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POST-2020 SAP BIO

ITALIAN ADRIATIC SEA SUBREGION CONSERVATION OF MEDITERRANEAN MARINE AND COASTAL BIODIVERSITY BY 2030 AND BEYOND

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Ecological Status, Pressures, Impacts, their Drivers and Priority Response Fields

POST-2020 SAPBIO

Strategic Action Programme
for the **Conservation** of **Biodiversity**
and **Sustainable Management**
of **Natural Resources**
in the **Mediterranean Region**

United Nations Environment Programme
Mediterranean Action Plan
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List of Acronyms

CACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea Mediterranean Sea and Contiguous Atlantic Area
ADRISEA	Adriatic Sea subregion
AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
BISE	Biodiversity Information System for Europe
BQE	biological quality elements
CBD	Convention on Biological Diversity
CC	Climate Change
CEPA	Classification of Environmental Protection Activities
CFP	Common Fisheries Policy
CIS	Common Implementation Strategy
CITES	Convention on International Trade of Endangered Species
CMS	Convention on the Conservation of Migratory Species
CNR	National Research Council
CRUMA	Classification of Resource Use and Management Activities and expenditures
CSOs	Civil Society Organizations
DCF	Data Collection Framework
EAF	Ecosystem Approach to Fisheries
EBSAs	Ecologically or Biologically Significant Marine Areas
EC	European Commission
EcAp	Ecosystem Approach
EEA	European Environment Agency
EFH	Essential Fish Habitats
EIA	Environmental Impact Assessment
EMFF	European Maritime and Fisheries Fund
EO	Ecological Objective
EPZ	Ecological Protection Zone
ERDF	European Regional Development Fund
ESF	European Social Fund
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FRA	Fishery Restricted Area
GES	Good Environmental Status
GFCM	General Fisheries Commission for the Mediterranean
IAS	Invasive alien species
IBA	Important Bird and Biodiversity Area
ICMED	Ionian and Central Mediterranean Sea sub-region
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
IMMAs	Important Marine Mammal Areas
IMO	International Maritime Organization
ISEA	Standardized Interventions for the Effective Management of Marine Protected Areas
ISPRA	Italian Institute for Environmental Protection and Research
IUCN	International Union for Conservation of Nature
IUFF	Illegal Unreported and Unregulated Fishing
LIFE	Environment and Climate Action Programme
LME	Large Marine Ecosystem
MAES	Mapping And Assessment of Ecosystem Services
MAP	Mediterranean Action Plan
MARPOL	International Convention for the Prevention of Pollution from Ships
MATTM	Itlaian Ministry of Environment Land and Sea Protection
MedECC	Mediterranean Experts on Climate and Environmental Change
MEF	Ministry of Economy and Finance
MiPAAF	Italian Ministry of Agricolutre Food and Forestry Policies
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
NGO	Non Governative Organization
NIS	Non-Indigenous Species
PAF	Prioritised Action Framework
OPRC	International Convention on Oil Pollution Preparedness Response and Cooperation
PoM	Program of Measures (Marine Strategy Framework Directive)
PSSA	Particularly Sensitive Sea Areas
REO	Execution and Organization Regulation
RFMO	Regional fisheries management organisations
ROV	Remotely Operated Vehicle

SAC	Special Areas of Conservation
SAP/BIO	Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region
SCI	Sites of Community Importance
SECA	Emission Control Areas for Sulphur
SH	Sensitive Habitats
SIBM	Italian Society for Marine Biology
So.De.Cr.i	SOftware for the Determination of allocation CRIteria
SPA	Special Protection Areas
SPA/BD	Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean
SPAMI	(Specially Protected Area of Mediterranean Interest)
SSC	Species Survival Commission
SSS	Side Scan Sonar
STECF	Scientific Technical and Economic Committee for Fisheries
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational Scientific and Cultural Organization
UnGa	United Nations General Assembly
UWWTD	Urban Waste Water Treatment Directive
VME	Vulnerable Marine Ecosystem
WCPA	World Commission on Protected Areas
WFD	Water Framework Directive
WISE	Marine Information System for Europe
WMED	Western Mediterranean Sea sub-region
WWF	World Wildlife Fund
ZTB	Biological Conservation Zone

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Executive Summary

Although several numbers of policies and regulatory instruments have been put in place globally to reduce and, where possible, stop the loss of biodiversity, there is still a long way to reach this goal. As highlighted in several publications and, most recently, by the recent Global Biodiversity Outlook 5 (Secretariat of the Convention on Biological Diversity, 2020), while progress was evident for the majority of the Aichi Biodiversity Targets, at the global level, none of these has been fully achieved.

At the Mediterranean level, the considerable attention dedicated to the protection of biodiversity has led in particular to the definition of strategic actions aimed firstly at bridging the significant knowledge gaps and, secondly, at implementing targeted and effective conservation measures. In this context, the provisions of the SPA/BD Protocol and the actions promoted by the Strategic Action Program for the Conservation of Biological Diversity in the Mediterranean Region (SAP BIO) have undoubtedly led to significant progress.

2020, a turning point for many of the policies linked to the conservation of biodiversity and marine ecosystems, therefore requires a reflection on what has been done so far and, in particular, on future prospects.

In this process it is a priority to apply the ecosystem approach to the management of human activities and to aim at a vision that is truly holistic and not sectorial, critically evaluating what has been done and enhancing the goals achieved, as indicated by the adaptive management principle.

This National Report, dedicated to the Adriatic Sea subregion, aims to provide an analysis of the state of the marine biodiversity of the sub-basin, identifying the primary sources of pressure as well as the main knowledge gaps that will require additional efforts in order to get filled. The report also reports the main national regulatory instruments dedicated to the governance of the sea-system, the available sources of funding and the main cross-border issues and actions of regional cooperation implemented by Italy in recent years.

In the last part of the document, priority needs and response actions were provided that it is recommended to consider in the coming years.

Although Italy has, in recent years, provided itself with an efficient and complete monitoring system within the Marine Strategy and the EcAp process, this cannot be considered enough.

Indeed, given the specific purposes of the Directive, to retrieve all the necessary information

to have a complete reference framework about the state and conservation trends of the critical marine species and habitats, for which targeted and specific monitoring actions should be identified allowing the compilation and the update of manuals and checklists. Another challenge in the coming years will be the analysis of the simultaneous effects of different pressures. Phenomena such as, for example, the effects of climate change, the overexploitation of resources or the spread of alien species are, in fact, increasingly studied and known. Nevertheless, to date, the links between these specific pressures and the understanding of the cumulative effects on species, habitats and food chains, not only locally but also in the sub-basin, represent a complex but inevitable challenge.

The publications and reports published nationally in recent years and used for compiling this report, are often well developed and respond to the reporting needs on which they often depend, but are often incomplete concerning complex assessments, due to the lack of information on many species and habitats and to specific pressures of the subregion. Another open question, at the regional and national level, is the identification of methods for integrating the data collected through monitoring in order to make an assessment that is as representative of the good environmental status of the subregion.

Regarding the measures implemented by Italy, it is clear that these are generally appropriate and effective from a methodological point of view and are based on the forecasts and fundamental principles of the leading frameworks aimed at protecting biodiversity. However, application, especially at the local level, is not always efficient, underlining the need for more significant efforts aimed at improving the integration of the various environmental policies in territorial development plans and strategies, as well as the need to identify additional sources of financing directed to the sustainable development.

An example of the strengths of Italian policies for the protection of marine ecosystems is the system of Marine Protected Areas, well defined at a regulatory level, which covers more than 10% of the peninsula's marine surface, responding to Aichi Target number 11. This system, however, needs strengthening, both through the creation of systematic and coherent monitoring systems within the same subregion and through the increase of the area subject to integral protection constraints as well as the full implementation of site-specific management measures.

Concerning this issue, as well as many other treaties within the report, it is also necessary to consolidate synergies with the other countries with which Italy shares the sub-basin, encouraging the already very valid cross-border research projects, integrating the results achieved both in monitoring activities and in environmental policies in a concrete way, promoting cross-border measures.

In this context, the Adriatic Sea subregion can provide important examples and insights, considering the growing importance that international and cross-border cooperation is assuming on key issues strongly linked to the protection of biodiversity, and in particular also to sustainable development and blue growth. Indeed, the Adriatic Sea is a candidate to be a real "laboratory" for standard monitoring methods and shared approaches to assessing the state of the sea as well as integrated policies and measures for environmental protection and biodiversity protection.

This renewed commitment will play a vital role in the development of new and effective environmental policies for the Mediterranean post-2020 period.

1.

Reference documents and information consulted

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1.1. Documents provided by SPA/RAC and its international consultants

- *Classification of benthic marine Habitat types for the Mediterranean Region* (UNEP/MAP RAC/SPA, 2006).
- *Synthesis of National Overviews on Vulnerability and Impacts of Climate Change on Marine and Coastal Biological Diversity in the Mediterranean Region* (UNEP/MAP RAC/SPA, 2009);
- *The Mediterranean Sea Biodiversity: state of the ecosystems, pressures, impacts and future priorities* (UNEP/MAP RAC/SPA, 2010);
- *Impact of climate change on marine and coastal biodiversity in the Mediterranean Sea: Current state of knowledge* (UNEP/MAP RAC/SPA, 2010);
- UNEP/MAP 2017 Mediterranean Quality Status Report;
- *Dark Habitats Action Plan* (UNEP/MAP RAC/SPA, 2015)
- *Handbook for interpreting types of marine habitat for the selection of sites to be included in the national inventories of natural sites of conservation interest* (UNEP/MAP RAC/SPA, 2015).
- *Adriatic Sea: Description of the ecology and identification of the areas that may deserve to be protected* (UNEP/MAP RAC/SPA, 2015);
- *Adriatic Sea: Status and conservation of fisheries* (UNEP-MAP-RAC/SPA, 2015);
- *Adriatic Sea: Important areas for conservation of cetaceans, sea turtles and giant devil rays* (UNEP-MAP-RAC/SPA, 2015);
- *Adriatic Sea: Status and conservation of Seabirds* (UNEP-MAP-RAC/SPA, 2015);
- FAO State of Mediterranean and Black Sea Fisheries (2018);
- *Updated Classification of Benthic Marine Habitat Types for the Mediterranean Region* (UNEP/MAP RAC/SPA, 2019)
- UNEP/MAP-SPA/RAC, 2020. SAP/RAC: SPAMIs in the Mediterranean - January 2020.
- UNEP/MAP-SPA/RAC, 2020. SAP/RAC: SPAMIs in the Mediterranean;
- IUCN Red Lists;

1.2. National documents and publications identified and available

- Italian National Strategy for Biodiversity (2010);
- Italian Strategy for Adaptation to Climate Change (2010);
- Italian National Strategy for Sustainable Development (2017);
- National Reports about Italian Natural Capital State and, in particular, the III report (2019);
- Italian National Report for the Convention on Biological Diversity and, in particular, the VI report referred (2019);
- V Italian General Report to Bern Convention, referred to the period 2005-2008;
- Italian Report to CMS (2010);
- Italian IV Report pursuant to Article 17 of Directive 92/43/EEC;
- Reports about the Italian National Strategy for Biodiversity implementation

and, in particular, the IV report referred to the period 2017 – 2018;
- 2016 Report on the State of the Environment (MATTM, 2016);
- 2018 – 2020 Italian GSAs Management Plans for demersal fishes;
- 2019 Italian Yearbook of Environmental Data (SNPA, 2020);
- 2020 Report on the State of the Environment (MATTM, on publishing);
- Annual report on Italy's efforts during 2018 to achieve an enduring balance between fishing capacity and fishing opportunities (in accordance with Article 22 of Regulation (EU) No 1380/2013);
- Italian MSFD Reports under art. 8 (initial assessment) and their updates;
- Italian MSFD determination of good environmental status and related environmental targets;
- Italian MSFD National Monitoring Programmes and National Programme of Measures;
- CAMP Italy Project Final Report.

1.3. Other documents identified

- Protected species according to the SPA/BIO Protocol (Barcelona Convention) present in Italy. (Relini and Tunesi, 2009);
- Priority habitats according to the SPA/BIO protocol (Barcelona Convention) present in Italy. Identification sheets (Relini and Giaccone, 2009);
- Yearbook on the State of Biological Resources and on the Production Facilities of the Italian Seas (Maiorano *et al.,* 2019);
- Manuals for monitoring species and habitats of community interest (Directive 92/43/EEC and Directive 09/147/EC) in Italy: marine environment (La Mesa *et al.,* 2019);
- Italian National Monitoring Programmes methodological sheets elaborated by ISPRA;
- FAO Deep-ocean climate change impacts on habitat, fish and fisheries (2018);
- IUCN Red List of Italian vertebrates (Rondinini *et al.,* 2013);
- IUCN Red List of Italian anthozoans (Salvati *et al.,* 2014);
- IUCN Red List of Italian marine bony fish (Relini *et al.,* 2017);
- European Red List of Habitats (European Union, 2016);
- EEA Multiple pressures and their combined effects in Europe's seas (Korpinen *et al.,* 2019);
- Marine protected areas in Europe's seas An overview and perspectives for the future, N.0/2015. (EEA, 2015);
- MedECC Risks Associated to Climate and Environmental Changes in the Mediterranean Region (Cramer *et al.,* 2018).

1.4. Quality and comprehensiveness of available information documents

The documentation relating to the state of the Mediterranean marine and coastal environment outlines a complete picture if it refers to the entire basin. Still, there are currently no reports available that specifically analyze the situation of the three marine subregions, except for some RAC/SPA reports referred to ADRISEA and ICMED.
However, we believe that the adoption of the Marine Strategy Framework Directive (MSFD) in the Italian legal system will be pivotal for the evaluation of the state of the environment in the three sub-regions.

Indeed MSFD implementation, that requires subregional evaluations has led, from 2010 to today, to a considerable effort in identifying specific pressures and impacts for the three areas, as well as the definition of habitats and species indicative of the state of the ecosystems. These aspects analyzed in the Reports relating to article 8 of the MSFD and inferable from the data collected through monitoring, available on the National Centralize Information System *(http://www.db-strategiamarina.isprambiente.it/app/#/)*.

Although the national commitment proves to be significant, both within the National Monitoring Program and the Measures Program, due to the recent establishment of the Framework Directive and its complexity, in-depth assessments based on long historical data series are not currently available.

Overall, national and Mediterranean reports about biodiversity are clear, but not always complete. Information provided, indeed, are often referred to the entire Mediterranean basin or the whole of the Italian nation and do not identify the specificities of the individual subregions, except for the more recent ones referred to the MSFD.

The information reported mainly derives from national reports and publications often linked to Italian or European regulatory instruments or linked to international conventions. Moreover, manuals and checklists, as well as Mediterranean and European reports, have been used. We decided to refer, first of all, to institutional documents, basing the analysis on those that best reflect the national and sub-regional situation, then using the most current and updated ones.

Most of the scientific articles cited in the report have been selected because used as sources in official reports. To give a picture as updated as possible information from recent scientific papers and publications have been included, when appropriate. Finally is not always easy to identify the most updated version of documents, even on institutional sites.

2.

Marine and coastal ecosystem status

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2.1. Biological characteristics

2.1.1. Description of water column biological communities

Although Italy boasts a long experience in plankton sampling, the last manual drawn up at national level dates back to 2006. In particular, the Ministry for Environment, Land and Sea Protection (MATTM), with the technical-scientific support of the Central Institute for Scientific Research and Applied Technology to the Sea (now merged into ISPRA) had prepared a guide for the recognition of phytoplankton and neritic zooplankton, referring to all national waters (Avancini *et al.*, 2006a; 2006b). It is therefore not possible at the moment to develop a specific characterization referring to the subregion, except through a review of the literature currently available.

Since in the WFD context (and consequently also in the MSFD context) the composition and abundance of phytoplankton are not used for evaluation purposes because shared metrics or consolidated approaches have been defined, it is currently possible to provide elements about the distribution of phytoplankton production only by referring to the parameter *chlorophyll-a*.

By way of example, a graphical representations relating to *chlorophyll-a* trend for the subregion, obtained from the processing of MSFD monitoring data, are shown in Figures 1 and 2.

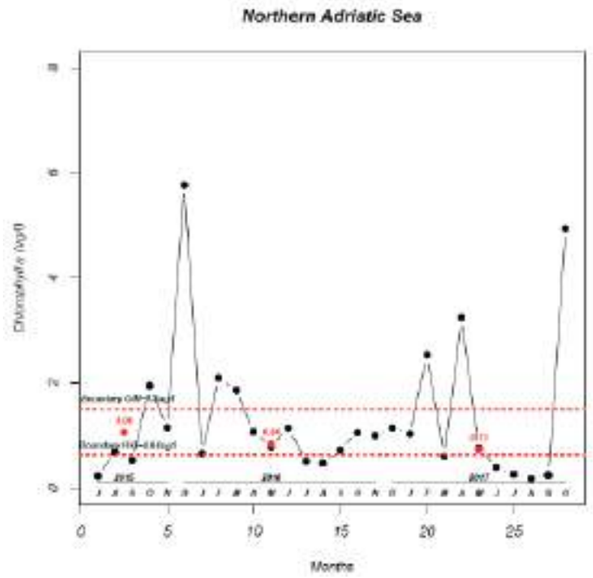


Figure 1

Concentrations (µg/L) of Chlorophyll-a (monthly geometric averages in black and annual average in red) in the marine waters of the Northern Adriatic Sea. The dashed lines represent the threshold values H/G (high/good) and G/M (good/moderate) of the parameter corresponding to type II A Adriatic. Source: ISPRA, 2018a.

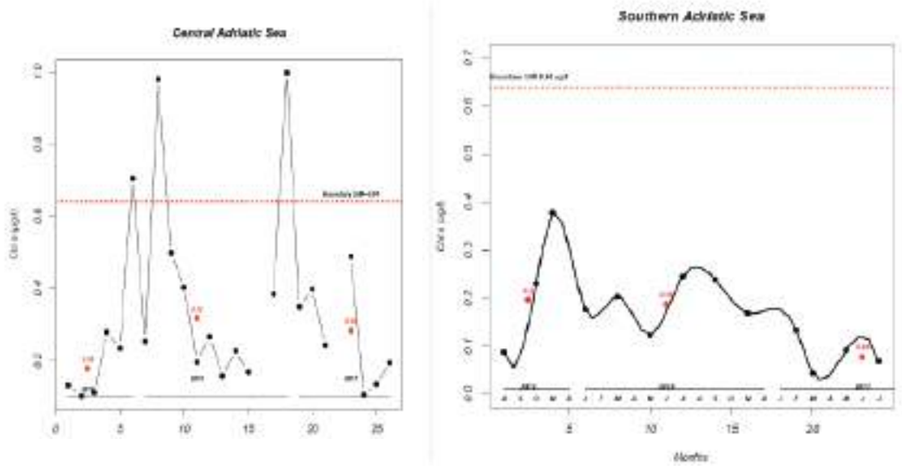


Figure 2

Concentrations (µg L) of Chlorophyll-a (monthly geometric averages in black and annual average in red) in the marine waters of the Central and Southern Adriatic Sea. The dashed line represents the G/M (good/moderate) threshold value of the parameter corresponding to the Type III W Adriatic type. Source: ISPRA, 2018a.

2.1.2 Information on invertebrate bottom fauna, macro-algae and angiosperms including species composition, biomass and annual/seasonal variability

Information about the species that constitute the Italian marine and coastal biodiversity, in the three marine subregions, come in particular from scientific literature, rather than from systematic and institutional monitoring and reporting, except for the species listed in the annexes of the Habitat Directive and evaluated under MSFD. Therefore, at the moment there are no available assessments relating to distribution, biomass and annual/sasonal variability relating to a single species for the entire subregion, but only locally, for individual cases. In order to complete this report, it was therefore decided to refer primarily to the species listed in the SPA/BD Protocol Annexes, especially considering information contained in the SIBM manual "*Protected species according to the SPA/BIO Protocol (Barcelona Convention) present in Italy*" (Relini and Tunesi, 2009), although the species inserted with the latest updates are not described. Where appropriate information coming from other sources are also reported and citate.

Angiosperms

The Italian Adriatic Sea marine subregion is home to four species of angiosperms. Among these, *Posidonia oceanica* shows the widest distribution and a greater biomass, forming extensive meadows in the infralittoral zone, from the surface of the sea to a maximum depth of about 40 m. Figure 3 describes the distribution of the meadows monitored under 2000/60/EC in the subregion and their classification relative to the *BQE Angiosperms* (ISPRA, 2018a).

Figure 3

classification for the EQB Angiosperms in the MSFD Adriatic Sea sub-region Modificated from ISPRA, 2018.

The warm-water species *Cymodocea nodosa* is widely distributed throughout the Mediterranean Sea. While local regressions of *Cymodocea nodosa* have been recorded in sectors subjected to heavy pressure from human activities, this species seems to be more influenced by long-term natural fluctuations, such as variations in salinity, the action of herbivores and climate change. There is also the growing evidence that, in degraded meadows, *P. oceanica* may be replaced by *C. nodosa* (Pergent *et al.,* 2012).

Zostera marina forms uninterrupted meadows or scattered tufts at the rivers mouths or around submarine springs, in the midlitteral and upper infralittoral zones, not exceeding 10 m of depth. The only meadow confirmed in Italy is the one recorded in the Panzano Bay, in the Gulf of Trieste. Scattered spots are known in the submarine springs of the seashore in Trieste and it is recorded in the Venetian Lagoon. It is considered regressing everywhere, especially because of frequent cryptogamic infections and due to the decreased flow of many water courses.

Zostera noltii grows forming not very dense meadows in a sheltered environment of lagoons and bays with superficial fine muddy sands. The species is distributed in all three marine subregions and does not present significant conservation problems.

Macro-algae

The brown algae of the genus *Cystoseira* are distributed on hard substrata of the lower mesolitoral plane and of the infralittoral fringe, up to the circalitoral plane, where they can produce typical belts and structure homogeneous populations capable of hosting a rich and diversified component of animal and plant species.. Among the most important structuring species it is possible to find: *Cystoseira amentacea, C. spinose* and *C. zosteroides.* It is also possible to detect populations formed by the following species: *C. barbata, C. brachycarpa, C. compressa, C. crinita, C. elegans, C. foeniculacea, C. humilis, C. sauvageauana.*

Cystoseira amentacea is present in the Italian subregions with three varieties (Giaccone *et al.,* 1994): *C. amentacea v. stricta, C. amentacea v. amentacea, and C. amentacea v. spicata.* The latter is mainly distributed in the Adriatic Sea, but recorded almost everywhere also in the other sectors. The population of the three varieties is recorded and substantial in all rocky coasts of the peninsula and of the islands but the state of preservation becomes precarious in areas with a strong urban, industrial, agricultural and zootechnical anthropization.

Cystoseira spinosa is present on the rocks of the lower limit in the infralittoral zone. The Italian subregions host three varieties: *var. compressa*, stenoecious and microphotic, populates rocky substrates with poor sedimentation, clear water and fluent one-directional hydrodynamism in the lower infralittoral zone; *var. tenuior* and *var. spinosa* are europhotic. The two varieties *spinosa* and *compressa* are strongly regressing both on the Italian coasts and in the Mediterranean Sea, while the variety *tenuior*, mainly recorded in the eastern Mediterranean Sea and in the Adriatic Sea, is expanding in all the habitats undergoing environmental unstableness. In particular, tolerating a certain environmental instability, it is recorded all over the infralittoral zone.

Cystoseira zosteroides is distributed all over the rocky circalittoral zone of the three Italian subregions, recorded above 40 m depth in the presence of rising currents. In Italy the species is in regression, mainly on the rocky coasts with upwelling currents, because of the heating of waters at depths between 15 and 40 meters.

Another important structuring species is the brown seawed *Laminaria rodriguezii,* widespread in environment characterized by one-directional currents, in the rocky circalittoral and coastal detritic bottoms with stable thermocline. It is present in almost all the Italian islands and in the Strait of Sicily. Important sources of disturbance for the species are represented by mudding of substrates and excessive dragging from trawl-nets. Some populations have been reported in the Adriatic Sea, where recent studies indicate a strong regression of the species, in particular due to the impact of fishing activities (Žuljevic *et al.,* 2016).

Among red algae, two species of bioconstructive *Corallinaceae* play an important ecological role: *Lithophyllum byssoides* and *L. trochanter*. Both the species are frequently distributed in all the three Italian subregions, in clean environments exposed to the wave motion on subvertical rocks in the midlittoral and infralittoral fringe. The species are regressing due to the strong both urban and industrial anthropization of the coasts.

Moreover, at a few locations under optimal hydrodynamic conditions, the calcified thallus of *Lithophyllum byssoides* can form extremely delicate rims in the lower mesoliotoral horizon. Due to its continuing decline in spatial extent and biotic quality, this biogenic concretion is considered vulnerable on the EU Red List of Habitats, as well as the one characterized by the algae *Neogoniolithon brassica-florida* and the vermetid gastropod *Dendropoma petraeum* (Gubbay *et al.,* 2016).

The *Gloiosiphoniaceae Schimmelmannia schousboei,* typical of cool superficial poorly lit waters with undersea springs, is reported as a very rare species in the Adriatic Sea. Its rarity makes of it an endangered species and the most important causes of threat are pollution and deflection of the littoral water table.
Finally, *Lithothamnion coralloides* and *Phymathplithon calcareum*, represent the main components of the maërl in Italy. The presence of this habitat (monitored under the MSFD), and therefore of the two species (assessed, instead, under the Habitat Directive), has been observed also in the Adriatic basin, although the greatest number of reports concern the Western Mediterranean Sea (Agnesi *et al.,* 2009).

Invertebrate bottom fauna

Regarding soft-bottoms, sediment characteristics (both physical and chemical) and their organic enrichment is one of the important factors that regulate the distribution and composition of the communities in the Adriatic Sea (UNEP/MAP-RAC/SPA, 2015a).

Regarding hard bottoms, instead, coralligenous habitat is one of the most studied. A checklist of the species that make up the coralligenous in the Italian seas is shown in Annex I, together with an indication of the structuring function of the species. In the Annex, the list of species commonly associated with the habitat is also reported (MATTM-ISPRA, 2018).

Many species of *Porifera* are present in the coralligenous, such as *Axinella cannabina, Axinella polypoides, Calyx nicaeensis, Spongia lamella, Sarcotragus foetidus* while other species make up their populations (*Clathrina clathrus, Acanthella acuta, Aplysina cavernicola, Axinella damicornis, Chondrosia reniformis Cliona viridis, Geodia spp, Haliclona citrina, Mediterranean Haliclona, Spongia officinalis, Petrosia ficiformis, Oscarella laburalis*) (MATTM-ISPRA, 2018).

With regard to the common species present in the Adriatic basin, some such as *Aplysina cavernicola*, *Axinella cannabina*, *Tethya aurantium, Geodia cydonium* and *Tethya citrina*, are often endangered by casual and unnecessary collection.

Axinella polypoides, instead, like all erect species, may be damaged by fishing gear and by an indiscriminate collection, mainly due to its widespread presence, although in limited habitat (circalittoral hard or detrital seabeds).

Some species of the genus *Spongia*, such as *S. lamella, S. officinalis* and *S. zimocca,* are of great commercial interest and subject to commercial fishing, so much that the last two species run the risk of being overfished. A further source of pressure is constituted by water pollution, like for the hardly detectable species *Petrobiona massiliana*, which dwells in cryptic habitats as marine caves and, more rarely, on the undersurface of stones.
A recent IUCN study carried out on 112 anthozoans species, although for most of them there is a significant lack of data, highlighted that 4 species are to be considered *Critically Endangered*, 2 *Endangered* and 4 *Vulnerable (Table 1).* Of the 112 species assessed, 10 are at risk of extinction. Considering that 60% of the species are *Data Deficient*, and assuming that the proportion of threatened species among these would be the same as among the data sufficient species, the study estimates that 14% of the Italian anthozoans are threatened with extinction. Only 32 species are currently classified as Least Concern (Salvati *et al.,* 2014).

An important assessment carried out in the same study concerns the demographic trends of populations, also evaluated in relation to the type of habitat (Figure 4). The availability of information is, however, limited to about 30% of the species evaluated. In relation to these percentages, it was found that most are stable or declining, while almost none are growing (Salvati *et al., 2014*).

Table 1

list of threatened It alian anthozoans. Modified from IUCN Red List of Italian anthozoans, Salvati *et al.,* 2014.

Order	Family	Species	RED LIST category
Alcyonacea	Isididae	*Isidella elongata*	CR
Pennatulacea	Funiculinidae	*Funiculina quadrangularis*	CR
Scleractinia	Caryophyllidae	*Lophelia pertusa*	CR
Scleractinia	Oculinidae	*Madrepora oculata*	CR
Alcyonacea	Coralliidae	*Corallium rubrum*	EN
Antiphataria	Leiopathidae	*Leiopathes glaberrima*	EN
Alcyonacea	Gorgoniidae	*Eunicella singularis*	VU
Pennatulacea	Virgularidae	*Virgularia mirabilis*	VU
Scleractinia	Caryophyllidae	*Desmophyllum dianthus*	VU
Scleractinia	Dendrophylliidae	*Dendrophyllia cornigera*	VU

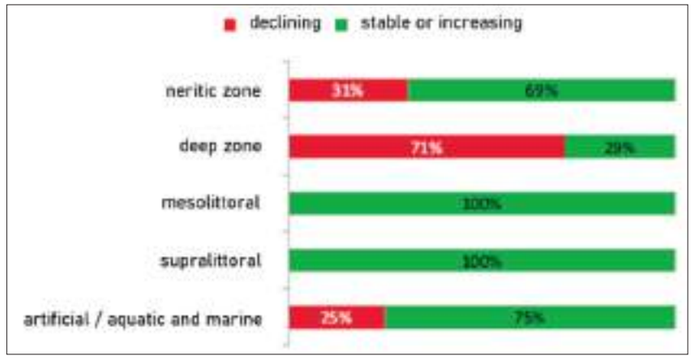


Figure 4

Demographic trends of Italian anthozoans in the different habitat categories considered. Modified from IUCN Red List of Italian anthozoans, Salvati *et al.,* 2014.

Corallium rubrum is the only species for which a historical series of data is available, being evaluated in Italy under the Habitat Directive. It is considered in a favourable conservation status but trend is unknown (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC). The species is distributed in all the Italian marine subregions and, in particular, abundant populations have been recorded in the Sicilian Channel (Bavestrello *et al.,* 2019). The excessive collection for commercial purposes represents the greatest source of pressure on the species in Italy as in the whole Mediterranean. Although the fishing of the species is currently regulated throughout the European Union and in Algeria and Morocco, red coral fishing has lead to a strong reduction of average colony dimensions (up to a depth of 50 m) and impoverished many deep banks. More recently, the effect of thermal stress on more superficial stands has also been recorded. The protection of the coral is, in fact, difficult to achieve as the fishing harvest is difficult to verify and easily concealable (Bavestrello *et al.,* 2019).

Along the eastern side of the Adriatic coast several populations of *Savalia savaglia* and *Anthipatella subpinnata* have been recorded, which play a key role both under a structural and functional point of view, being true ecosystem engineers (Cerrano *et al.,* 2010). Common sea pens such as *Funiculina quadrangularis*, *Virgularia mirabilis*, *Pennatula rubra* and *Ptereoides spinosum*, widely distributed in the Adriatic basin, are endangered by fishing activities of the most commercial value species like *Nephrops norvegicus*, with whom they share the habitat (UNEP/MAP - RAC/SPA, 2015a). *Antipathella subpinnata* has been recorded on the depths of the Tremiti Islands and it is endangered by trawl fishing (which destroys colonies and habitat) and by hight sedimentation.

In general, it can be noted that the main threat to Italian anthozoans is accidental mortality, due to fishing gear, which damages sessile species (10 species are at risk for this reason), especially those living along the continental platform and slope. For many animals, external threats interact with intrinsic factors (biological characteristics) that increase the likelihood of decline under external pressures. For the shallow water species, however, living in the tidal areas, in the lagoons, in the phanerogams or in the coralligenous bioconcretions, it is important to take into consideration also other risk factors, such as sedimentation, dredgings, pollution, anchorages, tourism, more related to the wide coastal urbanization (Salvati *et al., 2014*).

Concerning the Bryozoans, information is available regarding the genus *Hornera*, surely represented in Italian waters by the species *H. frondiculata*. In contrast, the species *H. lichenoides* seems to be absent, while the presence of another species, *Hornera sp*, not yet described and probably not present in the Adriatic Sea, was found. *H. frondiculata*, widely recorded, seems to be a species typical of coralligenous and corse-grained detritic bottoms. It is threatened by voluntary collection or accidental damage by scuba divers. Although more research is needed to evaluate the presence of large bryozoa in Adriatic areas, the available data show the costant present of *Tubicellepora incrasstata* (Relini and Giaccone, 2009). Some studies reported also the presence on offshore grounds of big quantities of the species *Amathia semiconvoluta* (Grati *et al.,* 2013).

The Italian marine waters, in the three subregions, host a high number of *Mollusca* species, for some of which checklists and classifications are still being updated, also due to the scarce information available. Concerning the *Gastropoda* class, out of about 1,000 species of prosobranchs and heterobranchs heterostrophies listed for the Mediterranean by Sabelli *et al.,* (1990; 1992), more than 75%, on the basis of the *Checklist of the flora and fauna of the Italian seas,* occur along the Italian coastline (proving how representative Italian fauna are in the Mediterranean basin). There are very few strictly endemic species, and probably no species can be considered endangered, but many species belong to communities of endangered or reverted biocoenoses along the Italian coastline, such as *Posidonia oceanica* meadows (Relini, 2008).

The gastropods *Mitra zonata* and *Tonna galea,* common on Italian seashores and in particular in the Adriatic Sea, are endangered by fishing, the first for ornamental purposes while the second for both food and ornamental purposes. The species *Luria lurida,* commonly recorded on Italian and Mediterranean seashores, might be an endangered species in the near future, due to fishing carried out by scuba divers who collect it for ornamental purposes.

Lithophaga lithophaga is considered in a favourable *conservation status* in Italy, while trend is unknown (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC). It is extended in all the Italian marine subregion and is endangered by illegal fishing carried out by scuba divers, which involves the destruction of substrates and leads to severe ecological consequences (Cerrano, 2019a). Also the indiscriminate fishing, carried out by scuba divers, of the species *Pholas dactylus*, common throughout the Mediterranean Sea, involves substrate destruction and severe ecological consequences.

Pinna nobilis, whose presence is reported along all the Italian coasts, is considered to be in a bad conservation status, while trend is unknown (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC). The species is endangered by regression of *Posidonia* meadows and also subject to collection for ornamental and food purposes. Furthermore, it is vulnerable to habitat loss, anchors, fishing gear, in particular to fixed gill nets and illegal trawling, and to climate change (La Mesa and Tunesi, 2019a). The negative effects related to the expansion of the presence of non-indigenous species, such as the alga *Lophocladia lallemandii*, can alter its potential sources of food (Basso *et al.,* 2015).

Finally, the species *Pinna rudis*, rare throughout the three Italian marine subregions, is mainly threatened by habitat destruction (*Posidonia* meadows and pre-coralligenous biocenosis) and direct commercial fishing.

Regarding *Echinodermata,* the endemic Mediterranean species *Astetina pancerii* is mainly recorded in meadows of *Posidonia* (between the leaves), in particular in the Western basin, but since it is a not well known species, studies covering a wide range of aspects must be forwarded. Living closely linked to the *P. oceanica* meadows, the species is threatened by the regression of this habitat. *Paracentrotus lividus* is widespread throughout the Italian waters. The cause of a steady decrease of Mediterranean stocks are fishing and industrial pollution.

