SEA AND IDENTIFICATION OF THE KEY GLOBAL DRIVERS AFFECTING THE ECONOMIC SECTORS IN THE SUB-REGION

The first part of the report consists in a general description of the current state of the Adriatic Sea including the identification of the main drivers affecting the economic sectors in the region. Examples of drivers considered in the report are the following:

- Demographic changes
- EU Policy
- Climate change

2. MAPPING AND DESCRIPTION OF THE CURRENT STATUS AND FUTURE TRENDS (WHERE POSSIBLE) OF THE KEY ECONOMIC SECTORS IN THE SUB-REGION

Key sectors were identified based on expert consultation, available literature and statistical information. An initial list was presented and approved by an Advisory Board composed of regional scientists and operators of maritime planning. Due to the lack of data, some sectors were discarded or combined with similar categories (professional and recreational fisheries). The final list of sector is illustrated in Table 1:

A background introduction briefly describing the political framework influencing the development of the sectors was produced, together with a map presenting the current importance and features of the sector.

Assessments of the future trends of these sectors were based on a single business-as-usual scenario (BAU). Starting from current available 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.

In order to assess future trends by 2030 the following information was used:

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

TABLE 1 **SECTORS CONSIDERED WITHIN THE MEDTRENDS PROJECT**

THEME	SECTOR
Extraction of living resources	Fisheries (professional and recreational)
	Marine aquaculture
Extraction of non-living resources	Marine mining
	Oil and gas exploration and extraction
Energy production	Marine renewable energy
Transport	Maritime transport and ports (freight and passenger transport)
Tourism	Tourism (coastal tourism, recreational boating, cruise tourism)
Other human activities	Military activities

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 sufficient time to carry out surveys and data collection in the field and therefore only existing information that could be directly integrated into a Geographic Information System (GIS) was used. Most of the data can be accessed freely on online databases (Atlas of the Sea, GEBCO, Eurostat, GFCM) or were kindly provided by scientific partners.

Additionally three fundamentally important datasets were purchased specifically for the project:
1. Data on the exploration and the exploitation of offshore oil and gas, completed with information gathered at national level by the project partners;
2. Automatic Identification System (AIS) data for maritime transport and fisheries;
3. Data on existing and planned projects of wind farms.

MAP PRODUCTION FOR MARITIME TRAFFIC AND FISHERIES

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. 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.)

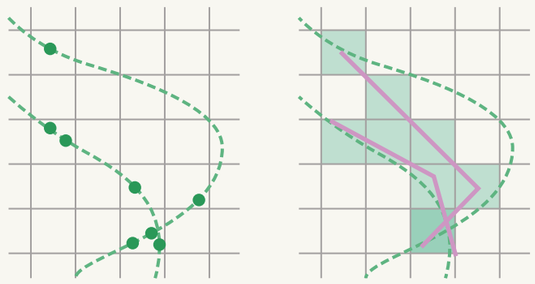
Based on these data, maps showing the density of AIS signals compiled over a year and projected on a grid in which each pixel is approximately 1 square km (exactly 0.01° in longitude and latitude, which makes 1.1 km on an east-west axis and 0.9 km on a north-south axis) were developed. Different algorithms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

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

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 process 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. A logarithmic scale was chosen in order to allow the representation of extreme values, which correspond to the characteristics of Mediterranean traffic.

FIGURE 5 **LINEAR INTERPOLATION ILLUSTRATION**



3. EVALUATION OF EACH SECTOR'S POTENTIAL IMPACTS ON THE ACHIEVEMENT OF GES

This section provided an assessment of the effects of the sectors on the Descriptors of the MSFD. A table summarizing the evolution of the impacts of the pressures exerted on the MSFD descriptors has been presented.

TABLE 2 **THE 11 MSFD DESCRIPTORS**

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

*:The landscape descriptor is not included in the MSFD list, but it has been adopted by the Barcelona Convention, and it was added to the list as it is particularly relevant for the Mediterranean region

4. EVALUATION OF POTENTIAL CONFLICTS WITH OTHER ECONOMIC SECTORS IN THE REGION

In this section, the interactions between sectors were assessed based on the results of the mapping exercise and the data obtained. An assessment of the level of interaction and the types of potential conflict (or compatible interests) between the sectors was performed.

5. CROSS CUTTING ANALYSIS

This cross cutting analysis aims to provide an assessment of the interaction and conflicts between different sectors through the following steps:

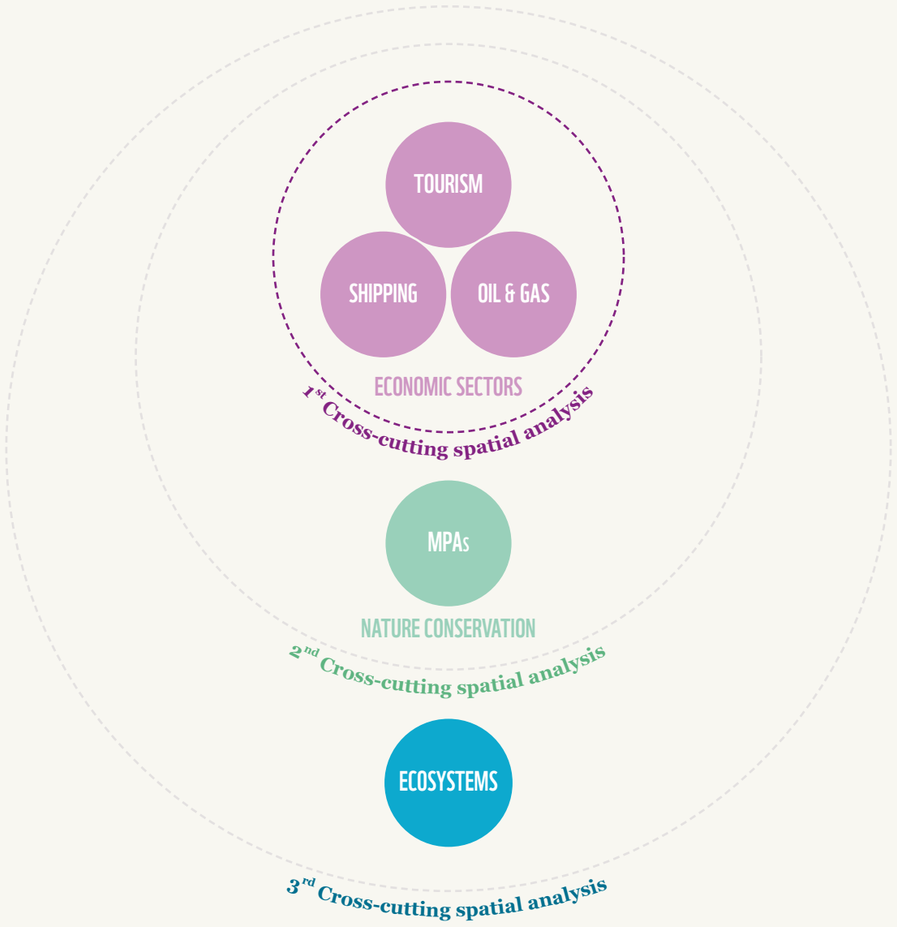
1. Initially an analysis of the increased conflicts of the use of the sea between the different sectors was performed, including the assessment of the relative importance of sectors and looking especially on the type of conflicting economic sectors that might grow by 2030. The analysis was performed by:

- Overlapping potential future locations of different sectors and marine uses
- Summarizing the different levels of interaction through a matrix.

2. The trends in MPAs have then been analysed in comparison with the trends expected in all economic sectors, in order to point out the potential issues for reaching the 10%-target of MPAs by 2020.
   MPAs and priority areas for conservation were overlaid with the spatial data collected for each sector, to identify potential areas of conflicting interest between Blue Growth and conservation priorities.

3. Then an analysis of the cumulative impacts of economic sectors and MPAs on the state of ecosystems in the Adriatic was also developed, to highlight the potentially conflictive uses that may hinder the achievement of the GES by 2020. The 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.

FIGURE 6 **CROSS-CUTTING ANALYSIS**



PROJECT AREA

The study area of the regional MedTrends project covers the Mediterranean marine waters under the jurisdiction of the 8 EU Mediterranean countries: Croatia, Cyprus, France, Greece, Italy, Malta, Slovenia and Spain.

FIGURE 7 **REGIONAL PROJECT AREA**

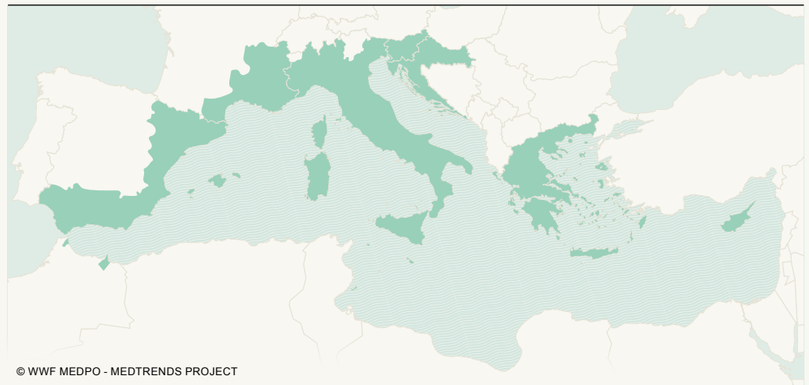


FIGURE 8 **THE STUDY AREA OF THE MEDTRENDS PROJECT IN THE ADRIATIC MACROREGION**

For the Adriatic sub-region report, the study area instead covers the Adriatic Sea as a whole excluding marine waters of Montenegro, Albania and Bosnia-Herzegovina.

SOURCE: TOMOBE03 (2012) CC BY-SA 3.0

Maritime limits and boundaries depicted on the MedTrends maps are not to be considered as an authority on the delimitation of international maritime boundaries. These maps are drawn on the basis of the best available information to the MedTrends project's team. Where no maritime boundary has been agreed, theoretical equidistance lines have been constructed. Where a boundary is in dispute, we attempted to show the claims of the respective parties where these are known to us and show areas of overlapping claims. In areas where a maritime boundary has yet to be agreed the MedTrends maps are not to be taken as the endorsement of one claim over another.

CHAPTER IV

STATE OF THE ADRIATIC SEA

The Adriatic is a semi-enclosed sea, intensively used by various maritime activities. The basin is also characterised by a rich marine biodiversity and furthermore, it is home to significant world heritage treasures.
The Adriatic Sea is part of the eastern basin of the Mediterranean and extends northward between Italy and the Balkans, communicating with the eastern Mediterranean basin through the Strait of Otranto. It has a surface area of 138,600 km^2, a volume of 33,000 km^3 and its shape can be approximated as a rectangle extending north-northwest, about 800km long and 200 km wide. The Adriatic receives a large amount of freshwater from numerous rivers, with an annual average of 5,700 m^3/s. Of this amount, about 28% (1,585 m^3/s) comes from the Po river, in the north-western corner and shallowest part of the basin. The second most important freshwater inflow is the set of Albanian rivers and surrounding drainage bringing in average 923-1,244 m^3/s
Croatia has by far the longest coastline of the six Adriatic countries. Including more than 1,000 islands, the Croatian coastline amounts to almost 6,000 km (30.5% mainland and 69.5% islands), which is approximately 75% of the total length of the Adriatic coastline [1].
Several important ports are located in the north of the Adriatic (e.g. Venice, Trieste, Koper), implying intense maritime traffic in the area. Other significant activities taking place at sea are fishing, gas extraction and coastal and marine tourism.
On the Adriatic Sea's coasts and islands there are numerous small settlements, and a number of larger cities. Among them the largest are: Bari, Venice, Triest, and Rimini in Italy, Split, Rijeka and Zadar in Croatia, Durrës and Vlorë in Albania and Koper in Slovenia. In total, more than 3.5 million people live on the Adriatic coasts [2].

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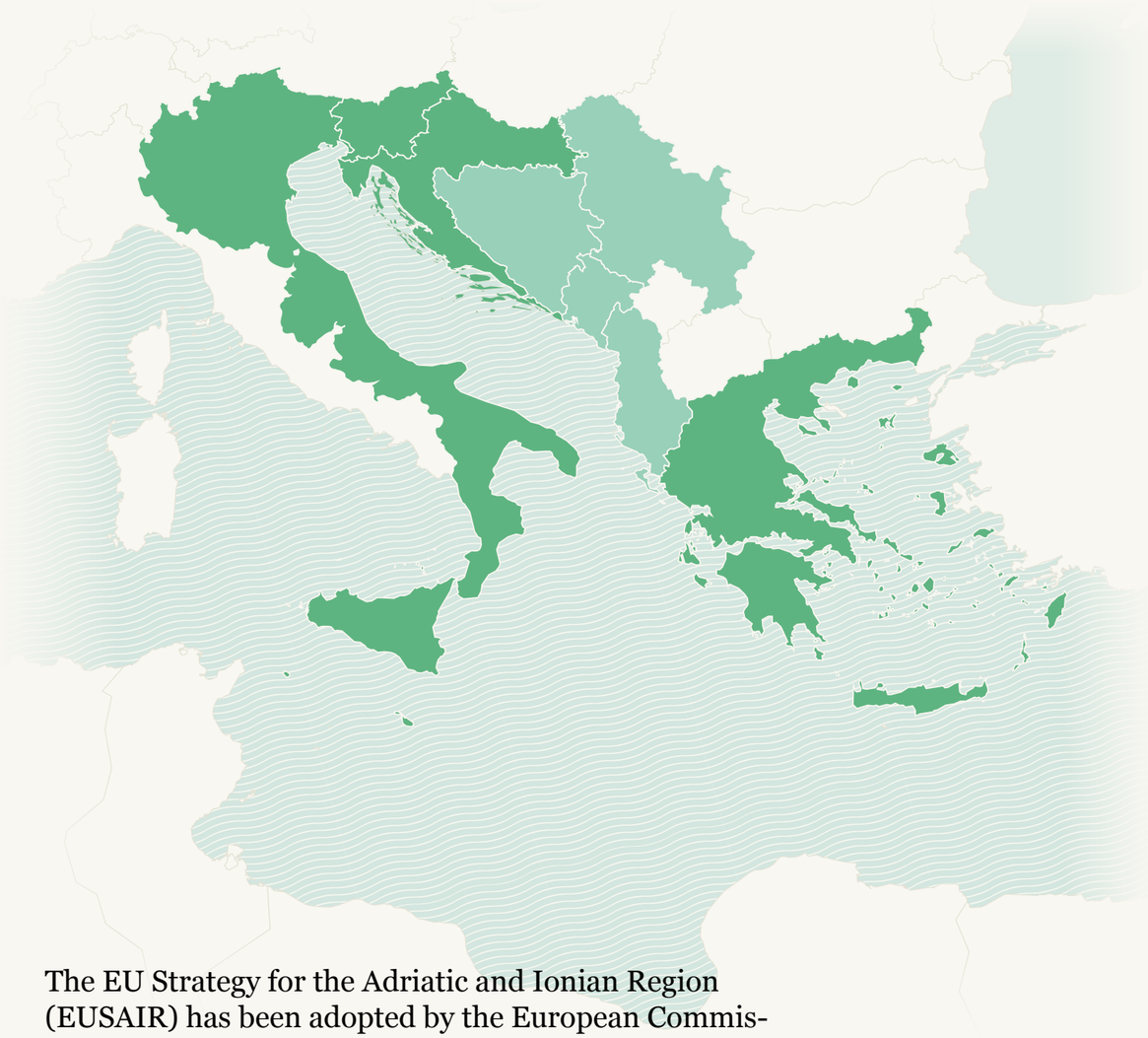
CHAPTER IV

EUSAIR



The EU Strategy for the Adriatic and Ionian Region (EUSAIR) has been adopted by the European Commission and endorsed by the European Council in 2014. The Strategy was jointly developed by the Commission, together with the Adriatic-Ionian Region countries and stakeholders, in order to address common challenges together. The EUSAIR covers eight countries: four EU Member States (Croatia, Greece, Italy, Slovenia) and four non-EU countries (Albania, Bosnia and Herzegovina, Montenegro, Serbia).

The Strategy aims at creating synergies and fostering coordination between all territories in the Adriatic-Ionian Region [3].

The Macroregional approach is an innovative mode of territorial cooperation between regions and nations, with balanced and sustainable development as a shared goal. The base of its philosophy is that common challenges and opportunities can better be faced through multilevel and more focused cooperation [4].

The Macroregion which will be based on the EUSAIR is not a geographical entity, but a functional area, composed of national, regional, and local bodies pooling their energies to tackle a number of shared issues. The Macroregion does not represent a further institutional level within the European Union(like states, regions, municipalities, etc.) but rather a network or, more precisely, a joint initiative involving several European, national, regional and stakeholders, policies and funding programmes [3].

OBJECTIVES OF THE STRATEGY

The general objective of the EUSAIR is to "promote economic and social prosperity and growth in the region by improving its attractiveness, competitiveness and connectivity". The Strategy should also play an important role in promoting the EU integration of Western Balkans. It is built on four thematic pillars:

- **Blue Growth**, aiming at boosting innovative marine and maritime growth by promoting jobs and business opportunities in the Blue economy;
- **Connecting the Region**, aiming at improving connectivity in terms of transport and energy;
- **Environmental Quality**, focusing on coastal and marine biodiversity and pollution of the sea, as well as on transnational terrestrial habitats and biodiversity; and
- **Sustainable Tourism**, aiming at developing the full potential of the Region in terms of innovative quality tourism while boosting businesses and creating stable jobs [3].

A pair of countries - one EU Member State and one non-EU country - coordinated the development of the Action Plan for each pillar:

- Greece and Montenegro on "Blue Growth";
- Italy and Serbia on "Connecting the Region";
- Slovenia and Bosnia and Herzegovina on "Environmental Quality";
- Croatia and Albania on "Sustainable Tourism".

Capacity building - including communication, research & innovation and SMEs development are cross-cutting aspects, whereas due account is to be taken of mitigation and adaptation to climate change effects as well as of efficient disaster risk management (including prevention) as horizontal principles underpinning all actions carried out under the four pillars [4].

Better coordination and cooperation between Adriatic Countries is needed especially in view of the great challenges that the region will be increasingly facing, such as socio-economic disparities, shortcoming in transport links (road, rail and air) and vessel traffic congestion; inadequate interconnections of electricity grids; unsustainability of fisheries; environmental threats such as marine pollution, the preservation of a highly diverse marine environment and the adverse effects of climate change (in the form of rising sea levels, flooding, drought, soil erosion and forest fires); and insufficient institutional and administrative capacity[3].

[3] http://www.aii-ps.org/index.php/adriatic-ionian-macroregion

INTEGRATED COASTAL ZONE MANAGEMENT IN THE ADRIATIC

The implementation of ICZM (Integrated Coastal Zone Management) has a fundamental role to achieve effective Coastal Management [5]. The ICZM strategy was adopted in 2008 in Madrid in the framework of The Barcelona Convention for the implementation of an efficient and sustainable management of coastal areas and resources [5]. The coordination among and between different levels of governance, both vertical and horizontal, is fundamental for an effective ICZM implementation [5].

The SHAPE[4] project (2011-2014), funded by the Instrument of Pre-accession Assistance (IPA) Adriatic Programme, involved all the Adriatic countries for the development of a multilevel governance system, on the basis of an holistic approach and on an integrated management of coastal areas. In this sense, the project promoted and assessed the implementation of the ICZM in the area [5].

Croatian coastal zones are protected by laws harmonized with the objectives of the Adriatic Ionian Cooperation programme 2014-2020. The implementation of the Croatian National Biodiversity Strategy and Action Plan (NBSP) already since 2008 highlights a positive commitment towards ecosystems and coastal protection. To achieve more positive trends and to improve sustainable coastal development management the NBSP should effectively implement action plans established within a period of 20 years [6].

Slovenia signed the Convention on Biological Diversity (CBD) 2012/2020, for an effective management of the Slovenian marine protected areas (MPAs), but its implementation is still in progress and some important marine and coastal areas are still without protection [7]. For the 2009-2015 period Slovenia adopted a national programme, including some measure aimed at preventing and mitigating the effects of natural hazards [8].

In Italy, there is not yet a National policy for the implementation of the ICZM, but there are different regional regulations for coastal management, in line with ICZM objectives [5]. The Emilia Romagna region in Italy is involved in the Coastal Area Management Programme CAMP Italy project for the piloting of actions for an effective and sustainable integrated coastal zones management [9] [10]. In the framework of the Adriatic-Ionian Cooperation programme 2014-2020, Croatia, Italy and Slovenia are eligible for funding from the European Territorial Cooperation (ETC) ADRION programme 2014-2020, for the promotion of national and regional cooperation towards social, economic and environmental sustainability of the region. One of the main aims of the ADRION programme is to protect maritime and coastal zones, reducing the impact of human activities on biodiversity [11].

[4] Shaping an Holistic Approach to Protect the Adriatic Environment between coast and sea

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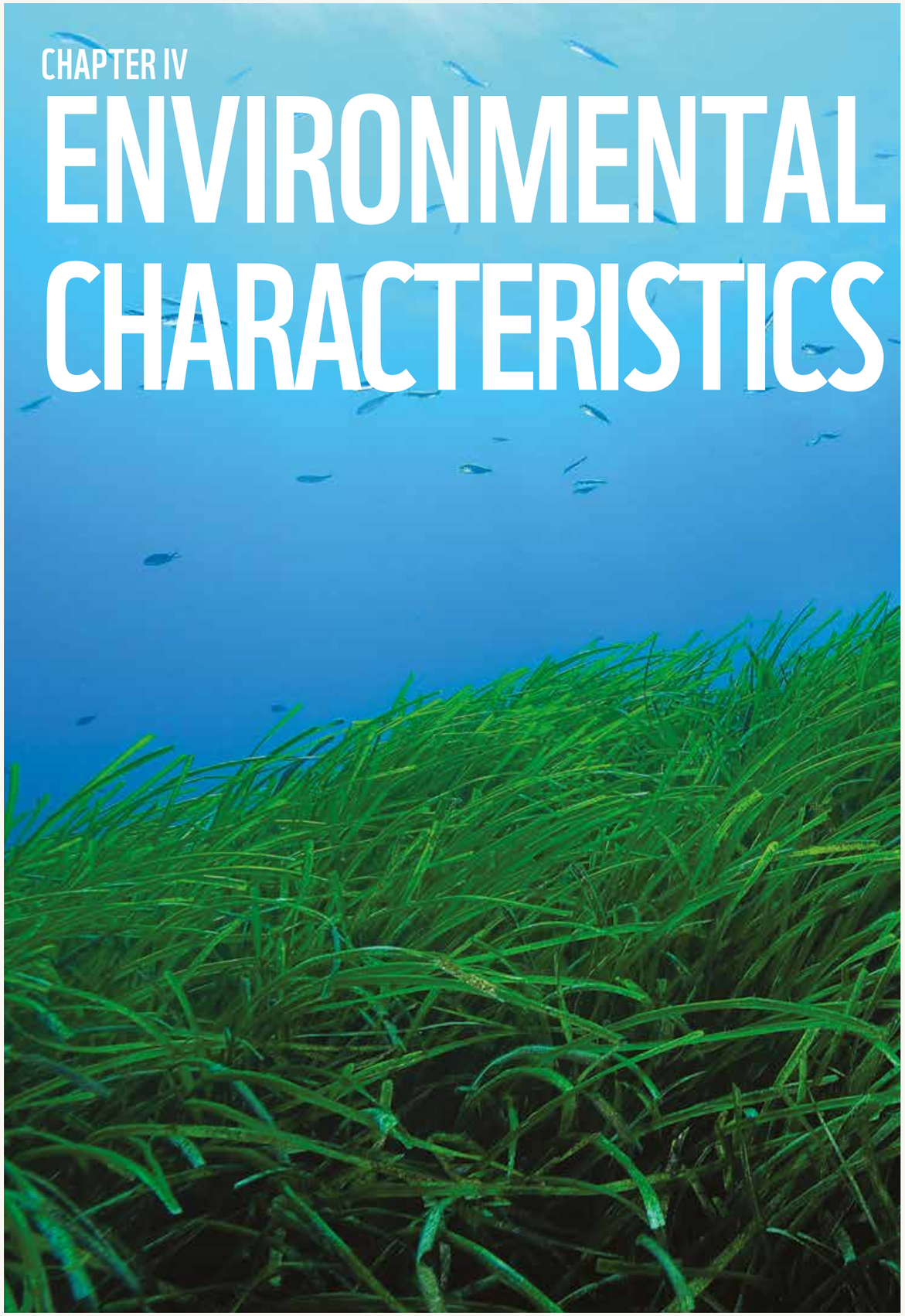

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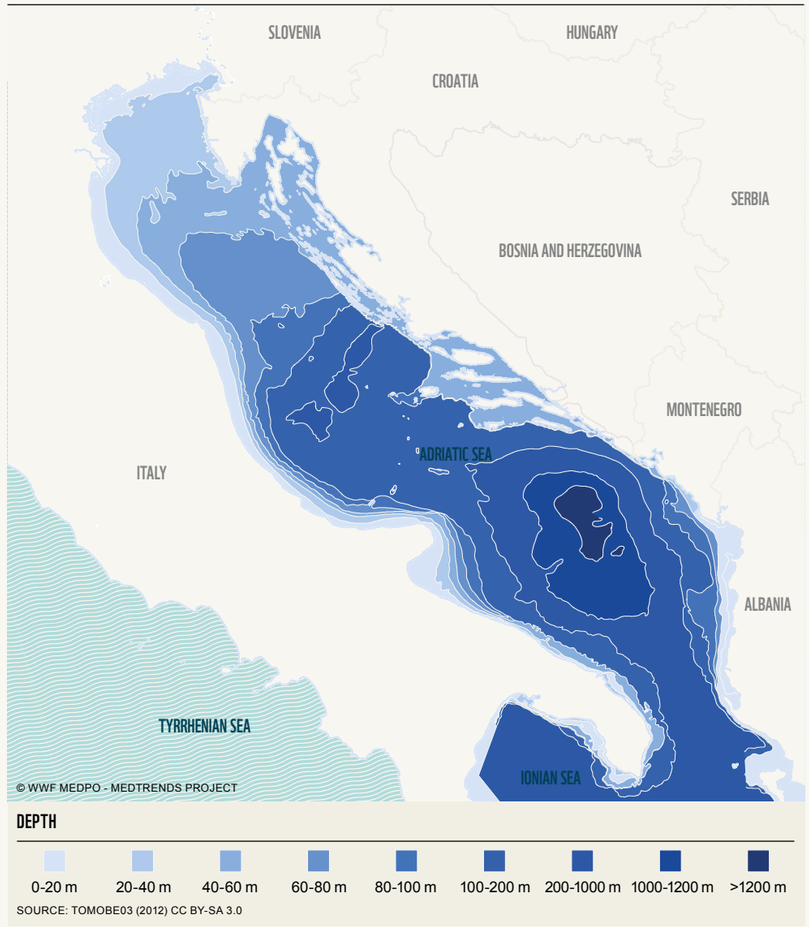
CHAPTER IV

ENVIRONMENTAL CHARACTERISTICS

BATHYMETRY

The Adriatic Sea's average depth is 259.5 metres (851 ft), and its maximum depth is 1,233 metres (4,045 ft); however, the North Adriatic basin rarely exceeds a depth of 100 metres (330 ft) [12]. The North Adriatic basin, extending between Venice and Trieste towards a line connecting Ancona and Zadar, is only 15 metres (49 ft) deep at its north-western end; it gradually deepens towards the southeast. The Middle Adriatic basin is south of the Ancona–Zadar line, with the 270-metre (890 ft) deep Middle Adriatic Pit (also called the Pomo Depression or the Jabuka Pit). The 170-metre (560 ft) deep Palagruža Sill is south of the Middle Adriatic Pit, separating it from the 1,200-metre (3,900 ft) deep South Adriatic Pit and the Middle Adriatic basin from the South Adriatic Basin. Further on to the south, the sea floor rises to 780 metres (2,560 ft) to form the Otranto Sill at the boundary to the Ionian Sea [13].

FIGURE 9 **BATHYMETRY OF THE ADRIATIC SEA**



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HYDROLOGY

The coastal water dynamics are determined by the asymmetric coasts and the Mediterranean seawater's inflow through the Straits of Otranto and further on along the eastern coast [14]. The smooth Italian coast (with very few protrusions and no major islands) allows the Western Adriatic Current's smooth flow, which is composed of the surface's relatively freshwater mass and the bottom's cold and dense water mass [15]. The coastal currents on the opposite shore are far more complex, due to the jagged shoreline, several large islands and the Dinaric Alps' proximity to the shore. The last produces significant temperature variations between the sea and the hinterland, which leads to the creation of local jets. The tidal movement is normally slight, usually remaining below 30 centimetres [16].

BIODIVERSITY

The Adriatic Sea is home to more than 7,000 species including many unique, rare, and endangered ones. The diversity and degree of specialization found here is due in part to the Dalmatian coastal islands, karst complexes, and submarine water flows, including some geothermal springs [17].

According to Boudouresque (2009) [18] 49 % of the known forms of life in the Mediterranean are present in the Adriatic Sea. The basin also hosts many endemic species, such as the brown algae *Fucus virosoides*, which is mainly found in the northern Adriatic. A number of rare and threatened species are also found along the Adriatic's coast, particularly on the western side. Species that can be found in the region include the common bottlenose dolphin, monk seals and sea turtles [19].

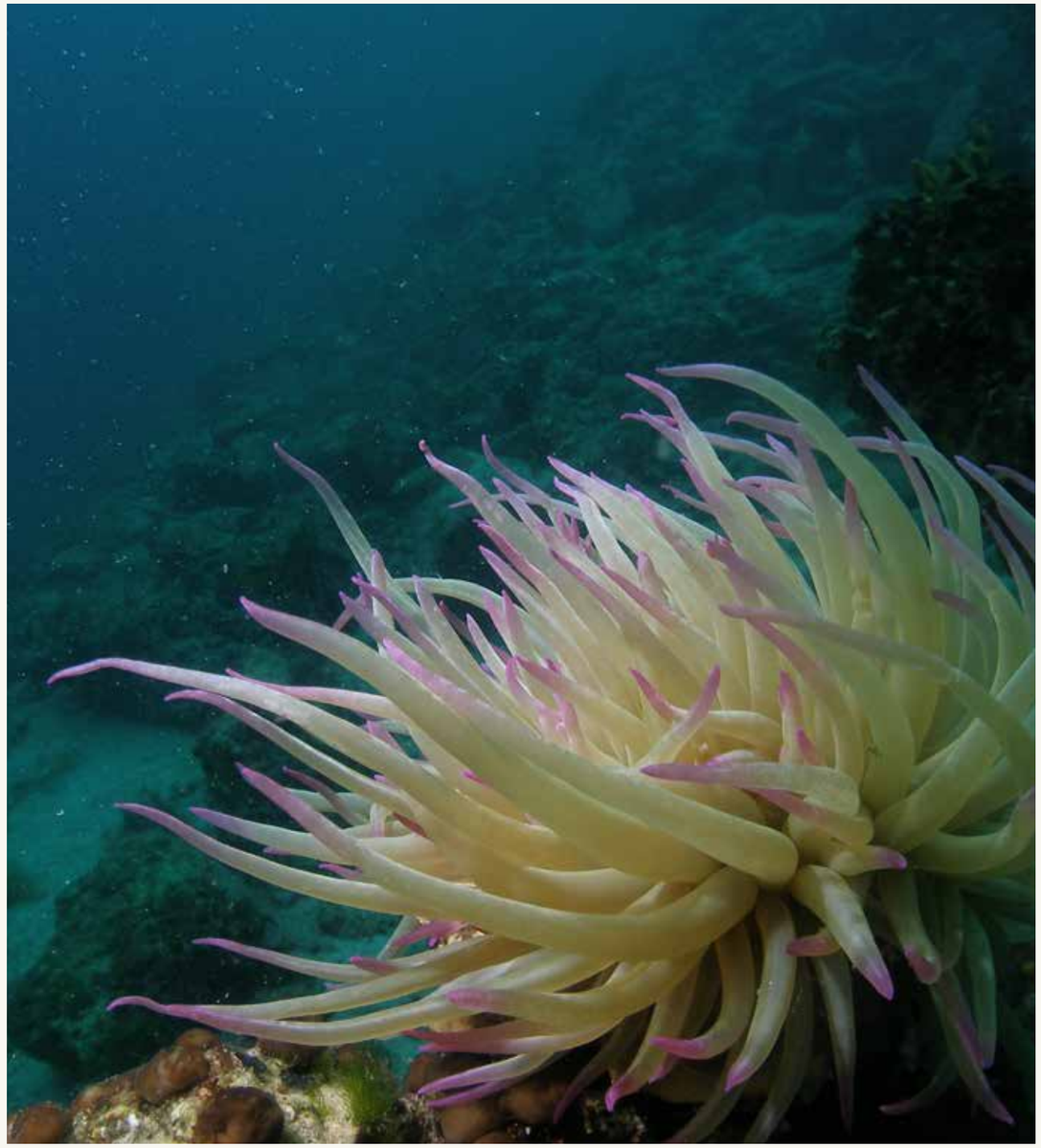
The Adriatic Sea features numerous species rated from declining to critically endangered, with representatives across the spectrum: various rockweeds and seagrasses including *Cystoseira zosteroides*, *Cystoseira spinosa*, *Zostera noltii*, and *Posidonia oceanica*); bivalves such as *Gibbula nivosa* and the ribbed Mediterranean limpet (*Patella ferruginea*); the European eel (*Anguilla anguilla*); Adriatic sturgeon (*Acipenser sturio*); the beluga or great sturgeon (*Huso huso*); the great white shark (*Carcharodon carcharias*); sea turtles such as the loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*); and marine mammals including various cetacean species and the Mediterranean monk seal (*Monachus monachus*) [17].

In the Adriatic, there are at least 410 species and subspecies of fish, representing approximately 70% of Mediterranean taxa, with at least 7 species endemic to the Adriatic. Sixty-four known fish species are threatened with extinction, largely because of overfishing [19]. The Jabuka pit (or Pomo Pit) hosts some of the most important hake nursery areas in the region [20].

Recently, many species indicators of warm water widely expanded their range of distribution and are becoming more abundant in the north-western portion of the basin. The occurrence of the orange coral *Astroides calycularis*, a quite thermophilous species fairly common in the eastern Mediterranean, seems to be related to sea temperature rise. There are also evidences that new sightings in Adriatic Sea coincided with the hottest periods [20].

According to UNEP/MAP there are 2 pelagic priority areas in the Adriatic:

- The Northern Adriatic, that includes important spawning grounds for anchovies and pilchards.
- The Northern & Central Adriatic that includes important areas for pelagic sharks [20].



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CLIMATE CHANGE

Recent studies show that climate change may have adverse impacts on the Adriatic region. Phenomena such as sea level rise, recurrent droughts, salt water intrusion, presence of tropical invasive species are expected to intensify in the region over time [21]. These changes may have a huge impact on the natural environment and will also affect important habitats such as wetlands [22].

From data monitoring of Venice and its lagoon, a long-term trend of rising sea level has been clearly established for the north Adriatic coast. This phenomenon is due both to global changes in sea level and to land subsidence, particularly in deltaic areas. This is exacerbated by water surges due to storms and by particularly strong winds typical of the Adriatic basin such as the Bora (cold, dry, north-eastern wind) and Sirocco (south-eastern wind). The combination of these factors has increased the frequency and intensity of floods in the northern Adriatic coastal areas [23].

For the eastern Adriatic coast, a Human Development Report (produced by UNDP) analyzed through modelling the area and type of land that would be covered by sea due to climate change phenomena. The study was developed according to two scenarios: 50 and 88 cm sea level rise. Preliminary results show that, for the first scenario, more of 100 km² of the mainland will be flooded while an additional 12 km² will be lost according to the second scenario [5]. One of the most recent climate change models is represented by the Climate Change and Impact Research: the Mediterranean Environment (CIRCE, 2011), applied on the Mediterranean to forecast the whole climate evolution in the region during this century. According to CIRCE projections in the period 2021- 2050, climate change might induce a mean strict sea level rise ranging between +7 and +12 cm in the Adriatic Sea, with respect to the period of reference (1961-1990) [24].

THREATS RELATED TO CLIMATE CHANGE - SEA LEVEL RISE

According to the United Nations Development Programme (UNDP) estimates, by the end of 2100, with a sea-level rise of 50 cm Croatia would lose 100 million square metres of land, with 2.8-6.5 billion euro loss in land value [25].

By 2020, along the Adriatic coastline in Italy, the territory under the sea-level could rise to 48% (15% at the end of the '80s) [26].

