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POST-2020 SAP BIO

CROATIA
CONSERVATION OF MEDITERRANEAN MARINE AND COASTAL BIODIVERSITY BY 2030 AND BEYOND

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CONSERVATION OF MEDITERRANEAN MARINE AND COASTAL BIODIVERSITY BY 2030 AND BEYOND

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
Specially Protected Areas Regional Activity Centre (SPA/RAC)
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List of Acronyms

BD	Birds Directive
CBC	Cross-Border Cooperation
CBD	Convention on Biological Diversity
COP	Conference of the Parties
CF	Cohesion Fund
CFP	Common Fisheries Policy
EBSA	Ecologically and Biologically Significant Areas
EU	European Union
EU ETS	EU Emissions Trading System
EFPZ	Ecological and Fisheries Protection Zone of the Republic of Croatia
EPEEF	Environmental Protection and Energy Efficiency Fund
FAO	Food and Agriculture Organization of the United Nations
FCS	Favorable Conservation Status
FRA	Fisheries Restricted Area
FPAs	Fishing Protected Areas
GES	Good Environmental Status
GFCM	General Fisheries Commission for the Mediterranean
HD	Habitats Directive
IAS	Invasive Alien Species
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICZM	Integrated Coastal Zone Management
IENP	Institute for Environmental and Nature Protection
IFM	Innovative financial mechanisms
IMMA	Important Marine Mammal Area
IUCN	International Union for Conservation of Nature
MEDITS	Mediterranean International Bottom Trawl-Surveys
MESD	Ministry of Economy and Sustainable Development
MFF	Multiannual Financial Framework
MPAs	Marine Protected Areas
MSCG	Marine Strategy Coordination Group
MSFD	Marine Strategy Framework Directive
NGO	Non-governmental Organization
NPA	Nature Protection Act
NPIS	Nature Protection Information System
NPSAP	Nature Protection Strategy and Action Plan of the Republic of Croatia for the Period 2017 – 2025
OG	Official Gazette
OG-IT	Official Gazette – International Contracts
OPCC	Operative Program “Competitiveness and Cohesion 2014-2020”
OPMAF	Operational Program for Maritime Affairs and Fisheries for the 2014-2020
PAs	Protected Areas
PAF	Prioritized action framework
pSCIs	proposed Site of Community Importance
PAP/RAC	Priority Actions Program / Regional Activity Centre
RAC	Regional Activity Centre
SACs	Special Areas of Conservation
RCmore	Croatian Marine Referral Centre
SCIs	Sites of Community Importance
SINP/CAEN	State Institute for Nature Protection / Croatian Agency for Environment and Nature
SNAPs	Strategic Nature Projects
SPAs	Special Protection Areas
SAPBIO	Strategic Action Programmme for the Conservation of Biodiversity and Sustainable Management of Natural Resources in the Mediterranean Region
SPA/BD	Priority Actions Program Regional Activity Centre Protocol Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean
SPA/RAC	Specially Protected Areas Regional Activity Centre
UNDP-GEF	United Nations Development Program – Global Environmental Finance Unit
WFD	Water Framework Directive

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Executive Summary

The Regional Activity Centre for Specially Protected Areas (SPA/RAC) has as part of its mandate the assistance to the Contracting Parties to the Barcelona Convention in the implementation of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol) adopted in 1995. In this context, following a request formulated by the Contracting Parties, it launched in 2020 the preparation of the "Post-2020 Strategic Action Programme for the Conservation of Biodiversity and Sustainable Management of Natural Resources in the Mediterranean Region" (Post-2020 SAPBIO). The elaboration of the Post-2020 SAPBIO is conducted through a participatory approach starting at national level (national processes) and involving the relevant authorities and other stakeholders. The national processes are followed by subregional consultations. The final stage of the elaboration process will use the outcomes of the national processes and the subregional consultations and compile them to craft the draft Post-2020 SAPBIO to be submitted for consideration by the Contracting Parties during 2021. This doc ument is the result of the national process for the Republic of Croatia, and it involved relevant national and local experts, authorities and institutions.

In chapter 2, this document presents the marine and coastal ecosystem status of the Republic of Croatia, including the description of water column biological communities – phytoplankton and zooplankton, which are characterized by high biodiversity. Knowledge on the status of some species of invertebrate bottom fauna, macroalgae and angiosperms is limited as monitoring programs of conservation status of species and habitats that are listed in the Annexes of EU Nature Directives (Birds Directive and Habitats Directive and Annexes of SPA/BD Protocol are being developed within two EU strategic projects that are still in their implementation phase. Within the two projects monitoring methodology is being developed for *Posidonia oceanica* (species and habitat type) – as their vulnerability status is one of the identified knowledge gaps in Croatia. Further data are also needed for the overall assessment of conservation status for species belonging to Crustacea, Mollusca (including Bivalvia), Echinodermata, Cnidaria as well as on vascular and non-vascular plants. Information on species and their status for vertebrates other than fish are provided for four species of seabird that nest in the coastal zone, feed at sea, have a relatively wide distribution area and are listed in the Annex I of the Birds Directive (*Calonectris diomedea*, *Puffinus yelkouan*, *Larus audouinii* and *Phalacrocorax aristotelis desmarestii)*. Among the 10 recorded species of cetaceans and 3 species of sea turtles, only 2 dolphin species (*Tursiops truncatus* and *Stenella coeruleoalba)* and the loggerhead turtle *(Caretta caretta)* permanently use the Adriatic Sea. Other than data on the status of the populations of marine birds, cetaceans and sea turtles,

the document provides information on major threats and pressures and proposes possible future actions. These include, among others, preparation of new and revision of existing management and action plans, improvement of data availability on marine species, on their distribution and habitat use. In the inventory of the temporal occurrence, abundance and spatial distribution of non-indigenous including invasive species information is provided regarding phytoplankton, zooplankton, macroalgae and benthic invertebrates as well as fish and crustaceans. In the information on the species of commercial interest for fishing available data are provided for commercial fish species that can be found on the Annex II and Annex III of SPA/BD Protocol. Regarding the list of main habitat types and of singular habitats in the country, data on the distribution of marine habitats are still scarce but, according to the marine habitat map prepared in 2004 which was primarily made by modelling and thus representing an indicative map, the predominant habitat types in the Croatian territorial sea are Circalittoral sand and Circalittoral mud. Through the implementation of the national strategic project financed by the EU new marine habitat map of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction will be prepared stretching over 51% of marine and coastal waters. Marine and coastal biodiversity gaps needed for scientifically based conservation include the need to perform additional research to address the remaining scientific reserves for the Natura 2000 network in the Republic of Croatia (for 1120* Posidonia beds and 1170 Reefs and *Tursiops truncatus* and *Caretta caretta*).

The chapter 3 presents the main pressures and biological disturbance: fisheries, mariculture, introduction of microbe pathogens and non-indigenous including invasive alien species (IAS). The direct effect of fishing is connected to significant proportion of organisms that are incidental bycatch due to the indiscriminateness of fishing gears. The Ministry responsible for fisheries is collecting data on incidental bycatch of vulnerable species, especially sea vertebrates, within the Croatian national data collection program. The establishment of systemic data collection has not been completed yet, so the death rate of these vulnerable species and the actual impact of bycatch has not been estimated yet. The production of Croatian mariculture is in continuous growth since 2013 and this represents a possible increase in environmental pressure. Regular monitoring of the environmental impact of mariculture and the correct application of zootechnical measures can significantly reduce the negative consequences of this industry in the future. Data on the introduction of microbial pathogens in the marine environment do not exist so the assessment of the presence of pathogens is based on bathing water quality assessments. In 2019 bathing water was analysed in 1010 sampling points: the quality was excellent for 92,28% of sampling points, good for 5,34%, satisfactory for 1,58% and not satisfactory for 0,79% of sampling points. IAS are one of the main drivers of biodiversity loss in Croatia. There are currently 66 species of IAS on the Union List, of which 23 are recorded in Croatia. Ongoing activities aim to increase knowledge on IAS, develop a monitoring system and planning acts (action plans and management plans) and increase capacities of authorities responsible for the implementation of the IAS Regulation. In chapter 3, data are provided on the most vulnerable marine ecosystems, that include Posidonion oceanicae – 1120 (habitat type), Reefs – 1170, Estuaries – 1130 and habitats in submerged caves. As already stated above, the data on the distribution and conservation status of marine main habitats are still scarce but efforts are being made to acquire relevant distribution data. Regarding emerging issues, the document addresses impact of climate change on species, habitats and ecosystems, which hasn'tbeen sufficiently investigated. The most important effects of climate change directly affecting natural ecosystems and biodiversity are changes in average air temperatures; reduction of quantities and changes in rainfall; occurrence of climate extremes (heatwaves, droughts, floods, strong winds); sea level rise. The application of an ecosystem-based management approach could reduce the adverse impacts of different maritime sectors on marine biodiversity and ecosystems. The economic value of ecosystem services should be assessed in marine pilot areas. To protect and conserve marine and coastal biodiversity, all relevant sectors should be involved in the development of future national maritime spatial plans, so it is important to ensure an effective stakeholder consultation process. Cumulative pressures must be assessed to support development of maritime spatial plans that respect the limits of ecosystems and support sustainable "blue growth". The problem of waste in the sea is becoming more visible and obvious in the Croatian part of Adriatic. Knowledge of the condition, quantities and properties, and the impacts of waste on the marine environment are currently insufficient and unsatisfactory. In addition, Croatia does not currently have a systematic model of sea waste management, and it is difficult to determine the amount of waste that arrives from neighbouring countries. Since mid-2017 Croatia has in implementation a systematic model of monitoring all elements of waste in the sea. Underwater noise is one of the threats identified for marine species. There is need for additional research to make evaluation and full assessment of its impacts on marine vulnerable species. National guidelines for mitigation of anthropogenic noise on marine mammals and sea turtles are under preparation.

In chapter 4, response measures are described, and they include protected areas and Natura 2000 areas in marine and coastal zones. Croatia has a long tradition of designation of protected areas, with the aim of their long-term protection within national and/or international Categories of protection, and sustainable use of natural resources. Taking into account both national categories and Natura 2000 sites, total protected surface in Croatia covers 38.26% of terrestrial and 8.54% marine territory under national jurisdiction. Further efforts should be made to achieve higher percentages or protected surface at the sea. During the Biogeographical Seminar held in 2014, the European Commission determined the Scientific Reserve for certain species and habitat types that should be furtherly researched. This has been addressed within national strategic project financed by the EU. Pending on the results new Natura 2000 sites could be potentially designated. So far, there is no recognition of Other effective area based measures (OECM) in Croatia, where they could be related to fisheries and Fisheries Restricted Areas (FRAs) although fishery management require temporary fishery closures which are time bound, and in place for a specific time period, which limits their ability to meet the criteria for the identification of an OECM, (to be "in place for the long term). Croatia reached an agreement with Italy to apply a bilateral joint management scheme to protect spawning and nursery grounds in the areas of Jabuka/Pomo Pit as a FRA. It is implemented in a form of a no-take zone which was bilaterally enforced by the Republic of Croatia and Italian Republic in extraterritorial waters over the surface of

2,500 km² over a three-year period (started 2017). However, management efficiency will be reviewed based on results from annual monitoring, with the possibility to prolong a declaration of this type of management regime. This chapter also describes the main institutional actors in relation to marine and coastal biodiversity. The document then lists the legal text of relevance to marine and coastal biodiversity, strategies, other regulations or plans including national plan for species and relevant international agreement on which the Republic of Croatia is a Party. The main transboundary issues and needed coordination at sub regional and regional level are identified for *Pinna nobilis* as well as for data availability and management of seabird, marine mammals and sea turtles. Regarding fisheries, the precondition for the establishment of long-term sustainable management is the dialogue between all participants in fishing with the aim of agreeing, establishing and harmonizing measures for fisheries regulation and protection of resources. Even though the IAS issue transcends state borders, current regional cooperation is insufficiently developed. Continuation and/or upgrade of existing transboundary cooperation is needed in the field of marine litter and in assessing impact of underwater noise on the marine ecosystem. Transboundary cooperation can significantly improve research on sensitivity, threat status and resilience of coastal and marine ecosystems on climate change and help identifying management priorities.

Chapter 5 contains the most relevant and important data presented in previous chapters on marine and coastal status and pressures and critical impacts and effects on marine and coastal biodiversity.

Chapter 6 contains an assessment of priority needs based on previous chapters and the identification of urgent response actions that are presented in Annex II to this document. Recommendations include biodiversity conservation and protection actions as well as actions aimed at limiting the impact of main pressures and threats, particularly of the most important direct drivers of biodiversity loss: climate changes, changes in land and sea use, overexploitation, IAS and pollution.

Chapter 7 analyses funding problems and more specifically analyses regular national sources, other sources (such as private and other public sources) as well as international funds, projects and programs.

Chapter 8 contains conclusions and recommendations and has been developed after consultation with national and local experts, authorities and institutions that participated to the national workshop and provided comments to this document.

1.

Reference documents and information consulted

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

Documents provided by Croatia SAPBIO National Correspondent

- Croatia 6th National Report for the Convention on Biological Diversity
- Report on the state of Nature from 2013 to 2017
- Proposal of Management Plan with action plan for Procellariformes
- National summary dashboards – Habitats Directive[1] – Article 17 (November 2020)[2]
- Database and base of indicators of the state of the marine environment, mariculture and fisheries (Baltazar database, November 2020)[3]
- SPA and BD Protocol Report 2016-2017
- National ACCOBAMS Report 2079-2019
- MPA Roadmap, National Survey Croatia
- Report on progress and implementation (Article 17, Habitats Directive, period 2013-2018)
- Report on progress and implementation (Article 12, Birds Directive[4], period 2013-2018)
- Article 12 Technical Assessment of the Marine strategy framework directive 2014 reporting on monitoring programs, Croatia Country Report, November 2015
- Article 16 Technical Assessment of the Marine strategy framework directive 2015 reporting on Program of Measures Croatia Report, November 2018
- Prioritized Action Format, draft 2020
- National summary dashboards – Habitats Directive – Article 17 (November 2020)[5]
- Database and base of indicators of the state of the marine environment, mariculture and fisheries (Baltazar database, November 2020)[6]
- Article 17 web tool on biogeographical assessments of conservation status of species and habitats under Article 17 of the Habitats Directive (November 2020)[7]
- Cumulative Impact Index for the Adriatic Sea: Accounting for interactions among climate and anthropogenic pressures (Furlan *et al.*, 2019)

1. Council Directive 92/43/EEC of May 21, 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
2. https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards
3. http://baltazar.izor.hr/azopub/bostalo
4. Directive 2009/147/EC of the European Parliament and of the Council of November 30, 2009 on the conservation of wild birds (Birds Directive)
5. https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards
6. http://baltazar.izor.hr/azopub/bostalo
7. https://nature-art17.eionet.europa.eu/article17/

Documents provided by SPA/RAC

- Protocol concerning specially protected areas and biological diversity in the Mediterranean (Barcelona, 1995)
- Strategic Action Programme for the conservation of Biological Diversity in the Mediterranean Region, 2003
- Legal and institutional framework assessment for conservation of coastal and marine biodiversity and the establishment of MPAs in Croatia, 2014
- Assessment and monitoring of coastal fisheries resources and socio-economic research of local fisheries at selected areas of the Primorje – Gorski Kotar County in Croatia, 2013
- Mapping marine and coastal habitats and species of the areas of Prvić, Goli Otok, Sv. Grgur, Unije, and Susak Islands in Croatia, 2014

1.2. National documents and publications identified and available

The EU Marine Strategy Framework Directive[8] (MSFD) requires Member States to take measures to achieve or maintain a good state of the marine environment by 2020 at the latest. To this end, marine strategies are being developed and implemented, within which an ecosystem approach to human activity management is applied. In the Republic of Croatia the MSFD is implemented through the alignment of national legislation with the provisions of the Strategy, through the development of a strategy for marine waters under national jurisdiction and through the establishment or continuation of sub-regional cooperation with neighboring countries in the Adriatic Sea and the cooperation within the Barcelona Convention.

The main documents of the marine strategy in the Republic of Croatia include the following:

- Initial assessment of the state and pressures on the marine environment of the Croatian part of the Adriatic, 2012 (Initial assessment, 2012)
- Updated documents of the Marine environment and coastal zone management strategy, 2019 (Updated documents, 2019)

The Initial assessment, 2019 and the Updated documents, 2019 were extensively used for the purpose of the development of this document, particularly in chapters 2. and 3. Other documents connected to the marine strategy that were consulted are:

- Monitoring and observation system for the continuous assessment of the state of the Adriatic Sea, 2014
- Program of measures for the protection and management of the marine environment and the coastal zone of the Republic of Croatia, 2017 (Program of Measures, 2017)

Other documents include:

- Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017 – 2025 (OG 72/2017)
- Climate Change Adaptation Strategy (OG 46/20)
- Report on assessed impacts and vulnerability to climate change per sector
- Operational Program "Competitiveness and Cohesion 2014-2020
- Operational Program for Maritime Affairs and Fisheries of the Republic of Croatia 2014-2020
- Interreg V-A Italy – Croatia 2014-2020.
- Interreg V-A Slovenia – Croatia 2014-2020.
- Interreg IPA Croatia – Bosnia and Hercegovina and Montenegro 2014-2020
- Interreg V-B Mediterranean Cooperation Program 2014-2020
- Interreg V-B Adriatic-Ionian Cooperation Program 2014-2020
- Integrated Coastal Zone Management Plan of Šibenik-Knin County – Coastal Plan
- Protocol for notification and action in the case of findings of dead, sick or injured strictly protected marine animals

1.3. Other documents identified

- Communication from the Commission to the European parliament, the council, the European economic and social committee and the committee of the regions – EU Biodiversity Strategy for 2030 Bringing nature back into our lives – COM/2020/380 final
- Communication from the Commission to the European parliament, the Council, the European economic and social committee and the Committee of the regions "An EU Strategy on adaptation to climate change" COM/2013/0216 final
- Council Recommendation of the European Parliament and the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe. Recommendation 2002/413/EC
- Post-2020 Global Biodiversity Framework
- Strategy on the Conservation of Cetaceans in the Adriatic Sea for the period 2016 – 2025, NETCET Project
- Strategy on the conservation of sea turtles in the Adriatic Sea for the period 2016–2025, NETCET Project
- Regulation (EU) 2019/982 of the European Parliament and of the Council on 5 June 2019 amending regulation (EU) No 1343/2011 on certain provisions for fishing in the General Fisheries Commission for the Mediterranean Agreement area.