Centrostephanus longispinus is considered in a favourable conservation status in Italy, while its trend is unknown (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC). Is present in Italy in all the marine subregion with the variety *longispinus.* The species lives on hard bottoms, typically coralligenous, where during the day remains protected in ravines and cavities and to detrital bottoms; is considered rare but this rarity is often considered apparent and essentially linked to the inaccessibility of its habitat and due to traditional sampling methods (Cerrano, 2019b). Some studies have identified depth as the most important variable for predicting the distribution of this species, followed by the type of substrate and the presence of flat bottoms (Guallart and Templado, 2012). Biology, ecology and the status of this species are not known. The lack of information makes the species particularly vulnerable, especially in light of anthropogenic impacts such as artisanal fishing and water acidification. A certain source of danger for this hedgehog is represented by the collection in underwater diving (Francour, 1991).

Finally, regarding *Crostacea*, many species present in Italian waters are exploited by commercial fishing and their abundance and distribution are known, while for others, not subject to fishing, not much information is available.

Palinurus elephas, recorded in all the Mediterranean Sea, and *Scyllarus arctus* are endangered by overfishing. *Maja squinado*, also subject to commercial fishing, is distributed in the three Italian marine subregion and commonly recorded along the coast of Liguria (WMED) while *Scyllarus pigmaeus*, recorded in all the Mediterranean Sea, is a rare species occasionally caught by trammel and creel fishing. It is often discarded because it is considered a juvenile specimen of other species of the family *Scyllaridae.*

Scyllarides latus, present throughout the Mediterranean, with the exception of the central and northern Adriatic (La Mesa and Tunesi, 2019b), is considered to be in a bad conservation status, while trend is unknown (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC). The main threat to *S. latus* is over-taking. The commercial interest for the species, also favored by its large size, has led to the overexploitation of populations in most of the area and especially in the Azores and Italy and (Bianchini and Ragonese, 2007; Pessani and Mura, 2007).

2.1.3. Information on vertebrates other than fish

Marine Mammals

The species of marine mammals recorded in the Adriatic Sea, with different densities, are: *Tursiops truncatus, Delphinus delphis, Stenella coeruleoalba, Balaenoptera physalus, Physeter macrocephalus, Globicephala melas, Grampus griseus and Ziphius cavirostris* (Holcer *et al.* 2002). Additionally, two more species, considered visitors to the Mediterranean Sea, have been recorded with solitary individuals: *Pseudorca crassidens* and *Megaptera novaeangliae* (Holcer *et al.,* 2002; Genov *et al.,* 2009).

The information reported in this section derive, in particular, from the volume "*Manuals for monitoring species and habitats of community interest (Directive 92/43/EEC and Directive 09/147/EC) in Italy: marine environment*" (La Mesa *et al.,* 2019). Where appropriate information coming from other sources are also reported and citate.

Table 2

species assessed by Italy under Directives Habitat (92/43/EEC) and MSFD (2008/56/EC) and their conservation status.

Species	Conservation Status (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC)	Trend (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC)	MSFD
Balaenoptera physalus	favorable	unknown	X
Delphinus delphis	unknown	unknown	
Globicephala melas	unknown	unknown	
Grampus griseus	unknown	unknown	
Monachus monachus	bad	unknown	

Species	Conservation Status (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC)	Trend (Italian IV Report pursuant to Article 17 of Directive 92/43/EEC)	MSFD
Physeter microcephalus	unknown	unknown	
Stenella coeruleoalba	favorable	unknown	X
Tursiops truncatus	favorable	unknown	X
Ziphius cavirostris	unknown	unknown	X

Tursiops truncates is the most common species of marine mammal in the coastal area of all three Italian subregions and it is the only species present consistently in the Adriatic Sea. In particular, in the central-northern Adriatic basin it is found in groups of 2-15 individuals especially in shallow waters, lagoons and estuaries (CNR - IRBIM, 2019). In the years 2010 and 2013 the density and spatial distribution of *T. truncates* in the vast area of the Adriatic basin was evaluated by aerial surveys, which allowed to evaluate the size of the population, ranging from 7,300 to over 10,000 individuals. (Fortuna *et al.,* 2011). The average density throughout the basin was 0.042 individuals / km^2, while for the northern Adriatic it was 0.057 individuals/km^2 (Fortuna *et al.,* 2018). Over that time, the density of sightings showed a tendency to gradually decrease from north to south. The abundance of the species is, in fact, lower compared to the past. Various events related to interactions with humans have caused the rarefaction of populations, like legal killings until the 1960s, accidental catch mortality due to commercial fishing and effects of the chemical pollution with negative influences on the immune system and reproductive capacity.

Balaenoptera physalus is considered sporadic in the Adriatic Sea. A study conducted in 2010 shows that, in this year, there was only one sighting in the Adriatic area, which occurred in the central-southern portion of the basin (ISPRA, 2012). The species is however considered nomadic and opportunistic. Its distribution, indeed, follows a particular pattern of contraction/dispersion caused by the variation in time and space of the availability of prey (Notarbartolo di Sciara *et al.,* 2016). The greatest impacts on the Mediterranean population of the species derive from the collision with ships, the contamination by organochlorines and trace elements and endocrine disruptors, which can alter their reproductive capacity. Other impact factors are: *Morbillivirus* infections, noise pollution and a general degradation of the habitat also linked to climate change.

The presence of *Delphinus delphis*, once very common, is now subject to a sharp reduction throughout the Mediterranean. The population has declined by more than 50% over the past 30-45 years. The intentional hinting and accidental catches in fishing gear, in particular between 1960s and 1980s, have led to a decline of the species in the Mediterranean, defined unsustainable for the population (International Whaling Commission, 1994). Other indirect threat factors concern the progressive degradation of the habitat (noise, chemical pollution and reduction of fish resources). The presence of this species in the Adriatic Sea is to be considered extremely rare and data are not available to estimate the number of individuals.

G. melas is considered a very rare species in the Adriatic Sea, with a presence limited to the southern portion (CNR - IRBIM, 2019).

The range of *Grampus griseus* is limited to the central-southern Adriatic, where a population of 510 individuals is estimated (Fortuna *et al.,* 2011). The interaction with fishing is a critical element (*bycatch* mortality events have been reported, especially in the past), as well as chemical pollution (aromatic hydrocarbons) that has negative influences on the immune system and reproductive capacities.

To date, there are no estimates on the size of *Physeter microcephalus* population for the Adriatic region; in fact, it is considered a "transit" species that does not regularly live in the basin (UNEP-MAP-RAC/SPA, 2014). The occasional presence of sperm whales in the Adriatic Sea is confirmed by 36 documented strandings, which occurred between 1555 and 2010 (Bearzi *et al.,* 2011). Furthermore, this is the only cetacean species that has had a mass stranding, in December 2009, when a herd of seven males ran aground on the northern side of the Gargano promontory (Mazzariol *et al.,* 2011). The commercial hunting of the species is estimated to have caused, in the past, a reduction of 70% of individuals in the Mediterranean. Today the main problems derive from anthropic activities and are represented by the accidental catches due to commercial fishing activities, by the collision with boats and marine noise.

The abundance estimates of *Stenella coeruleoalba* in the Adriatic indicate the presence of a population of about 15,000 individuals (ISPRA, 2012). Aerial survey carried out throughout the Adriatic in 2010 have shown that the presence of this cetacean appeared limited to the southern portion of the basin (ISPRA, 2012; UNEP-MAP-RAC/SPA, 2014), while the sightings are rare in the northernmost portions, due to its unsuitable bathymetric characteristics (CNR - IRBIM, 2019). The accidental catch due to commercial fishing is the most frequent cause of mortality. Another aspect of great criticality for the species is also the effect of the chemical pollution of the waters which determines the accumulation of organochlorines (PCB, DDT and derivatives), heavy metals and IPA (Polycyclic aromatic hydrocarbons). The high levels of contamination of the specimens has been directly related to the onset of *Morbillivirus* infection; between 1990 and 1992 the Mediterranean *Stenella* population has been affected by an epidemic of this virus which has resulted in the death of thousands of specimens.

Information on ecology of *Ziphius cavirostris* is very limited and there are no data to evaluate the abundance of this species in the Adriatic Sea (UNEP-MAP-RAC/SPA, 2014). From the distribution of sightings and strandings during both aerial (ISPRA, 2012) and on boats surveys (UNEP-MAP-RAC/SPA, 2014) conducted between 1939 and 2013, it can be deduced that the presence of this species is confined to the southern Adriatic. The sonar noise for military exercises is considered one the causes of disturbance and mortality events in the ICMED. Other disturbing factors are accidental catch due to commercial fishing and progressive degradation of the habitat (noise, chemical pollution and maritime traffic).

Marine reptiles

In the vast area of the Adriatic basin the presence of *Caretta caretta*, *Chelonia mydas* and *Dermochelys coriacea* has been reported, although the last two species are extremely rare. The total population of the three species is estimated at around 50,000 specimens, most of which come from nesting beaches in Greece, especially the island of Zakynthos

(Zakynthos) (Zbinden *et al.* 2011; Schofield *et al.* 2013) and make their way to the North-central Adriatic to feed attracted by the abundant concentration of fish (CNR - IRBIM, 2019).

Caretta caretta is widespread in all the Italian seas, where it can find all area types used in the different age classes, including migration corridors. Some stretches of coast of WMED and ICMED are also important nesting areas. In the Adriatic Sea has been identified as an important foraging area for *C. caretta* of all life stages (Casale and Simone, 2017), while the species is not nesting on the basin beaches due to excessive anthropization. Throughout the Adriatic, in the years 2010 and 2013, this species was found on average with 0.203 ind./km^2; in particular, the average density found in the northern Adriatic was 0.405 ind./km^2 (Fortuna *et al.,* 2018). The northern Adriatic Sea represents, indeed, an important area of aggregation of *C. caretta* in the neritic phase (Casale *et al.,* 2004, 2007). The Southern portion of the basin is, instead, a pelagic area for the growth of juveniles in an oceanic phase (Casale *et al.,* 2010). Finally, numerous strandings along the Adriatic coasts have been registered, such as the 468 individuals who beached at the AMP Torre del Cerrano between 2014 and 2018 (Di Camillo *et al.,* 2018).

C. caretta is subject, during all phases of its life cycle and during nesting, to various pressures related to anthropic activities, such as: frequentation and illumination of the beaches used for reproduction; sedimentological alteration of beaches; accidental catches caused by fishing activities (bottom trawls in the areas of neritic aggregation, longlines in the pelagic feeding areas and fixed nets near the breeding areas and coastal migration corridors), ingestion of plastic and other types of debris; intoxication by chemicals (Mo and Paglialonga, 2019). Over 11,000 incidental captures have been estimated to occur annually in the Adriatic Sea, mostly due to bottom trawlers (Casale, 2011).

Seabirds

Regarding the seabird species, the most closely studied in Italy are the ones included in the annexes of the Directive 2009/147/EC, also evaluated under the MSFD (Table 3).

Table 3

species assessed by Italy under Directives 2008/56/EC and 2009/147/EC and their phenology (referred to all the Italian waters).

Species	Phenology
Calonectris diomedea	Nesting
Hydrobates pelagicus melitensis	Nesting
Phalacrocorax aristotelis desmarestiis	Nesting/wintering
Puffinus yelkouan	Nesting
Thalasseus sandvicensis	Nesting/wintering
Ichthyaetus audouinii	Nesting/wintering
Somateria mollissima	Nesting/wintering
Gavia stellata	Wintering
Gavia arctica	Wintering
Podiceps nigricollis	Wintering
Mergus serrator	Wintering
Melanitta fusca	Wintering
Melanitta nigra	Wintering

Overall, in the Adriatic Sea, have been identified as areas of specific ornithological importance the Gulf of Venice and the central Adriatic. The Gulf of Venice support large numbers of tern and gull species, including *Larus melanocephalus*. Offshore, the area is home to regular aggregations of *Puffinus yelkouan*. A few thousand *Calonectris d. diomedea* and smaller numbers of *Puffinus yelkouan* nest on the islands of the central Adriatic Sea. *Phalacrocorax a. desmarestii* and *Larus audouinii* are present on the coast and *Larus melanocephalus* nests on the coastal salt pans and frequents the offshore waters. Because of the shallow depth of the large portions of the Adriatic, procellariiforms are instead scarce in the pelagic areas and only *Puffinus yelkouan* uses these productive waters to feed on clupeids and other small fish (Carboneras and Requena, 2010).

The breeding population of *Calonectris diomedea* was estimated to be of 13,344-21,873 pairs (Baccetti *et al.,* 2009), mainly concentrated in the islands. In fact, in the Adriatic the species is present only on the Tremiti Islands, where an estimated 400 breeding pairs nest (BirdLife International, 2013). They forage extensively over the mid-Adriatic basin and North to reach the productive waters of the Gulf of Venice (UNEP-MAP-RAC/SPA. 2015d). Various causes of disturbance of the species have been identified both on land during nesting when the main danger is represented by the possible predation of eggs or chicks by the black rat, and at sea, in particular caused by *bycatch* and by the decline of fishes, oil pollution and ingestion of plastic litter (Petry *et al.,* 2009).

The entire Italian population of *Puffinus yelkouan* has recently been estimated at 21,000-36,000 pairs, 12,000-19,000 of these nesting (Gaudard, 2018). The individuals are distributed in the three subregion in about thirty small and medium-sized islands and on some rocky stretches of the Sardinian coast. Being a long-lived species that reaches sexual maturity at 3-4 years of age, a significant fraction of immature individuals must be added to the reproducers, which contribute to the overall size of the population (Pezzo *et al.,* 2019).

The population breeding in the Adriatic Sea is mostly found between June and October, when about 2000 birds are present both for reproduction and for feeding, in particular along the north-west and the Croatian coast. The breeding population is relatively small in Italy, where just a few hundred pairs breed in the Tremiti islands (Bourgeois and Vidal, 2008). In a descending order, the main threats for the species are represented by: accidental catches in fishing gear; predation on adults, chicks and eggs by alien terrestrial predators (e.g., black rat, wild cat); reduction of fish stocks; chronic and persistent pollution (e.g., plastics, heavy metals, PCBs); reproductive habitat loss; direct human disturbance in colonies (e.g., invasive tourism); light pollution (Gaudard, 2018).

The recent international action plan dedicated to this species (*International Single Species Action Plan for the Conservation of the Yelkouan Shearwater - Puffinus yelkouan*) contributes in particular to guaranteeing the survival of adults, which is fundamental for the conservation of this species with a late sexual maturity (Gaudard, 2018).

Thalasseus sandvicensis has an extremely vast range and it is present in Europe with a single biogeographical population, characterized by two fairly disjoint nuclei: the first extends between the eastern North Atlantic and the Baltic Sea, the second between the Western Mediterranean and the Black Sea. The individual present in the Italian seas during

winter, especially in the western Mediterranean basin and in the Adriatic, came from the second nucleus (Pezzo *et al.,* 2019). In the Adriatic Sea a breeding population is recently settled (1979, Comacchio, Emilia Romagna) and has subsequently shown an increase of the number of birds and nesting sites. It is estimated that in coastal lagoon areas of Veneto and Emilia-Romagna are concentrated around 800 breeding pairs, equal to 0.1% of the European population (Nardelli *et al.,* 2015). Irregular nesting has also occurred in Puglia. In Italy the species shows a generally positive population trend (Nardelli *et al.,* 2015) and an expanding range; however, at the European level, the species has an unfavorable conservation trend.

The greatest dangers affect the nesting sites. The most common causes of colony failure are, indeed: changes in water level; predation by rats and gulls and anthropogenic disturbance, but the trampling by flamingos is also known (Nardelli *et al.,* 2015). In the Venice Lagoon the growing and unnatural phenomenon of high waters has often been the cause of flooding of important colonies (Pezzo *et al.,* 2019).

2.1.4 Inventory of the temporal occurrence, abundance and spatial distribution of non-indigenous, including invasive, species

One of the most recent inventories of marine non-indigenous (NIS), cryptogenic and data-deficient species was drawn up by Italy as part of the assessments conducted in 2012 for Descriptor 2 in the context of the MSFD. This inventory, which includes species reported by EC Member States up to 12/31/2011, has been recently refined using EASIN's data (Tsiamis *et al.,* 2019). The Italian update inventory is available for consultation in Annex 2 (Table A) and shows a total number of NIS of 266, 139 of which relate to ADRISEA.

The monitoring related to the first cycle of implementation of the Marine Strategy in Italy was previously concentrated in the port areas, considered at greater risk of the introduction of NIS and was aimed at the search for non-indigenous species of phytoplankton, mesozooplankton and benthos. However, the data obtained from these monitoring cannot be compared with literature data, as they were never systematically recorded before 2015 (the start year of the MSFD monitoring program in Italy) and therefore it is not possible to establish a trend.

The list of species found through the aforementioned monitoring program, in the years 2015 – 2017, is reported in the Annex 2 (Table B), together with the indications regarding the number of finds for the sub-region. The ports where the samplings were carried out are: Brindisi (Puglia), Ancona (Marche), Ravenna (Emilia-Romagna), Venezia (Veneto), Trieste (Friuli Venezia Giulia) (monitoring activities in this sites are still ongoing and they will end in December 2020) (ISPRA, 2018b).

A recent study drawn up by Servello *et al*. (2019) reviewed the data collected through the monitoring conducted as part of the Marine Strategy and described for each sub-region, taking into consideration the data available in literature, the Italian species of NIS divided by taxa. The review indicates the species invasiveness, settlement areas and possible vectors (for a more in-depth examination, refer to the aforementioned study). Very briefly, the work reports a total number of NIS for the Italian seas of 265 species, 143 of which detected in the ADRISEA. Most of these species were recorded in more than one subregion. Of these 105 species have established self-sustaining populations in the Adriatic Sea, while casual findings amount to 34. Approximately 44% of the NIS are warm water species, while 45% are cold species. Overall, for all the three Italian subregions, as regards the taxa involved, *Macrophyta* rank first, with 65 taxa. 55 of them are established in at least one sub-region, mostly in the ADRISEA and the ICMED. *Crustacea* rank second, with 48 taxa, followed by *Polychaeta* with 43 taxa, *Mollusca* with 29 taxa, and fishes with 28 taxa, which were mainly reported from the ICMED. Regarding rate of introduction, 45 new alien species were recorded in 2012-2017, i.e., approximately one new alien species every seven weeks.

2.1.5 Information on species of commercial interest for fishing (fish, mollusk and shellfish)

In Italy, data regarding the fishery resources exploited by fishing and the monitoring of the fishing fleet activity are collected through the *National Fisheries Data Collection Program*, conducted on the territory within the *Data Collection Framework* (DCF - EU Reg. 199/2008; Commission Regulation EC 665/2008 and Commission Decision EC 93/2010).
The demersal species considered as *target* in the sub-region GSAs management plan adopted by the Italy for years 2018 - 2020 are: *Merluccius merluccius*, *Parapenaeus longirostris, Solea solea, Mullus barbatus* and *Nephrops norvegicus.* Non - target species (species that contribute to making up 75% of the total volume of landings related to the GSA trawling systems are considered non-target) for GSA 17 are: *Squilla mantis, Sepia officinalis* and *Eledone cirrhosa.* Non-target species for GSA 18 are: *Eledone cirrhosa*, *Squilla mantis*, *Lophius budegassa* and *Lophius piscatorius*.

Those species are considered the most important ones in terms of volume and economic value of landings produced by the fishing segments considered by the plans. Moreover, recent analytical stock assessments in terms of spawning biomass, recruitment and fishing mortality are available for these species.

More detailed information about status indicators of the main commercial species, both demersal and pelagic, for all the Italian GSAs are contained in the 2019 *Yearbook on the State of Biological Resources and on the Production Facilities of the Italian Seas* (Maiorano *et al.,* 2019)[1]. A brief summary of the conclusions reported in the *Yearbook*, related to the ADRISEA GSAs (17 and 18), is provided in this paragraph. The assessments contained in the *Yearbook,* refer in particular to demersal communities on the western side of the Adriatic Sea basin only (Italian and international territorial waters) but the stocks present in GSAs are exploited not only by Italy, but also by Croatia and Slovenia.

1 The bathymetric units of reference for the elaborations of the 2019 Yearbook related to the MEDITS trawl-surveys are the 10-200 m and 200-800 m macrostrata (platform and slope). The time series are the years 1994 to 2016, for the trawl-surveys, and the years from 2009 to 2016 for the demersal resources and for the small pelagics of Campbiol.

GSA 17 – Northern Adriatic Sea

The analysis of the historical series of demersal fish reported in the 2019 *Yearbook*, referring to the years 1994-2016, highlighted a positive situation for *M. barbatus* which shows a statistically significant increase both for the abundance indices and for the occupied area. This increase is linked to the successful recruitment of the species, also reported for *P. longirostris*, which shows a peak of abundance in 2016.

S. officinalis results in a situation of stability while three important species in the area such as *M. merluccius, N. norvegicus* and *E. cirrhosa* show a fairly critical situation, linked to a significant decrease both for the abundance indexes and for the area occuped.
The assessments on the state of exploitation shows a state of overfishing in particular for *Solea solea* and *Squilla mantis*, despite a decrease in fishing mortality in recent years for both species and for *Merluccius merluccius*, assessed jointly for the GSA17 and 18.
In the case of the *Sepia officinalis*, although there are no clear indications of overfishing based on the reference points, the abundance is at a lower level than that of a healthy stock.

Regarding small pelagics species, the biomass of *E. encrasicolus*, estimated using acoustic methodology, shows considerable fluctuations in the period 1976 - 2016; in recent years a constant decrease has been registered, confirmed also in 2016. The biomass of *S. pilchardus* shows notable fluctuations, especially at the beginning and end of the analysis period (1976-2016); the last few years are characterized by a decline of the stock. For both stocks, with reference to GSA17 and 18, there is a state of overfishing.

GSA 18 – Southern Adriatic Sea

The 2019 *Yearbook* refers that, in general, only for *Mullus barbatus* current fishing mortality levels do not exceed the recommended levels based on the reference point (F_{MSY}), while for other species such as *Merluccius merluccius*, *Nephrops norvegicus* and small pelagics the exploitation is too high.

In the years 1994 to 2016, biomass and density of important species in the area such as *Mullus barbatus*, *Parapenaeus longirostris*, *Aristaeomorpha foliacea*, *Illex coindetii*, *Engraulis encrasicolus* and *Sardina pilchardus* show significant growth, while for *Merluccius merluccius*, *Nephrops norvegicus* and *Eledone cirrhosa* the abundance indices vary without any trend. Resources such as *Aristaeomorpha foliacea*, moreover, until a few years ago considered sporadic in the southern Adriatic, have density indexes which show considerable recruitment peaks, although contained compared to those of other species.

The L0.95 indicator appears to be significantly decreasing for many species: *Mullus barbatus, Illex coindetii, Nephrops norvegicus, Parapenaeus longirostris* and *Eledone cirrhosa*, for which (except for *Nephrops norvegicus*) an increase in the recruitment index is also observed. Furthermore, for *Mullus barbatus*, *Illex coindetii* and *Aristaeomorpha foliacea*, a recovery in abundance indices was observed in 2016. Significant positive trends are also observed for the occurrence of *Mullus barbatus, Eledone cirrhosa, Aristaeomorpha foliacea* and *Illex coindetii*. As regards small pelagics, the results of the acoustic surveys a highlight large fluctuations in the stocks of *E. encrasicolus* and *S. pilchardus*.

2.1.6 Others

In addition to fish species of commercial interest, the Italian seas are home to a great variety of coastal fish species, often threatened by tourist and economic anthropogenic activities.

In Italy there are 468 species of marine bony fish which make up about 78% of the total Mediterranean species. The species present belong to 132 families: some are particularly rich in species such as the *Gobiidae* (47 species) while families of *Sparidae, Labridae, Carangidae* and *Myctophidae* include at least 17 species each. However, most of the families represented in the Italian seas include small numbers of species: 71.9% contain a maximum of 3 species and 43.9% are monospecific families (Relini *et al.,* 2017).
With respect to the total of species, 407 have been considered native and included in a recent assessment, carried out by IUCN, about the risk of extinction of the Italian bony fish. According to this study, 8 species are threatened with extinction (1.9%) and 9 are close to be threatened Fiftyone (12.5%) lack sufficient data to determine their extinction risk (Table 4). The remaining 83.3% of the Italian bony fish species are not currently threatened with extinction. The population of most species are stable, but 7% are declining and 4% are increasing in number.

Table 4

List of threatened Italian marine bone fish. Modified from IUCN Red List of Italian marine bony fish, Relini *et al.,* 2017.

Order	Family	Species	RED LIST category
Perciformes	Sciaenidae	*Argyrosomus regius*	CR
Perciformes	Serranidae	*Epinephelus marginatus*	EN
Pleuronectiformes	Scophthalmidae	*Scophthalmus maximus*	EN
Perciformes	Serranidae	*Epinephelus aeneus*	VU
Perciformes	Serranidae	*Epinephelus costae*	VU
Perciformes	Polyprionidae	*Polyprion americanus*	VU
Perciformes	Sciaenidae	*Sciaena umbra*	VU
Perciformes	Scombridae	*Scomber scombrus*	VU

Accroding to Relini *et al.* (2017), *Argyrosomus regius* has been assessed as *Critically Endangered* as a decline of more than 80% is suspected in the last 75 years (3 generations), in particular due to overfishing and habitat degradation, consisting of coastal and estuarine environments. *Epinephelus marginatus* has been considered in danger in relation to the strong depletion of the populations due to excessive fishing activities. Recently there is a phase of restocking, in particular in the Marine Protected Areas, where anthropogenic disturbance is reduced (Relini and Tunesi, 2009; Reliti *et al.,* 2017). Even the species *Scophthalmus maximus*, of considerable commercial interest, has been strongly impacted since the 1970s by trawling.

For the 5 species considered in the *Vulnerable* category, a decline of at least 30% of pressures in the last 3 generations has been calculated, mainly due to excessive fishing pressure.

The reduction of the *Scomber scombrus* has also been attributed to the current warming phase of the Mediterranean which seems to favor the thermophilic congeneric species *Scomber japonicus* of which a conspicuous increase of the modifications has been noted. Moreover, in recent years, there has been a significant increase in the exploitation of the depth species *Centrolophus niger*, considered as *Near Threatened*. The specific fishing activity, carried out in particular in the Ligurian and Upper and Middle Tyrrhenian Seas, mainly concerns breeding individuals and has led, starting from 2012, to a population decline of 20-25% (last 5 years; one generation) and a further decline of 20-25% estimated for the future (29 years; two generations considering the potential levels of exploitation). Finally, the species *Hippocampus guttulatus*, *H. hippocampus* and *Pomatoschistus tortonesei*, listed in the SPA/BD Protocol annexes, are considered *Near Threatened*.

Regarding the two large pelagic osteichthyes *Thunnus thynnus* and *Xiphias gladius*, object of specific important fishing activities in all the Italian seas and carefully monitored on a Mediterranean and oceanic scale, a recovery of populations and a significant increased of the stocks, thanks to measures that regulate the catches envisaged by specific management plans based on a "conservation-dependent" approach, has been registered.

Another group of species that is particularly widespread and representative of the biodiversity of Italian seas is represented by cartilaginous fish. 76 species of *Chondrichthyes* have been reported in the three marine subregions, only a dozen of which can be considered occasional. The overall picture of the available information shows a worrying and net decline in the populations of cartilaginous fish in the Italian seas. The few series of data available indicate negative trends for the greater part of demersal spice, many of which once common, are now rare. Due to the significant lack of data it is not possible at the moment to elaborate evaluations about the status of many of these species and to identify protection measures, where necessary. From a study carried out within the IUCN about Italian vertebrate species (*IUCN Red List of Italian vertebrates*, 2013), however, it emerged that, considering the species for which, based on the information available, it was possible to identify the risk category, nine have to be considered *Critically Endangered* (*Alopias vulpinus*, *Galeorhinus galeus*, *Rhinobatos cemiculus* and *rhinobatos*, *Rostroraja alba*, *Squatina squatina*, *Squatina oculata*, *Squatina aculeata*, *Squalus acanthias*). Some species, including the dogfishes (*Mustelus mustelus*, *Mustelus asterias* and *Mustelus punctulatus*) and *Mobula mobular* are considered *Endangered*, while others, as *Prionace glauca*, are indicated as *Vulnerable*. Two species are close to a state of threat: *Leucoraja melitensis*, due to its small geographical range, and *Squalus blainville*, of which there are indications of decline (Rondinini *et al.,* 2013).

2.2. Main habitat types

The complexity in the ecology of the Mediterranean Sea can be mainly attributed to its geological history, combined with the diverse climate conditions that characterize its different zones and subregions. All these factors resulted in the coexistence of many ecosystems with a wide range of extent and distribution (UNEP/MAP and Plan Bleu, 2020).

The high variability of geographical, morphological and climatic conditions is reflected in a plurality of habitats and biocenosis along Italian coasts as well as in the surrounding basins. To give an overview of the representative environments of the subregion we focused on the priority habitats identified in the UNEP/MAP context as well as the habitats monitored according to the Habitat Directive, of which there are recent data on status and pressures.

The main information sources are La Mesa *et al. (*2019), Relini and Giaccone (2009), UNEP/MAP-RAC/SPA (2006, 2010a, 2019). If appropriate, information from other sources are also reported and adequately cited. As requested, we made an effort to compare the Habitats listed in the *"Classification of benthic marine Habitat types for the Mediterranean Region"* (UNEP/MAP-RAC/SPA, 2006) with the 2019 updated reference tool (UNEP/MAP-RAC/SPA, 2019). Please note that, to date, no handbooks or guides are available to compare the previous habitat list with the new classification. Therefore, the indication of the correspondence is indicative, and it should still be supported by scientific and official documents.

We refer to the IV Italian report under art. 17 of the Habitat Directive for information regarding conservation status and overall trend. The shape-files relating to the distribution of the habitats described in the IV report can be downloaded at the following link: http://www.reportingdirettivahabitat.it/downloads.

Coastal Lagoons

This habitat is present in the EU Habitat Directive (92/43/EEC, Habitat type 1150). These habitats may occur with different morphologies, sometimes dynamic over time, depending on sedimentary and hydrographic conditions. Variable connection with the sea can affect the salinity of these environments. Furthermore, the water can vary from brackish to hyperaline with rain, evaporation and arrival of new marine or continental waters, temporary flooding of the sea during the winter or exchange during the tide. The lagoons may appear without vegetation or with very varied aspects of vegetation. In both cases, the typical species are *Cymodocea nodosa*, *Ruppia maritima*, *Ulva* spp., *Chaetomorpha Ulva* spp (Villani, 2016).

Along the Italian coasts the remarkable variety of morphologies, accompanied by the different hydrographic and geological conditions, gives life to coastal lagoons that can take on peculiar forms and characteristic biocenosis.

On the coast of Northern Adriatic, we find Venice, Grado and Marano lagoons. These basins are constituted by large bodies of water, which are subject to some of the most extensive tidal excursions in the Mediterranean and the significant sedimentary contributions of main alpine rivers. These lagoons are delimitated by costal cordons that are interrupted in correspondence of the lagoon inlets, where tide spreads from the Adriatic Sea into the basins.

Down along the Adriatic coast, there are the "Valli", the most famous are those of Comacchio. These basins can present extremely variable dimensions and are distributed in correspondence with the Po delta, with essential supplies of freshwater and channels communicating with the sea.

Coastal lakes represent a different type of basin. The most important Italian coastal lakes are those of Lesina and Varano (located along the northern coast of the Gargano promontory in Puglia) and Alimini lakes that instead are further south. It is important to consider that many of these coastal environments have always been the nurseries for many species.

Transition environments are higly conditioned by natural hydrodynamics and human activity such as dredging of sub-lagoon canals or regulation of incoming and outgoing flows. The fluvial supply of loads of nutrients and pollutants of various types accelerates the natural eutrophication of the water with consequences on turbidity, development of algal flora and macrobenthic and fish communities. Among the critical issues, the presence of alien species is critical. In some cases, even indigenous animal species that are concentrated in limited areas and create mechanical damage to the seabed can be a risk (Villani, 2016).

For the correspondence in UNEP/MAP - RAC/SPA (2006, 2019) refers to:
Euryhaline and eurythermal biocenosis
UNEP/MAP - RAC/SPA, 2006: III.1.1, UNEP/MAP - RAC/SPA, 2019: MB5.54
Habitats Directive ANNEX I: 1150; EUNIS 2019: MB554

Seagrass Meadows

There are five strictly marine seagrass species in the Mediterranean Sea: one is endemic (*Posidonia oceanica*), three are also found in the Atlantic Ocean (*Cymodocea nodosa*, *Zostera marina* and *Zostera noltii*), and one is a Lessepsian migrant (*Halophila stipulacea*). These originate vast underwater meadows at between zero and 50 m down in the open sea and lagoons.

Seagrass form ecosystems of different structures, for the different environmental conditions and with the constituent species. The morphology of the various species, in fact, considerably affects the characteristics of their formations. The most impressive formations are those of *P. oceanica*. The formations of the other species, such as *C. nodosa*, *Z. marina*, *Z. noltii* and *H. stipulacea*, are usually smaller and less extensive. Very often seagrass meadows are mono-specific, but *C. nodosa*, *Z. marina* and *N. noltii* can be found in association, sometimes also with *P. oceanica*, especially in the sheltered areas along the coast. *H. stipulacea* can sometimes colonize areas with *P. oceanica*. The bathymetric distribution of seagrasses is related to light penetration but also hydrodynamic conditions (Relini, 2008a).

The *Posidonia oceanica* meadow
UNEP/MAP - RAC/SPA, 2006: III.5, UNEP/MAP - RAC/SPA, 2019: MB2.54
Habitats Directive ANNEX I: 1120; EUNIS 2019: MB252
The *Posidonia oceanica* meadow is among the most important ecosystem in the Mediterranean Sea in terms of its extent and role, and for both ecological and economic reasons.

The *P. oceanica* meadow is a priority habitat type for conservation under the Habitats Directive (Dir. 92/43/CEE, Habitat type 1120). This biocenosis is considered as the climax for the infralittoral sandy bottom habitats, is also present on hard bottoms, from the surface up to over 40 m depth (if there are good light conditions). *P. oceanica* prefers well-oxygenated waters and shows a relatively wide tolerance to variations in temperature and hydrodynamics, while it is sensitive to desalination, normally preferring a salinity between 36 and 39 ‰ and a temperature between 14-20 °C. The *Posidonia* meadows play a fundamental role in the marine ecosystem concerning primary production, biodiversity and balance of sedimentation dynamics. They also represent an excellent indicator of the quality of the marine environment (Rende, 2019).

The assemblage is exclusive to the Mediterranean but is regressing considerably both in the northern and in Middle Eastern parts. In Italy, it has almost disappeared throughout the High Adriatic Sea but is widespread elsewhere both on the mainland and island coastlines (Rende, 2019).

The animal population of the *Posidonia* meadows includes organisms that can be both on leaves and rhizomes. It is possible to group the animal species of the *Posidonia* meadow into five categories: sessile, micro- and meiofauna of the epiphytic felt, vagile fauna on leaves, bentho-nectonic on leaves and bentho-nectonic under the leaf canopy.

The ecosystem services of this habitat are relevant, also for appropriate conservation and management: it represents a spawning ground and nursery for many commercial species and a source of major primary production, plays an essential role in oxygenating the water, traps and fixes sediments, protects the beaches against erosion and enhances water transparency, being a useful tool for monitoring the quality of coastal waters. Finally, it can absorb and trap significant quantities of carbon dioxide (Mangos *et al.*, 2010).