FIGURE 9 **TYPES OF LAND COVERED WITH A SEA LEVEL RISE OF 50 CM AND ADDITIONALLY OF 80 CM**

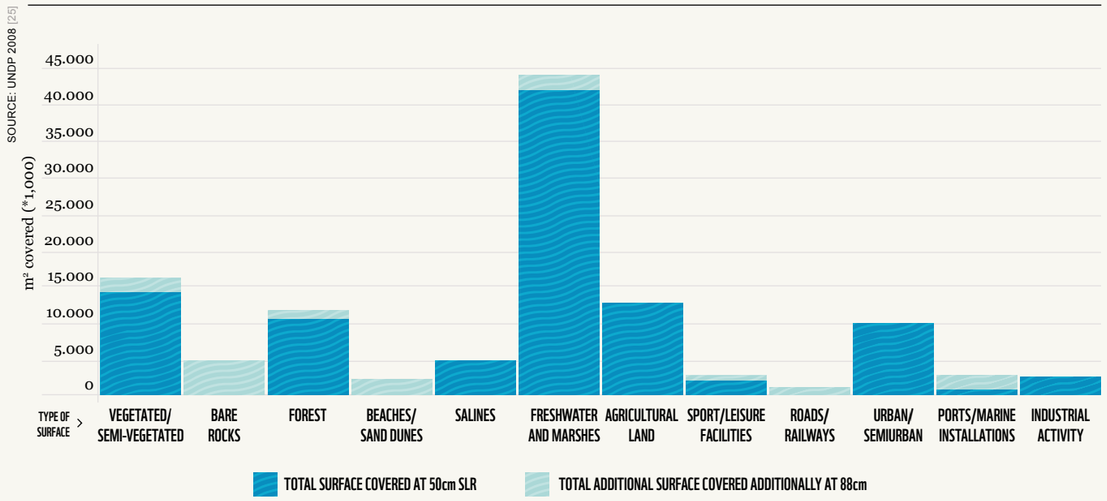
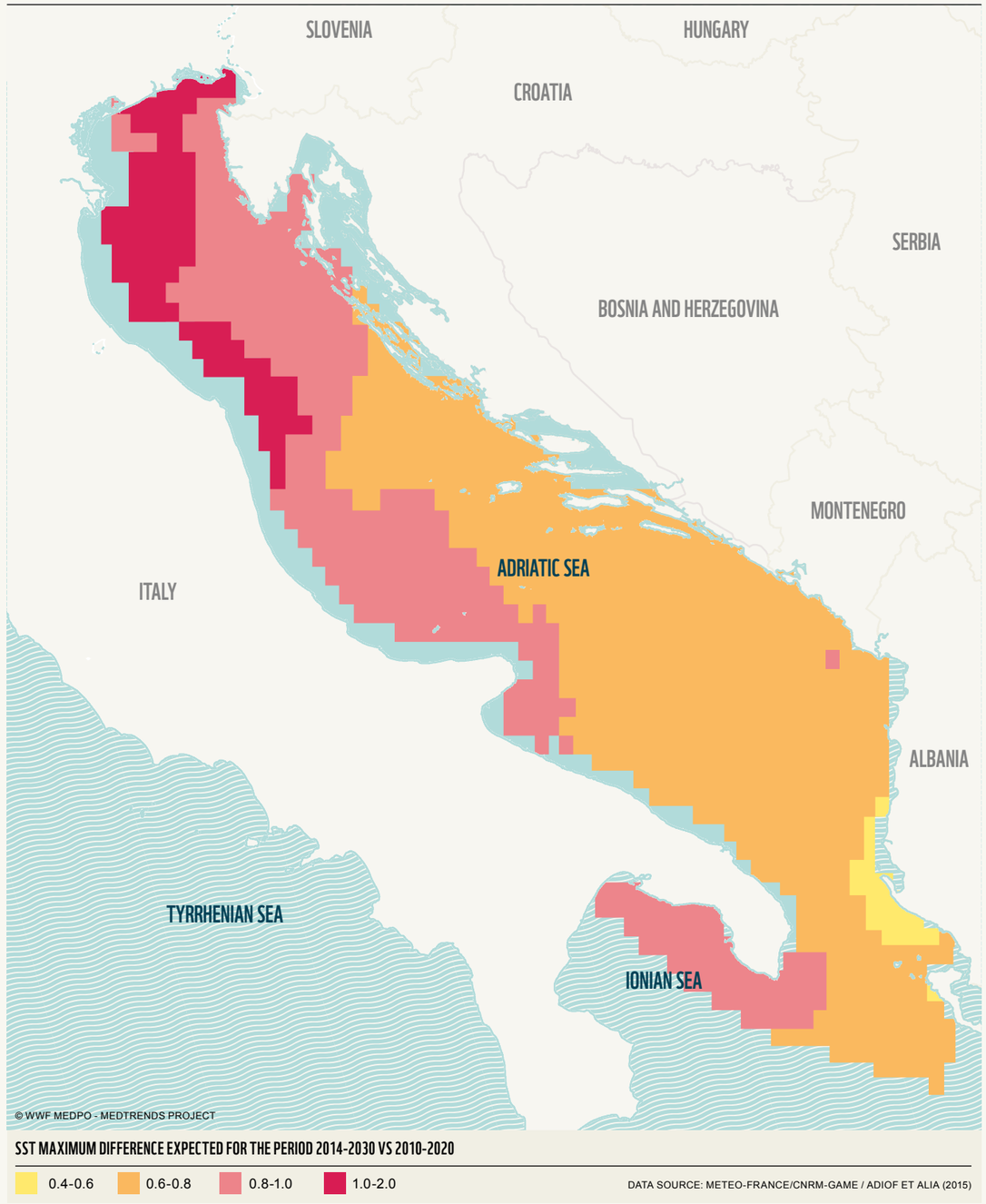
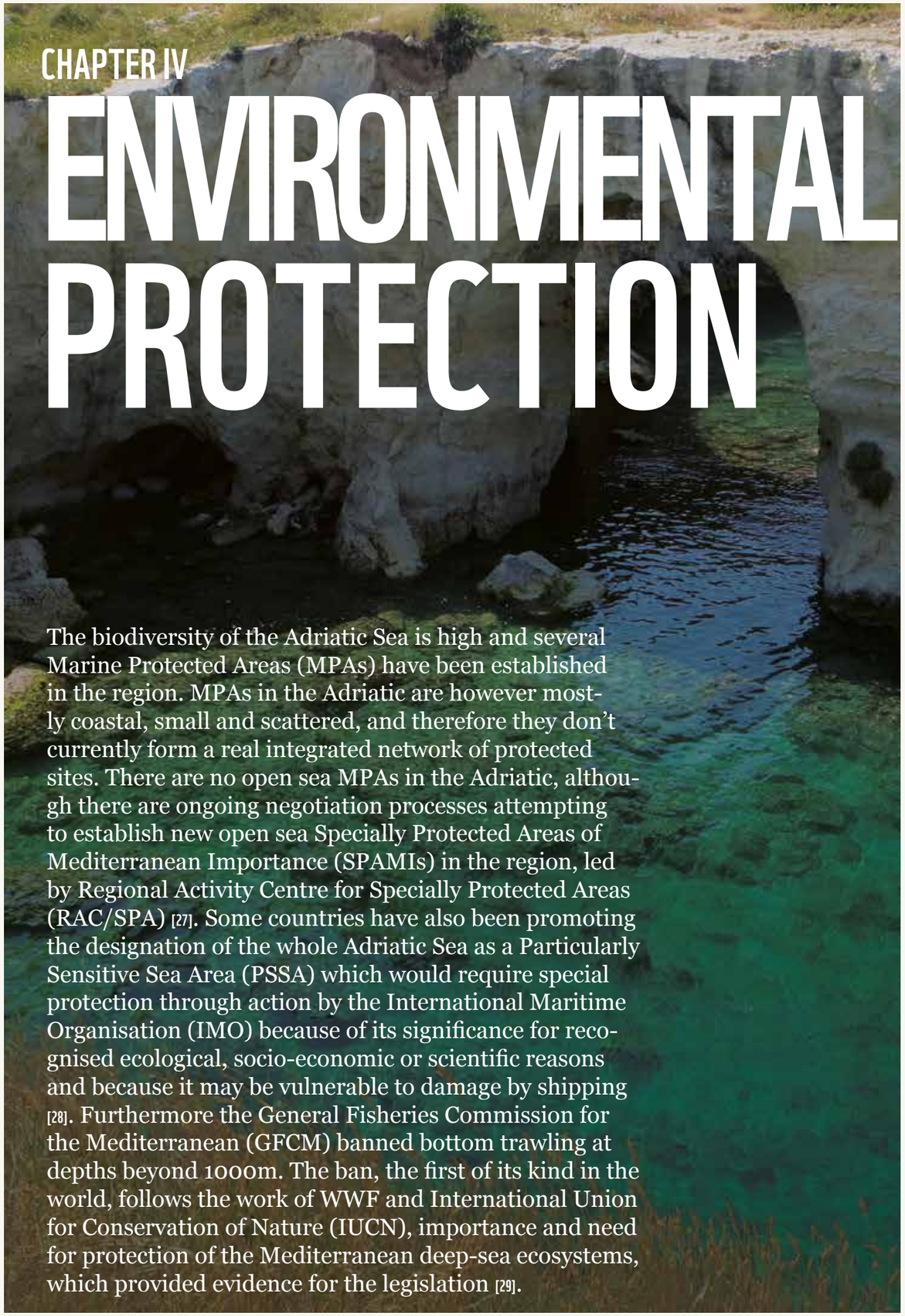


FIGURE 10 **CLIMATE CHANGE IN THE ADRIATIC SEA**





CHAPTER IV

ENVIRONMENTAL PROTECTION

The biodiversity of the Adriatic Sea is high and several Marine Protected Areas (MPAs) have been established in the region. MPAs in the Adriatic are however mostly coastal, small and scattered, and therefore they don't currently form a real integrated network of protected sites. There are no open sea MPAs in the Adriatic, although there are ongoing negotiation processes attempting to establish new open sea Specially Protected Areas of Mediterranean Importance (SPAMIs) in the region, led by Regional Activity Centre for Specially Protected Areas (RAC/SPA) [27]. Some countries have also been promoting the designation of the whole Adriatic Sea as a Particularly Sensitive Sea Area (PSSA) which would require special protection through action by the International Maritime Organisation (IMO) because of its significance for recognised ecological, socio-economic or scientific reasons and because it may be vulnerable to damage by shipping [28]. Furthermore the General Fisheries Commission for the Mediterranean (GFCM) banned bottom trawling at depths beyond 1000m. The ban, the first of its kind in the world, follows the work of WWF and International Union for Conservation of Nature (IUCN), importance and need for protection of the Mediterranean deep-sea ecosystems, which provided evidence for the legislation [29].

CURRENT SITUATION

Currently there are four protected areas in the Italian part of the Adriatic Sea: Miramare in the Gulf of Trieste (in the Northern Adriatic), Torre del Cerrano and Isole Tremiti in the Middle Adriatic basin and Torre Guaceto in the southern Adriatic. Three MPAs have been established along Slovenia's seashore Cape Madona, Debeli Rtič and Strunjan (Natural Reserve) [7]. Their management falls under the responsibility of the Ministry of Environment and Spatial Planning. Croatia has a different protected areas classification scheme, under which it has identified 17 MPAs which are listed in the following table together with the Italiana and Slovenian MPAs.

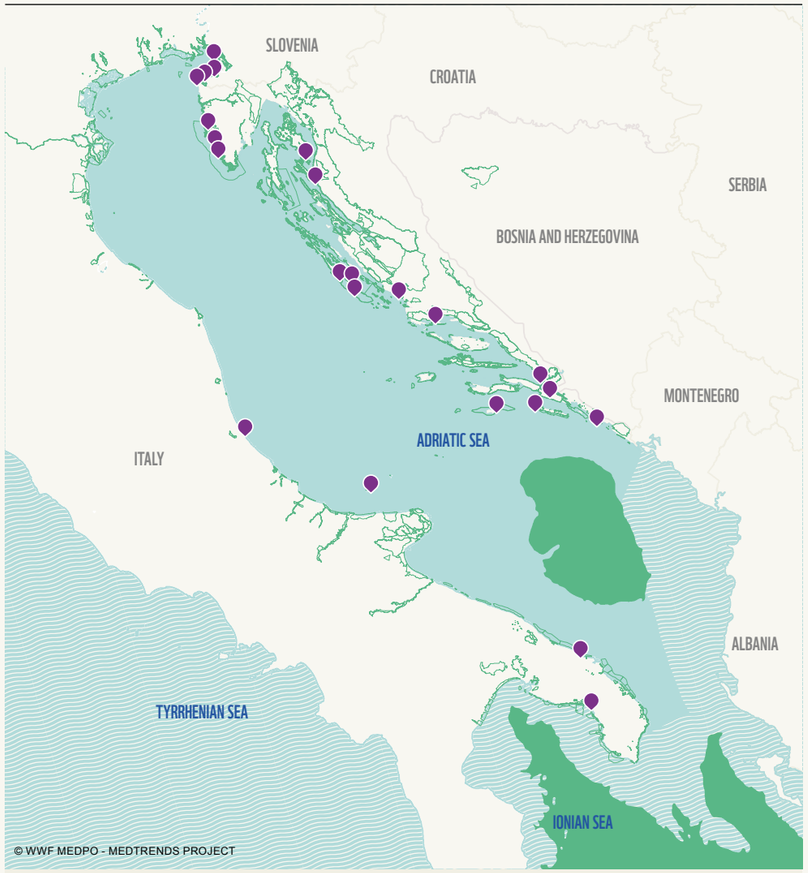
TABLE 3 MARINE PROTECTED AREAS IN THE ADRIATIC

	NAME	PA CATEGORY
ITALY	• **Miramare**	Marine Protected Area
	• **Torre del Cerrano**	Marine Protected Area
	• **Isole Tremiti**	Marine Protected Area
	• **Torre Guaceto**	Marine Protected Area
SLOVENIA	• **Cape Madona**	Marine Protected Area
	• **Debeli Rtic**	Marine Protected Area
	• **Strunjan**	Natural Reserve
CROATIA*	• **Kornati**	National Park
	• **Brijuni**	National Park
	• **Mljet**	National Park
	• **Telascica**	Nature Park
	• **Datule Barbariga**	Special Reserve
	• **Maloston Bay**	Special Reserve
	• **Lastovo Islands**	Nature Park
	• **Lim Fjord - reserve**	Special Reserve
	• **Neretva Delta - SE part**	Special Reserve
	• **Zut-Sit Archipelago**	Significant Seascape
	• **Labin, Rabac and Prklog Bay**	Significant Seascape
	• **Prvic Island with coastal waters and Grgur Channel**	Special Reserve
	• **Zrce close to Novalja**	Significant Seascape
	• **Dolina Blaca**	Significant Seascape
	• **Marine Cave Modra Spilja**	Nature Monument
	• **Marine Cave in the Island of Ravnik**	Nature Monument
	• **Kanal - Luka**	Significant Seascape

* Brijuni, Lastovo, Kornati, Telašćica, Mljet, Limski Zaljev are all managed MPAs [7]

In 2010, Albania established its first and only MPA, the Karaburun-Sazan National Marine Park at the Karaburun Peninsula where the Adriatic and Ionian Seas meet. Both Montenegro and Bosnia and Herzegovina do not have MPAs. A large number of coastal Natura 2000 sites are present along the Adriatic Coast. The current status of marine protection in the Adriatic is summarized in the next figure.

FIGURE 12 **CURRENT PROTECTION STATUS IN THE ADRIATIC BASIN**



FUTURE TRENDS

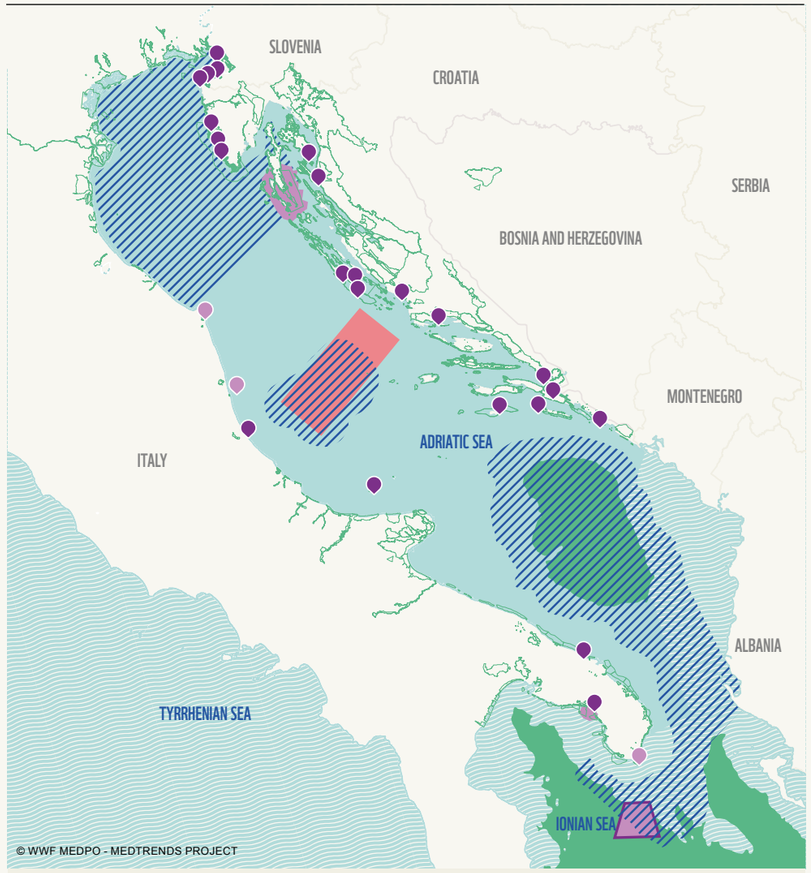
No new protected areas are expected to be established in Slovenia and Croatia in the near future, while two new protected areas are likely to be established in Italy, namely the Costa del Monte Conero and the Costa del Piceno [30]. Furthermore, two additional MPAs are planned in Albania: the Cape of Rodon (Albanian: Kepi i Rodonit) and Porto Palermo [28]. A process to identify potential SPAMIs in open sea in the Adriatic is also currently in place. The process is managed by RAC/SPA and involves all Adriatic countries.

Three Ecologically and Biologically Significant Marine Areas (EBSAs) have been recently identified (Figure 20) by the CBD in the Adriatic Sea. EBSAs are “special areas in the ocean that serve important purposes, in one way or another, to support the healthy functioning of oceans and the many services that they provide”[31]. EBSAs therefore represent macro areas in which potential new open sea MPAs can be established in the Adriatic.

The Adriatic Sea also includes an area containing critical habitats for cetaceans, that has been identified by ACCOBAMS[6] and a Pelagic priority area, corresponding to the Jabuka Pit, that has been recognized as an important nursery area for commercial species [32].

Finally the General Fisheries Commission for the Mediterranean (GFCM) banned bottom trawling at depths beyond 1000m, positively affecting areas in the southern Adriatic. The ban, the first of its kind in the world, follows the work of WWF and IUCN-The World Conservation Union on the diversity, importance and need for protection of the Mediterranean deep-sea ecosystems, which provided evidence for the legislation [33].

FIGURE 13 **MPAs AND CONSERVATION PRIORITY AREAS IN THE ADRIATIC REGION (FUTURE SCENARIO)**



All countries of the Adriatic Sea committed to establish networks of MPAs covering key areas of ecological importance and also extending into Areas Beyond National Jurisdiction (ABNJ). These networks would represent one of the most effective ways of conserving the Adriatic marine ecosystem biodiversity and functions [34].

[6] Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area

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CHAPTER IV
POLLUTION

Being a semi-enclosed sea with limited water circulation, the Adriatic is extremely vulnerable to pollution events. Particularly, coastal pollution from excessive nutrient inflow, typically from agricultural and municipal runoff [35]—has been one of the main factors affecting the Adriatic waters and coastal areas, leading in many cases to fish kills, algal blooms and low-oxygen conditions, particularly in the northern region of the sea [17].

Oil spills are also a major concern in terms of potential environmental impacts. Although no major accident has occurred in the Adriatic yet, small oil spills are a regular occurrence, especially from the ships in transit. Furthermore, a few reported accidents have occurred along the Italian coast, such as the one on the platform "Rospo di Mare" that reportedly lost 1,000 litres of oil in 2009 [36]. An additional risk is presented by oil refineries in the Po River basin, where oil spills have occurred before [37].

FIGURE 14 **MARITIME ACCIDENTS IN THE ADRIATIC SEA**

Solid waste is often identified as the priority pollution source, particularly in the Eastern Adriatic. At the moment, most of the waste is improperly disposed in non-sanitary landfills and dumpsites and a portion of it is being washed out to the sea. The problem is emphasized by the natural characteristics of the environment. The karst terrain allows for a fast transport of leachates from dumpsites to the sea, potentially decreasing water quality at the nearby beaches. The prevailing sea currents carry the washed out waste along the eastern coast in the north-west direction making it a trans-boundary issue. The waste originating from Albania has been regularly found on the southern Croatian beaches and on one occasion as far north as on the island of Dugi Otok located in the Zadar region. The current situation requires large investments in developing both the management capacity and the necessary environmental infrastructure [37].

Various projects are currently assessing the impacts of microlitter, including toothpaste microgranules, cosmetic microdust on the Adriatic ecosystem [39]. The particle remains of shredded plastic objects, textile microfibers, and more, are almost invisible, and can severely pollute the food chain.

POLLUTION HOTSPOTS

A study by the World Bank carried out in 2011 identified 27 pollution hotspots on the eastern coast in the Adriatic Sea, of which 6 in the eastern coast were identified as priority sites that "require immediate action" [38]. The report states that the main concern in most countries is represented by solid waste and the direct discharge of wastewater into the sea. The pollution spots identified in the study are the following (the priority sites are in red):

FIGURE 15 **OVERVIEW OF THE POLLUTION HOTSPOT IN THE ADRIATIC SEA (PRIORITY SITES IN RED)**

SOURCE: © ANDRICEVIC, R. ET AL (2011) [38]

TABLE 4 **MARINE PROTECTED AREAS IN THE ADRIATIC**

ALBANIA

- **Drinit Bay**
- **Rodonit bay**
- **Lazli Bay**
- **Durres & Porto Romano Bay**
- **Karavastase Bay - Fieri area**
- **Vlora bay**
- **Saranda bay**

ITALY

- **Gulf of Trieste**
- **Grado Maran Lagoon**
- **Venice lagoon**
- **Delta Po**
- **Ravenna**
- **Falconara Marittima Ancona**
- **Bari (Puglia)**
- **Brindisi (Puglia)**

CROATIA

- **Ploče-Neretva delta**
- **Split-Kaštela area**
- **Šibenik area (Krka's estuary)**
- **Zadar channel**
- **Rijeka area**
- **Pula Bay**

MONTENEGRO

- **Bar**
- **Budva**
- **Boka Kotorska Bay**
- **Ulcinj**

SLOVENIA

- **Koper bay**
- **Piran**

SOURCE: © ANDRICEVIC, R. ET AL (2011) [38]

ENDANGERED AREAS

The study also identifies a list of the sites that are not currently classified as pollution hotspots but may become so in the future due to the strong anthropogenic pressures they are subject to. The sites are illustrated in Figure 16 and listed in Table 5.

FIGURE 16 **OVERVIEW OF POTENTIAL FUTURE POLLUTION HOTSPOTS IN THE ADRIATIC SEA**

SOURCE: © ANDRICEVIC, R. ET AL (2011) [38]

Another potentially unknown source of pollution in the Adriatic is the illegal dumping of toxic waste (including radioactive materials) through ship sinking. The issue has been confirmed in recent years and actions are currently being undertaken to be able to map the sunken ships, and asses the contents [40]. The phenomenon seems to be particularly diffused along the coast of the Puglia Region in Italy.

The increasing population and economic activities in the region may lead to growing pollution issues in the area.

It is imperative that these issues are timely addressed, in order to avoid a further increase of pollution in the region. In this respect, at European Union level, the MSFD directive requires all member states to develop strategies to quantify and monitor marine pollution, and many Governments are starting to implement this action. Within the Adriatic Region, however the presence of non-EU countires that are not affected by the MSFD still poses an obstacle for the sustainable management of marine and coastal resources.

TABLE 5 LIST OF ENDANGERED AREAS ACCORDING TO THE WORLD BANK REPORT

	NAME	REASON FOR INCLUSION
BOSNIA AND HERZEGOVINA	**Neum and Mali Ston Bay**	Intensive aquaculture area that is close to the Neretva Delta
CROATIA	**City of Hvar**	Big seasonal tourism pressure, municipal infrastructure not yet developed
	Omiš	The River Cetina discharge carrying up stream wastewater pollution from municipalities in Croatia and Bosnia and Herzegovina
	Omišalj, Krk	Existing petrochemical industry, LNG terminal in development, popular seasonal tourist destination
	Bakar bay	Historical pollution site from the closed coke factory. Heavily polluted sediments
ITALY	**Golfo di Manfredonia**	Coastal industry, historical pollution site
	Civitanova Marche	Coastal industry, large river discharge, intensive agricultural area
	San Benedetto del Tronto	Densely populated area, aquaculture and intensive agriculture
	Portogruaro/Caorle	Densely populated, big port, coastal industry, large river discharge, intensive agriculture and aquaculture
	Riccione/Rimini	Densely populated, seasonal tourism, intensive agriculture and aquaculture
	Pesaro	Densely populated, big port, intensive agriculture and aquaculture, large river discharge
	Pescara	Densely populated, coastal industry, big port, intensive agriculture and aquaculture
	Termoli	Solid waste problems, intensive agriculture and aquaculture, large river discharge
	Vasto	Mining site, large river discharge, intensive agriculture

SOURCE: © ANDRICEVIC, R. ET AL (2011) [38]

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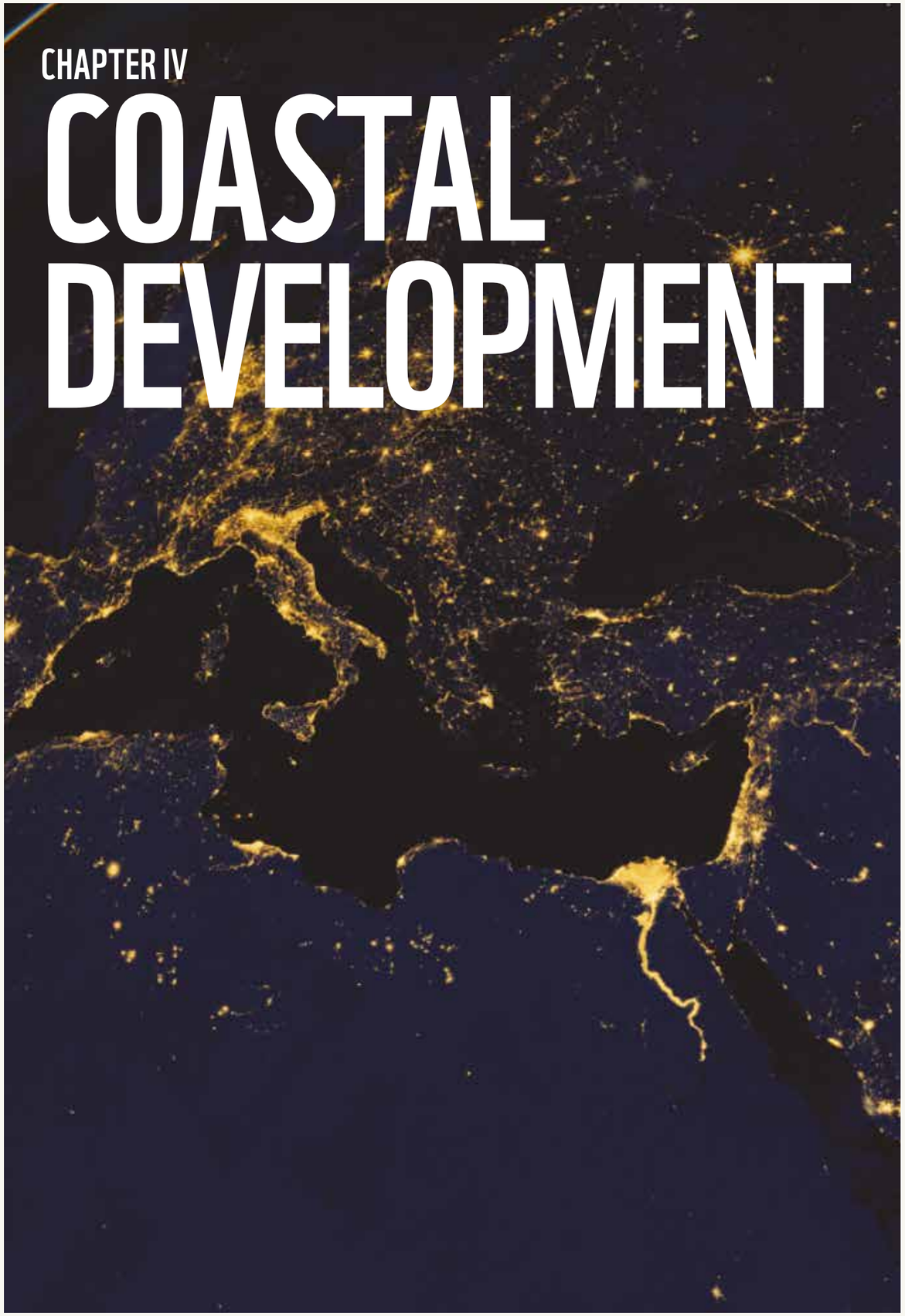

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CHAPTER IV

COASTAL DEVELOPMENT

The total length of the Adriatic coast is about 9,000 km and it is generally characterized by high urbanization, population density and tourism development [28], particularly in Italy and Slovenia.

The Croatian coastline extends for over 7,000 km, including its many islands and islets [28]; 33% of the Croatian population lives along the coastline with a density of 57 inhabitant/km². 14.3% of the Croatian coast is urbanized, counting [1]:

- 790 settlements – 1,050,000 inhabitants, 370,000 apartments, 190,000 secondary homes;
- 100 tourist areas – 430,000 beds;
- 100 harbours and marinas – 17,000 berths.

The Croatian coastal zones most exposed to urbanization and tourism activities are the rare sand and pebble beaches (92% of the total Croatian coast is rocky) [6]. According to UNDP [25], the economy sectors linked to coastal zones represent 9 billion euro of annual Gross Domestic Product (GDP) and 25% of the Croatian economy, employing half of the working population [25].

The Italian Adriatic coastline has a length of about 1,300 km, 15% of the total Adriatic coastline [28]; it represents 17% of the total Italian coast and is inhabited by about 6% of the Italian population [41]. The Italian Adriatic coast is the most urbanized in the whole Mediterranean Sea [41] [42]; urbanization was favoured by the morphology of the area, which is mainly flat [41].

The Slovenian coast has a length of about 47 km and is characterized by a growing population [28]. With an area of 1,524 km2 (7.5% of the Slovenian territory), the South Primorska region is inhabited by 6% of the total Slovenian population. The coastal are of the region has a population density of 213 inhabitants/km² [8].

More than 75% of the total Slovenian coast has been modified by the urbanization process and human activities, especially touristic infrastructures construction [41].
The main pressures on the Slovenian coastal area arise from urbanization and tourism which contribute to the increased discharge of urban waste waters into the sea. The pressures from urbanization also contribute to erosion, that is further exacerbated by climate change [8].

TABLE 6 COASTAL CHARACTERISTICS OF ADRIATIC COUNTRIES

	ALBANIA	BOSNIA AND HERZEGOVINA	CROATIA	ITALY	MONTENEGRO	SLOVENIA
ADRIATIC COASTLINE (km)	362	23	5,835	1,300	294	47
ISLANDS AND ISLETS (km)	not available	not available	1,185	not available	not available	not available

SOURCE: EUROPEAN COMMISSION, 201 [28]

FIGURE 17 **COASTAL ARTIFICIALIZATIN AND URBANIZATION**

Figure 17 instead illustrates the percentage of artificial coastal length by NUTS3 and the main urbanized area along the coast. The data (are available only from the Italian coast) show a very high degree of urbanization and artificial coastal areas particularly in the northern Adriatic, but also in the Rimini and Bari Provinces.

In the Mediterranean region, coastal development is expected to grow rapidly in the future. As reported by the Italian Ministry of Environment (2011) [43] the Mediterranean coastal population is expected to increase from 70 million inhabitants registered in 2000 to 90 million inhabitants by 2025 [43].

Specifically, the eastern Adriatic coast is characterized by the most rapid tourism development in the whole Mediterranean area [44]. Cruise tourism, in particular, is growing steadily and could have several effects on coastal development, especially for what concerns marine and coastal pollution [45].

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REFERENCES

[1] SHAPE Project (2013). Definition of the Adriatic ecosystem quality as basis for Maritime Spatial planning. Report on status, pressures and conflicts in Adriatic Sea according to Directive 2008/56/CE

[2] Sekulić, Bogdan; Sondi, Ivan (December 1997). "Koliko je Jadran doista opterećen antropogenim i prirodnim unosom tvari?" Hrvatski geografski glasnik (in Croatian) (Croatian Geographic Society) 59 (1). ISSN 1331-5854. Retrieved 27 January 2012.

[3] EUSAIR 2015. http://www.adriatic-ionian.eu/about

[4] Adriatic and Ionian Initiative, 2015. http://www.aii-ps.org/index.php/adriatic-ionian-macroregion

[5] SHAPE Project (2013). Ensuring appropriate co-ordination: An explanatory report on Article 7 of the ICZM Protocol. www.pap-thecoastcentre.org: http://www.pap-thecoastcentre.org/pdfs/explanatory_article_7_outline_final_feb13.pdfhttp://www.shape-ipaproject.eu

[6] Ministry of Environmental and Nature Protection of the Republic of Croatia, 2014

[7] Vidmar, B. And Turk, R. (2012). Marine Protected Areas in Slovenia: how far are we from the 2012/2020 target? VARSTVO NARAVE, Supl. 1

[8] SHAPE Project (2012). Analysis of ICZM practices in Slovenia (Final).

[9] CAMP - Coastal Area Management Programme. http://www.minambiente.it/pagina/il-progetto-camp-italia

[10] CAMP - Coastal Area Management Programme http://www.camp-italy.org (consultato il 11/06/2015)

[11] EC European Territorial Cooperation (2014). Adrion – Adriatic Ionian Cooperation Programme 2014-2020. Citizen's summary

[12] Blake, Gerald Henry; Topalović, Duško; Schofield, Clive H (1996). The maritime boundaries of the Adriatic Sea. IBRU. ISBN 978-1-897643-22-8.

[13] Bombace, G. (1992). "Fisheries of the Adriatic Sea". In Colombo, Giuseppe. Marine Eutrophication and Population Dynamics: With a Special Section on the Adriatic Sea: 25th European Marine Biology Symposium, Institute of Zoology, University of Ferrara. Olsen&Olsen. ISBN 978-87-85215-19-2.

[14] Mannini, Piero; Massa, Fabio; Milone, Nicoletta. "Adriatic Sea Fisheries: outline of some main facts" . AdriaMed. Retrieved 29 January 2012

[15] Del Negro, Paola (2001). "Bacterial Abundance in the Adriatic Sea". In Faranda, Francesco; Guglielmo, Letterio; Spezie, Giancarlo. Mediterranean Ecosystems: structures and processes. Springer. ISBN 978-88-470-0114-5. Retrieved 21 June 2012.

[16] Cushman-Roisin, Benoit; Gačić, Miroslav; Poulain, Pierre-Marie (2001). Physical oceanography of the Adriatic Sea. Springer. ISBN 978-1-4020-0225-0. Retrieved 26 January 2012.

[17] Publication from The Coastal & Marine Union: http://www.eucc.net/en/climate_change/MAKMuir-AdriaticSeaArticle.pdf

[18] Boudouresque, C.F., 2009. Protection, restauration et développement durable en milieu marin. 1. Développement durable, biodiversité. www.com.univmrs.fr/~boudouresque.

[19] Chemonics International Inc (31 December 2000). "Biodiversity assessment for Croatia". Natural Resources Management & Development Portal. Retrieved 31 January 2012

[20] UNEP-MAP RAC/SPA 2010. The Mediterranean Sea Biodiversity: state of the ecosystems, pressures, impacts and future priorities. By Bazairi, H., Ben Haj, S., Boero, F., Cebrian, D., De Juan, S., Limam, A., Lleonart, J., Torchia, G., and Rais, C., Ed. RAC/SPA, Tunis; 100 pages.

[21] Lipej, L. & Dobrajc Ž., 2008. National overview on vulnerability and impacts of climate change on marine and coastal biodiversity, Contract RAC/SPA, N° 7: 38 pages

[22] Med-IAMER, 2014. Climate Change on Coastal Zones. http://www.medmaritimeprojects.eu/download/ProjectMediamer/SH_Meeting_AIE/AIo_ClimateChange_factsheet.pdf

[23] Adaptation to Climate Change in Coastal Areas of the ECA Region: A contribution to the Umbrella Report on adaptation to climate change in ECA, http://siteresources.worldbank.org/ECAEXT/Resources/258598-1243892418318/Coastal.pdf

[24] Gualdi S. et al (2013). The CIRCE simulations: regional climate change projections with realistic representation of the Mediterranean Sea. Bulletin of the American Meteorological Society 94 (1), 65-8159, 2013.