8. Directive 2008/56/EC of the European Parliament and of the Council of June 17, 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive – MSFD)

- Regulation (EU) 2017/1004 of the European parliament and of the Council of May 17, 2017 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy and repealing Council Regulation (EC) No 199/2008
- Council Regulation (EC) No 1967/2006 of December 21, 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, amending Regulation (EEC) No 2847/93 and repealing Regulation (EC) No 1626/94
- Regulation (EU) No 1143/2014 of the European Parliament and of the Council of October 22, 2014 on the prevention and management of the introduction and spread of invasive alien species.

1.4. Quality and comprehensiveness of available information documents

The documents provided by national SAPBIO Correspondent, by SPA/RAC and its international consultants, as well as information contained in national documents and publications, including in relevant national databases, can be assessed as comprehensive and providing quality data that are necessary for the development of this documents.

This includes data on marine and coastal ecosystem status and their species, information on invertebrate bottom fauna, macro-algae and angiosperms, information of marine mammals, marine turtles and seabirds, information on the temporal occurrence, abundance and spatial distribution of non-indigenous species and on species of interest for fishing. The analysis of the above-mentioned documents allowed collection of data that were relevant for the description of main pressures and impacts to the Croatian marine and coastal biodiversity. This includes data on impact of fisheries, incidental bycatch, mariculture, climate change, invasive alien species, pollution.

From these documents it was possible also to collect information on current response measures especially regarding marine protected areas (MPAs) and other area-based conservation measures and to define legal and institutional frameworks relevant for the Republic of Croatia.

The data collected from these documents were the basis for the assessment of marine and coastal status and pressures and related national priority needs and response actions. These assessments were subject to review within the public consultation process that included a workshop with national/local experts, authorities and institutions that were invited to review the documents and whose comments were taken into consideration in the final phase of the document development.

2.

Marine and coastal ecosystem status including their species

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INTRODUCTION

Rich and diverse nature is one of the most valuable resources available to the Republic of Croatia. Conserved nature and ecosystems in good condition are basis for providing ecosystem services to ensure all functionalities necessary for livelihoods and economic development. The natural heritage provides opportunities for economic and social development primarily on the local level and related to the sustainable tourism. In the Republic of Croatia, as well as in the world, nature is facing permanent pressures from human activities. Even though significant efforts are being invested in nature conservation, certain nature components are still being threatened. The Adriatic Sea is one of the most valuable and biodiversity rich ecosystems of the Country, and therefore investing in its protection and sustainable management is recognized as a priority for nature protection in the Republic of Croatia. Within the process of protection and conservation of marine biodiversity, the Republic of Croatia is primarily focused on implementing existing obligations to the EU Nature Directives (Habitats Directive, or HD and Birds Directive, or BD), especially establishment of mechanisms aimed at ensuring a favourable conservation status of species and habitat types, primarily establishment of the Natura 2000 ecological network, but also the implementation of obligations under Convention on Biological Diversity, Barcelona Convention and other relevant international conventions and agreements. There are almost 40,000 known species and subspecies in the Republic of Croatia, and it is assumed that the actual total number is in fact significantly higher (ranging from 50,000 to over 100,000). Approximately 2.7% of the total number of known species are endemic species. The status of wild species in Croatia is assessed through the development of red lists based on the criteria of the International Union for Conservation of Nature (IUCN). Furthermore, in accordance with Article 12 of the BD and Article 17 of the HD, the Republic of Croatia, as a member of the European Union, has the obligation of six-year reporting on the conservation status of species and habitat types. Croatia has submitted the first report to the European Commission in 2019, covering the period from 2013 to 2018.

2.1. Biological characteristics

2.1.1. Description of water column biological communities

Phytoplankton

In accordance with the information published in the document “Updating the documents of the Marine environment and coastal zone management strategy based on the obligations" laid out in Art.8, Art.9 and Art.10 of the MSFD (in further text: Updated documents, 2019), the phytoplankton community in the Adriatic is characterized by high biodiversity. According to the 2002 list 888 species of phytoplankton were recorded in the eastern part of the Adriatic, and recent research shows that this number is higher (Mozetič *et al*., 2017; Bužančić *et al*., 2017; Maric Pfankuchen *et al*., 2018). In the period from 2013 to 2018, the total number of phytoplankton in the coastal areas of the Croatian part of the Adriatic

ranged from 4.4x103 to 2.9x106 L-1 cells. The abundance ranges of phytoplankton are largest in Šibenik and Kaštela Bay. The lowest numbers of phytoplankton refer to open water stations. Abundancies of phytoplankton species and their composition are common to the Adriatic region. The frequency of phytoplankton blooms, i.e., when species or taxon occurs in numbers above 106 L-1 cells, is quite low. During the six-year period (from 2013 to 2018), only 7 cases recorded a number exceeding this value and in particular spring diatomaceous blooms. Taxons that have been recorded during spring blooms are *Pseudonitschia delicatissima* group, *Leptocylindrus danicus* and *Chaetoceros* spp. The usual composition of phytoplankton species has been observed. A slightly higher median and the maximum number of species per sample was recorded in the coastal area in relation to channels and open water. Several new species of phytoplankton have been recorded in the Adriatic relating to the coccolithophore group (Šupraha *et al*., 2016, Skejić *et al*., 2018). Non-indigenous species of phytoplankton recorded in the Adriatic from 2013 to 2018 are two: *Skeletonema gravileii* (Marić Pfannkuchen *et al*., 2018) and the species *Pseudo-nitzschia multistriata* (Mozetič *et al*., 2017) but they did not adversely affect other phytoplankton species, (groups) and/or ecosystem in general. Similarly, no particularly sensitive phytoplankton species, which play a key role in the functioning of the phytoplankton community, have been defined, that is, those species, the absence of which would possibly affect the functioning of the system. The total number of phytoplankton communities in the Adriatic is most contributed by small flagellate organisms (nano-flagellate) and diatoms. The proportion of the nano-flagellate in the community is slightly lower in the coastal area than in the waters of the continental shelf and continental slope. Dinoflagellates are outnumbered in the warmer part of the year, which is consistent with the seasonal cycle of phytoplankton in the Adriatic Sea. The share of dinoflagellate in the phytoplankton community is small at all stations, even during the summer period (Updated documents, 2019).

Zooplankton

The Zooplankton of the Adriatic Sea is characterized by high biodiversity and the presence of various types of zooplankton communities such as estuary, coastal and epipelagic, mesopelagic and deep-sea open water communities (Initial assessment of the state and pressures on the marine environment of the Croatian part of the Adriatic, in further text: Initial assessment, 2012)[9]. Although each of these communities contains individual characteristic species, most zooplankton organisms are very widespread, which is greatly conditioned by the motions of water masses that carry them up over long distances. Differences in the taxonomic composition of zooplankton are generally most noticeable between the coastal and the open sea communities, and between the surface and bottom waters communities of the open sea. Geographically, the shallower waters of the northern Adriatic are habitat for a small number of very abundant species, while the peak of biodiversity is found in the deep waters of the southern Adriatic that is constantly inhabited by deep-sea native species, but here we can often find non-native species entering through the Strait of Otranto. In addition to the taxonomic composition, differences between coastal communities and those in the open waters of the Adriatic are also evident as changes in the total abundance of organisms and in the relative representation of individual groups and species are observed. Zooplankton research has a long history in the Adriatic Sea, so for the most part the typical time-space distribution of species and groups (Hure and Kršinić, 1998) is well known, which makes it easy to identify the natural state and possible deviations from it. However, data for some groups of zooplankton (Ameboida, Foraminifera, Rotatoria, meroplankton larvae) are still scarce, mainly due to a lack of taxonomy specialists (Updated documents, 2019).

In the period from 2013 to 2018, the total abundance of mesozooplankton in the Croatian part of the Adriatic follows the expected gradient coast-open sea, and the recorded values do not deviate significantly from the multiannual ranges recorded in the same areas under previous projects and multi-year monitoring (Monitoring within the Water Framework Directive[10], 2012-2018, or WFD monitoring, 2012-2018). As expected, higher total mesozooplankton numbers were recorded in bays and canals near urban centers (Zadar, Šibenik, Split) as more favorable trophic habitats, while the lowest values were always recorded at oligotrophic deep stations. The composition of species within groups is common for each type of pelagic habitat and reflects the natural composition of communities. Given the dominant representation in the mesozooplankton community and the important trophic role in the pelagic feeding network, biodiversity within the group of copepods, of which there are about 250 species in the Adriatic (Hure and Kršinić, 1998), is particularly high. The highest single percentage of representation in all areas is shown by the Oithonidae family (35-53%). This percentage is highest in the two areas of variable salacity, Šibenik Bay (53%) and Vranjički Bay (63%), under the influence of Krka and Jadra river flows. In November 2015, the presence of a non-indigenous species of copepod shrimp *Pseudodiaptomus marinus* (Calanoida) was observed in Šibenik Bay.

The percentage of representation of *P. marinus* in the copepod community is very low and does not indicate harmful effects on the biodiversity of the native community. However, since the species is characterized by benthopelagic distribution on a daily scale, occurring in benthos during the day, and in the water column at night, future research should be adapted to this life strategy (Updated documents, 2019).

2.1.2. Information on invertebrate bottom fauna, macroalgae and angiosperms including species composition, biomass and annual/seasonal variability

Members States are required, according to the Article 11 of the HD, to undertake monitoring of the conservation status of priority natural habitat types. Monitoring is addressed to gather data useful to preserve the natural heritage and to ensure a favorable conservation status (FCS) of habitats types as well as to highlight any degradation conditions or any change in their distribution. Article 17 of the HD requires a report to be sent to the

9. https://mzoe.gov.hr/UserDocsImages/NASLOVNE%20FOTOGRAFIJE%20I%20KORI%C5%A0TENI%20LOGOTIPOVI/doc/pocetna_procjena_stanja_i_pritisaka_na_morski_okolis_hrvatskog_dijela_jadrana.pdf

10. Directive 2000/60/EC of the European Parliament and of the Council of October 23, 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive -WFD)

European Commission every 6 years[11] following an agreed format (in the following text: Article 17 reporting). Monitoring programs of conservation status of species and habitats that are listed in the Annexes of EU Nature Directives, such as *Centrostephanus longispinus*[12], *Corallium rubrum*[13], *Lithophaga lithophaga*[14], *Lithothamnium coralloides, Phymatholithon calcareum, Pinna nobilis*[15] and *Scyllarides latus*[16] are being developed within the national strategic project financed by the European Union (EU) "Development of a system for monitoring the conservation status of species and habitat types" (framework for monitoring and reporting under Articles 12 and 17 of HD). Extensive data will be collected within another national strategic project financed by the EU "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction". Both projects are financed by the Cohesion fund (CF), within the Operational program, "Competitiveness and Cohesion 2014-2020." (OPCC). The beneficiary of these projects is the Institute for Environment and Nature (IENP) (formerly the State Institute for Nature Protection, i.e., the Croatian Agency for the Environment and Nature) of the Ministry of Economy and Sustainable Development (MESD). In certain cases, information on invertebrate bottom fauna, macroalgae and angiosperms lack due to capacity shortages on some taxonomic groups. In line with the action 4.1.18 of the Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017 – 2025 (NBSAP)[17], a limited number of initiatives were undertaken to improve the taxonomic expertise, where gaps still exist concerning the taxonomic knowledge and taxonomic experts for the groups Bryozoa, Polychaeta, Porifera.

Crustacea

Scyllarides latus

Scyllarides latus is listed in Annex III of SPA/BD protocol. In accordance with Article 17 reporting obligations Croatia reported for that the current and future prospect of the specie in terms of its range, population and habitat are unknown and the same is true for the assessment of conservation status. Considering the above it is important to improve knowledge on the conservation status of *Scyllarides latus*.

Bivalvia

Pinna nobilis

Based on Article 17 reporting, the range of the population was unknown, the population was in unfavorable – bad status while the habitat for the species in unfavorable inadequate – status. Furthermore, future prospects and overall assessment of conservation status were unfavorable – bad as well while there were no sufficient data to determine the overall trend in the conservation status of the species.

During the autumn of 2016, deaths of *Pinna nobilis* were recorded on the coast of Spain. The first confirmation of a disease outbreak in the Croatian part of the Adriatic Sea was confirmed in May 2019. The disease spread to Istria, which confirms the fact that the contagion has affected the entire Croatian part of the Adriatic. The cause of the death of *Pinna nobilis* is not completely known. Possible causes could be *Haplosporidium pinnae*, a parasite from the group of Sporozoa and the bacterium *Mycobacterium* sp. However, it has not yet been confirmed that these are the causes of a 100% mortality rate in certain locations. Measures that have been implemented throughout the Mediterranean, activities regarding protection of adult specimen, are also being implemented in Croatia with the participation of the scientific community. The situation is alarming, and it requires joint, regional approaches and actions, a transboundary exchange of knowledge between scientific and expert institutions, joint monitoring and joint implementation of protection and conservation measures. It is necessary to focus on capacity building of professional and technical capacities. Due to all the above, the IENP of the MESD is monitoring the state and progression of *Pinna nobilis* infestation in the Croatian par of Adriatic in order to collect the data needed to prepare and implement conservation measures in cooperation with relevant stakeholders. During July 2020, the IENP launched the public action "Did you see them" with the aim of involving the public in determining the distribution of species and raising awareness on the importance of *Pinna nobilis* conservation. The action calls on the public to report locations where *Pinna nobilis* has been observed, as well as photographs and information on the presence of dead or living individuals. Finances for the implementation of future conservation activities of *Pinna nobilis* for the period 2020 to 2025 are ensured. Those include *in situ* activities, such as the installation of larvae collectors, protection of larvae and adult living individuals from predators and anthropogenic influences, marking of sites for protection and education, as well as *ex situ* activities such as placing living individuals of *Pinna nobilis* in closed systems in aquariums and maintaining them.

Spatial data on the distribution of *Pinna nobilis* (including information on their health status) is available on http://www.bioportal.hr/gis/.

Lithophaga lithophaga

Based on Article 17 reporting, *Lithophaga lithophaga* population, species habitat, future prospects and the overall assessment of the conservation status are unfavorable – bad. The range is unknown while the overall trend in conservation status is deteriorating. There is a need to improve the knowledge on the distribution and conservation status of the species.

Echinodermata

The following species of Echinodermata are strictly protected, in accordance with the Ordinance on strictly protected species (OG No 114/13, 73/16) and is listed in Annex

11. The last report that was sent to the European Comission by the Republic of Croatia covered the period from 2013 to 2018)
12. Annex II of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD) protocol
13. Annex III SPA/BD Protocol
14. Annex II SPA/BD Protocol
15. Annex II SPA/BD Protocol
16. Annex III SPA/BD Protocol
17. Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017 – 2025 (OG 72/2017)

II of SPA/BD protocol: *Asterina pancerii, Centrostephanus longispinus* and *Ophidiaster ophidianus*. Of the abovementioned, in accordance with Article 17 reporting obligations Croatia reported for *Centrostephanus longispinus* that the population size is unknown and that the quality of species habitat, future prospects and the assessment of conservation status are unknown too.

Paracentrotus lividus

The species is listed in Annex III of SPA/BD protocol. In the Croatian part of the Adriatic it is not endangered. In fact, this species is very common and widespread along the coast, where it creates dense populations across large areas. However, since there are many examples in the Mediterranean where overfishing has taken place and thus this species is endangered, exploitation needs to be approached with caution. Since there is insufficient data on the biology, ecology and distribution of the species in the coastal area of the Republic of Croatia, it is necessary to conduct detailed scientific research and systematic monitoring of their condition so that measures and conditions under which the species collection is allowed can be evaluated and revised if necessary. The monitoring of the state of the population over a three-year period is being implemented in at least 13 localities along the Croatian coast. It is financed from the Operational Program for Maritime Affairs and Fisheries for the 2014-2020 (OPMAF) and its aim is to monitor populations using a standardized methodology in order to determine the state of populations and changes in their dynamics.

Cnidaria

Corallium rubrum

According to Updated documents, 2019, the abundance of red coral (*Corallium rubrum*) has significantly decreased in the Croatian part of the Adriatic Sea due to exploitation. Good environmental status (GES) was not assessed for the period from 2013 to 2018 due to very limited data on the ecology and distribution of this species. Based on Article 17 reporting, for the period from 2013 to 2018, the short term trend direction of the population size is decreasing and the overall assessment of Conservation Status is Unfavourable – Inadequate, based on expert opinion with very limited data collected in the period from 2002 to 2016.