Over the past century, *P. oceanica* has undergone a significant regression, especially near the most important industrial areas and ports. This regression, which affects both the lower and upper limits of the meadows, initially leads to a decrease in the density of leaf bundles and the increase (or new formation) of *intermatte* areas. There are numerous regression factors, most of which of anthropogenic origin, which often are acting in a synergic manner: the decrease in water transparency and the alteration of granulometry and sedimentary rate (often caused by beach nourishment), anchoring of boats, fishery and other trawling activities. Moreover, this biocenosis is quite sensitive to other specific disturbances such as pollution and dumping of urban and industrial not purified and undiluted wastewaters. Another cause of regression is the coverage deriving from the construction of coastal works (Rende, 2019).

Also, there are new pressures indirectly or directly linked to global change, such as the introduction of exotic species, and the rise of sea surface temperature and sea level. The competition from alien algal species and invasive macrophytes, in general, is a significant concern.

To assess the state of the *Posidonia* meadows specific monitoring programs, for the three Mediterranean subregions of Italy, have been identified within the MSFD. To date, there is an information gap that prevents to give an adequate assessment for the achievement of the GES for this habitat (ISPRA, 2018)

Sandbanks which are slightly covered by seawater all the time

This habitat is a priority habitat type for conservation under the Habitats Directive (Dir. 92/43/CEE, Habitat type 1110). The sandbanks are shallow sandy hills, always submerged (with a maximum depth of 20 meters). This habitat includes sandbanks without vegetation and those with sparse or well-represented vegetation, for the nature of sediments and the current characteristics of the individual site. Generally, in the Mediterranean, the biocenosis of well-classified fine sands is considered the one most corresponding to the characteristics of this habitat (Cerrano, 2019c).

In the case of vegetation, the marine phanerogams most commonly associated with this type of habitat in the Mediterranean are *Cymodocea nodosa*, *Zostera marina* and *Zostera noltii*, scattered patches of Posidonia oceanica and *Halophila stipulacea*. Among the algae, some species belonging to the genera *Gracilaria*, *Gracilariopsis*, *Polysiphonia*, *Rytiphlaea*, Cladophora, and *Chaetomorpha*. Due to the variability of the particle sizes and the presence or absence of marine phanerogams, this habitat can present a series of variations. A great variety of benthic organisms live in the sandbanks (Cerrano, 2019c). This habitat hosts communities with seasonal variability, therefore also subject to the effects of climate change. Coastal fishing activities, such as clam fishing using turbo blowers, widespread beach nourishment, extensive use of breakwater barriers and high attendance by bathers during the summer can profoundly alter the original structure of this habitat along the Italian coast, compromising almost everywhere the possibility of finding intact reference habitats. On a national level, the marine protected area of Torre Cerrano represents a relevant example of the protection of this habitat and is a reference site for deepening the knowledge of its natural and optimal structure (Cerrano, 2019c). The presence of sandbank is widely reported along all the Italian coasts especially in the top and middle Adriatic. According to the IV report under art. 17 of the Habitat Directive, the overall assessment of Conservation Status has been evaluated as unknown, as well as the overall trend.

Various biocoenosis of the Barcelona Convention and described along the Italian coasts can be referred to this habitat (UNEP/MAP - RAC/SPA, 2006 and 2019):

- Biocenosis of well-sorted fine sands;
- Biocenosis of coarse sands and fine gravels stirred up by the waves;
- Biocenosis of coarse sands and fine gravels under the influence of bottom currents (also to be found in the circalittoral zone).

Biocenosis of well-sorted fine sands

UNEP/MAP - RAC/SPA, 2006: III. 2. 2;
Habitats Directive ANNEX I: 1110; EUNIS 2019: MB552
Biocenosis of well-sorted fine sands is typical of the infralittoral area, from 2 to 25 m. Biocenoses of well-sorted fine sands are described throughout the Italian peninsula as well as in some Sicilian sites. These biological communities turn out to be sensitive to pollution, beach nourishment, landfill of sea areas, fishing and tourism. Other disturbing causes are related to the accumulation of debris and pollutants due to the high rate of sedimentation in specific periods of the year and the low exchange of water.

Reef and Bioconstructions

The reefs are made up of hard and compact substrates, of different nature and origin, which emerge from the seabed. They can be formed by geogenic rocks or biogenic constructions, due to the phenomenon of concretion produced by organisms, both animal and vegetable, capable of producing limestone. This habitat may present extremely heterogeneous environmental characteristics. In general, the animal and plant populations associated with this habitat differ significantly both with the structural complexity and the nature of the substrate and to the change in environmental conditions, such as the quantity of light, temperature, hydrodynamic, associated with the increase in bathymetry (Canese, 2019). This habitat is present as “Reefs” in the EU Habitat Directive (92/43/EEC, Habitat type 1170) and, given its heterogeneity, it presents several biocenoses. Only the main ones are considerate here. Regarding the deep-sea bioconstructions, they are discussed below.

Biocenosis of the upper midlittoral rock

UNEP/MAP - RAC/SPA, 2006: II.4.1; UNEP/MAP - RAC/SPA, 2019: MA1.53
Habitats Directive ANNEX I: 1170; EUNIS 2019: MA153
This biocenosis occurs in the upper horizon of the midlittoral zone with a higher covering rate in areas exposed to wave motion. The characteristic species of this biocenosis are the cirripeds crustacean *Chthamalus stellatus* and *C. montagui*, whose abundance depends on the extent of their exposition to wave motion, the gastropods *Patella rustica* and *P. ferruginea* (the former confined to the upper horizon of the biocenosis and the latter often in association with the former but most characteristic of the insular zones) and, finally, the Phaeophyta *Hapalospongidion macrocarpum*. This biocenosis is present especially in Southern Adriatic. It results to be vulnerable to wastewaters, hydrocarbons and trampling by bathers.

Biocenosis of the lower midlittoral rock

UNEP/MAP - RAC/SPA, 2006: II.4.2; UNEP/MAP - RAC/SPA, 2019: MA1.54
Habitats Directive ANNEX I: 1170; EUNIS 2019: MA154
The biocenosis of the lower subzone of the midlittoral zone is influenced by three main factors: the presence of waves, irregular variations in atmospheric pressure, and wind and tide when present. Flora and fauna of this biocenosis are richer than those of the biocenosis of the upper midlittoral rock. Among the algae, the characterizing species of this biocenosis are the Rhodophyta *Lithophyllum byssoides*, *Neogoniolithon brassica-florida* and *Calothrix crustacea* and among animals the chiton *Lepidochitona caprearum* and the gastropods *Patella ulyssiponensis*, *Osilinus turbinatus*, typical of an exposed environment and *Osilinus articulatus* typical of a sheltered environment. It results to be vulnerable to wastewaters and trampling by bathers.

Biocenosis of infralittoral algae

UNEP/MAP - RAC/SPA, 2006: III.6.1; UNEP/MAP - RAC/SPA, 2019: MB1.51
Habitats Directive ANNEX I: 1170; EUNIS 2019: MB151
The biocenosis of infralittoral algae is found on rocky substrates that can be more or less well lit. The fauna is rich and includes various crustaceans. The Corallinales form a very important basal concretion, together with the sessile gastropod *Vermetus triquetrus* and the sedentary polychaete *Spirobranchus polytrema*. Calcareous concretions are also due to the gastropod *Dendropoma petraeum* and the serpulid polychaetes.

This biocenosis is present along all Italian coasts, and it results to be vulnerable to turbidity due to wastewaters and industrial wastes. Other stressing factors are fishing and tourist activities.

Coralligenous

UNEP/MAP - RAC/SPA, 2006: IV.3.1; UNEP/MAP - RAC/SPA, 2019: MC1.51

Habitats Directive ANNEX I: 1170; EUNIS 2019: MC151

This circalittoral biocenosis, also present in the infralittoral zone, is characterized by weak light and by vegetal dominance in the organogenous construction. If the community of vegetal organisms is stratified, in the upper layer there are Phaeophyta, calcareous, spherical or filamentous Chlorophyta and in the underlying layer are present other Phaeophyta, encrusting Chlorophyta and calcareous Rhodophyta. It is also common to find various algae with soft thallus.

This biocenosis has been described along the Northern and Southern Adriatic coastline. For the great structural complexity and the multiplicity of microhabitats, the coralligenous can host an extraordinary variety of fauna and flora, so much so that it is considered one of the most important biodiversity hot spots in the Mediterranean.

There are numerous causes linked directly or indirectly to anthropic activities that contribute to the degradation and destruction of the coralligenous. Some, such as the anomalies in the summer thermocline linked to climate change underway, can act on a large scale, while others have effects on more or less limited areas. In this regard, we can mention: pollution and eutrophication; anchors and excavation activities for laying cables and pipes; fishing activities; the construction of maritime works and port structures that can act negatively both directly (covering the substrate) and indirectly (beach nourishment with the consequent increase in turbidity); the expansion of invasive non-indigenous species (NIS), such as algae *Caulerpa taxifolia* and in particular *Womersbeyella (Polysiphonia) setacea*, is dangerous.

Italy collects data relating to coralligenous in the framework of the Marine Strategy Monitoring Program. The surveys will provide useful information for overcoming the knowledge gaps concerning the presence and mapping of the habitat, as well as to provide a first characterization of the same and to highlight any portions of habitat affected by anthropogenic activities. Please, refer to Annex 1 for the species list.

Marine Caves

Underwater caves are remarkable habitats that represent a reservoir of knowledge and biodiversity as well as having, in many cases, a great aesthetic value (UNEP/MAP-RAC/SPA, 2015e). This habitat is present as "Submerged or partially submerged sea caves" in the EU Habitat Directive (92/43/EEC, Habitat type 8330) and it related to caves situated under the sea or opened to it, at least at high tide, including partially submerged sea caves (EUR 28, 2013).

The caves are abundant along Mediterranean rocky coasts, especially where karst processes are relevant (Danovaro and Boero, 2019). These cavities can vary significantly in terms of origin, size and ecological characteristics. Sciaphilic algae are mainly present at the mouth of the caves. This habitat includes semi-submerged caves (whose opening is partially above the sea surface) and submerged caves (whose opening is entirely below the sea surface); the latter can be both semi-dark and total darkness. The biological communities that inhabit these three types of caves are very different from each other (Bavestrello *et al.*, 2019a).

This differentiation is correlated at three different biocenoses:

Biocenosis of midlittoral caves

UNEP/MAP - RAC/SPA, 2006: II.4.3, UNEP/MAP - RAC/SPA, 2019: MA1.52

Habitats Directive ANNEX I: 8330; EUNIS 2019: MA155

The typical population of the semi-submerged cave biocenosis is characterized by the algae *Hildenbrandia rubra* and *Phymatolithon lenormandii*. In some cavities, it is also possible to find the Rhodophyta *Catenella caespitosa*, frequently present in the Adriatic Sea and along the western Italian coastline. The assemblage changes depending on cave typology and on the size of the opening towards the sea (related to hydrodynamic activity and light penetration are connected). Monk seal (*Monachus monachus*) used to visit some caves, particularly in Sardinia.

Biocenosis of semi-dark caves (also in enclaves at upper levels)

UNEP/MAP - RAC/SPA, 2006: IV.3.2, UNEP/MAP - RAC/SPA, 2019: MC1.53/MB1.56

Habitats Directive ANNEX I: 8330; EUNIS 2019: MC152

The biocenosis of semi-dark caves presents no herbivores as the vegetal component is absent except for some calcareous algae and it is dominated by sessile species mainly belonging to the madreporarians, sponges and bryozoans. The presence of *Corallium rubrum* is the most distinctive and well-known aspect of the biocenosis of semi-dark caves.

Caves and ducts in total darkness, biocenoses in enclaves in the upper zones

UNEP/MAP - RAC/SPA, 2006: V.3.2, UNEP/MAP - RAC/SPA, 2019: ME1.52

Habitats Directive ANNEX I: 8330; EUNIS 2019: ME152

Dark underwater caves are a reserve of unknown biodiversity and refuges for generally very non- resilient communities (UNEP/MAP-RAC/SPA, 2015e). The population of the dark caves is poorer in species in comparison with that of the semi-dark caves, but differently according to the various groups: the difference is low for sponges and bryozoans (20%) and very high for scleractinie (Madreporaria).

All types of caves are habitats with stable and spatially confined biotic communities. It is well known that climate change can lead to significant changes in the cave community with a trivialization of the community and a reduction of species with vertical development. Moreover, changes in the quality of the waters, due to accumulation of nutriments and contamination by run-off water, can impact these environments. Indeed, in several cases in the submerged caves have been observed leaks of freshwater of terrestrial origin that can carry pollutants, sometimes even of wastewater origin. These substances can quickly concentrate in environments such as these, where there is little water exchange. Instead in partially submerged caves, often visited by boats, solid waste and floating hydrocarbons can accumulate interfering with the delicate balance of these environments (UNEP/MAP-RAC/SPA, 2015e)

Scuba divers for their high aesthetic value visit submerged cavities often. This activity negatively affects the environment both due to the emission of air bubbles, which accumulate on the vault, destroying the communities present and by causing mechanical-abrasive damage caused by the passage of divers in spaces that are often narrow. In particular, fragile organisms with a carbonate skeleton such as cnidarians and, above all, bryozoans are affected by this impact.

To date a certain number of underwater caves enjoy protection status because they fall within the geographical boundaries of Marine Protected Areas such as at the Tremiti Islands (UNEP/MAP-RAC/SPA, 2015e).

According to the IV report under art. 17 of Habitat Directive, for this habitat the overall assessment of Conservation Status has been evaluated as favourable. Instead, the overall trend is reported as unknown. Indeed, the number of underwater caves that penetrate the rocky shores of the Mediterranean basin (as well as in the Italian seas) remains unknown and systematic mapping efforts are needed to fill the distribution gaps, especially in the eastern and southern parts of the Mediterranean (Bavestrello *et al.,* 2019).

Deep Seas

The deep-sea contains several potential "hot spots" of biodiversity, such as highly heterogeneous seafloor of open continental slope systems, submarine canyons, seamounts, pockmarks and volcanic ridges, deep-water coral reefs and other biogenic reefs, hydrothermal vents, cold seeps and related structures, gas hydrates, volcano fields affected by brines, abyssal plain deep and hypersaline anoxic basins (Danovaro *et al.,* 2010; Cartes *et al.,* 2004).

Biocenosis of bathyal muds

UNEP/MAP - RAC/SPA, 2006:V.1.1; UNEP/MAP - RAC/SPA, 2019: MF6.5 /MF6.51
EUNIS 2019: ME651
This biocenosis is typical of the bathyal area, below 150-200 metres. Constant homeothermy of around 13°C and almost total absence of light occur (Relini and Giaccone, 2009). Deep-water species are usually slow-growing with a low reproductive capacity and are adapted to live in an environment with a low energy turnover. The biocenosis of bathyal muds is one of the richest in terms of characterizing species, but the density of these species is low.

Two different facies, considered priority habitat, have been described in Italian Sea.
Facies of soft muds *with Funiculina quadrangularis* and *Aporrhais serresianus* - V. 1. 1. 3. (Refer to MF6.514 Facies with Pennatulacea in UNEP/MAP - RAC/SPA, 2019); it presents good representativeness in Italy and the WMED (Liguria, Lazio and Tuscany), but the conservation status under threat because severely endangered by trawling.

Facies of the compact muds with *Isidella elongate* - V. 1. 1. 4. (Refer to MF6.512 Facies with Alcyonacea in UNEP/MAP - RAC/SPA, 2019). They present good representativeness in Italy in the WMED (especially in Lazio but also present off the Ligurian, Tuscan and Sicilian coasts).

However, for both of them, the conservation status under threat because severely endangered by trawling. Indeed, one of the main traits for this kind of habitat it is represented by intensive trawl fishery. Trawl fishery carried out on these bottoms is mainly of Norway lobster (*Nephrops norvegicus*), pink and red shrimps (*Parapenaeus longirostris, Aristeus antennatus, Aristaeomorpha foliacea*) and a variety of fish (*Merluccius merluccius, Micromesistius poutassou, Phycis blennoides, Helicolenus dactylopterus, Mora moro, Lepidorhombus boscii, etc.*). Moreover, this environment may be affected by industrial and harbour wastes and by organic matter.

Biocenosis of deep sea corals

UNEP/MAP - RAC/SPA, 2006: V.3.1; UNEP/MAP - RAC/SPA, 2019: ME1.5
Habitats Directive ANNEX I: 1170; EUNIS 2019: ME151
The biocenosis of deep corals is also known as the biocenosis of white corals due to the absence of zooxanthellae (symbiotic dinoflagellates) that give the characteristic colour to tropical corals. This biocenosis is characterized by the presence of three species of massive colonial Madreporaria with extremely slow growth: *Lophelia pertusa*, *Madrepora oculata* and *Desmophyllum dianthus*. These species can be present from 200 meters deep, usually along the walls of canyons. This biocenosis extends up to the bathyal environments (2000 meters deep), and its colonization capacity is generally connected to the presence of currents capable of transporting the nourishment necessary for growth to the colonies of the corals, basically composed of zooplankton and suspended debris (Canese, 2019). The biocenosis of deep corals is also characterized by numerous other species of porifera, polychaetes, bryozoans and other cnidarians which grow on the dead portions of the madrepores and the surrounding rocky substrates and which, in turn, combine to compose a favourable habitat for the life of vagile species, such as crustaceans and molluscs, and acting as a nursery for fish species that spawn here (Canese, 2019). These sites, therefore, represent great hotspots of marine biodiversity.

Cliffs at *Madrepora oculata* been found in the area of S. Maria di Leuca, where the current conditions increase productivity (Mastrototaro, 2002; Ardizzone *et al.,* 2018).
Recently they have been recorded in the Bari Canyon (South-Western Adriatic Sea). So far, the Italian seas play a crucial role in the presence and distribution of deep corals in the Mediterranean Sea (Ingrosso *et al.,* 2018).

Despite the depth of these coral formations, they still reflect the effect of anthropic activity, in particular pollution and fishery. Trawling activities damage the biocoenosis both directly, with the destruction of the colonies, and indirectly, causing the suspension of fine sediments whose redeposition causes the suffocation of the benthic species present. Other fishing activities such as deep-line longline and deep lobster trammel nets, interacting with benthic species, also cause further damage to these delicate biocoenoses (Canese, 2019).

Submarine structures made by leaking gases

Finally, we refer to this particular type of habitat that is listed in the EU Habitat Directive (92/43/EEC, Habitat type 1180). It consists of underwater rock formations originating from the overbuilding of carbonate through microbial oxidation processes in the presence of gas emissions, mainly methane.

The main formations present in the Adriatic Subregion are the "bubbling reefs": These are cliffs sometimes associated with intermittent gas emissions and formed by rock slabs, vertical pillars and stratified structures rich in ravines. On these cliffs, according to gradients, various algal or animal benthic communities typical of hard bottoms develop, which can give rise to biogenic formations (for example in the Upper Adriatic).

The most relevant anthropogenic stress factors for this habitat reported in the literature are trawling, with its abrasive action on the bottom, the exploration and drilling of the seabed in offshore areas for extraction purposes, the dumping of solid waste into the sea (including abandoned fishing gear), the spill of hydrocarbons (Canese and Tunesi, 2019).

Subregional characteristics

Overall national and Mediterranean reports about habitat biodiversity are quite comprehensive but they are mostly referred to the entire Mediterranean basin or the whole Italian seaside. The data deriving from MSFD monitoring will lead to a more detailed picture of the environmental status of habitat referred to in the Directive, as seen above, for each subregion.

Moreover the Italian committee for "Capitale Naturale" quantified the extent for each sub-region of the main marine macro-ecosystems: Phanerogams, Hard photophilic Bottom, Hard Sciaphilic Bottom, Soft bottom. (Comitato Capitale Naturale, 2018).
The percentage extension contribution of each type of substrate (soft bottom excluded) for the ADRISEA subregion is:

- 44% Phanerogams
- 12% Hard photophilic Bottom
- 44% Hard Sciaphilic Bottom.

To estimate the covered area of the main macro-ecosystems can allow calculating the biophysical value of the natural capital stocks of marine ecoregions, which are fundamental for their conservation, enhancement and restoration in the event of damaged habitats. For more details, please refer to (Comitato Capitale Naturale, 2018).

2.3. Singular habitats in the country

For the selection of singular habitats, it was considered appropriate to refer to the "Ecologically or Biologically Significant Areas" (EBSAs) as one of the selection criteria is referred to as uniqueness and rarity (COP Decision IX/20, Annex I). For the present paragraph, it has been consulted on the following website: https://www.cbd.int/ebsa/.

Moreover, the areas that meet the "Important Marine Mammal Areas" (IMMA) criteria were taken into consideration (see paragraph 2.4). For more details, please refer to the website: https://www.marinemammalhabitat.org/

Northern Adriatic

The area is in the northern part of the North Adriatic Sea Basin, with an average depth of 35 m where there is a strong influence of the Po river plume. It includes mobile sandy bottoms, seagrass meadows, hard bottom associations and unique rocky outcrops called "trezze" and "tegnue". The area is essential for several threatened species. It hosts a population of the highest density of bottlenose dolphin *(Tursiops truncatus)* in the Mediterranean, and it is one of the most important feeding grounds in the Mediterranean of *Caretta caretta.* Northern Adriatic is a nursery site for several vulnerable species: blue shark *(Prionace glauca),* sandbar shark *(Carcharinus plumbeus),* anchovies *(Engraulis encrasicolus),* etc. The site hosts a substantial diversity of benthic and pelagic habitats due to a critical gradient of environmental factors from its western portion to its eastern coasts. It is also one of the most productive areas in the Mediterranean Sea.

The area meets the EBSA criteria (COP Decision XII/22), with a level of uniqueness equal to Medium. This because it is the only area in the Mediterranean Sea where rocky outcrops called "trezze" and "tegnue" can be found is in the Northern Adriatic area. The ecological role played by these outcrops in the Northern Adriatic is extraordinary because they are the only hard substrates in the area offering shelter and reproduction sites for several fish and invertebrate species, including stocks under stress due to severe fishing pressure (Casellato *et al.,* 2007). The Mediterranean subpopulation of Bottlenose dolphin *(Tursiops truncatus)* is present in this area with the highest high population density (Notarbartolo di Sciara and Birkun, 2010). This area is the northernmost occurrence of the Mediterranean monk seal *(Monachus monachus).*

It should be noted that this area meets the criteria of "Important Marine Mammal Areas" for the *Tursiops truncates.*

Pomo Pit

The area encompassing the adjacent depressions, Pomo Pit is situated in the Middle Adriatic Sea and has a maximum depth of 200 - 260 m. It is a sensitive and critical spawning and nursery zone for significant Adriatic demersal resources, especially European hake *(Merluccius merluccius).* This area hosts the largest population of Norway lobster *(Nephrops norvegicus)* and is essential mostly for juveniles in the depths over 200 m. Based on an available scientific data it is a high-density area for giant devil ray (*Mobula mobular)* which is an endemic species listed on Annex II of the SPA/BD Protocol and listed as "Endangered (EN)" on the IUCN Red List. The Pit could function as a favourable environment for some critical life-history stages of the porbeagle shark, and *Lamna nasus,* which is critically endangered (IUCN, 2007), and both of which are listed on Annex II of theSPA/BD Protocol. Regarding benthic species, several types of corals can be found (Scleractinia and Actiniaria).

The area described as meeting EBSA criteria that were considered by the Conference of the Parties (COP Decision XII/22).

Pomo Pit is a unique area in the Adriatic Sea due to geomorphologic and oceanographic features (Artegiani *et al.,* 1997; Würtz, 2010; Zavatarelli and Pinardi, 2003). Moreover, it plays an essential role in the overall oceanographic dynamic of the entire Adriatic Sea (FAO AdriaMed 2011).

We underline how this area is considered to be of interest for potential marine mammal conservation within the Mediterranean region and may require enhanced effort for monitoring species of marine mammal.

South Adriatic Ionian Straight

The area is in the centre of the southern part of the Southern Adriatic basin and the northern Ionian Sea. It is characterized by steep slopes, high salinity and a maximum depth ranging between 200 m to 1500 m. Water exchange with the Mediterranean Sea takes place through the Otranto Channel, which presents a sill that is 800 m deep. This area contains critical habitats for Cuvier's beaked whales *(Ziphius cavirostris),* an Annex II species of the Protocol. Moreover, it presents a significant density of other megafauna listed in Annex II of SPA/BD Protocol: the giant devil ray *(Mobula mobular),* striped dolphin *(Stenella coeruleoalba),* Mediterranean monk seal *(Monachus monachus)* and loggerhead turtle *(Caretta caretta).* Benthos includes deep-sea cold-water coral communities and deep-sea sponge aggregations, representing important biodiversity reservoirs and contributing to the trophic recycling of organic matter. Tuna, swordfish and sharks are also common in this area. The area meets the EBSA criteria (COP Decision XII/22) with a level of uniqueness equal to High. It has to be under attention because it presents a low level of naturalness due to the high levels of human usage (fishing, shipping, recreation, population pressure along the coastline, pollution).

We underline how this area is considered to be of interest for potential marine mammal conservation within the Mediterranean region and may require enhanced effort for monitoring species of marine mammal.

2.4. Transboundary issues

As indicated explicitly by the Marine Strategy Directive, Member States that have a marine region or sub-region in common must appropriately provide that the measures necessary to achieve environmental objectives are coherent and coordinated with each other. Italy adopted the *National Marine Strategy Measures Program* within the framework of the principles and policies of the European Union, with particular reference, as regards conservation policies, to the Convention for the Protection of the Mediterranean Sea from Pollution (Barcelona Convention) and related Protocols, with a view to integrated management at the Mediterranean level.

E.g. the fish stocks protection measures are formulated with a view to cooperation between the Member States, within the framework of a macro-regional strategy. The measures relating to fishing activities are currently managed within the GFCM.

The reform of the CFP provides for the implementation of the so-called "regionalization", that is an approach by sea basins to create a system of coordination, exchange of experiences for the adoption of common measures that have to be implemented at a national and sub-regional level.

An example of this is the implementation of the new EU strategy for the Adriatic and Ionian region, launched in 2014 by the European Commission.

A further cooperation framework is represented by the Euro-Mediterranean partnership (1995), which is a regional forum for political, economic and social cooperation.
Some examples are:

- Maritime Spatial Planning in the Adriatic and Ionian seas (ADRIPLAN project);
- PERSEUS project for environmental research in the southern European seas;
- Development of a Mediterranean network of marine and coastal protected areas (MedPAN Sud project).

Furthermore, the criteria for the definition of an area which, due to its geomorphological, biological and ecological characteristics, may be worthy of particular attention by the international community have been defined, in all the relevant forum, to identify shared management and protection measures. Some examples are:

- Particularly Sensitive Sea Areas (PSSA): these sites need special protection through the action of the International Maritime Organization (IMO) for recognized ecological or socio-economic or scientific reasons and which may be vulnerable to damage by international maritime activities.

- Ecologically or Biologically Significant Areas (EBSAs): they are select areas that support the healthy functioning of the sea and its many ecological services; In 2008, the ninth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP 9) adopted the scientific criteria for identifying EBSAs in need of protection in open-ocean waters and deep-sea habitats.

- Important Marine Mammal Areas (IMMAs) these sites are defined as discrete portions of habitat, important to marine mammal species, that have the potential to be delineated and managed for conservation. The criteria for the identification of these areas have developed by the IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force for the in order to prioritize their consideration for conservation measures by governments, intergovernmental organizations, conservation groups, and the general public.

- Important Bird and Biodiversity Areas (IBAs): they are identified in the framework of the BirdLife International's program to contribute to the identification of priority sites for the conservation of birds around the world.

2.5. Identification of the country's marine and coastal biodiversity gaps needed for scientifically sound based conservation

The UNEP-MED 2019 highlighted some relevant knowledge gaps for the Mediterranean Sea:

- a lack of data on soft and rocky cliffs and shore ecosystems, their characteristics, the status of their retreat and erosion and the associated impacts on human livelihoods;
- insufficient inventories of invasive species and their impact;
- limited information on the occurrence, distribution and composition of coralligenous communities;
- a lack of monitoring of the biodiversity of deep/dark habitats (canyons, trenches, seamounts).

The 2017 Mediterranean Quality Status Report (UNEP/MAP - RAC/SPA, 2017) also identified several knowledge gaps: data on marine habitats are still scarce, fragmented and discounted in time and would benefit from a complete mapping of the most significant marine habitats to direct management measures. More in detail, the cited Report identify the following gaps in knowledge regarding Common Indicators 1 and 2 (E01 - Biology):

- Role of resting stage banks for plankton dynamics;
- Impact of gelatinous macrozooplancton on the functioning of ecosystems;
- Links between deep-sea systems and coastal areas;
- Habitat identification for the pelagic habitats and mapping processes;
- Knowledge of connectivity processes;
- The development of innovative techniques, such as remote sensing and acoustic for the study of the seabed, to cover large areas at high resolution.

Regarding the pelagic system, at the Mediterranean level, both in the context of EU sub-regional cooperation and in the context of the Barcelona Convention, no shared metrics or consolidated approaches have been defined in order to characterize and assess the state of this habitat. The composition and abundance of phytoplankton are elements of evaluation provided for by Directive 2000/60/EC, but despite the efforts made at an international level, for the biological quality element phytoplankton is nowadays only chlorophyll 'a' (indicator of phytoplankton biomass) is used. Instead, the composition and abundance of phytoplankton are not used for evaluation purposes. A reflection on the most appropriate way of using the data deriving from the MSFD Monitoring Program requires both the involvement of experts from various national bodies and a comparison with the other States at subregional level (ISPRA, 2018a).

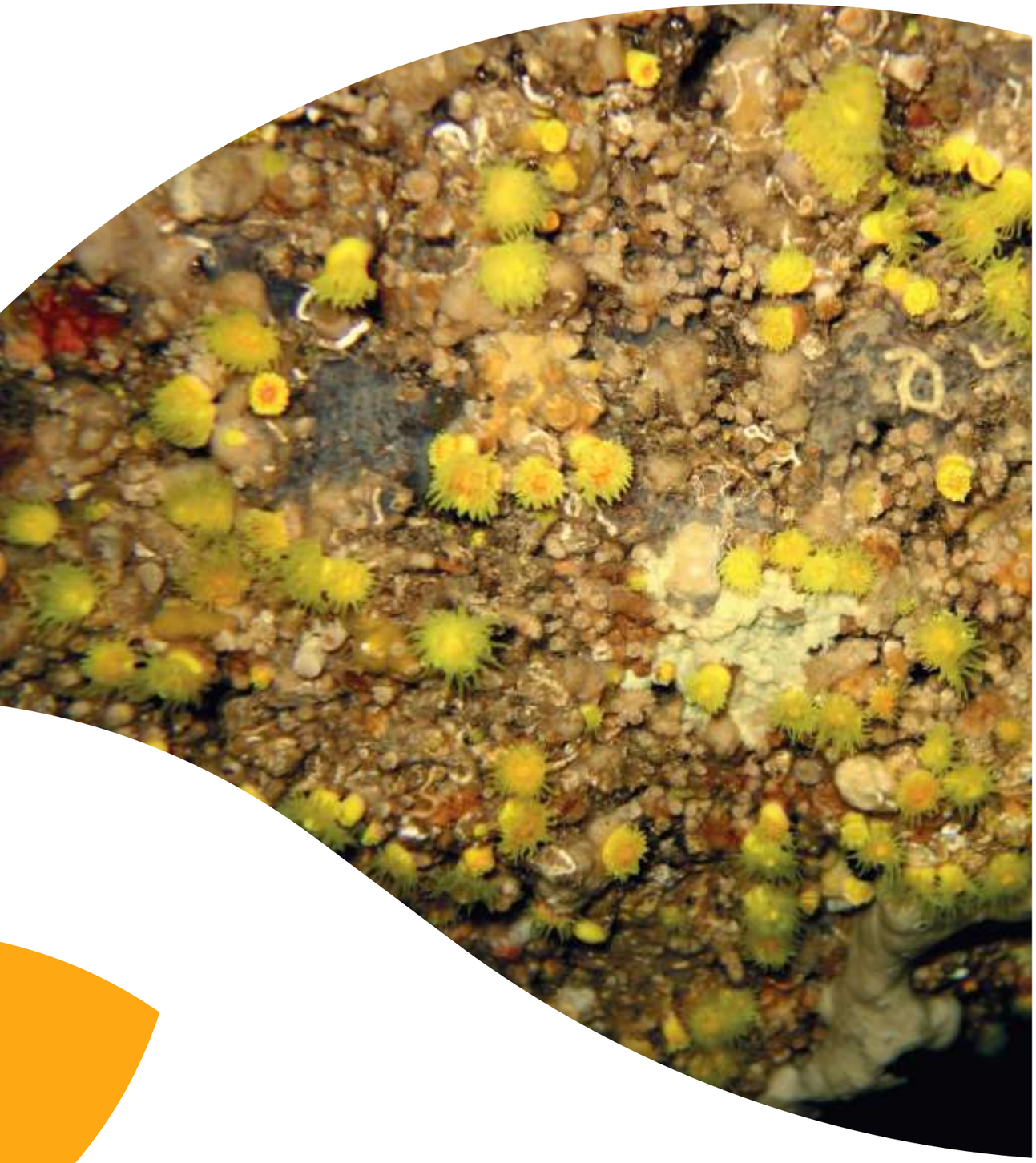
Finally, it is important to underline how deep-sea ecology is only partially known. Our knowledge is mainly limited to the bathymetric range over which commercial fishing operates (up to 800 m depth). Only limited systematic oceanographic sampling campaigns have been carried out in the deep-sea (UNEP/MAP - RAC/SPA, 2010).

The national monitoring programmes should aim to fill these knowledge gaps in line with IMAP (UNEP/MAP and Plan Bleu, 2020).

In this regard, it is important to underline how Italy is about to finalize the new Marine Strategy Monitoring Program, which wants to fill some of these gaps in the descriptors 1, 3, 4 and 6. So we can expect a more robust dataset on the state of ecosystems in the next years.

3.

Pressures and impacts



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The Mediterranean marine environment and its organisms are exposed to a large number of pressures deriving, directly or indirectly, from human activities. The number of impacts these activities create is also high and widely diversified, depending on the characteristics of the environment we are considering.

Among the types of anthropogenic pressures detectable in the Mediterranean Sea and more distributed in the basin, we can include the introduction of non-indigenous species, the exploitation of fish stocks and molluscs for commercial purposes, eutrophication, the physical damage caused to the seabed, modifications to the hydrological conditions of the basin, the introduction into the marine environment of contaminants and waste, microbial pathogens, and climate change (Korpinen *et al.,* 2019).

The loss of marine biodiversity, as well as the occasional irreversible damage to habitats, are generally caused by the cumulative effect of some of the pressures described, which often act synergistically by amplifying the impacts and speeding up the degradation processes of the ecosystem. Alien species introduced through anthropogenic vectors, for instance, can be favored by the rise in temperatures due to climate change, competing with populations of indigenous species that instead undergo regressions due to pollution.

3.1. Biological disturbance

Non-indigenous and invasive species

According to recent estimates, the Mediterranean Sea hosts approximately over 800 established non-indigenous species (Tsiamis *et al.,* 2018). In terms of diffusion of alien species, approximately 98% of Mediterranean coastal area are impacted by invasive species (Korpinen *et al.,* 2019). Although only some alien species exhibit invasive behaviour (invasive alien species - IAS), the presence of the latter can have strong impacts on marine ecosystem, causing adverse effects on environmental quality and functioning and in particular on biodiversity (UNEP-MAP - RAC/SPA, 2010a; Korpinen *et al.,* 2019). Furthermore, the impacts caused by invasive species can cause loss of important ecosystem goods and services offered by the marine environment, causing negative economic effects on human activities, as well as health risks (Galil *et al.* 2017; Korpinen *et al.,* 2019). The main pressures and impacts of invasive alien species responsible for the loss of biodiversity are summarised in Figure 5.