[25] UNDP, 2008. A climate for change. Climate change and its impacts on society and economy in Croatia. http://hdr.undp.org/sites/default/files/nhdr_2008_en_croatia.pdf

[26] Antonioli et al. 2007. Variazioni relative al livello del mare e vulnerabilità delle pianure costiere italiane. Quaderni della Società Geologica Italiana. N. 2. Ottobre 2007.

[27] RAC/SPA 2015. MedOpenseas Project (Ongoing) - http://medabnj.rac-spa.org/index.php?option=com_content&view=article&id=14

[28] Policy Research Corporation, 2011. The potential of Maritime Spatial Planning in the Mediterranean Sea – Case study report: The Adriatic Sea. European Commission. Directorate-General for Maritime Affairs and Fisheries

[29] WWF Mediterranean Programme, 2011. http://mediterranean.panda.org/?18831/Bottom-trawling-beyond-1000m-banned-in-the-Mediterranean

[30] Ministero dell'Ambiente e della Tutela del Territorio e del Mare http://www.minambiente.it/pagina/aree-marine-di-prossima-istituzione

[31] Convention on Biological Diversity, 2015. https://www.cbd.int/ebsa/about

[32] UNEP MAP RAC/SPA. 2010a. Fisheries conservation and vulnerable ecosystems in the Mediterranean open seas, including the deep seas. By de Juan, S. and Lleonart, J. Ed. RAC/SPA, Tunis: 103 pp.

[33] WWF, 2005. Bottom trawling beyond 1000m banned in the Mediterranean. http://mediterranean.panda.org/?18831/Bottom-trawling-beyond-1000m-banned-in-the-Mediterranean

[33] Notarbartolo di Sciara G. 2010. Methods for the identification of EBSAs in the ADriatic Sea. 3rd International Workshop on Biodiversity in the Adriatic: towards a representative network of MPAs in the Adriatic. Piran, Slovenia, 28-29 October 2010.

[34] Chin, David A. (2006). Water-quality engineering in natural systems. John Wiley and Sons.

[35] D'Orsogna, D. (2009) Osservazioni sulla Richiesta di pronuncia di Compatibilità Ambientale Presentata dalla società EDISON Spa. Variazione programma lavori nell' ambito della concessione di coltivazione "B.C8.LF.

[36] The Guardian, 2010. "Environmental disaster warning as oil spill reaches the Po, Italy's biggest river". The Guardian. 24 February 2010.

[37] Andricevic, R. Et al (2011) Adriatic Sea Environment Program: Rapid Assessment of Pollution Hotspots for the Adriatic Sea. World Bank.

[38] Ca' Foscari (2015). Hunting for micro-waste in the Adriatic Sea. http://www.unive.it/nqcontent.cfm?a_id=179966

[39] Lannes, G. 2011. Navi dei veleni in Adriatico e Jonio. http://sulatestagiannilannes.blogspot.it/2015/04/navi-dei-veleni-in-adriatico-e-jonio.html

[40] Romano B. and Zullo, F. (2013) The urban transformation of Italy's Adriatic coastal strip: Fifty years of unsustainability. Land use policy 38 (2014) 26-36. http://www.planeco.org/InternationalPapers/LUP_2013.pdf

[41] WWF, 2014. Cemento coast-to coast: 25 anni di natura cancellata dalle più pregiate coste italiane.http://awsassets.wwfit.panda.org/downloads/dossier_coste_bd.pdf

[42] Ministero dell'Ambiente e della Tutela del Territorio del Mare. (2011). Breve guida alla Strategia Nazionale per la Biodiversità. From: www.minambiente.it: http://www.minambiente.it/sites/default/files/archivio/allegati/biodiversita/dpn_guida_strategia_nazionale_biodiversita.pdf

[43] Pikelj, K., & Juračić, M. (2013). Eastern Adriatic coast (EAC): Geomorphology and coastal vulnerability of a karstic coast. From: www.bioone.org: http://www.bioone.org/doi/pdf/10.2112/JCOASTRES-D-12-00136.1

[44] Caric, H., & Mackelworth, P. (2014). Cruise tourism environmental impacts e The perspective from the Adriatic Sea. From: www.researchgate.net: http://www.researchgate.net/profile/Hrvoje_Caric/publication/267390733_Cruise_tourism_environmental_impacts_-_The_perspective_from_the_Adriatic_sea/links/544e2dde0cf26dda088e57a0.pdf

CHAPTER V

ANALYSIS OF ECONOMIC SECTORS AND THEIR IMPACTS

CHAPTER V

OIL AND GAS

The Adriatic Sea is one of the sub-regions of the Mediterranean with the highest concentration of oil and gas (O&G) activities. Most O&G extraction activities have been historically occurring in Italian waters. Italy has over 140 offshore active fields while Croatia currently has only 3 although the sector is expected to grow considerably in the near future [1] as the country is initiating a large scale process of exploration and production (E&P) in its territorial waters that involves 29 new concessions. Italy is also planning to develop a further 11 new drilling projects [2] in the coming years, and similarly exploration and production activities are likely to occur in Montenegro and Albania. Potential pressures on the Adriatic marine ecosystems from the O&G sector and potential conflicts with other sectors (particularly tourism) in the sub-region are therefore very likely to increase in the near future, as E&P activities increase.

BACKGROUND AND CURRENT SITUATION

Recent surveys in the Adriatic indicate reserves of 3 billion barrels of oil and 5.7×1010 cubic metres of gas [3]. The first Adriatic fields were discovered in the 1970s [4] but their development commenced only much later in the 1990s. In 2000, investigation works intensified, and by the decade's end, new O&G reserves were discovered in the Puglia Region.

Italy has 67 active concessions for extraction, for a total area of 9,025 km², and has drilled a total of 335 gas wells and 61 oil wells, the majority of which are in the Adriatic, with over 100 platforms located only in the Emilia Romagna Region. Ente Nazionale Idrocarburi (ENI) estimates that its concessions in the Adriatic Sea could hold at least 40 billion cubic meters of natural gas.

Croatia currently has only 3 active offshore gas exploitation fields [5]. Croatian O&G production has decreased steadily from 1992 to 2013, but it is expected to increase in the near future, as the Adriatic reserves may start being exploited. 2014 data from the U.S. Energy Information Administration show that the proved gas reserves in Croatia amount to almost 0.9 trillion cubic feet [6]. Croatia currently covers about 65 percent of its annual gas consumption of 3 billion cubic metres from its own fields offshore.

Improved licensing and regulatory terms are expected to sustain interest and investment in Croatia's O&G sector, with the Government planning large investments over the next five years.

According to Figure 18, gas production in the Adriatic has been decreasing since 1992, going from over 500 Billion cubic feet to just below 300 Billion Cubic Feet while oil production in the Adriatic has been increasing from 100,000 Barrels per day to over 160,000 thousand Barrels per day.

FIGURE 18 **OFFSHORE OIL AND GAS TOTAL PRODUCTION IN THE ADRIATIC SEA (1992-2013)**

SOURCE: WWF MEDPO ELABORATION BASED ON EIA [7] AND ITALIAN MINISTRY OF ECONOMIC DEVELOPMENT [8] DATA.

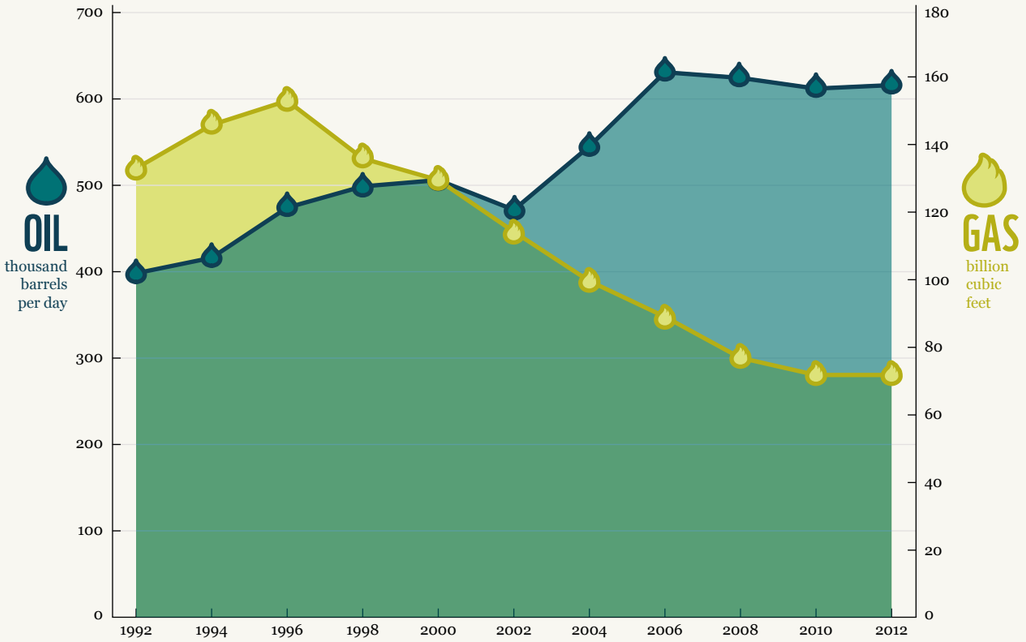
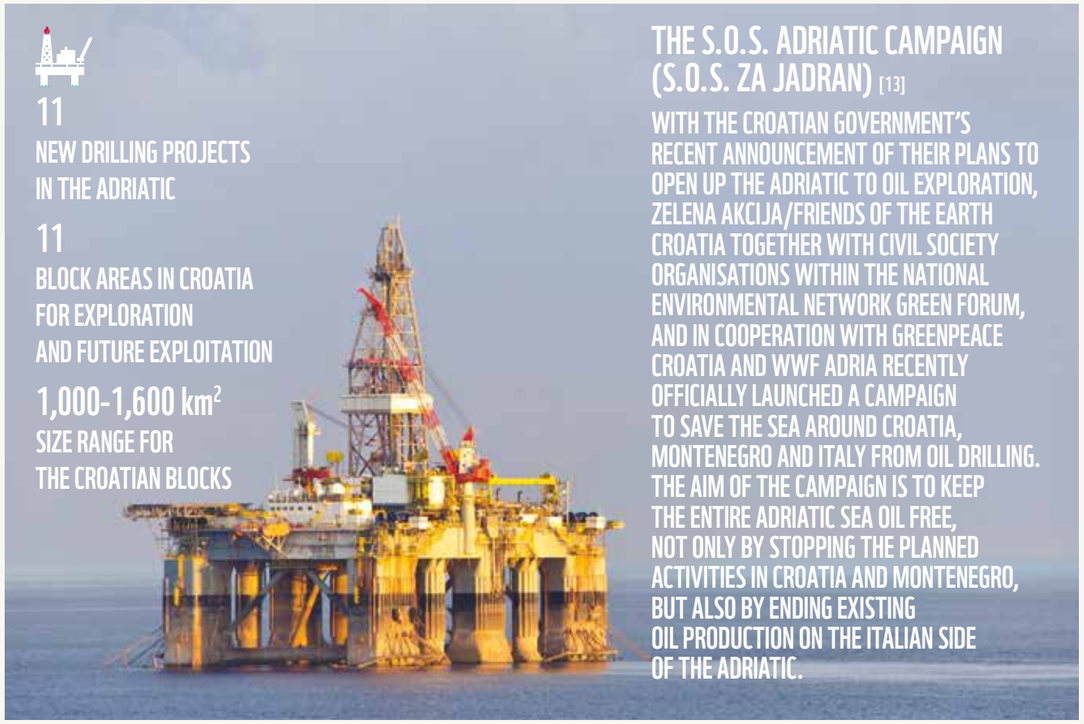


FIGURE 19 **CURRENT SITUATION OF THE OIL AND GAS SECTOR IN THE ADRIATIC SEA**

FUTURE TRENDS

Oil and gas production in the Adriatic is expected to increase rapidly in the near future. In 2014 Croatia has opened a call for tender for O&G exploration and investments worth some $2.5 billion in exploration activities are expected over the next five years. The tender comprised 29 block areas, eight in the north and 21 in central and southern Adriatic for exploration and potential future exploitation for a period of 25 years [9]. The size of one block ranges from 1,000 to 1,600 square kilometres. According to the preliminary data, gas reserves are more likely to be found in the north while crude deposits are expected where the seabed is deeper [10]. Ten of these licenses to explore the coast for O&G were already awarded in January 2015 [10]. Croatia's potential reserves could prove significant both for the country and a wider region that is belatedly coming to terms with the importance of energy diversification in the wake of the Ukraine crisis [11]. Montenegro has held a similar tender for offshore O&G exploration blocks covering 1,200 sq. miles and announced in February 2015 that it had started initial negotiations with bidders [12]. Although Italy has recently decreased its concessions area by implementing stricter regulations on the zoning of allowed activities, it is also planning to increase O&G activities in the Adriatic as 11 new drilling projects have been approved. Requests concern mainly the coasts of Ravenna (platforms and LNG terminal), Abruzzo (drilling platforms) Sicily (drilling platforms) and Puglia (coastal gas deposits near Manfredonia). Furthermore, the latest reforms implemented by the Italian Government are likely to speed up the bureaucratic aspects related to exploration and extraction processes, which will probably lead to further E&P activities. An offshore terminal has also been proposed in the Gulf of Trieste (Terminal Alpi Adriatico, by Endesa Europa) in the Italian territorial waters, near Slovenia. The presence of such terminal may lead to competition with other maritime activities within the Adriatic Sea basin.

Finally, the next few years may see the development of new pipelines across the Adriatic, such as the IGI Poseidon planned between Italy and Greece and the TAP pipeline, between Italy and Albania.



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11
NEW DRILLING PROJECTS IN THE ADRIATIC

11
BLOCK AREAS IN CROATIA FOR EXPLORATION AND FUTURE EXPLOITATION

1,000-1,600 km²
SIZE RANGE FOR THE CROATIAN BLOCKS

THE S.O.S. ADRIATIC CAMPAIGN (S.O.S. ZA JADRAN) [13]

WITH THE CROATIAN GOVERNMENT'S RECENT ANNOUNCEMENT OF THEIR PLANS TO OPEN UP THE ADRIATIC TO OIL EXPLORATION, ZELENA AKCIJA/FRIENDS OF THE EARTH CROATIA TOGETHER WITH CIVIL SOCIETY ORGANISATIONS WITHIN THE NATIONAL ENVIRONMENTAL NETWORK GREEN FORUM, AND IN COOPERATION WITH GREENPEACE CROATIA AND WWF ADRIA RECENTLY OFFICIALLY LAUNCHED A CAMPAIGN TO SAVE THE SEA AROUND CROATIA, MONTENEGRO AND ITALY FROM OIL DRILLING. THE AIM OF THE CAMPAIGN IS TO KEEP THE ENTIRE ADRIATIC SEA OIL FREE, NOT ONLY BY STOPPING THE PLANNED ACTIVITIES IN CROATIA AND MONTENEGRO, BUT ALSO BY ENDING EXISTING OIL PRODUCTION ON THE ITALIAN SIDE OF THE ADRIATIC.

FIGURE 20 **POTENTIAL DEVELOPMENTS IN THE OIL AND GAS SECTOR BY 2020 IN THE ADRIATIC SEA**

IMPACTS ON GES

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 [14].

Offshore structures and waste streams can affect marine species and the whole food web through the noise occurring and the possible introduction of non-indigenous species. Explosions and drilling can also cause seafloor and geological disturbances. This impact is especially increased through the deepening of offshore exploration activities, a trend that is observed worldwide and in the Mediterranean Sea. Among other impacts of this activity, risks of bioaccumulation and biomagnifications through the continuous use of chemicals and the release of polluted water should also be accounted for.

The second category of impacts arising is through potential oil spills. Potential sources for oil pollution caused by offshore installations include well blowouts, acute or slow releases from sub-sea equipment and pipelines, structural failure or damage of production or pumping platforms, platform-tanker loading activities and other accidental releases [15].

The large majority of spills from oil and gas production and exploration have only been a minor source of oil compared to other sectors like shipping [14]. Spills from oil production are mostly small (<7t) or medium (>700t) and occur mainly during loading and discharging operations in ports and oil terminals [14].

It is worth mentioning that a review of accidents worldwide over the past 50 years has shown that the majority of well blowouts have occurred during exploratory drilling operations [15]. As the number of offshore explorations and installations is increasing across a range of geographical locations in the Mediterranean, this will ultimately lead to a higher likelihood that oil spills will occur.

TABLE 7 **POTENTIAL IMPACTS OF THE OIL AND GAS SECTOR ON GES**

MSFD DESCRIPTOR	IMPACTS ON GES	FUTURE TRENDS
D1 **Biodiversity**	Smothering, sealing, toxic substances introduction	↗
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 damage	↗
D7 **Hydrographical conditions**		
D8 **Contaminant**	Introduction of toxic substances	↗
D9 **Contaminant in seafood**		
D10 **Marine litter**		
D11 **Energy**	Underwater noise	↗

INTERACTION WITH OTHER SECTORS

Main impacts of the O&G sector may occur on the fisheries and transport sectors, due to the navigation restrictions within drilling and operation areas. Furthermore, exploration and production activities (E&P) could also result in potential accidents, including oil spills, which could have a devastating effect on the tourism and on the ecosystems, which in turn would again affect fisheries and aquaculture in the region. E&P activities could also be visible from the coast and islands, and this could potentially discourage tourists. Noise and pollution could have a negative impact on marine organisms (particularly cetaceans, marine turtles, fish and birds). Chemicals used during exploration activities contain a large amount of toxic compounds, that may include (phenols, heavy metals, radioactive substances and nitrogen compounds), which are acutely toxic and have a devastating impact on the environment. Taking into account that activities are planned for the next 25 years, there is a large risk of continuous impacts through bioaccumulation and biomagnification, which may affect human consumption of marine organisms as well.

Moreover, during E&P, a significant amount of pollution is being discharged into the air, including greenhouse and other gases (CO_2, CH_4, NO_x, SO_2, etc.). Finally, it is possible that new Natura 2000 sites or EBSAs would be located in the exploration and future exploitation fields.

REFERENCES

[1] Narodne novine (2014) Strategija pomorskog razvitka i integralne pomorske politike Republike Hrvatske za razdoblje od 2014. do 2020. godine. Zagreb: Narodne novine d.d., (93).

[2] Trivelle in vista, WWF Italy, (2013). Available at: http://awsassets.wwfit.panda.org/downloads/wwfdossier_trivelleinvista_2013.pdf

[3] Ashcroft, J. 2011. Northern Petroleum to expand exploration of Rovesti and Giove oil discoveries. Proactive Investors Australia

[4] Ianniello, A., Bolelli, W., and Di Scala, L., 1992, Barbara Field, Adriatic Sea, Offshore Italy, In Giant Oil and Gas Fields of the Decade, 1978-1988, AAPG Memoir 54, Halbouty, M.T., editor, Tulsa: American Association of Petroleum Geologists, ISBN0891813330

[5] Croatian Hydrocarbon Agency, 2014. http://www.azu.hr/hr-hr/

[6] See the International Energy Statistics website http://www.eia.gov/countries/country-data.cfm?fips=hr#ng

[7] Energy Information Administration, 2014. http://www.eia.gov/countries/country-data.cfm?fips=IT&trk=m#ng

[8] Ministry of Economic Development, Directorate General for Energy and Mineral Resources http://unmig.sviluppoeconomico.gov.it/home.asp

[9] See the following blog (only available in Italian) http://www.ecoblog.it/post/127941/piattaforme-petrolifere-la-strategia-della-croazia-nelladriatico

[10] See Reuters' website page on Croatia's gas and oil exploration http://www.reuters.com/article/2014/11/03/croatia-exploration-idUSL6N0ST3UJ20141103

[11] MacDowall A. (2014): Croatian oil & gas: an Adriatic game-changer? Available here: http://blogs.ft.com/beyond-brics/2014/05/05/croatias-hydrocarbon-tender-an-adriatic-game-changer/

[12] See the article on the Guardian available here: http://www.theguardian.com/world/2015/mar/09/adriatic-coast-oil-gas-exploration-opposition-cherie-blair-summit

[13] S.O.S. Adriatic campaign. http://soszajadran.hr/en/s-o-s-adriatic-no-oil-drilling/

[14] Plan Bleu, 2014. Economic and social analysis of the uses of the coastal and marine waters in the Mediterranean, characterization and impacts of the Fisheries, Aquaculture, Tourism and recreational activities, Maritime transport and Offshore extraction of oil and gas sectors, Technical Report, Plan Bleu, Valbonne.

[15] EMSA, Pollution Preparedness and Response Activities, Action Plan for response to marine pollution from oil and gas installations, EMSA's Administrative Board at its 37th Meeting held in Lisbon, Portugal, on 13 -14 November 2013

CHAPTER V

FISHERIES

The fisheries sector in the Adriatic is diverse, largely made up of small-scale fisheries, and has an important role in many national economies [1]. Highest catches are recorded from Italian vessels, followed by Croatia, Albania and Slovenia. The sector is following different trends for each Adriatic country, for instance it is growing in Croatia and decreasing in Italy and it is strongly influenced by regional and national policies, particularly the Common Fisheries Policy. The current state of heavy exploitation of Adriatic fishery resources is evident and although some stocks may be recovering, for others the situation remains critical. Future changes in the sector will therefore also strongly depend on the population dynamics of commercial species in the region. Main conflicts with other sectors may arise particularly with oil and gas developments, which could occupy large areas of the Northern Adriatic Sea in the next 20 years. Conflicts may also arise with the recreational fisheries sector and with the artisanal fishery sector (especially between different types of gears).

BACKGROUND AND CURRENT SITUATION

Fisheries have always played an important role as a source of livelihood for the local populations of the Adriatic Sea. Until 1990, the sub-region was the second most significant for fishing and economic importance of the 10 fishing areas in the Mediterranean. Several countries fish in the Adriatic Sea: Italy is the country with the highest catches (with 79% of the total), followed by Croatia (16%), Albania (2.6%), Slovenia (2%), and Montenegro (0.3%) [2].

The Adriatic Sea is one of the largest and the best-defined area of occurrence of shared fish stocks in the Mediterranean [3], which makes shared management of fisheries an essential requirement in order to ensure sustainability of the sector. Due to its moderate slope and soft sea bottom, it is particularly suitable for trawl fishery and dredgers for clams [4]. The bottom trawl fishery for demersal resources takes place over the entire Adriatic continental shelf and on some parts of the continental slope in the southern Adriatic. It mostly targets the red mullet (Mullus barbatus), the European hake (Merluccius merluccius) and the Norway lobster (Nephrops norvegicus) [5].

Coastal small scale or artisanal fishery (reaching up to 50 km from the shore or 200 m depth) also occurs and in some countries such as Croatia, can reach important catches, averaging 1,991 tonnes per year between 2000 and 2010. Recreational fisheries also have an important impact on coastal resources in Croatia, where catches have reached an average of 3,150 tonnes per year between 2000 and 2010 [2] [6].

According to the European Fleet Register (2014) [7], the Italian fishing fleet in the Adriatic is composed by approximately 5,000 motorized fishing boats. The fishing fleet registered in Croatia instead includes just over 4,000 vessels [6] and the one of Slovenia consists in about 186 vessels [8]. The largest percentage of the fleet (over 80%) is comprised of vessels with size lower than 12 meters, which also constitute the largest segment of the fleet capacity in terms of power (some 50% kW). It should be specified that fleet capacity and fishing power can be assumed to vary widely between national fleets.

The state of heavy exploitation of Adriatic fishery resources is evident and for some stocks is critical. It can be noted that several different factors, often interacting simultaneously, have affected Adriatic fisheries. Fishery production dynamics are based not only on resources availability but are also strongly driven by market demand and prices and other socio-economic forces such as political changes (such as Croatia's entry in the EU) [3].

The main legislatory framework influencing the sector is the Common Fisheries Policy (CFP), the EU instrument for the management of fisheries sets the maximum quantities of fish that can be safely caught every year. National strategies (such as the National Strategic Plan for Development of Fisheries [4] in Croatia) for the fishing sector are also particularly important in shaping the future of commercial fisheries in the Adriatic.

In order to map the current status of commercial fisheries, Automatic Identification System (AIS)[7] data from 2014 were analysed and raster maps were produced. Although the dataset does not include small-scale fisheries, it can provide an indication on the spatial distribution of commercial fishing effort within the project area.

According to the analysis of AIS signals for the whole of 2014, carried out by WWF and NAVAMA and illustrated in Figure 21, the main fishing areas in the Adriatic can be identified along the Italian coast, specifically in the Northern and Central Adriatic.

[7] Automatic tracking system used on ships and by vessel traffic services (VTS) for identifying and locating vessels by electronically exchanging data with other nearby ships, AIS base stations, and satellites.

RECREATIONAL FISHERIES

So far, very few qualitative and quantitative assessments of recreational fishing and its socio-economic and environmental impacts have been undertaken, especially in the Mediterranean.

Recreation fishing entails "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" [9]. There are four types of recreational fishing: "on feet", shore-based, boast-based, and underwater. Each involves different fishing techniques and practices, thus carrying specific impacts on marine ecosystems and socio-economic implications.

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 even showed that the sum of catches in recreational fishing in some coastal areas represents between 10% and 50% of the total catches of small-scale fishing (excluding trawls and seines) [9].

Recreational fishing in the Mediterranean is of socioeconomic importance and this importance is likely to increase as the tourism sector is expected to expand, the population to increase in non-EU countries, ports to develop, and disposable incomes to increase in the basin.

It may be expected that recreational fishing will soon become more regulated. Already at the international (UNCLOS, FAO [10] [11]) and EU levels [12], recreational fishing is mentioned in various regulations.

As European regulations are directly applicable within Member States, concerned administrations, including the relevant Mediterranean countries, will need to ensure that these provisions are respected by recreational fishermen. So far, each country has its own rules and regulations. For instance, some countries require that recreational fishermen obtain a license for fishing and in some MPAs the catches are limited. However, there is no homogenous framework concerning recreational fishing at the scale of the Mediterranean yet.

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FIGURE 21 **FISHING PRESSURE IN THE ADRIATIC SEA (2014)**

FLEET VESSEL NUMBER

- <100
- 300
- >300

DATA SOURCE: EU Fleet register

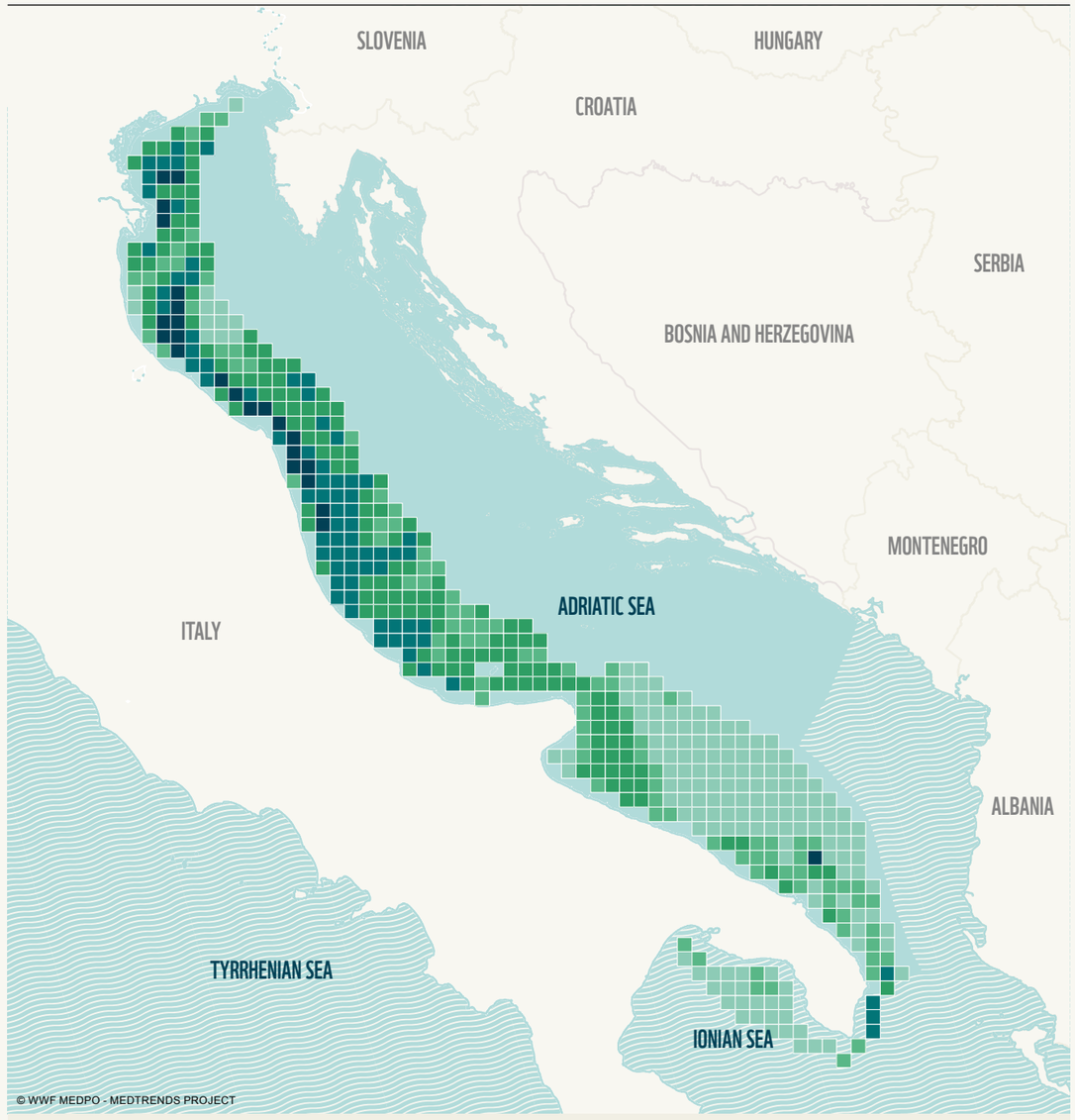
ALL FISHING VESSELS 2014.
DENSITY OF AIS SIGNALS.
SPEED 1-5 kn

High : 255
Low : 35

DATA SOURCE: Navama 2015

navama
technology for nature

FIGURE 22 **AGGREGATE FISHING PRESSURE IN THE ADRIATIC SEA (2009-2014)**



FISHING PRESSURE (AVERAGE DENSITY OF AIS SIGNALS 2009-2014)

1,000 2,700 4,800 8,000 14,900

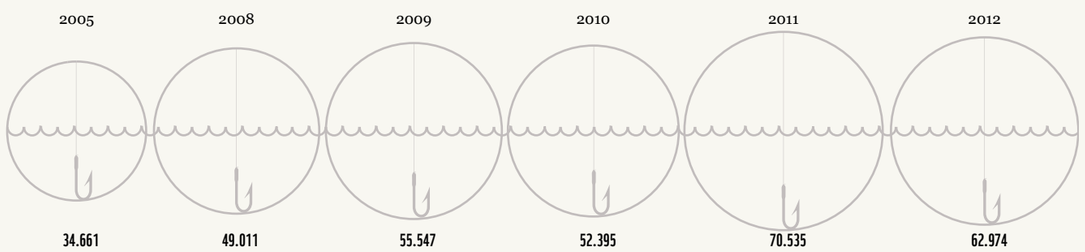
DATA SOURCE:
Annuario della Pesca, 2014
Russo T. 2014

FUTURE TRENDS[8]

In order to understand the future trends of the fisheries sector in the Adriatic it is important to first analyse historical data. Capture fishery production trends in the Adriatic from 1970 to 2000 show that landings have reached a peak in the 1980s (200,000 tonnes per year) while by the year 2000 they almost halved (110,000 tonnes) [3]. Different factors affected the catch decrease, such as the subsidised production during the 1980s, EU fisheries regulation policies in the 1990s, political changes in the Eastern Adriatic and also the changes in stocks size [3].

Trends in fleet size are similar to the production trends, the regional fleet including all fleet segments, i.e. from small-scale fishery vessels to large trawlers reached its maximum numerical size between the 1990s and the year 2000. However, since the 1980s two trends appear to have taken place: the number of fishing vessels has been decreasing along the Italian coast and in Montenegro (small-scale fishing vessels not included) while the opposite has been observed in the cases of Croatia and Albania [7]. According to the current trends in Croatian fisheries, total catches have been generally increasing since 2005, with a peak in 2011, with 70,535 Tonnes of fish caught.

FIGURE 23 **TOTAL CATCH (TONNES) OF FISH IN CROATIA**



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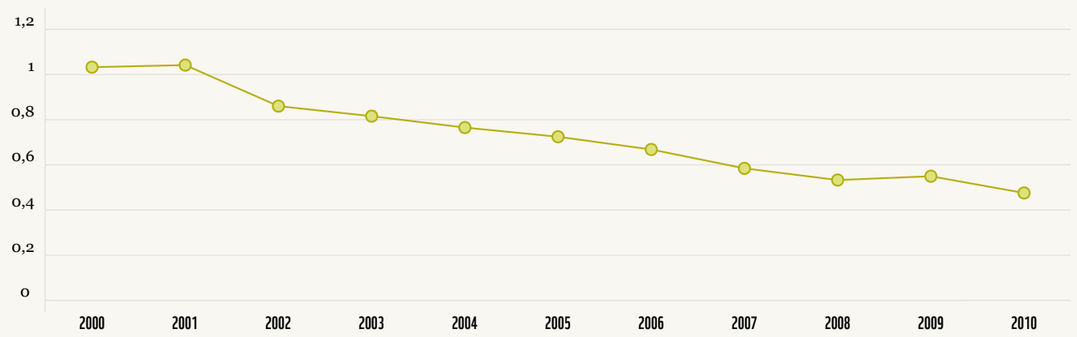
However the overall trend remains negative, as fishing capacity of the Northern and Central Adriatic Sea trawler fleet, as identified with the quantity of capital and is often associated with the variables of gross tonnage (GT) and engine power, has undergone a constant reduction between 2000 and 2010 [7].

FIGURE 24 **TOTAL FISHING DAY TRENDS FOR THE NORTHERN AND CENTRAL ADRIATIC TRAWLER FLEET FOR THE PERIOD 2000-2010. INDEX NUMBER (BASE YEAR 2000)**



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[9] The fisheries sector analysis carried out in the present report relies solely on available literature Very limited information on the maps and trends of fishing pressure have been obtained from the Italian Government and while no data have been obtained from the Croatian Government.

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Despite the reduction in fishing capacity, according to the recent GFCM analyses, the examination of management dynamics shows that stable results have not been reached in terms of sustainability and stock recovery and Catch Per Unit Effort (CPUE) in the last three years have shown a worrying decrease that indicates a decline in fishable biomass that is proportionally greater than the reduction in fishing effort [13].

Despite the planned investments in the sector, the limiting factor for the Adriatic fisheries development could be represented by the future status of commercial fish populations. Fish stock assessments in the Adriatic Sea show that the state of some important commercial fish stocks (hake, pilchard-sardine, red mullet, sole, bluefin tuna and swordfish) may be outside safe biological limits [14]. The assessment is based on only 5 species and therefore cannot give a true representation of the trends of all commercial species populations, however for the purpose of this study we can assume that it can at least give an indication on current trends. Furthermore, the fishing sector in the Eastern Adriatic, following the entry of Croatia in the EU, will have to adapt to EU's fisheries laws and regulations and therefore some contractions could be expected, at least for the first part of the process [15].

Finally, the establishment of a multiannual management plan for the Northern Adriatic Sea small pelagic fisheries is seen as a great improvement for the fishery sector in the region, although the results in the long term are yet to be assessed [16].

Based on the above assumptions, it is unlikely to expected a large increase in catches in the next 15 years, while it is more feasible to expect an initial transition period with some contraction in the fishing sector due to the recovery process of fish populations and the adjustments to EU regulations[9].

[9] The fisheries sector analysis carried out in the present report relies solely on available literature. Very limited information on the maps and trends of fishing pressure have been obtained from the Italian Government and while no data have been obtained from the Croatian Government.

IMPACTS ON GES

If unsustainable fishing practices are going to be increasingly adopted in the Adriatic, they could affect descriptors D1 (Biodiversity) and D4 (Foodwebs) in particular, as the potential impacts of overfishing and by-catch may provoke cascading effects on the Adriatic ecosystem [14]. Obviously the fisheries sector may also have an impact on commercial species (D3). Sea-floor integrity (D6) could be impacted from trawling activities.