Considering the above it is important to improve the knowledge on the conservation status of *Corallium rubrum* and enhance monitoring with focus on coral utilization/extraction. This is why red coral research activities are currently being conducted as a part of several projects: other than the above mentioned strategic EU project "Development of a system for monitoring the conservation status of species and habitat types" others are "Expert base proposal for the *Corallium rubrum* management plan in Croatia", "ADRICOR[18] – Impact of climate change on coral biodiversity in the Adriatic sea", the coral monitoring project in Mljet National Park, Monitoring the coral of coralligenous community in Kornati National Park. Furthermore, monitoring of coralligenous was performed in the Brijuni National Park within the project "MPA – Adapt, Guiding Mediterranean MPAs through the climate change era: building resilience and adaptation"[19], that was financed by the Interreg Mediterranean program. Moreover, the monitoring protocol on the impact of climate change on corals is being performed within the project "MPA – Engage, Engaging Mediterranean key actors in Ecosystem Approach to manage Marine Protected Areas to face Climate Change"[20] that is financed by the Interreg Mediterranean program.

Vascular plants

Four seagrass species have been recorded for the Croatian part of the Adriatic Sea – *Posidonia oceanica*, *Cymodocea nodosa*, *Zostera marina* and *Zostera noltii*. Among them, *Posidonia oceanica* makes the largest and the most widespread meadows. Due to their importance for biodiversity and different ecosystem services it provides, their sensitivity and the threats they face, all the seagrasses are strictly protected species.

Posidonia oceanica (species) and Posidonion oceanicae (habitat type)

The *Posidonia* meadows are considered to be the most important part of the Adriatic ecosystem in biological, ecological and economic terms. The habitat *Posidonion oceanicae* – 1120 is considered a biodiversity storage and develops in the infralittoral zone and in more transparent waters up to 40 meters deep. *Posidonia* is found in areas where the pressure of human activities is extremely high. The natural restoration of damaged settlements of *Posidonia* takes tens of years, making this species particularly vulnerable and endangered. Anchoring of vessels as well as the impact of fishing gears in areas where *Posidonia* grows significantly damage its rhizome bead, which then becomes susceptible to the destruction of waves. The advancement of invasive species, like the algae *Caulerpa*, threaten *Posidonia* because they are direct rivals in the battle for living space, so invasive algae can easily penetrate such a weakened habitat, further endangering it. According to EU legislations (WFD, MSFD, HD), *Posidonia oceanica* due to its wide distribution in the Mediterranean Sea and specific response to anthropogenic pressures, proved to be a good biological indicator (Updated documents, 2019). Considering the above, and in accordance with WFD, MSFD and HD, *Posidonia oceanica* has been set as indicator species or habitat type included in different monitoring programs.

Within the Article 17 reporting, based on expert opinion of the habitat type P*osidonion oceanicae* – 1120, the conservation status is favorable in terms of range of habitat but unfavorable – inadequate for future prospects and in regard of overall assessment of conservation status. The overall trend in conservation status is unknown. The specific approach for monitoring *P. oceanica* meadows in the scope of the MSFD in Croatia will be

18. The objective of the project is to gain new information regarding the consequences of global climate change on marine ecosystems, particularly in coastal regions. The project identifies and characterizes negative impacts on marine biodiversity and develops methods and models for predicting future changes.

19. https://mpa-adapt.interreg-med.eu/

20. https://mpa-engage.interreg-med.eu/our-story/the-mpa-engage-project/

aligned with the methodology which is being developed under the two national strategic projects financed by the EU and aligned with HD[21].

Under the WFD, the index POMI[22] is applied for the monitoring program for coastal waters in Croatia since 2009. Some of the measures needed for monitoring the ecological status according to the POMI index can be shared for the assessment of the conservation status of the habitat type Posidonion oceanicae – 1120 under the HD.

During the period from 2013 to 2018, as part of the monitoring of the status of coastal waters for the needs of WFD, systematic surveys of *Posidonia oceanica* settlements were carried out using the POMI method. The research was carried out at 45 stations in the Croatian part of the eastern Adriatic. On the basis of expert opinion, which does not include the quantification of the area on which possible changes occur, it was concluded that the ratio of ecological quality at the researched stations is good and very good except for the isolated sites that are directly influenced by human activities and in the immediate vicinity of the source of anthropogenic influence (direct mounding, mariculture, anchoring, urban and industrial pollution) (Updated documents, 2019).

In consideration of the significance that *Posidonia oceanica* and *Posidonion oceanicae* – 1120 have in terms of safeguarding biodiversity, it is important to improve their current conservation status by reducing or eliminating the most impacting pressures and threats. Furthermore, it is also important to conserve existing and restore threatened Posidonia beds (habitat type).

During the Biogeographical Seminar held in 2014, the European Commission determined the Scientific Reserve (SR) for certain species and habitat types that should be furtherly researched: *Caretta caretta* (for the marine Mediterranean biogeographical region), *Tursiops truncatus* (for marine area outside of territorial seas under the national jurisdiction, *Posidonion oceanicae* – 1120 for the region and Reefs – 1170 for the marine area outside of territorial seas under the national jurisdiction). This has been addressed within national strategic project "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction". Pending on the results new Natura 2000 sites will be potentially designated for *Posidonion oceanicae* – 1120 and Reefs – 1170.

Considering the above it is important to improve the knowledge on the distribution and conservation status of the species *Posidonia oceanica* and of the habitat type *Posidonion oceanicae* – 1120 (but also on the other two species for which the SR was expressed).

21. „Development of a system for monitoring the conservation status of species and habitat types" and "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction".

22. Posidonia oceanica Multivariate Index is designed to provide indications on the environmental quality (i.e. ecological status of coastal waters) and is based on the combination of multiple physiological, morphological, structural and community level descriptors.

Nonvascular plants (Algae)

Phymatolithon calcareum

Based on Article 17 reporting, there is no data on the range, population size, quality of habitat for the specie. Only very limited data is available for the distribution of this species. Future prospects and the assessment of conservation status are unknown.

Lithothamnium coralloides

Based on article 17 reporting, there is no data on the range, population size, quality of habitat for the specie. Favourable reference value, future prospects and the assessment of conservation status are also unknown

Considering the above it is important to improve the knowledge on the conservation status of non-vascular plants that are listed in the Annexes of EU Nature Directives.

2.1.3. Information on vertebrates other than fish

Birds

INFORMATION ABOUT SPECIES AND THEIR STATUS

Seabirds that can well demonstrate the state of the marine environment are:

Calonectris diomedea
(Scopoli's shearwater)

Larus audouinii
(Audouin's gull)

Puffinus yelkouan
(Yelkouan shearwater)

Phalacrocorax aristotelis desmarestii
(European shag)

These species meet the following criteria: they nest in Croatia in the coastal area, exclusively feed at sea, have a relatively wide area of distribution in the Adriatic Sea. Furthermore, the birds are listed in Annex I of the BD and are qualifying species of several Specially Protected Areas (SPAs) in Croatia and therefore there is an obligation to monitor population numbers, distributions and threats (Updated documents, 2019). Protocols for monitoring the above species will be developed and tested within the national strategic EU project "Developing a system for monitoring the conservation status of species and habitat types". The project will also develop detailed monitoring programs for the above-mentioned species of seabirds detailing the sampling area, frequency and methodologies as well as measurement and data processing methods. The programs will also consider

the criteria according to Commission Decision 2017/848/EU[23] i.e., the results of the implementation of the seabird conservation monitoring program shall give an assessment of the given primary and secondary descriptors. Completion of the project, as well as developed monitoring programs, are planned for 2023.

Calonectris diomedea

Calonectris diomedea nests on the outer islands of the South Adriatic. The size of the Croatian population is 515-1300 nesting pairs (Kapelj *et al*., 2018). Based on the monitoring carried out for this species the trend of abundance for the species is stable, and the distribution area of 1100 km² is stable. Due to high prevalence of rats and cats on the islands, the productivity of the population is low – therefore the species is not in a good conservation status and there are no scientific findings available to assess whether the extent and condition of the species habitat can support the different stages of the species life cycle (Updated documents, 2019).

Puffinus yelkouan

Puffinus yelkouan nests only in three places: Lastovo archipelago, the island Svetac and the islet of Kamik. The size of the national population is 300-400 nesting pairs (Budinski, 2013). The trend of abundance for the species is unknown. Based on the monitoring carried out for this species, it is concluded that the distribution area is stable and is 600 km². Due to the high prevalence of rats and cats on islets, the productivity of the population is low – therefore the species is not in a good conservation state and there are no scientific findings available to assess whether the extent and condition of the species habitat can support different stages of the species life cycle (Updated documents, 2019).

Larus audouinii

Larus audouinii has an estimated population of 13-60 nesting pairs (Jurinović *et al*., 2018, Jurinović 2018). It nests on several islands of the South Adriatic, on the territory of the islands of Korčula, Mljet, Lastovo and Pelješac peninsula (Jurinović, 2013). The trend in population numbers is uncertain (due to large differences in annual levels it is not possible to tell whether the population is growing, declining, or just fluctuating). In the area of the Lastovo archipelago, there is a predation from the *Larus cachinnans* and possibly rats, so the productivity of colonies is low – therefore the species is not in a good conservation state. The distribution area is stable and is 500 km². There is no scientific knowledge available to assess whether the extent and condition of the species habitat can support different stages of species life cycle (Updated Documents, 2019).

23. Commission Decision (EU) 2017/848 of May 17, 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardized methods for monitoring and assessment, and repealing Decision 2010/477/EU

Phalacrocorax aristotelis desmarestii

The population of *Phalacrocorax aristotelis desmarestii is estimated* between 1600 and 2000 nesting pairs. It nests on small, unsettled islets along the entire Adriatic. The largest population (more than 30% of the national population), nests in the Central Adriatic, within the Natura 2000 SPA HR1000034, northern part of the Zadar archipelago (Barišić *et al*., 2013). Based on the monitoring carried out for this species, the trend of abundance for the species is stable (1600-2000 pairs) while the distribution area is stable and is 4700 km². Demographics data about the species, which may indicate population health and the impact of anthropogenic pressures are unknown. There is no scientific knowledge available to assess whether the extent and condition of the species habitat can support different stages of species life cycle (Updated Documents, 2019).

PROBLEMS, THREATS, CURRENT AND POSSIBLE FUTURE ACTIONS

The Regulation (EU) 2017/1004[24] established rules on the collection, management and use of biological, environmental, technical and socioeconomic data in the fisheries sector and rules out that the Commission shall establish a multiannual Union program for the collection and management of the mentioned data. The Commission implementing decision (EU) 2019/909 establishing the list of mandatory research surveys and thresholds for the purposes of the multiannual Union program for the collection and management of data in the fisheries and aquaculture sectors[25] defined the list of research surveys at sea that includes the International bottom trawl survey in the Mediterranean (MEDITS) that is to be implemented in the period spring-summer and targets mostly demersal species. The Commission delegated decision (EU) 2019/910 establishing the multiannual Union program for the collection and management of biological, environmental, technical, and socioeconomic data in the fisheries and aquaculture sectors[26] adopted the multiannual Union program for the collection, management and use of data in the fisheries sector for the period 2020-2021. In Chapter III the decision rules to collect, among others, data to assess the impact of Union fisheries on marine ecosystems in Union waters and outside Union waters. Those data consist of data, for all types of fisheries, on incidental bycatch of all birds, mammals and reptiles and fish protected under Union legislation and international agreements, including absence in the catch, during scientific observer trips on fishing ships or by the fishers themselves through logbooks .

In line with the above, the Ministry of Agriculture, as a central State Administration Body (SAB) responsible for fisheries policies, adopted the Ordinance on the form, content and manner of keeping and submitting catch data in commercial fishing at sea (OG 38/18, 48/18, 64/18, 35/20)[27]. The ordinance defined the obligation for those engaged in commercial fishing at sea and for small-scale coastal artisanal fisheries, to deliver data on incidental bycatch of vulnerable species of whales, seals, cartilaginous fishes,

24. Regulation (EU) 2017/1004 of the European parliament and of the Council of May 17, 2017 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy and repealing Council Regulation (EC) No 199/2008
25. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX: 32019D0909&from=EN
26. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX: 32019D0910&from=EN
27. https://narodne-novine.nn.hr/clanci/sluzbeni/2020_03_35_736.html

seabirds and sea turtles beginning from October 1st, 2018. At national level, data on incidental bycatch and the impact of fisheries on marine ecosystem is collected by the Directorate of Fisheries at the Ministry of Agriculture in cooperation with the Institute of Oceanography and Fisheries in Split[28]. The monitoring of incidental bycatch takes place as part of the monitoring of commercial fishing at sea, through a sampling program performed by scientific observers. The monitoring methodology is harmonized with the results of the fishPiresearch project with the aim of strengthening regional cooperation in the area of fisheries data collection[29], financed by the EU MARE/2014 grant. The death rate of seabirds has not been estimated because the establishment of systemic collection of data on bycatch in the fishery sector has not been completed yet.

The project "LIFE Artina – Seabird Conservation Network in the Adriatic", financed by the LIFE Program of the EU is designed to address the main problems of the protection of three marine species: the Audouin's gull, the Scopoli's shearwater and Yelkouan shearwater.

The project identified the following major threats for seabirds, which are identified also within the Proposal of Management Plan with action plan for Procellariformes:

- the presence of predators on islands where birds land for nesting.
  The most threatening ones are ship rats (*Rattus rattus*), domestic cats (*Felis catus*) and Javan mongoose (*Herpestes javanicus*)
- habitat competition with other, more aggressive seabird species
- bycatch during fishing (a threat that has not yet been researched enough in Croatia)
- reduction of food availability due to large exploitation of fish
- increase in tourist activities as cruises and boat trip near breeding sites greatly affect the success of breeding (noise, excessive use of light)
- marine litter including plastic ingestion (a threat that has not yet been researched enough in Croatia).

Another probable threat that has not been researched in Croatia is the one connected with climate change. It is important to conduct detailed scientific research on the diet and selection of habitats for seabirds and the availability of prey. These activities are beyond the scope of the BD and are linked to the monitoring of marine production and the state of fisheries that could be incorporated into the JADMON project[30] (Updated documents, 2019). The data are needed to identify and potentially designate new marine SPAs that will be entirely at sea[31]. It is an additional tool for their better protection. Furthermore, seabird species that are protected should be managed through the adoption and/or revision of an existing draft management plan with action plans.

Considering the above, it is important to:

- Conduct research and data collection including on migration pathways, monitor populations and develop and conduct necessary conservation activities targeting the most important threats during migration: incidental bycatch, poisoning and illegal killing.
- Establish transboundary platform for research cooperation, data collection and exchange of information on seabird species, especially on their migration pathways
- Research nutrition of seabirds, their habitats selection and food/prey availability
- Improve data availability and conduct research on seabird distribution and habitat use in the Adriatic Sea to assess anthropogenic impact and improve management of MPAs
- Revision of draft/proposals of management plans with action plans for marine species (marine mammals along with marine turtles, seabirds) and implementation of those plans
- Preparation of protection and conservation project for the seabird species *Phalacrocorax aristotelis desmarestii*
- Assess the impact of fisheries and the incidental bycatch of endangered species, also through continuous improvement of The Croatian national data collection program conducted by the Ministry responsible for fisheries (this is a prerequisite to design urgent mitigation measures that could include time-space fishing closures, alternatives to fishing gears etc.)

28. The Institute of Oceanography and Fisheries in Split is the lead partner while the Institute Ruđer Bošković is partner in the consortium forming the Croatian Marine Referral Centre (RCmore). RC-more performs systematic monitoring, observation and assessment of the state of the marine environment, fisheries and mariculture, collects and analyses of related data including indicators from the National List of Indicators for the Ministry of Economy and Sustainable Development (MESD) of the Republic of Croatia. RC-more performs activities in six areas of work. The first area of work encompasses monitoring of the various marine environmental parameters needed to describe status of the eleven descriptors (D1-D11) within the framework of the implementation of the EU MSFD.

29. https://datacollection.jrc.ec.europa.eu/documents/10213/1329983/NA-NS_MARE2014-19_final+report.pdf/c0106e3d-eb62-41c1-82b9-789a20aeed47

30. JADMON project or „Monitoring of marine environment of the Adriatic Sea in the period 2018-2024" project is being implemented by the Croatian Marine Referral Centre (RCmore).

31. Proclamation of new Natura 2000 sites could be proposed within the Protected Ecological and Fisheries Zone (EFPZ) over which the Republic of Croatia claims sovereign rights. According to the requirements of the HD for highly mobile species neighbouring countries (Croatia, Italy) will have to work together towards designating a cross-border site based on the latest scientific information coming from the different projects. Conservation measures necessary for the site that could possibly not be taken under the common fisheries policy, could be taken under the framework of the HD (GFCM) as it was successfully done with the establishment of the Fisheries Restricted Area in the Pomo/Jabuka Pit.

- Analyze the impact of marine litter on marine species
- Improve cooperation between scientists and fishermen that should report incidental bycatch and actively work to increase awareness of fishermen on the importance of the protection and restoration of marine biodiversity as their understanding and acceptance is the key to the sustainability of protection and conservation measures
- Raise awareness on seabirds and support behavioral change of tourist and tourism stakeholders.
- Determination of marine species and habitat types sensitive to climate change and develop specific conservation measures
- Proclamation of new marine SPAs

Marine mammals

INFORMATION ABOUT SPECIES AND THEIR STATUS

All marine mammals species (the monk sea, the dolphins that are native to the Republic of Croatia and all other species of whales (Cetaceans) naturally occurring in the Adriatic Sea) are strictly protected under the Ordinance of strictly protected species (OG, 144/2013, 73/2016)32. Also, in line with the Act on Protection of Animals (OG, 102/2017, 32/19)33 it is forbidden to keep in the captivity dolphins and other marine mammals from the Cetaceans family, except for the purpose of veterinary treatment, recovery and care and as an official animal. All the marine species occurring in the Croatian part of the Adriatic Sea are also listed in Annex II to SPA/BD protocol.