Pressures	Impacts
Competition for space and/or food	Reduction and niche contraction of native species; replacement of native species; other indirect ecosystem effects including negative impact on structures and functioning of the ecosystems
Predation (or grazing)	Reduction of prey (or vegetation) mainly because native prey species may not have evolved defenses against the novel predators; other indirect ecosystem effects including negative impact on structures and functioning of the ecosystems
Hybridizing with native species	The invaders genes "flood" the native species, such that no individuals contain the entire genotype of the native species, thus effectively driving the indigenous species to extinction
Introduction of pathogens	Reduction of indigenous species devoid of defenses against new pathogens; other indirect ecosystem effects

Figure 5:
Main pressures and impacts of invasive alien species. Source UNEP-MAP - RAC/SPA, 2010a.

In the marine environment, species extinctions caused by invertebrate alien species are poorly documented, while most of the literature refers to the effect on native community of non-native algal, but it seems clear that it will be important to investigate the interactions between invertebrate NIS and native communities, since sometimes the former are not immediately detected (such as worms and molluscs in sediments), but can lead to local replacement of species (Corriero *et al.,* 2016).

The studies carried out in recent years have led, in particular, to the compilation of various lists and inventories, on non-indigenous, invasive and cryptogenic species (see Chapter 2). Many studies have investigated both the major vectors of introduction and the methodologies for estimating the impacts caused by these species. Inventories, in particular, need to be updated frequently, both due to substantial changes in the status of several European marine NIS (Zenetos *et al.,* 2017) as well as to changes in the taxonomic classification, in the nomenclature and in the assessments relating to the autochthonous nature or otherwise of a species.

Italy, due to more than 7,000 km of coastline and his prominent position in the Mediterranean Sea placed at the intersection of distinct basins, characterized by different hydrographic and physico-chemical characteristics, hosts a large number of non-indigenous species, many of which are invasive. A 2011 study by Occhipinti-Ambrogi *et al.* notes that Italian waters hosted, from 1945 to 2009, a number of NIS equal to 165 species. From 2010 to date, several updates have been carried out with respect to the aforementioned inventory which, also thanks to greater knowledge of the problem, better sampling techniques and an increased number of monitoring programs, have seen the number of these species rise to a total of 265, some of which are present in more than one subregion (in detail 154 species have been detected in the ICMED, 151 in the WMED and 143 in the ADRISEA) (Servello *et al.,* 2019). The rate of introduction, however, appears to be lower than in the past (Zenetos, 2017; Zenetos *et al.,* 2017), going from one new entry every two weeks (Zenetos, 2010) to approximately one new alien species every seven weeks in the period 2012 - 2017 (Servello *et al.,* 2019).

Among the major carriers of introduction, the most important in Italy are those linked to maritime traffic. Ports, in particular, are hotspots of introduction, where ballast water and biofouling cause the transport of alien species. Around half of the NIS (~ 52%) recorded in Italy has probably arrived as transport-stowaways (attributed to maritime traffic). As regards the transport-stowaway/shipping related pathway, ~28% of the aliens appear to have arrived as biofoulers on ship hulls, while 22% introduced with ballast waters (Servello *et al.,* 2019). Furthermore, enlargement of the Suez Canal was expected to cause increasing rate of introductions, but some studies indicated the opposite, a rather decreasing rate of introductions (Zenetos, 2017).

Several studies have identified the main Italian hotspots of alien species (Figure 6). Italian coastal lagoons and harbors, in particular, tend to host the highest number of alien species due to the numerous anthropogenic activities due to the degraded environmental conditions and few competitors number that facilitate occupation by opportunistic species (Occhipinti-Ambrogi and Savini, 2003), whereas the records of alien species from natural environments are less common in the literature (Corriero *et al., 2016).*

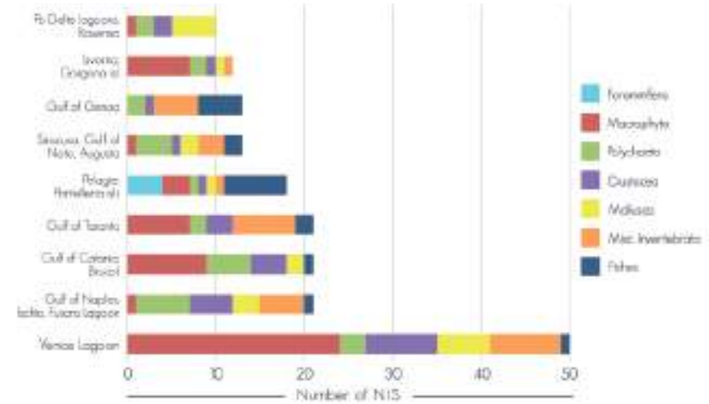

Figure 6

Hotspots of first introduction to Italy. Source: Servello *et al.,* 2019.

Concerning the Adriatic Sea, where maritime traffic was responsible for 46.5% of the introductions between 1970 and 2017 (Servello *et al.,* 2019), the highest number of alien species has been observed in the northern Adriatic Sea and particularly in the Lagoon of Venice (Occhipinti- Ambrogio *et al.,* 2011). It has recently been estimated that 50 new alien species, among those reported as first records in Italy, were first detected in Venice Lagoon: four of these, namely, the worm *Hydroides elegans,* and the molluscs *Xenostrobus securis*, *Haminoea japonica* and *Rapana venosa* display invasive behavior (Servello *et al.,* 2019).

Several cases of species of NIS settle in the Italian basins, which can cause both environmental and economic or health concerns are reported in literature. An example of local extinction, in Italy, is the case of the repeated introductions of the commercial mollusc *Ruditapes philippinarum* in the North Adriatic, has led to the depletion and local disappearance of the closely related native *R. decussatus* (Pranovi *et al.,* 2006). Moreover, the presence of the invasive mollusc is indirectly responsible for the alteration of the physical environment in which it lives, since fishing activities on this species cause an increase in suspended sediment, damaging the species living in the same environment.

Also the bivalve *Arcuatula senhousia*, considered locally invasive along the Italian coast (Mistri *et al.,* 2004), is able to alter directly sedimentary properties of soft bottoms, through the construction of byssal mats on the surface of sediments. Among the algal invaders, currently spreading along the Italian coasts (Piazzi *et al.,* 2005), there are the filamentous red alga *Womersleyella setacea* and the green alga *Caulerpa cylindracea*. Regarding, finally, the deep-sea habitats, only few information are available about the present of NIS. An example, is the case of the hydroid *Clytia linearis* which may be considered as invasive. To date, however, no data are available about its possible influence on native communities which needs further investigation (Corriero *et al.,* 2016).

Unfortunately, knowledge about the impacts, direct or indirect, caused by these species on Italian marine biodiversity is still scarce and often linked to the effects on human activities, such as fishing and tourism, or on human health, rather than on biodiversity. Examples are the species *Womersleyella setacea*, *Acrothamnion preissii*, *Rhopilema*

nomadica and *Caulerpa taxifolia,* known because they cause damage to fishing gear and tourism. *Ostreopsis ovata* is well known and monitored for bathing purposes due to its toxic blooms.

The lessepsian species *Lagocephalus sceleratus*, which caused severe ecological and socio-economic impacts in the Eastern sectors of the basin (Nader *et al*. 2012; Kalogirou 2013) is monitored in Italy also through reports collected through citizen science due to its toxicity and danger to human health (Azzurro *et al.,* 2016; 2020). It was reported in Italy for the first time in 2013, in the waters of the island of Lampedusa - ICMED (Azzurro *et al.* 2014). Further reports in other Mediterranean countries have ascertained its rapid spread also in the western Mediterranean Sea up to the Strait of Gibraltar, opening up the possibility of a future spread of Lessepsian species in the Atlantic Ocean through this passage under climate change scenarios (Marras *et al.,* 2015; Azzurro *et al.,* 2020).

Impact of fisheries

Fishing is considered to be one of the most impacting human activities in the marine environment (UNEP-MAP - RAC/SPA, 2010a; Micheli *et al.,* 2013; FAO, 2016; Korpinen *et al.,* 2019). This condition is determined by various factors which act simultaneously and with different intensity on species, both because they are object of direct fishing and of accidental capture, and on habitat. To determine direct and indirect impacts on marine biodiversity is not only the overexploitation of the target species of the various Mediterranean and Italian seas, but also the accidental catches, often of vulnerable species at high risk of extinction, the damage to the seabed and the compromise of habitats and biocoenoses, both on hard and soft bottoms, and the modifications of the trophic chain. This modifications act in combination with the ongoing climate forcing and the rapid expansion of NIS and are rapidly changing the structure and functioning of the ecosystem with strong effects on their health and, consequently, on the goods and services provided. It has to be noted, moreover, that while, on one hand, the pressure on some important habitats has decreased thanks to the provision of measures that prevent fishing in some areas, such as in MPAs, on the other hand deep-sea fisheries have become economically important in recent decades, reaching previously only marginally impacted environments (Korpinen *et al.,* 2019).

Furthermore, the greatest pressures at the national level do not come only from intensive and commercial fishing but also from artisanal and small-scale fishing, while at the local level, high disturbance situations can be determined by recreational and illegal fishing (IUUF).

Finally, the assessment of the impacts and the identification of adequate measures that guarantee the maintenance of healthy species and habitats and at the same time allow to avoid significant losses in economic terms for the operators in the sector, is complicated by both the lack of data and the multidisciplinary nature of fishing activities (UNEP/MAP - RAC/SPA, 2010b; Korpinen *et al.,* 2019)

The Italian fishing fleet, in all three subregions, is very active; at 31 December 2018 the number of vessels entered in the register of fishing licenses amounted to 12,032, of which 12,023 operate in the Mediterranean (2018 *Italian report under Article 22 of Regulation (EU) No 1380/2013*). Moreover, the value of landings in Italy is the highest compared to other Mediterranean countries, accounting for approximately 30% of total revenue in the region. In particular, in ADRISEA, 54% of landings by weight are Italian (FAO, 2018a).

More specifically, the pressures and impacts caused by all fishing activities, the majority of the *target* species fished in the Italian GSAs, as described in paragraph 2.1.5, are overfishing. Furthermore, an important percentage of stocks remain without formal analytical assessment conducted through stock assessment.

The Adriatic is the Italian subregion with the highest percentage of stocks for which an assessment is possible (71%) and within biologically safe limits (14%), but at the same time the one with the highest prevalence of stocks in unsuitable conditions (57%) (ISPRA, 2018c).

In addition to the high exploitation of fish resources, which affects the health of fish stocks, fishing activities also cause significant negative effects on other species.

The *bycatch*, defined by FAO as: "*the part of the catch unintentionally captured during a fishing operation, in addition to target species. It consists of other commercial species (that may be secondary targets or may become target species if the market develops) and non-commercial species (returned to the sea or landed, in case of a discard ban) as well as incidental catches of vulnerable species, which may include species of commercial value or not, formally declared as "vulnerable" or "species at risk" as a result of natural or, more commonly, anthropogenic pressure, including fishing pressure*" (FAO, 2018a), causes important changes to the food web, as well as the deterioration of populations of vulnerable, rare and often protected species.

Discards is represented by the portion of the catch that is not retained on board during a fishing operation and that is discarded at sea (being the organisms dead or still alive) and may constitute a large portion of the total *bycatch* (Alverson *et al.,* 1994). The organisms that are part of the discards are generally species that have little or no commercial interest and individuals of exploited species but, for example, at vital stages that do not allow their commercialization, such as the juvenile stages. Other factors that determine the discards are the damage to individuals by fishing gear, the fact that they are in poor condition or the lack of space on board (Kelleher, 2005). The composition and amount of waste also varies, depending on the season, the tool used and the geographical area. Bottom trawl fisheries is the most important in terms of economic value of the catches and also the one that cause the large number of discards, as well as the "rapid trawl" in the Adriatic Sea (FAO, 2016; 2019).

Although monitoring of this practice is very difficult and a lot of information is missing (Tsagarakis *et al.,* 2014; Sala *et al.,* 2015) it is estimated that in the Mediterranean, discards are around 230,000 tonnes per year (approximately 18% of the total catch) (Tsagarakis, *et al.,* 2013). Many of the discards, although for European countries the CFP has recently imposed the landing of all the fish, is returned to the water, both dead and alive. The negative effects caused by the removal of these organisms primarily affect the food chain, consequently putting at risk also the target stocks, which are part of it. The levels of dead organisms or in poor condition present in the water column and therefore easily subject to predation, interact negatively with the functioning of the food chain ecology, altering the

relative prey-predator abundance and causing additional interactions between species (e.g., scavenging organisms on the sea floor, and feeding populations of sea birds, marine mammals, and sharks) (FAO, 2018a). Finally, many of the organisms that make up the discarded fraction are sexually immature juveniles which, if killed, will not constitute the future spawning stock biomass. This implies a reduction of the potential for the stock to rebuild and lead to its faster decline (FAO, 2018a).

The reproductive success of many species, in particular those object of fishing that already presented situations of overexploitation, has also been negatively influenced, in recent decades, by jellyfish blooms. It is believed that these phenomena still poorly known, are natural but rare and that they interfere with the normal path of the trophic chain, which brings many fish feeding on plankton. When such blooms occur, the gelatinous plankton prey on both the fish food and their eggs and larvae, decreasing the spawning biomass stock (Boero*, 2013*). When this predation occurs on species in decline due to fishing, the effect of a flowering of jellyfish, albeit short, could affect the health of the stock for many years. An example is that of the bloom of *Pelagia noctiluca*, which occurred in the 1980s in the Adriatic Sea. This sudden event, considered part of a general and normal trend of the species (CIESM, 2001), caused serious damage to the already overfished fish stocks of the Adriatic basin (Boero, 2013).

The *bycatch* of vulnerable species concerns the incidental capture and mortality of marine animals such as mammals, reptiles, seabird and elasmobranchs. In order to get to know the phenomenon and prepare measures to reduce it, at the same time training fishing operators and raising their awareness on the issue, several monitoring programs and research projects have recently been launched, as well as guides and manuals for the recognition of species (such as FAO, 2019; Otero *et al.,* 2019).

According to a survey of studies and reviews dedicated to this issue conducted by the GFCM (FAO, 2018a), the fishing gears that most cause *bycatch* are the longline, in particular for marine reptile species, and the bottom trawl, responsible in particular for the capture of marine mammals (in particular in the ICMED and ADRISEA) and elasmobranchs (in particular in the ADRISEA). The marine sub-region with the highest number of reports (50% of the available literature refers to this area) is the WMED (Figure 7).

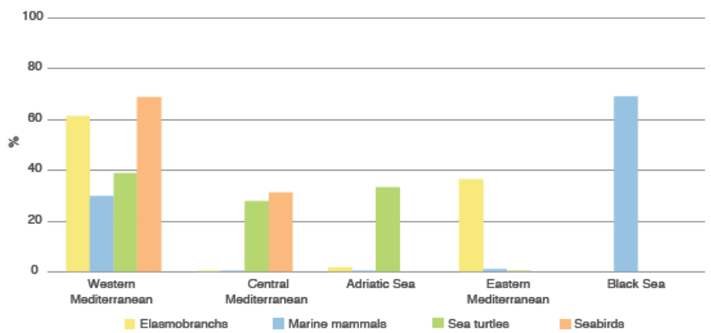

Figure 7

Number of specimens (in percentage), by different group of vulnerable species and by GFCM subregion, reported as bycatch in the scientific publications analysed (preliminary analysis). Source: FAO, 2018a.

Among the groups of species most subject to bycatch in Italy, there are sea turtles, in particular *Caretta caretta*, and elasmobranchs. The overall picture for these latter species, in particular, once very abundant in the waters of all three Italian marine subregions, is now very worrying, especially due to fishing activities (Rondinini *et al.,* 2013; Mazzoldi *et al.,* 2017). Furthermore, the removal of these upper-level predator species from the marine environment and the marine food web can induce changes at an ecosystem level (Serena *et al.,* 2014).

Regarding the demage of sea bed, we can distinguish between different types of impacts caused by different types of fishing, both commercial and recreational and illegal. The illegal fishing of the rock-boring mollusk mussel *Lithophaga lithophaga*, formally prohibited in Italy since 1988, for instance, cause the scrape off the upper centimeters of rocky substrates, madewith hammer and chisel, to make extraction of mollusks easier. The major consequence is the removal of the biological cover (macroalgae and zoobenthos), which ranges from bare patches to complete desertification (Fraschetti *et al.,* 2001; Giudetti *et al.,* 2003).

The activity responsible for the spatially widest disturbance in the Mediterranean is, therefore, the demersal fishery, especially bottom trawling. Effects of this activities can be divided to blunt impacts (dislodgement or crushing), line shear by a narrow object and hooking (snagging animals) (Clark *et al.,* 2016). Secondary impacts consist of siltation of resuspended sediment plumes, increasing turbidity, sedimentation rate and nutrient resuspension. Effect of the bottom communities are the reduction of the biomass and biodiversity of the benthic ecosystem, the decrease of the complexity of seabed habitats and affect the functioning and productivity of the benthic ecosystem through a progression of state changes (Eigaard *et al.,* 2017). Furthermore, trawling may cause severe damage to branched organisms, mostly in the form of broken and smothered colonies (Bavestrello *et al.,* 2015).

In the Mediterranean, bottom trawling pressure on all northern and western coasts. The Italian areas with the highest pressure are in the western margin of the Adriatic Sea and in the Ionian Sea (Korpinen *et al.,* 2019).. The lack of information on the extent and distribution of some sensitive habitats, such as the maërl, as well as the current impossibility of interpolating these data with data relating to areas with different fishing efforts, do not currently allow an estimate of the pressure by fishing on benthonic communities.

Literature data, however, report several examples of negative interactions of fishing gear on the bottom. The northern Adriatic Sea, for instance, is an extensive area of trawlable seabed, exploited by the Italian commercial fleet with otter trawls, rapido, and hydraulic dredges. The rapido, in particular, is a towed gear used only in the Adriatic Sea for fishing scallops in sandy offshore areas and flatfish in muddy inshore areas. A study conducted by Pravoni *et al.* (2000) found that the fishing gear produced flat tracks on the bottom that were still clearly visible after a week by means of sidescan sonar. The trawl did not change the sediment grain size, although it did disturb the upper 6 cm of sediment. Experimental trawling induced a modification in the macrobenthic community that was most evident immediately after the haul. Changes to the meiobenthic community were probably due to sediment disturbance and were recorded after 1 week.

Microbial pathogens

A vast majority of pathogens may have potential adverse effects on marine ecosystem both in transitional and coastal waters (Korpinen *et al.,* 2019). The resulting marine diseases can decimate marine populations; the outbreaks are particularly problematic when they affect or remove keystone predators or/and foundational species, which consequently disrupt ecosystem function and can shift the ecosystem into a novel state (Groner *et al.,* 2016). Microbial pathogens can also cause human diseases, such as diarrhoea, gastroenteritis, and cholera, or have socio-economical effects such as reduced aquaculture yields or tourism.

Microbial pathogens are introduced to the marine environment from various sources: municipal sewage, ships, bathing sites, aquaculture, agriculture, animal husbandry, industrial waste, tourism, fishing and wildlife excrement. At sea, maritime transport (e.g., ballast waters and sewage) can be an important source (Ciftci Turetken and Altuğ, 2016). Recent studies have also proved that microorganisms can colonize plastic surface of marine debris forming a "plastisphere". Members of the potentially pathogenic genus Vibrio, have also been detected over these plastic surfaces and may be dispersed over long distances by floating debris (Zettler *et al.,* 2013).

In Italy most of the current monitoring and systematic examination of pathogens in marine waters is implemented under the Bathing Water Directive (2006/7/EC). Furthermore, the presence of pathogens is monitored in organisms intended for human consumption caught or reared at sea, such as from shellfish farming.

One of the systematically monitored species in the marine environsment is *Osteropsis ovata*. The origin of this potentially toxic benthic dinoficea is still doubtful. According to some authors it would have always been present in the Mediterranean with low abundances and, for reasons still to be clarified, in the last decade it would have begun to produce intense and invasive blooms that have made it possible to identify it. Genetic studies support this hypothesis as in the Atlantic/Mediterranean area *O. ovata* constitutes a genetically well-represented and homogeneous population (Penna *et al.,* 2010; Nascimento *et al.,* 2012). Another recent hypothesis argues that *O. ovata* was introduced from Japan on the basis that some Japanese specimens were found to be genetically identical to those of the Mediterranean Sea (Sato et al. 2011), however this hypothesis needs to be further demonstrated. The study and monitoring of the microalga began, in the Mediterranean, also due to its potential toxicity to humans, when its blooms became more and more frequent.

The first official report of *O. ovata* in Italy dates back to 1994 on the Lazio coast, in the Western Mediterannean Sea (Tognetto *et al.,* 1995); since the end of the 90s it has also been reported in the coastal waters of other regions of the sub-region (Tuscany, Puglia and Liguria) (Simoni *et al.,* 2004; ISPRA, 2010) and, gradually, its blooms have been detected in an increasing number of coastal regions of all and three marine sub-regions, up to the spread of the species in most of the coasts during the summer season or early autumn (ISPRA, 2019).

Harmful effects (suffering or mortality) due tu this pathogen have been observed on benthic marine organisms such as mussels, hedgehogs, starfish and macroalgae (Borrello *et al.,* 2015; Accoroni *et al.,* 2012; ISPRA, 2019).

Although the monitoring data collected in recent years have not highlighted a relationship of blooms with the trophic state, a study has recently identified the N:P ratio, together with the water temperature, as determining factors for the early stages of bloom. The blooms would, in fact, start thanks to the achievement of threshold temperature values (about 25°C) which would allow the germination of the cysts, which however would survive and proliferate generating a real bloom only in balanced nutritional conditions (N:P ≈ 16) (Accoroni *et al*, 2014; 2015).

Another important and recent example of pathogens in the marine sea, in this case that affect and damage a marine species in particular, is *Haplosporidium pinnae*, responsible for the recent mass mortality event of *Pinna nobilis* specimens in populations of all three Italian subregions (Catanese *et al.,* 2018). Due to this sudden and intense death, which in some areas has also led to the death of 100% of the individuals present on the site (Catanese *et al.,* 2018; Carella *et al.* 2020), the IUCN has classified *P. nobilis* as Critically Endangered on the IUCN Red List due to the drastic population size reduction caused by the still ongoing mass mortality event and the fact that the causing pathogen is still present in the environment (IUCN, 2019).

This haplosporidan parasite was first detected in 2016 along the Spanish coast (Vazquez-Luis *et al.,* 2017) and rapidly spread along all the Mediterranean, reaching, in particular, population of P. nobilis settled along the Italinan Tyrrhenian coastline –WMED and the Ionian Sea, in particular Sicily and Puglia – ICMED (Carella *et al.,* 2020; Catanese *et al.,* 2018; Panarese, *et al.,* 2019). Moreover, the study conducted by Carrella *et al*. in 2020 demonstrated that the mortality events of *P. nobilis*, in samples from both Italian (WMED and ICMED) and Spanish (Catalunya) sites were caused by the simultaneous presence and quantity of multiple pathogens potentially involved in disease pathogenesis. In the tissues of sampled individuals, in fact, it was found the presence of other comprehending bacteria and parasites of different taxonomy, such as *Mycobacterium* sp. This condition, according to the author, suggest that may be a common primary cause, not yet identified, which favors the above infections.

3.2. Vulnerable marine ecosystems

The vulnerable marine ecosystem (VME) concept emerged from discussions at the United Nations General Assembly (UnGa, 2007). VMEs constitute areas that may be vulnerable to impacts from fishing activities. A marine ecosystem should be classified as vulnerable based on the characteristics that it possesses (FAO, 2009).

For more detailed information consult the FAO website: http://www.fao.org/in-action/vulnerable-marine-ecosystems/en/.

The scientific debate on the identification and evaluation of VMEs in the Mediterranean is ongoing, as well as on the management of these sites.

For the selection and identification of VME, the attention of researchers and policy maker has to focus on Sensitive Habitats (SH) and Essential Fish Habitats (EFH). SHs consist on those areas with endemic species, high biodiversity or high productivity and vulnerable to fishing practice. Instead EFHs are those habitats necessary for feeding, refuge or reproduction of the species (UNEP-MAP-RAC/SPA 2010a, 2010b).

EFH and SH can be considered as critical areas vulnerable for pressure of open seas fishing on marine and coastal biodiversity. Their identification and management could represent an essential tool for addressing a sustainable fishery in Mediterranean open seas within an Ecosystem Approach to Fisheries (EAF) and Precautionary Approach; however, these areas might imply effective restriction of fishing activities, needing an adequate surveillance system and a long-term monitoring (UNEP-MAP-RAC/SPA 2010a, 2010b).

Areas in which are present habitats and ecosystems considered vulnerable and deserving of particular attention are listed below, as reported in UNEP-MAP-RAC/SPA (2010a, 2010b), FAO (2017, 2018a, 2018b). If appropriate, information from other sources are also reported and properly cited.

- The Northern Adriatic: Spawning grounds for anchovies and adpilchards represent important pelagic ecosystems.

- The Northern & Central Adriatic: Important areas for pelagic sharks important for the pelagic ecosystems present.

- The Central Adriatic: Fossa di Pomo/Jabuka Pit is an Essential Fish Habitats for the demersal specie hake *(Merluccius merluccius)*. It is an important nursery area for hake, quite sensitive to demersal fishing activities, mainly trawling. Besides that, Pomo Trench presents cold seeps.

- The Southern Adriatic: Cold coral reefs *(Lophelia pertusa)* off Cape Santa Maria di Leuca. This represent a Sensitive Habitat highly vulnerable to any physical disturbance inflicted by bottom trawling; It has been already adopted as FRA (Fishery Restricted Area) by GFCM, since 2006 by a FAO-CGPM Decision that has banned trawl fishery in this zone (REC.CM-GFCM/30/2006/3) in order to to protect its fragile demersal ecosystem. Cold coral reefs are also present in the Otranto Channel.

- The Southern Adriatic: The vulnerable cold water coral ecosystems of the Bari canyon, where the combination of oceanographic factors and favourable topography sustains a biodiversity hotspot characterized by valuable megafaunal sessile assemblages which are largely dominated by the highly emblematic cold water corals Madrepora oculata and subordinately *Lophelia pertusa,* sponges *(Pachastrella monilifera and Poecillastra compressa)* and other benthos communities.

- The Southern Adriatic: Essential Fish Habitats for Albacore (pelagic species).

- Mediterranean Bottoms beyond 1000m: Sensitive Habitat of poorly known and vulnerable fauna (Tudela *et al.,* 2004) that encompasses the whole region and is present in all three Italian subregions. Fishing using towed gears in this area has been prohibited by a FAO-CGPM Decision (REC.CM-GFCM/29/2005/1).

3.3. Emerging issues such as climatic change effects and open sea including deep-sea ecosystem concerns

Climate change

Climate change is rapidly modifying the marine ecosystems of the Mediterranean, considered as a climate change hotspot because of the rates of changing that exceed global averages for a number of variables, in particular for a more rapid warming in the air and sea during all seasons. Air temperature, for instance, are now approximately 1.5°C higher than during the preindustrial period (1880-1899), well above current global warming trends (+1.1°C). The trend of warming is also higher than in the resto of the world, equal to 0.03°C per year (Grasso and Feola, 2012). In the northern Adriatic, the average annual surface temperature has increased by 0.5 ° C in the last 35 years, but with increases of 1.1 ° C in autumn (Conversi *et al.,* 2010; Giani *et al.,* 2012). It is believed that, without additional mitigation, regional temperature increase will be 2.2 °C in 2040, possibly exceeding 3.8 °C in some regions in 2100 (Cramer *et al.,* 2018). The combination of warming with the contemporary reduction of rainfall generates strong trends towards drier conditions. For each degree of global warming, mean rainfall will likely decrease by about 4% in much of the region (Lionello and Scarascia, 2018), while heavy rainfall events are likely to intensify by 10-20% in all seasons except for summer (Toreti and Naveau, 2015). Warming of the sea surface is currently estimated at 0.4°C per decade for the period between 1985 and 2006 (+0.3°C per decade for the western basin and +0.5°C per decade for the eastern basin). Regarding Italian seas, it has been found that maximum increases were found in June in the Tyrrhenian, Ligurian and Adriatic Seas, reaching the value of 0.16°C of increasing, per year (Cramer *et al.,* 2018). Increasing trends of sea level rise are also expected: there has been a sharp increase of this level during the last two decades reaching about 3 mm per year (Tsimplis *et al.,*2013). During the years between 1970 and 2006 the rise of marine level was of 1.1 mm per year (Meyssignac *et al.,* 2010). Al this factors strongly influence salinity ranges and circulation patterns generating regional sea level changing patterns (Adloff *et al.,* 2015), with local differences in sea surface height of up to 10 cm. In Southern Italy, for example, substantial coastal inundation is expected by 2100 (Antonioli *et al,* 2017; Aucelli *et al,* 2017).

The Mediterranean basin represents a nature-based contribution to the efforts of climate change mitigation by sequestrating an important share of anthropogenic CO_2 from the atmosphere. CO_2 uptake by the basin is expected to lead, by 2100, to acidification of the water, with a decrease pH estimated by 0.018 to 0.028 units per decade (Meier *et al.,* 2014; Kapsenberg *et al.,* 2017).

All the described factors will influence, often in association with other anthropic pressures such as pollution, industrial activities, urbanization, transport and unsustainable use

of resources, the biodiversity of the Mediterranean, leading to different environmental changes. Among the major impacts induced by climate change, according to UNEP/MAP (UNEP/MAP – RAC/SPA, 2010c) and MedCC (Cramer *et al.,* 2018), we can include:

- environmental changes in coastal ecosystems. Sea level rose will impact, for example, vulnerable and sensitive to environmental changes species like the calcified cushion-like red alga *Lithophyllum byssoides*, whose delicate bioconstructions run the danger of being irremediably submerged. The primary production of some coastal areas may be impacted by the reduction in freshwater discharge from the rivers, a factor which also leads to an increase in the erosion rate. Research also suggests a loss of 59% and 67% of nesting areas for the Mediterranean green turtle (*Chelonia mydas*) and the loggerhead turtle (*Caretta caretta*) under a 1.2 m sea level rise (Varela *et al.,* 2019). Moreover, marine storms, associated with strong winds, waves and currents, as well as heavy rains and flash floods, are known to damage marine and coastal ecosystems such as *Posidonia* meadows (Gera *et al.,* 2014);

- changes in hydrodynamic conditions;

- homogenization of the Mediterranean biota, with an increase of the abundance of warm-water species and a consequent decrease of the col-water ones, causing a 'meridionalization' of the biota;

- changes in the geographic distribution of many native species. Due to the warming of the Mediterranean, warm-water species, like the fishes *Caranx crysos*, *Sparisoma cretense*, *Coryphaena hippurus*, *Balistes capriscus* and *Sphyraena viridensis* are all moving northwards (Azzurro, *et al.,* 2011) are moving northwards. The effects of climate and environmental change are particularly serious in areas where range shifts of species are physically constrained such as in the Ligurian Sea - WMED, where replacement of species has been reported in Mediterranean submarine caves. The endemic cave mysids (*Crustacea*), cold-water stenothermal species (*Hemimysis speluncola*) are, in fact, replaced by closely related species with warmer affinities (*Hemimysis margale*) (Chevaldonné & Lejeusne, 2003);

- increasing number of non-indigenous, invasive species, favoured by the warmer conditions;

- water acidification. It has negative impacts on many pelagic and benthic organisms with calcareous body parts, such as corals, mussels, pteropods, sponges and coccolithophores. The effects of the acidification could be at biological (e.g. reduced early stage survival), ecological (e.g. loss in biodiversity, changes in biomass and trophic complexity) and community level (e.g. modifications in species composition and abundance shifting from assemblages dominated by calcifying species to non-carbonated species even under moderate decrease in pH). Moreover, acidification will result in a decrease in the biomass of calcifying plankton organisms such as coccolithophorids;

- changes in the primary production, in the marine food web and increasing planktonic blooms. For example, seawater warming will lead to a shift in dominant species towards smaller species (picophytoplankton and nanoflagellates) and a decrease in diatoms. Shifts in plankton composition will provoke changes in the abundance on organisms feeding directly on plankton and then on all levels of the food web;

- increasing extent and intensity of jellyfish outbreaks, which reduced prey available for fishes, is probably favored by higher water temperature (Licandro *et al.,* 2010; Boero, 2013);

- diffusion of toxic or pathogenic organisms, such as the dinoflagellates *Gymnodinium catenatum* (Gómez, 2003), *Alexandrium catenella*, (Laabir *et al*, 2011) and *Ostreopsis ovata* (Accoroni *et al*, 2014; 2015), warm-affinity species and could form dangerous outbreaks both for human and marine species. Also the introduction and spread of a pathogenic *Vibrio* might have been promoted by climate warming. Gorgonians were among the most affected species during recent disease outbreaks from infections with *Vibrio* in the north-western Mediterranean. Furthermore, in cases of temperature-induced diseases, it has been found that pathogens can also afflict stressed invertebrates: bacteria of the genus *Vibrio* were present, for example, in specimens of the starfish *Astropecten jonstoni*, near the coast of Sardinia - WMED (Staehli *et al.,* 2009);

- mass mortality events in particular in coralligenous and in sponges or molluscs;

- changes in water column stability, which may favour the transformation of marine snow (small amorphous aggregates with colloidal properties) into marine mucilage, large marine aggregates representing an ephemeral and extreme habitat (Danovaro *et al.,* 2009);

- cumulative, negative impacts of climate change and fisheries, which reduce, for instance, resilience of the stocks (Fortibuoni *et al.,* 2015).

- According to a recent and in-depth analysis of the effects of CC on the Italian environment and biodiversity, conducted as part of the preparation of the Italian Strategy for Adaptation to Climate Change (Castellari *et al.,* 2014), moreover, the deep Mediterranean environments have also started to show signs of suffering, although further studies are needed to investigate the issue. Finally, the Adriatic Sea is identified as the Italian sea with the greatest climatic vulnerability, also due to the presence in the basin of lagoons, areas often already subject to different anthropic pressures and where the effects of CC would lead to a rapid decline of biotic communities.

Marine litter

Marine litter is defined by UNEP and NOAA (2012) as *"any solid material of anthropogenic origin, manufactured or transformed (regardless of size) discharged, disposed of or abandoned in the environment, including all materials released into the sea, on the shore or brought indirectly into the sea by rivers, waters wastewater, rainwater, waves or winds"*. It is a complex and multi-dimensional problem with significant implications for the marine and coastal environment and human activities the world over due to its wide spectrum of negative environmental, economic, safety, health, and cultural impacts. Despite efforts

made internationally, regionally, and nationally, there are indications that the marine litter problem continues to worsen.

The objects or parts of them that are commonly found in the sea and along the coasts are of all sizes and made up of different materials, mostly plastic, paper, wood, textiles, metal, glass, ceramic and rubber. Plastic, in particular, in its various forms and polymers, constitutes between 60% and 90% of waste dispersed at sea, reaching, in some areas, even 100% of the total (UNEP and GRID-Arendal, 2016). In more detail, considering the different matrices to which we can refer, it is noted that the categories of waste most commonly found on beaches are cigarette butts, plastic bags, fishing gear and disposable food containers (Andrady, 2015) while the 90% of the litter found through trawling nets is made up of plastic (Derraik, 2002; Galgani *et al.,* 2015). It is clear that marine litter has multiple negative effects on marine biodiversity, from ingestion by species of fish, mammals and sea turtles, to entanglement of these animals caused by abandoned fishing nets, up to the degradation of microplastics and the consequent release of toxic substances for the biota (CBD, 2016).