Impacts on other descriptors may include entanglement of marine organisms in marine litter (D10), especially discarded or lost fishing nets (ghost nets fishing), and amounts of marine litter in fishing nets (fishing for litter) which are directly linked to descriptors D1 (Biodiversity) and D3 (Commercial species). Ghost fishing may also influence benthic species, as it exists a possibility of suffocation and/or injuries due to abrasion [17]. Following the assumption of a stable trend in the fisheries sector, the future trends of the above impacts are expected to remain constant.

TABLE 8 **POTENTIAL IMPACTS OF THE FISHERIES SECTOR ON GES**

MSFD DESCRIPTOR	IMPACTS ON GES	FUTURE TRENDS
D1 **Biodiversity**	Nursery areas affected, food supplies affected by overfishing and depletion of food populations, damage to species by entanglement in fishing gears, by-catches, discards	→
D2 **Non-indigenous species**		
D3 **Commercial species**	High pressure on commercial species.	→
D4 **Foodwebs**	Food supplies affected by overfishing and depletion of food populations, feeding on discards changes seabird trophic habits,...	→
D5 **Eutrophication**		
D6 **Sea-floor integrity**	Local-mechanical impacts on seabed generated by bottom trawling, destruction of habitats and physical support, changes in ecosystem structure and function	→
D7 **Hydrographical conditions**	Sediment resuspension	→
D8 **Contaminant**	Oil release from vessels	→
D9 **Contaminant 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	→

INTERACTION WITH OTHER SECTORS

The main conflicts involving the fisheries sector in the Adriatic could arise with the oil and gas developments, which may occupy large areas of the Northern Adriatic Sea in the near future. The limitation of navigation spaces and potential development of new pipelines could severely limit fishing areas both for the Croatian and Italian fleets. Spatial conflicts may also arise with the maritime transport sector which is constantly increasing in the Adriatic and also with the renewable energy sector although no large scale projects are expected in the area. Other conflicts may arise between the fishermen and MPAs, which are expected to increase in size in the coming years (if the promises of Aichi are maintained). Conflicts with the aquaculture sector may arise and they may be especially due to the presence of cages in fishing zones and to the introduction of alien species.

Some of the most important conflicts will probably arise within the fisheries sector itself, specifically between professional and recreational fishing and between professional and artisanal fishing, where different gear types may overlap in some areas.

The adoption of sustainable fishing practices could instead be highly compatible and beneficial for the tourism sector.

REFERENCES

[1] See Maritime Affairs and Fisheries online magazine http://ec.europa.eu/dgs/maritimeaffairs_fisheries/magazine/en/places/croatia-joins-family

[2] Matić-Skoko S., Soldo A., Stagličić N., Blažević D., Šiljić J. and Iritani D., (2004) Croatian Marine Fisheries (Adriatic Sea): 1950-2010, Working Paoper series, Fisheries Department, University of British Columbia available at: http://www.fisheries.ubc.ca/webfm_send/385

[3] Mannini P., Massa F., Milone N., Adriatic Sea Fisheries: outline of some main facts, available at: http://www.faoadriamed.org/pdf/publications/td13/MMM-td-13.pdf

[4] Republic of Croatia, 2013, National strategic plan for the development of fisheries available at http://www.mps.hr/ribarstvo/UserDocsImages/NSP/NSP_OP_06112013/1511OP_NSP_ENG/National%20strategic%20plan%20for%20development%20of%20fisheries%20of%20the%20Republic%20of%20Croatia.pdf

[5] Vrgoč N, Arneri E, Jukić-Peladić S, Krstulović Šifner S, Mannini P, Marčeta B, Osmani K, Piccinetti C and Ungaro N (2004) Review of current knowledge on shared demersal stocks of the Adriatic Sea. AdriaMed Technical Documents No 12, FAO-MiPAF Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea. 91 p.

[6] See Croatian Ministry of Agriculture Directorate of Fisheries website available at: http://www.mps.hr/ribarstvo/default.aspx?id=45

[7] European Fleet Register, 2014. Available from http://ec.europa.eu/fisheries/fleet/index.cfm

[8] Scientific, Technical and Economic Committee for Fisheries (STECF) – The 2013 Annual Economic Report on the EU Fishing Fleet (STECF-13-15). 2013. Publications Office of the European Union, Luxembourg, EUR 26158 EN, JRC 84745, 302 pp. Available at http://stecf.jrc.ec.europa.eu/documents/43805/581354/2013-09_STECF+13-15+-+AER+EU+Fleet+2013_JRC84745.pdf

[9] Font T., J. Lloret, and C. Piante (2012). Recreational fishing within Marine Protected Areas in the Mediterranean. MedPAN North Project. WWF-France, 168 pp. Available from http://www.medmpaforum2012.org/en/node/2264

[10] FAO (2008). The EIFAC Code of Practice for Recreational Fisheries. EIFAC Occasional Paper No. 42 SEC/EIFAC/OP42.

[11] FAO (2012). FAO technical guidelines for responsible fisheries: Recreational fisheries, No. 13. Rome, Italy: FAO, 178 pp.

[12] Council Regulation (EC) No. 1967/2006 of 21 December 2006.

[13] UNEP-MAP-RAC/SPA. 2014. Status and Conservation of Fisheries in the Adriatic Sea. By H. Farrugio & Alen Soldo. Draft internal report for the purposes of the Mediterranean Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas, Malaga, Spain, 7-11 April 2014. Available at: http://www.cbd.int/doc/meetings/mar/ebsaws-2014-03/other/ebsaws-2014-03-submission-rac-spa-sr-02-en.pdf

[14] State of commercial fish stocks in Mediterranean Sea, European Environment Agency http://www.eea.europa.eu/downloads/c965d57b699d1c74d580d4db9dc813a1/1354185600/state-of-commercial-fish-stocks-in-mediterranean-sea-up-to.pdf?direct=1

[15] See article on Euractiv website “Croatian fishermen see little to celebrate under EU policy“ available at: http://www.euractiv.com/cap/croatian-fishermen-see-little-ce-news-528970

[16] EC, 2015. Development of a regulation establishing a multiannual plan for the management of Northern Adriatic Sea small pelagic fisheries. http://ec.europa.eu/dgs/maritimeaffairs_fisheries/consultations/northern-adriatic-multiannual/index_en.htm

[17] http://www.mzoip.hr/doc/Propisi/Nacrt_dokumenta_19_05_2014.pdf

CHAPTER V

MARITIME TRASPORT AND PORTS

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Due to its strategic position, the Adriatic Sea has been an important trade and transport route since antiquity. The maritime transport sector has a fundamental economic importance for the whole region and its relevance is expected to grow in the future. In particular, the container shipping sub-sector is expected to increase steadily in the North Adriatic ports within the next 20 years due to the intensifying transport routes of goods to emerging eastern European economies and to the doubling of the Suez canal [1] [2]. The intense traffic in the area and the lack of sufficient management measures represent a real menace to the environment in case of accidents and potential oil spills [3] [4].

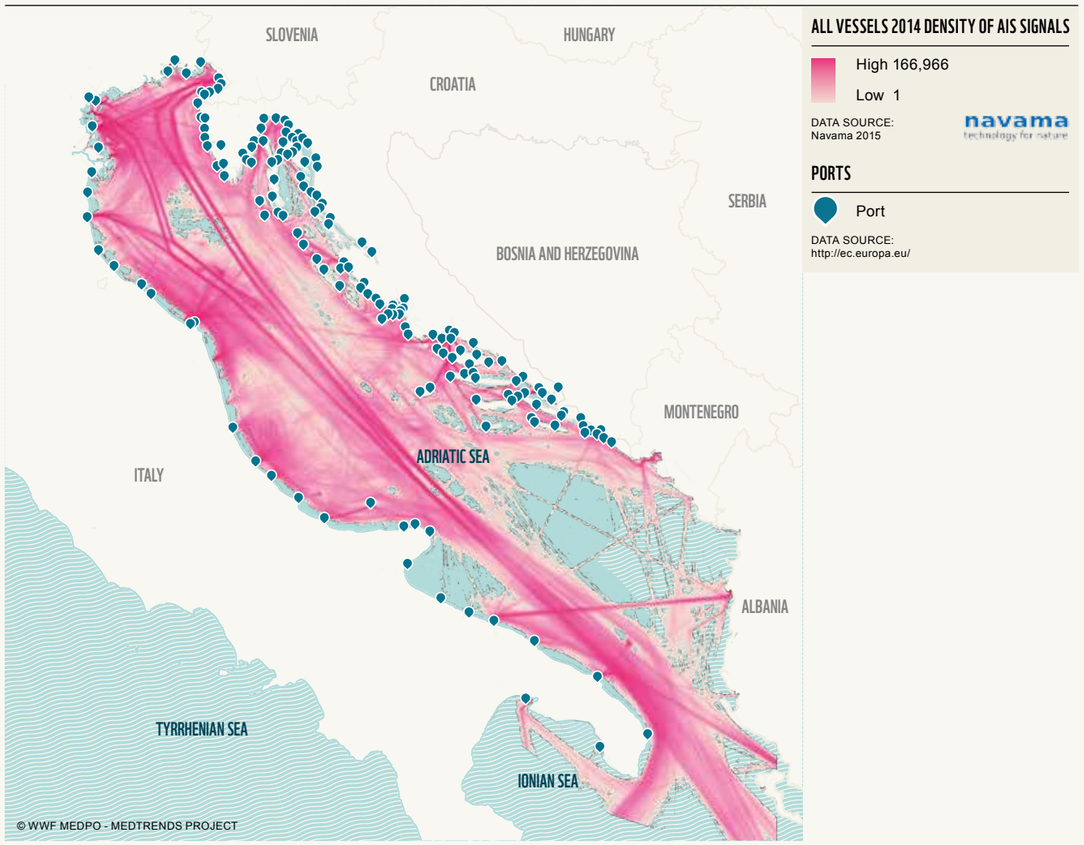
BACKGROUND AND CURRENT SITUATION

Maritime transport is generally considered as one of the most important economic sectors of the Adriatic Sea. This is due to various reasons, particularly the location of important industrial centres, especially along the western Adriatic coast, but also due to ports serving for transit to other countries in Central Europe, particularly in the north of the Adriatic coast (the ports of Trieste, Venice, Koper and Rijeka).

MARITIME TRAFFIC

Maritime traffic in the Adriatic Sea (largely including international shipping activity) is characterized by the interaction of four main patterns [5]. First, the traffic along the Adriatic Sea, between the Strait of Otranto in the south and north to the Bay of Trieste, in which many large commercial vessels are involved. Second, the crossing traffic between the ports on the western and eastern Adriatic Sea coasts. Third, the traffic between the ports along the same coast of the Adriatic Sea, which in case of the western coast is domestic (Italian) traffic only, while along the eastern Adriatic coast can involve ports in several states (Slovenia, Croatia, Italy, Montenegro, Albania). And fourth, various "irregular" navigation forms, involving large cruise vessels, numerous yachts, fishing vessels, as well as various other small boats.

FIGURE 25 ADRIATIC MARITIME TRAFFIC IN THE YEAR 2014 (AIS DATA) AND MAIN PORTS



PORTS

Croatia has numerous ports but only six have a significant value within the international economic sphere: Ploče, Dubrovnik, Šibenik, Šplit, Rijeka and Zadar. Slovenia has only one main port: Koper. While the Italian side of the Adriatic has many ports of which the most important are: Ancona, Bari, Ravenna, Trieste and Venice [5], [6], [7].

Passenger traffic is particularly intense in Venice and Dubrovnik due to cruise transport. Moreover, Adriatic ports are very important for bulk traffic, and NAPA ports (North Adriatic Ports Association, comprising[10]: Venice, Trieste, Rijeka and Koper) play a fundamental role in cargo traffic [9]. Koper has the largest market share among them with 600,000 TEU[11] [10] in 2013, whereas Trieste and Venice are crucial points for container handling [9].

NAPA ports and especially Rijeka, Trieste and Venice have a strategic geographic position at the core of Europe and are nearer to Asian and African ports with respect to North European ports (thus granting lower CO_2 emissions and more cost-efficient solutions for goods transport) [10] [11] [12]. The table below summarizes the traffic of bulk and passengers in the main Adriatic Ports (in alphabetical order) for 2014.

[10] Ravenna left the Association back in 2013.
[11] TEU (twenty Foot Equivalent Unit) it is a standard measure in container transport.

TABLE 9 TRAFFIC OF GOODS AND PASSENGERS IN THE MAIN ADRIATIC PORTS (2014)

PORT	PASSENGER TRAFFIC (N° OF PASSENGERS)	LIQUID BULK (TONS)	SOLID BULK (TONS)	N° OF SHIPS MOVED
Ancona (IT)	1,042,896	4,779,460	637,543	4,496
Bari (IT)	n.a.	4,221,834	1,425,159	2,031
Dubrovnik (HR)	806,187	n.a.	n.a.	n.a.
Koper (SLO)	n.a.	n.a.	n.a.	> 5,000 vessels in transit
Ploče (HR)	n.a.	402,229,826	3,724,423	n.a.
Ravenna (IT)	n.a.	264,846	1,132,931	3,122
Rijeka (HR)	159,607	4,882,695	4,140,081	n.a.
Šplit[13]	424,263	n.a.	n.a.	41,904
Trieste (IT)	129,691	42.400.894	790,057	3,949
Venice (IT)	2,072,642	6,889,980	7,001,983	3,366
Zadar (HR)[14]	2,400,862	4,583	110,597	n.a.

[12] In the cases of Bari and Ravenna the data refers to the n° of arriving vessels and not to the total vessels moved as in all other cases.
[13] The most recent data refer to year 2013, the n° of ships moved encompasses all types of vessels also ferries, i.e. the number is higher than in other ports' statistics.
[14] The most recent available data for the port of Zadar refer to the year 2013.

SOURCE: AUTORITÀ PORTUALE DI TRIESTE, 2014 [13]; VENICE PORT AUTHORITY (B), 2014 [14]; PORT AUTHORITY OF RIJEKA, 2014 [15]; PORT OF ZADAR AUTHORITY [16]; AUTORITÀ PORTUALE DI ANCONA, 2015 [17]; AUTORITÀ PORTUALE DI RAVENNA, 2014 [18]; AUTORITÀ PORTUALE DEL LEVANTE, 2014 [19]; PORT OF DUBROVNIK, 2014 [20]; PORT OF PLOCE, 2014 [21]; PORT OF SPLIT, 2014 [22]; REPUBLIC OF SLOVENIA, 2012 [23])

As shown in Figure 25, traffic separation schemes represent true "highways of the sea" in the Adriatic. Traffic hotspots can be observed particularly in the north Adriatic, in the southern part by the Otranto strait and near Ancona, one of the ports with the highest traffic density.

The legal framework of the maritime transportation sector in the Adriatic Sea is not homogenous. However Croatia, Italy and Slovenia, being all part to the EU, are bound to the European legal framework, which includes Directive 2002/59/EC (as modified by Directive 2009/17/CE) [24] that established the SafeSeaNet mechanism to harmonize the monitoring of traffic and the information exchange. According to the European Commission, further modernization and harminization efforts are needed in this field [2].

FIGURE 26 **ADRIATIC FREIGHT TRAFFIC AND PORTS (2014)**

FREIGHT TRAFFIC (KT)

- < 1,500
- < 10,000
- < 50,000

DATA SOURCE:
http://ec.europa.eu/

CARGO VASSELS 2014 DENSITY OF AIS SIGNALS

High 20,064
Low 1

DATA SOURCE:
Navama 2015

FIGURE 27 **PASSENGER TRAFFIC (2014)**

PASSENGER TRAFFIC (NUMBER OF PASSENGERS)

- < 1,500
- < 10,000
- < 50,000

DATA SOURCE:
http://ec.europa.eu/

DENSITY OF AIS SIGNALS (PASSENGERS TRAFFIC, 2014)

High 35,402
Low 1

DATA SOURCE:
Navama 2015

FUTURE TRENDS

Trends in the development of maritime shipping activities seem to lead to an increased density of traffic in the next years, with special emphasis on several parts of the Adriatic Sea, as well as partly to the change in the nature of traffic. Specifically, a significant increase in the volume of transport of oil and other harmful substances is expected, including liquefied natural gas (LNG).

Furthermore the development of the (freight) maritime traffic in the Adriatic area is supported by the EU, with a focus on strengthening the existing land infrastructures and further developing the Motorways of the Sea [25], which represent an alternative to road transport [2] with the final aim of doubling the container traffic of the macro-region by 2020.

The creation of new touristic routes, especially the international ones connecting the two sides of the Adriatic, can also be expected in the near future as proposed by the EC [2]. The Adrimob project, co-funded by the EU, identified Pula, Mali Losini, Zadar and Split as possible Croatian ports for the development of new passenger shipping routes connecting Italy and Croatia by 2017 ([25]; [6]). Short-shipping routes for touristic purposes also display great development potential for both Italy and Croatia [26].

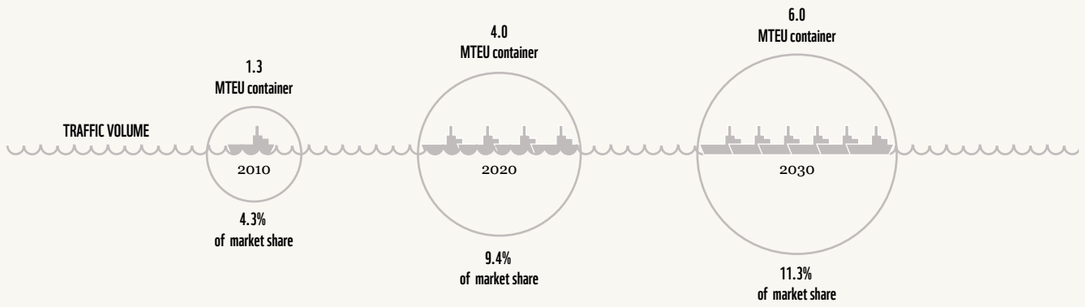
In the future, the Northern Adriatic ports are expected to further increase their importance in the freight traffic, particularly in Croatia and Slovenia. Projections for the Koper port in the very short term (2015) highlight a growing tendency, with the Luka Koper Group (which is in charge of managing the port) expecting a growth of 9% in this field, mainly due to the constant increase in the container sector [27].

Meanwhile, the Port of Rijeka expects an increase of 600,000 TEU by 2020 for the container traffic, The development trends in shipping containers is confirmed by the research of Bendekovic et al. (2014) [11] who suggest the building of a new terminal on the Croatian island of Kirk to meet future needs (estimated in 20.426.596 tonnes of goods by 2020 and in 33,459,332 tonnes by 2030) [11].

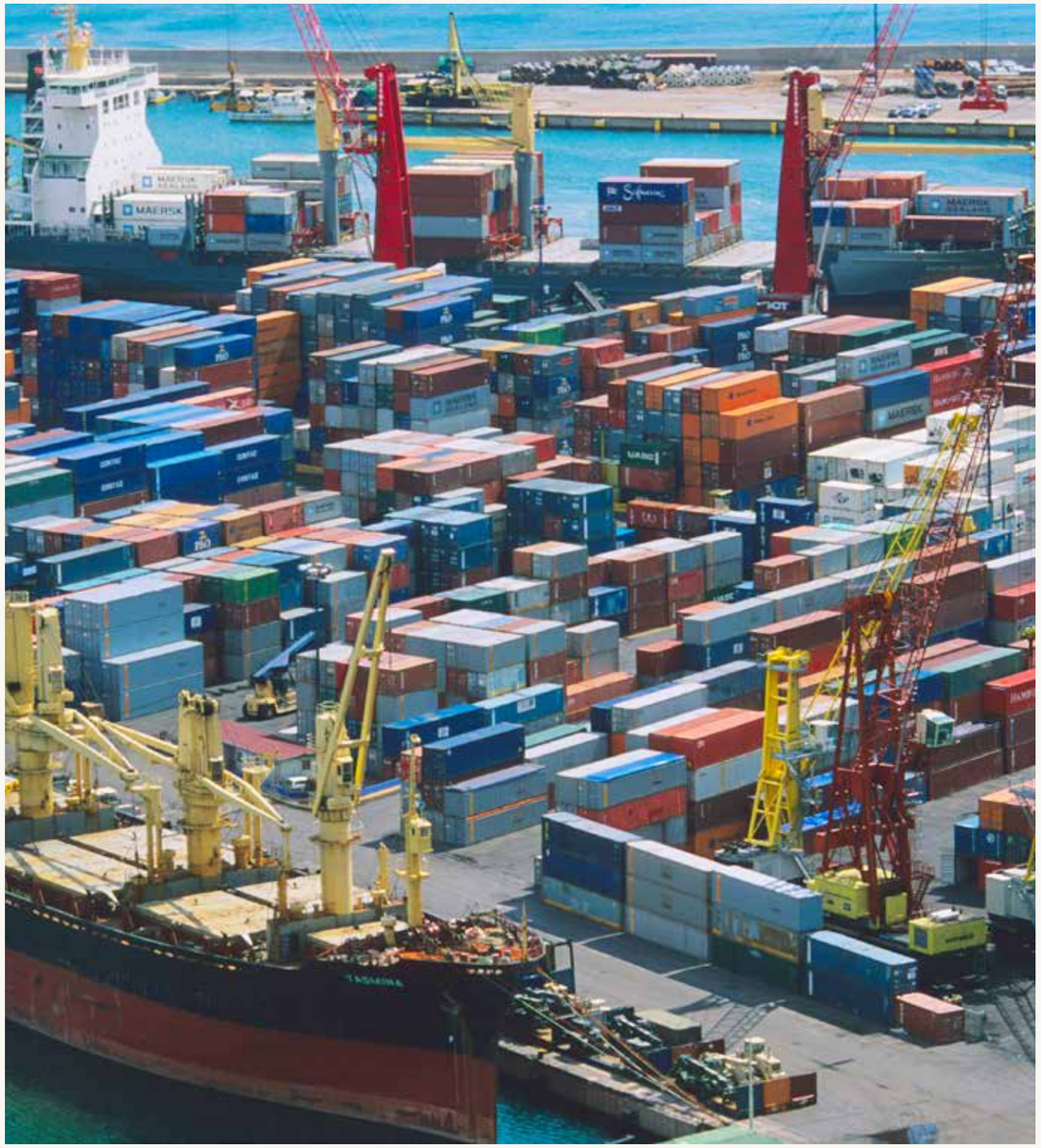
According to a market research of MDS Transmodal commissioned by the NAPA [2], the container traffic in the five North Adriatic Ports of Koper, Ravenna, Rijeka, Trieste and Venice is expected to increase both in volume and as a total market share. NAPA ports are expected to increase their container traffic from 1.3 in 2010 to 4.0 in 2020 and to 6.0 (MTEU) in 2030 with a total increase of 348%. Their market share will pass from 4.3% in 2010 to 9.4% in 2020 and 11.3% in 2030. The research compared the NAPA figures with other ports (in Northern Europe, Tyrrhenian and Black Sea): the Adriatic ports show the highest growth prospects, ([1]; [2]).

Finally, recent transit ports are expected to gain significance in the south of the eastern Adriatic coast, such as Ploče in Croatia, Bar in Montenegro and Vlorë in Albania from where a major new transportation route for Caspian oil export may be expected.

FIGURE 28 **CONTAINER TRAFFIC IN NORTH ADRIATIC: 2020 AND 2030 TRENDS**



SOURCE: (MDS TRANSMODAL 2011 [1]; SWD (2014) 190 2014 [2])



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IMPACTS ON GES

The major environmental impact of the transport sector in the Adriatic is represented by the potential accidents and the consequent oil spills ([3]; [28]). Other pressures on the environment are linked to acoustic and chemical pollution, risk of collision between ships and marine mammals and the introduction of alien species as a consequence of the discharge of ballast waters. The latter is especially true for the Italian coastal/port areas [28] responsible for 80% of discharge [29].

Furthermore, the International Maritime Organization (IMO) estimates that carbon dioxide emissions from shipping were equal to 2.7% of the global human-made emissions in 2007 and expects them to rise by as much as 2 to 3 times by 2050 if no action is taken [30].

TABLE 10 **POTENTIAL 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.	↗
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 such as abrasion and anchoring damage	↗
D7 **Hydrographical conditions**		
D8 **Contaminant**	Oil pollution (releases/discharges), eventual or chronic, shipping-derived antifouling biocides	↗
D9 **Contaminant in seafood**		
D10 **Marine litter**	Littering, waste discharge	↗
D11 **Energy**	Shipping noise (damage, disturbance to/of marine mammals and fish	↗

INTERACTION WITH OTHER SECTORS

Marine pollution from maritime transport as well as marine noise or the introduction of invasive species through ballast water seriously affect marine and coastal biodiversity and thus tourism and fishing activity. Conflicts for space may also arise with the aquaculture and fisheries sectors that may be affected by maritime traffic. Conflicting interests may also occur with as the development of offshore energy installations such as wind farms or oil and gas rigs, which may increase the risks of accidents.

REFERENCES

[1] MDS Transmodal Limited 2011. NAPA: Market study on the potential cargo capacity of the North Adriatic ports system in the container sector. http://www.its-napa.eu/attachments/article/7/MDS-market%20study-North%20Adriatic%20-%20container%20sector.pdf

[2] SWD(2014) 190 . «COMMISSION STAFF WORKING DOCUMENT Action Plan concerning the European Union Strategy for the Adriatic and Ionian Region.» ec.europa.eu. 2014. http://ec.europa.eu/regional_policy/sources/cooperate/adriat_ionian/pdf/actionplan_190_en.pdf (last accessed May 2015).

[3] Adrimob (a). «WP4 Definition and Organization of sustainable multimodal cross border circuits. Act 4.2 Cross-border mobility intervention plan South and Central Area.» www.adrimob-ipa.eu. s.d. http://www.adrimob-ipa.eu/materiali/action_plan_south_and_central_area.pdf (last accessed May 27, 2015).

[4] See article on the Telegraph website: http://www.telegraph.co.uk/news/worldnews/europe/italy/11316135/Watch-Turkish-cargo-ship-sinks-off-Italy-coast.html

[5] Vidas D., Particularly Sensitive Sea Areas: the need for regional cooperation in the Adriatic Sea, The Fridtj of Nansen Institute Oslo, Norway http://www.ijf.hr/eng/EU4/vidas.pdf

[6] Adrimob (b). «WP4 Definition and Organization of sustainable multimodal cross-border circuits.» www.adrimob-ipa.eu. s.d. http://www.adrimob-ipa.eu/materiali/action_plan_na.pdf (last accessed May 27, 2015).

[7] Med-Iamer. «Adriatic Ionian Ecoregion (AIE) Maritime Transport.» www.medmaritimeprojects.eu. 2014. http://www.medmaritimeprojects.eu/download/ProjectMediamer/SH_Meeting_AIE/AIo_Transport_factsheet.pdf (last accessed May 26, 2015).

[8] Port of Koper . «Annual report 2014.» www.luka-kp.s. 2014. http://www.luka-kp.si/poslovna-porocila-234 (last accessed May 28, 2015).

[9] Simonella, Ida. «Forum delle Camere di Commercio dell'Adriatico e Ionio. Osservatorio traffici marittimi. Relazione 2013. Porti dell'Adriatico e dello Ionio. Porti, traffici e strategia politica europea per la Regione dell'Adriatico Ionio». www.forumaic.org. 11th June 2014. http://www.forumaic.org/layout/informazioni/allegati/Osservatorio 2014_IT.pdf (last accessed 3rd June 2015)

[10] http://data.worldbank.org/indicator/IS.SHP.GOOD.TU/countries, last accessed 4th June 2015

[11] Bendekovic, J., Rogoraz Z., and Naletina D.. «The role and importance of intermodal Transport in Croatia for EU Countries.» www.daaam.info. 2014. http://www.daaam.info/Downloads/Pdfs/science_books_pdfs/2014/Sc_Book_2014-022.pdf (last accessed May 28, 2015).

[12] Venice Port Authority (a). «IPA CBC Programme. Port Organization and Analysis of Processes - Analysis of the organization of the Port of Venice Extension to NAPA Documents for the Optimization of Gate Processes.» www.apcwindow.eu. 2013. http://www.apcwindow.eu/sites/default/files/documents/WP3-VenicePA_Port%20_and_process_analysis.pdf (last accessed May 28, 2015).

[13] Autorità portuale di Trieste. «Movimento marittimo nel porto di Trieste 2013-2014.» www.porto.trieste.it. 2014. http://www.porto.trieste.it/wp-content/uploads/2015/04/ESPO-2014-2.pdf (last accessed May 28, 2015).

[14] Venice Port Authority (b). «IPA CBC Programme. Port Organization and Analysis of Processes - Analysis of the organization of the Port of Venice Extention to NAPA Documents for the Optimization of Gate Processes.» www.apcwindow.eu. 2013. http://www.apcwindow.eu/sites/default/files/documents/WP3-VenicePA_Port%20_and_process_analysis.pdf (last accessed May 28, 2015).

[15] Port Authority of Rijeka. «Throughput in the Port of Rijeka 2014.» www.portauthority.hr. 2014. http://www.portauthority.hr/en/docs/portauthorityEN/documents/1008/Original.pdf (last accessed May 28, 2015).

[16] Port of Zadar authority, Statistics, http://www.port-authority-zadar.hr/i_en_stat.html, last accessed 28th May 2015;

[17] Autorità Portuale di Ravenna . «Statistiche 2014.» www.port.ravenna.it. Dicember 2014. http://www.port.ravenna.it/wp-content/uploads/2015/01/Dicembre-2014.pdf (last accessed May 29, 2015).

[18] Autorità Portuale di Ancona . «Statistiche - tabellone 2012 - 2013 - 2014.» www.autoritaportuale.ancona.it. 2015. www.autoritaportuale.ancona.it/files/tabellone%202012-13-14.xlsx (last accessed May 29, 2015).

[19] Autorità Portuale del Levante. «Porto di BAri 2004-2013.» www.aplevante.org. March 2014. http://www.aplevante.org/attachments/article/446/Porto%20di%20Bari%202004-2013%20%282%29.pdf (last accessed May 29, 2015).

[20] Dubrovnik Port Authority, Statistics, Cruise, http://portdubrovnik.hr/statistika/?idKat=2&godina=2014, last accessed 29th May 2015

[21] Luka Ploce, Statistics, http://www.luka-ploce.hr/en/str/statistic.php, 29th May 2015, last accessed 29th May 2015

[22] Autorità Portuale di Trieste, "Il porto. Descrizione" http://www.porto.trieste.it/ita/il-porto/descrizione, last accessed 28th May 2015

[23] Republic of Slovenia . «REGIONAL EXCHANGE OF MARITIME TRAFFIC DATA UPGRADING EXISTING SOLUTIONS.» www.up.gov.si. 2012. http://www.up.gov.si/fileadmin/up.gov.si/pageuploads/Predstavitve/Regional_exchange_of_maritime_traffic_data.pdf (last accessed May 29, 2015).

[24] Ratcliff Christina, Trasporto Marittimo regole di Traffico e sicurezza, http://www.europarl.europa.eu/aboutparliament/it/displayFtu.html?ftuId=FTU_5.6.12.html, last accessed 29th May 2015

[25] For further information please refer to: https://www.port.venice.it/en/new-motorways-of-the-seas-terminal.html-9, last accessed 3rd June 2015

[26] Adriplan. «Maritime Spatial Planning needs and priorities in Focus Area 1. Discussion Paper. » adriplan.eu. May 2014 http://adriplan.eu/index.php/dissemination/flyers-misc-files/trieste-workshop-discussion-paper/download (last accessed 4th June 2015)

[27] Port of Koper . «Annual report 2014.» www.luka-kp.s. 2014. http://www.luka-kp.si/poslovna-porocila-234 (last accessed May 28, 2015).

[28] Abdulla, Ameer, Linden, e Olof. «Maritime Traffic Events on Biodiversity in the Mediterranean Sea.» cmsdata.iucn.org. 2008. https://cmsdata.iucn.org/downloads/maritime_v1_lr.pdf (last accessed May 28, 2015).

[29] Med-IAMER, "Matrix of Drivers-Pressures for the Adriatic-Ionian ecoregion", http://www.medmaritimeprojects.eu/download/ProjectMediamer/SH_Meeting_AIE/AIo_DriversPressuresMatrix.pdf, last accessed 28th May 2015

[30] See Wikipedia page on Environmental impact of shipping http://en.wikipedia.org/wiki/Environmental_impact_of_shipping

CHAPTER V

AQUACULTURE

Since the 1970s, the Mediterranean marine aquaculture sector has been developing rapidly, with a regional growth rate of 70% recorded between 1997 and 2007 [1]. The aquaculture sector in the Adriatic Sea has also followed similar trends and it 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]. Italy is the Adriatic country with the most developed aquaculture sector, while other Adriatic riparian countries (Croatia, Albania and Montenegro) have relatively small aquaculture industries with particularly high growth potential for the coming years.

Although estimates point out that the Mediterranean aquaculture sector may show more than 100% growth by 2030 in terms of production and value, it is unlikely that such growth will occur in the Adriatic Sea, where the lack of suitable areas for the installation of new farms is the main constraint for the further development of this sector, together with the potentially increasing conflicts with the tourism and fisheries sectors. However, the future aquaculture developments that are likely to occur in Croatia and Albania may contribute to a moderate increase of aquaculture production in the region. If unsustainably managed, this production growth may lead to substantial environmental challenges.

BACKGROUND AND CURRENT SITUATION

According to FishStat Data [3] the total fish aquaculture production in the Adriatic, including marine & brackish waters sp., accounts for 3 % of the total production in the Mediterranean Sea and it is of approximately 31,000 Tonnes. The most cultured species are sea bream and sea bass [4] which are grown in round plastic (PEHD) cages of 12 - 38 meters in diameter with nets suspended into the water column to contain the fish [5].

Aquaculture's value in the Adriatic Sea reaches 90 million euro in terms of production and provides about 6,000 direct jobs and 250,000 indirect jobs, a number that highlights the development of the secondary sector, mainly linked to seafood in the sub-region.

Italy and Croatia are the two leading Adriatic countries in terms of aquaculture production. Italy produces 70% of aquaculture products in the region and is the largest producer of shellfish, particularly in its northern and central Adriatic Regions. The policy and administrative framework of the aquaculture sector in Italy is managed by the Ministry of Forestry, Department of Fishery and Aquaculture [6]. Croatia follows with 21% of the total Adriatic aquaculture production [3]. In Croatia, marine finfish farming is dominated by European seabass, gilthead seabream and Atlantic bluefin tuna. Shellfish farming includes farming of Mediterranean mussel and European flat oyster. Croatian aquaculture is managed by the Ministry of Agriculture, Development, Directorate of Fisheries. All development programmes for the sector are based on the Strategies for Croatian Fisheries of 2002 which lays down a series of growth objectives for marine aquaculture activities.

At regional level, specifically in Croatia and Albania, efforts are been made to improve existing legal framework in order to encourage further development of this activity. Licensing procedures have been simplified, potential sites have been valued and included in physical planning and integrated coastal zone management has been used for coastal zone planning in areas where marine aquaculture is dominating.

As illustrated in Figure 29, the majority of aquaculture farms are located in the northern Adriatic, along the Italian coast.

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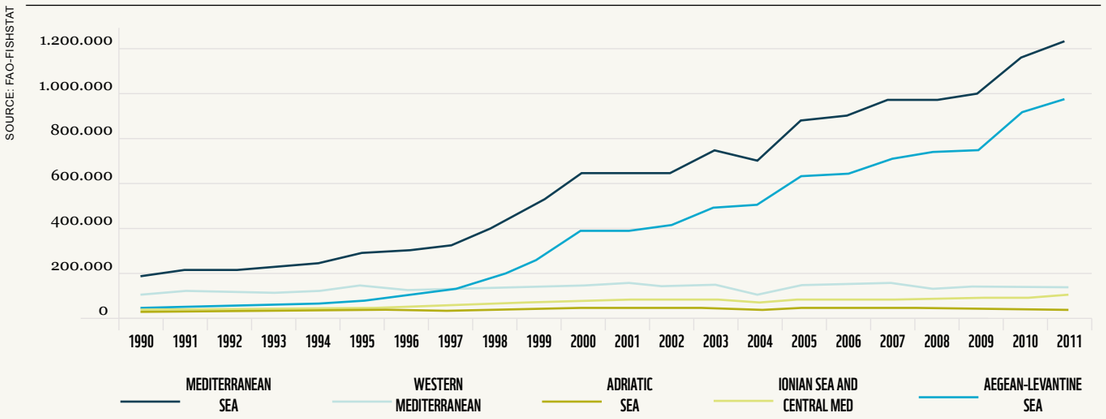
FIGURE 29 **LOCATION OF ADRIATIC AQUACULTURE FARMS**

FUTURE TRENDS

Aquaculture is a growing sector in the Adriatic Region. The decrease in fish stocks and the unfavourable conditions for fishermen, coupled with an improvement of farming technologies are some of the main reasons that contributed to an increasing trend in the sector in recent years. Almost all Mediterranean countries register a deficit of fisheries products, which is due to the rising population and to the increasing per capita consumption, as well as to the stagnation or even decline of wild fish captures. For this reason, a scenario of increasing prices has been predicted, which derives from the uncertainty as to how aquaculture will develop in many states. The demand on fishing products can also be satisfied through imports (as it is now) and therefore this projected scenario may not necessarily benefit aquaculture producers [2].