To this date, 10 species of whales (Cetacea) have been recorded in the Adriatic. Of the recorded species, *Tursiops truncatus* and *Stenella coeruleoalba* are permanently inhabited in the Adriatic, while the Cuvier's beaked whale (*Ziphius cavirostris*) and *Grampus griseus* are probably constantly present but in small numbers. Modelling of critical habitats for Cuvier's beaked whale, the southern Adriatic area has been identified as an area of higher population density than other areas of the Mediterranean (Cañadas *et al*., 2018). The large whale (*Balaenoptera physalus*) is present seasonally and the number of individuals probably depends on the seasonal appearance primarily of euphasid planktonic shrimp. The common dolphin (*Delphinus delphis*) once inhabited the entire Adriatic but the species has completely disappeared over the last two decades and can probably be considered regionally extinct. In recent years, there have been occasional observations of a number of individuals in the Middle Adriatic region. Other species of whales (*Physeter macrocephalus, Globicephala melas, Pseudorca crassidens, Megaptera novaeangliae*) appear as stray individuals (Updated documents, 2019).

In National Report on the Implementation of the Agreement for the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) for the period from 2017 to 2019 data on population sizes of cetaceans are reported from the document "Conservation of cetaceans and sea turtles in the Adriatic Sea: status and potential conservation measures" that was developed within the scope of the NETCET[34] project. The project was funded within the IPA Adriatic Cross-border Cooperation Program. The general objective of the project NETCET was to develop common strategies for the conservation of cetaceans and sea turtles in the Adriatic through a pan-Adriatic cooperation. Partners of the project included relevant institutions and civil society organizations from Italy, Slovenia, Croatia and Albania.

In the abovementioned documents, the species *Grampus griseus* (Risso's dophin) is considered regular in the Adriatic Sea. The *Delphinus delphis* (Short-beaked common dolphin) is considered regionally extinct. *Ziphius cavirostris* (Cuvier's beaked whale) is considered regular in the South Adriatic Sea. *Physeter macrocephalus* (Sperm whale) is considered rare. *Balaenoptera physalus* (Fin whale) is seasonally regular in the central and south Adriatic Sea. Also in accordance with Article 17 reporting, the range, population size, the sufficiency of area and the quality of habitat (habitat for the species), future prospects and the overall assessment of conservation status are unknown for the species: *Balaenoptera physalus, Grampus griseus, Physeter microcephalus, Stenella coeruleoalba*, and *Ziphius cavirostris*. The species *Pseudorca crassidens* has not been recorded since 1938. A rapid decline of the population of *Delphinus delphis*, was recorded during the 1970s (Bearzi 1989; Notarbartolo di Sciara and Bearzi 1992; Bearzi and Notarbartolo di Sciara, 1995; Bearzi and Politi *et al*., 2000). Since then, only vagrant individuals were seen. Aerial research conducted in 2010 and 2013 covered the entire Adriatic Sea (Fortuna and Holcer *et al*., 2011; Fortuna and Mackelworth *et al*., 2014), but no *Delphinus delphis* was observed, leading to the conclusion that the species became regionally extinct in the Adriatic Sea[35] The species Mediterranean monk seal is considered regionally extinct in Croatia. There have been some observations every decade since its disappearance in the second half of the 20th century but only a few have been confirmed with no signs of recolonization. The last specimen that has visited Croatian waters since 2005 was of old age and died in 2014 (Updated documents, 2019). The conservation status of the species *Turisops truncatus* is favorable, while it is unknown for *Stenella coeruleoalba* (as above stated). More detailed information on these two species follow.

Tursiops truncatus

The species is present throughout the Adriatic. Higher abundance and density is recorded in the area of continental shelf up to a depth of 150-200 m and in the area of the inner sea of the Republic of Croatia. The assessment of the number and distribution of the species was done by aerial research using conventional distance sampling (CDS) method.

32. https://narodnenovine.nn.hr/clanci/sluzbeni/dodatni/441255.pd
33. https://narodnenovine.nn.hr/clanci/sluzbeni/full/2019_03_32_656.html
34. https://www.netcet.eu/
35. https://www.netcet.eu/files/Conservation_measures/NETCET_WP7_Conservation_measures_for_CSTs.pdf

According to the non-corrected estimate of the abundance obtained by pooling data from the air survey in the summer of 2010 and 2013, the total number of bottlenose dolphins in the Adriatic is 5700. The density of individuals in the northern Adriatic is higher than the average (0.042 dolphins/km²) and is 0.057 dolphins/km². Also, in the territorial sea of the Republic of Croatia the density is 0.046 dolphins/km². In the Ecological and Fisheries Protection Zone (EFPZ), the density is 0.056 dolphins/km² while in Sites of Community Importance (SCI) for dolphins is 0.048 dolphins/km²) (Fortuna *et al*., 2018) (Updated documents, 2019).

In article 17 reporting the species *Tursiops truncatus* is not considered as sensitive. The range of the species is 55.349 km² and is considered as stable. The best estimation for the population size is of some 600 individuals. The area and the quality of habitat are considered sufficient for the long-term survival of the species. While prospects are unknown, the overall assessment of conservation status is favourable.

The most impacting pressures and threats are:

- Marine fish and shellfish harvesting (professional, recreational) causing reduction of species/prey populations and disturbance of species; Geotechnical surveying (high)
- Bycatch and incidental killing (due to fishing activities); industrial or commercial activities and structures generating noise, light, heat or other forms of pollution; Extraction of oil and gas, including infrastructure; Sports, tourism and leisure activities; shipping lanes and ferry lanes transport operations

The identified main conservation measures that need to be implemented include:

- Reduce/eliminate noise, light, thermal and other forms of pollution related to resource exploitation and energy production
- Management of professional/commercial fishing (including shellfish and seaweed harvesting)

In the National Report on the Implementation of the ACCOBAMS for the period from 2017 to 2019 the specie is the only one considered as a regular inhabitant of the Adriatic Sea.

Tursiops truncatus is one of the two species for which the European Commission determined the SR During the Biogeographical seminar held in 2014.

Stenella coeruleoalba

The species is present in the southern Adriatic. The area of habitation is the pelagic part of the southern Adriatic valley in an area of depth greater than 200 m. Occasionally, individuals or smaller groups appear in areas of the central and northern Adriatic. The status of the species in the Adriatic is not fully known. According to the non-corrected estimate of the number obtained by the 2010 aerial survey, the total minimum estimated number of *Stenella coeruleoalba* in the Adriatic is greater than 15,000, representing the last estimate of the number of this species (Updated documents, 2019). In accordance with Art. 17, the range, population size, the sufficiency of the area and the quality of habitat (habitat for the species), future prospects and the overall assessment of conservation status are unknown.

In the National Report on the Implementation ACCOBAMS for the period from 2017 to 2019 the specie is considered Regular in the South Adriatic Sea; occasional in the North Adriatic Sea.

On the basis of the analysis of available data from recent monitoring on *Tursiops truncatus* and *Stenella coeruleoalba* communities at the level of the Adriatic Sea, no significant change in the abundance of *Tursiops truncatus* has been identified so the impact of anthropogenic pressures does not jeopardize the long-term sustainability of the species. The demographic characteristics in the monitored *T. truncatus* populations have not changed while for *S. coeruleoalba* the information does not exist. The area and the pattern of distribution is consistent with the expected distribution. Since the distribution has not changed, it is concluded that the state of the habitat is such that it can support the life cycle of species (Updated documents, 2019).

PROBLEMS, THREATS, CURRENT AND POSSIBLE FUTURE ACTIONS

Aerial monitoring of cetaceans is conducted during the summer season. However, data on the abundance and on the distribution of species during the winter period, still do not exist. In the future, it is necessary to conduct aerial research during the winter months to determine the patterns of distribution, abundance, and possible migration of individual species. To assess the anthropogenic impact on the status of populations of whale species in the Adriatic and to determine appropriate management measures, additional research is needed.

Regarding the predation of fish by dolphins, the Ministry responsible for fisheries adopted the Ordinance on the conditions, the criteria and manner of granting state aid within the state aid program "Protection and restoration of marine biodiversity and marine ecosystems and compensation regimes within sustainable fishing activities" – compensation for damage to catches caused by marine mammals (OG 20/2019)[36] regulating compensation to fishermen in the form of non-repayable grants for damages on annual basis that are caused by dolphins on certain commercial fish species caught using single and triple static nets and trawls.

Data on incidental bycatch of vulnerable species of whales, seals, cartilaginous fishes, seabirds and sea turtles are collected within the Croatian national data collection program conducted by the Ministry responsible for fisheries but, the death rate of cetacean has not been estimated, as the establishment of a systemic collection of data in the fishery sector has not been completed and analyzed yet. Furthermore, at national level, sporadic data on

36. https://narodne-novine.nn.hr/clanci/sluzbeni/2019_02_20_421.html

bycatch is collected through the National Stranding Network. Stranding of cetacean has been monitored continuously in Croatia since 2010 on the national level through Protocol for Alerting and Monitoring of dead, sick or injured strictly protected marine species (marine mammals, sea turtles and cartilaginous fish) – National Stranding Network. Cetacean stranding data is gathered in the database organized by IENP. These data include species, geographic location, condition of animal, weight, sex, age, cause of death.

During the NETCET project bycatch appeared to be the likely cause of death in the 27% of animals examined, meaning it could be the main threat for cetaceans

According to the Report on the implementation of the Protocol for notification and action in the case of findings of dead, sick or injured strictly protected marine animals (marine mammals, sea turtles and cartilaginous fish) for the year 2017 (Protocol implementation report, 2017)[37], 124 marine mammals were recorded during 2017, of which 41 (33.06%) were dead, 81 (65.32%) were not injured while 2 were injured (1.61%). The most numerous species of marine mammals recorded was *Tursiops truncatus*. A total of 99 individuals of this species were recorded, accounting for 79.84% of the total number of marine mammals recorded in 2017. In addition to this, two individuals of *Balaenoptera physalus* were recorded together with two individuals of *Ziphius cavirostris* and five of *Stenella coeruleoalba*. For 16 individuals, it was not possible to determine the exact species, due to a lack of information and data. Of the 41 individuals who died, in 82.93% of cases, that is for 34 individuals, it was not possible to determine the cause of mortality. Comparing the data with those from 2016, in 2017 the percentage of individuals whose causes of mortality could not be determined increased by about 20%. For only seven individuals, the causes of death are known. Two individuals died due to drowning in the fishing net, four died from unknown fishing gear while one individual died due to disease, i.e.,, from the consequences of parasite infestation (Protocol Implementation Report, 2017).

The national management plan with action plan for the conservation of cetacean's species was drafted within the scope of NETCET. The project implementation period ended in September 2015, so the draft national management plan with an action plan should be revised (updated) and specific activities from the plan implemented.

The existing threats that were identified during the document analysis and within the NETCET project[38] include:

- Interactions with fisheries: that include bycatch and depredation of fish by dolphins. Bycatch includes direct interaction with fishing gears, entanglement in fishing gears, net ingestion.
- Anthropogenic noise[39] from oil and gas exploitation, seismic survey, shipping, military activities, and construction: these include physical/physiological effects and behavioral changes potentially leading to direct and indirect mortality.

The project identifies the need for more investigations on this issue in Adriatic waters.

- Anthropogenic noise from tourism (with seasonal occurrence) impacting in terms of behavioral change, acting as trigger to displace the local population of dolphins
- Marine debris/litter: this includes the ingestion of plastic litter, fecal contamination due to poor waste management systems, pollution from agriculture.
- Climate change: The significance of climate change is at least known, but due to the geographical features of the Adriatic, it expects this is an important issue to tackle in the future.

Considering the above it is important to:

- Improve data availability and conduct research and monitoring on marine mammals and turtles' populations, distribution and habitat use in the Adriatic sea, data gap analysis, assessing anthropogenic impact, also in order to improve management of existing/new protected marine areas.
- Assess the impact of fisheries and the incidental bycatch of endangered species (cetaceans) including through continuous improvement of The Croatian national data collection program conducted by the Ministry responsible for fisheries (this is a prerequisite to design urgent mitigation measures that could include time-space closures, alternatives to gears etc.)
- Improve the cooperation between the Ministry responsible for nature protection with Ministry responsible for fisheries and stakeholders
- Improve cooperation between scientists and fishermen that should report accidental bycatch and actively work to increase awareness of fishermen on the importance of the protection and restoration of marine biodiversity as their understanding and acceptance is the key to the sustainability of protection and conservation measures
- Continue improving EIA procedures as a mitigation measure of anthropogenic noise derived from gas exploitation, seismic survey, shipping, military activities and construction and tourism
- Finalize guidelines for mitigation of anthropogenic noise on marine mammals and sea turtles that is being developed by the MESD
- Upgrade of existing transboundary cooperation for assessing the impact of underwater noise on the marine ecosystem
- Education on human dimension in the management of species, conflict resolution, harmonized coexistence of humans, public involvement in management plan development (for the interaction with fisheries

37. file: ///C: /Users/Windows/Desktop/Izvjesce_o_provedbi_Protokola_za_2017._godinu.pdf
38. https://www.netcet.eu/files/Conservation_measures/NETCET_WP7_Conservation_measures_for_CSTs.pdf
39. MESD is preparing guidelines for mitigation of anthropogenic noise on marine mammals and sea turtles.

and the threat connected to anthropogenic noise from tourism activities)
- Establish transboundary cooperation for knowledge exchange regarding impact of marine litter on marine biodiversity.
- Revision of draft management and action plans for marine species (cetaceans) and implementation of specific activities from those plans
- Determine marine and coastal species and habitat types sensitive to climate change and develop specific conservation measures

Sea turtles

All marine turtles naturally occurring in the Adriatic Sea are strictly protected under the Ordinance of strictly protected species (OG 144/2013 and 73/2016).

Three species of sea turtles were recorded in the Adriatic: *Caretta caretta, Chelonia mydas* and *Dermochelys coriacea*. *Caretta caretta* is the only species of sea turtle that constantly uses the Adriatic Sea. Although it does not reproduce in the Adriatic, the Adriatic is one of the two most important areas of nutrition and wintering of this species throughout the Mediterranean Sea. The shallow water of the northern Adriatic, with depths of up to 100 m, rich in bottom communities, is one of the two largest and most important neritic feeding habitats for *Caretta caretta* in the Mediterranean.

Potential new areas have not been clearly identified but research activities are conducted through the transboundary "LIFE Euroturtles project – Collective actions for improving the conservation status of the EU sea turtle populations"[40] financed by the LIFE Program and with the project implementation period from 2016 to 2021. The objective of the project is to improve the conservation status of the EU populations of two sea turtle priority species, *Caretta caretta* and *Chelonia mydas*.

Caretta caretta

Estimates of the number and distribution of the species was performed on the basis of combined data from aerial surveys in the summer of 2010 and 2013. The total number of *Caretta caretta* in the Adriatic is 27,000. The average density in the Adriatic is 0.203 individuals/km², while in the northern Adriatic the density is almost twice as high (0.405 individuals/km²) and is slightly above the average in the EFPZ of the Republic of Croatia (0.251 individuals/km²) (Fortuna *et al*., 2018). In relation to the latest monitoring carried out for the species, no significant change in the number of *Caretta caretta* was determined so it could be concluded that the impact of anthropogenic pressures did not jeopardize the long-term sustainability of the species. The mortality rate of sea turtles due to incidental bycatch has not been estimated, as the establishment of a systemic collection of data in the fishery sector has not been completed and analyzed yet. Demographic characteristics of the population of the *Caretta caretta* in the Adriatic have not been established/ investigated. The area and pattern of distribution have not changed and are in line with the expected distribution. Since the distribution has not changed, it is concluded that the state of the habitat is such that it can support the life cycle of the species (Updated documents, 2019).

In line with Article 17 reporting, the range (surface area) occupied by the specie is stable (short term trend period). The population size as well as the quantity and the quality of habitat (habitat for the species) are also considered stable and the overall assessment in Conservation status is favorable.

The most impacting pressures and threats are:

- Shipping lanes and ferry lanes transport operations
- Bycatch and incidental killing
- Water and air transport activities generating noise, light and other forms of pollution
- Mixed source marine water pollution (marine and coastal)
- Geotechnical Surveying

The list of main conservation measure includes:

- Manage/reduce/eliminate noise, light, and other forms of pollution from transport
- Reduce bycatch and incidental killing of non-target species

Caretta caretta is one of the two species for which the European Commission determined the SR during the Biogeographical seminar held in 2014.

Chelonia mydas and Dermochelys coriacea

In accordance with Article 17 reporting, the range, population size, the sufficiency of area and the quality of habitat (habitat for the species), future prospects and the overall assessment of conservation status of both species are unknown.

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Data on abundance and on the distribution of all three species are not precise. To assess the anthropogenic impact on the status of populations of turtles in the Adriatic and to determine appropriate management measures, additional research is needed.