In Europe, the phenomenon has been included among the 11 qualitative descriptors of the Marine Strategy (Descriptor 10) and among the EcAp Ecological Objectives (EO 10) and is currently monitored through the monitoring programs referable to these two instruments.
In particular, in Italy, in order to monitor the the phenomenon in the MSFD context, surveys are conducted in all three marine subregions, on different matrices, listed in Table 5 together with the data collected in the first three years of monitoring 2015-2017. As a pure comparative exercise, in order to frame the results obtained for the different elements of Descriptor 10, ISPRA (2018e) has drawn up a first comparison with respect to the regional panorama, for each subregion. Table 5 therefore shows the maximum, minimum and average values of the data analyzed by comparing them to the "baselines" processed by UNEP/MAP in 2016.

Table 5

Comparison between the data from the MSFD monitoring program (2015-2017) for the Adriatic Sea and the "baseline" reported by UNEP/MAP for the Mediterranean (2016). Modified from: ISPRA, 2018e.

Element	Minimum value	Maximum value	Average value	IMAP Baseline (UNEP/MAP, 2016)
Beached marine litter (number of objects/100 m)	8.947	15.032	12.321	450-1,400
Floating marine litter * (number of objects/Km2)	0.8	24.3	4.7	3-5
Microlitter (number of objects/m2)	0.00	3.75	0.2	0.2 – 0.5
Litter on the seabed (Number of objects/Km2)	/	/	/	130-230
Litter ingested by Caretta caretta (FO%) and (g)	/	/	/	40-60% 1 – 3 g

*Arcangeli *et al.,* 2018. Amount, composition, and spatial distribution of floating macro litter along fixed trans-border transects in the Mediterranean basin. Marine Poluution Bulletin. (F0 %)= % of turtles that have ingested waste out of the total number of specimens (g) = amount of waste in grams ingested

Overall in Italy, in the three-year period 2015-2017, 64 beaches were monitored for the analysis of beached waste, 2,725 km^2 of marine surface for the analysis of floating waste, 426,564 m^2 of marine surface for the analysis of micro-waste and 289 stations at different depths up to about 800m for bottom waste analysis. In addition, more than 120 specimens of *Caretta caretta* were analyzed for the verification of ingested waste.
The data obtained are the first collected in Italy at an institutional level and provide a first knowledge base of reference on the quantity of marine litter in its various compartments (on the surface, on the seabed, on the beaches). The data obtained from the national monitoring programme were largely collected and processed by the SNPA in collaboration with universities and marine researchers. From the analysis of data collected under Marine Strategy (2015-2017), for all the investigated sectors, emerge that abundance are comparable to those found in other Mediterranean countries. This demonstrates the cross-border nature of the problem, which therefore requires a close and effective regional cooperation activity to be adequately addressed.

Deep-sea

The main pressures affecting deep-sea can be summarized as: trawl bottom fishery, other fishing practices, waste disposal (solid refuse), other marine pollutants, oil exploration and exploitation, climate change (UNEP-MAP - RAC/SPA 2010a; Cartes *et al.,* 2004).
Problems related to fishing have already been widely discussed in the previous paragraphs. Regarding deep environments, bottom trawls and, to a lesser extent, long linings exert the most significant impacts (Clark *et al.,* 2016; Korpinen *et al.,* 2019). Of the deep-sea species, several are currently red-listed (Korpinen *et al.,* 2019). In addition to a direct impact on target and non-target species, other threats already identified in UNEP-MAP - RAC/SPA (2010a) are:

- Removal of top predators with consequences for ecosystem functioning;
- Removal from soft bottoms of gorgonian communities such as *Isidella elongate* and other sessile organisms, with consequent changes in the community structure and negative repercussions for species of commercial interest and in general for biodiversity;
- Accumulation of organic matter from discards and consequent alteration of the ecosystem balance;
- Loss of complexity and heterogeneity of the sea bottom through the elimination of all sediment structures;
- Increase in turbidity, which can have negative impacts on filter feeders (e.g., *Leptometra phalangium*).

Regarding long lining and gillnet, the impact is mainly on target species and *bycatch* but these practices are particularly impacting because large-sized breeders can be caught (UNEP/MAP - RAC/SPA (2010a-).

There is an increasing awareness that deep-sea bottoms are sites of accumulation of solid waste. To date, great attention was paid to plastic and micro-plastic debris, either beached or floating, instead of the distribution of macro-litter on the seafloor, especially for the deep waters, which is still poorly known (UNEP-MAP 2015; Pierdomenico *et al.,* 2019).

Only a few studies have focused on debris located at depths of over 500 m in the Mediterranean (Galil, 1995; Galgani *et al.,* 1996 and 2000; Pham *et al.,* 2014; Ramirez-Llodra *et al.,* 2013; UNEP-MAP, 2015).

The most common litter types found on the deep seafloor in the Mediterranean are soft plastic (e.g., bags), hard plastic (e.g., bottles, containers), glass and metal (e.g., tins, cans). Surveys in the continental slope and bathyal and abyssal seafloor have shown that litter accumulates even at these depths (Korpinen *et al.* 2019; Ramirez-Llodra *et al.,* 2011).

A recent study (Pierdomenico *et al.,* 2019) indicates how the presence of macro-marine litter in the depths is worth of further investigation because it can extensively affect large seafloor sectors and it can generate severe impacts on vulnerable deep-sea ecosystems. The consequences on deep ecosystems and biodiversity of this waste accumulation are still not adequately analyzed in the scientific literature, but the physical impact (mainly covering) on sessile benthic communities and the risk from toxic substances in the environment suggest a negative effect on marine habitats (UNEP/MAP - RAC/SPA 2010a). Other marine pollutants that can impact deep environments are mainly chemical but chemical contamination of deep-sea sediments and their effect on the fauna is still mostly unstudied (UNEP/MAP - RAC/SPA 2010a; RamirezLlodra *et al.,* 2013, UNEP/MAP - RAC/SPA, 2017).

There is also a need to know the level of contaminants in deep-sea environments, and the dynamic of inputs, streams and distribution of contaminants, to be able to link sources, input entrances and environmental status.

Regarding oil and gas exploration and exploitation, we have to notice that offshore oil and gas production constitutes an important energy source of hydrocarbons in Italy since 1950s (Kostianoy and Carpenter, 2018). The Adriatic Sea is the location of the majority of oil and gas exploration and exploitation activities The majority of offshore rigs is located along the Northern and Central Adriatic coasts (in February 2018): 138 platforms and subsea wellheads, from them production platforms, 120; production support platforms, 10; and non-production platforms, 8. In addition Italy has three FPSO (Floating Production Storage and Offloading): *Alba Marina*, *Firenze* FSPO and *Leonis* (Kostianoy and Carpenter, 2018). Some offshore platforms are located also in the South Adriatic Sea (Kostianoy and Carpenter, 2018).

Starting from 2007, the level of exploration drilling progressively dropped, due to exploration maturity of the biogenic gas together with the heavy bureaucratic process to obtain exploration. Since 2013, new drilling is prohibited in the Tyrrhenian Sea, in the marine protected areas, and the waters within 12 nautical miles from the coast, but the concessions approved before 2013 may continue until all of the resources are extracted (Cazzini, 2018).

The different types of offshore platforms that are used for oil and gas exploration and production in the sea pose a severe threat to the marine and coastal zone environment, the seabed, and sea-bottom habitats and species, since oil contamination can persist in the marine environment for many years, depending on the oil type, the location of a spill, and the area in which the contamination occurs (Kingston, 2002; Kostianoy and Carpenter, 2018; Oceana, 2018).

Another critical factor whose effects on the deep sea still need to be investigated is climate change. In the deep-sea ecosystem, climate change implies a series of important processes such as a rise in CO_2 levels and ocean acidification, temperature change, expansion of hypoxic zones, destabilization of the slopes and gas hydrates and changes in productivity regimes (Ramirez-Llodra *et al.,* 2011). According to Danovaro *et al.* (2001), it can be responsible for an accumulation of organic matter on the deep-sea floor, the alteration of carbon and nitrogen cycles and adverse effects on deep-sea bacteria and benthic fauna, indicating that deep-sea ecosystems do respond quickly to climate change. Deep-sea organisms have evolved life strategies and physiological adaptations (e.g., slow metabolism and growth rates, high longevity, and late maturity) that allow them to succeed in the cold and generally food-limited deep-sea environment but that may partially impair their ability to physiologically compensate for and adapt to changes in climate. Therefore, a deeper understanding of species biological and ecological traits, as well as their tolerance thresholds to single and cumulative climatic stressors (e.g., temperature and nutrition, pH and O_2) is much needed (FAO, 2018b).

All these anthropogenic influences can modify deep-margin habitats through physical smothering and disturbance, sediment resuspension, organic loading, and toxic contamination and plume formation, with concomitant losses in biodiversity, declining energy flow back to higher trophic levels, and impacts on physiology from exposure to toxic compounds, such as hydrocarbons, polycyclic aromatic hydrocarbons, heavy metals (Ramirez-Llodra *et al.,* 2011; UN, 2017).

4.

Current response measures

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4.1. Marine protected areas and other area based conservation measures

In the last few decades, the recognized importance of protecting the marine environment and the role that marine protected areas play in this context, has grown worldwide. Indeed, the protected marine areas subjected to safeguard, characterized by high natural habitat and species, can be considered as reference sites for evaluating the measures effectiveness, aimed at achieving the good environmental status, as emphasized by both the MSFD and the Barcelona Convention.

Marine protected areas play an important role as essential tools to fight the loss of marine biodiversity; therefore, the CBD Aichi Target number 11 and the SDG 14 *"Conserve and sustainably use the oceans, seas and marine resources for sustainable development"* of Agenda 2030, commits countries to protect at least 10% of all coastal and marine areas by 2020.

In recent years, a great international effort for the establishment of new marine protected areas, in order to create a network of adequate ecological coherence, able to emphasize the positive effects of the protection measures, has been made (Gabrié *et al.,* 2012; EEA, 2015).

In Italy, measures of spatial protection can be pursued through the application of various regulatory instruments such as, for example, Directive 92/43/EEC (Habitat Directive), which requires Member States to create the Natura 2000 Network trought the designation of specific protected areas, namely the *Sites of Community Importance* (SCIs), the *Special Areas of Conservation* (SACs) and the Wild Birds Directive 79/409/EEC *Special Protection Areas* (SPAs). Italian National laws n. 979/82 and n. 394/9 both provide for the establishment of Marine Protected Areas (MPAs). The establishment and networking of marine-coastal Natura 2000 Network and MPAs are considered full-fledged "measures" aimed at protecting the marine ecosystem.

In this paragraph we have taken into consideration the marine protected areas as defined by Italian legislation and for which direct regulatory and management tools are available. As regards sites with natural characteristics that require particular attention (such as EBSA and IMMA described in paragraph 2.4), other tools and policies guarantee protection of the species and habitats, even if an indirect way.

Natura 2000 Network

Within the Natural Protected Areas, the SACs represent one of the highest protection systems provided by European legislation for species and habitats. The designation of the SACs starting from SCIs is a fundamental step for the realization of the Natura 2000 Network, as it guarantees the full implementation of site-specific conservation measures and a correct management of the network. Furthermore, this process has so far been strategic in order to achieve the goal of halting the loss of biodiversity, in Europe and in the world, by 2020. In Italy Administrative Regions and Autonomous Provinces are the competent authorities responsible for identifying entity in charge of management and adopting the conservation measures necessary for the SACs. These measures imply the definition of appropriate management plans, which can be specific or integrated with

other regulatory and development plans. If the SACs fall within other Natural Protected Areas (National and Regional Parks or Marine Protected Areas), the latter apply the conservation measures provided by current legislation, and the management is entrusted to the Managing Body of the Protected Area.

To date, 2,347 SCIs have been identified in all the national territory, 2,278 (97%) of which have been designated as SACs. 285 are marine-coastal SCIs and 38 are SACs (data updated in April 2020).

In summary, in Italy Natura 2000 Network covers a total of about 19% of the national land territory and more than 7% of the marine one (Figure 8).

Figure 8

The Natura 2000 network in Italy (SCI and SAC). Data processed by national experts, source: MATTM.

Table 6 shows the overall marine-coastal SCIs / SACs in the ADRISEA sub-region. In this basin there are 38 SCIs / SACs (13% of the total Italy), with a total area of 128,982 hectares (9% of the total Italy).

Finally, as regards SPAs, although various areas of the Natura 2000 Network foresee an extension to the sea, it should be noted that the identification of areas for the protection of seabirds is still an ongoing process. In particular, in the last two decades, several studies have been conducted to define the criteria for identifying the IBAs for seabirds nesting in Italy, through the adapting of methodologies developed by Bird Life Interantional to the national context (Lipu, 2009).

More recently a study focused on Cory's Shearwater has identified four IBAs, one of them in the ADRISEA subregion (IBA of Middle Adriatic Sea), in which it is strongly encouraged that SPAs, with a wide extension also far from the coast, will be established (Lipu and ISPRA, 2015).

Table 6

Marine-coastal Natura 2000 sites designated pursuant to Article 4 of the Habitats Directive in ADRISEA subregion. Data processed by national experts, source: MATTM.

	Number	Area (ha)	% of the total number of sites
Site N2000	38	128.982	
SCIs	5	3.309	13%
SACs	33	125.673	87%

Information about Natura 2000 Sites, their cartography and species and habitat that characterize them, could be found in the dedicate section of the MATTM website (http://www.pcn.minambiente.it/mattm/) and on the National Biodiversity Network information system (http://www.nnb.isprambiente.it/it/il-network).

Marine Protected Area (MPA)

The Italian Marine Protected Areas are constituted by marine environments, consisting of waters, seabed and stretches of facing coast line, with a remarkable role in terms of natural, geomorphological, physical, biochemical characteristics. The MPAs have to be also important areas for the marine and coastal flora and fauna and for the scientific, ecological, cultural, educational and economic activities.

They have been brought into the Italian legislation by Title V - Marine Reserves - of Law n. 979 of 1982, containing *"Provisions for the defense of the sea"*, which identified a list of 20 marine areas where to establish marine reserves. With the subsequent *"Framework law on protected areas"*, (Law n. 394 of December 6, 1991) additional 26 areas have been identified.

At present, after various regulatory changes, the marine protected areas are under the direct jurisdiction of the Italian State and established by Decree of the Italian Minister of the Environment and Land and Sea Protection (MATTM), in agreement with the Minister of Economy and Finance, after consulting Administrative Regions, the competent municipalities and the permanent Conference for Relations between the Italian State, Administrative Regions and Autonomous Provinces *(Unified Conference)*. The managing body of the MPAs, identified by MATTM, can be a public authority, a scientific institution and/or recognized association, including consortium members.

The identification and establishment of a MPA does not only concern the choice of conserving sea envitonments, with its living species, but provides also for a clear regulation of human activities. The presence of man, in particular, is not considered as a disturbing factor but rather as an added value: law 394/1991, in fact, identifies coastal populationsa as an integral part of the environment to be protected, considering the relationship nature-man in a strategic way. The object of protection is therefore not only the naturalistic heritage, but also the economic, historical and social ones, considering the importance of the ecosystem services, including the cultural function, that MPAs can offer to man.

A peculiarity of the Italian legislation in comparison with the global legislative system is the fact that the indication of the areas worthy of protection happens through a national law. Only the areas identified by law, classified at first as a "procurement" area, can become an MPA after an apporpriate feasibility study, aimed at ascertaining and enhancing the environmental and socio-economic characteristics of the area object worthy of attention.

To date, on the basis of this regulatory framework, 29 Marine Protected Areas have been established in Italy, as well as 2 Underwater Parks (Underwater Park of Baia and Underwater Park of Gaiola) and the International Sanctuary for marine mammals protection. Considering also two National Parks (Tuscan Archipelago Park and Maddalena Archipelago Park), which provide sea protection measures as well, the total number rises to 34 (Figure 9).

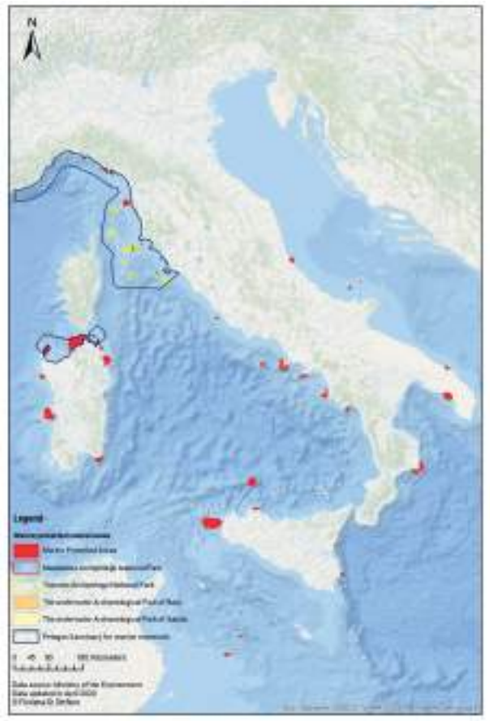

Figure 9

Marine natural protected areas in Italy. Data processed by national experts, source: MATTM.

The listo of the MPAs of the ADRISEA subregion in reported in Table 7 shows (http://www.pcn.minambiente.it/mattm/).

Table 7

List of the marine protected natural areas with the extension in the ADRISEA sub-region
Data source: MATTM 2020, processing by national experts

Type	Name	SubRegion	Area (ha)	Length coast (Km)	SPAMIs (SPA/BD)	WEB SITE
MPA	Miramare MPA	ADRISEA	30,00	1,10	IT 2 - Miramare MPA	http://www.riservamarinamiramare.it
MPA	Torre Cerrano MPA	ADRISEA	3.431,00	0,01		http://www.torredelcerrano.it
MPA	Torre Guaceto MPA	ADRISEA	2.227,00	8,41	IT5 -Torre Guaceto MPA	http://www.riservaditorreguaceto.it
MPA	Tremiti MPA	ADRISEA	1.466,00	20,41		https://www.parcogargano.it
	TOTAL ADRISEA	4	7.154,00	29,93	2	

The data of protected area alone, however, does not allow going back to the actual degree of protection, which is strictly correlated to the distribution in the different zoning levels. The percentage distribution of the areas of the 29 MPAs according to the level of protection provided by the zoning, highlights that only 2.8% of the total area is subject to integral protection restrictions (zone A), while in the remaining part anthropogenic activities are regulated and/or permitted in line with the protection objectives (zone, C and D). However, it is important to remember that some MPAs are equipped with *Special Zone B*, in which any form of withdrawal and alteration of the environment is prohibited and access is only permitted (Figure 10) (ISPRA, 2020).

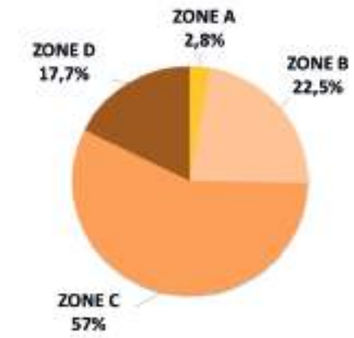

Photo : GDNCNP

Figure 10

Percentage distribution of the surface of the MPAs according to the zonation levels.
Source: modified from ISPRA, 2020.

The Italian zoning system, infact, is the first element characterizing an MPA, defining the reference scheme for future management. The zoning process is usually based on a preliminary study that analyzes and considers, in an integrated manner, the environmental and socio-economic values of sea and coast areas concerned.

The system is generally based on 4 levels of protection:

- *Zone A* or integral reserve: forbidden to all activities that may cause damage or disturbance to the marine environment. In this area, only scientific research and service activities are generally permitted;

- *Zone B* or general reserve: where a series of activities are permitted, often regulated and authorized by the management body. This activities, while granting a sustainable fruition and use of the environment, have a minimal impact;

- *Zone C* or partial reserve: represents the buffer zone between the areas of greatest naturalistic value and the sectors outside the protected marine area, where the activities of fruition, with modest environmental impact, and sustainable use of the sea are allowed and regulated by the management body, in addition to what is already allowed in the other areas;

- *Zone D:* present only in rare cases, it provides for a less restrictive regulation than the other zoning levels.

As mentioned above, *Special Zone B,* where access is possible and fishing activities are prohibited, have also been established in some MPAs.

The management tools that are defined for each MPA are:

- *"Regulation governing the permitted activities in the various zones of the marine protected area",* which defines the division into protection zones within the MPAs and identifies the activities allowed in each zone;

- *"Implementing and Organization Regulation"* (REO), which regulates the organization of the MPA and details how permitted activities can be carried out, in compliance with the zoning;

- *"Disciplinary",* which details methodological criterion of "dynamic and adaptive management" for all the planned activities. It could be updated annually, if needed, in order to make them functional and adaptive to the needs of the MPA.

In general, within the MPAs, prohibited activities are: the capture, collection and damage of animal and plant species as well as the removal of minerals and archaeological finds; the alteration of the geophysical environment and of the chemical and hydrobiological characteristics of the waters; carrying out advertising activities; the introduction of weapons, explosives and any other means of destruction and capture; motor navigation; any form of landfill of solid and liquid waste.

With regard to the annual and three-year planning, the managing body implements periodically a conceptual map based on the ISEA *model (Standardized Interventions for the Effective Management of Marine Protected Areas).* This model has to be filled with all the management activities identified by managing bodies aimed at safeguarding and protecting the designated territory, on the basis of the threats identified and the consequent strategies to be implemented.

Finally, in order to contribute to the implementation of the management activities planned with the ISEA model, the Ministry of the Environment assigns resources to each MPA through distribution criteria based on principles of transparency, efficiency, effectiveness, and impartiality. The amount of resources is allocated using the software *So.De.Cri.*

Biological Conservation Zones (ZTBs)

Additional marine protected areas, in Italy, are the Biological Conservation Zones (ZTBs – *Zone di Tutela Biologica*), established under art. 98 of the Law n. 963/65 by the Ministry of Agricultural, Food and Forestry Policies (MIPAAF) in order to safeguard and repopulate fish resources.

MIPAAF may prohibit, or limit in time and in places, fishing activities or the use of particular fishing gear in the areas recognized as important for reproduction, recruitment or growth of marine species of economic importance. The measures of management provided for in these areas are aimed, in particular, at preserving the health of stocks subject to intense exploitation, allowing their restocking, in line with the current European legislation about fishing and with the sustaibability principles of CFP.

The conservation measures adopted are in general:

- ban on fishing for juveniles of all species of fish, throughout the year and in all areas of biological protection;

- prohibition of professional, artisanal and recreational fishing, including underwater fishing unless explicitly allowed;

- restriction of the use of specific fishing gears.

Currently, there are in Italy 12 ZTBs, 7 of which in the ADRISEA subregion (Figure 11):

- Tenue di Chioggia
- Miramare
- Area fuori Ravenna
- Barbare
- Porto Falconera - Caorle
- Al largo delle coste della Puglia
- Area Tremiti

Figure 11
Distribution of National ZTBs.

Fisheries Restricted Areas (FRAs)

Another conservation tool linked to the fish resource is the establishment, by the GFCM and RFMO, of Fisheries Restricted Areas (FRAs). GFCM has the right to adopt spatial management measures that regulate and/or restrict fishing activities in specific areas. Fishing activities may be fully prohibited the use of certain fishing gear could be limited. Since 2006, 8 FRAs have been established to ensure the protection of sensitive deep-sea habitats and essential fish habitats (EFHs) in well-defined sites.

In addition, in 2005, GFCM banned the use of towed dredges and trawl-nets in all waters deeper than 1000 meters, in order to protect little-known deepwater benthic habitats in the Mediterranean. In 2016, this vast protected area below 1000 meters was officially declared FRA by the Commission. Figure 12 shows the FRAs located in the ADRISEA sub-region.

Figure 12
Fisheries Restricted Areas in ADRISEA subregion. Data processed by national experts, source: MATTM.

Specially Protected Areas of Mediterranean Importance (SPAMI)

Through the SPA/BD Protocol, the Contracting Parties decided to establish the Special Protected Areas of Mediterranean Importance (SPAMI), in order to promote cooperation in the management and conservation of natural areas as well as in the protection of threatened species and their habitats at Mediterranean level.

The SPAMIs are marine and coastal sites established to conserve the components of biological diversity in the Mediterranean, ecosystems specific to the Mediterranean area or the habitats of endangered species and areas of special interest at the scientific, aesthetic, cultural or educational levels.

To be included in the SPAMI List, a site must meet the criteria set out in Annex I of the SPA/BD Protocol, such as:

- uniqueness,
- natural representativeness,
- diversity,
- naturalness, as a result of the lack or low level of human-induced disturbance and degradation,
- presence of habitats critical to endangered, threatened or endemic species,
- cultural representativeness.

It is therefore evident that the SPAMI selection is based mostly on their high biodiversity value within the Mediterranean region.

In particular, they are highly relevant to limit the risk associated with biodiversity loss and, at the same time, to further opportunities inherent to its conservation.

Moreover, one of the criteria for identification of SPAMIs is cultural representativeness, based on the existence of sustainable and traditional activities that support the well-being of local communities. Some of these sites will therefore hold a high socio-cultural value. For this reason, it is even more relevant to promote the involvement of local communities in the management of SPAMIs, as required by suitable management plans.

Indeed each SPAMI requires a management plan, where management measures are set. These measures include: prohibiting the discharge or unloading of waste, regulating shipping operations, regulating the introduction of any non-indigenous species. Moreover, managing plans have to provide regulation or prohibition of wildlife exploitation activities as well as of any activity involving the exploration or modification of the soil and subsoil. Furthermore, any other appropriate measures must be taken. Traditional activities of local populations can be permitted as long as they do not endanger the protected ecosystems. SPAMIs are legally protected and constitute the most important network of protected areas recognised by all Mediterranean country signatories to the Barcelona Convention. Indeed, being designated as SPAMI does not only mean having international recognition but also means having tools for cooperation, mutual exchange, continuous improvement aimed at preserving biodiversity values both locally and in the Mediterranean.

The designation of SPAMIs is an on-going process with more sites periodically being added.

During the 21st ordinary meeting of the Contracting Parties to the Barcelona Convention (Naples - Italy, December 2019), 4 new areas have been included in the SPAMI List.
To date, the SPAMI List contains 39 sites, including one in the high sea: the Pelagos Sanctuary for marine mammals.

In Italy, there are currently 12 SPAMIs, including the Pelagos Sanctuary (Figure 13).

In the Italian Adriatic subregion there are 2 SPAMI (UNEP/MAP-SPA/RAC, 2020). :

- IT 2 - Miramare MPA ;
- IT 5 - Torre Guaceto MPA and Natural Reserve.

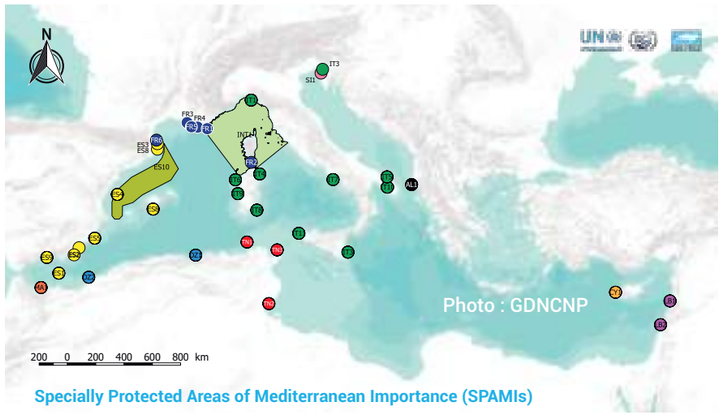

Figure 13
SPAMIs in the Mediterranean: in green the Italian SPAMIs. Source: SPA/RAC, 2020

In 2018, a framework cooperation agreement was signed between MATTM and UNEP/MAP called SPAMI Project *(Development and strengthening of effective management of Specially Protected Areas of Mediterranean Importance)*.

Inside the project, some activities for the development of twinning programs between Italian SPAMI / MPA and SPAMI / MPA of the Mediterranean sub-regions of which Italy is part, have been planned in order to promote networking and standardise management. The project aims to support best practices and experience sharing between SPAMI MPA twins, strengthen the MPAs' capacity-building, involve local population and NGO with the goal to guarantee effective management of SPAMIs.

During the kick-off meeting in in February 2019, four SPAMI twinning agreements were signed:

- Karaburun Sazan SPAMI (Albania) and Torre Guaceto SPAMI (Italy, ADRISEA);
- Habibas Islands SPAMI (Algeria) and Tavolara – Punta Coda di Cavallo SPAMI (Italy, WMED);
- Strunjan Marine Protected Area (Slovenia) and Torre del Cerrano Marine Protected Area (Italy, ADRISEA);
- Kneiss Islands SPAMI (Tunisia) and Egadi Islands Marine Protected Area (Italy, WMED).

Within the project, a web platform was created aimed to share documents and tools, as well as to strengthening the partnership created (http://spami.medchm.net/en).

This initiative appears very useful to promote and strengthen a Mediterranean MPAs' network. Indeed the MPAs should create a common view and work together to standardise management methodologies and approach in order to protect their biodiversity. Surely the results of the project can be extended to other SPAMIs.

Other meausers

Italy has always been very active in the context of UNESCO Conventions and Programs, in order to raise the level of protection and improve the conservation and knowledge of biodiversity and ecosystem services. In this context, participation in the initiative "Man and the Biosphere Program" is very relevant.

The attention to this program is demonstrated by the increment of recognized Italian Biosphere Reserves. In the period 2014-2018, they have almost doubled, from 9 to 19 (of which one is cross-border).

Of these, five include marine areas and one is located in ADRISEA: Miramare (Friuli Venezia Giulia, established 1979).

The MAB programme wants to provide a platform for cooperation on research and development, capacity-building and networking to share information, knowledge and experience regarding biodiversity loss, climate change and sustainable development. Therefore this program represents a fundamental tool for addressing the issues of biodiversity in a global context, directing attention to the future challenges that communities are and will have to face in the protection and enhancement of natural resources, both by managing their threats and enhancing their opportunities. This approach is possible also thanks to the presence of theme-specific networks that provide valuable insights into sustainable development models and climate change mitigation and adaptation possibilities. They include networks and research, capacity building and educational collaborations on several topics, such as "Wetland" or "Marine, Coastal and Island Areas".

4.2. Legal and institutional frameworks governing the conservation and sustainable use of marine and coastal biodiversity

The governance of the sea-system, in Italy, is entrusted to various regulatory instruments mainly related to national implementation of international/regional conventions and European policies. The instruments adopted at national level to prevent the loss of biodiversity are both direct, such as actions aimed at the protection of species and ecosystems (e.g., establishment of Protected Areas and the Natura 2000 Network) and indirect (i.e. measures designed to reduce sources of pressure and impacts on biodiversity).

The coherence between the different policies implemented in very different sectors, such as environmental protection, the exploitation of marine biological resources, maritime traffic, energy exploitation or economic development, to name a few, is guaranteed in particular by programs and national reference strategies, implemented by Italy in response to the main international conventions and protocols to which it adheres. Some examples are the *National Strategy for Biodiversity* (2010) and its mid-term review until 2020, the National Strategy for Sustainable Development (2018) and the *National Strategy for Adaptation to Climate Change* (2015).

In addition to the spatial protection measures described in paragraph 4.1 and to other obligations deriving from the application of the Habitats and Birds Directives, an important role for the protection and management of the marine ecosystems is played by the implementation of the Framework Directive on Marine Strategy (2008/56/CE - MSFD, implemented in Italy by Legislative Decree n. 190 of 2010) and the Directive on Maritime Spatial Planning (2014/89/UE - MSP, implemented in Italy with Legislative Decree n. 201 of 2016). Both based on the application of the ecosystem approach, they provide for a single and structured systemic action, which aims to ensure proper management and protection of the marine ecosystem and, at the same time, sustainable economic and social development. The integration of the provisions of the two policies with the policies and activities that already insist on marine and coastal environments will be guaranteed by the application of the MSFD Program of Measures and of the Management Plans of the MSP, both based on compliance with the European Strategy 2020 and the 2030 Agenda for the Sustainable Development.

The Marine Strategy, main tool for the integrated management of the sea-system and environmental pillar of the Integrated Maritime Policy, has required all member States to make an important effort to define coherent and effective strategies, based on data and information relating to both marine biodiversity and to the pressures that insist on it.

Through the initial assessment of 2012, Italy was able to identify the presence of various information gaps related to each of the 11 qualitative descriptors provided for by the MSFD and developed monitoring programs that made it possible, over the years, to fill the lack of data.

Italy also elaborated, in 2012 and then updated in 2018, a set of GES and Targets definitions that reflect achievable and consistent objectives not only with the criteria of the Framework Directive, but also with the main commitments undertaken at international level.

This orientation is evident, for example, in the definitions of GES and Environmental Targets for Descriptor 1 - biodiversity, which take into consideration, in addition to the species and habitats listed by the Habitats and Birds Directives, also those referring to the SPA/BD protocol, aiming to align the European process on a national level with the regional one of the Barcelona Convention (Table 8).

The attention dedicated to the alignment of the two processes is also prominent within the National Monitoring Programs provided for by art. 11 of the MSFD. The recent update of the Programs, subjected to public consultation in recent months, in particular, aims not only to identify those activities useful for responding to the requests of the new GES decision EU 848/2017 and to verify the achievement of national objectives, but also to foresee sampling and analysis that comply with the provisions of the EcAp, through IMAP.

Many of the monitoring methodologies developed by ISPRA and collected in special forms referring to each monitoring program, for instance, have been developed taking into account methodological standards identified within the UNEP-MAP, which Italy has also helped to define.

As regard to the implementation, at national level, of regional Action Plans related to the protection of biodiversity and developed within the UNEP/MAP activities, it should be noted that Italy has never formally ratified these instruments within its own legal system. This condition, however, is not due to a lack of will or interest but to the lack of an adequate legislative instrument for transposition and Italy has, in any case, always committed itself to implementing actions and strategies envisaged by the Action plans, also because most of the principles and provisions of the plans, now also part of the acquis communautaire, have been implemented through national environmental policies.

Table 8

Italian MSFD Descriptor 1 – biodiversity definitions of GES and related environmental Targets, as updated in 2018 (Ministerial Decree of february 15th, 2019).

Good Environmental Status
G 1.1 Marine species listed in the Habitat Directive, in the Birds Directive and in the SPA/BD Protocol of the Barcelona Convention maintain or achieve a satisfactory conservation status.
G 1.2 Marine habitats listed in the Habitat Directive and referred to the SPA/BD Protocol of the Barcelona Convention maintain or achieve a satisfactory conservation status.
G 1.3 The populations of fish and cephalopods, also of commercial interest, are in line with the prevailing physiographic, geographical and climatic conditions.
G 1.4 Coastal fish communities have satisfactory demographic characteristics.
Environmental Targets
T 1.1 Increase in the number of marine species listed in the Habitats Directive, the Birds Directive and the SPA/BD Protocol of the Barcelona Convention which maintains or achieves a satisfactory conservation status.
T 1.2 Increase in the number of marine habitats listed in the Habitats Directive and referred to the SPA/BD protocol of the Barcelona Convention which maintains or achieves a satisfactory conservation status.
T 1.3 The condition of the populations of representative species of fish and cephalopods, also of commercial interest, shows an improvement. These include vulnerable species due to their low reproductive capacity (sharks and rays) and/or commercially exploited fish and cephalopod species. To the latter species is applied the environmental target T 3.1 of Descriptor 3 (for all target species exploited by commercial fisheries subject to national and international management plans subject to analytical assessments, together with the main species of small pelagics (anchovies and sardines), which currently have fishing mortality above the relative sustainable reference limit, estimated taking into account a "precautionary margin" based on the levels of uncertainty, measured statistically or empirically (eg percentile approach), the current fishing mortality (Fcurr) or the "exploitation rate" (E) is reduced by 2020 in accordance with what is defined by the Multiannual Management Plans of the CFP, whose objectives are to bring stocks back to sustainable conditions by 2020).
T 1.4 The coastal fish populations show an improvement evaluated on the basis of the demographic characteristics of the populations of the coastal fish species that compose them, with reference to the conditions of the MPAs.