FIGURE 30 **MARINE AND BRACKISH AQUACULTURE PRODUCTION IN THE MEDITERRANEAN (T) (1990-2011)**

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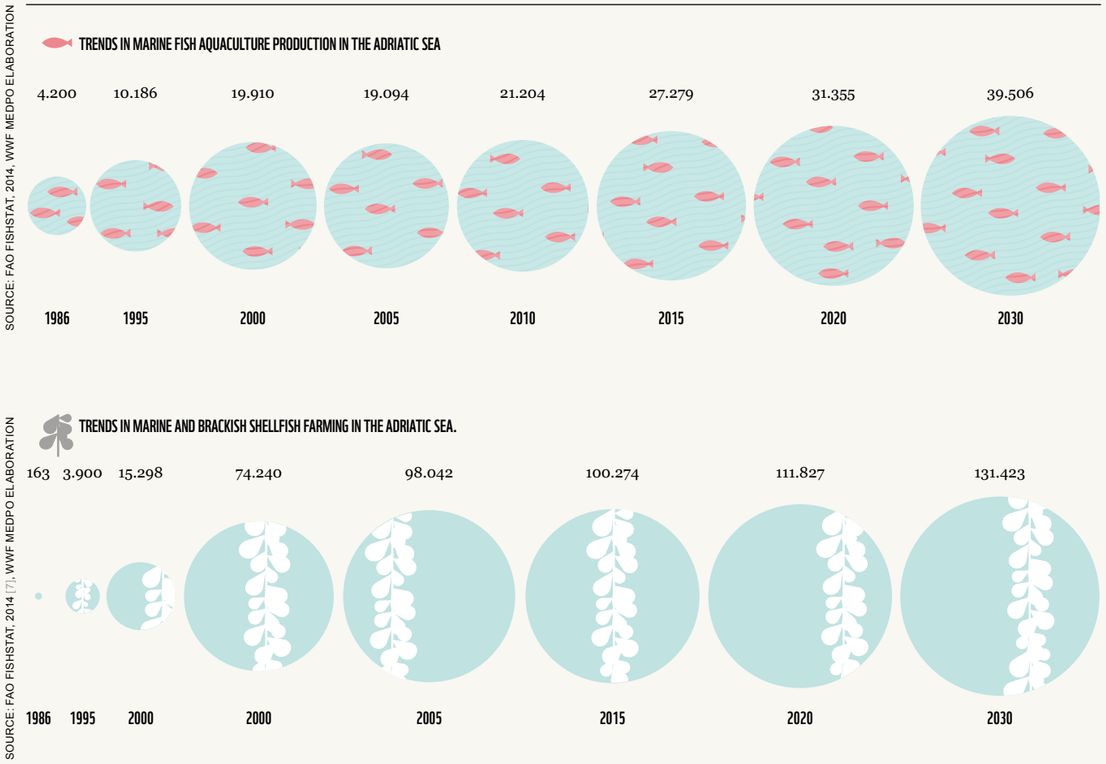
Regional projections estimate that the European aquaculture in the Mediterranean Sea could grow more than 100% by 2030, meaning a total production exceeding 600,000 tonnes, a rise of the sector's total (direct and indirect) value of 5 billion Euros, and the provision 10,000 more direct jobs in the Mediterranean EU MS [3]. However, according to the trends that can be observed in Figure 31, the increasing trend is not uniform in all sub-regions.

A great increase in production has been observed in the Aegean-Levantine Sea, but not in many other parts of the Mediterranean Sea. It can be assumed, therefore, that although marine aquaculture in the Adriatic has been increasing in recent years, and it is expected to continue increasing in the near future, the growth trends are not going to be as fast as the ones observed for the Aegean-Levantine Sea. A potentially fast growth may be however observed in some Adriatic countries such as Albania, Croatia and Montenegro, that currently have relatively small aquaculture industries with important growth potential for the coming years [8]. Even in these countries however, the sector is facing environmental and spatial constraints, as the locations suited for the installation of offshore farms are getting progressively less available [3], especially in countries that strongly depend on tourism. Nevertheless, projections based on FishStat Data show that an increasing trend can be observed in the sector, both for shellfish farming and fish farming (see Figure 31 below).

FIGURE 31 **TRENDS IN MARINE FISH AQUACULTURE AND SHELLFISH FARMING PRODUCTION IN THE ADRIATIC SEA**



IMPACTS ON GES

Aquaculture faces today a significant challenge: how to alleviate the pressure exercised on fish populations and respond to the increasing demand of sea products in local and international markets without leading to environmental problems [1]. As a matter of fact, poorly managed aquaculture activities may cause substantial environmental damage. One of the major environmental concerns of aquaculture is the unintentional release of farmed organisms and the introduction of non-indigenous species into the environment. In both cases, cultured organisms may 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 as the cause of changes in benthic community structure, which may favour some organisms over others [8]. Furthermore, effluent discharges from aquaculture facilities pose environmental concerns, as they may contain residues of therapeutic products, antifouling agents or uneaten fish feed. If improperly managed, aquaculture can also lead to antibiotic pathogen resistance, water eutrophication, oxygen depletion and other problems contributing to environmental damage.

Aquaculture activities can also cause damages by the anchoring of the structures, from Marine litter from abandoned or poorly dismantled cages/by-products of farming activities and from the pollution from fuel from boats and other machineries

The shifting production from herbivorous fish to predatory species, such as sea bass, at the top of the food chain also requires a large amount of fish to be caught to provide the feed [8].

Environmentally friendly techniques are necessary to avoid potentially negative impacts of aquaculture on the Adriatic ecosystems [4].

TABLE 11 **POTENTIAL IMPACTS OF THE AQUACULTURE SECTOR ON GES**

MSFD DESCRIPTOR	IMPACTS ON GES	FUTURE TRENDS
D1 **Biodiversity**	Pathogen transfer and effects on local wild marine organisms, therapeutans and antifouling effects on local wild marine organisms, 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 the 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**		
D10 **Marine litter**	Littering, waste discharge	↗
D11 **Energy**		

INTERACTION WITH OTHER SECTORS

The interactions of aquaculture with other sectors are numerous. The limited access to space/water and licensing, especially in coastal areas, have been highlighted as a particular challenge for the sector.

As in other parts of the Mediterranean, there is also a strong competition for coastal resources between the aquaculture and the tourism sector. As an example, according to the national experts consulted for the present project, it is often likely to find sail boats stuck in cages along the Croatian coast.

The presence of farms in coastal areas competes with the need for high water quality near beaches for tourism development but also with professional fisheries grounds and other coastal activities.

Cages are also considered to be aesthetically unpleasing, and therefore their presence has often been thought to discourage touristic activities in the same area. Similarly, large aquaculture developments enter into conflicts for space with transport and with the fisheries sector and marine sports. As previously mentioned, the release of farmed organisms, the introduction of invasive species and the potential transfer of diseases and parasites, may also have affected other sectors (particularly the fisheries and tourism).

Some synergies are instead potentially achievable with the renewable energy sector, as aquaculture farms can be located near wind farms without causing disturbance.

This competition for space with the aquaculture sector is also impacting marine protected areas as the EU Commission has committed itself to facilitate the development of aquaculture in Natura 2000 sites [9], posing serious risks to local biodiversity due to potential pollution and farmed species escapes.

REFERENCES

[1] Plan Bleu, 2014. Economic and social analysis of the uses of the coastal and marine waters in the Mediterranean, characterization and impacts of the Fisheries, Aquaculture, Tourism and recreational activities, Maritime transport and Offshore extraction of oil and gas sectors, Technical Report, Plan Bleu, Valbonne.

[2] CIHEAM (2010). Atlas of Mediterranean agriculture, food, fisheries and rural areas. Presses de Sciences Po. 136 p.

[3] Policy Research Corporation, 2011. "The potential of Maritime Spatial Planning in the Mediterranean Sea". EC.

[4] Basurco, B. Mediterranean Aquaculture: marine fish farming development. http://www.oceandocs.org/bitstream/handle/1834/544/BBasurco.pdf?sequence=1

[5] PAP/RAC. 1996. Approaches for zoning of coastal areas with reference to Mediterranean Aquaculture. PAP-10/EAM/GL.1. Split, Croatia.

[6] See FAO website on National Aquaculture Sector Overview Italy http://www.fao.org/fishery/countrysector/naso_italy/en#tcN70118

[7] A short overview of the status of aquaculture in the Adriatic countries, A Short overview of the status aquaculture in Italy, Marino G., Ingle E., Cataudella S. http://www.fao.org/docrep/009/a0141e/A0141E03.htm

[8] GFCM, 2013. Trend and issues of aquaculture in the Mediterranean and Black Sea.

[9] EC, 2012. Guidance document on aquaculture activities in the Natura 2000 Network. Feap website http://www.feap.info/default.asp?SHORTCUT=611

CHAPTER V

MARINE RENEWABLE ENERGY

The importance of the marine renewable energy sector is growing, as shown by the attention given to the topic by the European Union by means of the European Commission Communications COM(2014) 8 on Blue Energy (regarding the use of marine power to boost employment and decrease pollution) [1] and COM (2014) 357 [2] on the Strategy for the Adriatic-Ionian Region. Marine renewable energies can be divided in wind energy (onshore and offshore coastal installations) and marine energy produced using the power of tides, waves and sea water for heating/cooling. Although onshore wind energy in the Adriatic Sea is already being exploited, offshore installations have not been built yet. In general, the Adriatic Sea does not have strong tidal nor wave power, however heat pumps seem to present greater potential in the region [3]. Existing impacts from this sector can be considered as negligible, but larger impacts may occur in the future as the sector will expand. The nature of marine renewable energy plants, that generally occupy large areas, may lead to potential spatial conflicts with other economic sectors in the future.

BACKGROUND AND CURRENT SITUATION

Nowadays, offshore wind and sea energy have no impact on the economy of the Adriatic Region as no activity relevant for the Gross Value Added (GVA) can be traced [4]. Existing onshore wind installations (and possible future offshore) may have an impact on the marine environment[15], affecting: the skyline [5] [6] and the marine flora and fauna due to the acoustic pollution [7] [5] [8], thus these aspects may represent an argument of debate against the installation of such offshore plants in the future.

Furthermore the sector of offshore energy production may not have had yet a great development for the obstacle it might represent for other already on-going economic activities (such as fishery, transport and tourism [7].

The legal framework of marine Renewable Resources (RR) falls under the national legislations on renewable energies in general, thus the Adriatic Sea management in this sense is not homogenous, as each country has its own regulations.

Even if Croatia, Italy and Slovenia are all bound to the EU Directives, such as Directive 2009/28/EC on Renewable Energy and National Action Plans and the Directive 2001/77/EC on the production of electricity from renewable sources, yet, the 3 countries are at different stages of implementation of such norms due to different entry dates into the EU.

The EU contributes to the development of the off shore renewable energy production in the Adriatic Region also through funding [9] by means of the SEE Programme, the Interreg IVC, the IPA Programme and the MED Programme.

WIND ENERGY

Wind coastal installations onshore can be found in all the three Adriatic countries analysed (i.e. Croatia, Italy, Slovenia). However, no offshore plants are present. Onshore wind plants in the area are growing in number especially in Croatia [6].

MARINE ENERGY

In the Adriatic Basin wave power, on average, does not exceed 2kW/m , a very low record in comparison to other seas within the Mediterranean basin [11] [12] [13]. A 15 years study (1996-2011) showed that the strength decreases to 1.5 kW/m on average in the northern part (Gulf of Venice) of the Adriatic, whereas it rises to 2- 3 kW in the Central and Southern part (Otranto Straight) [13]. Tide energy is also very weak, thus making the Adriatic unsuitable for the exploitation of wave and tidal energy [14].

Beside wave and sea tides energy production, water can be used as a thermal source for heat pumps, the latter exploit the difference between the temperature of sea water and the one inside buildings for heating or cooling the air inside [15].

[15] The acoustic pollution is referred to wind farm installations
[16] Data on the Porto Corsini Turbine have been retrieved from: POWERED, "Funziona a pieno regime l'impianto mini eolico di Porto Corsini", http://www.powered-ipa.it/it/blog/2013/07/15/funziona-a-pieno-regime-limpianto-minieolico-di-porto-corsini/, last accessed 25th May 2015
[17] Higher values may occur due to storms (Barbariol, et al. 2013).

TABLE 12 **MARINE ENERGY INSTALLATIONS ON THE ADRIATIC COAST**

COUNTRY	HEAT PUMP LOCATION	TEMPERATURE OF SEA WATER	DISTANCE FROM SHORE	HEATING/COOLING PER YEAR OR HEATED SURFACE
Croatia	Apartment, Pazdigradska ulica	13°C	n.a.	Surface: 520 sqm
	Novi Vinodols	13°C	n.a.	Surface: 260 sqm
Italy	n.a.	n.a.	n.a.	n.a.
Slovenia	Grand Hotel Bernardin	16,8°C	130 m	n.a.
	Portorož, Faculty of maritime studies and transport	15,8°C	60 m	91 kWh/y (heat); 75 kWh/y (cool)

SOURCE: (ENERCOAST (A) 2014) [3]

FIGURE 32 **CURRENT RENEWABLE ENERGY INSTALLATIONS IN THE ADRIATIC SEA**

FUTURE TRENDS

According to the National Renewable Energy Action Plans (NREAPs) presented by each of the countries analysed here (i.e. Croatia, Italy and Slovenia), as established by the Directive 2009/28/EC, the wind sector has by far the greater development potential [16] [17].

For what concerns sea energy: heat pumps are still little diffused but show potentiality, while wave and tidal energy still need further background research [3].

Trends in Renewable Energy Sector (RES) development in the Adriatic Region for 2020 are shown in the table below, a comparison with previous years is provided in order to acknowledge the trend progression.

FIGURE 33 **PONTENTIAL RENEWABLE ENERGY INSTALLATION AREAS IN THE ADRIATIC**

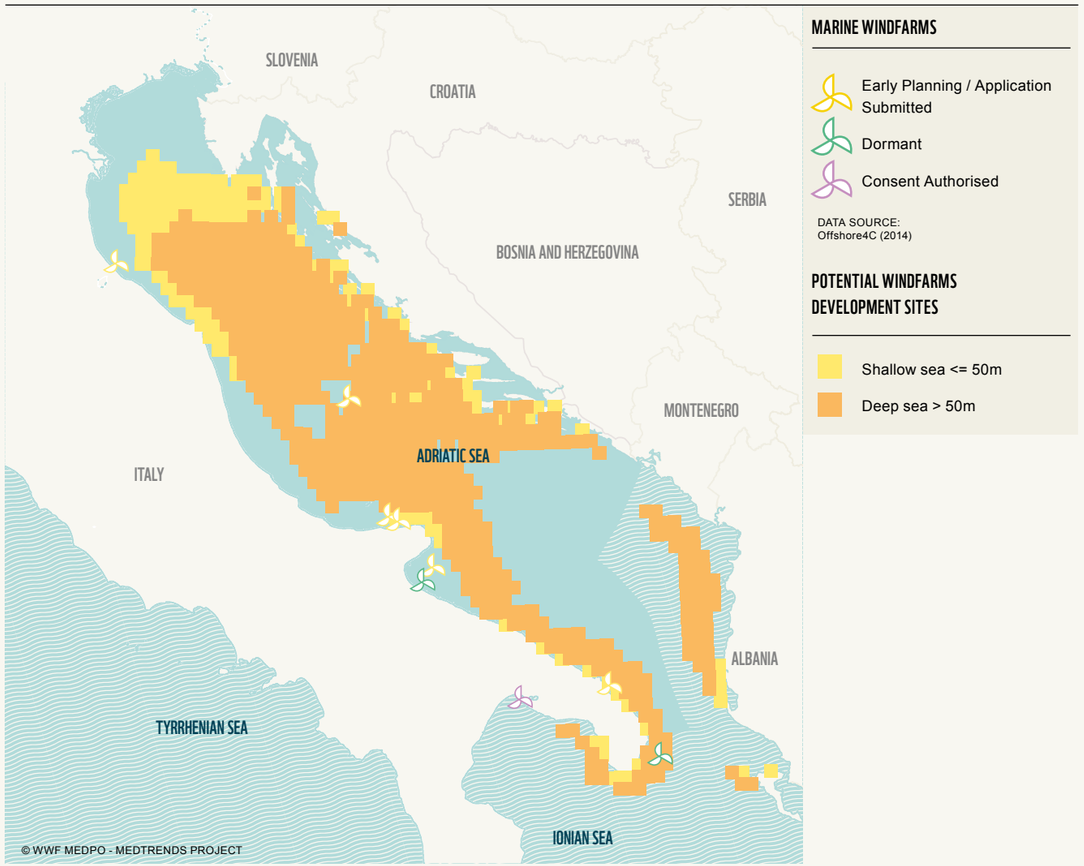


TABLE 13 **MARINE ENERGY INSTALLATIONS ON THE ADRIATIC COAST**

COUNTRY	HEAT PUMP LOCATION		TEMPERATURE OF SEA WATER		DISTANCE FROM SHORE		HEATING/COOLING PER YEAR OR HEATED SURFACE	
	2005	2020	2010	2020	2010	2020	2010	2020
Croatia	12.8 %	20%	0 GWh	0 GWh	139.1 GWh	880.0 GWh	0 GWh	0 GWh
Italy[18]	4.9%	17%	0 GWh	2000 GWh	8398 GWh	18.000 GWh	0 GWh	5 GWh
Slovenia	16.2 %	25%	0 GWh	0 GWh	2 GWh	191 GWh	0 GWh	0 GWh

[18] The Italian data is aggregated therefore it accounts for the whole Italian area not only for the Adriatic coasts.

WIND ENERGY

As shown in Table 13 above, Croatia has not planned yet offshore wind farms in its territorial waters. This is due to inadequate meteorological and physical conditions (scarcity of shallow sea areas) [3]. However a 2014 research[19] highlights the economic advantages of building offshore wind plants and identifies two suitable locations: in the sea facing Pula and the Island Mali Lošinj and in the sea between the town of Primošten and the Žirje island. The plants would provide 78.73 GWh each per year [6]. Along the coast, the towns of Borajica, Smokovljani and Brač are also well positioned [3].

In Italy there is a high potential of installing offshore wind turbines but mainly in the Tyrrhenian Sea. For the Adriatic Sea, only the areas near Volturino (estimated 13.200 MWh) and Manfredonia (52.7040 MWh) are deemed as suitable [3].

In Slovenia, the limited space available of coastal area, the diffusion of wide protected zones (Natura 2000) on the coast and the low strength of the wind hinder the realization of wind plants. Thus the achievement of 2020 target remains much lower than in the other two countries also for the on-shore plants [3]. The only available area for wind plants is near Kozina and Hrpelje [3].

According to recent developments in the offshore wind energy sector, it is now possible to install floating turbines in waters ranging from 50 to 200 m, increasing therefore considerably the area available for wind power generation development, which was previously limited to 50 meters depth maximum (Figure 33).

The EU funded POWERED project is trying to facilitate bureaucratic procedures and deepening research on sea grounds in the Adriatic area in order to foster the development of wind power installations [12].

MARINE ENERGY

The entire Adriatic Basin displays little potential for wave and also for tidal power. According to the EU-funded ENERCOAST project [3], some islands along Croatian coasts and the area near the city of Ancona (Italy) might be exploited for tidal range energy production.

Concerning heat pumps, ENERCOAST found that in Trieste, Ravenna and Ancona, considering their favourable conditions, sea water could be used for heating purposes.

Slovenia shows the least potential for sea energy development due to weak waves and tidal ranges (0.68 m of the 7 m required to operate a turbine). However the numerous touristic locations along its coast (e.g. Piran, Portorož, Koper and Ankaran) represent an interesting chance for developing heat pump using sea water [3].

[19] The research was developed by researchers of the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb.

IMPACTS ON GES

Marine renewable energy generating facilities in the Adriatic are currently in the pilot phase, therefore existing impacts from this sector can be considered as negligible. If the sector will develop as expected however, some impacts will occur, and will depend on the type of power generating plant.

Wind farms and wave generation plants generally occupy large marine areas and during construction phases they may cause a reduction in biodiversity due to direct disruption of the sea floor, especially affecting benthic organisms. Moreover, in construction phase noise disturbance and vibrations may be generated, affecting fish and mammal populations. After construction, the main disturbances may be associated with the physical presence of the power generating structures and the space occupied by the submarine cables that are also potential sources of electromagnetic fields if not appropriately isolated.

TABLE 14 **IMPACTS OF MARINE RENEWABLE ENERGY FACILITIES ON GES**

MSFD DESCRIPTOR	IMPACTS ON GES	FUTURE TRENDS
D1 **Biodiversity**	The construction stage leads to negative impacts on marine biodiversity (abrasion, substrate loss, smothering, death of 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 artificial reef that could benefit to 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 re-suspension, change of water flow rate	↗
D8 **Contaminant**	The construction of wind farms may lead to the introduction of synthetic and non-synthetic compounds in the sea	↗
D9 **Contaminant in seafood**		
D10 **Marine litter**		
D11 **Energy**	Underwater noise, mainly at the construction stage	↗

INTERACTION WITH OTHER SECTORS

Large scale wind farms located offshore are frequently discussed as their presence in certain area often collides with other interests such as shipping, fishery, extraction of sediment, laying of cables and pipelines and military activities.

Furthermore, wind farms change the natural scenery which may affect the highly developed Mediterranean tourism and recreational activities in a negative way. According to the Vectors Project, if an offshore wind farm was installed in front of a Catalan beach, a reduction of 10%-13% in the number of users would be observed [19].

Finally, there may also be opportunities in the future to combine offshore wind farms with open ocean aquaculture [20].

Despite the fact that the Mediterranean is not the main priority for the sector, and presenting a more limited opportunity, ports will still need to be developed in the area to facilitate offshore renewable energy deployments [21].

REFERENCES

[1] COM(2014) 8. «Communication from the Commission the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Blue Energy. Action Needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond.» ec.europa.eu. 20 January 2014. http://eurlex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:52014DC0008&from=EN

[2] COM(2014) 357 . «Communication form the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions concerning the European Union Strategy for the Adriatic and Ionian Region.» 17 June 2014. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0357&from=EN

[3] ENERCOAST (b). «ENERCOAST_Final report potential Enercoast12May2015.pdf.» www.medmaritimeprojects.eu. 2014. http://www.medmaritimeprojects.eu/download/ProjectEnercoast/action_1/ENERCOAST_Final%20report%20potential%20Enercoast12May2015.pdf

[4] EUNETMAR. «Studies to support the development of sea basin cooperation in the Mediterranean, Adriatic and Ionian, and Black Sea. Analysis to support the elaboration of the Adriatic and Ionian maritimeAction Plan.» www.webgate.ec.europa.eu. March 2014. https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Report%202_21_03_2014.pdf.

[5] POWERED. «WP 3 Task 3.1 Technological State of the art .» www.powered-ipa.it. May 2012. http://www.powered-ipa.it/wp-content/uploads/2015/02/IPA-POWERED-WP3-ReportTask3.1-finalrelease-23feb15.pdf

[6] Liščić, Božidar, Ivo Senjanović, Većeslav Čorić, Hrvoje Kozmar, e Marko, Hadžić, Neven Tomić. «Off shore Wind Power Plant in the Adriatic Sea: An Opportunity for the Croatian Economy.» 2014. http://webcache.googleusercontent.com/search?q=cache:TKc5nTkwuZQJ:hrcak.srce.hr/file/190340+&cd=1&hl=it&ct=clnk&gl=it

[7] Shape. «MSP in the Adriatic: problem and opportunity analysis, thematic mapping and inputs for a future.» www.shpae-ipaproject.eu. 10 February 2014. http://www.shape- paproject.eu/download/listbox/WP4%20action%204.3/MSP%20in%20the%20Adriatic%20-%20Veneto%20Region%20Final%20Report.pdf

[8] POWERED. «WP 5 Analysis and experimental evaluation of the environmental, infrastructural and technological issues.» www.powered-ipa.it. 15 December 2014. http://www.powered-ipa.it/wp-content/uploads/2015/04/POWERED%20WP5%20Final%20Report.pdf.

[9] COM (2012) 491. «Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.» ec.europa.eu. 11 September 2012. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0491&from=EN

[10] ENERCOAST (c). «ENERCOAST_Final report legislation Enercoast 12May2015.pdf.» www.medmaritimeprojects.eu. 2014. http://www.medmaritimeprojects.eu/download/ProjectEnercoast/action_1/ENERCOAST_Final%20report%20legislation%20Enercoast%2012May2015.pdf (consultato il giorno May 22, 2015).

[11] Vicinanza, D., L. Cappietti, V. Ferrante, e P. Contestabile. «Estimation of the wave energy in the Italian offshore.» www.ics2011.pl. 2011. http://www.ics2011.pl/artic/SP64_613-617_D.Vicinanza.pdf (consultato il giorno May 21, 2015).

[12] OWEMES. «oFFSHIRE WIND AND OTHER MARINE RENEWABLE ENRGIES IN MEDITERRENEAN AND EUROPEAN SEAS.» www.enea.it. 2012. http://www.enea.it/it/produzione-scientifica/pdf-volumi/v2013-proceedingsowemes-pdf

[13] Barbariol, Francesco, Alvise Benetazzo, Sandro Carniel, e Mauro Sclavo. «Improving the assessment of wave energy resources by means of coupled wave-ocean numerical modeling.» www.researchgate.net. 2013. http://www.researchgate.net/profile/Sandro_Carniel2/publication/239553767_Improving_the_assessment_of_wave_energy_resources_by_means_of_coupled_wave-ocean_numerical_modeling/links/02e7e51c1871e4dcbf000000.pdf

[14] European Science Foundation. «Marine Board. Vision Document Marine Renewable Energy. Research Challenges and Opportunities for a New Energy Era in Europe. .» www.esf.org. October 2010. http://www.esf.org/fileadmin/Public_documents/Publications/MB_vision_document2.pdf

[15] IRENA (International Renewable Energy Agency) (2013) «Heat Pumps. Technology in brief » www.irena.org January 2013. https://www.irena.org/DocumentDownloads/Publications/IRENA-ETSAP%20Tech%20Brief%20E12%20Heat%20Pumps.pdf

[16] Beurskens, L., W., M., e M. Hekkenberg. «Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States. Covering all 27 EU Member States.» en.openei.org. 2011. http://en.openei.org/wiki/Renewable_Energy_Projections_as_Published_in_the_National_Renewable_Energy_Action_Plans_of_the_European_Member_States

[17] Ministry of Economy - Croatia. «NATIONAL ACTION PLAN FOR RENEWABLE ENERGY SOURCES TO 2020.» ec.europa.eu. 2013. https://ec.europa.eu/energy/sites/ener/files/documents/dir_2009_0028_action_plan_croatia.zip

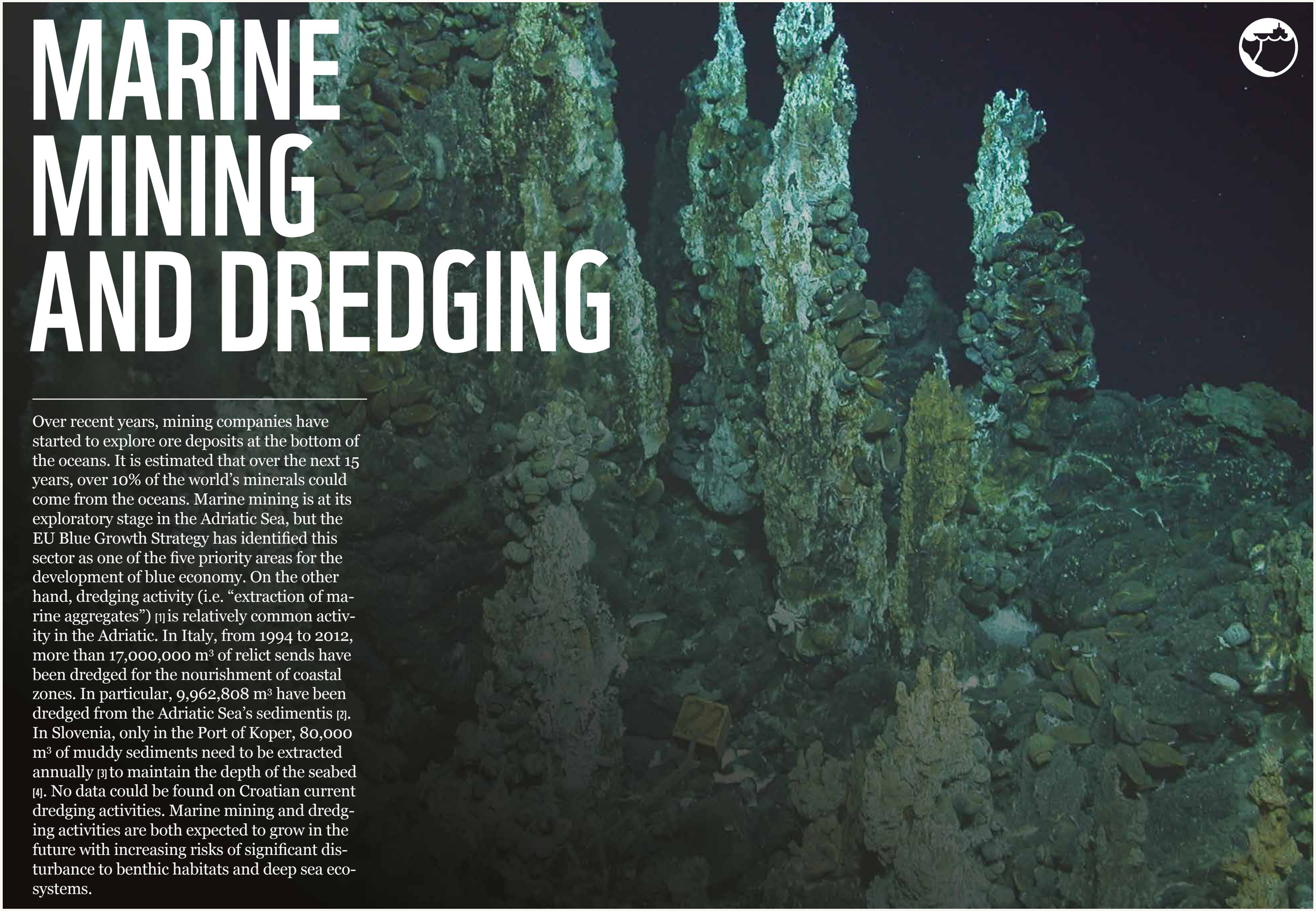
[18] Ministry of Economy - Croatia. «National Action Plan for Renewable Energy Sources to 2020.» ec.europa.eu. 2013. https://ec.europa.eu/energy/sites/ener/files/documents/dir_2009_0028_action_plan_croatia.zip

[19] Vectors project webpage: http://www.marine-vectors.eu/Core_pages/Offshore_wind_farms_impact_assessment_on_the_Catal

[20] Bailey, H, Brookes, K L & Thompson, P M, 2014, Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future, Aquatic Biosystems, 10:8

[21] ORECCA, 2011, European Offshore Renewable Energy Roadmap, ORECCA Coordinated Action Project.

MARINE MINING AND DREDGING



Over recent years, mining companies have started to explore ore deposits at the bottom of the oceans. It is estimated that over the next 15 years, over 10% of the world's minerals could come from the oceans. Marine mining is at its exploratory stage in the Adriatic Sea, but the EU Blue Growth Strategy has identified this sector as one of the five priority areas for the development of blue economy. On the other hand, dredging activity (i.e. "extraction of marine aggregates") [1] is relatively common activity in the Adriatic. In Italy, from 1994 to 2012, more than 17,000,000 m^3 of relict sends have been dredged for the nourishment of coastal zones. In particular, 9,962,808 m^3 have been dredged from the Adriatic Sea's sedimentis [2]. In Slovenia, only in the Port of Koper, 80,000 m^3 of muddy sediments need to be extracted annually [3] to maintain the depth of the seabed [4]. No data could be found on Croatian current dredging activities. Marine mining and dredging activities are both expected to grow in the future with increasing risks of significant disturbance to benthic habitats and deep sea ecosystems.

BACKGROUND AND CURRENT SITUATION

Deep sea mineral mining involves the excavation of mineral deposits located in the deep sea. Ocean mining sites are usually around large areas of polymetallic nodules or active and extinct hydrothermal vents at about 1,400 – 3,700 m below the ocean's surface [5]. The vents create sulphide deposits, which contain valuable metals such as silver, gold, copper, manganese, cobalt, and zinc [6]. The deposits are mined using either hydraulic pumps or bucket systems that take ore to the surface to be processed. As with all mining operations, deep sea mining raises questions about potential environmental impact on surrounding areas.

Dredging activity is very common in the Adriatic Sea. In fact, the growing maritime traffic and the consequent port activity require the extraction of sediments by means of dredging operations, in order to improve navigability and seaports accessibility [7]. Dredging operations generally concern large volumes of materials; an adequate disposal and reuse of dredged materials is fundamental to achieve a sustainable dredging activity [8].

In Italy, dredged materials, relict sands in particular, are re-used for the beach nourishment of coastal zones that have been reduced by the effects of erosion [9]. According to ISPRA, from 1994 to 2012, 17,796,373 m^3 of relict sands have been dredged in Italy. In particular, in the Adriatic Sea 9,962,808 m^3 of relict sands have been dredged [9].

In Slovenia, dredging activity is required on a regular basis. The Port of Koper, one of the biggest and most significant ports in the Northern Adriatic Sea [3], manages 10 million tonnes of freight every year [4] and sea-bottom dredging and muddy sediments extraction are fundamental for ensuring a sufficient port depth that allows for maritime navigability [4]. The quantity of muddy sediments, which need to be removed annually in the Port of Koper, corresponds to a total of 80,000 m^3 [3]. Sediments are usually re-used for the construction of new port structures and service areas [4]. The Slovenian National Building and Civil Engineering Institute states that the muddy sediments dredged from the Port of Koper do not produce environmental pollution; more than 40% of the sediments investigated consists of clay minerals [3]. The mineral composition of the dredged sediments analyzed is illustrated in Table 15.

Although there is no detailed legal framework that at EU level regulates the management of dredging activities, some normative principles in this sense can be extrapolated from Directives regulating parallel issues/topics. The EU Water Framework Directive (WFD), implemented in 2000, defines environmental quality standards for what concern the emission, the discharge and loss of substances in surface (coastal) water [10] [11].

In Croatia the Nature Protection Act, adopted in 2005, regulates dredging and mining activities in the seven Marine Protected Areas [12] [7].

In Italy, dredging activity is regulated by means of the Article 109 of the Legislative Decree n. 152/2006, which regulates the discharge of materials produced from the excavation activities [13]. In Slovenia, the protection of coastal ecosystems is regulated by the Nature Conservation Act, adopted in 1999 [14] and the regulations related. The Slovenian system integrates biodiversity protection into different sectors (i.e. tourism, water management, spatial planning, etc.) promoting a sustainable use of natural resources [12].

TABLE 15 **DREDGING OPERATIONS IN ITALY, PERIOD 1994-2012. THIS TABLE SUMMARIZES ONLY THE VOLUMES DREDGED FROM THE ADRIATIC SEA**

SOURCE: ISPRA 2014 [2]

RELICT SAND DEPOSITS	YEAR OF DREDGING OPERATIONS	DREDGED VOLUMES (m^3)
Adriatic Sea / Tagliamento and Adige rivers offshore	1994-1999	
Adriatic Sea / Tagliamento and Adige rivers offshore	1995-1999	
Adriatic Sea / Tagliamento and Adige rivers offshore	1999-2000	7,231,570
Adriatic Sea / Tagliamento and Adige rivers offshore	1999-2003	
Adriatic Sea / Tagliamento and Adige rivers offshore	2004	
Adriatic Sea / Ravenna offshore (Area C1)	2002	799,850
Adriatic Sea / Civitanova Marche offshore (Area B1)	2006	1,106,039
Adriatic Sea / Ravenna offshore (Area C1 & A)	2006	825,349

FUTURE TRENDS

Currently there are no deep sea mining projects in the Adriatic Sea, but exploration activities may reveal potential deposits in the future, particularly in the deeper southern part of the Sea.

Concerning dredging activities, in 2013, Italian Port Authorities (i.e. Three-years plans and Regulatory plans) planned more than 60,000,000 m^3 of sediments to be dredged in the future. In the Adriatic Sea area 21,528,584 m^3 of sediments are foreseen to be dredged in the 3 years period covered by the plan [15].