Within the scope of the NETCET project partners developed a report on the causes of mortality of sea turtles in Adriatic see. In the report, although the data do not have a statistical significance due to the low number of samples analyzed, the impact of bycatch together with the bacterial presence in the water seem to be the greater threats for sea turtles in the Adriatic Sea. Incidental capture in fishing gear has been recognized as a major threat with bycatch ranging between 2000–2500 turtle captures in the bottom

40. www.euroturtles.eu

trawls per year and at least 400 – 600 captures in set nets per year in the Croatian part of Adriatic (LIFE Euroturtles project). Activities aimed at reducing the impact of fishing by providing fishermen with the best practices to significantly reduce the mortality of turtles incidentally caught have been done in the scope of the LIFE Euroturtles project. Data on incidental bycatch of vulnerable species of whales, seals, cartilaginous fishes, seabirds and sea turtles are collected within the Croatian national data collection program conducted by the Ministry responsible for fisheries but, the death rate of sea turtles has not been estimated, as the establishment of a systemic collection of data in the fishery sector has not been completed yet. Furthermore, at national level, sporadic data on bycatch is collected through the National Stranding Network. Stranding of sea turtles has been monitored continuously in Croatia since 2010 through the Protocol for Alerting and Monitoring of dead, sick or injured strictly protected marine species (marine mammals, sea turtles and cartilaginous fish) – National Stranding Network. These data include species, geographic location, condition of animal, weight, sex, age, cause of death.

In 2017, 78 sea turtles were recorded, that is 7 more than year before. The majority of them were dead individuals (50 or 64.10%), injured individuals were 25 (32.05%), and only 3 (3.85%) were not injured. Two individuals belonged to the species *Dermochelys coriacea* and 76 were individuals of *Caretta caretta*. Of the 50 deaths reported, for 40 individuals it was not possible to determine the cause of death, which is as many as 80% of the total dead individuals. The cause of death was determined for only 10 individuals. Of these, six individuals suffered mechanical injuries (propeller blow or swallowing hook), one individual died from drowning in the fishing net and hypothermia, while one individual died from swallowing a nylon bag and spleen torsion. In 2017, there were 25 cases of injured sea turtles. The most common causes of injury were hypothermia and suffocation in the fishing net. Of the injured individuals, as many as 11 individuals died. Other recorded causes of death include malnutrition, mechanical injury, and plastic ingestion (Protocol Implementation Report, 2017).

The national management plan with action plan for the conservation of turtles was drafted within the scope of NETCET project. The project implementation period ended in September 2015, so the draft national management plan with an action plan should be revised (updated) and specific activities from the plan implemented.

The existing threats that were identified during documents analysis and within the LIFEeuroturtle and NETCET project include:

- Interaction with fisheries, including bycatch:
- Marine debris/litter: this includes the ingestion of plastic litter, contamination due to poor waste management systems, pollution from agriculture.
- Anthropogenic noise / Collision with boats along with the impact of tourism
- Climate change: The significance of climate change is at least known, but due to the geographical features of the Adriatic, it is expected to be an important issue to tackle in the future.

Considering the above it is important to:

- Improve data availability and conduct research and monitoring on marine mammals and turtles, distribution and habitat use in the Adriatic Sea, data gap analysis, assessing anthropogenic impact also in order to improve management of existing new marine areas.
- Assess the impact of fisheries and the accidental bycatch of endangered species (turtles) also through continuous improvement of the Croatian national data collection program conducted by the Ministry responsible for fisheries (this is a prerequisite to design urgent mitigation measures that could include time-space fishing closures, alternative fishing gears etc.).
- Improve cooperation between scientists and fishermen that should report accidental bycatch and actively work to increase awareness of fishermen on the importance of the protection and restoration of marine biodiversity as their understanding and acceptance is the key to the sustainability of protection and conservation measures.
- Continue improving EIA procedures as a mitigation measure of anthropogenic noise derived from gas exploitation, seismic survey, shipping, military activities, construction, tourism.
- Finalize guidelines for mitigation of anthropogenic noise on marine mammals and sea turtles.
- Upgrade existing transboundary cooperation for assessing the impact of underwater noise on the marine ecosystem.
- Education on human dimension in management of species, conflict resolution, harmonized coexistence of humans, public involvement in management plan development (for the threat of anthropogenic noise from tourism activities).
- Establish transboundary cooperation for knowledge exchange regarding impact of marine litter on marine biodiversity.
- Revision of draft management and action plans for marine species (turtle) and implementation of specific activities from those plans.
- Determine marine species and habitat types sensitive to climate change and develop specific conservation measures.
- Proclamation of new Natura 2000 sites.

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

In 2017, the national list of non-indigenous species was updated with the data available the European Alien Species Information Network portal (EASIN)[41]. As a result, the list consists of 80 non-indigenous marine species recorded in the Croatian waters of the Adriatic until 2012. Among them, 12 species have cryptogenic status[42] while for 8 species there are no sufficient data for the identification of their status. The other 60 have confirmed the status of non-indigenous species (Updated Documents, 2019). The list of non-indigenous marine species recorded in the Croatian part of the Adriatic until 2012 is in Table 4.2. of Updated documents, 2019. In the reporting period 2013. – 2018 of the MSFD new non-indigenous species were recorded and included in the national list. They are listed in Tables 4.4, 4.5, 4.6, 4.7 and 4.9 of the Updated documents, 2019. These lists have been transposed to Annex I of this document.

Phytoplankton

In the period from 2013 to 2018, in the phytoplankton community, two new non-indigenous species have been introduced through ballast waters. The *Pseudo-nitzschia multistriata* diatom was identified in the estuary of the Krka River during the implementation of the monitoring plan for the quality of the sea and Bivalvia. This species is classified as non-indigenous in the framework of research conducted within the Balmas project (Mozetič *et al*., 2017), which was funded by the EU IPA Adriatic Program 2007-2013[43]. The objective of the project was to establish a common cross-border system linking all Adriatic researches, experts and national responsible authorities to avoid the unwanted risks to the environment and humans from the transfer of Harmful Aquatic Organism and Patogenous (HAOP), through the control and management of ships' Ballast waters and sediments. In the same research the species *Ostreopsis cf. ovata* was also classified as a non-indigenous species. Since this benthic dinoflagellate was identified in the Croatian part of the Adriatic (Kaštela Bay) in the early 1980s (Marasović, 1990), it is considered that this species cannot be considered non-native. In addition, species of the genus *Ostreopsis* in the Mediterranean Sea have been recorded during the survey and comparison of regions with respect to benthic and epiphytic dinoflagellates (Monti *et al*., 2007) (Updated documents, 2019).

41. https://easin.jrc.ec.europa.eu/easin

42. Species whose origin is unknown (it is not known whether the species was introduced or is native)

43. The objective of the project was to establish a common cross-border system linking all Adriatic research, experts and national responsible authorities to avoid the unwanted risks to the environment and humans from the transfer of Harmful Aquatic Organism and Patogenous (HAOP), through the control and management of ships' ballast waters and sediments. More information can be found on: http://www.ismar.cnr.it/organization/geographic-units/ismar-lesina/projects-in-progress/balmas-project

Zooplankton

In the period from 2013 to 2018, three new non-indigenous zooplankton species were recorded, two from the group of Copepoda and one from the Ctenophora group. Both species of Copepoda *(Parvocalanus crassirostris* and *Pseudodiaptomus marinus*) were found in the immediate vicinity of the Adriatic ports (Rijeka, Šibenik, Ploče) and can be connected to the ballast waters of ships as input vectors. Furthermore, in the Adriatic there was an expansion into Croatian waters of the invasive species of Ctenophora *Mnemiopsis leidyi*. Since *Mnemiopsis leidyi* is known for its high invasive potential as it has caused dramatic changes at all levels of the food network and thus in fisheries, after inadvertently entering into the Black Sea through ballast waters of ships in the 1980s, it is necessary to monitor the population's status in order to assess the potential impact on other biological components of the Adriatic ecosystem in the future (Updated Documents, 2019).

Macroalgae and benthic invertebrates

A total of 31 non-indigenous species of macroalgae and benthic invertebrates were recorded, including 18 algae and 13 benthic invertebrates. In the period from 2013 to 2018, four algae and five benthic invertebrates were recorded. Through the implementation of MSFD monitoring it was confirmed that tuna farms and the port of Split are "hot-spot" places of occurrence and development of non-indigenous species. However, isolated islands have also been shown to be areas of intensive settlement, which is not in line with the view that preserved ecosystems are less suitable for the settlement of alien species. The most intense negative influence is given by the red algae *Womersleyella setacea*, which is spread almost everywhere between the depths of 10 to 30 m, on the rocky bottoms and in the *Posidonia oceanica* beds. This alga develops dense settlements, covers other organisms and enhances sedimentation, thus likely leading to a drastic reduction in biodiversity. The alga *Acrothamnion preissii* has a similar influence, but its distribution is limited to the wider Dubrovnik area. In 2018 it is still recorded in Kornati national park, but the expansion area where is still unknown. Among the most invasive alga is *Caulerpa cylindracea*, which is spread almost everywhere from the surface to the depths of almost 50 m. It builds settlements of varying density and seems to have a particularly significant influence in the coralligenous community. The algae *Caulerpa taxifolia* was known as an extremely invasive species around the year 2000, but it experienced an inexplicable retreat throughout the Mediterranean, including in the Starigradski Bay, the only known locality in Croatia at the time. At the end of 2017 it covered only around 30 m², while at the end of 2018 it was no longer present in the Starigradski Bay. Red algae *Asparagopsis taxiformis* (gametophyte phase) was monitored in the Dubrovnik area where the expansion of the primary settlement has not been established. However, the algae has been recorded in new locations, including in the areas that are not polluted. The red algae *Lophocladia lallemandi* was found in Blitvenica, Palagruža and Biševo. It develops during the autumn and builds dense settlements that certainly have an impact on indigenous species, especially on the composition of the community. Judging by the size of the settlement developed on Blitvenica, it is expected that the species will spread further due to the transmission of sea currents (Updated documents, 2019).

Fish and crustaceans

In the period from 2013 to 2018, another non-indigenous type of crab was recorded (*Homarus americanus (*H. Milne Edwards, 1837) and two non-indigenous species of fish (*Oplegnathus fasciatus* (Temminck & Schlegel, 1844) and *Abudefduf vaiginesis* (Quoy and Gaimard, 1825)). The *Homarus americanus* was found in the waters of Savudria and represents most likely a direct anthropogenic entry. The *Oplegnathus fasciatus* was found in the waters of Urinja and has entered most likely due to ship activity (ballast water). In Zenta bay (Split) the presence of *Abudefduf vaiginesis* was confirmed by an underwater camera, and in it has entered, most likely, due to ship activity (ballast waters). In all cases only one individual was found (Updated Documents, 2019).

2.1.5. Information on the species of commercial interest for fishing (fish, mollusc and shellfish) identified populations, their abundance, spatial distribution, and age/size mainly encountered in the country

The Ministry of Agriculture that is responsible for fisheries policies in Croatia and the Institute for Oceanography and Fisheries in Split are partners in the project "Adri.SmArtFish – valorisation of small-scale coastal fishing along the Adriatic coast in the context of sustainability"[44] that is being financed within the cross-border cooperation (CBC) Program Interreg V-A Italy-Croatia 2014 – 2020. According to the EU definition, the small-scale coastal fishing is a segment of the fishing fleet that includes vessels smaller than 12 m in length and that do not use towed gears. The project addresses common challenges such as the lack of capacities of the small-scale coastal fishing sector to compete with industrial fisheries, difficulties in market access, low prices, reductions in fish stocks and diversity in catches, and average sizes of individual fish, ultimately resulting in weak economic profits.

The main commercial species in terms of quantities of caught fish (expressed in tons/year) are listed in the Table 1. Of these species the following are found in the Annex II to the SPA/BD Protocol: *Thunnus thynnus* and *Palinurus elephas*.

Table 1
Quantities of commercial fish, shellfish, oysters and other molluscs and bivalve in tons for the year 2018, Republic of Croatia[45]

	Quantity (tons/year)
Pelagic fish	
European pilchard (***Sardina pilchardus***)	46,267.00
European anchovy (***Engraulis encrasicolus***)	13,251.00
Tuna (***Thunnus thynnus, Thunnus albacore, Xipias gladius***)	679.00
Chub mackerel (***Scomber Japonicus)***	1,807.00
Atlantic horse mackerel (***Trachurus trachurus)***	1,464.00
Mixed small fish	-
Other Species	346.00
Total pelagic fish	**63,814.00**
Other fish (that are not pelagic fish)	
European hake (***Merluccius merluccius***)	992.00
Mullet (***Mullus barbatus barbatus, Mullus surmuletus)***	871.00
Mugil (Mugilidae, such as ***Mugil cephalus***)	105.00
European conger (***Conger conger***)	38.00
European bass (***Dicentrarchus labrax***)	9.00
Sea bream (***Sparus aurata)***	135.00
Picarel (Sparidae such as ***Spicara smaris)***	90.00
Bogue (***Boops boops)***	110.00
Leaf (***Solea***, such as ***Solea vulgaris***)	218.00
Other types of fish	1,131.00
Total other fish (that are not pelagic fish)	**3,699.00**
TOTAL FISH	**67,513.00**
Crustacea	
Lobster (***Palinurus elephas***)	7.00
Prawns (such as ***Nephrops norvegicus***) and other crustaceans	1,172.00
Total crustacea	**1,179.00**
Mollusca and Bivalvia	
Oyster (***Ostrea edulis***), Mussels (***Mytilus galloprovincialis***) and other Bivalvia	394.00
Squid and Common Squids (***Loligo vulgaris, Todarodes sagittatus)***	215.00
Cuttlefishes (Sepiidae)	92.00
Octopus (***Octopus vulgaris***) and other Mollusca	439.00
Total Oysters, Mollusca, Bivalvia	**1,140.00**
TOTAL 2018	**69,832.00**

44. https://www.italy-croatia.eu/web/adrismartfish

45. Croatian Bureau of Statistics, last available data (2018)

According to fisheries indicators[46], the estimate of stocks[47] for 2017 (and for 2018) obtained within the MEDITS project that includes only assessment of the conditions of populations from trawl nets, shows that, of the economically most important species, the most widespread were *Merluccius merluccius* and *Mullus barbatus*, while the least prevalent was *Nephrops norvegicus*. An increase in the frequency of occurrence was observed in *Merluccius merluccius, Mullus barbatus, Pagellus erythrinus and Eledone moschata* while a decrease in frequency of occurrence was observed in *Engraulis encrasicolus*, *Sardina pilchardus*, *Nephrops norvegicus* and *Eledone cirrhosa* (Baltazar database, 2020).

The total biomass index[48] and the biomass index of commercially important species show higher values in 2017 than in 2016, but the actual values are still lower than the previous periods. A slight increase in the biomass index of commercially important species is recorded in all fishing zones. The biomass index of *Merluccius merluccius* shows a growth compared to 2016 in more or less all fishing zones. Similar situation is present for *Mullus barbatus* and *Pagellus erythrinus*, which also show an increase in the biomass index. Shrimp biomass indices continue to show poor condition. *Eledone moschata* and *Eledone cirrhosa* populations generally show a decline in the biomass index, and the decline is more pronounced in *Eledone cirrhosa* (Updated documents, 2019).

In regard of trawling fisheries, during 2017, the General Commission for Fisheries of the Mediterranean (GFCM) declared a Fisheries Restricted Area (FRA) in the area of the Jabuka/Pomo Pit in the Adriatic Sea, during the session held on October 17 2017 (GFCM/41/2017/3)[49]. This decision was confirmed bilaterally and on a higher, international level the agreement between Croatia and Italy was signed to establish a FRA in the Jabuka/Pomo Pit for a period of 3 years (starting with 2017).

During 2019 and 2020, the Ministry responsible for fisheries has established a spatial and time limit for the conduct of commercial fishing at sea by bottom trawls (from September 16 to October 15, in a large part of the middle and southern Adriatic)[50]. In order to scientifically evaluate the status of biological resources for the purpose of their sustainable management, the Ministry has banned the collection of Bivalvia, Gastropoda, Spongia and Echinodermata from October 10, 2019 to October 15, 2020 in the waters of Pag Bay[51]. This ban was later prolonged to April 15, 2021[52]. In order to protect the overfished populations of sardines and anchovies, the Republic of Croatia has established highly restrictive fisheries control measures that include commercial fishing bans for pelagic fish twice a year – in the winter period during the spawning of sardines and in the spring period during the spawning of anchovies[53]. Furthermore, fishing with purse seine – srdelara (fishing nets for sardines) is prohibited in most of the inner sea (Baltazar database, 2020). The Ordinance on the regulation of fishing in protected areas (OG 125/2020) [54], stipulates regulation of fishing in parts of the sea which are protected in the category of national and nature park, in the special ichthyological reserves and in special reserves in the sea prescribes regulation of commercial and non-commercial fishing in specific habitats and areas and will revised the Regulation of fisheries in specific habitats and areas[55]. More detailed information on species that are listed in the Annex III SPA/BD Protocol and/or that are monitored as part of the assessment of the good condition of the marine environment follow (although the monitoring carried out from 2014 did not cover the biological component of the fish).

Species of interest for fishing

Tuna (Thunnus thynnus, Thunnus albacore) and swordfish (Xiphias gladius)

Thunnus thynnus and *Xiphias gladius* are found on Annex III of the SPA/BD Protocol. Given the biomass of small pelagic fish, the Adriatic Sea is one of the most important habitats for the growth of tunas, which according to the literature data, spawn in the Mediterranean. The tuna and tuna-like species populations (*Thunnus thynnus, Thunnus albacore, Xiphias gladius*) that reside in the Adriatic Sea are under the supervision of the International Commission for the Conservation of Atlantic Tunas (ICCAT) of which the EU is a member.

The ICAAT allocates the tuna quotes among its member and the EU subsequently allocates quotas to Member States. Over the last six years, the quota defined by ICCAT for tuna fishing for the Republic of Croatia ranged from 390.59 t/yr (in 2014.) to 862.79 t/yr (in 2019.) (Updated documents, 2019 and the Ministry responsible for fisheries policies). The total quantity of tuna caught (three of the above species) in 2018 was 679.00 tons (Croatian Bureau of Statistics, 2020).