A further source of alignment, at national and regional level, between the MSFD and EcAp processes is also guaranteed by the activities envisaged by the MEDREGION project, "Support Mediterranean Member States towards the implementation of the Marine Strategy Framework Directive new GES Decision and programs of measures and contribute to regional/subregional cooperation", in which Italy is involved both through the Ministry of the Environment, as competent authority and leader, together with Slovenia, of Activity 2 -"Addressing cooperation needs of Member States' competent authorities in their implementation of the Directive (Regional cooperation)", and through ISPRA, leader of Activity 7 -"Operational assessment of GES setting at sub-regional level: Pilot analyzes of processes, alternatives and implications" and partner in other Activities.

The main objectives of the project are:

- Complete gaps in monitoring data in the Mediterranean region/subregions (with a focus on assessing the distribution, intensity and effects of the key pressures), by improving the data/information collection for the regional GES assessment and for the updated monitoring programmes, to be aligned and coherent to the IMAP process. This activity should take into account INSPIRE, EMODNET and WISE-Marine, as well as CORMON;

- Support the development and operational implementation of (sub)regional indicators, lists of elements, threshold values, to implement the GES Decision, in line with the main gaps identified in the EcAp project and with GES Decision requirements, in order to lead to updated, improved and more complete (sub)regional assessments;

- Focus on biodiversity descriptors and indicators based on criteria according to the new GES decision (EC 2017);

- Link pollution pressures (D5, D8, D10) with biodiversity;

- Support to the development of effective regional measures with a special focus on biodiversity in relation to pressures exerted on it and to coordinated measures to protect species and habitats, by: identification (and testing) of mechanisms to measure the effectiveness of PoMs; linking monitoring programmes with measures; identification of relation between measures, their objective (i.e. how each measure is designed to help reaching GES and the updated environmental targets) and results; coordination of measures (link with other Directives); relation to MPAs and ICZM; pave the ground for a coherent and consistent implementation of the provisions of the new Commission Decision performing pilot studies in Mediterranean areas, aiming to testing the applicability and effectiveness of approaches developed within the above mentioned activities of the project, using data derived by the MSFD monitoring projects.

Finally, the Italian National PoM (Program of Measures) addresses the most relevant pressures of the marine environment by identifying measures (actions) that help to achieve or maintain the GES and the environmental Targets set at national level. The measures are based on a wide range of existing legal acts, conventions, action plans and commitments that Italy has taken on at EU, regional, subregional and national level,

identifying where necessary new measures. Specifically, in order to reach the GES and Targets linked to biodiversity, the actions indicated in the PoM (DPCM of 10 October 2017) can be summarized in:

- Measures related to the management of the Natura2000 network sites;
- Planned measures for the designation of SACs of Natura2000 sites;
- Complete the network of Natura 2000 sites at sea and consequent identification of conservation measures
- Protection measures of the target species and of the target habitats through the MPA;
- Planned measures to increase marine protected areas;
- Protection measures of target habitats through other protected areas;
- Management measures of benthic habitats in the Mediterranean Sea and identification of protected species and habitats;
- Measures for the protection of fish fauna through other protected areas (Biological Protection Zones);
- Measures for the conservation of wild flora and fauna and natural habitats and the promotion of cooperation between States;
- Protection measures of benthic habitats associated with European legislation (planning, impact assessment, river basin management plans);
- Protection measures for habitats and target species associated with international conventions;
- Measures to protect biodiversity through European policies;
- National measures to protect biodiversity;
- Coastal territorial planning measures;
- Acquisition systematization and homogenization as well as coherent recognition of the data coming from the monitoring activities carried out in the national territory with particular reference to the EIA procedure;
- Implementation of awareness and information measures to avoid taking and damaging benthic species and protected habitats.

Regarding new measures for the protection of biodiversity, the Italian PoM identify the following:

- Complete the Natura 2000 Network at sea and consequent identification of conservation measures;
- Implementation of technical solutions (methodological and instrumental) to reduce the phenomenon of collisions with cetaceans;
- Implementation of training and awareness measures to reduce the mortality deriving from *bycatch* of elasmobranchs;
- Implementation of training and awareness measures to reduce *bycatch* mortality of cetaceans and sea turtles;
- Implementation of training and awareness measures to reduce *bycatch* mortality of seabird;
- Implementation of awareness-raising and information measures to avoid taking and damaging benthic species and protected habitats.

In addition to the measures dedicated to the protection of biodiversity, the PoM addresses also all other topic of the Marine Strategy, and identifies measures already in place and new ones, some of which are reported in chapter 5.

As regards to the application of the ecosystem approach and of principles of sustainability to the exploitation of the biological marine resources, it's also important to mention the national implementation of the EU *Common Fisheries Policy* (CFP), which finds its most tangible expression through the *National three-year program of fisheries* and aquaculture and related plans, such as the demersal fisheries management plans or *the Strategic Plan for aquaculture in Italy 2014-2020*, periodically adopted by the MiPAAF. These tools take on particular importance in the planning and management of interventions, as well as in the periodic verification of the predetermined results, in compliance with the commitments that Italy has assumed through multilateral agreements for the regulation of the joint exploitation of the fish resources shared between Italian and other countries fleets, mainly in the European/Mediterranean regional framework.

Finally, in order to obtain a correct application of the principles of environmental sustainability and of the ecosystem approach in the Management Plans envisaged by the MSP, as well as to draw up plans that are coherent and coordinated with the objectives and principles of the Marine Strategy, Italy adopted, in 2017, the "Guidelines for the management of the maritime space". This document, in particular, in addition to reporting methodological indications for the drafting of plans and for the consequent Strategic Environmental Assessment (SEA) and Assessment of Implication under Directive 92/43/ECC procedures, reaffirms and develops the connections between the MSFD and MSP Directives, the integration of which must be guaranteed through the identification of strategic objectives, ambitious but still achievable, to be able to decline them into concrete and measurable actions. In accordance with the provisions of the MSFD, moreover, the territorial areas identified by the Guidelines for the preparation of the related management plans coincide with the three Italian marine subregions used for the development of the Marine Strategy. The Guidelines also identify the areas important for land-sea interactions,

defined as "interactions in which natural phenomena or terrestrial human activities have an impact on the environment, on marine resources and activities and in which natural phenomena or marine human activities have an impact on the environment, resources and terrestrial activities". Great importance is finally reserved for the development of strong international cooperation both with EU and non-EU countries, in order to develop plans and strategies in line with cross-border maritime planning for the same marine subregion.

In order to provide an overview of the main reference frameworks for the definition of national environmental policies and in particular those dedicated to the protection of the sea and the coastal area, a list, although not exhaustive, of international conventions and protocols, as well as of European policies is provided:

International Conventions and Strategies	
1976/1995	Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention) and related protocols
	Protocol for the prevention of pollution of the Mediterranean sea by dumping from ships and aircraft (Dumping Protocol)
	Protocol Concerning Cooperation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea (Prevention and Emergency Protocol)
	Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources (Land-Based Sources Protocol)
	Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol)
	Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil (Offshore Protocol)*
	Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal (Hazardous Wastes Protocol)*
	Protocol on Integrated Coastal Zone Management (ICZM) in the Mediterranean*
1973	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
1973/1979	International Convention for the Prevention of Pollution from Ships (MARPOL)
1979	Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
1979	Convention on the Conservation of Migratory Species of Wild Animals (CMS – Bonn Convention)
1982	United Nations Convention on the Law of the Sea (UNCLOS)
1992	Convention on Climate Change (CCC)
1992	Convention on Biological Diversity (CBD)
1995	Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)
1996	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS)
2004	International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)
2010	Strategic Plan for Biodiversity 2011 – 2020 and Aichi Biodiversity Targets
2015	2030 Agenda for Sustainable Development

* Not yet ratified by Italy

European policies	
1971/2006	Directives 76/160/EEC and 2006/7/ECconcerning the quality of bathing water.
1979 / 2009	Directives 79/409/EEC and 2009/147/EC on the conservation of wild birds ("Birds Directive")
1985/2011/2014	Directives 85/337/EEC, 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment (EIA)
1991	Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources (Nitrates Directive)
1991/1998	Directive 91/271 /EEC and 98/15/EC concerning urban waste water treatment
1992	Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ("Habitat Directive")
2000	Directive 200/60/EC - EU Water Framework Directive (WFD)
2001	Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (SEA)
2002	Recommendation 2002/413/EC concerning the implementation of Integrated Coastal Zone Management in Europe
2008	Directive 2008/56/EC - The Marine Strategy Framework Directive (MSFD)
2008	Directive 2008/98/CE on waste
2013	Regulation EU 1380/2013on the Common Fisheries Policy (CFP)
2014	Directive 2014/89/EU establishing a framework for maritime spatial planning (MSP)
2014	Regulation EU 1143/2014 on the prevention and management of the introduction and spread of invasive alien species

In addition to the Italian regulatory instruments directly linked to the implementation of European policies (transposition laws and consequent implementing decrees) or international ones (such as, for example, ratification instruments), the following provisions are noted :

Italian regulatory instruments	
1982	Law n. 979 of December 31, 1982 - Provisions for the defense of the sea
1991	Law n. 394 od December 6, 1991 n. 394 – Framework law on protected areas
2006	Legislative Decree n. 152 of April 3, 2006 - Environmental regulations
2015	Law n. 221 of December 28, 2015 - Environmental provisions to promote green economy measures and to limit the excessive use of natural resources

The Law 979 of 1982 and subsequent amendments, with which "Provisions for the Defense of the Sea" are defined, represents in particular one of the first and most complete Italian

laws adopted for the protection of marine ecosystems, providing the establishment of marine areas to be placed under protection, one of the first institutional monitoring and, finally, a national system aimed at the prevention and fight against marine pollution, through the use of specialized naval units, managed by MATTM. With respect to this last issue the law, in line with the provisions of international conventions regarding the fight against marine pollution by hydrocarbons and toxic-noxious substances, such as the OPRC (International Convention on Oil Pollution Preparedness, Response and Cooperation), provides, through the implementation of the "Operational emergency plan for the defense of the sea and coastal areas from accidental pollution by hydrocarbons and other harmful substances" (updated in 2013), that the anti-pollution fleet operates promptly as soon as an accident occurs at sea that could cause damage to the environment. The ships of the anti-pollution facility operate in stand-by mode with the staff always available (24 hours a day) ready for use, providing the following services:

- intervention activities in territorial waters, in case of ascertained pollution or imminent danger of pollution following a request by the competent maritime authority, on the basis of preventive and specific authorizations issued by MATTM at the request of the maritime authority (Corps of the Port Authorities);

- interventions outside territorial waters with the use of offshore units, if the need arises, within the framework of the principles of collaboration between States in the fight against marine pollution, sanctioned by international conventions to which Italy adheres.

4.3. Transboundary issues and existing, planned or needed coordination / harmonisation at subregional or regional level

In light of the maturity of the Italian management system of coastal and marine resources, the identification of cross-border measures to be implemented at the subregion level in order to manage shared resources in a better way and minimize common problems is identified as a priority. A clear example concerns the management of the marine litter, for which Italy has now equipped itself with many robust management tools. Nonetheless, without shared efforts on the part of the countries sharing the subregional basin, it will be impossible to achieve the objectives set.

In this context, Italy is committed to several fields of action. At an international level, in anticipation of the new strategic objectives that will soon be adopted by the CBD for the post-2020, Italy is also participating in governative international initiatives, such as the "30by30 initiative in protection of the ocean", launched by the UK in 2020 and to which several nations are joining. This initiative aims to alert on ocean's safety and protection of its wildlife, while pushing for at least a 30% of the global ocean to be protected in Marine Protected Areas by 2030.

At the regional level, for example, Italy is making strong efforts to make it possible to create a control area for sulfur emissions (SECA) in the Mediterranean basin. The negotiations conducted in the context of the 21st Conference of the Contracting Parties of the Barcelona Convention, held last December in Naples, led to the definition of a path, shared by the other Mediterranean countries, aimed at the designation of the Mediterranean Sea as a SECA area by 2022.

The MATTM is committed to allowing that the timing identified by the established road map could be respected and that the important milestone of adopting the SECA is achieved quickly. Also, Italy is making efforts to ensure that clear and well-defined financial and economic instruments are also identified to support the approval process.

In relation to the implementation of the MSFD, Italy is also strongly involved in the follow-up of the New GES Decision, through the work of defining, within the CIS, the unional and regional threshold values for the criteria identified by the Decision. The aforementioned MEDREGION project, ideed, was drafted to support Mediterranean Member States for the second cycle of the MSFD implementation. In synthesis, the overall objectives of the project have been identified with the specific aim to provide the necessary support to the CIS for the coordinated implementation of the New GES Decision at a Mediterranean level and to provide a useful platform for the necessary regional and subregional cooperation, in order to support the further development of the Programmes of Measures and to align the MSFD with the EcAp Process.

A topic that will be increasingly important in the coming years and which will need shared governance tools between cross-border countries is the blue growth.

In the last decade, the development of the blue economy has proved crucial for Italy, for both the number of employees and GDP deriving from this sector (European Commision, 2020). For this reason, it is important to give the proper attention to sustainable development in the various sectors of interest of the blue economy, also to better protect biodiversity. The European Union has addressed the member states to activate one integrated maritime policy to coordinate actions relating to the various sectors of the sea. In this framework, Blue Growth is a significant opportunity to create new jobs, support system competitiveness and strengthen social cohesion. Within the 2014-2020 Research and Development Program, it is translated into specific intervention tools.

This approach is also in full harmony with the objectives of the 2030 Agenda for sustainable development of the United Nations, in particular Sustainable Development Objective n. 14 "Store and use the oceans, seas and marine resources for sustainable development".

The European Union is strongly enhancing cooperation policies between Mediterranean Countries (e.g., EUSAIR strategy, BLUE MED) to tackle the fragmentation of the sectors of the sea and to develop a shared approach in the use of the sea resource. Moreover, the creation of clusters is encouraged. Their scope is to become aggregators and centres of excellence for economic activity, research and innovation. Their main objective is to ensure sustainable growth in this sector.

In this context, Italy has excellent positions and excellent growth potential: shipbuilding, maritime transport and the fishing industry are the primary sectors, followed by offshore activities, coastal and maritime sports and recreational activities; aquaculture, resources minerals, marine biotechnologies, environmental forecasting and information services

and new technologies submarines offer new business opportunities (CTN BIG, 2018).
For further information, please refer to:

- VIII Fourth Report on the economy of the sea (Unioncamere, 2019);
- VI Report on the economy of the sea (CENSIS, 2019).

Furthermore, the National Research Program 2014-2020 identifies 12 Areas of specialization of skills - including Blue Growth - around which to structure national policies and effective instruments in terms of impact on the social and economic development of the country.

Within these tools, it is possible to include the Blue Med Initiative that is aimed at developing programs of R&D based on blue growth in the marine and maritime sectors. It sees the participation of nine EU member countries committed to jointly defining a Strategic Research and Innovation Agenda. The 2015-2020 Italian National Research Program provides support for the necessary networking and coordination activities of BlueMed within the "Blue Growth" National Technology Cluster (*http://www.clusterbig.it/*).
Important tools for cooperation and sustainable development shared between cross-border states are also Macro-Regional Strategies

The European Council approved the European Strategy for the Adriatic and Ionian Macroregion (EUSAIR) in 2014. This Strategy aims to promote the economic and social well-being of the Adriatic-Ionian Region through growth and job creation, improving its attractiveness, competitiveness and connectivity, at the same time preserving the environment and guaranteeing healthy and balanced marine and coastal ecosystems.
For the details refer to the EUSAIR Action Plan. The Strategy is based on four Pillars:

- Pillar 1 "Blue growth";
- Pillar 2 "Connecting the Region";
- Pillar 3 "Environmental quality";
- Pillar 4 "Sustainable tourism".

Beyond these Pillars, there are transversal themes such as capacity building and research and innovation.

As can be understood from the chosen pillars, this macro-regional Strategy offers a real opportunity to coordinate and concentrate the efforts of the various countries involved to protect and conserve biodiversity with a view to the sustainable exploitation of marine and coastal resources.

These purposes are a priority for pillars 1 and 3. But other activities can also contribute to strengthening cooperation in crucial areas for the sustainable management of the marine environment.

More in details, the overall objective of Pillar 1 "Blue Growth" is about driving innovative maritime and marine growth in the Adriatic-Ionian Region by promoting sustainable economic growth and jobs as well as business opportunities in the blue economy sectors.

The specific objectives for this pillar are:

1. To promote research, innovation and business opportunities in blue economy sectors, by facilitating the brain circulation between research and business communities and increasing their networking and clustering capacity.

2. To adapt to sustainable seafood production and consumption, by developing common standards and approaches for strengthening these two sectors and providing a level playing field in the macro-region.

3. To improve sea basin governance, by enhancing administrative and institutional capacities in the area of maritime governance and services.

To achieve the abovementioned objectives, Pillar 1 will focus on three topics:

- Blue technologies;
- Fisheries and aquaculture;
- Maritime and marine governance and services.

The overall objective of the pillar 3 "Environmental quality" is to address the issue of environmental quality, concerning marine, coastal and terrestrial ecosystems in the Region. Inside the Strategy, the Environmental quality is considered as essential for underpinning human activities in the macro-region and for ensuring economic and social well-being for its peoples. The pillar will deal with the environmental issues that can only be adequately tackled through cooperation at the level and scale of the macro-region.
The specific objectives for this pillar are:

- To ensure a good environmental and ecological status of the marine and coastal environment by 2020 in line with the relevant EU acquis and the ecosystem approach of the Barcelona Convention.

- To contribute to the goal of the EU Biodiversity Strategy to halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restore them in so far as feasible, by addressing threats to marine and terrestrial biodiversity.

- To improve waste management by reducing waste flows to the sea and, to reduce nutrient flows and other pollutants to the rivers and the sea.

Inside this framework, the marine environment topic takes on considerable importance, and it is deepened within the Strategy in two main aspects:

a) Threat to coastal and marine biodiversity
b) Pollution of the sea

For each of them, the Strategy identifies indicative actions and proposed targets.
Many Italian regions are firmly committed on several fronts to make the most of the opportunities for cross-border financing and cooperation made available within the Strategy to follow common goals and solutions for the marine environment.

Another tool implemented by Italy for sustainable management of marine and coastal resources was the CAMP project. The CAMP Italy Project was born within the Coastal Area Management Program (CAMP), which is part of the activities of protection of the Mediterranean in the framework of Barcelona Convention. The CAMP is a component of the Mediterranean Action Plan (MAP) and it is oriented towards the implementation of coastal management projects, developed for pilot areas located in the Mediterranean. The CAMP projects are therefore based on the Protocol on Integrated Coastal Zone Management (ICZM).
For the CAMP Italy Project, the pilot areas have been chosen on the bases of several elements, such as: evaluation of the naturalistic aspects, anthropic pressures and governance tools. The main objective of CAMP Italy concerned the development and implementation of strategies and procedures for sustainable development of coastal areas, in particular by identifying and testing methodologies tools for ICZM. The CAMP Italy activities regarded in particular three thematic areas:

- Planning of land and coastal sea zones;
- Protection, preservation and restoration of coastal and marine habitats;
- Sustainability of socio-economic pressures in the coastal zone.

Within these thematic areas, the local stakeholder involved has carried out multiple pilot actions, over the period 2014-2016 such as: coastal nourishment activities and monitoring, protection of dunes, conservation of marine and coastal biodiversity, sustainable tourism activities, education and communication on the sustainability of coastal areas, sustainable use of beaches and the protection of coastal ecosystems, enhancement of coastal historical-architectural heritage integrated management of fishery resources.

Moreover, during the project, all stakeholder proposed innovative methods and tools for planning and management of coastal zones that can be shared and implemented in future actions at subregion level.

For further details on project tools and results, please refer to the final report of the CAMP Italy Project:
https://www.minambiente.it/sites/default/files/archivio/allegati/CAMP/CAMP_Italy_Final_Report_it.pdf

Cross-border cooperation is also an essential tool for creating and implementing shared methodologies for the protection of species and habitats. This goal was pursued through the significant activity and participation of research institutions and institutions in projects funded and implemented through Interreg or under the Life Programs.In this regard, some of them of particular relevance for the conservation and correct management of biodiversity are mentioned here.

- The NETCET project, financed by the IPA Adriatic Cross-border Cooperation Programme, ended in 2015. The main objective of the NETCET project is to develop joint strategies for the conservation of cetaceans and sea turtles in the Adriatic through pan-Adriatic cooperation. Among the project results, there are two strategic documents regarding the strategies for conservation of cetaceans and sea turtles in the Adriatic in the 2016 – 2025 period. These documents contain conservation actions proposed at the sub-regional level and for each Adriatic country - including Italy. One of the products of the project was the realisation of the Atlas of cetaceans and sea turtles. It represents an essential tool to deepen the knowledge of these organisms and to implement effective protection measures.

- LIFE EUROTURTLES project, which is aimed at improvement of sea-turtles population knowledge, to develop joint action as well as possible proposition of sea turtles relevant Natura 2000 sites in the Adriatic.

- INDICIT II, founded by the DG Environment of the European Commission, focus on the Descriptor 10 of the MSFD (Marine litter). The overarching aim is to develop a common approach for a monitoring set of standardized tools for monitoring the marine debris and assessing impacts of litter on marine fauna as bio-indicators.

- GHOST, co-financed by the LIFE + Biodiversity instrument of the European Union, promotes concrete measures to preserve and improve the ecological status of the rocky habitats (Tegnue) in the northern Adriatic Sea. One of the main objectives is the assessment of the impacts that discarded fishing gears (known as ghost nets) can have on marine biodiversity. To this end, they will be recovered in sample areas, the most suitable procedures for their recycling and disposal will be identified. Moreover, the economic value of the ecosystem benefits associated with their removal will be quantified. One of the aims is to facilitate the adoption of conscious management practices by fishers. Finally, a regulation will be proposed which, addressing the various problems associated with the eco-sustainable management of ghost nets, can constitute a tool for reference that can be adopted by the local administrative authorities for the mitigation, together with prevention, of environmental impact and economic damage.

- SOUNDSCAPE project, founded by Italy-Croatia Interreg, aimed at underwater noise mapping in the northern part of the Adriatic and proposition of mitigation measures. The main objective of the project is to create a cross-border technical, scientific and institutional cooperation between Italy and Croatia in the Northern Adriatic Sea to face together the challenge of assessing the impact of underwater environmental noise on the marine fauna and in general on the ecosystem on a basin scale.

- QUIETMED2, founded by the DG Environment of the European Commission, that aims to support Member States in the GES assessment Descriptor 11 (Underwater noise) trough a common to establish threshold values. Besides to boost current regional cooperation efforts of the Barcelona Convention developing new Mediterranean Region cooperation measures.

5.

Assessment of marine and coastal status and pressures and impacts on the marine and coastal biodiversity

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5.1. Marine and coastal status and pressures relevant for national marine and coastal areas

The severe threats of the coastal and marine environments are several.
The Italian National Strategy on Biodiversity groups in the following points:

- pollutants of terrigenous origin and in particular eutrophication and pollution by dangerous and nutrient substances from agriculture, the dumping of waste from industrial activities, tourism and urban growth induced by the increase and the demographic concentration;
- fishing and the general over-exploitation of marine biological resources by national and international fleets, and above all due to illegal, undeclared and unregulated fishing;
- the voluntary and unintentional introduction of invasive alien species through the ballast waters of ships, fouling, imports of non-indigenous species and pathogens;
- commercial and recreational maritime traffic;
- physical alteration of coastal and marine habitats;
- climate change.

The threats, as mentioned above, cause a significant loss or degradation of biodiversity and alterations of its structure, through the contamination and destruction of species, habitats and ecosystems (MATTM, 2010a).

On 2019, Italy reported under Art. 17 of Habitat Directive the assessments of the conservation status of listed species and habitats, relating to the period 2013-2018 (IV Report). ISPRA processed the data submitted in the IV Report (VV.AA., 2020).

The overall picture that emerges shows that the current pressures on the species and habitats listed in the directive derive mainly from anthropogenic activities and only they are minimally attributable to natural processes.

Regarding the marine environment, the conservation status of 18 species was assessed (9 species were not considered as being occasional or marginal).

Comparing last report (2013-2018) to previous one (2007-2012), the updating of knowledge has led to an overall increase of marine species that are in a "good conservation status" (from 13% to 39%). Nevertheless, the specie percentage (39%) for which the available information is not sufficient to formulate an assessment is still high (Figure 14).

Regarding the marine habitats, there is as well an increment of the number of habitats that are in a "good conservation status". However, in this case, the evaluation work highlighted that the knowledge gaps remain still relevant comparing last report (2013-2018) to the previous one (2007-2012) (Figure 14):

Moreover, the Habitats Directive IV Report allowed to carry out an analysis of the existing pressures, and therefore of the threats, of investigated species and habitats.

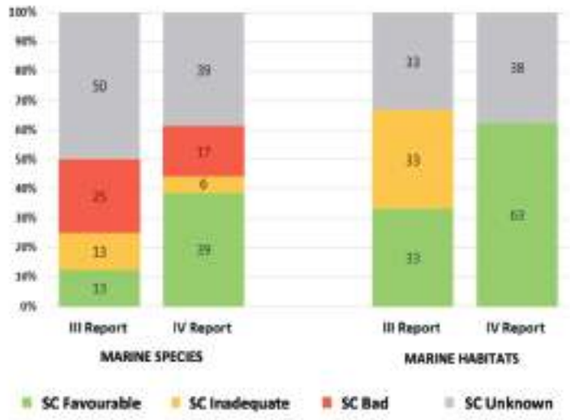

Figure 14

Marine species and habitas listed in the Habitat Directive: comparison between the result of the last two reporting cycles for the conservazion status (SC). Source: modified from VV.AA., 2020.

The detailed analysis of the pressures acting on species and habitats underlines the dominant role of anthropogenic pressures.

Going into more detail, the analysis conducted by ISPRA highlights how pollution (voluntary or accidental) is the most critical pressure factors, in terms of the number of species involved, regardless of the taxonomic group (Figure 15). Changes in the coast and tourist pressure are other disturbing factors, which affect more than one taxonomic group.

Instead, extraction activities, military exercises and maritime transport are relevant disturbing factors limited to some mammals.

As regards marine habitats, the most widespread pressures are related to the construction of infrastructures on the coast and fishing activities; followed, in order of importance, by pollution, tourism activities and factors related to climate change (Figure 16).

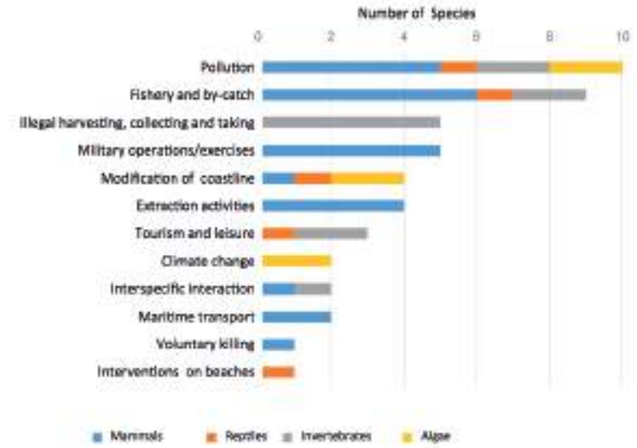

Figure 15

Overview of the pressures on marine species listed in the Habitats Directive, period 2013- 2018. Source: modified from VV.AA., 2020.

Figure 16

Overview of the pressures on marine habitat listed in the Habitat Directive, period 2013- 2018. Source: modified from VV.AA., 2020.

Interventions on beaches, hydrocarbon extraction activities and maritime traffic represent additional sources of disturbance, which affect only some habitats.

In light of these critical issues and to limit the threats of marine ecosystems, it is urgent and important to have appropriate management tools. At the same time, it is necessary to give priority to the most pressing problems.

Information regarding the significant pressures and impacts are often referred to the entire Mediterranean basin or the whole Italian seaside and can hardly identify peculiar subregional features.

The data deriving from MSFD monitoring will lead to a more detailed picture of pressures and impacts affecting biodiversity at the sub-region level in the next years.

The Italian committee for "Capitale Naturale" recently reported an analysis regarding the principal pressures that insist on marine habitats are subject, based on the approach developed in MERCES project (Comitato Capitale Naturale, 2019; Dailianis *et al.,* 2019). This approach, which needs further investigation, tries to differentiate the impacts that are most present in the three sub-regions. This analysis could provide a relevant contribution to environmental assessment as well as to the identification of the most significant impacts on biodiversity in the subregional context. To date, information on the effects of cumulative impacts is still lacking. In particular, little is known about how climate change can amplify the vulnerability of species and habitats.

Regarding pollution, as noted above, marine litter is a problem that is becoming increasingly important. In the framework on the National Marine Strategy Program of Measure (PoM), Italy has identified a series of measures already implemented that allow protecting the marine environment from waste through:

- the reduction of discharges into the sea, in particular illegal ones, of waste and cargo residues produced by ships as well as the increase in the availability and use of port reception facilities for waste;

- regulation of single-use shopping bags;

- public awareness and communication measures to increase knowledge of the marine litter, favouring their prevention and progressive reduction of the phenomenon;

- green economy measures relating to the cleaning of the seabed and the reduction of microlitter and smoke products.

Moreover, further Italy had defined additional measures, which aimed in particular to:

- better management of waste both generated and recovered at sea through fishing activities,

- the creation of a collection and disposal chain of waste accidentally collected by fishermen.

A further objective is to raise awareness and sensitivity of the stakeholders about the problem.

More recently, Budget Law fot 2018 (n. 205 of 2017) provides that, from 1 January 2019, the marketing and production, on the national territory, of the sticks for cleaning ears that have the support in plastic or in non-biodegradable and compostable material are prohibited. It's also mandatory to indicate, on the packaging of the same sticks, clear information on the correct disposal of the sticks themselves, explicitly mentioning the prohibition of throwing them in the toilets and drains. Moreover, the Law provides that from 1 January 2020 it is forbidden to market cosmetic rinse-off products with exfoliating or cleansing action containing microplastics.

Some actions have also been launched at a subregional level, aimed at classification, geo-localization, continuous updating and dynamic exchange of information on environmental criticalities detected by monitoring of the marine litter. An example is represented by the bilateral agreement for the two-year period 2018-2020 between MATTM and the UNEP/MAP, which provides for the development of a management software, connected to the collection server, data processing with an operator interface and the development of an APP for the user interface.

These tools, interconnected with the InfoMAP system, were developed by INFO/RAC on behalf of the MATTM, with the aim of collecting, through a *user-friendly* APP, data on marine litter, with particular regard to the IMAP EO 10 indicator and to Marine Strategy descriptor 10. A section dedicated to invasive species has also been developed within the APP itself, addressed to experts in the sector and to professional and recreational fishing. The main objective pursued through the APP, already developed and called *SeaWatcher*, is to develop an integrated interactive system of communication, updated in real time, which can also allow a quick and concrete response to reports, enhancing the contribution of *citizen science,* institutional subjects and other stakeholders, such as fishermen.

At the moment, the first release of the APP has already been released and will follow subsequent updates to integrate additional components and features.

A first testing of the APP is foreseen in the MPAs of the Egadi Islands and Lampedusa, where it is intended to exploit the activities of the various diving centers that operate in these areas in order to report gatherings of waste and ghost nets.

In the near future, a twinning with the MPA of Egadi Islands and of the Kneiss Islands will also be initiated, in order to be able to spread the app throughout the Mediterranean, also preparing campaigns dedicated to the species of conservation interest.

Regarding the effects of maritime and naval traffic on biodiversity, the *PoM* provides for the implementation of technical solutions (methodological and instrumental) for the reduction of the phenomenon of collisions with cetaceans.

The measure intends to promote at a national level a system of methodologies aimed at reducing the risks of the collision between large cetaceans and commercial ships, defined in the context of specific design experiences, such as REPCET and Life WHALE SAFE projects.

These pilot systems will be able to be promoted on a large scale both to navigation users and for the construction of databases.

The systems can be applied to commercial maritime traffic. Moreover, military ships, vessels used for monitoring and research, whale-watching operators or pleasure boating can also participate in the alert system.

The national PoM provides measures specific to reduce the bycatch mortality of elasmobranchs, cetaceans, sea turtles and seabirds.

These measures aim at training and awareness-raising campaigns on these species, in particular relating the best practices relating to the methods of treatment and release in case of capture, among professional and recreational fishers, trade associations, producer organizations, MPAs, etc.

The training will provide information on protected species, object of accidental catches, on biological characteristics and distribution, on technical and managerial measures to mitigate catches, on the methods of collecting and transmitting data concerning the species subject to bycatch. Awareness-raising actions will also be extended to other stakeholders and the general public through large-scale information campaigns.

Regarding coastline modification and construction of infrastructures, Italy has included two new measures in the PoM.

The first concerns the acquisition, classification and homogenization, as well as the consistent recognition of the data coming from the monitoring activities, carried out in the national territory with particular reference to the Environmental Impact Assessment (EIA) procedures.

This measure will make it possible to systematize the data relating to the target species and habitats to cover various information gaps present.

The measure wants to provide tools for recognition of possible data sources, acquisition, homogenization and classification of data from monitoring activities, with particular reference to EIA procedures.

The proposed measure appears to be positive from the cost-effectiveness point of view for the acquisition of environmental and socio-economic data standardized between the various bodies that deal with monitoring the marine environment as well as the economic activities connected to it to better guide decisions of policymakers.

The second concerns the preparation of "Guidelines for the limitation and mitigation of anthropogenic impacts deriving from sealing on biogenic substrates".

These guidelines are being defined and will be of a technical-scientific and operational nature, aimed at providing sector operators and authorities in various capacities responsible for the protection of habitats and biocoenoses of community interest, cognitive and operational tools to avoid, prevent or to mitigate the impacts deriving from the various anthropic activities that determine the sealing of relevant biogenic substrates (*Posidonia oceanica* meadows, Rodolites beds, coralligenous biocoenosis and deep corals).

Another significant impact on the populations of conservationist benthic species is the illegal harvesting and damage caused by nautical tourism (anchorages) and incorrect behaviour of scuba divers.

In addition to the rigorous application of the management and control measures already provided for in the regulations and regulations on the protection and collection of protected species, the national PoM provides for specific awareness and information measures to avoid collection and damage activities on benthic species and protected habitats. The measure aims to promote awareness-raising activities for different users of the sea (sport and recreational fishers, diving operators, recreational operators) in order to determine an overall increase in information to users, by carrying out training and awareness activities.

Finally, severe threats for the marine ecosystem are climate change and the progressive spread of alien species. To limit the latter, Italy has adopted one new measure that provides for the implementation of a *National Focal Point for alien and dangerous species*, which involves various national administrations in order to prepare quick responses to situations of emergency, based on an early warning system coordinated centrally by ISPRA and supported by a panel of national experts.

Moreover, in 2015, Italy adopted the National Strategy for Adaptation to Climate Change that identifies the more significant impacts of climate change for the major socio-economic and natural sectors and proposes adaptation actions. More recently, the preparation of the National Climate Change Adaptation Plan was started to identify priority adaptation actions for the key sectors identified, specifying the timing and those responsible for the implementation of the actions. Its aim is to provide indications to improve the exploitation of any opportunities and promote the coordination of actions at different levels.