The MedPartnership report "Assessment of Coasts of Sea-Level Rise in Republic of Croatia and Costs and Benefits of Adaptation" foresees the possibility to use dredged material for beach nourishment to counteract coastal erosion [16]. In a high sea-level rise scenario an erosion of about 8,600 m^2 of coastline is expected, in the period ranging from 2010 to 2100 (3,800 m^2 in a medium sea-level rise scenario and 2,100 m^2 in a low sea-level rise scenario). According to the MedPartnership report, in a high sea-level rise scenario, in 2100, up to 700 m^3 of sand will be necessary annually for beach nourishment; with an annual cost of 2,000 $ [16].

In the Adriatic Sea, sustainable management of dredged sediments will be one of the key elements of future environmental policies [10].

FIGURE 34 **CURRENT AND PORTENTIAL FUTURE DREDGING SITES IN THE ADRIATIC SEA**

IMPACTS ON GES

There is considerable environmental concern regarding the disturbance of deep sea ecosystems and benthic habitats by dredging and extraction of mineral resources. The functioning of deep sea ecosystems is critical to global biogeochemical cycles. Operations on the seafloor may destroy unique habitats and impact fish stocks and primary production. The main potential impacts would be the following:

- Large scale loss of habitat due to extraction techniques
- Potential use of toxic substances in the extraction process
- Impacts of sediment plumes on pelagic organisms
- Sealing and creation of anoxic condition for benthic organisms.

The environmental impact and the risk involved in deep sea exploration are significant and largely unknown, as data are scarce. More research should be conducted to assess potential impacts of these activities.

TABLE 16 **POTENTIAL IMPACTS OF THE MINING AND DREDGING ON GES**

MSFD DESCRIPTOR	IMPACTS ON GES	FUTURE TRENDS
D1 **Biodiversity**	Large scale loss of benthic habitats due to extraction activities, impacts on pelagic organisms	↗
D2 **Non-indigenous species**		
D3 **Commercial species**	Disturbance through noise, pollution and bottom sediments disruption	↗
D4 **Foodwebs**	Potential release of contaminants in the water column	↗
D5 **Eutrophication**		
D6 **Sea-floor integrity**	Disturbance to benthic habitats	↗
D7 **Hydrographical conditions**		
D8 **Contaminant**	Potential release of contaminants in the water column	↗
D9 **Contaminant in seafood**		
D10 **Marine litter**		
D11 **Energy**	Marine noise caused by extraction activities	↗

INTERACTION WITH OTHER SECTORS

Mining activities are in the exploratory stage in the Mediterranean, however future development may lead to potential conflicts with activities such as oil and gas exploration and extraction, wind farms. But it may also affect other sectors by impacting living organisms, for instance commercial fisheries populations could be impacted by noise, bottom sediment disruption or pollution.

Similarly, dredging and sand extraction activities may enter into conflict with the tourism sector if the activities are carried out near or along the coast and with the oil and gas sector.

REFERENCES

[1] European Commission. (2013). Methodology for identifying and estimating maritime activities using NACE and other data. From webgate.ec.europa.eu: https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Methodology%20CF%20MEA.pdf

[2] ISPRA (2014). Aspetti ambientali dell'utilizzo delle sabbie sommerse per la gestione e la difesa della costa: il protocollo di monitoraggio ambientale.

[3] Slovenian National Building and Civil Engineering Institute. (2012). Dredged mud from the port of koper – civil engineering applications.

[4] EUROSION. (2003). Slovenian coast (SLOVENIA). http://copranet.projects.eucc-d.de/files/000152_EUROSION_Slovenian_coast.pdf

[5] European Commission, (in press). Scoping study on a conceptual approach for addressing green growth potential for the marine economies. Final report. Report on tasks 6+7 of the study on Potential for stimulating growth in the water and marine sector. Report by Ecorys, ACTeon, REC for DG Environment. ENV.F1./FRA/2010/044. Rotterdam/Brussels.

[6] MIDAS project. Managing impacts of deep sea resource exploitation. [online] Available at: http://www.eu-midas.net/

[7] MetisGmbH. (2014). Strategic Environmental Assessment Adriatic-Ionian Operational Programme 2014-2020. www.southeast-europe.net: http://www.southeast-europe.net/download.cmt?id=4360

[8] Life. (2013). Co-ordinated Approach for Sediment Treatment and Beneficial reuse in Small harbours neTworks (COAST_BEST). www.coast-best.eu: http://www.coast-best.eu/site/wp-content/uploads/annex-2.01-General-part-of-the-technical-report.pdf

[9] SHAPE. (2014). Caratterizzazione dei depositi di sedimenti. sistemavenezia.regione.veneto.it: http://sistemavenezia.regione.veneto.it/sites/default/files/documents/08_Shape/SHP_WP5_Action%205.4.1_Progetto%20Pilota_Caratterizzazione%20dei%20depositi%20di%20sedimenti_RdV.pdf

[10] SedNet. (2011). Sustainable dredging of Mediterranean Ports: the future for sediment management Regulatory aspects of Sediment Management in the EU. Tratto il giorno June 18, 2015 da www.sednet.org: http://www.sednet.org/download/SpecialSession1-Sustainable-dredging-of-MediterraneanPorts.pdf

[11] European Commission. (2015). Strategies against chemical pollution of surface waters. ec.europa.eu: http://ec.europa.eu/environment/water/water-dangersub/index.htm

[12] SHAPE. (2012). Analysis of ICZM practice in Slovenia (Final). www.shape-ipaproject.eu: http://www.shape-ipaproject.eu/download/listbox/WP3%20action%203.1/Analysis%20of%20ICZM%20practice%20in%20Slovenia.pdf

[13] Life Sedi Port Sil. (2013). Bibliographic review of possible use of dredged sediments and to environmental setting of the territory (coastal zone and mines). www.lifesediportsil.eu: http://www.lifesediportsil.eu/webservices/send_file.php?file=/files/00168/a5_sub5a_bibliographic_review__coastal_zone_and_mines__v03.pdf.

[14] Council of Europe. (2000). Convention on the conservation of european wildlife and natural habitats. nature conservation in Slovenia. wcd.coe.int: https://wcd.coe.int/com.instranet.InstraServlet?command=com.instranet.et&InstranetImage=1336144&SecMode=1&DocId=1460052&Usage=2

[15] Servizio per le infrastrutture e la regolazione dei servizi di pubblica utilità. (2014). Iniziativa di studio sulla portualità italiana. www.cipecomitato.it: http://www.cipecomitato.it/it/documenti/Rapporto_portualitx_finale.pdf

[16] MedPartnership (2015). Assessment of Coasts of Sea Level Rise in Republic of Croatia and Costs and Benefits Adaptation. http://meetings.pap-thecoastcentre.org/docs/diva.pdf

CHAPTER VII

TOURISM

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The Adriatic Sea is among the top touristic destinations in the Mediterranean Sea. Tourism is mainly concentrated in Italy and Croatia, however it is expanding also in other countries in the region. The sector contributes to an important portion of the GDP of Adriatic countries. Development of coastal tourism, cruise tourism and recreational boating in the Mediterranean Sea will depend on several factors, but it is generally expected to increase as it has in recent years. Potential impacts of tourism on the ecosystem are many and they will tend to increase if sustainable tourism management practices are not implemented. Conflicts may emerge with different sectors, but particular attention should be given to the potential impacts of the oil and gas sector on tourism in the Adriatic, especially if the foreseen exploration and extraction activities are going to take place.

BACKGROUND AND CURRENT SITUATION

Tourism covers a fundamentally important role in the economy of Adriatic countries, contributing greatly to the GDP of national economies [1]. Touristic activities in the region can be divided in three main categories: coastal tourism, cruise tourism and nautical tourism, which will be described in further detail in the following paragraphs.

COASTAL TOURISM

The Adriatic Sea is an important coastal tourism destination in the Mediterranean. Italy and Croatia host most of the tourists targeting this region, representing respectively 71% (> 40 million arrivals with over 90 million overnight stays) and 18% (>10 million arrivals with over 50 million overnight stays) of the total tourist arrivals [2]. Slovenian statistics show a total of 2.8 million tourists arrivals (2008) with 8.4 million overnight stays in the same year [3]. The contribution of the tourism sector to the GDP of national economies in the Adriatic region is high, with estimates ranging from over 21% for Croatia [4], 12.8 in Slovenia and 10.5% in Italy. Tourism in the Adriatic is strongly seasonal and generally peaks in July and August [2].

FIGURE 35 **TOURISM CAPACITY (NUMBER OF BEDS) ALONG THE ADRIATIC COASTLINE**

CRUISE TOURISM

Cruising is the form of tourism that has shown the highest growth curve in the past decade. Despite the Costa Concordia accident, which occurred in the early 2012 season, the sector continues to grow on a global scale reaching 21.3 million passengers in 2013 [5]. The Adriatic Sea also registered an increase of importance in the Mediterranean geography of cruising. This is particularly evident in relation to the share of the entire Mediterranean cruise sector as Adriatic cruise passenger movements in 2013 represented the 22.3% of overall traffic in the Med, recording over 5.2 M cruise passengers (including transit and embarking/ disembarking operations) in the 20 main cruise ports. Venice is the main cruise port with over 1.8 M visitors per year followed by Dubrovnik (1 M) and Corfu (744,000) [5].

FIGURE 36 **TOURISM - MAIN CRUISES, PORTS AND PASSENGER TRANSPORT IN THE ADRIATIC SEA**

NAUTICAL TOURISM

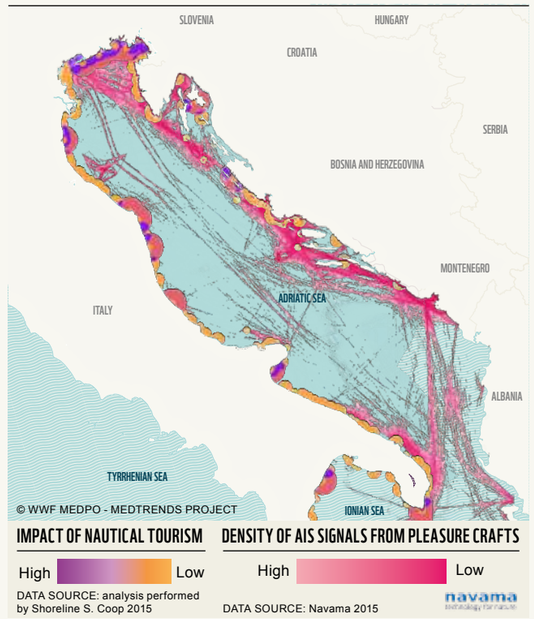
The Adriatic is one of the top nautical tourism destinations in the Mediterranean and therefore pressures from this sub-sector are significant. Data from 2013 show that there are 350 structures dedicated to this form of tourism that could host up to 80,000 boats. As shown in Table 22 below, in Italy there are 253 Marinas, while there are 81 in Croatia with over 16,000 moorings at sea. There are over 4,700 charter boats registered in Croatia and number of arrivals of charter guests has been steadily increasing [5]. 'Marine' tourists are mostly attracted to areas under different categories of protection as they are characterised by a high natural value and their biodiversity. Particularly attractive are the Marine Protected Areas.

TABLE 17 **NUMBER OF MARINAS AND MEAN DISTANCE BETWEEN NAVIGATIONAL PORTS IN THE MEDITERRANEAN SEA**

SOURCE: PLAN BLEU,2011 [6]

COUNTRY	NUMBER OF MARINAS	DISTANCE (KM)
Italy	253	29
Croatia	81	72
Albania	11	38
Slovenia	3	16
Montenegro	2	147

FIGURE 37 **NAUTICAL TOURISM IMPACT RANGE (BASED ON THE NUMBE OF VESSELS IN EACH MARINA) AND PLEASURE CRAFT VESSELS AIS TRACKS IN THE ADRIATIC SEA**

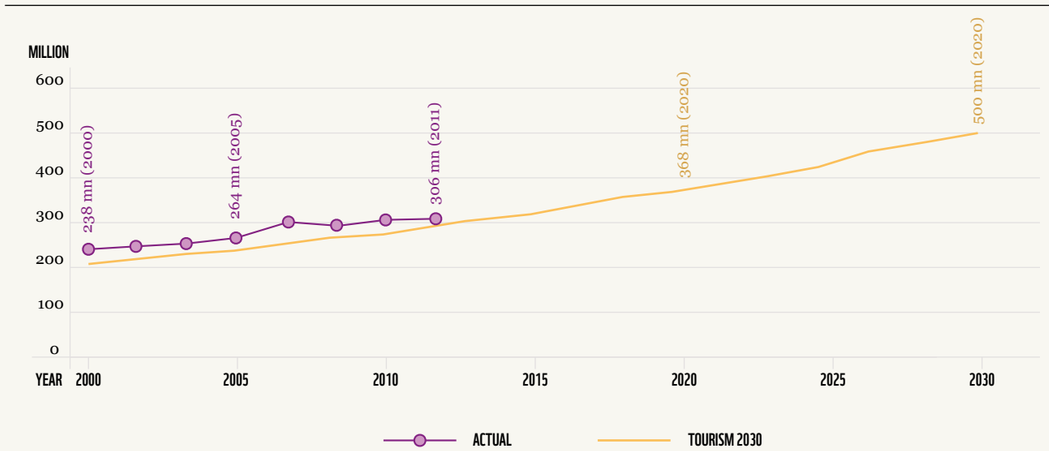


FUTURE TRENDS

Following the Mediterranean growth trends (see Figure 38, below), in the next years the tourism sector of the Adriatic is expected to increase in most countries, although the highest growth is expected to occur mainly in the eastern part, especially in Croatia and Montenegro.

FIGURE 38 **EXPECTED TRENDS OF INTERNATIONAL TOURIST ARRIVALS IN THE MEDITERRANEAN REGION**

SOURCE: PIERRET, 2012 [1]



CLAUDIA AMICO / WWF

COASTAL TOURISM

Coastal tourism has suffered a contraction during the economic crisis, nonetheless it has continued grow in the past years [8] and seems to have already recovered [9]. From 1995 to 2010 international tourism around the Mediterranean grew on an average annual growth rate of 3.7% [2].

Tourism in the Adriatic is also expected to grow considerably in the next years. Recent forecasts from the World Travel and Tourism Council (WTTC) estimate that by 2024 the direct contribution of Tourism to GDP in Italy is expected to grow by 2,3 %, contributing to 4,7% of GDP, while in Croatia it should grow by and 5,4%, contributing to 17% of GDP [2]. According to different sources however, the above is a very conservative estimate, considering that data from the Croatian Ministry of Tourism show that during the first 10 months of 2014, tourism already exceeded 20% of Croatian GDP [10]. Slovenian coastal tourism is also growing rapidly as estimates show that tourist density may increase by 52% until 2025 [2]. According to the analysis performed in this project, based on available data on the number of nights spent in touristic establishment by NUTS[23] 2, the Italian coast will grow considerably in the coming years, particularly in the central and southern Adriatic regions, such as Puglia, Marche and Abruzzo (Figure 56).

[23] Nomenclature of Territorial Units for Statistics

FIGURE 39 **TOURISM CAPACITY (NUMBER OF BEDS) ALONG THE ADRIATIC COASTLINE - 2013**

FIGURE 40 **FUTURE TRENDS IN COASTAL TOURISM IN THE ADRIATIC SEA - 2020**

FIGURE 41 **FUTURE TRENDS IN COASTAL TOURISM IN THE ADRIATIC SEA - 2030**

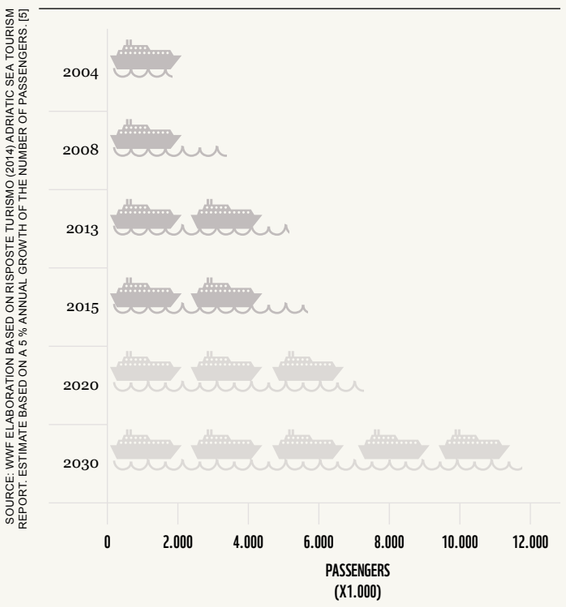
SOURCE: EC STATISTICS, 2014 [7] APPLYING ORDINARY LEAST SQUARES METHOD

CRUISE TOURISM

Cruise tourism has been growing for the past 10 years at very high rates. Since 2011 however the number of cruise passenger movement has been increasing at a lower rate, with an increase of 1,1 % between 2011 and 2012 and 4,9% between 2012 and 2013. According experts consulted in the framework of the present study, we can expect cruise tourism to keep growing, but at a lower rate than the 2000-2010 period. As specified in the Adriatic Sea Tourism Report [5] some cruise ships have been redeployed in other parts of the world and there is a general tendency to deploy larger ships, therefore decreasing the number of calls in each port, while maintaining or increasing the number of passengers.

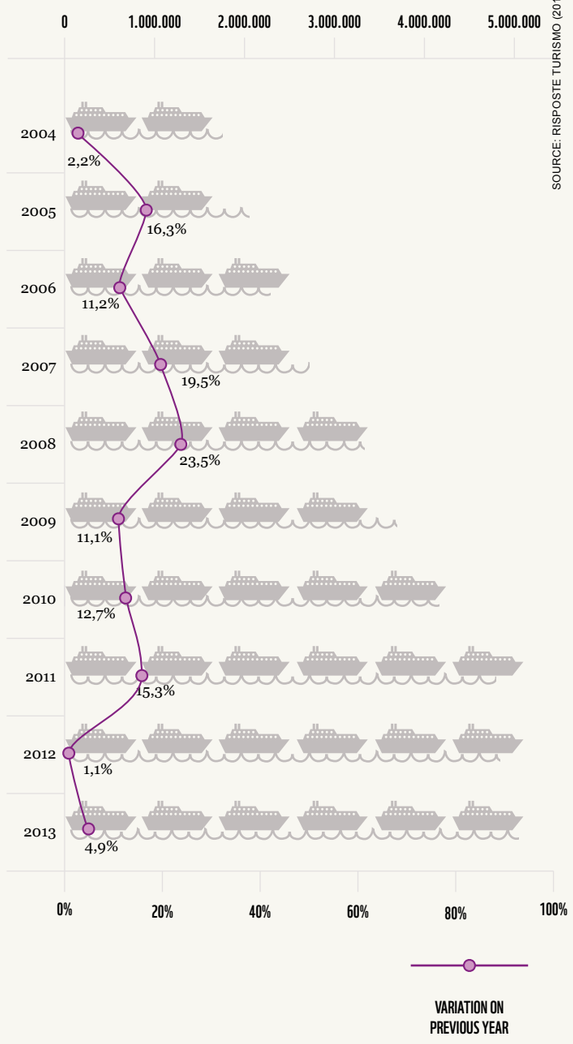
Based on available cruise passenger traffic data, the cruise tourism sector is expected to increase considerably up to 2030, as illustrate in Figure 42 below.

FIGURE 42 **TRENDS IN CRUISE PASSENGER MOVEMENTS**



SOURCE: WWF ELABORATION BASED ON RISPOSTE TURISMO (2014) ADRIATIC SEA TOURISM REPORT. ESTIMATE BASED ON A 5 % ANNUAL GROWTH OF THE NUMBER OF PASSENGERS. [5]

FIGURE 43 **TREND IN PASSENGER MOVEMENTS AND CALLS IN THE LAST DECADE FOR THE 10 MAIN ADRIATIC CRUISE PORTS**



SOURCE: RISPOSTE TURISMO (2014) [5]

NAUTICAL TOURISM

Countries in the Adriatic are generally planning to increase the number of nautical ports and coastal moorings. A specific example is represented by Croatia which planned to increase the number of nautical ports and coastal moorings from 21,020 in 2007 to over 33,000 in 2016 [11]. Further increase in nautical ports at the same rates are however unlikely, considering the lack of suitable areas for port development. Nautical tourism is however definitively expected to increase, therefore more pressures can be expected.

It is evident that the tourism sector in the Adriatic will grow considerably in the next few years and sustainable management practices will therefore become very important to protect the environment. Inevitably, conflicts with other sectors are expected to increase as well.

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IMPACTS ON GES

If unsustainably managed, the tourism sector can cause severe environmental impacts. All impacts associated with tourism accommodation and services, can have a strong effect on various descriptors, such as biodiversity and commercial species that are caught in larger numbers to supply the restaurants, or the increase in contaminants (D8, D9) and eutrophication (D5) from the sewage and polluted waters discharged in the environment from tourist facilities, especially when wastewater treatment plants lack the capacity to treat all wastewater. Noise pollution is another of the main impacts of tourism, especially where water sports and navigation with powerful engines occur. A further important impact is littering (D 10), as tourists, particularly when they are in large numbers, contribute to the phenomenon to a great extent. Coastal protection through beach nourishment instead of using protection barriers (due to unattractive sight) may have negative environmental effects as well. Although less significant, marine tourism activities may also affect the environment. For instance, diving can damage marine benthic communities. Potential environmental impacts of nautical tourism include issues of waste management (waste collection and separation), wastewater management (no minimum standards, black and grey tanks), ballast water (e.g. from cruisers), pollution from anti-fouling paints (bottom paints), and especially anchoring. For instance, anchoring is very loosely regulated in Croatia and sailing boats are allowed to anchor in most of the bays, which causes detrimental impacts to sea-bottom communities, especially Posidonia meadows and coralligenous communities. Negative impacts from anchoring have already been recorded in Croatia, especially in MPAs, since the regulation for setting-up of the mooring system in MPAs is complicated and not clear. It is worth mentioning that cruises in the Mediterranean are also a source of considerable ecological pressure including water and coastal pollution and seabed destruction. Considering the foreseen large scale increase in tourism in the Adriatic, it is expected that most of those impacts will increase, if sustainable management practices are not put in place.

TABLE 18 **POTENTIAL IMPACTS OF THE TOURISM SECTOR ON GES**

MSFD DESCRIPTOR	IMPACTS ON GES	FUTURE 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 introduction of non-indigenous species through ballast waters and anchoring	↗
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**	Eutrophication can be triggered by 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 **Contaminant**	Release of oil and contaminants	↗
D9 **Contaminant in seafood**	Pollution from tourism and recreational boating can impact seafood	↗
D10 **Marine litter**	Marine litter from beach tourism	↗
D11 **Energy**	Recreational boating increases underwater noise potentially affecting marine species	↗

INTERACTION WITH OTHER SECTORS

The foreseen growth if the tourism sector in the Adriatic Sea will probably bring new challenges and conflicts with other sectors in the future. Conflicts are particularly likely to arise with the oil and gas sector, as the foreseen developments in Croatian and Italian waters may create visual impacts and/or reduce access to large marine areas that are currently available for touristic activities, including nautical tourism. Cruise tourism could also compete for space with shipping and passenger transport while sailing and other touristic activities at sea may compete with the fisheries sector and aquaculture developments along the coast. Aquaculture could also compete with touristic locations for available space along the coast, particularly with sun and sea and nautical tourism destinations.

Instead, tourism activities may be highly compatible with sustainable fishing practices, and with the development of new MPAs although suitable management of those areas needs to be in place to avoid overcrowding of tourists or other types of damage. Many tourists join packed excursion boats during the peak tourist season (July-August) to visit MPAs. Not only does this has an impact on marine biodiversity, but it also affects the visitor's satisfaction.

REFERENCES

[1] Pierret F., 2012. The Mediterranean – a tourism stronghold: Facts and figures, UNWTO.

[2] WTTC, 2014. http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/

[3] Statistical office of the Republic of Slovenia (2013).Tourist arrivals and overnight stays by countries. December 2013.

[4] Articolo "Turismo-record in Croazia, vale quasi il 21% del PIL", Il Piccolo "http://ilpiccolo.gelocal.it/trieste/cronaca/2015/01/05/news/turismo-record-in-croazia-vale-quasi-il-21-del-pil-1.10612126

[5] Risposte Turismo, 2014. Adriatic Sea Tourism Report.

[6] Plan Bleu, 2011. Cruise and Recreational Boating in the Mediterranean. http://planbleu.org/sites/default/files/publications/2-1-en_croisiereplaisance.pdf

[7] http://ec.europa.eu/eurostat/statistics-explained/index.php/Tourism_statistics

[8] EUNETMAR, 2014. Study to support the development of sea basin cooperation in the Mediterranean, Adriatic and Ionian, and the Black Sea. MARE/2012/07 – Ref No 2

[9] Plan Bleu, 2014. Economic and social analysis of the uses of the coastal and marine waters in the Mediterranean, characterization and impacts of the Fisheries, Aquaculture, Tourism and recreational activities, Maritime transport and Offshore extraction of oil and gas sectors, Technical Report, Plan Bleu, Valbonne.

[10] Il Piccolo, 2015. Turismo da record in Croazia, vale quasi il 21% del PIL. http://ilpiccolo.gelocal.it/trieste/cronaca/2015/01/05/news/turismo-record-in-croazia-vale-quasi-il-21-del-pil-1.10612126

[11] The Republic of Croatia – 2009. Nautical Tourism development strategy 2009-2019. http://www.mppi.hr/UserDocsImages/Strategija%20razvoja%20nautickog%20turizma%20ENGL%201.pdf

CHAPTER V

MILITARY ACTIVITIES

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Military activities in the Adriatic Sea are carried out mainly by Navies and Coast Guards . The navies of the three countries the report focuses on (i.e. Croatia, Italy and Slovenia) differ for strength and number of assets. However, their core activities are similar and mainly include defence and surveillance. Moreover, navies are involved in secondary activities such as: Search and Rescue (SAR), environmental protection, de-mining operations and exercises both within NATO and among the members of the ADRION Initiative [1].

Environmental impacts of military activities are mainly linked to the use of sonars, which cause cetaceans' disorientation and direct damage and disturbance to aquatic animals and birds during shooting exercises. The Adriatic Sea is still polluted by the ordnance of World War II and of the Kosovo conflict (1999) that have not yet been removed from the seabed.

Regarding future developments of the military sector in the 3 countries, Croatia envisages a general increase in its naval strength in the Adriatic, whereas Italy will see a general decrease in Navy assets (in all Italian seas) and Slovenia will concentrate mainly on developing land forces, therefore overall the pressure from military activities is expected to decrease.

BACKGROUND AND CURRENT SITUATION

Military activities in the Adriatic Sea are mainly carried out by Navies and Coast Guards.

The Italian Navy counts 30,923 sailors employed and 60 vessels [2]. The Croatian Navy has 25 vessels[25] [3] and includes the Coastal Surveillance Battalion (bOSMIO) that gathers data for surveillance and security at sea [4]. The Slovenia Navy has only 5 vessels and 60 military employees [5].

The naval bases in the Adriatic are situated in the following locations:

CROATIA

bases are located in Split and Pula [6];

SLOVENIA

the 430th Naval Division is located in Ankaran [7];

ITALY

the main bases are located in the Tyrrhenian Sea and Ionian Seas. However, the port of Venice hosts two hydro-oceanographic ships of the Italian Navy: the Aretusa [8] and the Galatea Ship [9].

FIGURE 44 MILITARY ACTIVITIES IN THE ADRIATC SEA

The Adriatic waters shared by Croatia, Italy and Slovenia are controlled by the three countries, each one for its area of responsibility.

The Navies carry out secondary activities, such as: SAR, de-mining and environmental protection activities and international exercises, mainly among NATO[26] [10] (including the Republic of Croatia – Ministry of Defence 2014, Croatian Armed Forces [11], Republic of Slovenia [12], Marina Militare [2]) and in collaboration with the navies of the other Adriatic countries.

TABLE 19 MAIN NAVAL ACTIVITIES IN THE ADRIATIC (2012- 2015)

	NAME OF THE ACTIVITY	YEAR	COUNTRY INVOLVED
RESEARCH	Whale watching	June 2015	Bari – Porto Corsini (IT), Palinuro Ship
	Hydro-graphic activities	2013	Port of Venice (IT), Aretusa Ship
DEMINING	Removal of a German IIWW bomb	January 2014	Numana (IT)
	Identification of unexploded bombs	October 2014	Dubrovnik (HR), Croatian navy and USA divers (with support of bomb-sniffing dolphins)
RESCUE AT SEA	Rescue of Norman Atlantic passengers	December 2014	30 miles from Otranto (IT), San Giorgio and Durand de La Penne ships
CONTROL OF MIGRATION AND BOARDERS	Operation Aeneas to monitor migrants entering the EU	2013-2014	European operation, focused on the Ionian sea but also comprising a little part of the Adriatic (Apulia region)[27] [13]
INTERNATIONAL EXERCISES	NATO Exercise	February 2015	Split (HR) – SNGM2 Group[27] [14] (8 ships from: USA, Italy, Spain, Canada, France, Turkey, Germany)
	Passex NATO	April 2015	Split (HR), Croatian Navy and USA Ship (USS Mitscher, 25 crew members)
	ADRION Livex	June 2014	Kastela (HR) – 10 vessels: 5 Croatian and one each from Albania, Greece, Italy, Montenegro and Slovenia

SOURCE: MARINA MILITARE [15]; DIVERS INSTITUTE OF TECHNOLOGY [16]; NATO [17]; MINISTRY OF DEFENCE OF CROATIA [18]; FRONTEX [19]

The ADRION Livex exercises occur annually, in a different port area each year. These exercises are part of the Adriatic-Ionian (ADRION) Initiative and aim at strengthening the cooperation between the navies and enhance maritime security [20]. The Initiative started in 2000 in Ancona, following the Summit on Development and Security on the Adriatic and Ionian Seas, it focuses on different sectors (e.g. transport, tourism, safety etc.) [21]

Particularly relevant from the Maritime Spatial Planning perspective are the military training areas, and the areas where unexploded weapons are present. As shown in Figure 36, most of these areas are located in the southern Adriatic, although some training areas can be found in the central and northern sections.

[24] The Slovenian Navy (which is part of the Armed Forces and it is not a separate body) coordinates its surveillance activity at sea with the Police and the Maritime Administration.
[25] The number of vessels of the Croatian Navy was derived from the list of ships of the Navy on the official website of the Croatian Armed Forces, therefor it could be subject to variations.
[26] Croatia, Italy and Slovenia are all NATO members.
[27] No official data or statistics were found on the number of immigrants arriving in Adriatic ports, however the judgment of the European Court of Justice declared unlawful the2008-2009 rejection of migrants from the Adriatic ports, thus some arrivals occur also in this area usually after having entered Europe through Greece.
[28] The SMGT is a NATO force made up of vessels of member States the NATO has at its disposal for exercise or operational purposes.

FUTURE TRENDS

Future trends have been obtained from the Development plans of the Croatian, Italian and Slovenian Navies and from the European guidelines in the maritime security sector[29].

According to the Croatian Armed Forces Development Plan for the years 2015-2024, by 2017 the Croatian Navy will employ 1,200 military plus 100 civilians [22]. Priority will be given to the equipping and further development of the Coast Guard and to the integration of civil and military sectors in the collection and exchange of information at sea. The development of new bases (besides the two existing ones) in the South Adriatic will also be considered. From 2017 forward the Development Plan forecasts an increase in the defence and control abilities of the Croatian Navy in the Adriatic basin. Between the years 2015-2020 Croatia will: increase its counter-mine assets acquiring two new ships, provide Coast Guard with additional five boats, modernise and equip two missile boats and one ship for environmental protection. By 2024 the Croatian Navy plans to acquire 5 used patrol boats and begin the acquisition of new anti-missile ships [22] [23].

According to the Italian Navy documents the Italian fleet will see, by the 2025, the disposal of 51 ships (out of 60) [24] [25] and the acquisition of 10 frigates, as part of a joint programme with France, 2 new submarines in cooperation with German, 1 amphibious and 6 patrols ships [25]. The majority of new ships will be devoted to a dual-use, being thus also feasible for non-military purposes [25] [26].

The Slovenian Armed Forces Development Programme (valid until 2025) states that the main objective of the Republic is to increase its land forces; as for the naval components the focus will be on increasing their coordination and integration with the other military units operating in the sea sector [27].

The table below summarizes the developments of the Croatian, Italian and Slovenian fleets.

TABLE 20 **ADRIATIC FLEETS TOWARDS 2025**

	ACQUISITIONS	DISPOSAL
CROATIA (2015-2024)	2 counter-mine ships, 5 new patrol ships (Coast Guard), 5 used patrol ships	n.a.
ITALY (2015-2025)	2 submarines, 6 patrol ships, 1 amphibious ships and 10 frigates	51 vessels (47 ships and 4 submarines)
SLOVENIA (up to 2025)	n.a.	n.a.

SOURCE: (THE REPUBLIC OF CROATIA – MINISTRY OF DEFENCE 2014) [22]; (PROGRAMMA PLURIENNALE DI A/R N. SMD 01/2014 ATTO 116, 2014) [25]

The EU strategic framework established in 2014 by the Council of the European Union in the field of Maritime Security, called for greater cooperation between civil and military (i.e. the Navy) stakeholders [28]. In this sense, the Integrated System for Maritime Surveillance within EU and EEA[30] [29] members (CISE – Common Information Sharing Environment) is currently under development with the aim of simplifying the exchange of data and information between stakeholders (including defence organisms) [30]. Moreover, the Adriatic Ionian Initiative promotes cooperation between all Adriatic countries, fostering civil-military cooperation. In Italy, the Navy and the Regions of Veneto and Marche signed an agreement in the fields of maritime culture, innovation and safety (2015) [31].

The Italian Navy also contributes to the implementation of the EU Marine Strategy through activities of environmental monitoring.

[29] The Italian Navy development was only available at an aggregate level.
[30] European Economic Area (EEA) composed by EU Members States and Iceland, Lichtenstein and Norway participating in one single market.

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IMPACTS ON GES

Environmental impacts of military activities may be caused by the use of sonars that may interfere with orientation abilities of cetaceans (e.g. 7 sperm whales stranded on the shore of Punta Penna (Chieti) in 2014, thought to be due to the effects of military sonars) [32]. Moreover, underwater explosion cause substantial habitat damages, causing for instance the reduction of *Posidonia oceanica* meadows military training areas along the Croatian coast [33][31].

Furthermore, according to a 2012 study carried out by the Italian association "Legambiente", the Adriatic is polluted by unexploded bombs (around 30,000, 10,000 only in the port area of Molfetta and Torre Gavetone) discharged during WWII and the Kosovo War (1999) [34].

Other impacts from military training exercises may include the creation of litter and direct damage to the fish population caused by exploding weapons and pollution from military bases, particularly when the number of military personnel increases during periods of instability.

[31] Bakran-Petricoli is affiliated to the University of Zagreb

TABLE 21 **POTENTIAL IMPACTS OF MILITARY ACTIVITIES ON GES**

MSFD DESCRIPTOR	IMPACTS ON GES	FUTURE TRENDS
D1 **Biodiversity**	Direct impact to cetaceans through the use of sonar and to other species through the use of explosives	↘
D2 **Non-indigenous species**	Potential introduction of non-indigenous species from ballast waters	↘
D3 **Commercial species**		
D4 **Foodwebs**		
D5 **Eutrophication**		
D6 **Sea-floor integrity**	Potential impact through shelling.	↘
D7 **Hydrographical conditions**		
D8 **Contaminant**		
D9 **Contaminant in seafood**		
D10 **Marine litter**	Unexploded ordinances, and litter from exploding targets	↘
D11 **Energy**	Sonar and noise affecting marine species	↘

INTERACTION WITH OTHER SECTORS

The military sector may enter into conflict with the transport sector as some of the military training areas are located inside or very closed to some of the main motorways of the sea in the Adriatic (i.e. the Otranto strait). Military activities may also enter into conflict with fishing, due to the potential damage to commercial species. Tourism is another sector that may be seriously impacted by military activities and military exercises in particular. Military activities are also incompatible with aquaculture development and with the oil and gas sector.