Palinurus elephas

Lobster (*Palinurus elephas*) is listed on Annex III of the SPA/BD protocol. The total quantity caught in 2018 was 679.00 tons (Croatian Bureau of Statistics, 2020). Lobster fishing is banned from September 1 to May 15 [56].

46. Database of data and indicators of the state of the marine environment, mariculture, and fisheries http://baltazar.izor.hr/azopub/bindex (Baltazar Database, 2020)
47. Stock means specimens of the same species inhabiting a given geographical area and that do not mix (almost at all) with specimens from other areas.
48. Biomass represents a quantitative assessment of organisms in an area (e.g. the total mass of individuals of one species per unit of surface or habitat volume) and demonstrates the productivity of the area.
49. http://www.fao.org/gfcm/data/reporting/frajabukapomopit/en/
50. Ordinance on spatial and temporal cessation of commercial fishing at sea by bottom trawls for the year 2020 (OG 101/20)
51. Decision on the prohibition of the collection of Bivalvia, Gastropoda, Spongia and Echinodermata in the Pag Bay (OG 101/19)
52. Decision on the prohibition of the collection of Bivalvia, Gastropoda, Spongia and Echinodermata in the Pag Bay (OG 111/20)
53. During 2020, the Ministry of agriculture that is responsible for fisheries established rules on commercial fishing opportunities with purse seine – srdelara (fishing net for sardines). Those rules include limits to quantities of small pelagic fish caught with purse seine – srdelara nets of up to 40 tons per vessel during the period from February 16 to February 29 and of up to 100 tons per vessel during the period from February 29 to April 30. Purse seine – srdelara are completely prohibited from December 24, 2019 until January 31, 2020. Furthermore, at the end of 2019, the total catch of small pelagic fish with purse seine – srdelara was limited to 120 tons per vessel for the period from October 31 to December 24.
54. https://narodne-novine.nn.hr/clanci/sluzbeni/2020_11_125_2406.html
55. Regulation of fisheries in specific habitats and areas (OG 148/04, 152/04, 55/05, 96/06, 123/09 and 130/09)
56. Regulation on protection of fish and other marine organisms (OG 42/2016)

Scyllarides latus

The specie *Scyllarides latus* is listed in Annex III of SPA/BD protocol. There is no precise information on the species in terms of fished quantities. More information are given in section 2.1.2.1.

Merluccius merluccius

On the basis of the monitoring results, it can be concluded that the total biomass of adult *Merluccius merluccius* individuals was stable from 1998 to 2006 (3.561 tons) but subsequently decreased, reaching its lowest in 2013 (1.124 tons). After this period, a growth trend followed until 2017 (1.708 tons). Recruitment has been stable over the years, peaking in 2006 (488.000 individuals) and in 2015 (465.000 individuals). Fishing mortality trend increased in 2013 and then decreased in 2017. Indicators show the status of overexploitation of this stock. Between 2013 and 2018, biomass and abundance indexes for *Merluccius merluccius* in the northern and central Adriatic show oscillating values with a general positive trend and stable frequency. Biomass and density indexes in the Croatian territorial sea has a positive trend compared to the rest of the Adriatic Sea (Updated documents, 2019).

Mullus barbatus barbatus

Numbers of juvenile fish show a positive trend since 2011 onwards. Fishing mortality is declining despite a slight increase in catches in recent years. The results of the stock assessment show that the *Mullus barbatus barbatus* is in a state of overfishing with relatively high biomass and it is recommended to reduce fishing mortality and move toward a progressive reduction of fishing effort. Indices of biomass and abundance in the Adriatic Sea show a positive trend from 2015. The frequency of occurrence is stable, which is also true for catches of fishing fleets, and a slight negative trend is attributed to the introduction of spatial time regulations for trawlers, in particular on the Italian side (extension of the temporary time ban on fishing and the prohibition of trawling within 6 nautical miles of the Italian mainland) (Updated documents, 2019).

Nephrops norvegicus

The results of *Nephrops norvegicus* biomass estimate show a continuous decrease especially since the mid-1990s. The stock in the Adriatic Sea is overfished and it is recommended to reduce fishing efforts. Indices of biomass and abundance in the Adriatic Sea for the period from 2013 to 2018 show an oscillating trend with generally low values, as evidenced by the negative trend of total catches of the fishing fleet of both Italy and Croatia. A slight increase manifested in 2018 is due to the introduction of new trawling fishing regulation measures (temporary suspension of fishing as well as trawling ban in a part of Jabuka/Pomo Pit through proclamation of a FRA) (Updated documents, 2019).

Sardina pilchardus and Engraulis encrasicolus

The two species are distributed along the entire area of the Adriatic Sea, with the sardines being found to be somewhat denser along the eastern Adriatic coast (Sinovčić *et al*., 1991), while anchovies were more represented along its west coast. According to the scientific literature, it seems that there is a unique population of sardines and anchovies in the Adriatic Sea. These two small pelagic species of fish are among the most economically significant species along the entire Adriatic Sea.

The biomass of the sardine's population in the Adriatic Sea is 161,297 tones. The level of exploitation is slightly higher than the desired value. From 2013 to 2016 (when the last official biomass assessment was made), the biomass was within limits, without a significant trend or change, while the juvenile index in the same period showed a slight increase. In view of all the above, the population of sardines in the Adriatic Sea is under excessive exploitation. The biomass of the anchovies population in the Adriatic Sea (according to the last official estimate) was 57,469 t. The level of exploitation is slightly higher than the desired value. During the period from 2013 to 2016, the level of biomass as well as the level of juvenile index for the anchovies population in the Adriatic Sea showed a slight decline, which is why this population in the Adriatic Sea is considered overfished and under overexploitation. In the period from 2013 to 2018, the total length of sardines and anchovies varied within a very narrow range, with a slight decrease of the value of the total length of the body for sardines and a slight increase for anchovies. Looking at the average values over the last two decades, there has been no statistically significant decline as well as increase in the average length of the body of sardines or anchovies (Updated documents, 2019).

Mullus surmuletus

The reproductive capacity of the stock cannot be assessed, due to the lack of data for biomass evaluation. According to data collected during the Croatian national program for the collection of data in economic fishing for the period from 2013 to 2018, the maximum length was 33.5 cm. The age of individuals was assessed by oolite readings and ranged from 3 to 9 years of age. The proportion of individuals that were longer than the average length at sexual maturation (18 cm) calculated from the collected commercial fish data was greater than 83%, indicating a general stable trend. Considering the minimum fishing length of this species of 11 cm, non-grown individuals were almost not present. However, it should be noted that the minimum fishing length determined by law is not biologically justified for *M. surmuletus*, since this length is determined for both species of the Mullidae family (*M. surmuletus* and *M. barbatus*) inhabiting the Adriatic Sea (Updated Documents, 2019).

Spicara smaris

After analyzing the length frequencies of *S. smaris* for the last five years, no statistically significant differences were identified, which is an indicator of population stability. Of total quantities, females were represented with 79.85% and males with 15.64%. In the period from 2013 to 2018, the maximum measured length was 21.2 cm and the maximum age was 5 years, according to the Croatian national data collection program. The age

estimated by the otolith reading, ranged from 1 to 5 years. Individuals having 2+ and 3+ years of age were the most abundant during commercial fishing (72.51%). The proportion of individuals longer than the length at the first sexual maturity (10.3 cm), in commercial fishing is about 13.5%, indicating a general stable moment on the eastern Adriatic coast (Updated documents, 2019).

Bivalvia

Data on shellfish stocks along the entire Adriatic coast were collected within the PAHRE project "Assessment of demersal fish and shellfish stocks commercially exploited in Croatia" in 2008 and subsequently no research of this type was carried out. This research was carried out in locations where shellfish harvesting is carried out by divers exclusively by manual harvesting. According to the results of the mentioned project (Vrgoč *et al*., 2008; Peharda *et al*., 2010) there was no indication that shellfish stocks at these sites were overfished. However, it should be taken into account that this research was carried out during a period when the Republic of Croatia had no possibility of exporting Bivalvia to the EU market and that the need for Bivalvia was limited to the local market.

With the opening of the EU market, as well as the increase of tourism in the Republic of Croatia, the fishing of shellfish has intensified and new systematic research is needed to determine the status of the shellfish population hunted by divers. Data collected as part of the national data collection program indicate that there has been a decrease in the biomass index and abundance for the species *Pecten jacobaeus*. If we compare the available length structure data from 2013 and 2014 with the length structure of 2017, it is evident that there has been a decline in the proportion of individuals greater than 10 cm, which represents the minimum allowed length at harvesting. Compared to the 2013/2014 surveys, when the proportion of undersized individuals catches versus the number of grown individuals was 43%: 57%, during the 2017 survey a significantly higher proportion of undersized specimens – 78%: 22% was recorded (Updated documents, 2019).

2.2. Main Habitat types

It is important to note that the "conversion key" for the conversion of classes of habitats from national classification of habitats types into appropriate classes of habitats of the "Classification of benthic marine habitat types for the Mediterranean region and the Reference List of Marine and Coastal Habitat Types in the Mediterranean (2019)" has not been done yet. A revision of the national classification of habitat types and the development of the "conversion key" is planned within the national strategic project financed by the EU "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction". The data on the distribution of marine habitats are still scarce but, according to the marine habitat map prepared in 2004 and made by modelling, the predominant habitat types in the Croatian territorial sea are Circalittoral sand and Circalittoral mud (from the publication Tatjana Bakran-Petricioli: Manual for the determination of marine habitats in Croatia according to the EU Habitats Directive, State Institute for Nature Protection, Zagreb, 2011: "circalittoral bottoms make 88% of the total marine bottom surface of the Croatian territorial sea, but they are mostly sedimentary bottoms: muds and sand – there is little coralligenous, which again warns us on its sensitivity to the impact of human activities").

The following are habitats of special economic or biodiversity interest:

- Biocenosis of beaches with slowly-drying accumulation of marine vegetation
- Pebble beaches with halophytes
- Supralitoral rock
- Supralitoral sand
- Supralitoral mixed sediment
- Association with *Zostera noltii* (in transitional waters)
- Association with *Zostera marina* (in transitional waters)
- Association with *Cymodocea nodosa*
- Association with rhodolits
- Facies with maerl
- *Posidonia oceanica* meadows
- Biocenosis of infralittoral algae
- Association with *Cystoseira amentacea*
- Association with *Cystoseira compressa*
- Association with *Laminaria rodriguezii*
- Coralligenous biocenosis
- Facies with *Eunicella cavolinii*
- Facies with *Paramuricea clavata*
- Biocenosis of semi-dark caves
- Facies with *Corallium rubrum*
- Biocenosis of shelf-edge rock
- Biocenosis of vrulja (Specific karst phenomenon is the "vrulja" – the spring under he sea)
- Biocenosis of deep-sea corals
- Biocenosis of caves and ducts in total darkness

As above stated, the detailed distribution of marine habitats is not yet known. The implementation of the national strategic project financed by the EU "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction" will result in a new marine habitat map of coastal and benthic marine habitats stretching over 51% of marine and coastal waters. . The most valuable known sites of habitat types are included in Natura 2000, and these are:

- 1130 – Estuaries
- 1110 – Sandbanks which are slightly covered by sea water all the time
- 1170 – Reefs
- 8330 – Submerged or partially submerged sea caves
- 1150 – Coastal lagoons
- 1160 – Large shallow inlets and bays
- 1120 – Posidonia beds (Posidonion oceanicae)
- 1140 – Mudflats and sandflats not covered by seawater at low tide

Spatial data on the distribution of marine habitat types for which reports have been prepared in accordance with Article 17 of the HD for the period from 2013 to 2018 (grids 10x10 km) are annexed to this document. The distribution of habitat types can be seen here.

The assessment table of habitat types at the EU Member State level that includes information on the range (in km²), area (km²), structure and functions (km²), distribution as well as future prospect and the overall assessment can be seen here.

Certain marine habitats, especially Posidonia beds (1120*) and reefs (1170), are known to be locally threatened by fishing, nautical tourism (e.g., anchoring) or mariculture. For the Posidonia beds in the northern part of the eastern Adriatic, some analysis show a negative trend in the last 50 years. Complex estuary habitats also have unfavourable conservation status. For other habitats, the status was evaluated as unknown. If the result of the national strategic project financed by the EU "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction" show this need, new Natura 2000 sites will be designated for Posidonion oceanicae – 1120 and Reefs – 1170.

2.3. Singular habitats in the country

The following are habitats of special economic or biodiversity interest that are prioritized for mapping:

- Biocenosis of beaches with slowly-drying accumulation of marine vegetation
- Pebble beaches with halophytes
- Supralitoral rock
- Supralitoral sand
- Supralitoral mixed sediment
- Association with *Zostera noltii* (in transitional waters)
- Association with *Zostera marina* (in transitional waters)
- Association with *Cymodocea nodosa*
- Association with rhodolits
- Facies with maerl
- *Posidonia oceanica* meadows
- Biocenosis of infralittoral algae
- Association with *Cystoseira amentacea*
- Association with *Cystoseira compressa*
- Association with *Laminaria rodriguezii*
- Coralligenous biocenosis
- Facies with *Eunicella cavolinii*
- Facies with *Paramuricea clavata*
- Biocenosis of semi-dark caves
- Facies with *Corallium rubrum*
- Biocenosis of shelf-edge rock
- Biocenosis of vrulje (Specific karst phenomenon is the "vrulja" – the spring under the sea)
- Biocenosis of deep-sea corals
- Biocenosis of caves and ducts in total darkness

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

1 _ There is a need for capacity building of taxonomic expertise, particularly marine biologists, for habitats and species listed in the Annexes of BD and HD.

This reflects in:

- Lack of data on zooplankton (particularly Amoeba, Foraminifera, Rotatoria. meroplankton larvae)
- Lack of data on invertebrate bottom fauna (Bryozoa, Polychaeta, Porifera).

2 _ Lack of knowledge on alien species *Pseudodiaptomus marinus* especially regarding its presence in benthos and/or water column

3 _ Natura 2000 network is still incomplete: additional research on insufficiently known species and evaluation of data collected is needed to address the remaining scientific reserves that are mainly related to the mapping of marine habitat types (Posidonion oceanicae – 1120* and Reefs – 1170) and species (*Tursiops truncatus* and *Caretta caretta*) as well as to possible proposals of new SPAs for marine birds. Proclamation of new Natura 2000 sites could be proposed within the EFPZ over which the Republic of Croatia claims sovereign rights.

4 _ Map of marine habitats in marine areas under the jurisdiction of the Republic of Croatia (including the map on threatened and rare habitat types and on habitat types listed in Annex I of HD) still under development

5 _ System for monitoring the conservation status of species and habitat types still under development

Points 3., 4 and 5 reflect in the following gaps:

- Inadequate knowledge on the distribution and conservation status of habitats 1120 – Posidonion oceanicae and 1170 – Reefs
- Inadequate knowledge on the distribution and conservation status of Cnidaria that are listed in the Annexes of EU Nature Directives and/or SPA/BD Protocol Annexes such as *Corallium rubrum.*
- Inadequate knowledge on the most effective methods for *Pinna nobilis in situ* and *ex situ* conservation (there is a need for a transboundary cooperation between expert and scientific institutions in order to exchange knowledge, including monitoring data and implementation of conservation and protection measures for the species *Pinna nobilis)* Inadequate knowledge on the distribution and conservation status of marine Bivalvia that are listed in the Annexes of EU Nature Directives and/or SPA/BD Protocol Annexes such as *Lithophaga lithophaga* and *Pinna nobilis*.

- Inadequate knowledge on the distribution and conservation status of marine nonvascular plants that are listed in the Annexes of EU Nature Directives and/or SPA/BD Protocol Annexes, such as *Phymatholithon calcareum* and *Lithothamnium coralloides*

- Inadequate knowledge on the distribution and conservation status of crustaceans that are listed in the Annexes of EU Nature Directives and/or SPA/BD Protocol Annexes such as *Scyllarides latus*

- Inadequate knowledge on the distribution and conservation status of Echinodermata including for the ones that are listed in Annexes of EU Nature Directives and/or SPA/BD Protocol Annexes such as *Asterina pancerii* and *Centrostephanus longispinus*.

6 _ Inadequate knowledge on the distribution of *Phalacrocorax aristotelis desmarestii* in terms of pressures (including anthropogenic) and the status of the habitat for the species. This is important to start the preparation of protection and conservation project.

7 _ Inadequate knowledge on seabird migration pathways, their population that has as a consequence lack of data to develop and conduct necessary conservation activities targeting the most important threats during migration: incidental bycatch, poisoning and illegal killing.

8 _ Inadequate knowledge on seabirds nutrition, their habitats selection and food / prey availability.

9 _ Inadequate knowledge on the impact of marine litter on seabirds, mammals, sea turtles

10 _ Inadequate knowledge of utilization / extraction of marine organisms (coral, sponges, crustaceans), in particular of species in Annex V of the HD

11 _ Inadequate knowledge on the distribution and conservation status on some marine cetaceans and turtles that is needed to revise the management and action plan for marine mammals and to identify and implement specific activities from those plans.

12 _ Need to improve knowledge on the impact of fisheries (the impact of incidental bycatch) on endangered species including through continuous improvement of Croatian national data collection program conducted by Ministry of Agriculture.

13 _ Need to gather and exchange data on distribution, invasion pathways and eradication methods of IAS on regional level. This includes also developing a platform for transboundary IAS management system.