5.2. Critical impacts and effects on marine and coastal biodiversity

Areas and sites in which the most significant impacts can occur as well as present habitats and ecosystems considered vulnerable and deserving of particular attention are listed below, as reported in UNEP-MAP-RAC/SPA (2009, 2010a, 2010b), IUCN (2019), DG ENV (2020) and in the website *https://www.marinemammalhabitat.org/*. If appropriate, information from other sources are also reported and properly cited. Furthermore, the effects that may exert on VME areas or other significant areas from a biological and ecological point of view, already described in detail in the previous chapters, have been taken into consideration.

The Northern Adriatic

The area represents a critical pelagic ecosystem (included between EBSAs and IMMAs). Moreover, it presents rocky outcrops called *trezze* and *tegnue*, which are very vulnerable to any bottom disturbance. The entire area experiences high anthropogenic pressure due to high fishing effort, maritime traffic, tourism and pollution.

Venice and Grado-Marano lagoons, Miramare MPA, Padanian Plain and Po delta system, result to be vulnerable to CC, for risks correlate for sea-level rise and biodiversity loss.

Venice lagoon, Po delta system and all northern-western Adriatic Italian coast are also Sensitive Areas Identified Under the Urban Waste Water Treatment Directive (UWWTD). Moreover, the north-western coastal area of the Adriatic is affected by both micro- and macroalgal blooms and can be classified as eutrophic, showing periodic phenomena of anoxia.

The Central Adriatic

The area represents a critical pelagic ecosystem (included between EBSAs) and contains stocks susceptible to depletion due to overfishing.

- Fossa di Pomo is an EFH and should be protected from demersal fishing activities, mainly trawling.
- Conero Promontory results to be vulnerable to CC, for risks correlate for sea-level rise and biodiversity loss.

The Southern Adriatic

The entire area experiences high anthropogenic pressure due to fishing effort, maritime traffic, tourism, pollution and intense population pressure along the coastline. The area meets the EBSA criteria. Moreover, it is an Essential Fish Habitat for Albacore.

It presents some vulnerable ecosystems to any physical disturbance (especially bottom trawling), such as cold coral reefs off Cape Santa Maria di Leuca (already FRA), cold-water coral ecosystems of the Bari canyon and Otranto Channel.

There are several sites vulnerable to CC, for risks correlate for sea-level rise and biodiversity loss: Salento Peninsula (marine caves), Coastal dunes and Alimini coastal lakes, MPA Torre Guaceto, Apulian coastal lakes and wetlands, Lesina and Varano lagoons, Tremiti Archipelago.

6.

Assessment of national priority needs and response actions

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6.1. Needs

The protection of biodiversity and, specifically, marine biodiversity, has always been one of the priorities of Italian environmental policies, also because of the extraordinary biological and genetic diversity that distinguish the peninsula's flora and fauna and which deserve targeted actions. The most concrete national tool for the protection of biodiversity is represented by the *National Strategy for Biodiversity* (MATTM, 2010) and its mid-term review, which incorporates the principles dictated by both the CBD *Strategic Plan for Biodiversity 2011 - 2020* and the *Aichi Biodiversity Targets* and the forecasts of the European Biodiversity Strategy 2010-2020.

The National Strategy identifies, in particular, three general objectives considered as pillars:

- By 2020, ensure biodiversity conservation, understood as the variety of living organisms, their genetic variability and the ecological complexes of which they are part, and ensure the safeguarding and restoration of ecosystem services in order to guarantee their key role in life on Earth and for human well-being;

- By 2020, substantially reduce the impact of climate change on biodiversity in the national territory, defining the appropriate measures to adapt to the changes induced and mitigate their effects and increasing the resilience of natural and semi-natural ecosystems;

- By 2020, integrate biodiversity conservation into economic and sector policies, including as an opportunity for new employment and social development, by strengthening the understanding of the benefits of ecosystem services deriving from it and awareness of the costs of their loss.

On the basis of these general purposes, specific objectives have been defined for 15 work areas. A contribution to the protection of marine ecosystems derives from the set targets, in particular, from areas 1 "*Species, habitat, landscape*", 2 "*Protected areas*" and 7 " *Marine environment* ".

All the policies implemented in Italy, also referring to other issues, such as water pollution from urban sources, waste or infrastructures, contribute more or less directly, to the achievement of the objectives of the strategy, thanks to the integration in these tools of the principles of environmental protection and sustainability.

In light of the recent update of the European Biodiversity Strategy, which sets new goals for 2030 and the forthcoming approval of the CBD the *Post-2020 Global Biodiversity Framework*, Italy will adopt a new strategy, in line with the most recent global goals. In this context, it will be essential to carefully evaluate which objectives have been achieved and which, on the other hand, need a deeper commitment and incisive actions to be implemented.

As regards to the marine environment, for example, it is evident that important progress has been made in the application of the ecosystem approach to the management of the

sea system, in particular through the implementation of the MSFD, the MSP and the PCP. Although further developments are needed, the trend can be considered positive on a national level. However, this national trend is not yet fully reflected on small-scale actions, where the integration of biodiversity protection tools with relevant economic and social policies and sectoral or intersectoral plans, the so-called *Biodiversity Mainstreaming*, does not appear complete. The synergy between environmental protection tools and other management instruments must therefore be increased, also by encouraging moments of exchange and discussion between local and central administrations and the identification of *best practices* to be applied in particular at the sub-basin scale. The sub-regional dimension, governed by national and regional principles and objectives, must in fact be considered the first starting point for the local implementation of wider environmental policies and the ecosystem approach. The future application of the first Management Plans relating to Maritime Spatial Planning, for example, will provide the opportunity for the strengthening of a subregional vision, which has already begun through the implementation of the MSFD but which can now be outlined in a more concrete and complete way.

In this sense, it may be useful to encourage environmental dissemination actions, also aimed at the creation of new professionals and projects aimed at strengthening administrative capacity, through the training and awareness of political *decision-makers* and administrators about the importance of environmental issues and biodiversity, as well as identifying the transversal actions to be activated. These actions must be aimed, on the one hand, at the protection of nature and, on the other hand, at the sustainable use of resources and ecosystem services, as well as at the promotion of tools for blue growth. Some example are the projects *"CReIAMO PA"* and "*METTIAMOCI in RIGA*", initiated by the MATTM and financed within the framework of the *National Operational Programs* of the European Commission, aimed to promote economic and social equality of all regions of the European Union.

From this perspective, it will also be necessary to enhance the institutional and human skills that Italy has at its disposal, encouraging cooperation tools, including international ones, which allow for the creation of knowledge and professionalism. The world of various *stakeholders* who interact in various ways with marine ecosystems and, in particular, NGOs can also provide important and useful contributions through an even greater involvement in decision-making processes in the environmental field. In Italy, for example, the activities of NGOs such as *WWF*, *Legambiente* and *Marevivo* regarding marine biodiversity play an important link between civil society and knowledge and awareness of environmental dynamics, also through the production of reports and increasingly complete and complex analyzes, that offer important food for thought and awareness for *competent authorities* (es. the reports "*Living Planet Report 2020*" – WWF, 2020 and "*Biodiversità a rischio 2020*" – Legambiente, 2020).

Another theme addressed by the National Strategy is the enhancement of scientific research linked to the sea. In this context, it would be necessary to encourage, also at an institutional level, projects that fill the important knowledge gaps still present and in particular related to the state of biodiversity and the causes that determine its erosion. Understanding the phenomena that threaten ecosystems and in particular the cumulative action of certain anthropogenic pressures, will allow the implementation of effective policies for the prevention and mitigation of biodiversity loss, also in relation to the progressive worsening of the effects of climate change.

To date, information on the effects of cumulative impacts is still lacking. In particular, little is known about how climate change can amplify the vulnerability of species and habitats. Among the issues for which more in-depth knowledge would be needed, moreover, we also remember the distribution and status of habitats and in particular of priority ones, the status of groups of species that are more sensitive and threatened by anthropogenic activities, such as cartilaginous fish, knowledge of the dynamics of deep environments and alterations of the trophic network. Finally, it will be necessary to fully understand not only the effects of climate change on species and habitats, but also how to integrate the protection of biodiversity into adaptation policies in a profitable way.

In addition to fill knowledge gaps, national and, above all, international research projects can develop new and often more efficient methodological approaches, allowing the identification of data monitoring and analysis methods that can be shared at regional and subregional level, favoring the comparability of data and the consequent identification of shared objectives and related measures. In addition, in order to assess the real effectiveness of the policies and measures adopted, it will be necessary to intensify, in the coming years, the efforts aimed at identifying *integration rules* at subregional level, in particular thanks to international cooperation. Knowledge of ecosystem processes can be facilitated by the creation of shared databases among different States, also creating synergies between different information tools, such as BISE and WISE and similar regional tools. In order to avoid duplication of actions and more efficient use of resources, it would be advisable to speed up the harmonization and alignment, even temporal, of the reporting processes provided for by European Directives and international conventions, also identifying common data format and favoring the reuse of data.

Finally, it would be appropriate to encourage, where possible and appropriate, the integration and use of the results and deliverables of research projects within national and regional strategies and programs, using them in a concrete way, exploiting the acquired *know-how*.

A more in-depth knowledge of the characteristics and structure of marine ecosystems as well as of the processes that regulate them will allow us to fully define the physical and economic dimensions of the stocks of natural capital they provide. The correct identification of ecosystem services and the definition of their value, also in monetary terms, is also necessary in order to identify appropriate environmental restoration activities, defining the cost-benefit ratio. There are clear linkages between human activities, pressures, marine ecosystems, marine ecosystem services and the benefits we get from theme: the identification of specific anthropic pressures which, at a subregional level, affect the biotic and abiotic marine resources, will therefore allow to better detail action plans for environmental remediation and economic development strategies that enhance specific sectors of the blue economy, strategic for the sub-basin. Projects that allow the identification of integrated methodologies and approaches for the study of environmental accounting systems to be applied to the marine environment could also be implemented. An example is the recent project funded by the MATTM, "*Environmental accounting for Italian Marine Protected Areas*", aimed at implementing an environmental

accounting system for MPAs that evaluates the stocks of Natural Capital and the flows of ecosystem services generated by these areas, both biophysically and economically (*Comitato Capitale Naturale*, 2018).

Finally, another crucial issue, must be considered in the need, si the national capacity-building. Currently, within the CBD, a long-term strategic framework for capacity-building beyond 2020 is under development (see CBD/POST2020/WS/2020/2/3 20).

To enhance the capacity-building is considered as priority to support the CBD implementation, both at the local and global level. Capacity-building activities broadly fall into two groups, as underlined by UNEP-WCMC (2020):

1. those that aim to enhance and maintain effective engagement and participation of countries in the context of the Convention and its Protocols and processes at global level;

2. those that aim to improve and maintain effective implementation of the Convention and its Protocols.

To date, a detailed analysis of the human and institutional capacities present in Italy, for biodiversity protection and management, has not yet been carried out. Indeed, there is a strong network of university, research bodies and consortia with considerable background and expertise in the protection and conservation of the marine environment. Moreover, professional figures capable of intercepting funds and creating networks that allow the exchange of knowledge and mutual growth, both nationally and cross-border level, are increasingly present. On the other hand, central and local institutions complain about a lack of human and economic resources. It appears therefore necessary to map and assess the human and institutional capacities to define capacity-building needs, gaps and priorities in the next future.

6.2. Urgent actions proposed

Biodiversity

Although Italy can boast a long tradition of monitoring marine programs, which began on the national territory with Law 979 of 1982, containing provisions for the defense of the sea and subsequently continued with the implementation of the Water Framework Directive (2000/60/EC), the knowledge on trends and distribution of single species and habitats, especially of deep or slightly studied environments, has not been deepened, except for the species and habitats listed in the annexes of the Habitats and Birds Directives. In more recent years, as part of the national implementation of the MSFD, a complex and articulated monitoring program has been prepared and implemented. At the end of 2020 the first cycle of monitoring will end and in 2021 the second cycle will start. Italy has already completed the public consultation relating to the update of Marine Strategy Monitoring Programs. The new program seems to be appropriate to respond to the requests of the Directive and in particular of the Decision UE 848/2017. The results of the first and subsequent monitoring cycles will concretely contribute to expanding knowledge about the marine environment and, although rarely aimed at estimating indicators relating to individual species, may help to identify appropriate management measures for species or habitat vulnerable or at risk. The data relating to the activities carried out under MSFD, however, are still few and often not supported by solid historical series, mainly because many of the monitoring had never been carried out before. Moreover, in Italy, a considerable institutional effort for the identification of standardized sampling and analysis methods at the national level has been made. The monitoring activities are planned differently for the three subregions and can allow to highlight and appropriately investigate conditions characteristic of specific geographical areas. The process of developing monitoring methodologies is still ongoing and will be enriched from year to year by new and important scientific discoveries.

The growing synergy between the national strategies for the marine environment and other Community instruments, such as the MSP, and regional ones, such as the EcAp Process, however, suggests that in the near future more precise and representative estimates and assessments of the three subregions will be developed, for which cooperation with the States bordering the same basin will also be indispensable.

Moreover, cetaceans and sea turtles are a shared endangered natural heritage which cannot be managed by a single country but they need active shared polices and measures. Due to the migratory nature of these species and the joint responsibility at the subregional level, collaboration is essential to planning effective long-term conservation strategies.

The information about less known and studied species and habitats, often also due to the location that requires the use of particular and expensive methodologies and instruments, such as for example for deep environments are, instead, less abundant, both nationally and internationally, highlighting the presence of various information gaps. This information will give the opportunity to identify specific measures of protection. However, the scientific literature is very abundant, which in some cases, even if on a local rather than subregional scale, makes up for the lack of information.

Proposed actions:

- ensure the full implementation of the ecosystem approach, providing a better and more effective integration of the issues regarding the protection of biodiversity with other sectors policies and considering the protection of biodiversity in a systemic logic, which envisages coordinated local and subregional actions consistent with the general objectives;

- provide for the updating of the manuals relating to the protected species and the priority habitats identified in the UNEP/MAP context, also including the recent updates of the list of species contained in Annexes II and III of the SPA/BD Protocol of the Barcelona Convention as well as the new classification of habitat of 2019;

- provide for the updating of the checklists of the fauna and flora of the Italian seas, determining, where possible, particularly endangered species and identifying the singularities of the marine subregions. In particular, great attention it should be dedicated to groups of species that still not deeply studied but for which a high degree of disturbance has been estimated, such as elasmobranchs and invertebrate bottom fauna;

- increase the efforts aimed at the knowledge of the trophic network and the effects of anthropogenic pressures on the interactions between the species that compose it; in particular, it will be necessary to be able to define in detail, on the basis of experimental analyzes and subregional cooperation, the specific composition of trophic guilds;

- in order to obtain an overall picture of the scientific studies currently in progress, it would be useful to improve a collection of existing publications available, in particular, at a subregional level, that allows to highlight knowledge gaps and can also guide the world of research towards the definition of common methodologies and tools, in order to elaborate increasingly coherent and exhaustive evaluations;

- identify adequate protection measures and monitoring activities also for species not targeted by regulatory instruments, even outside marine areas protected by various type of regulatory instruments.

Measures of spatial protection

The protected marine areas under safeguard, characterized by high natural habitats and species, can be considered reference sites for the evaluation of the effectiveness of the measures, aimed at recovering the good environmental status, as highlighted by European Directives and the Barcelona Convention. Moreover, marine protected areas play an important role as essential tools to combat and halt the loss of marine biodiversity.

Italy is contributing by establishing a system of national protected areas (Law n.394/91) which, together with the Natura 2000 network, covers 21% of the earth's surface and 19.1% of the marine area. In reference to the Aichi biodiversity target 11, Italy has therefore achieved the goal and exceed the required percentages of 10% of coastal and marine areas conserved through effectively and equitably protection measures (MATTM, 2019).

Although the achievement of this objective is an important and encouraging goal, in anticipation of the forthcoming adoption of the new *CBD Action Targets* which envisage, in particular, increasing the protected area to 30% of marine and coastal areas, of which at least 10% under strict protection, it will be important to increase the areas where fisheries levy is not allowed. The percentage of *No-Take Areas,* as seen in paragraph 4.1, is still quite low and should be increased, as well as areas where fishing activities should be more strictly regulated. The aim is to increase the vision of MPAs as a sanctuary area for biodiversity, from which the entire marine ecosystem can benefit, towards the achievement of the *good ecological status* for the entire Mediterranean Sea.

Despite the establishment of new offshore SCIs ("Mare della Magna Grecia" SCI in Basilicata and "Protection of *Tursiops truncatus*" SCI in Tuscany), it remains a priority for the future to ensure adequate, coherent and representative protection measures also for deep and off-shore environments.

Proposed actions:

- create and enhance, where existing, technical structures at national and regional level capable of guaranteeing the development of network of protected areas in terms of ecological, social and economic performance, through the assistance and provision of qualified services;

- strengthen and make the MPAs network more effective at national and regional level as expected within the SPAMI scope;

- improve the financial resources of the MPAs system for personnel, equipment, monitoring, research, infrastructure, training and management, in order to strengthen protected areas performance and to facilitate their creation and implementation;

- improve the Natura 2000 Network at sea and identify other area-based conservation measures, where appropriate, in particular for the protection of deep and off-shore habitats;

- increase the surface of the *No-Take Zones* within the MPAs;

- provide, within the MPAs, a systematic, coordinated and coherent monitoring system that is shared both at the subregional and Mediterranean level, also in order to facilitate the comparability of data;

- optimize the use of funding inside Natura 2000 Sites, in particular through the *Prioritised Action Framework* (PAF);

- improve the management of MPAs and Natura 2000 Sites by integrating the various protection and planning tools in order to make it more effective.

Pollution

Pollution remains an open problem, and alongside the usual sources of pollution (wastewater, organic contaminants, nitrates, etc.) there are emerging ones such as marine litter, whose impacts on marine organisms are still being studied.

Regarding eutrophication, total nutrient inputs have declined in the last decades, which is also visible in the level of nutrients at sea and the direct and indirect effects of eutrophication, including anoxic crises. Nevertheless, it remains a problem of several coastal sea areas, especially in the area with a high level of anthropization. This phenomenon is especially true in the North Adriatic for the peculiar oceanographic characteristic, for the low level of water exchange and the higher relevant river intake.

To date, Italy has already implemented relevant measures to combat and prevent coastal and marine eutrophication. For an overview, please refer to the Measures related to descriptor 5 detailed in Italian PoM for Marine Strategy, including those provided for the WFD.

Regarding contaminant, human activities may result in discharges, losses and emissions of contaminants such as heavy metals and human-made chemicals; these substances may end up in the Mediterranean. Contaminants are accordingly widespread in the marine realm in seawater, in sediment and in living organisms, where they may have adverse effects. Contamination is highest in coastal waters; hazardous substances accumulate on the seabed, which causes a high risk to benthic fauna (EEA, 2019).

At the moment it is already underway the implementation of effective and applicable assessment tools on a national scale on the effects of chemical contaminants in biota (as foreseen by the Marine Strategy monitoring program related to descriptor 8). For an overview, please refer to the Measures related to descriptor 8 detailed in Italian PoM of Marine Strategy, including those provided for the WFD.

Proposed actions:

- enhance the results of "Contratti di Fiume" at the national level, such as best practices, success stories, operational tools, management measures, conservation policies, etc. ("Contratti di Fiume" are governance tools that involve public and private stakeholder interested in waterways and hydrographic systems connected to them, such as aquifers, coasts, wetlands, etc.);
- guarantee the complete implementation of the measures envisaged in the context of WFD, especially in the territories where they are currently lacking;
- remediation and restoration of contaminated sites (initiative already partially started with the establishment of the *Registry of Sites of National Interest*).

Marine Litter

The measures to combat the marine litter phenomenon implemented by Italy appear to be appropriate and, at the current state of knowledge, sufficient to guarantee both the reduction of the debris present in the sea and to limit new introduction.

The transposition into Italian law of EU directives relating to port reception facilities for the delivery of waste from ships (EU Directive 2019/883) and the reduction of the incidence of certain plastic products on the environment (EU Directive 2019/904) and, in particular, the approval of the so-called "*sea-saving law*" which provides for the rehabilitation of the marine environment and regulatory solutions for the problem of waste abandoned at sea, as well as solutions for the transfer of waste collected by fishermen at sea during fishing operations, will complete the regulatory when in the near future. Moreover, the inclusion of the litter monitoring along the rivers in the updated MSFD monitoring programs will also ensure a complete knowledge framework.

The integration of policies and incentives for the development of the circular economy in the measures to reduce marine litter will be decisive. In this regard, the Italian legislation must take into account the "extended producer responsibility" (as defined by Directive 2008/98/EC and amended by Directive 2018/851). More generally, greater attention to technologies and economic instruments that will lead to the implementation and diffusion of the circular economy approach will bring an essential contribution to the reduction of the phenomenon as well as a decrease in the adverse effects on biodiversity.

Proposed actions:

- it would be appropriate to capitalize on the pilot experiences of collection and disposal of ghost nets, carried out locally or in specific projects, extending this practice to the subregional level with the development of appropriate guidelines; It would be advisable to map the sites of the highest concentration of the marine debris, also with the support of suitable technologies and with the enhancement of citizens' science; moreover, this approach would be useful for focusing attention on sites where this problem is more impactful for the quantity or vulnerability of the habitats, in order to concentrate any collection efforts in these areas;
- develop methodologies for mapping and evaluation of the presence of marine debris in deep environments, even with the help of modelling approaches based on local oceanographic conditions.

Fishery

Commercial, artisanal and recreational fishing has a strong impact on species and habitats. There is intense pressure on fish stocks which appear to be overfished.

The high fishing pressure combined with very invasive tools results in high levels of *bycatch* together with effects due to physical stress on benthic bottoms and habitats.

To date, data and information relating to the leading indicators are systematically collected as prescribed by the international framework for the management of fish resources. The assessment are conducted using the methodological approach defined within the *Scientific, Technical and Economic Committee for Fisheries* (STECF) and the *General Fisheries Commission for the Mediterranean* (GFCM).

In order to define a complete picture of the state of the stocks exploited by both artisanal and commercial fishing, the number of species subjected to stock assessment is necessary in all the Italian GSAs. Furthermore, information on recreational and illegal fishing seems scarce at the moment and should be expanded. The monitoring program of the Marine Strategy foresees, in Italy, investigations also on these two sectors and will probably provide, in the next few years, useful data for the identification of any specific measures. The same program also includes surveys on *bycatch* and on the impact of fishing on habitats, for which information are still limited.

Proposed actions:

- increase the number of target species subjected to stock assessment;
- guarantee the complete implementation of the Italian Marine Strategy Monitoring Program referred to descriptor 3, in order to bridge information gaps about the bycatch of vulnerable species;
- guarantee the complete implementation of the Italian Marine Strategy Monitoring Program referred to Descriptor 6, in order to bridge information gaps about the interactions of fishing gear on benthonic communities;
- guarantee the increase of knowledge about recreational and illegal fishing and identify, where necessary, appropriate measures to limit the impact on biodiversity;
- ensure more effective implementation of the ecosystem approach to artisanal and commercial fishing, with particular attention to the VME;
- assess accurately current *bycatch* rate and hot-spots of fisheries interactions with cetaceans and sea turtles, as well as other potentially impacted species;
- promote specific measures provided by the national PoM of Marine Strategy on training and awareness-raising campaigns, aimed to reduce the *bycatch* mortality of elasmobranchs, cetaceans, sea turtles and seabirds;
- spread at subregional level training and awareness-raising campaigns on vulnerable species, in particular relating the best practices relating to the methods of treatment and release in case of capture, among professional and recreational fishers, trade associations, producer organizations, MPAs, etc.

Non-Indigenous Species

The observed rate of introductions has been getting slower in the past few years, but cumulative numbers of NIS are still increasing.

To date, knowledge regarding the introduction and presence of alien species is quite advanced. Furthermore, there is a good monitoring system of the same within the framework of the Marine Strategy, which will be further strengthened in the next cycle of implementation of the directive.

The impacts that introduced species have on native species, and habitats have also been fairly studied. Discovering what makes ecosystems susceptible to biological invasion and the estimation of the degree of impact that non-indigenous species cause on the Mediterranean environment and its biodiversity, of the trends of introduction and diffusion and of the risk associated with each species also depending on the sub-basin or specific habitat considered, combining the effects of the NIS also with other pressures such as, for example, climate change or physical loss, will be the challenge of the future years.

The international regulatory framework is part of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (which will come into force on 8 September 2017). Italy is among the countries that have not yet ratified the convention. Taking note of the general difficulties in implementing the BWM Convention, EU action was set up according to a more gradual path. This through the application of the European guidelines "The development of a full standard methodology for testing ballast water discharges for gross non-compliance of the IMO's Ballast Water Management Convention" which faithfully reproduce the criteria and principles already contained in the BWM Convention. Finnally, in Italy, one of the new measures included in the National PoM provides for the implementation of a *"National Focal Point for alien and dangerous species"* (NFP), which involves various national administrations in order to prepare quick responses to situations of emergency, based on an early warning system coordinated centrally by ISPRA and supported by a panel of national experts.

Proposed actions:

- BWM Convention ratification, the process is already formally started;
- The EC additionally recommended that Member States could add the IMO biofouling guidelines to the NIS prevention (COM2018-562 final);
- Improve international cooperation for the definition of cross-border measures at subregion level (One of the objectives brought about by the BALMAS project within the Adriatic subregion);
- Ensure rapid and complete implementation of the new measure MSFD on NFP alien and dangerous species.

Coastal modification and tourism

Coastal developments (e.g. infrastractures, shore protections) can cause physical loss and alteration of hydrological conditions, causing direct and indirect effects on biological components.

To date, the EIA tool and the assessment under art 6 of the Habitat Directive (better known as VINCA in Italy) provided by national legislation for new infrastructures, including coastal ones, have been widely implemented.

The PoM includes the new measure for "*Guidelines for the limitation and mitigation of anthropogenic impacts deriving from sealing on biogenic substrates*", as previously mentioned.

As regards specifically coastal tourism, this sector includes activities related to the establishment and running of infrastructure as well as to accommodation and transport. This sector leads to direct and direct effects on biodiversity. Indeed, human presence can disturb sensitive marine species, that are facing changes in living conditions due to fragmentation and loss of natural habitats.

Proposed actions:

- finalize the approval process of MSP plans at the subregion level, which will represent a useful tool for the sustainable development of the sea and its resources (Italy has already ratified the MSP Directive and the sub-basin level plans are being drafted and approved);
- enhance the results of Coastal Area Management Programme (CAMP) projects at the national level (best practices, success stories, operational tools, management measures, conservation policies, etc);
- adoption of measures that promote sustainable tourism; in this process, National Parks and especially MPAs can catalyse innovation processes in the realities in which they are present; as they are privileged places of conservation and protection of the environment and biodiversity but also because they are increasingly becoming laboratories of sustainable practices and approaches.

Maritime traffic

Maritime traffic can be it is mainly due to commercial and tourist transport. The impacts of marine ecosystems are many, of which the main ones are: direct collisions with marine fauna, polluting emissions, underwater noise. Indeed, Maritime traffic presents the most considerable anthropogenic contribution of low-frequency continuous noise in seas (EEA, 2019).

As previously mentioned, the Italian PoM provides for the implementation of technical solutions for the reduction of the phenomenon of collisions with cetaceans. As regards magnitude, impacts and effects on the biota of underwater noise, there are still critical information gaps, which will be partially filled with the new Marine Strategy Monitoring Program.

Proposed actions:

- provide specific measures to reduce the impact of underwater noise, including at transnational and subregional level (for details refer to the next point "underwater noise");
- direct the monitoring activities of migratory species to know in depth the most frequent migratory routes; it could allow addressing effective maritime traffic management measures to make any collisions as less likely as possible.

Underwater noise

The implementation of the national register on impulsive noise (range 10Hz - 10kHz), as provided for in the Marine Strategy, will give an important Italian response for this problem. Indeed, the monitoring activities defined by the updated monitoring programs of Marine Strategy (2021 - 2026) will provide useful elements for the definition of noise pollution mitigation measures.

Proposed actions:

- ACCOBAMS joint register of impulsive noise promotion at the subregional level;
- identify noise hot spots where there is a strong interaction with cetaceans and sea-turtles and other impacted species, in order to provide adequate areal protection measures;
- develop market and economic mechanisms to reduce noise input to the marine environment in cooperation with industry and businesses sector.

Climate change

Climate change is a global stressor that causes several adverse phenomena, such as increased water temperature and acidification. It also exposes ecosystems to greater sensitivity to possible invasions and spread of NIS.

The effects of climate change on biodiversity are not yet assessed. However, it is now evident that it is increasing the sensitivity of marine ecosystems to other pressures. Moreover, considering the current evolutionary scenarios, climate change impacts are expected to increase, causing leading to adverse effects in coastal areas and open seas.

To date, the biological elements most vulnerable to climate change have been assessed. Furthermore, the coastal areas most likely to be impacted by an increase in temperatures, sea-level rise and extreme water phenomena are quite well known. There is a need to increase knowledge about the oceanographic and hydrological changes that can be triggered by climate change. Furthermore, little is known about the effects on pelagic ecosystems, food webs, deep environments.

Proposed actions:

- improve the monitoring system for climate change and its long-term effects;
- improving at the national level the assessment of the effect of climate change on biodiversity and ecosystems;
- identify and possibly predict (also spatially) the effects of sea-level rise on transitional environments such as lagoons and estuaries and coastal environments as well as on their ecosystem services;
- identify and quantify the synergistic consequences of climate change and anthropogenic "multiple stressors" on biodiversity loss and the consequent alterations of vital systemic functions such as primary and secondary production or nutrient cycles;
- select and restore seabed habitats with a high capacity for CO_2 captures, such as seagrass meadow, biogenic reefs and soft-bottom invertebrate communities;

- promote actions to mitigate coastal marine erosion, favouring and increasing the conservation of coastal vegetation as well as its restoration, also to reduce the impacts due to sea-level rise;

- implement mitigation and adaptation actions at the local level on the coastline, in particular for Adriatic basin.

7.

Funding problems and opportunities

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7.1. Regular national sources, potential co-financing for international funding

To represent Italy's economic effort for the protection and sustainable use of natural heritage, we have taken into consideration to the 2019 National Environmental Account by the State General Accounting Department, which coordinates the collection of data from the central administrations concerned, has been made.

The National Environmental Account is a document attached to the State General Report which, according to the provisions of paragraph 6 of the article 36 of Law n. 196 of December 31, 2009 ("Law on accounting and public finance"), illustrates the results of the environmental expenses of the central administrations of the State, defined as "the resources used for environmental protection purposes, regarding protection, conservation, restoration and sustainable use of resources and natural heritage ". There are two types of expenses:

- expenses for "environmental protection", classified according to the CEPA classification (Classification of environmental protection activities);
- expenses for the "use and management of natural resources", classified according to the CRUMA classification (Classification of Resource Use and Management Activities and expenditure).

The financial resources allocated by the State for primary expenditure for the protection of the environment and the use and management of natural resources, according to the National Budget Law, amounted approximately to 4.5 billion euros in 2020, equal to 0.8% of the total primary expenditure of the state budget. The resources will be affected by a significant increase in 2021 (0.9% of the total primary expenditure of the state budget), while they predict a future decline (0.8%) in 2022. These are the initial resources allocated to accruals for the three-year 2020-2022. Compared to the initial allocations for the same purposes in 2019, equal to around 2.4 billion euros, the increase in 2020 is mainly due to the greater resources allocated to interventions against hydrogeological instability and for the development of the Green New Deal program.

The sectors in which most of the initial resources destined for primary environmental expenditure in 2020 are concentrated (about 65%) are the following (Figure 17):

- protection and rehabilitation of the soil, subsoil and surface waters (42.0%);
- *other environmental protection activities (13.3%);*
- *biodiversity and landscape protection (9.7%).*

Moreover, a further percentage, equal to 17.9%, is divided between the sectors *use and management of non-renewable energy raw materials* (8.7%), *wastewater management (4.7%) and use and inland water management* (4.5%).

In the years 2021 and 2022 the primary environmental expenditure continues will be mainly aimed at the protection and rehabilitation of the soil, subsoil *and surface waters and other environmental protection activities,* which absorb the overall 56.4% and 50.4% of primary environmental expenditure (MEF, 2019).

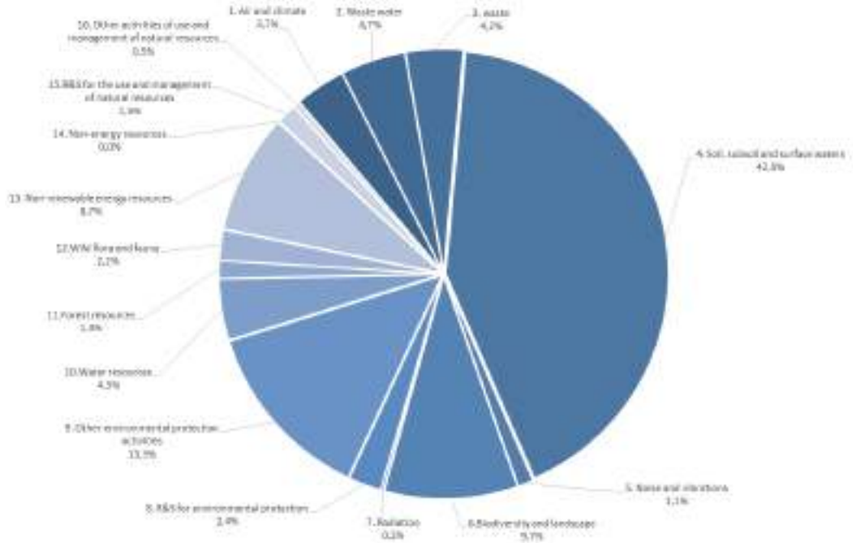

Figure 17

Primary expenditure on the environment: initial allocation to environmental sector - 2020 (percentage distribution). Source: modified from MEF, 2019.

7.2. Other sources (private, public, partnership)

In recent years, Italy is actively promoting the involvement of private sector in co-financing environmental-related projects and programmes in developing countries. In particular, all bilateral cooperation programs promoted by the Ministry of Environment, Land and Sea Protection are aimed to incentivize private sector participation and activities to implement Public-Private Partnerships. The main channel is the publication on the MATTM's website of calls for interest to participate in technical visits in countries where the Ministry signed bilateral agreements, in order to present best available technologies in response to the counterpart's expressed needs. Moreover, MATTM organizes seminars, workshops, events and B2B to inform on opportunities related to multilateral and bilateral cooperation activities that could involve the private sector, mainly through technology transfer (MATTM, 2019).

7.3. International funds, projects, programmes, national eligibility for international programmes/funds (e.g., green funds) identified.

The environment topic is integrated into many of the national and international funding programs, including the following sources of funding.

1 _ Community action programs:

Environment and Climate Action Programme (LIFE). Launched in 1992, the LIFE Programme is one of the spearheads of EU environmental and climate funding. In the proposal for a new LIFE programme for 2021-2027 the European Commission intends to allocate € 5.450 billion to projects supporting the environment and climate action, with an increase of €1.950 billion euro compared to the previous programme. The new life programme will contain two main fields of action, environment and climate action and four sub-programmes:

_ nature and biodiversity
_ circular economy and quality of life
_ climate change mitigation and adaptation
_ clean energy transition

2 _ European Structural and Investment Funds will contribute to implement the Europe 2021-2027 strategy, at the national, regional and local level. The main founding instruments will be:

_ **European Regional Development Fund** (ERDF), for investment in blue growth sectors and for sea-basin strategies;

_ **European Social Fund** (ESF), to develop skills in both the fisheries and maritime sectors;

_ **InvestEU instrument**, which could play an important role in promoting financial instruments and supporting a targeted investment platform for the blue economy;

_ **European Maritime and Fisheries Fund** (EMFF), which supports sustainable EU fisheries and maritime sectors, as well as the EU's role as an international leader in sustainable ocean management. The proposed EMFF budget amounts to EUR 6.14 billion in current prices, for the years 2021 to 2027. EMFF resources are mainly split between shared and direct management. The post-2020 EMFF will focus on four priorities:

- Fostering sustainable fisheries and the conservation of marine biological resources;
- Contributing to food security in the European Union through sustainable and competitive aquaculture and markets;

- Enabling the growth of a sustainable blue economy and fostering prosperous coastal communities; Strengthening international ocean governance and enabling safe, secure, clean and sustainably managed seas and oceans.