REFERENCES

[1] Farnesina, "Iniziativa Adriatico-Ionica (IAI)", http://www.esteri.it/mae/it/politica_estera/aree_geografiche/europa/ooii/iai.html, last accessed 22nd June 2015.
[2] Marina Militare, "Cosa Facciamo", http://www.marina.difesa.it/cosa-facciamo/Pagine/cosa-facciamo.aspx, last accessed 22nd June 2015
[3] Croatian Armed Forces, "Croatian Flotilla", 23rd December 2013, http://www.osrh.hr/, last accessed 13th June 2015; Croatian Armed Forces, "Coast Guard of the Republic of Croatia (OSt RH)", 22nd July 2014, http://www.osrh.hr/, last accessed 13th June 2015
[4] Croatian Armed Forces, "Coastal Surveillance Battalion" (bOSMIO)", http://www.osrh.hr/, last accessed 22nd June 2015
[5] Republic of Slovenia, Ministry of Defence, Slovenian Armed Forces, "Naval Equipment and Vessels", http://www.slovenskavojska.si/en/armament-and-equipment/naval-equipment-and-vessels/http://www.slovenskavojska.si/en/armament-and-equipment/naval-equipment-and-vessels/special-purpose-vessels-and-equipment/ - c2571, last accessed 18th June 2015; European Defence Information, "Slovenia", http://www.armedforces.co.uk/Europeandefence/edcountries/countryslovenia.htm#Slovenian%20Maritime%20Service, last accessed 9th June 2015
[6] Croatian Armed Forces, "Coast Guard of the Republic of Croatia (OSt RH)", 22nd July 2014, http://www.osrh.hr/, last accessed 13th June 2015; Croatian Armed Forced, "About Croatian Navy", http://www.osrh.hr/, last accessed 18th June 2015
[7] Ministry of Defense, Slovenian Armed Forces, "430th Naval Division", http://www.slovenskavojska.si/en/structure/430th-naval-division/, last accessed 18th June 2015
[8] Marina Militare, "Aretusa", http://www.marina.difesa.it/uominimezzi/navi/Pagine/Aretusa.aspx, last accessed 18th June 2015
[9] Marina Militare, "Galatea", http://www.marina.difesa.it/uominimezzi/navi/Pagine/Galatea.aspx, last accessed 18th June 2015.
[10] NATO, "NATO members Countries", http://www.nato.int/cps/en/natohq/nato_countries.htm, last accessed 18th June 2015
[11] Croatian Armed Forces, "Coast Guard of the Republic of Croatia (OSt RH)", 22nd July 2014, http://www.osrh.hr/, last accessed 13th June 2015;
[12] Republic of Slovenia, 430th Naval Division, http://www.slovenskavojska.si/en/structure/combat-support-forces/430th-naval-division/#c1135, last accessed 11th June 2015; Republic of Slovenia – Ministry of Defence – Slovenian Armed Forces, "Naval Equipment and Vessels. Multi-purpose patrol Triglav 11", http://www.slovenskavojska.si/en/armament-and-equipment/naval-equipment-and-vessels/all-purpose-patrol-boat-triglav-11/#c2566, last accessed 18th June 2015
[13] European Court of Human Rights, "Affaire Sharifi et autre c. Italie et Grèce", http://hudoc.echr.coe.int/sites/eng/pages/search.aspx#{%22display%22:[2],%22languageisocode%22:[%22FRA%22], %22itemid%22:[%22001-147287%22]}, 2014, last accessed 12th June 2015 and (Frontex 2012).
[14] Please visit the NATO official website for further information: http://www.mc.nato.int/org/smg/Pages/default.aspx, last accessed 18th June 2015
[15] Marina Militare Web TV, "I palombari della marina intervengono in Adriatico su mina tedesca della 2° guerra mondiale", http://webtv.marina.difesa.it/Detail/Dettaglio?ChannelId=28ecce8b-e4be-4781-b090-d49a9b3f58ce&VideoId=f3b8fea2-a011-4ecb-bf8d-4e1d91642b11, last accessed 9th June 2015; Marina Militare, "Aretusa", http://www.marina.difesa.it/uominimezzi/navi/Pagine/Aretusa.aspx,
[16] Divers Institute of Technology, "Bomb Sniffing Dolphins: a Navy Diver's Best Friend", 14th October 2013, https://www.diversinstitute.edu/bomb-sniffing-dolphins-navy-divers-best-friend/, last accessed 17th June 2015
[17] NATO, "SNMG2 visits Split", 6th February 2015, http://www.mc.nato.int/PressReleases/Pages/SNMG2-Visits-Split.aspx, last accessed 17th June 2015
[18] Ministry of Defence of the Republic of Croatia, "Navy Ship in Adrion Livex 12 international exercise", 4th June 2012, http://www.morh.hr/en/news/press-releases/7319-navy-ship-in-qadrion-livex-12q-international-exercise.html, last accessed 18th June 2015; Ministry of Defence of the Republic of Croatia, "ADRION 14 – Joint Operation in the Adriatic Sea" http://www.morh.hr/en/news/press-releases/9900-adrion-14-joint-operation-in-the-adriatic-sea.html, last accessed 18th June 2015
[19] Frontex, "EPN Aeneas", http://frontex.europa.eu/operations/archive-of-operations/6g8Yly, last accessed 17th June 2015
[20] Ministry of Defence of the Republic of Croatia, "ADRION 14 – Joint Operation in the Adriatic Sea" http://www.morh.hr/en/news/press-releases/9900-adrion-14-joint-operation-in-the-adriatic-sea.html, last accessed 18th June 2015; Ministry of Defence of the Republic of Croatia, "Croatian Navy on "ADRION LIVEX 11" international military exercise", 6th June 2011, http://www.morh.hr/en/news/press-releases/6820-croatian-navy-on-qadrion-livex-11q-international-military-exercise.html, last accessed 18th June 2015
[21] Farnesina, "Iniziativa Adriatico-Ionica (IAI)", http://www.esteri.it/mae/it/politica_estera/aree_geografiche/europa/ooii/iai.html, last accessed 19th June 2015; Adriatic and Ionian initiative, "Who we are", www.aii-ps.org/index.php/about-the-aii, last accessed 19th June 2015
[22] The Republic of Croatia - Ministry of Defence. «The Croatian Armed Forces Long Term Development Plan 2015-2024.» www.morh.hr. 2014. http://www.morh.hr/images/stories/morh_2015/pdf/dpr/ltdp_en_2015.pdf
[23] Croatian Armed Forces, "Croatian Flotilla", 23rd December 2013, http://www.osrh.hr/, last accessed 13th June 2015
[24] Marina Militare. «Linee Programmatiche.» 2013. http://www.marina.difesa.it/conosciamoci/notizie/Documents/2013/06/Linee_programmatiche_Marina_Militare.pdf
[25] Programma Pluriennale di A/R n° SMD 01/2014 Atto n° 116. « Programma Pluriennale di A/R n° SMD 01/2014, relativo al programma navale per la tutela della capacità marittima della Difesa. Atto del Governo n° 116. ». documenti.camera.it. 2014. Documenti.camera.it/Leg17/Dossier/Pdf/DI0200.pdf
[26] Source: Ministero della Difesa, Marina Militare, "Programma navale 2014", http://www.marina.difesa.it/uominimezzi/nuoviprogetti/Pagine/programma-navale-2014.aspx, last accessed 9 June 2015; Ministero della Difesa, Marina Militare, "U212A II Serie", http://www.marina.difesa.it/uominimezzi/nuoviprogetti/Pagine/U212A_II_serie.aspx, last accessed 9th June 2015; Marina Militare, "Fregate Europee Multimissione", http://www.marina.difesa.it/uominimezzi/nuoviprogetti/Pagine/LeFregate.aspx, last accessed 15th June 2015; Marina Militare, "Classe Todaro", http://www.marina.difesa.it/uominimezzi/sommergibili/Pagine/ClasseTodaro.aspx, last accessed 16th June 2015
[27] Ministry of Defence, Slovenian Armed Forces, "430th Naval Division", http://www.slovenskavojska.si/en/structure/430th-naval-division/, last accessed 18th June 2015
[28] Council of the European Union 11205/14. «Note from the General Secretariat of the Council to the delegations on the European Union Maritime Security Strategy.» register.consilium.europa.eu. 2014. http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2011205%202014%20INIT.
[29] See Gov.uk webpage "Countries in the EU and EEA" https://www.gov.uk/eu-eea, last accessed 18th June 2015
[30] Commissione Europea – Affari Marittimi, "Sorveglianza marittima integrata. Definizione e campo di applicazione", http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_it.htm, last accessed 18th June 2015
[31] Regione Marche, "Strategia Macroregione Adriatico Ionica: Regione Marche e Marina Militare firmano un Accordo di Collaborazione", 3rd February 2015, http://www.regione.marche.it/Home/Comunicazione/ComunicatiStampa/Comunicato.aspx?IdNews=24632, last accessed 18th June 2015; Bollettino Ufficiale della Regione del Veneto, "Deliberazione della Giunta Regionale n°273 del 10 marzo 2015", Bur n° 31 del 31 marzo 2015, http://bur.regione.veneto.it/BurvServices/pubblica/DettaglioDGR.aspx?id=294269, last accessed 18th June 2015
[32] Senato della Repubblica, "Legislatura 17 Atto di Sindacato Ispettivo n° 4-02694", http://www.senato.it/japp/bgt/showdoc/showText?tipodoc=Sindisp&leg=17&id=801636, last accessed 9th June 2015
[33] Bakran-Petricioli, T., D. Petricioli, S. Schultz, e K. Fedel. «Research of circular pattern damage to Posidonia meadows along the Eastern Adriatic Sea» www.researchgate.net. 2014. http://www.researchgate.net/profile/Tatjana_Bakran-Petricioli/publication/267865671_Research_of_circular_pattern_damage_to_Posidonia_meadows_along_the_eastern_Adriatic_Sea/links/545b99450cf249070a7a770d.pdf
[34] Legambiente, "Armi chimiche un'eredità ancora pericolosa: oltre 30 mila gli ordigni inabissati nel mare Adriatico. L'analisi dei siti inquinanti", 21st February 2015, http://www.legambiente.it/contenuti/comunicati/armi-chimiche-un-eredita-ancora-pericolosa-oltre-30mila-gli-ordigni-inabissati-, last accessed 9th June 2015

CHAPTER VI

CROSS-CUTTING ANALYSIS

While in the previous chapters each economic sector has been described and analysed individually, this crosscutting chapter investigates potential conflicts between and among economic sectors, and assesses the potential environmental impacts which may be created by the growing sectors. Finally it analyses the potential consequences of Blue Growth on environmental protection commitments in the Adriatic Sea.

The cross-cutting analysis has been divided into three main parts:

- Analysis of conflicts and compatibility between sectors
- Analysis of the interactions between the growing economic sectors and areas of conservation interest (with a specific focus on the 10% Aichi target of coastal and marine protection to be reached by 2020)
- Analysis of the potential impacts of economic sectors on GES, to be achieved by 2020.

ANALYSIS OF CONFLICTS AND COMPATIBILITY BETWEEN SECTORS

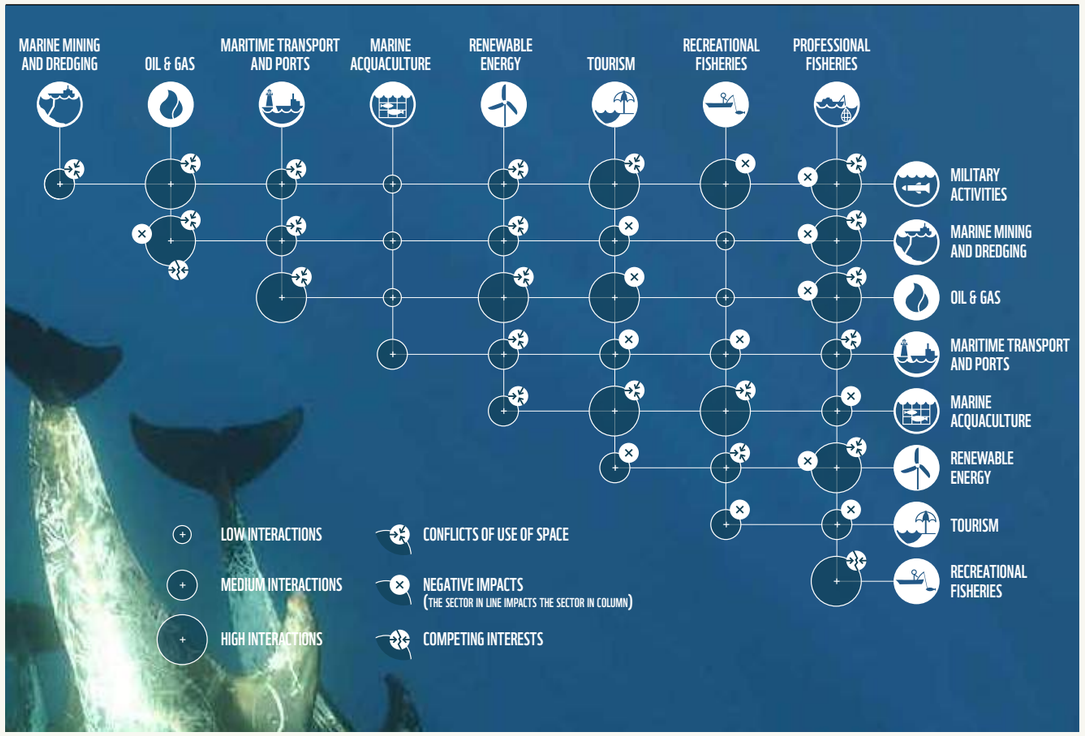
Spatial uses in the Adriatic are many and some of the marine economic sectors considered in the present report are often located in the same areas, thus a variety of conflicts may arise. In fact many of the sectors described in the report cannot coexist in the same areas, either because a specific area is occupied (e.g. an oil rig and a wind power station), or due to the negative impact one sector may have on another (e.g. coastal tourism and aquaculture).

Trends observed in the Adriatic show that some sectors are expected to grow considerably in the next few years, therefore it is also important to understand the potential conflicts that may arise from this expansion.

Based on the analysis carried out for each sector, a matrix was developed to assess the potential conflicts/compatibility among the different sectors. Apart from the direct interaction the type of conflicts were assessed, dividing them into 3 categories:

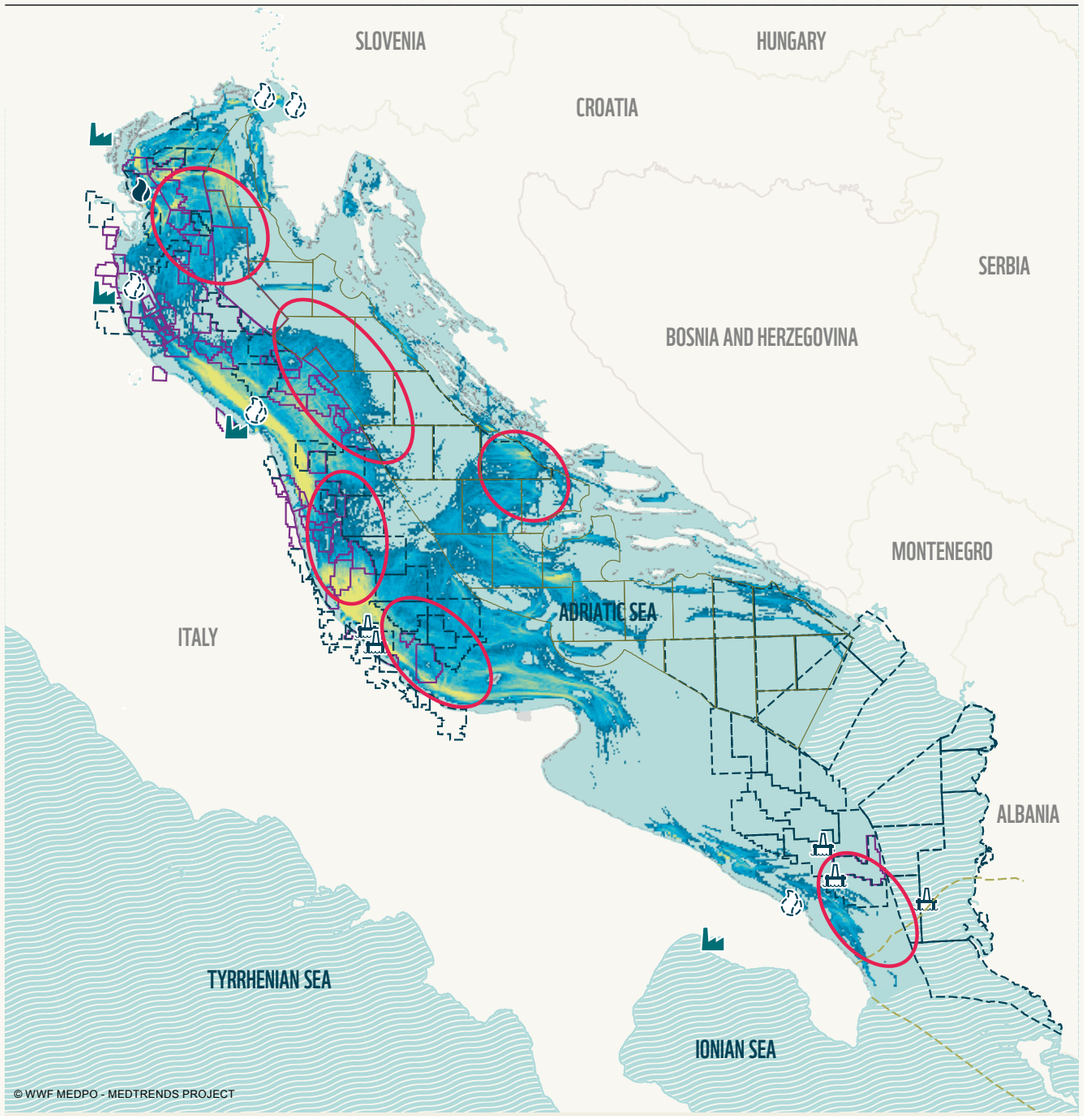
- **Conflicts regarding the use of space**: when two sectors occupy the same area.
- **Negative impacts** of some sectors against others that are highly dependent on ecosystem services (e.g. fisheries and tourism)
- **Competing interests** due to the exploitation of the same resources (e.g. recreational and professional fisheries)

FIGURE 45 **MATRIX OF COMPATIBILITY BETWEEN SECTORS AND TYPES OF CONFLICTS**



The compatibility assessment of the spatial data from maritime sectors in Figure 45 highlights that conflicts can be divided spatially between coastal activities and offshore activities. Coastal conflicts will increase as a result of the growth of sectors such as marine aquaculture, coastal tourism and recreational fisheries. Meanwhile, from the offshore perspective it is evident that the foreseen oil and gas developments may lead to potentially important conflicts with typically offshore sectors, such as maritime transport, commercial fisheries and dredging and mining. Some of the sectors may be compatible with appropriate planning.

FIGURE 46 **INTERACTIONS BETWEEN FISHERIES AND THE OIL AND GAS SECTOR IN THE ADRIATIC SEA**



Planned wells
Refinery

LNG TERMINAL

Active
Project

Area of potential conflict

OIL & GAS CONTRACTS AND BIDBLOCKS

Exploration
Production
BidBlocks (Croatia)

DATA SOURCE:
Oil and gas from DrillingInfo (2015)*

EXISTING AND PROPOSED O&G PIPELINES

Active, marine
Active, terrestrial
Project, marine

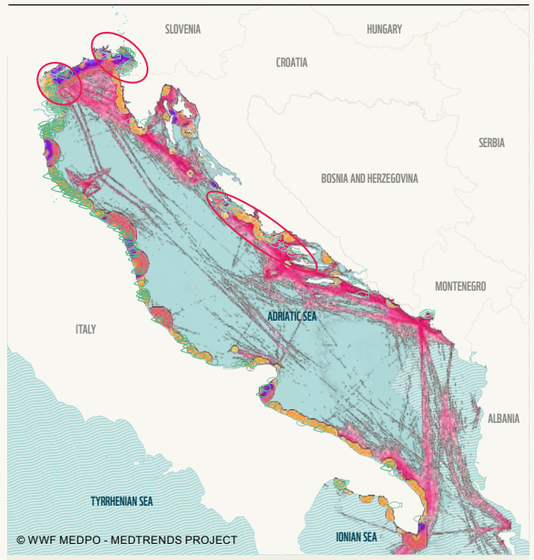
*Oil and gas from DrillingInfo (2015) part of the Africa Land Use Planning and Monitoring System /ALES)

DENSITY OF AIS SIGNALS FOR ALL FISHING VESSELS WITH SPEED 1-5KM (2014)

High 1,926
Low 1

DATA SOURCE:
Navama 2015

FIGURE 47 **INTERACTIONS BETWEEEN TOURISM AND AQUACULTURE IN THE ADRIATIC SEA**



DENSITY OF AIS SIGNALS (PLEASURE CRAFTS, 2014)

High 1,926
Low 1

DATA SOURCE:
Navama 2015

AQUACULTURE

Aquaculture farm

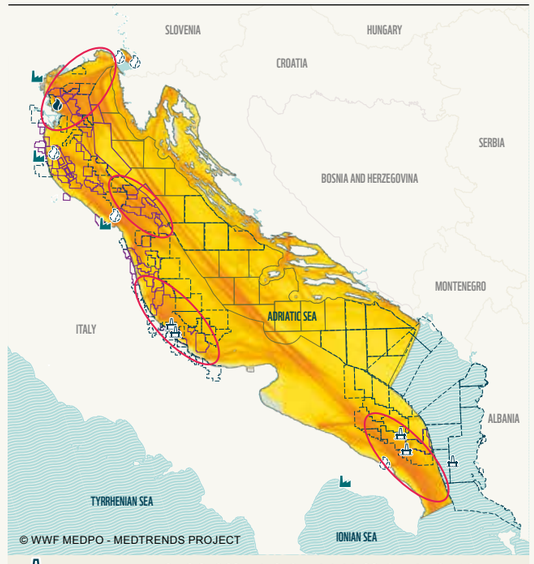
MARINAS (NUMBER OF BEDS)

0 1,730

DATA SOURCE:
http://www.pagineazzurre.com/

Area of potential conflict

FIGURE 48 **INTERACTIONS BETWEEN MARITIME TRANSPORT AND OIL AND GAS IN THE ADRIATIC SEA**



Planned wells
Refinery

*Oil and gas from DrillingInfo (2015) part of the Africa Land Use Planning and Monitoring System /ALES)

OIL & GAS CONTRACTS AND BIDBLOCKS

Exploration
Production
BidBlocks (Croatia)

LNG TERMINAL

Active
Project

DATA SOURCE:
Oil and gas from DrillingInfo (2015)*

DENSITY OF AIS SIGNALS (ALL VESSELS, 2014)

High 168,966
Low 1

DATA SOURCE:
Navama 2015

Area of potential conflict

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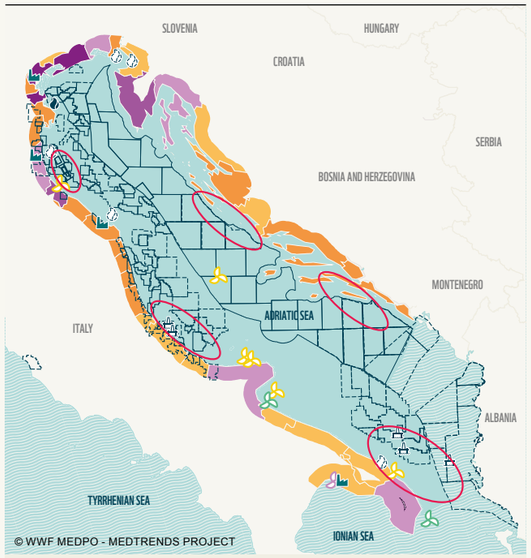
FIGURE 49 **INTERACTIONS BETWEEN COASTAL TOURISM, OIL AND GAS AND THE RENEWABLE ENERGY SECTOR IN THE ADRIATIC SEA**



Planned wells

Refinery

Oil and gas from DrillingInfo (2015) part of the Africa Land Use Planning and Monitoring System (ALES)

drillinginfo

navama technology for nature

OIL & GAS CONTRACTS AND BIDBLOCKS

Exploration

Production

BidBlocks (Croatia)

LNG TERMINAL

Active

Project

DATA SOURCE:
Oil and gas from DrillingInfo (2015)*

CAPACITY N BEDS

< 25 000

< 50 000

< 105 000

< 170 000

< 370 000

MARINE WINDFARMS

Early Planning / Application Submitted

Consent

Dormant

DATA SOURCE:
Offshore4C (2014)

0 Area of potential conflict

FIGURE 50 **INTERACTIONS BETWEEN COMMERCIAL FISHERIES AND THE MARITIME TRANSPORT SECTOR IN THE ADRIATIC SEA**

POTENTIAL CONFLICT BETWEEN FISHERIES AND TRANSPORT SECTORS

High — Low

DATA SOURCE:
analysis performed by Shoreline S Coop based on Navama dataset 2015

0 Area of potential conflict

navama technology for nature

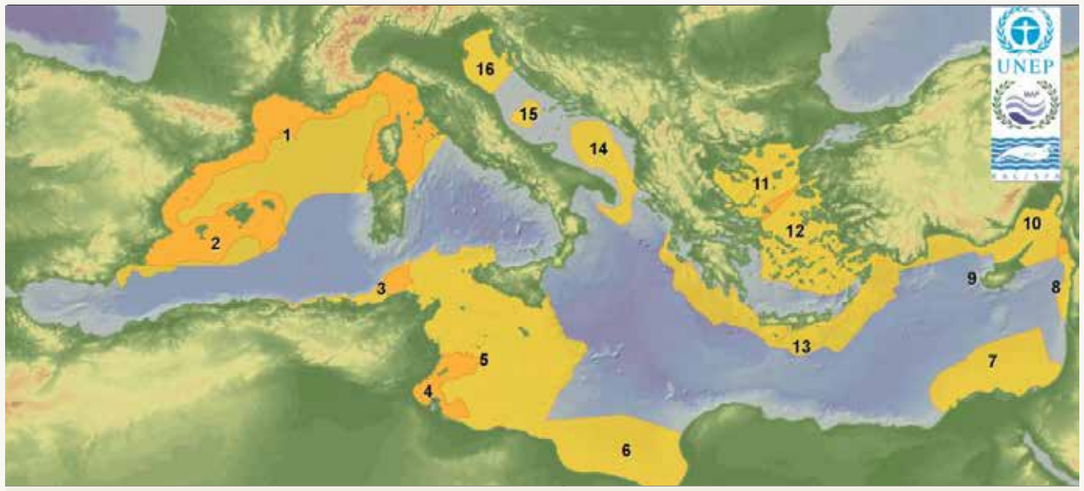
ANALYSIS OF THE INTERACTIONS BETWEEN THE GROWING ECONOMIC SECTORS AND AREAS OF CONSERVATION INTEREST

While 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 [1]), the current status of marine protection in the Adriatic Sea is clearly insufficient, with small, scattered and mainly coastal protected areas. Together, all the MPAs of the Adriatic make up a mere 1% of the area of the basin, a percentage very far from the 10% target set by the CBD.

The analysis of the economic sectors shows that in the majority of cases they will develop and eventually occupy large areas both offshore (oil and gas, fisheries, renewable energy and maritime transport) and at the coastal level (aquaculture and recreational fisheries for instance). Therefore despite the current proposals of new MPAs in open sea [1] [2], the identification of EBSAs (Figure 50) and GFCM trawling restrictions[32], it still seems unlikely, that significant new protection measures will be adopted by 2020 as they would very likely enter in to conflict with the developing economic sectors.

[32] GFCM have adopted recommendations requiring members to prohibit the use of towed dredges and trawl net fisheries at depths greater than 1,000 metres

FIGURE 51 **PROPOSED ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT AREAS IN THE MEDITERANNEAN (2014)**



SOURCE: UNEP/MAP- 2014

LEGEND

EBSAs as defined in 2014

Overlapping area between EBSAs

1.North-western Mediterranean Pelagic Ecosystems
2.North-western Mediterranean Benthic Ecosystems
3.Algerian - Tunisian Margin
4.Gulf of Gabès
5.Sicilian Channel
6.Gulf of Sirte
7.Nile Delta Fan
8.East Levantine Canyons (ELCA)
9.Akamas and Chrysochou Bay
10.North-East Levantine Sea
11.North Aegean Sea
12.Central Aegean Sea
13.Hellenic Trench
14.South Adriatic Ionian Strait
15.Jabuka / Pomo Pit
16.Northern Adriatic

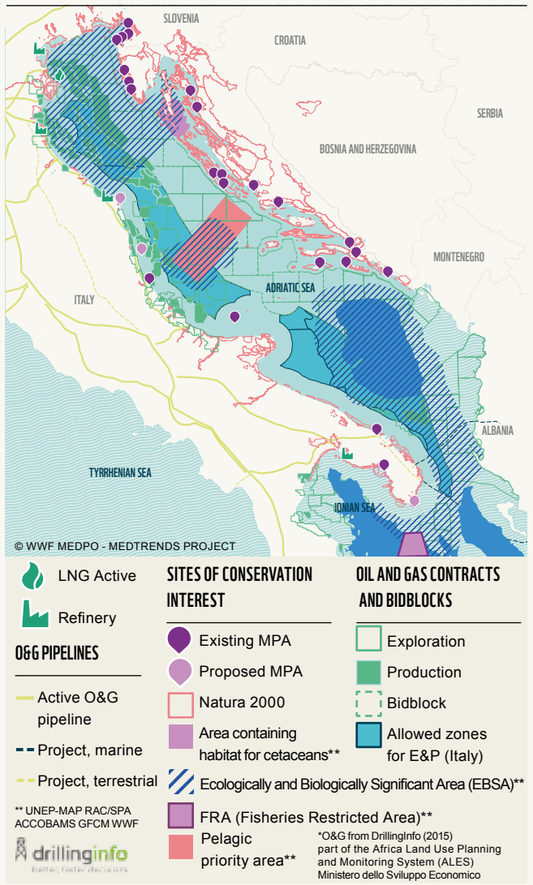
Lambert azimutal Equal Area (LAEA)-ETRS-1989
GIS: RAC/SPA-S Requena. Vers. October, 2014

Map of the 16 Mediterranean Ecologically or Biologically Significant Areas (EBSAs) adopted by the 12th meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD), (October 2014; Pyeongchang, Republic of Korea). They were chosen among the 17 ones defined by a regional workshop held jointly by the CBD and the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (April 2014; Malaga, Spain).

They are the result of works started in 2008 by the Parties to the SPA/BD Protocol of the Barcelona Convention, which prepared already in 2010 a draft list of Mediterranean areas following the EBSA criteria for the 17th Ordinary Meeting of the Contracting Parties to the Barcelona Convention (February 2012; Paris, France). The 2010 draft list was presented by the Barcelona Convention Secretariat to the 11th meeting of the Conference of the Parties to the Convention on Biological Diversity (October 20112; Hyderabad, India) where the celebration of the 2014 workshop CBD-Barcelona Convention to jointly sharpen up the definition of Mediterranean EBSAs was recommended.

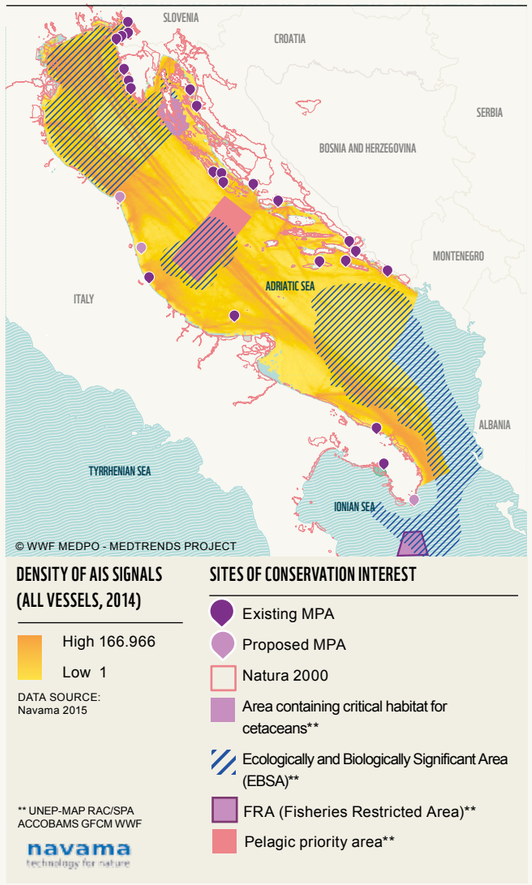
The following cross-cutting maps show some of the most evident examples of the overlap between offshore oil and gas contracts, maritime traffic, tourism, marine aquaculture and sites of conservation interest.

FIGURE 52 **OFFSHORE OIL AND GAS CONTRACTS AND POTENTIAL CONCESSIONS AND SITES OF CONSERVATION INTEREST IN THE ADRIATIC SEA**



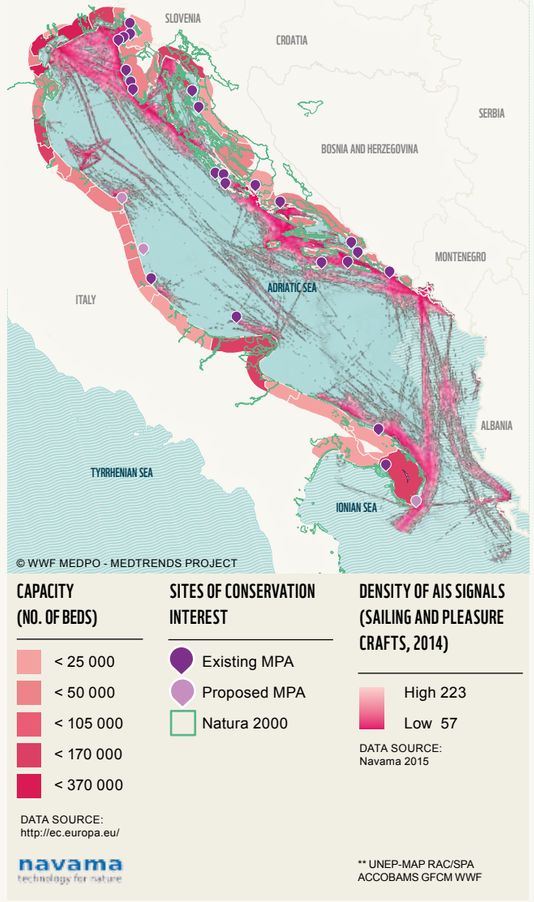
- All Adriatic MPAs are coastal and therefore there is no direct overlap with oil and gas developments;
- However some oil and gas production sites are located in the vicinity of MPAs (e.g. in the northern Adriatic Sea) and generate potential pollution risks;
- A large number of oil and gas concessions overlap with priority areas for conservation, which do not have yet a protection status such as EBSAs, ACCOBAMS areas, and trawling ban zones.
- 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 53 **MARITIME TRAFFIC DENSITY AND AREAS OF CONSERVATION INTEREST IN THE ADRIATIC SEA**



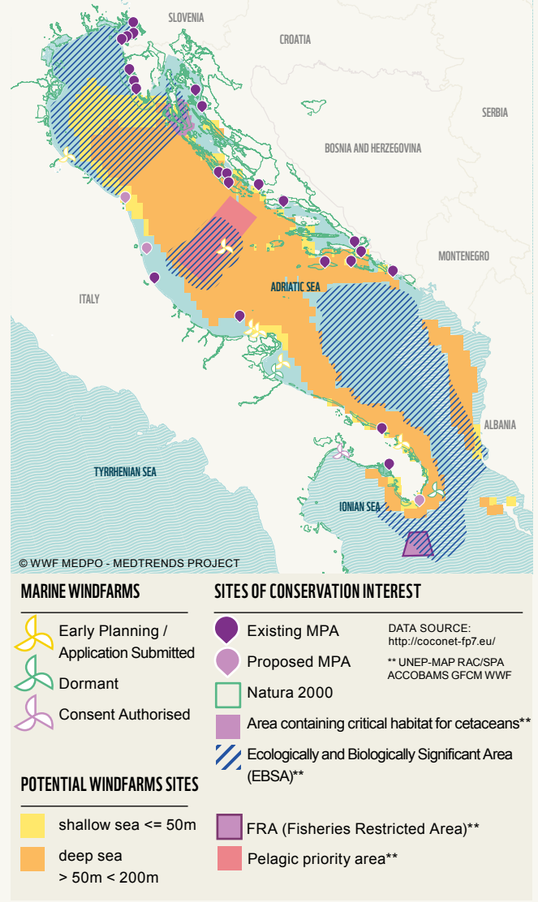
- Oil tanker traffic is expected to increase in the coming years due to new oil export routes from the Caspian region and similarly new pipelines are being developed in the southern Mediterranean (TAP, IGI Poseidon) posing a serious risk for the areas of conservation interest in the Adriatic.
- Many MPAs are potentially vulnerable to a pollution incident due to the intense maritime traffic in their proximity,
- A significant share of maritime traffic overlaps with priority areas for conservation. The interactions between the transport sector and conservation issues should be more thoroughly assessed and potentially raised with the IMO level.