14 _ Need to improve data availability and conduct research on marine mammals and turtles, distribution and habitat use in the Adriatic Sea in order to asses anthropogenic impact and improve of management of existing / new protected marine areas.

15 _ Need to improve knowledge on which marine species and habitat types are sensitive to climate change and develop specific conservation measures

3.

Pressures and impacts

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3.1. Biological disturbance

3.1.1. Impact of fisheries

According to the Initial Assessment, fishing activities during 2012 were one of the most important anthropogenic pressures on marine organisms and are manifested through direct and indirect effects on individual marine organisms and their habitats, as well as on the marine ecosystem as a whole.

Human activities that lead to physical disturbances on the natural seabed are trawling bottom gears such as bottom brakes and shore seines and fish farms that permanently overshadow the seabed with their infrastructure (Updated documents, 2019).

The direct effect of fishing is achieved through harvesting of commercially important organisms with the aim of retaining them (as catches) for further sale or consumption (described in point 2.1.5 of this document). However, fishing has other, indirect effects on marine organisms. In fact, there is also a significant proportion of organisms that suffer as "collateral casualties" (or incidental bycatch) due to the indiscriminateness of fishing gears. These are organisms that get caught, but since they have no commercial value, they are returned to the sea dead or significantly damaged, reducing their chances of survival. Catches by fishing gear generally consist of catches of target species (commercially important species for which a particular gear is intended), and catches made up of species caught by accident. Bycatch is present for each gear and it includes catch of commercial species for which the gear is not designed. Since most fishing gears in the Republic of Croatia are dedicated for a specific purpose (i.e.,, it is prescribed which species can be fished for almost every fishing gear used in Croatia), the proportion of bycatch is sometimes defined by specific regulations (for example it is limited to 20% in case of purse seine – srdelara). In this way, the non-purposeful use of the gear is limited. In order to prevent extraction of undersized specimens, for the most part of economically important species, a minimum size under which specimens must not be fished is required and, for certain species, there is a spatial time ban on fishing with certain spawning gear. The second category of bycatch during fishing are economically irrelevant species that get caught and then returned to the sea alive, damaged or dead. As a rule, towed gears are extremely poorly selective, and therefore have a large share of specimen bycatch (Initial assessment, 2012). Among the most indiscriminate gears are the bottom trawling nets, rampons, shore seines[57] etc. At the level of the entire fishing sea of the Republic of Croatia, the most common species that were bycatch were sponges (12%), followed by bivalves of the genus *Chlamys* (10%) and *Pinna* (8%) and along the west coast of Istria. A significant part of the bycatch were also economically less important species, as well as economically important species, but small in size. Picarels[58] were represented in the catch with 7%, mackerels[59] with 4%, ray[60] with 4%, crab *Liocarcinus* with 3% (in

57. migavica, girarica
58. Like ***Spicara smaris***
59. Like ***Trachurus trachurus***
60. Like ***Myliobatis aquila***

the open Adriatic), and other species were present with a share of less than 1%. Any marine organism caught with a fishing gear does not have to end up as a catch. Thus, for example, a significant part of the organism escapes through the eye of the trawling net. Often these specimens are so damaged that they are unable to survive. Likewise, damage to fish occurs with the hooks when the fish is ripped off the hook. An additional problem is damaged or lost gears that remain permanently in the sea. Such gears continue to actively hunt for a longer period after they have been abandoned (so-called "ghost fishing"). In the Republic of Croatia there are no special researches on this problem, but according to the information obtained from divers a significant part of these gears are located in the coastal area. Big problems represent also shrimp traps that are lost in the area of the norther Adriatic channels (where they are most intensely used). In addition to the impact on marine organisms, some fishing gears also have negative impact on seabed habitats and marine sediment. This influence is most pronounced in the bottom trawl nets but also in shore seines, primarily for those that are dragged through the *Posidonia oceanica* beds (such as the net for picarels). Highly destructive are different types of dredges, especially the hydraulic dredger "vongolara". This fishing gears physically breaks down marine sediment up to 10 cm deep and destroys communities of the seabed. In Croatia, the legal regulation for "vongolara" is extremely restrictive, so in Croatia there are only two such gears that work only along the western coast of Istria. Some gears can have intensely negative effects if used in particularly sensitive areas, such as spawning grounds and growing habitats where a problem is not only fishing but also disturbance of organisms. The impact of fisheries on ecosystems in terms of physical damage it inflicts on habitat and the impact on biodiversity, primarily benthic organisms, have not been systematically researched in the Croatian territorial sea (Initial assessment, 2012).

Furthermore, in accordance with the Program of measures for the protection and management of the marine environment and the coastal zone of the Republic of Croatia (Program of Measures, 2017)[61], fisheries involving the use of nets have a markedly negative impact on sessile organisms such as gorgonians, but the effects of these impacts on coralligenous are still poorly explored in the Adriatic.

The Ecological Network Impact Assessment (ENIA) is one of the most important mechanisms for the protection of protected and Natura 2000 areas. To assess possible negative effects of demersal gears in Natura 2000 sites, ENIA has to be implemented for fisheries management plans (fishing gear management plans). However, although regulations in the area of nature protection are harmonized with the EU acquis, and the legal framework for sustainable use of natural resources is defined, additional efforts are needed to ensure effective implementation of these regulations and to raise awareness on the need for sustainable use of natural resources. It can be done thorough the continuation of efforts to strengthen the system for implementation of ENIA, this includes improvement of cooperation with all sectors adopting sectoral/ spatial plans, improvement of controls, further research of specific impacts of particular fishing gears etc.

61. https://mzoe.gov.hr/UserDocsImages/Uprava_vodnoga_gospodarstva_i_zast_mora/Strategija_upravljanja_morem/program_mjera_zastite_i_upravljanja_morskim_okolisem_i_obalnim_podrucjem.pdf

A way to limit the impact of fisheries on marine and coastal biodiversity, and particularly on vulnerable species, could be to strengthen integration of conservation objectives for species into regulations related to the Common Fisheries Policy (CFP), such as into control regulations and into technical measures.

With a view to achieve sustainable exploitation of marine resources, Croatia continues to implement a management regime of marine resources which includes the spatial and temporal regulations within the internal and territorial waters (long-term or periodic closures that refer to pelagic and/or demersal fishery with fine-tuned closures for optimal protection of early ages of target species; e.g., anchovies and sardines closure period is observed from December 15 to January 15). Incentives are introduced for the temporary cessation of fishing activities through OPMAF for the programming period 2014-2020. The basic regulation for the fishing activity in the Mediterranean Sea is Council Regulation (EC) No 1967/2006[62]. It has provisions about Management Plans and Fishing Protected Areas. It provides for the establishment of Fishing Protected Areas (FPAs), within territorial waters and beyond. It has provision for forbidding the fishing with trawl nets, dredges, purse seines, boat seines, shore seines or similar nets above sea grass beds of marine phanerogams or above coralligenous habitats and marl beds, with some derogation possibilities. Derogation from Council Regulation (EC) 1967/2006 as regards the minimum distance from coast, the minimum sea depth and the prohibition to fish above protected habitats for shore seines fishing in territorial waters of Croatia has been adopted through Commission Implementing Regulation (EU) 2018/1586[63] and the Derogation from Council Regulation (EC) 1967/2006 as regards the minimum distance from coast and the minimum sea depth for purse seines fishing in territorial waters of Croatia has been adopted through Commission Implementing Regulation (EU) 2018/1585[64] (both derogation apply from October 26, 2018 to October 26, 2021). Relevant Italian and Croatian institutions are part of the project "Argos"[65] that is financed within the Interreg V-A Italy-Croatia Program. Argos – Shared Governance of Sustainable fisheries and aquaculture activities as leverage to protect marine resources in the Adriatic Sea aim is to deploy a common management framework that will allow all actors of fisheries and aquaculture management to implement joint actions in management and protection of common biological resources.

WWF Adria is partner in the project FishMPABlue2 – Fishers and marine protected areas, a partnership for sustainability in the Mediterranean[66] that is financed by the Interreg Mediterranean Program. The project aim is to provide results and specific guidance for the management of artisanal fisheries in MPAs through testing the process of a governance toolkit, bringing capacity building for stakeholders (MPAs managers and local fishermen groups) and supporting policy recommendations in order to set up fishery management

62. Council Regulation (EC) No 1967/2006 of December 21, 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, amending Regulation (EEC) No 2847/93 and repealing Regulation (EC) No 1626/94
63. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX: 32018R1586&from=EN
64. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX: 32018R1585&from=HR
65. https://strukturnifondovi.hr/program-prekogranicne-suradnje-italija-hrvatska-2014-2020-ugovoreno-11-strateskih-projekata/ (project web page still not available, October 2020)
66. https://fishmpablue-2.interreg-med.eu/

models. WWF Adria, together with public institutions responsible for the management of the Nature park Lastovo Islands, of the Nature Park Telašcica and with the ministries responsible for fisheries and nature protection, has engaged in development and implementation of co-management model for governance of fisheries in the respected areas.Thanks to this engagement fishermen and relevant institutions reached a consensus on which fishery management measures to apply. The overall result is a fishery management plan which reduces the fishing effort and the main highlight is introduction of no take zones in Telašcica Nature Park, first ever no take zones in Croatia that were endorsed by fishing community. Co-management of fisheries, a decentralized fishing management framework where fishers and the administration share responsibilities over a fishery or fishing area, is very well highlighted in the strengthened focus on stakeholder participation in the EU Common Fishery Policy and Regional plan of action for small-scale fisheries in the Mediterranean and the Black sea[67]. Potentially, multi-stakeholder engagement, which includes cooperation of fishers in management and overall planning, can build or implement effective fisheries management, so to ensure sustainability in the exploitation of the marine environment.

Impact of incidental bycatch on sea vertebrates

Information on incidental bycatch of vulnerable species of whales, seals, cartilaginous fishes, seabirds and sea turtles have been provided in section 2.1.3. of this document. One of the biggest problems of modern fisheries is the incidental bycatch of long living marine vertebrates with low reproductive potential. It is considered as one of the main causes of death of these organisms (Initial assessment, 2012).

Data on incidental bycatch are collected within the Croatian national data collection program conducted by the Ministry responsible for fisheries but, the death rate of these organisms has not been estimated, as the establishment of a systemic collection of data in the fishery sector has not been completed yet. Furthermore, at national level, sporadic data on bycatch is collected through the National Stranding Network. Stranding of cetacean has been monitored continuously in Croatia since 2010 on the national level through Protocol for Alerting and Monitoring of dead, sick or injured strictly protected marine species (marine mammals, sea turtles and cartilaginous fish) – National Stranding Network. Stranding data is gathered in the database organized by IENP. These data include species, geographic location, condition of animal, weight, sex, age, cause of death.

Sea turtles

In line with Article 17 reporting the most impacting pressures and threats for the specie *Caretta caretta* include incidental bycatch and incidental killing (due to fishing activities). Incidental bycatches of sea turtles in the northern Adriatic are among the larger ones in the Mediterranean, especially for bottom trawl net and stag (standing) nets (Initial assessment, 2012).

Incidental capture in fishing gear has been recognized as the major threat with bycatch ranging between 2000–2500 turtle captures in the bottom trawls per year and at least 400 – 600 captures in set nets per year in Croatian Adriatic (LIFE Euroturtle). Within the scope of the NETCET project partners developed a report on the causes of mortality of sea turtles in Adriatic see. In the report, although the data do not have a statistical significance due to the low number of samples analysed, the impact of bycatch together with the bacterial presence in the water seems to be the greater threats for sea turtles in the Adriatic Sea. Incidental bycatch in trawl nets of *Caretta caretta* in the north Adriatic Sea in 2011 was estimated of up to 3500 individuals (Program of measures).

Of the 78 specimen of sea turtles recorded in 2017, the majority were dead individuals: 50 or 64, 10%. The cause of death was determined for only 10 individuals. Of these, six individuals suffered mechanical injuries (propeller blow or swallowing hook), one individual died from drowning in the fishing net and hypothermia, while one individual died from swallowing a nylon bag and spleen torsion. In 2017, there were 25 cases of injured sea turtles. The most common causes of injury were hypothermia and suffocation in the fishing net. Of the injured individuals, as many as 11 individuals died. Other recorded causes of death include malnutrition, mechanical injury, and plastic ingestion (Protocol Implementation Report, 2017).

According to the Initial assessment, 2012, the impact by type of fishing gear is as follows:

- Bottom trawl nets: incidental bycatch of *Caretta caretta* in bottom trawl nets in the Eastern Adriatic has been estimated up to 2500 specimen per year, with a higher unit catch in the north rather than in the central and southern Adriatic (10 catches per vessel per year vs. 3 – 4 catches per vessel per year) (Lazar & Tvrtković, 1995). Time-space analyses of incidental bycatches indicate a statistically significant frequency during the cold period of the year (November-April), indicating the existence of a sea turtle wintering station in the outer waters of the Adriatic, in areas south of 45° and with sea temperatures higher than 11-12 °C (Lazar *et al*., 2004)

- Stag (standing) nets: the incidental bycatch of *Caretta caretta* in the northern Adriatic was estimated at 658 bycatches per year, with an immediate mortality rate of 74.7% (Lazar *et al*., 2006). In addition to the *Caretta caretta* bycatch static nets in Croatia was recorded also for *Chelonia mydas* (Lazar *et al*., 2004; Lazar *et al*., 2008) and for *Dermochelys coriacea* (Lazar *et al*., 2008).

- Hooking gears: quantified data on the incidental bycatch of sea turtles do not exist, but several *Caretta caretta* were found with a hook in the mouth or within the digestive tract.

Activities aimed to reduce the impact of fishing by providing fishermen with the best practices to significantly reduce the mortality of turtles incidentally caught, by removing ghost gears from the sea floor; and by providing fishermen with fine-scale information about turtle hot-spots in key foraging/breeding marine areas have been done in the scope of the LIFE Euroturtles project.

67. Regional plan of action for small-scale fisheries in the Mediterranean and the Black sea

Marine mammals

The maximum number of dead specimens due to bycatch is of the species *Tursiops truncatus* as the only remaining native species of marine mammals in the Adriatic. Occasionally, specimens of other species of whales inhabiting the Mediterranean Sea are also found, but their mortality in the Adriatic is unlikely to have a greater impact on regional populations. The causes of fisheries-related dolphin mortality include being stuck in stag nets, choking due to swallowing parts of the net, and killing with dynamite while fishing pelagic fish. Although rare, dolphins are also found as a bycatch in trawl nets, most of these findings are specimen that died before they entered the net, but in some cases there are indications that this is an incidental bycatch due to the dolphin's entry into the net itself. The average number of dead dolphins *Tursiops truncatus* found during the year is between 15 and 20 animals. Of this number, around 30% of causes of death are fisheries-related activities, but the sustainability of such a mortality rate on *Tursiops truncatus* in the Adriatic Sea cannot be determined at this time. More detailed data on incidental bycatches of marine mammals per unit of fishing effort and random catch trends do not exist (Initial assessment, 2012)

In the period between 2008 and 2012, 15 dolphins were found, which are presumed to have perished in fishing activities. So far, the data collected mainly relate to coastal populations of *Tursiops truncatus*, and the results indicate an increase in the impact of fishing gear (Program of measures).

Of the 41 individuals who were found dead in 2017, in 82.93% of cases, that is for 34 individuals, it was not possible to determine the cause of death. Comparing the data with those from 2016, in 2017, the percentage of individuals whose causes of mortality could not be determined increased by about 20%. For only seven individuals, the causes of death are known. Two individuals died due to drowning in the fishing net, 4 died from unknown fishing gear while one individual died due to disease, i.e., from the consequences of parasite infestation (Protocol Implementation Report, 2017).

During the NETCET project bycatch appeared to be the likely cause of death in the 27% of animals examined, meaning it could be the main threat for cetaceans.

CONCLUSION ON THE IMPACT OF FISHERIES

One of the most serious threats to the preservation of the Adriatic ecosystem, which is endangered in many ways, is the uncontrolled fishing and destruction of habitats due to uncontrolled fishing, especially spawning and growing habitats of many marine organisms (Program of Measures, 2017). Also, many vulnerable species such as dolphins, seabird species and sea turtles often end up on nets and hooks as bycatch. The actual impact of incidental bycatches and impacts on species and populations has not been assessed yet.

Considering the above, it is extremely important to carry out the following activities:

- Assess the impact of fisheries and the incidental bycatch of endangered species (marine mammals, turtles, seabird) including through continuous improvement of Croatian national data collection program conducted by Ministry responsible for fisheries (this is a prerequisite to design urgent mitigation measures that could include time-space closures, alternative gears etc)
- Improve cooperation between Ministry responsible for nature protection with Ministry responsible for fisheries
- Strengthen integration of conservation objectives for species into regulation related to the CFP
- Improve cooperation between scientist and fishermen that should report incidental bycatch and actively work to increase awareness of fishermen on the importance of the protection and restoration of marine biodiversity as their understanding and acceptance is the key for the sustainability of protection and conservation measures
- Continue further work in identifying and protecting important areas for biodiversity including spawning areas particularly in EFPZ as geographically and spatially clearly defined areas with adequate conservation measures
- Strengthen the system for implementation of Ecological Network Impact Assessment, this includes improvement of cooperation with all sectors adopting sectoral / spatial plans, improvement of controls, conducting further research of specific impacts of particular fishing gears
- Continue cooperation on conducting analyses and assessment of possible negative impacts of bottom fisheries gear on marine Natura 2000, primarily through Ecological Network impact assessment for management plans of the fisheries sector (primarily management plans of fisheries gears)
- Monitor the recovery of living resources of the Adriatic in critical areas (Program of measures).