Moreover, for the first time, the EMFF will support the European Union's international commitments and objectives. In addition, funding will be available for maritime surveillance and coastguard cooperation.

3 _ Interregional cooperation program

Interregional cooperation is aimed at enhancing EU regional development through transfers of know-how and exchanges of experiences between regions. The program aims to improve the effectiveness of regional development policies and contribute to economic modernization and increased competitiveness in Europe.

4 _ PAF regional funding - Prioritized Action Framework

The PAF, defined in Italy at the regional level, is the main tool in planning the financial resources necessary for the implementation of the Natura 2000 Network. In 2018, the European Commission changed the format of the PAF, in cooperation with the Member States and on the basis of the experience gained in the 2014-2020 programme. The goal was to strengthen the PAF as a strategic multiannual planning tool, to provide a general overview of the necessary and priority measures to implement the Natura 2000 network, specifying the financial needs for these measures and linking them to the corresponding EU funding instruments. The most important innovation of the new format concerns, in particular, its structure. The conservation and restoration measures related to Natura 2000 are divided by general ecosystem category and divided into eight classes, largely identified on the MAES (Mapping And Assessment of Ecosystem Services) typology, established as a conceptual basis for the evaluation of ecosystems at EU level. Another interesting news relates to the expansion of the analysis also to green infrastructures, such as areas outside the Natura 2000 network.

8.

Conclusions and recommendations

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The growing and consolidated awareness of Mediterranean biodiversity threats led to the identification of targeted and specific actions for its protection, both at an international, European and regional level. The conservation of the marine environment, also in consideration of the high number and multidisciplinary nature of human activities that affect it, cannot ignore the application of the Ecosystem Approach, which allows the conservation and, at the same time, fair use of resources, ensuring the resilience of ecosystems.

In this context, within the framework of the CBD and the 2030 Agenda for Sustainable Development, important commitments have been taken on a global level that Italy is maintaining thanks to the implementation of specific national initiatives, declining the forecasts of these instruments into national measures, plans and strategies. At the regional level, for example, the recent Italian commitment to the creation of the SECA area in the Mediterranean has shown a strong push by the country to identify concrete measures for environmental protection, identifying regional cooperation as a priority tool for achieving of important environmental goals.

The definition of adequate management and conservation measures, together with the achievement of the Good Environmental Status, is based on an in-depth knowledge of the biological resources that make up the Mediterranean marine ecosystem, their distribution, abundance, conservation status and the pressures that weigh on them. The launch of a regional and subregional coordination process for the definition of methodological thresholds and standards, envisaged by both MSFD and the EcAp process, will also provide shared and more effective approaches for assessing the state of Mediterranean biodiversity.

The information found and reported in this document shows a picture of the main biological characteristics of the Adriatic Sea marine subregion, about pressures, areas that deserve particular interest, both for their biological particularities and for specific impacts and, finally, an analysis of the main measures implemented by Italy for their protection and restoration, with special reference to spatial protection measures present in the basin. Through the analysis of the information collected, it is possible to state that Italy has launched various initiatives aimed at both the collection of information and the definition of measures, covering the vast majority of the topics highlighted in this report. However, it is possible to identify the following criticalities:

1. Presence of information gaps: Italy has activated various monitoring campaigns in the subregion, in particular in the context of the MSFD which, in responding to the needs dictated by the Directive and the EU Decision 848/2017, complies well with the EcAp process and IMAP. In the next few years, the MSFD Monitoring Programme will allow outlining a complete assessment of the state of biodiversity, pressures and impacts. The Italian monitoring programme implemented in the period 2015-2020 and its update for the six-year period 2021 - 2026, however, does not provide for the collection of information about many of the vulnerable and endangered species and habitats. Therefore, these needs are highlighted:

- envisage the updating of the manuals relating to the protected species of the SPA/BD protocol and priority habitats identified in the UNEP/MAP context, also including the recent updates of the list of species contained in annexes II and III of the SPA/BD Protocol of the Barcelona Convention as well as the updated classification of habitats of 2019;

- envisage the updating of the checklists of the fauna and flora of the Italian seas, determining, where possible, particularly endangered species and identifying the singularities of the subregion;

- to date, information on the effects of cumulative impacts is still lacking; in particular, little is known about how climate change can amplify the vulnerability of species and habitats.

2. Presence of intense anthropogenic pressures: in the report, several pressures that affect coastal and marine biodiversity have been highlighted. These factors can act individually or in multiple ways with cumulative adverse effects. Moreover, it is crucial to consider that, under the influence of climate change, marine ecosystems become more vulnerable to other anthropogenic pressures. To date, it appears that Italy has already implemented relevant measures to combat and prevent the erosion of biodiversity and the protection of marine environments. Nonetheless, there are still severe threats to biodiversity. From the analysis conducted, those that are more severe and deserve more attention are the following:

- pollution remains an open problem, and alongside the usual sources of pollution (wastewater, organic contaminants, nitrates, etc.) there are emerging ones such as marine litter, whose impacts on marine organisms are still being studied;

- commercial, artisanal and recreational fishing has a substantial impact on species and habitats. There is intense pressure on fish stocks which appear to be overfished. The high fishing pressure combined with very invasive tools results in high levels of bycatch together with effects due to physical stress on benthic bottoms and habitats.

- coastal developments (e.g. infrastructures, shore protections) can cause physical loss and alteration of hydrological conditions, causing direct and indirect effects on biological components.

- the coastal tourism and leisure sector includes activities related to the establishment and running of infrastructure as well as to accommodation and transport; This sector leads to direct and direct effects on biodiversity. Indeed, human presence can disturb sensitive marine species, which are facing changes in living conditions due to fragmentation and loss of natural habitats.

- maritime traffic can be it is mainly due to commercial and tourist transport; the impacts of marine ecosystems are many, of which the main ones are: direct collisions with marine fauna, polluting emissions, underwater noise.

3. Climate change is a global stressor that causes several adverse phenomena, such as increased water temperature and acidification. It also exposes ecosystems to greater sensitivity to possible invasions and spread of NIS. The effects of climate change on biodiversity are not yet assessed. However, it is now evident that it is increasing the sensitivity of marine ecosystems to other pressures. Moreover, considering the current evolutionary scenarios, climate change impacts are expected to increase, causing leading to adverse effects in coastal areas and open seas. From the analysis carried out, it appears that for many of the pressures and threats to biodiversity, Italy has already equipped itself with legislative and management tools for both an accurate monitoring of the persistent pressures on the subregion and adequate measures to reduce threats and mitigate impacts. Nevertheless, the following transversal actions are proposed for more effective protection of marine environments:

- finalize the approval process of MSP plans at the subregion level, which will represent a useful tool for the sustainable development of the sea and its resources (Italy has already ratified the MSP Directive and the sub-basin level plans are being drafted and approved);

- enhance the results of Coastal Area Management Programme (CAMP) projects at the national level (best practices, success stories, operational tools, management measures, conservation policies, etc);

- improve the monitoring system for climate change and its long-term effects;

- Improving at the national level the assessment of the effect of climate change on biodiversity and ecosystems;

- identify and quantify the synergistic consequences of climate change and anthropogenic “multiple stressors” on biodiversity loss;

- implement mitigation and adaptation actions at the local level on the coastline.

4. Need to strengthen spatial protection measures and in particular.
The protected marine areas, characterized by high natural habitats and species, can be considered reference sites for the evaluation of the effectiveness of the measures, aimed at recovering the good environmental status. Moreover, marine protected areas play a crucial role as essential tools to combat and halt the loss of marine biodiversity.
For these reasons, it will be appropriate to work in the coming years towards the following goals:

- improve human, technical and financial resources of the MPAs system to strengthen protected areas system both at subregional, national and Mediterranean level;

- improve the Natura 2000 Network at sea and identify other area-based conservation measures, where appropriate, in particular for the protection of deep and off-shore habitats;

- increase the surface of the No-Take Zones within the MPAs;

This approach may be useful to strengthen the Mediterranean amp network by increasing opportunities and possibilities for mutual exchange and comparison. This approach will be useful both as regards the monitoring of biodiversity and the assessment of the

environmental status, and as regards the implementation of suitable protection and management measures.

5. Lack of cross-border management measures: in light of the maturity of the Italian management system of coastal and marine resources, the identification of cross-border measures to be implemented at the subregion level in order to manage shared resources in a better way and minimise common problems are identified as a priority. A clear example concerns the management of the marine litter, for which Italy has now equipped itself with many robust management tools. Nonetheless, there are reported some pilot experiences that could be valorised in the next future, also as joint measures. Indeed, without shared efforts on the part of the countries sharing the subregional basin, it will be impossible to achieve the objectives set. The report includes some examples or proposals of shared space measures, mostly linked to international agreements or elaborated in the context of cross-border projects. This winning approach highlights that cross-border cooperation is also an essential tool for creating and implementing shared methodologies for the protection of species and habitats.

In this context, the Adriatic Sea subregion can provide important examples and insights, in light of the growing importance that international and cross-border cooperation is assuming on key issues strongly linked to the protection of biodiversity, and in particular also to sustainable development and blue growth.

The Adriatic sub-region presents peculiar hydrogeological and ecological characteristics, which distinguish it from the other Mediterranean sub-regions. Considerable fluvial contribution, especially in the northern part, relatively shallow waters, reduced water exchange, high presence of coastal wetlands, all together make this portion of the Mediterranean a unique environment rich in biodiversity, a refuge for many organisms and a nursery for a large number of marine species. On the other hand, the strong anthropization present on the coast, substantial coastlines modification, an extreme fishing effort including forms of fishing that are destructive of the seabed ecosystems, an increase in recreational and tourist activities are pushing ecosystems to the limit of their resilience. The attention paid to this basin in recent years has undoubtedly contributed to the improvement of monitoring activities as well as to the general knowledge of Adriatic biodiversity. At the same time, the adoption of effective measures to contain the most critical issues is favouring the protection of fragile environments and ecosystems. Just by way of example, measures to contain eutrophy and anoxia problems have been positively contributed to the state fo Adriatic ecosystems. The international policies, together with their local implementation, apply the EcAp to marine and coastal management, in a sustainable way and to achieve the GES.

Nonetheless, the problems involving the Adriatic are many and interrelated, as we highlighted in the report. To date, information on the effects of cumulative impacts is still lacking. In particular, little is known about how climate change can amplify the vulnerability of species and habitats. Adequate measures cannot do without cross-border cooperation. Fortunately, the Adriatic states have already gained considerable experience and outlined good practices to be enhanced soon. Italy must continue to work in this direction, both in the joint planning of shared protection measures and in strengthening the Adriatic MPA network. Italy has already shown its commitment through the active implementation of macro-regional strategies as well as cooperation at multiple levels.

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Annexes

Annex I.

List of coralligenous species, with indication of the structuring epi-megazoobenthic species (MATTM-ISPRA, 2018).

Phylum	Class	Taxon	Epi-megazoobenthic structuring species
Chlorophyta	Ulvophyceae	*Caulerpa cylindracea*	
Chlorophyta	Ulvophyceae	*Flabellia petiolata*	
Chlorophyta	Ulvophyceae	*Halimeda tuna*	
Chlorophyta	Pyramimonadophyceae	*Palmophyllum sp*	
Ochrophyta	Phaeophyceae	*Cystoseira spp*	
Ochrophyta	Phaeophyceae	*Laminaria ochroleuca*	
Ochrophyta	Phaeophyceae	*Sargassum spp*	
Ochrophyta	Phaeophyceae	*Zanardinia sp*	
Rhodophyta	Florideophyceae	*Lithophyllum spp*	
Rhodophyta	Florideophyceae	*Mesophyllum spp*	
Rhodophyta	Florideophyceae	*Osmundaria volubilis*	
Rhodophyta	Florideophyceae	*Peyssonnelia spp*	
Rhodophyta	Florideophyceae	*Polysiphonia sp*	
Rhodophyta	Florideophyceae	*Spongites fruticulosus*	
Porifera	Calcarea	*Clathrina clathrus*	
Porifera	Demospongiae	*Acanthella acuta*	
Porifera	Demospongiae	*Aplysina cavernicola*	
Porifera	Demospongiae	*Axinella damicornis*	
Porifera	Demospongiae	*Axinella cannabina*	X
Porifera	Demospongiae	*Axinella polypoides*	X
Porifera	Demospongiae	*Calyx nicaeensis*	X
Porifera	Demospongiae	*Chondrosia reniformis*	
Porifera	Demospongiae	*Cliona spp*	
Porifera	Demospongiae	*Cliona viridis*	
Porifera	Demospongiae	*Geodia spp*	
Porifera	Demospongiae	*Haliclona citrina*	
Porifera	Demospongiae	*Haliclona mediterranea*	
Porifera	Demospongiae	*Spongia lamella*	X
Porifera	Demospongiae	*Spongia officinalis*	

Phylum	Class	Taxon	Epi-megazoobenthic structuring species
Porifera	Demospongiae	*Petrosia ficiformis*	
Porifera	Demospongiae	*Sarcotragus foetidus*	X
Porifera	Homoscleromorpha	*Oscarella laburalis*	
Cnidaria	Hydrozoa	*Hydrozoa ind*	
Cnidaria	Hydrozoa	*Errina aspera*	X
Cnidaria	Hydrozoa	*Eudendrium pp.*	
Cnidaria	Anthozoa	*Acanthogorgia hirsuta*	X
Cnidaria	Anthozoa	*Alcyonium acaule*	
Cnidaria	Anthozoa	*Alcyonium coralloides*	
Cnidaria	Anthozoa	*Antipathella subpinnata*	X
Cnidaria	Anthozoa	*Antipathes dichotoma*	X
Cnidaria	Anthozoa	*Callogorgia verticillata*	X
Cnidaria	Anthozoa	*Caryophyllia sp.*	
Cnidaria	Anthozoa	*Cladocora caespitosa*	X
Cnidaria	Anthozoa	*Corallium rubrum*	X
Cnidaria	Anthozoa	*Dendrophyllia cornigera*	X
Cnidaria	Anthozoa	*Dendrophyllia ramea*	X
Cnidaria	Anthozoa	*Ellisella paraplexauroides*	X
Cnidaria	Anthozoa	*Eunicella cavolinii*	X
Cnidaria	Anthozoa	*Eunicella singularis*	X
Cnidaria	Anthozoa	*Eunicella verrucosa*	X
Cnidaria	Anthozoa	*Leptogorgia sarmentosa*	X
Cnidaria	Anthozoa	*Leptopsammia pruvoti*	
Cnidaria	Anthozoa	*Paramuricea clavata*	X
Cnidaria	Anthozoa	*Paramuricea macrospina*	X
Cnidaria	Anthozoa	*Parazoanthus axinellae*	
Cnidaria	Anthozoa	*Savalia savaglia*	X
Cnidaria	Anthozoa	*Viminella flagellum*	X
Cnidaria	Anthozoa	*Parantipathes larix*	X
Cnidaria	Anthozoa	*Leiopathes glaberrima*	X
Annelida	Polychaeta	*Hydroides spp*	
Annelida	Polychaeta	*Salmacina-Filograna complex*	
Annelida	Polychaeta	*Polychaeta ind*	
Annelida	Polychaeta	*Serpula vermicularis*	
Mollusca	Bivalvia	*Chama gryphoides*	
Mollusca	Bivalvia	*Manupecten pesfelis*	
Mollusca	Grastropoda	*Vermetus sp.*	
Bryozoa	Staenolemata	*Hornera frondiculata*	
Bryozoa	Gymnolaemata	*Adeonella pp.*	
Bryozoa	Gymnolaemata	*Caberea boryi*	
Bryozoa	Gymnolaemata	*Cellaria fistulosa*	
Bryozoa	Gymnolaemata	*Margaretta cereoides*	
Bryozoa	Gymnolaemata	*Myriapora truncata*	X
Bryozoa	Gymnolaemata	*Pentapora fascialis*	X
Bryozoa	Gymnolaemata	*Reteporella spp*	
Bryozoa	Gymnolaemata	*Turbicellepora spp*	
Bryozoa	Gymnolemata	*Smittina cervicornis*	
Echinodermata	Crinoidea	*Antedon mediterranea*	
Echinodermata	Ophiuroidea	*Astrospartus mediterraneus*	
Chordata	Ascidiacea	*Ciona edwardsi*	
Chordata	Ascidiacea	*Cystodytes dellechiajei*	
Chordata	Ascidiacea	*Halocynthia papillosa*	
Chordata	Ascidiacea	*Microcosmus sabatieri*	
Chordata	Ascidiacea	*Rhodosoma callense*	

List of the associated of the coralligenous habitat (MATTM-ISPRA, 2018).

- Algae: *Cystoseira usneoides, Cystoseira zosteroides, Lithophyllum stictaeforme, Mesophyllum lichenoides, Neogoniolithon mamillosum, Peyssonelia rubra;*
- Briozoi: *Hornera lichenoides*;
- Polychaetes: *Sabella spallanzani, Serpula vermicularis*;
- Clams: *Hiatella arctica, Lithophaga lithophaga, Pteria hirundo, Serpulorbis arenaria, Spondylus gaederopus*;
- Crostacei: *Homarus gammarus, Palinurus elephas, Scyllarides latus*;
- Echinoderms: *Asterina pancerii, Centrostephanus longispinus, Echinus melo, Ophidiaster ophidianus, Paracentrotus lividus*;
- Osteitti: *Anthias anthias, Acantholabrus palloni, Conger conger, Epinephelus marginatus, Gobius auratus, Hippocampus guttulatus, Labrus mixtus, Lappanella fasciata, Phycis phycis, Sciaena umbra, Scorpaena scrofa*.

Annex II

Table A: Italian Adriatic Sea refined baseline inventory of non-indigenous, cryptogenic and data-deficient species. Source: modified from Tsiamis *et al.*, 2019.

NR.	SPECIES	STATUS	NOTE
1	*Acanthophora nayadiformis (Delile) Papenfuss, 1968*	cryptogenic	
2	*Acartia (Acanthacartia) tonsa Dana, 1849*	non-indigenous	
3	*Acromegalomma claparedei (Gravier, 1906)*	data-deficient	
4	*Acrothamnion preissii (Sonder) E.M.Wollaston, 1968*	non-indigenous	
5	*Agardhiella subulata (C.Agardh) Kraft & M.J.Wynne, 1979*	non-indigenous	
6	*Aglaothamnion feldmanniae Halos, 1965*	non-indigenous	
7	*Amathia verticillata (delle Chiaje, 1822)*	non-indigenous	
8	*Ammothea hilgendorfi (Böhm, 1879)*	non-indigenous	

NR.	SPECIES	STATUS	NOTE
9	*Amphibalanus eburneus (Gould, 1841)*	non-indigenous	
10	*Amphibalanus improvisus (Darwin, 1854)*	cryptogenic	
11	*Anadara kagoshimensis (Tokunaga, 1906)*	non-indigenous	
12	*Anadara transversa (Say, 1822)*	non-indigenous	
13	*Antithamnion hubbsii (E.Y.Dawson, 1962)*	non-indigenous	
14	*Antithamnionella elegans (Berthold) J.H.Price & D.M.John, 1986*	cryptogenic	
15	*Antithamnionella spirographidis (Schiffner) E.M.Wollaston, 1968*	cryptogenic	
16	*Antithamnionella sublittoralis (Setchell & Gardner) Athanasiadis, 1996*	data-deficient	
17	*Aplysia parvula (Mörch, 1863)*	cryptogenic	
18	*Arcuatula senhousia (Benson, 1842)*	non-indigenous	
19	*Artemia franciscana (Kellog, 1906)*	non-indigenous	
20	*Asparagopsis armata (Harvey, 1855)*	non-indigenous	
21	*Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon, 1845*	non-indigenous	data-deficient
22	*Aurelia coerulea (von Lendenfeld, 1884)*	non-indigenous	
23	*Austrominius modestus (Darwin, 1854)*	data-deficient	
24	*Balanus trigonus (Darwin, 1854)*	non-indigenous	
25	*Bonnemaisonia hamifera (Hariot, 1891)*	non-indigenous	
26	*Botrylloides violaceus (Oka, 1927)*	non-indigenous	
27	*Botryocladia madagascariensis (G.Feldmann, 1945)*	non-indigenous	
28	*Botrytella parva (Takamatsu) H.S.Kim, 1996*	non-indigenous	
29	*Brachidontes pharaonis (P. Fischer, 1870)*	non-indigenous	
30	*Branchiomma luctuosum (Grube, 1870)*	non-indigenous	
31	*Bugula neritina (Linnaeus, 1758)*	cryptogenic	
32	*Bursatella leachii (Blainville, 1817)*	cryptogenic	
33	*Callinectes danae (Smith, 1869)*	non-indigenous	
34	*Callinectes sapidus (Rathbun, 1896)*	non-indigenous	
35	*Caprella scaura (Templeton, 1836)*	non-indigenous	
36	*Caulerpa cylindracea (Sonder, 1845)*	non-indigenous	
37	*Celleporella carolinensis (Ryland, 1979)*	non-indigenous	
38	*Ceramium strobiliforme (G.W.Lawson & D.M.John, 1982)*	non-indigenous	
39	*Cerithium scabridum (Philippi, 1848)*	non-indigenous	
40	*Chaetozone corona (Berkeley & Berkeley, 1941)*	non-indigenous	
41	*Charybdis (Charybdis) japonica (A. Milne-Edwards, 1861)*	non-indigenous	
42	*Charybdis (Charybdis) lucifera (Fabricius, 1798)*	non-indigenous	
43	*Chondria pygmaea (Garbary & Vandermeulen, 1990)*	non-indigenous	
44	*Cladosiphon zosterae (J.Agardh) Kylin, 1940*	non-indigenous	
45	*Clytia hummelincki (Leloup, 1935)*	non-indigenous	
46	*Clytia linearis (Thorneley, 1900)*	non-indigenous	
47	*Codium fragile (Suringar) Hariot, 1889*	non-indigenous	
48	*Colaconema codicola (Børgesen) H.Stegenga, J.J.Bolton & R.J.Anderson, 1997*	non-indigenous	

NR.	SPECIES	STATUS	NOTE
49	*Cuthona perca (Er. Marcus, 1958)*	non-indigenous	
50	*Cutleria multifida (Turner) (Greville, 1830)*	non-indigenous	
51	*Dasysiphonia japonica (Yendo H.-S.Kim, 2012)*	non-indigenous	
52	*Desdemona ornata (Banse, 1957)*	non-indigenous	
53	*Diadumene cincta (Stephenson, 1925)*	non-indigenous	
54	*Diadumene lineata (Verrill, 1869)*	non-indigenous	
55	*Didemnum vexillum (Kott, 2002)*	non-indigenous	
56	*Dyspanopeus sayi (Smith, 1869)*	non-indigenous	
57	*Epinephelus coioides (Hamilton, 1822)*	non-indigenous	
58	*Erinaceusyllis serratosetosa (Hartmann-Schröder, 1982)*	non-indigenous	
59	*Eriocheir sinensis (H. Milne Edwards, 1853)*	non-indigenous	
60	*Eucheilota paradoxica (Mayer, 1900)*	cryptogenic	
61	*Eudendrium merulum (Watson, 1985)*	non-indigenous	
62	*Fabriciola ghardaqa (Banse, 1959)*	non-indigenous	
63	*Ficopomatus enigmaticus (Fauvel, 1923)*	non-indigenous	
64	*Fistularia commersonii (Rüppell, 1838)*	non-indigenous	
65	*Garveia franciscana (Torrey, 1902)*	non-indigenous	
66	*Godiva quadricolor (Barnard, 1927)*	non-indigenous	
67	*Gonionemus vertens (A. Agassiz, 1862)*	non-indigenous	
68	*Gracilaria vermiculophylla (Ohmi Papenfuss, 1967)*	non-indigenous	
69	*Grateloupia turuturu (Yamada, 1941)*	non-indigenous	
70	*Grateloupia yinggehaiensis (H.W.Wang & R.X.Luan, 2012)*	non-indigenous	
71	*Halothrix lumbricalis (Kützing Reinke, 1888)*	non-indigenous	
72	*Haminoea japonica (Pilsbry, 1895)*	non-indigenous	
73	*Herbstia nitida (Manning & Holthuis, 1981)*	non-indigenous	
74	*Hesionura serrata (Hartmann-Schröder, 1960)*	non-indigenous	
75	*Hydroides elegans (Haswell, 1883) [nomen protectum]*	non-indigenous	
76	*Hypnea cervicornis (J.Agardh, 1851)*	non-indigenous	
77	*Hypnea valentiae (Turner) Montagne, 1841*	non-indigenous	data-deficient
78	*Jassa marmorata (Holmes, 1905)*	cryptogenic	
79	*Leathesia marina (Lyngbye) Decaisne, 1842*	non-indigenous	
80	*Leiochrides australis (Augener, 1914)*	non-indigenous	
81	*Littorina saxatilis (Olivi, 1792)*	non-indigenous	
82	*Lomentaria hakodatensis (Yendo, 1920)*	non-indigenous	
83	*Lophocladia lallemandii (Montagne) F.Schmitz, 1893*	non-indigenous	
84	*Lumbrinerides neogesae (Miura, 1981)*	non-indigenous	
85	*Lysidice collaris (Grube, 1870)*	non-indigenous	
86	*Magallana gigas (Thunberg, 1793)*	non-indigenous	
87	*Megabalanus tintinnabulum (Linnaeus, 1758)*	non-indigenous	data-deficient
88	*Melanothamnus harveyi (Bailey) Díaz-Tapia & Maggs, 2017*	non-indigenous	
89	*Mercenaria mercenaria (Linnaeus, 1758)*	non-indigenous	
90	*Metacalanus acutioperculum (Ohtsuka, 1984)*	non-indigenous	
91	*Metasychis gotoi (Izuka, 1902)*	cryptogenic	

NR.	SPECIES	STATUS	NOTE
92	*Mya arenaria (Linnaeus, 1758)*	non-indigenous	
93	*Neanthes agulhana (Day, 1963)*	non-indigenous	
94	*Neopseudocapitella brasiliensis (Rullier & Amoureux, 1979)*	data-deficient	
95	*Nereis jacksoni (Kinberg, 1865)*	non-indigenous	
96	*Notomastus aberans (Day, 1957)*	non-indigenous	
97	*Novafabricia infratorquata (Fitzhugh, 1973)*	data-deficient	
98	*Ophryotrocha japonica (Paxton & Åkesson, 2010)*	non-indigenous	
99	*Ostreopsis ovata (Fukuyo, 1981)*	cryptogenic	
100	*Palaemon macrodactylus (Rathbun, 1902)*	non-indigenous	
101	*Paracartia grani Sars (G.O., 1904)*	non-indigenous	
102	*Paracerceis sculpta (Holmes, 1904)*	non-indigenous	
103	*Paraleucilla magna Klautau, (Monteiro & Borojevic, 2004)*	non-indigenous	
104	*Paranthura japonica (Richardson, 1909)*	non-indigenous	
105	*Penaeus japonicus (Spence Bate, 1888)*	non-indigenous	
106	*Percnon gibbesi (H. Milne Edwards, 1853)*	non-indigenous	
107	*Perophora multiclathrata (Sluiter, 1904)*	non-indigenous	
108	*Perophora viridis (Verrill, 1871)*	cryptogenic	
109	*Pinctada imbricata radiata (Leach, 1814)*	non-indigenous	
110	*Pista unibranchia (Day, 1963)*	non-indigenous	
111	*Podarkeopsis capensis (Day, 1963)*	non-indigenous	
112	*Polycera hedgpethi (Er. Marcus, 1964)*	non-indigenous	
113	*Polydora colonia (Moore, 1907)*	non-indigenous	
114	*Polydora cornuta (Bosc, 1802)*	non-indigenous	
115	*Polysiphonia atlantica (Kapraun & J.N.Norris, 1982)*	cryptogenic	
116	*Polysiphonia morrowii (Harvey, 1857)*	non-indigenous	
117	*Pseudodiaptomus marinus (Sato, 1913)*	non-indigenous	
118	*Pseudo-nitzschia multistriata (Takano) Takano, 1995*	non-indigenous	
119	*Punctaria tenuissima (C.Agardh) Greville, 1830*	non-indigenous	
120	*Pylaiella littoralis (Linnaeus) Kjellman, 1872*	non-indigenous	
121	*Pyropia yezoensis (Ueda) M.S.Hwang & H.G.Choi, 2011*	non-indigenous	
122	*Rapana venosa (Valenciennes, 1846)*	non-indigenous	
123	*Rhithropanopeus harrisii (Gould, 1841)*	non-indigenous	
124	*Ruditapes philippinarum (Adams & Reeve, 1850)*	non-indigenous	
125	*Saccostrea cucullata (Born, 1778)*	non-indigenous	
126	*Saccostrea glomerata (Gould, 1850)*	non-indigenous	
127	*Sargassum muticum (Yendo) Fensholt, 1955*	non-indigenous	
128	*Scyllarus caparti (Holthuis, 1952)*	non-indigenous	
129	*Scytosiphon dotyi (M.J.Wynne, 1969)*	non-indigenous	
130	*Siganus luridus (Rüppell, 1829)*	non-indigenous	
131	*Solieria filiformis (Kützing) P.W.Gabrielson, 1985*	non-indigenous	
132	*Spermothamnion cymosum (Harvey) De Toni, 1903*	non-indigenous	
133	*Streblosoma comatus (Grube, 1859)*	non-indigenous	
134	*Styela plicata (Lesueur, 1823)*	non-indigenous	
135	*Tremoctopus gracilis (Souleyet, 1852)*	non-indigenous	data-deficient
136	*Tricellaria inopinata (d'Hondt & Occhipinti Ambrogi, 1985)*	non-indigenous	
137	*Ulva australis (Areschoug, 1854)*	non-indigenous	
138	*Ulva californica (Wille, 1899)*	non-indigenous	
139	*Ulvaria obscura (Kützing) P.Gayral ex C.Bliding, 1969*	non-indigenous	
140	*Undaria pinnatifida (Harvey) Suringar, 1873*	non-indigenous	
141	*Uronema marinum (Womersley , 1984)*	non-indigenous	
142	*Vertebrata fucoides (Hudson) Kuntze, 1891*	cryptogenic	
143	*Womersleyella setacea (Hollenberg) R.E.Norris, 1992*	non-indigenous	
144	*Xenostrobus securis (Lamarck, 1819)*	non-indigenous	

Table B: Alien, cryptogenic and dubious species sampled under the MSFD in the Adriatic Sea in the three-year period 2015 – 2017. Source: modified from ISPRA, 2018b.

TAXONOMIC GROUP	SPECIES	STATUS	FIND RANGE
FITOPLANCTON			
Haptophyta	*Chrysochromulina lanceolata*	non-indigenous	?
Chlorophyta	*Pyramimonas longicauda*	non-indigenous	?
Ochrophyta	*Asteromphalus cleveanus*	non-indigenous	?
	Chaetoceros furcellatus	non-indigenous	?
	Dictyota implexa	dubious	?
	Pseudo-nitzschia multistriata	non-indigenous	
	Skeletonema grevillei	cryptogenic	?
	Skeletonema tropicum	non-indigenous	X
	Vicicitus globosus	cryptogenic	?
Myzozoa	*Alexandrium insuetum*	cryptogenic	?
	Azadinium spinosum	non-indigenous	?
	Blepharocysta splendor-maris	cryptogenic	?
	Dinophysis bibulbus	non-indigenous	?
	Dinophysis infundibulum	non-indigenous	?
	Gymnodinium catenatum	cryptogenic	
	Gynogonadinium aequatoriale	non-indigenous	?
	Karenia papilionacea	cryptogenic	?
	Katodinium glaucum	cryptogenic	?
	Ostreopsis cf. ovata	non-indigenous	
	Prorocentrum mexicanum	cryptogenic	
	Protoperidinium quinquecorne	non-indigenous	?
	Scaphodinium mirabile	cryptogenic	?
MESOZOOPLANCTON			
Copepoda	*Paracartia grani*	non-indigenous	
	Pseudodiaptomus marinus	non-indigenous	
BENTHOS			
Ascidiacea	*Botryllus schlosseri*	dubious	

TAXONOMIC GROUP	SPECIES	STATUS	FIND RANGE
	Didemnum candidum	dubious	?
	Didemnum maculatum	dubious	?
Cirripedia	*Amphibalanus eburneus*	non-indigenous	
	Amphibalanus improvisus	cryptogenic	
	Verruca stroemia	dubious	?
Malacostraca	*Apohyale prevostii*	dubious	?
	Elasmopus pectenicrus	non-indigenous	X
	Ianiropsis serricaudis	non-indigenous	X
	Jassa marmorata	dubious	
	Monocorophium sextonae	dubious	
	Paracerceis sculpta	non-indigenous	
	Paranthura japonica	non-indigenous	
	Pilumnus minutus	non-indigenous	X
Pycnogonida	*Nymphon brevirostre*	dubious	?
Bivalvia	*Anadara inaequivalvis*	non-indigenous	
	Anadara transversa	non-indigenous	
	Magallana gigas	non-indigenous	
	Ruditapes philippinarum	non-indigenous	
	Saccostrea glomerata	non-indigenous	
Polychaeta	*Acromegalomma vesiculosum*	dubious	X
	Gallardoneris iberica	dubious	
	Glycera capitata	dubious	
	Hydroides dirampha	non-indigenous	X
	Hydroides elegans	non-indigenous	
	Lumbrineris perkinsi	non-indigenous	X
	Lysidice collaris	non-indigenous	
	Mediomastus capensis	cryptogenic	
	Notomastus aberans	non-indigenous	
	Pistella lornensis	dubious	?
Bryozoa	*Bugula neritina*	dubious	
	Nolella gigantea	dubious	?
	Tricellaria inopinata	non-indigenous	
	Watersipora cucullata	dubious	?
Rhodophyta	*Antithamnion hubbsii*	non-indigenous	

	1 find
	2 - 9 finds
	More than 10 finds
X	Species found that were not present before 2012
?	Species detected for which the presence or absence before 2012 is doubtful

SPA/RAC WORKING AREAS

*SPA/ RAC, the UNEP/ MAP **Specially Protected Areas Regional Activity Centre**, was created in 1985 to assist the Contracting Parties to the Barcelona Convention (21 Mediterranean contries and the European Union) in implementing the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol).*

POST-2020 SAPBIO

Strategic Action Programme for the **Conservation** of **Biodiversity** and **Sustainable Management** of **Natural Resources** in the **Mediterranean Region**

SPAMI

Specially Protected Areas of **Mediterranean Importance**

Marine turtles

Cetaceans

Mediterranean Monk Seal

Cartilaginous fishes
(Chondrichtyans)

Marine and coastal bird species

Listed in Annex II of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean

Specially Protected Areas

Monitoring

Coralligenous and other calcareous bio-concretions

Marine vegetation

Dark Habitats

Habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemo-synthetic phenomena

Species introduction and invasive species

POST-2020

SAP BIO

Strategic Action Programme
for the **Conservation** of **Biodiversity**
and **Sustainable Management**
of **Natural Resources**
in the **Mediterranean Region**

UN environment programme

Mediterranean Action Plan
Barcelona Convention

SPA/RAC
The Mediterranean Biodiversity Centre

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