FIGURE 54 **TOURISM AND AREAS OF CONSERVATION INTEREST IN THE ADRIATIC SEA**



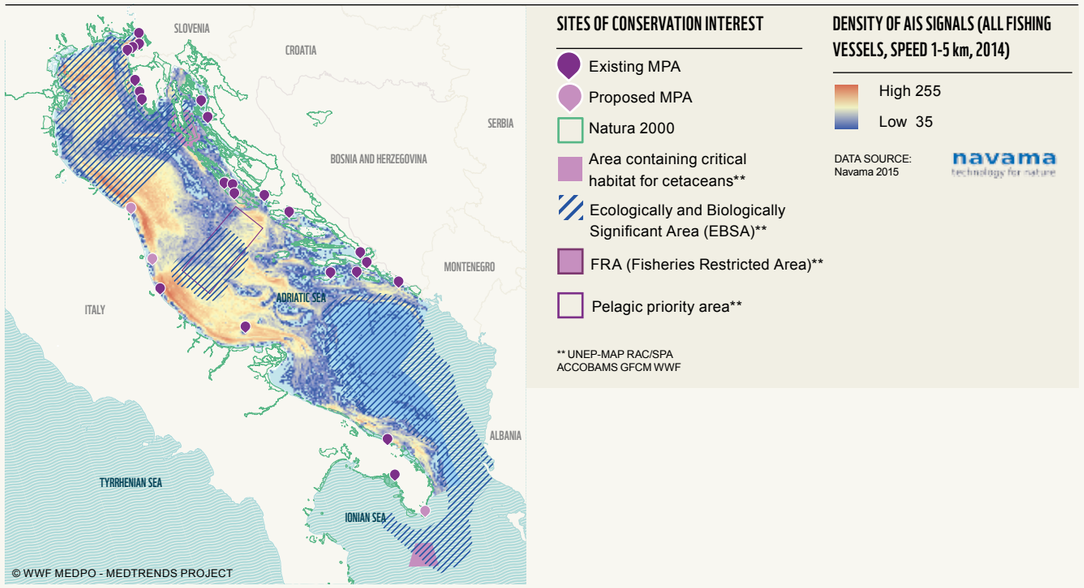
- Tourism may have serious negative impacts to MPAs, and its expected growth in the near future means that the risk could be increasing.
- However, tourism, in its most sustainable forms, may represent a resource for MPAs and areas of conservation (e.g. eco-tourism activities) and such activities should therefore be promoted in the region.

FIGURE 55 **OFFSHORE WIND ENERGY AND AREAS OF CONSERVATION INTEREST IN THE ADRIATIC SEA**



- As no energy producing plant is currently active, the impacts of windfarms on the marine environment in the Adriatic are relatively unknown and therefore the monitoring of the first operating sites will be very important to suggest best practices for future developments.

FIGURE 56 **FISHERIES AND AREAS OF CONSERVATION INTEREST IN THE ADRIATIC SEA**



- According to the AIS data analysed in the present report, commercial fisheries are particularly intensive in the northern and central Adriatic, particularly within the northern and central EBSAs areas.

- The nature of the analysed data (mainly fishing vessels longer than 12 m) and the scale of the study do not allow us to identify specific areas of conflict between fisheries and MPAs that are generally small and coastal. However, recreational fishing activities are expected to have higher impact at the local MPA level.

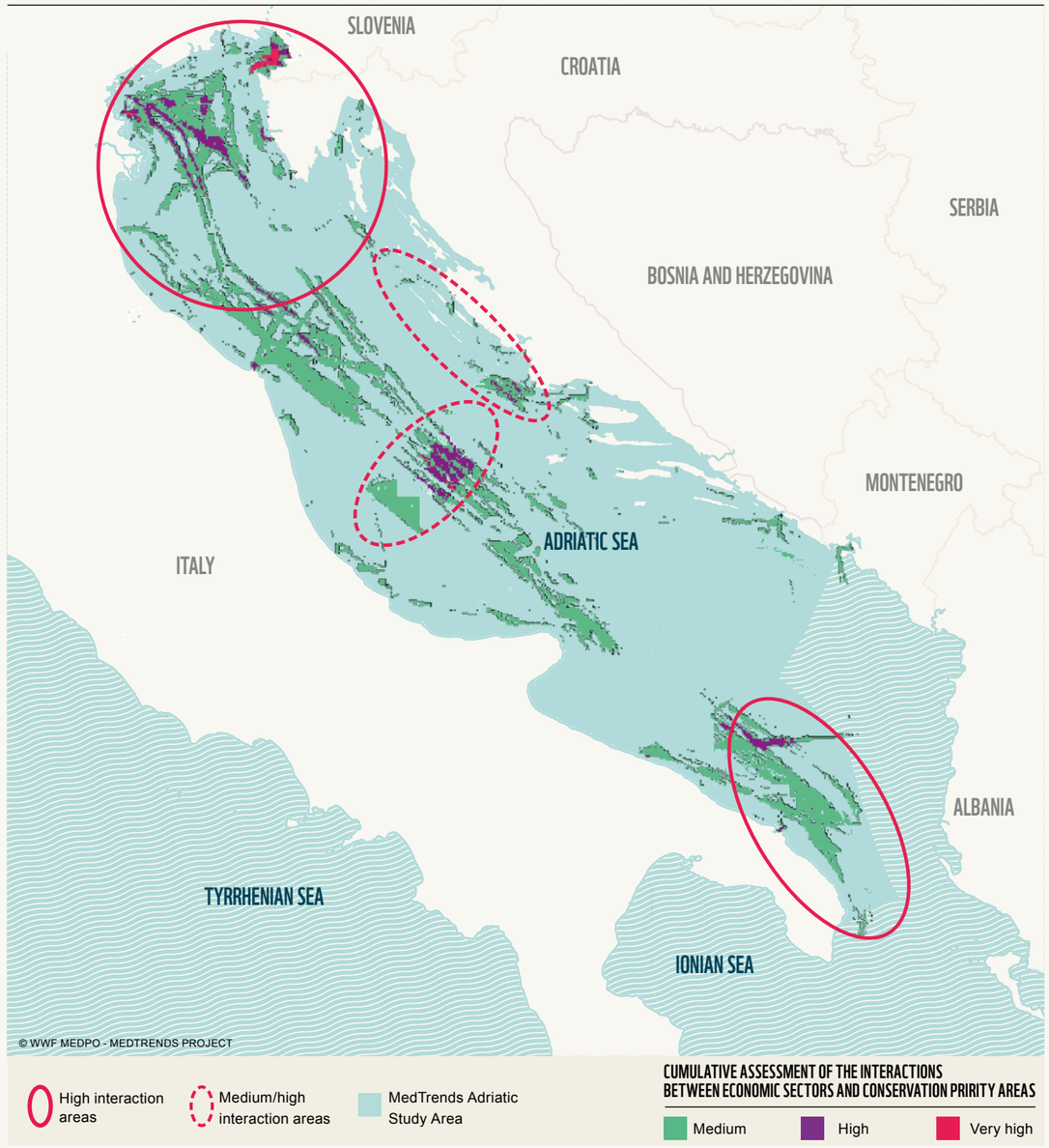
ACHIEVEMENT OF THE AICHI TARGET IN THE ADRIATIC SEA

Marine Protected Areas in the Adriatic are small and scattered. Despite the newly proposed national MPAs, the achievement of the 10% target looks very unlikely. The main chance to increase protection of the Adriatic and implement a true network of MPAs would be to establish open sea MPAs. However, considering the analysis of the economic sectors performed in the present report, this option seems unreachable unless uses of the sea are appropriately planned and limited to specific areas. The recent identification of EBSAs in the Mediterranean can hopefully be seen as a first step in the process that will eventually lead to enhanced protection of the marine environment. In the future Governments will in fact be expected to adopt appropriate measures for conservation and sustainable use in relation to EBSAs, in particular by establishing representative networks of marine protected areas.

AREAS OF INTERACTIONS BETWEEN BLUE GROWTH AND SITES OF CONSERVATION INTEREST

Hotspots of high interactions between Blue Growth and sites of conservation interest in the Adriatic Sea were identified by the MedTrends experts based on the following criteria: at least two sectors exerting major pressures overlapping with existing conservation areas or priority areas for conservation or EBSAs (Figure 56).

FIGURE 57 **AREAS OF HIGH INTERACTION BETWEEN BLUE GROWTH AND SITES OF CONSERVATION INTEREST IN THE ADRIATIC SEA**



These areas include:
1. The Northern Adriatic,
2. The Southern Adriatic area in front of the coast of Apulia
3. The area of the Jabuka pit
4. The central Croatian coast (Zadar-Sidbenik) and adjacent areas

Implementation of Maritime Spatial Planning through an ecosystem based approach is of paramount importance for the above areas that include key areas for conservation and are also subject to substantial anthropic pressure from a variety of economic sectors.

IMPACTS ON GES

The Marine Strategic Framework Directive (MSFD) aims at achieving Good Environmental Status in European Seas. In this paragraph the result of the trends analysis for the different sectors will be assessed for each individual GES descriptor, in order to assess the potential likelihood to achieve the GES by 2020. The assessment is compared to the EU-funded ODEMM project (Options for Delivering Ecosystem-Based Marine Management) that has assessed the risk of failing to achieve GES for each European Marine Region. Table 22 compares the results of the ODEMM assessment for each of the MSFD descriptor in the Mediterranean. 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. The results show that according to the MedTrends assessment, the risk of not achieving GES by 2020 in the Adriatic Sea is high for 9 Descriptors out of 12 (including Landscape), highlighting the need for enforcement of strict regulations to avoid failure to meet the MSFD targets that EU countries have committed to achieve.

TABLE 22 **RISKS OF NOT ACHIEVING GES BY 2020 IN THE MEDITERRANEAN AND ADRIATIC SEA**

SOURCE : ODEMM [3] ADAPTED BY WWF

GES DESCRIPTORS		RISKS OF NOT ACHIEVING GES MED	RISKS OF NOT ACHIEVING GES ADRIATIC	MAIN SECTORS AT THE ORIGIN OF THE RISK (MEDTRENDS ANALYSIS)
D1 **Biodiversity**	1B **Plankton**	Moderate	Moderate	Many of the main growing economic sectors may cause impacts on biodiversity, especially on marine mammals and reptiles. Specific impacts may include the ones brought by maritime traffic through direct strikes, noise and sonar disturbances, or the ones associated to the fisheries sector through accidental catches. Furthermore indirect impacts from other sectors such as the oil and gas sector, could affect most species and habitats through oil spills, and aquaculture, which may also contribute through the introduction of alien species.
	1B **Fish**	Moderate	High	
	1C **Marine mammals and reptiles**	High	High	
	1D **Seabirds**	Moderate	Not assessed	
	1E **Predominant habitats**	Moderate	High	
D2 **Non-indigenous species**		High	High	The increasing maritime traffic and aquaculture sectors are the ones that most of all may contribute to an increased risk of invasive species introduction. Increased invasive species are also expected as a consequence of the expansion of the Suez Canal and by the effects of climate change.
D3 **Commercial species**		High	High	Although the commercial fisheries sector is not expected to increase in the long term, from the analysis performed in the present report it emerges that many stocks of commercial species are already compromised and will require a long time to recover. Furthermore growing sectors that may in the future have an indirect impact on commercial fish species, such as mining and oil & gas exploration and production increase the risks for this descriptor.
D4 **Foodwebs**		High	High	Increasing pressures on marine mammals from the maritime transport, noise and sonars from the oil and gas sector coupled with overfishing and capture of top-level predators indicate potential further foodwebs degradation in the future.
D5 **Eutrophication**		Moderate	Moderate	Various economic sectors may contribute to eutrophication in the Adriatic in the future, including tourism and marine aquaculture. Furthermore increasing land-based pollution and coastal developments, which are also expected to increase in the future, may also contribute to eutrophication events. However recent improvements in the fertilizers and water treatment facilities reduce the risk of not achieving this GES to Moderate.
D6 **Sea-floor integrity**		High	High	Sea floor integrity is going to be mainly affected by dredging, oil and gas development and trawling fisheries
D7 **Hydrographical conditions**		Not assessed	Not assessed	-
D8 **Contaminants**		Moderate	High	An increase in toxic compounds is expected along with an increase in oil and gas extraction, maritime transport, coastal development and the potential development of marine mining.
D9 **Contaminants in seafood**		Low	Moderate	Concentrations of Mercury currently exceed benchmark dose limits and concentrations of some heavy metals are high, but studies show that they are often from heavy metal natural sources [3]. Not many economic sectors however are expected to contribute to increased contaminants in food in the Adriatic. The main sectors potentially contributing to seafood contamination are mining and oil and gas exploration and extraction.
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 land based waste collection has reduced macro-waste flows from the coast, shoreline and recreational activities continue to discard large volumes of litter into the marine environment. Sectors that may particularly increase marine litter are: tourism, maritime transport and ports, fishing activities through discarded nets and dolly ropes.
D11 **Energy (underwater noise)**		High	High	Various growing sectors assessed in the present report may contribute to underwater noise, such as oil and gas, tourism, maritime transport, mining and military activities. Oil and gas exploration and mining activities may be particularly impacting.
Marine and coastal landscape		High	High	The foreseen development of new activities such as offshore wind energy, and oil and gas may contribute to increase impacts on marine landscapes. Moreover, uncontrolled coastal development may threaten natural landscape integrity and diversity in the Adriatic.

REFERENCES

[1] UNEP-MAP-RAC/SPA. 2010. Overview of scientific findings and criteria relevant to identifying SPAMIs in the Mediterranean open seas, including the deep sea. By Notarbartolo di Sciara, G. and Agardy, T. Ed. RAC/SPA, Tunis: 71pp.

[2] RAC/SPA MedOpenSeas Project (2015) http://medabnj.rac-spa.org/index.php?option=com_content&view=frontpage&Itemid=1&lang=en

[3] Knights, A.M., Koss, R.S., Papadopoulou, N., Cooper L.H. and L.A. Robinson, 2011. Sustainable use of European regional seas and the role of the Marine Strategy Framework Directive. [pdf] Deliverable 1, EC FP7 Project (244273) 'Options for Delivering Ecosystem-based Marine Management'. University of Liverpool. Available at: https://www.liv.ac.uk/media/livacuk/odemm/docs/ODEMM,Deliverable,1.pdf

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The results of the MedTrends Adriatic study show that most global marine economic sectors in the Adriatic will significantly grow in the next 15 years, with the exception of the fishery and military sectors. New maritime sectors, such as offshore renewable energy will increase in importance in the future. In addition, it is expected that the three biggest sectors, maritime transport, tourism and offshore oil and gas industry, will show large-scale increase in the coming years.

The rapid growth of the sectors is mainly determined by the following drivers:
- The fast development of the number of offshore oil and gas exploration and production contracts, potentially covering over 50% of the basin.
- The push from the Blue Growth Strategy of the EU Commission, which aims to support sustainable growth in all marine and maritime sectors and in which 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 [1].
- The growth of trade between Europe and Asia and the growth of Eastern European Economies, which drives the growth of the international maritime traffic in the Adriatic.

The specific emphasis on Blue Growth of the EU Strategy for the Adriatic and Ionian Region (EUSAIR) is expected to contribute even further to the growth of maritime economic sectors in the region.

A summary of the results of the trends assessment for each sector is illustrated in Table 23:

TABLE 23 SUMMARY TABLE OF THE MAIN MARITIME ACTIVITIES IN THE ADRIATIC SEA, THEIR POTENTIAL ENVIRONMENTAL IMPACTS AND EXPECTED FUTURE TRENDS

SECTORS	EXPECTED DEVELOPMENT TREND	QUANTITATIVE AND/OR QUALITATIVE ESTIMATES OF THE TRENDS
Oil and gas	↗	Offshore oil and gas production is expected to increase in the Adriatic as: • Croatia may allow exploration and production activities in 29 new concessions averaging 1,500 m² each • 11 new concessions have been approved by the Italian Government in the Adriatic • Exploration activities are under way in Montenegro and Albania
Maritime transport and ports	↗	NAPA Ports, which had a 4, 3% share of the shipping market in the year 2010 are expected to increase to 9,4 % by 2020 and to 11,3 % by 2030
Fisheries	→	A stable trend is expected in the medium term, as many commercial fish stocks have declined considerably. Professional fishing pressure is increasing in Croatia and decreasing in Italy, although Croatia's entry in the EU may initially slow down the fisheries sector, that will have to adjust to the new regulations. Trends in recreational fisheries are unknown although regionally are reported to be increasing.
Marine aquaculture	↗	The aquaculture production forecasts anticipate an increase from the current 20,000 Tonnes of cultured fish and shellfish to over 27,000 Tonnes by 2020 and 32,649 tonnes by 2030
Turism	↗	By 2024 tourism contribution to GDP is expected to grow by 2,3 % in Italy, and 5,4 % in Croatia, covering 17 % of GDP At current rates, the number of cruise passengers is expected to grow to over 7 M by 2020 and to over 11 M by 2030 The number of marinas is increasing in the short term and expected to remain constant in the long term.
Renewable energy	↗	While there has been no marine renewable energy produced in 2014, new renewable energy plants are very likely to be established in the near future (8 wind farms have already been proposed in the Adriatic Sea and new floating wind farms technology may allow a rapid offshore development of the sector.
Marine mining	↗	Dredging activities should increase in the long term, due to the increasing needs for beach nourishment and to the increasing market request for sand. Although there is no evidence of mineral ores deposits in the Adriatic, an upward trend is expected at an uncertain rate in the long term.
Military activities	↘	Based on the foreseen changes in the Adriatic countries naval forces (which will consist in a reduction in the Italian fleet and a moderate increase in the Croatian one), the overall pressure from military activities it is expected to decrease.

FIGURE 58 FIVE SECTORS WITH HIGH POTENTIAL FOR SUSTAINABLE BLUE GROWTH

SOURCE: EC, 2015 [1]

The following key findings emerge from the study:

- The growing trends will generate significant conflicts between sectors, such as marine and coastal tourism, fisheries, aquaculture that rely on coastal ecosystems and offshore extractive industries and maritime traffic that may have to share the same areas. Specifically, the development of the offshore oil and gas sector could strongly impact the tourism economy of Adriatic riparian countries.

- There is a very high risk of further compromising the fishing sector due to the further loss of fishing grounds, increased pollution likely to affect fish stocks, or competition for resources given the rapid growth of recreational fishing. All these factors may undermine the productivity (as well as the profitability) of this sector. Moreover, if no new open sea MPAs will be declared in EBSAs, future fish stock recovery will be unlikely.

- Conflicts between sectors reflect political conflicts: 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 on pristine landscapes and marine environment for tourism. The interests of local communities are thus potentially incompatible with energy independency objectives.

- These growing trends, despite technological progress and environmental legislation, are likely to increase impacts on the marine environment. The risk of failing to achieve Good Environmental Status in the Adriatic in 2020 for 8 out of 11 of the descriptors of the Marine Strategy Framework Directive in the Mediterranean Sea is high.

- The growth of maritime sectors also increases the challenge faced by Adriatic EU countries to meet the Convention on Biological Diversity Aichi Target 11, which requires 10% of EU waters to be within MPAs or other effective area-based management measures by 2020 [1]. The current, small extent and fragmentation of MPAs within the study area, will in fact make it very difficult to reach the target (and Good Environmental Status as well). A further obstacle to the achievement of the Aichi commitments is represented by the competition for space between areas potentially suitable for the establishment of MPAs and some developing economic sectors. The development of marine aquaculture, one of the 5 sectors identified in the EU Blue Growth agenda, is for instance likely to overlap with existing or new MPAs. The recommendation set by the 2014 IUCN World Parks Congress to increase the Convention on Biological Diversity target to 30% by 2030 is therefore even more unrealistic at the present day.

- Marine Protected Areas in the Adriatic are small, coastal and scattered and there is a clear absence of a true ecological network of MPAs in the region, that is fundamentally important to geographically connect areas of high biodiversity or conservation importance.

- Preventing or reducing environmental damage and achieving sustainable use of the marine environment remains a huge challenge for the Adriatic 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.

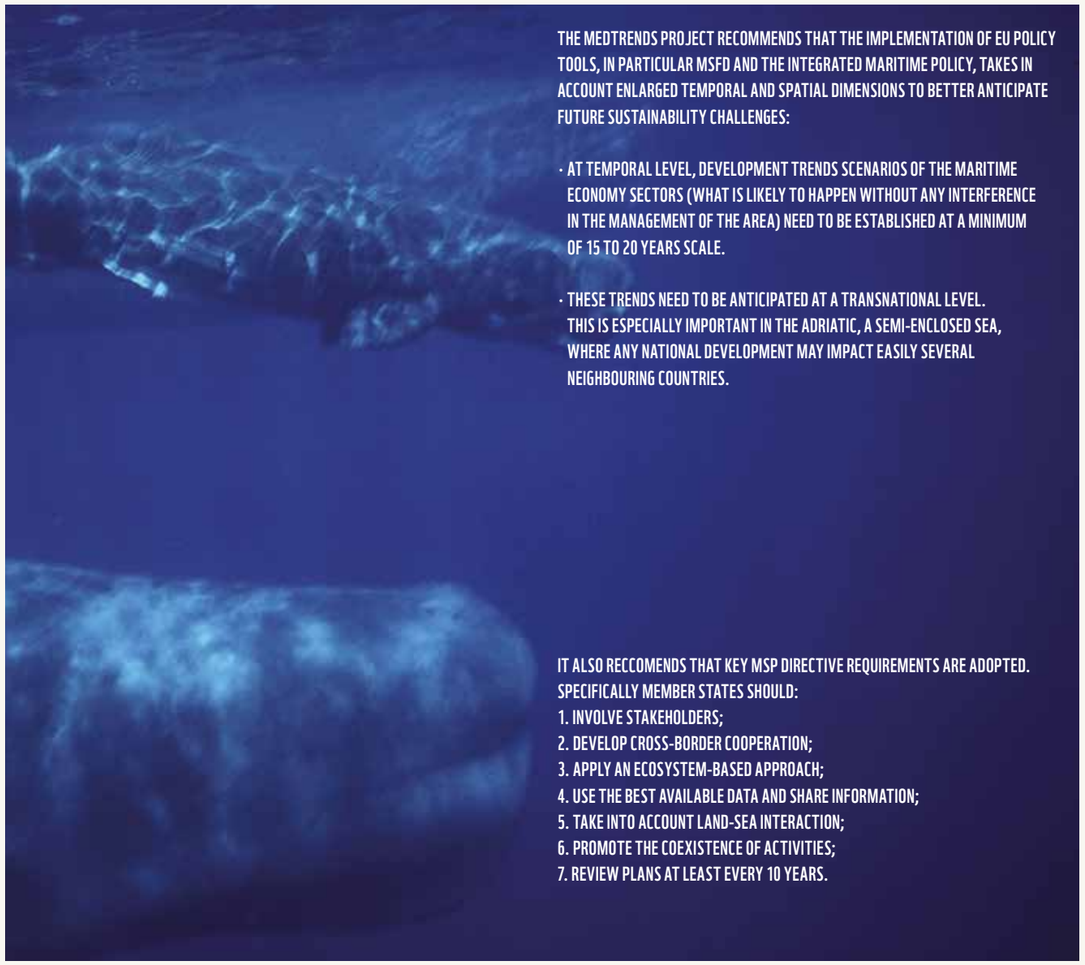
- Guidance a sustainable blue economy is currently missing in the Adriatic. All these changes are happening against a background of vague concepts and relatively weak formulations about what needs to be done to ensure that the Blue Economy is truly sustainable [2]. The context of the future implementation of the Blue Growth Strategy and the Maritime Spatial Planning Directive (2014/89/UE), which needs to be transposed by Member States at the latest by 18 September 2016, is still complex and very unclear.

- Finally, the study showed that lack of biological and socio-economic data is an issue for many areas of the Adriatic, either because the areas are not covered by existing monitoring efforts or because national governments do not publically share all available datasets. To be able to successfully implement Maritime Spatial Planning, it is fundamentally important to be able to start collecting data at a regional level and for Adriatic countries to make all their datasets available.

GENERAL RECOMMENDATIONS

Most of the sectoral pressures, whether point source or diffuse, can be addressed directly by the EU through its existing policies and legislation. EU policy tools that focus on the sustainable exploitation of marine resources 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 and the EU Strategy on adaptation to climate change which is key to coastal areas. In addition, the Barcelona Convention protocols provide basin-wide integrated approaches to reach Good Environmental Status for the whole Mediterranean and to implement Integrated Coastal Zone Management (ICZM) protocol[33], signed by Italy and already ratified by Croatia and Slovenia. However, sustainability challenges will remain unless smart and innovative solutions are developed and implemented at a rate that coincides with increasing exploitation of the seas [1].

[33] Article 3 of the Protocol of ICZM in the Mediterranean defines the geographical scope and reads: "the seaward limit of the coastal zone, which shall be the external limit of the territorial sea of Parties", by integrating both land and sea.



THE MEDTRENDS PROJECT RECOMMENDS THAT THE IMPLEMENTATION OF EU POLICY TOOLS, IN PARTICULAR MSFD AND THE INTEGRATED MARITIME POLICY, TAKES IN ACCOUNT ENLARGED TEMPORAL AND SPATIAL DIMENSIONS TO BETTER ANTICIPATE FUTURE SUSTAINABILITY CHALLENGES:

- AT TEMPORAL LEVEL, DEVELOPMENT TRENDS SCENARIOS OF THE MARITIME ECONOMY SECTORS (WHAT IS LIKELY TO HAPPEN WITHOUT ANY INTERFERENCE IN THE MANAGEMENT OF THE AREA) NEED TO BE ESTABLISHED AT A MINIMUM OF 15 TO 20 YEARS SCALE.

- THESE TRENDS NEED TO BE ANTICIPATED AT A TRANSNATIONAL LEVEL. THIS IS ESPECIALLY IMPORTANT IN THE ADRIATIC, A SEMI-ENCLOSED SEA, WHERE ANY NATIONAL DEVELOPMENT MAY IMPACT EASILY SEVERAL NEIGHBOURING COUNTRIES.

IT ALSO RECCOMENDS THAT KEY MSP DIRECTIVE REQUIREMENTS ARE ADOPTED. SPECIFICALLY MEMBER STATES SHOULD:

1. INVOLVE STAKEHOLDERS;
2. DEVELOP CROSS-BORDER COOPERATION;
3. APPLY AN ECOSYSTEM-BASED APPROACH;
4. USE THE BEST AVAILABLE DATA AND SHARE INFORMATION;
5. TAKE INTO ACCOUNT LAND-SEA INTERACTION;
6. PROMOTE THE COEXISTENCE OF ACTIVITIES;
7. REVIEW PLANS AT LEAST EVERY 10 YEARS.

Ambitious shared prospective visions for the Adriatic maritime space's future need to be built at different spatial scales. The current revision of the Mediterranean Strategy for Sustainable Development provides a useful framework at a basin-wide level, with a strong Integrated Coastal Zone Management dimension. However, prospective visions need to be built primarily at national level and in a second step, at macro-regional level, to ensure transnational coordination and optimization.

WWF believes that a sustainable blue economy is 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;

- 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 ocean 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 long into the future. WWF believes that the following principles are key:

- Taking into account EU policy visions of establishing a circular green economy: (for instance, recycling rare metals waste should be maximized before considering deep-sea mining).

- As far as strategic energy development infrastructures are concerned, giving preference to transition to renewable energies. switching to renewable energy isn't 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 Med, the WWF is taking a strong approach with a no-go position for new 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 the issue of food sovereignty and thus giving priority to the restoration of fish stocks and their ecosystems;

- Applying the precautionary principle when key data necessary to inform smart decision-making is missing.

- Data availability is key to support and share ocean knowledge and solutions through which problems can be understood and methodologies evaluated and applied. Despite the highly significant efforts made by the EU to support data-sharing, access to data is still very difficult for many sectors (fossil energy, fisheries) and pressures and impacts. Paywalls or unwillingness of some EU-funded research projects to share results are some of the difficulties encountered. WWF calls for the EU to further enhance data accessibility from the private and research sectors.

- 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 transnational level. The EU must clearly demonstrate its ability to incorporate the MSFD ecosystem-based approach its macro-regional strategies.

As regards the implementation of Maritime Spatial Planning, the use of decision-making support tools incorporating the value of ecosystem services in spatial scenarios is recommended (i.e. InVest).

REFERENCES

[1] European Environment Agency 2015. SOER 2015 - The European Environment - State and Outlook 2015 http://www.eea.europa.eu/soer-2015/europe/marine-and-coastal

[2] WWF, 2015. Principles for a sustainable blue economy

ANNEX 1

SECTOR RECOMMENDATIONS

REFERENCES

[1] International Symposium on the Stabilisation of greenhouse gas concentrations, 2005. Report of the International Scientific Steering Committee. http://www.stabilisation2005.com/Steering_Commitee_Report.pdf

[2] WWF, 2015. Accessed 19 January 2015 from wwf.panda.org/energyreport

[3] UNEP, FA0, IMO, UNDP, IUCN, World Fish Center, GRID-Arendal, 2012, Green Economy in a Blue World.

[4] Hrvoje Carić (2011) Cruising Tourism Environmental Impacts: Case Study of Dubrovnik, Croatia. Journal of Coastal Research: Special Issue 61 - Management of Recreational Resources: pp. 104 – 113. http://www.researchgate.net/profile/Hrvoje_Caric/publication/258705285_Cruise_Tourism_Environmental_Risks/links/00463528dca0ed70a6000000.pdf

[5] NOAA, The tourism industry. Available from: http://sanctuaries.noaa.gov/management/pdfs/Day7_INDUSTRY_MANUAL.pdf

[6] Seas At Risk, 2014. Deep sea mining-where no man has gone before. Available from: http://www.seas-at-risk.org/20-blue-growth/542-deepsea-mining-where-no-man-has-gone-before.html

[7] Cressey, D. (2008). Sonar does affect whales, military report confirms. Nature, 1 August, doi; 10.1038/news.2008.997.

OIL AND GAS

According to the International Energy Agency (IEA), to have a 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 [1]. 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 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.

WWF

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.

- 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.

- 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, such as the northern Adriatic and the Otranto Strait.

- 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 landfills;

- National /European cooperation/ specification instead of competing multimode harbours;

- Shore side electricity for ships at berth in order to reduce emissions.

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

WWF

FISHERIES

The overall objective of this sector is to contribute to food security and livelihoods while preserving a healthy ecosystem, through effective ecosystem based resource management. In order to achieve this objective, the following are needed:

- Effective delivery of the reformed Common Fisheries Policy 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 keeps producing science-based management measures for the Bluefin tuna, ensuring enforcement of the implemented measures and develops a recovery plan for 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).

WWF

AQUACULTURE

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WWF holds that the impacts of aquaculture on the Mediterranean marine environment should be reduced 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.

ANTIFOULING CHEMICALS

- 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)

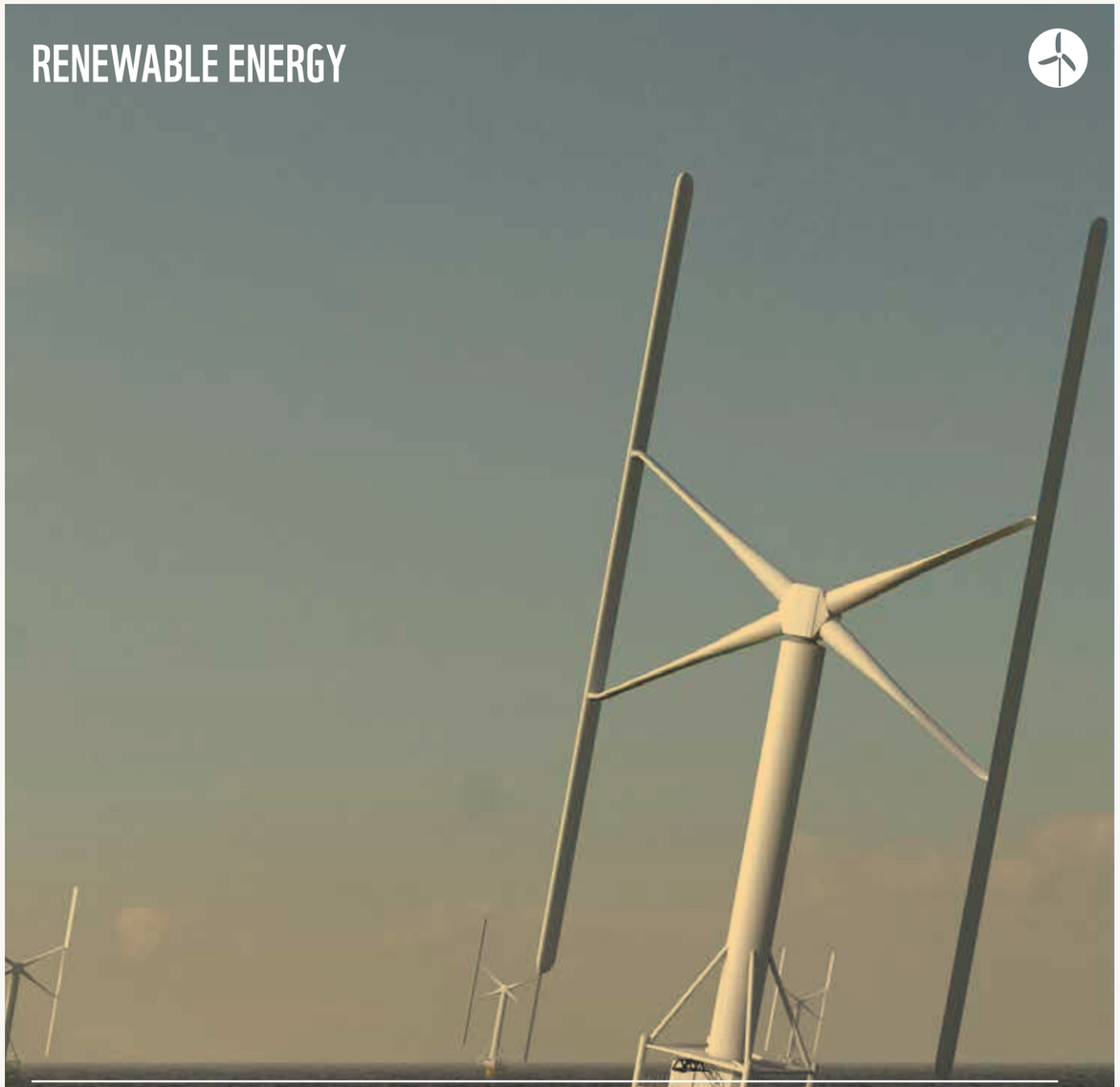
SOURCING OF FEED

- 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)
- Avoid 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.

WWF

RENEWABLE ENERGY



WWF HAS A VISION OF A WORLD THAT IS POWERED BY 100 PER CENT RENEWABLE ENERGY SOURCES BY THE MIDDLE OF THIS CENTURY.

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 **[2]**.

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 **[3]**

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.

WWF

TOURISM

WWF supports the Objectives of the Mediterranean Strategy for Sustainable Development related to sustainable tourism that aim 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;
- reduce the adverse territorial and environmental impacts of tourism, especially in existing coastal tourist areas;
- increase the added value of tourism for local communities and for actors in developing countries;
- improve governance for sustainable tourism.

More specific measures that should be adopted include:

- respect of the Limits of Acceptable Change of touristic areas;
- reduction of impacts of mass tourism: limits to the artificialization of the coast, development of sustainable practices (recycling, water use, etc.);
- 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 **[4]**.

Specific recommendations to reduce the environmental impacts of the cruise sector are the following [5].

- 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.

WWF

MINING

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 Marine Protected Areas in open sea.

WWF supports the position of Seas At Risk[34] 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 **[6]**.

[34] Seas At Risk is an umbrella organisation of environmental NGOs from across Europe that promotes ambitious policies for marine protection at European and international level

MILITARY ACTIVITIES

As confirmed by Cressey (2008) **[7]**, the main impacts from military activities consist in noise production and the use of sonars, that often have devastating consequences for the sea and represent a direct cause of cetaceans stranding and internal bleeding due to the excessively rapid ascent of the animals frightened by the sounds. The research debunks the myth that marine mammals are not subject to the problems caused by a rapid ascent toward the surface of the sea. The analysis of the bodies of beached whales proved that the animals died because of a blood clot: the inner cavities of the head were full of blood. It is therefore important to adopt detection systems that allow to spot cetaceans on time before using sonars and exploding weapons, furthermore these mechanisms would allow vessels to stay at a safe distance to avoid direct hits.

ANNEX 2

WWF PRINCIPLES FOR A SUSTAINABLE BLUE ECONOMY

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A SUSTAINABLE BLUE ECONOMY 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 these 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 behaviours 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.

The above paragraphs are based on WWF's report "Principles for a sustainable blue economy" (2014). Available at the following link: http://d2ouvy59p0dg6k.cloudfront.net/downloads/15_1471_blue_economy_6_pages_final.pdf

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Why we are here

To stop the degration of the planet's natural environment and to build a future in which humans live in harmony with nature.

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