3.1.2. Impact of mariculture on the marine environment

Mariculture in Croatia includes the farming of white fish, pelagic fish and shellfish. Total annual production for 2018 is about 16,800 tons. The mariculture of white fish is dominated by *Dicentrarchus labrax* and *Sparus aurata*, in quantities of more than 5,000 tons per year. Pelagic fish mariculture is dominated by tuna culture with 3,227 tons per year. Production of Croatian mariculture has been in continuous growth since 2013. During 2018, compared to the previously observed period and 2017, maricultural production grew by 21% or 2,939 tons (Croatian Bureau of Statistics, 2020). The increase in fish and shellfish production also represents a possible increase in environmental pressure. Regular monitoring of the environmental impact of mariculture on one hand, and the correct application of zootechnical measures on the other hand can significantly reduce the negative consequences of this industry. The common pathway of introduction of alien organisms is through the relocation of breeding cages or various gears from one area to another area, since various processing organisms are also transferred together with them. To avoid negative consequences, a regulation on the transfer of breeding animals,

breeding gears and breeding cages from one area to another should be drawn up and adopted (Program of Measures).

The Institute of Oceanography and Fisheries in Split is currently implementing the project "Aquapop – Aquaculture impact on wild marine populations[68]" whose main objective is the ecological and genetic aquaculture impact assessment on wild marine populations at temporal and spatial level. The main problem that the project is addressing is that the expansion of marine farming sites raised the concern that aquaculture may pose a threat to biodiversity due to the potential adverse impacts on wild populations and ecosystems.

The main impacts resulting from mariculture activities, according to the Initial Assessment, 2019 include:

- Physical destruction of *Posidonia oceanica* beds due to anchored mariculture gear (cages)
- Changes in oxygen content and concentrations of nutrient salts in the area of maricultural activities and consequent changes in the biomass of phytoplankton communities
- Increased sedimentation of organic matter to the seabed, change in granulometric composition, redox potential and nutrient salt content in sediment, changes in the composition of benthic communities and in particular degradation of *Posidonia oceanica* beds
- The entry of alien organisms into new areas during the relocation of breeding cages

3.1.3. Introduction of microbe pathogens

Data on the introduction of microbial pathogens in the marine environment do not exist so here data are shown data from the National Report on the yearly and final bathing water quality assessment of the Croatian Adriatic (Report for the year 2019)[69]. The main source of microbiological pollution of the sea are waste waters of fecal origin which come from different sources (households, hotels, bathing areas, industrial plants, etc.). Due to its physical and chemical characteristics, waste water spreads across the sea surface at quite a long distance from the source of pollution depending on surface currents and wind. The indicators of fecal pollution are also indicators of the presence of pathogens in the sea since pollution is always present when pathogens are present and pollution concentration is generally proportional to the concentration of pathogens. Therefore, based on bathing water quality assessments, the eventual presence of pathogens can also be assessed. Data are collected within the bathing water quality monitoring program that is being implemented systematically and continuously since 1989. In 2019 bathing water was analysed in 1010 sampling points and the assessments show that the quality is excellent for 92.28% of sampling points, good for 5.34%, satisfactory for 1.58% and not satisfactory for 0.79% of sampling points. The general public and the local population can leave comments related to bathing water quality, beach conditions, report on perceived deficiencies/pollution or suggest new testing spots through a bilingual online application on the MESD website.[70] (Updated documents, 2019)

CONCLUSION

To improve the quality of the sea bathing water at the sampling points where the bathing water is annually classified as "poor", it is necessary to undertake following measures:

- to connect all entities to the public sewerage system,
- to ensure appropriate stormwater drainage without its mixing with fecal wastewater and its relocation outside the zones of impact on sea bathing water quality, especially beaches,
- The maintenance of impermeable septic tanks,
- The construction of a municipal wastewater drainage system in settlements without sewerage,
- An adequate treatment and disposition of treated wastewater,
- The maintenance of the public sewerage system

3.1.4. Non-indigenous, including invasive species

IAS are one of the main drivers of biodiversity loss in Croatia. Analysis of the state of nature in the Republic of Croatia in the period from 2008 until 2012 has shown that IAS results in biggest threats to amphibians, freshwater fish species, reptiles, marine fish species and dragonflies, while the number of alien species is rising (Convention on biological diversity, the 6th report of the Republic of Croatia – CBD, 6th report Croatia).

The European Commission, through the process defined by EU Regulation No 1143/2014[71], adopts a list of IAS of concern in the Union (the so-called Union list). There are currently 66 species of IAS on the Union List, of which 23 are recorded in Croatia. In order to increase knowledge on alien species and IAS, the MESD, implements the project "Establishing a national IAS monitoring system" in which it is planned to collect data and understand the actual situation of non-indigenous and IAS in Croatia, to establish an information system

68. http://jadran.izor.hr/~tsegvic/aquapop/
69. https://mzoe.gov.hr/UserDocsImages//Uprava_vodnoga_gospodarstva_i_zast_mora/More_za_kupanje//Nacionalno_IZVJESCE_kupanje_2019..pdf
70. http://www.izor.hr/kakvoca/ and http://www.izor.hr/bathing/
71. Regulation (EU) No 1143/2014 of the European Parliament and of the Council of October 22, 2014 on the prevention and management of the introduction and spread of invasive alien species.

on alien species and IAS, and to development monitoring programs, thus creating the basis for future management activities. Furthermore, with the purpose of developing the IAS management and control system, the Ministry is implementing the project "Developing the Management and Control System of Invasive Alien Species" through which planning acts for IAS (action plans[72] and management plans[73]) will be developed and the capacities of the staff of the authorities responsible for implementing the IAS Regulation strengthened through the design and systematic implementation of educational activities (https://invazivnevrste.haop.hr/ October, 2020).

As part of the project, it is planned to develop the management plan for the specie mongoose (*Herpestes javanicus*) which is present on the Adriatic islands and is identified as a threat to seabirds.

IAS represent one of the main threats to biodiversity and related ecosystem services. The risks such species pose may intensify due to increased global trade, transport, tourism, and climate change. According to the Updated Documents, 2019, possible pathways of introduction into Croatia are: ships and encrustations on the hull, ballast waters, sea currents, anthropogenic (direct) introduction.

Croatian institutions were partner in the implementation of the "Balmas – Ballast water management system for Adriatic Sea protection"[74] project which was funded by the EU CBC Program IPA Adriatic 2007-2013 .The objective of the project was to establish a common cross-border system linking all Adriatic research, experts and national responsible authorities to avoid the unwanted risks to the environment and humans from the transfer of Harmful Aquatic Organism and Patogenous (HAOP), through the control and management of ships' Ballast waters and sediments.

Obstacles to a systematic and effective resolution of the IAS issue include lack of systematic knowledge on the paths of introduction and on the impact of alien species, lack of a comprehensive list of alien species, and lack of systematic prioritization of alien species in the Republic of Croatia. Furthermore, insufficient financial, human and technical resources pose an obstacle to the establishment of a management system for alien species. In addition, it would be necessary to harmonize intersectoral activities through the national legislative framework, as that would create a foundation for effective inclusion of various stakeholders in resolving the IAS issue. Even though the IAS issue transcends state borders, current regional cooperation is insufficiently developed, and it is not coordinated, which poses an additional problem (CBD, 6th report Croatia).

72. In accordance with the Law on the prevention of the introduction and spread of alien species and IAS (OG 15/18, 14/19) (hereinafter: Law on IAS) an action plan on the control of pathways of unintentional introduction and spread of IAS is an act of planning involving timetables for action, measures to be implemented and codes of good practice regarding priority routes and the prevention of the inadvertent introduction and spread of IAS in or within the Republic of Croatia.

73. In accordance with the Law on IAS, the management plan of IAS is an act of planning involving management measures of those IAS that are widespread in the territory of the Republic of Croatia in order to minimize their effects on biodiversity, ecosystem services and/or human health, taking into account the potential adverse impact on the economy as a worsening factor

74. http://www.ismar.cnr.it/organization/geographic-units/ismar-lesina/projects-in-progress/balmas-project

Addressing this driver of biodiversity loss include:

- The establishment of a platform for gathering and data exchange on distribution, invasion pathways and eradication methods of IAS on a regional level
- Developing a platform for transboundary IAS management system
- Continue to map, define pathways of introduction routes, and establish monitoring management system for (marine) IAS and potential IAS
- Establishing functional intersectoral committee for IAS and for coordination (communication) of competent bodies.
- Define risk assessment standard for groups of IAS
- Improving knowledge and training of officials of competent bodies on IAS procedures and IAS identification.

3.2. Vulnerable marine ecosystems

Data on the distribution and conservation status of marine habitats (the starting point to understand the status of biotic and abiotic factors of related ecosystems) are still scarce and are being collected within the EU project "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction". The project results should enable the evaluation of the total area of marine and coastal waters from the nature protection point of view.

Unknown is the vulnerability status and the distribution of Posidonia beds and reefs. Posidonia beds (1120) and reefs (1170), are known to be locally threatened by fishing, nautical tourism (e.g., anchoring) or mariculture. For the Posidonia beds in the northern part of the eastern Adriatic, there have been negative trends in the last 50 years. Complex estuary habitats also have unfavorable conservation status. For other habitats, the status was evaluated as unknown. It is expected that new Natura 2000 sites will be designated for 1120* and 1170 after marine habitat mapping.

Posidonion oceanicae – 1120

The importance of Posidonion oceanicae (habitat type) is described in the section 2.1.2.5. of this document. *Posidonia oceanica* beds are habitats with very important ecosystem services and are included in Annex I of the HD. They are "oxygen factories" and "reservoirs" of biodiversity where many species feed, reproduce and find shelter. The inadequate knowledge on the distribution and conservation status of the habitat 1120 is one of the identified marine and coastal biodiversity knowledge gaps, which are needed for scientifically sound based conservation. The results of the project "Mapping of coastal

and benthic marine habitats in the Adriatic Sea under national jurisdiction" will show whether new Natura 2000 sites should be designated for Posidonion oceanicae – 1120.

As *Posidonia oceanica* is found where the pressure of human activities is high, it is threatened by nautical activities (anchoring of vessels), wastewater pollution, IAS (such as green algae of genus *Caulerpa*), marinas, ports, fish and shell cultivation facilities as well as some fishing gears like the bottom trawl nets (CBD, 5th report Croatia).

In Article 17 reporting for Posidonia beds (Posidonion oceanicae – *1120*) the range is favourable, the specific structure and functions, including of typical species are unknown (the exact area too). Prospects and the overall assessment of conservation status are unfavorable or inadequate. The trend in conservation status is unknown: although the trend is negative at the Mediterranean level, according to the scarce monitoring data in the eastern Adriatic, it cannot be concluded that the trend is negative for that whole area. Only for the northern part of the eastern Adriatic there are analyses with a negative trend in the last 50 years. The main threats are: marine water pollution, aquaculture, fish and shellfish harvesting, shipping lanes, ferry lanes and anchorage infrastructure. Medium threats are the presence of IAS, modification of coastlines, sports tourism and residential activities and drainage.

Reefs – 1170 HD

Reefs are habitats included in Annex I of the HD. The inadequate knowledge on the distribution and conservation status of the habitat Reefs – 1170 is one of the identified marine and coastal biodiversity knowledge gaps, which are needed for a scientifically sound conservation. The results of the project "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction" will show whether new Natura 2000 sites should be designated for Reefs – 1170.

In Article 17 reporting for Reefs – 1170 the range is favorable; the area is unknown. The specific structure and functions as well as future prospects and the overall assessment of conservation status is unfavorable-inadequate.

Main threats are marine fish and shellfish harvesting; Shipping lanes, ferry lanes and anchorage infrastructure; Mixed source marine water pollution; Modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas. Medium threat are industrial, commercial or residential and recreational activities and structures generating marine pollution; sports, tourism and leisure activities; IAS, natural processes of eutrophication and acidification. Part of this habitat is the specie *Corallium rubrum* for which, based on Article 17 reporting there are data, but only for a part of the population or habitats in shallow waters, where some research shows that the situation is stable. At the level of the entire population, many shallow-water localities have disappeared. Deep-sea communities are not sufficiently researched although experts believe they are likely to be stable due to more stable conditions, and less extraction pressure. Therefore, the trend is not certain.

Considering the above it is important to:

- Improve monitoring and knowledge on the distribution and conservation status of habitat Reefs – 1170
- Improve knowledge on the conservation status of *Corallium rubrum*
- Enhance monitoring with focus on coral utilization/extraction.
- Combat IAS (see activities proposed for limiting the impact of this driver of biodiversity)
- Combat marine pollution/litter (see activities proposed for limiting the impact of this driver of biodiversity)

Estuaries – 1130 (HD)

In Article 17 reporting for Estuaries – 1130 the range is favourable; the area and the specific structure and functions are unknown. Future prospects and the overall assessment of conservation status is unfavorable-inadequate. The main threats are: modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas; discharge of urban waste water generating pollution to surface or ground water; agricultural activities generating marine pollution. Medium threats are the modification of hydrological flow; deposition and treatment of waste/garbage from household/recreational facilities and mixed source marine water pollution as well as drainage.

Considering the above it is important to:

- Improve the cooperation between Ministry responsible for nature protection with Ministry responsible for fisheries and stakeholders (to reduce/eliminate impacts from marine pollution from agricultural activities)
- Combat IAS (see activities proposed for limiting the impact of this driver of biodiversity)
- Combat marine pollution / litter (see activities proposed for limiting the impact of this driver of biodiversity)
- Strengthen the system for implementation of Ecological Network Impact Assessment, this includes improvement of cooperation with all entities that are responsible for adopting sectoral or spatial planning documents, improvement of controls, preparation of thematic manuals, creation of databases

Habitats in submerged caves

Habitats that are characteristic for the Croatian part of the Adriatic Sea are those in submerged karst: marine lakes, karst estuaries, bare karst in the sea, anchihaline caves, submerged caves and pits, submerged river canyons. Because they are rare and occupy very small areas, as well as they are under great anthropogenic influence, these habitats are extremely threatened.

Marine caves and pits were formed in subareal conditions and became submerged upon rising of the sea level after the last glaciations. Due to ecological characteristics which are present in submerged caves and pits (lack of light and food, poor water exchange, lower and more stable temperatures) some of these habitats are very similar to those in deep sea. That is why deep-sea organisms can be found even in shallow areas in littoral zone, like the carnivorous sponge *Asbestopluma hypogea*.

Anchihaline caves extend from a few meters to a few kilometers from the coast toward the inland, forming a transition zone between freshwater underground and the sea. In the surface parts of anchihaline caves there is an inflow of freshwater, while marine water remains in the bottom.

Karst marine lakes are sea water bodies enclosed in limestone, which are in contact with surrounding coastal sea through fissures in karst rocks or very narrow and shallow channels. They are characterized by weak exchange of water with the surrounding sea, lower tidal amplitude, temperature extremes, almost permanent water column stratification, and temporal hypoxia or anoxia in the bottom layers. In the marine lakes, the number of species is small, but their population density is high. The most famous karst marine lakes in Croatia are Rogoznica Lake and Lake Mir on the island of Dugi otok. Vruljas are submerged pits or springs which are formed as a result of pressurized freshwater flow in the karstified coast. There are two types of vruljas. In the case of sieve-type vruljas freshwater is flowing from the sea bottom through numerous small openings. Pit-type Vruljas are much bigger and marine organisms that inhabit them have a great ability to adapt to changes of salinity and strong hidrodynamism (CBD, 5th report Croatia).

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

3.3.1. Climate change

The impact of climate change on species, habitats and ecosystems in Croatia has not yet been sufficiently investigated although climate change is a real threat to their long-term conservation, especially given the latest estimates on the likely increase of the average global temperature by 1.5° C. The impact will depend largely on the size and speed of the changes, geographical location, sensitivity, and selection of appropriate mitigation measures. While some shifts in the assessment of the current state and sensitivity of ecosystems to climate change have been made, the inclusion of analyses of the potential impacts of climate change in all segments of the conservation of natural resources should be encouraged in the coming period. (Report on the state of Nature from 2013 to 2017)[75].

According to the Report on assessed impacts and vulnerability to climate change per sector (Vulnerability Report)[76], the most important climate changes directly affecting natural ecosystems and biodiversity in the Republic of Croatia are:

- Changes in average air temperatures.
- reduction of quantities and changes in rainfall;
- occurrence of climate extremes (heatwaves, droughts, floods, strong winds);
- sea level rise.

Air temperature

By 2040, the highest increase in the average air temperature of between 1.1 and 1.2° C is expected in all seasons, and by 2070 the largest increase in the average air temperature is expected to reach 2.2° C. The maximum air temperature (Tmax) by 2040 is projected to rise between 1 and 1.5° C, and for the period 2041-2070, the trend continues in the range of 1.4 to 2.3° C. The minimum air temperature (Tmin): by 2040 in the winter months has a projected increase between 1.2° C in northern Croatia and up to 1.4° C in the coastal part. For the period 2041-2070, the largest increase in the minimum air temperature is expected in winter, in the continental part of 2.1 to 2.4° C, and in the coast from 1.8 to 2° C.

Rainfall

By 2040, in winter and for much of Croatia, rainfall is expected to rise to a minor degree in the spring, while rainfall is expected to decrease throughout the country in the summer and autumn. Between 2041 and 2070, rainfall in all seasons except winter expected to decrease.

Evaporation

By 2040, evaporation is expected to increase in spring and in summer up to 10 mm, but in much of northern Croatia changes in total summer evaporation is not expected. The increase in evaporation continues in the period 2041-2070, primarily in the spring, with rises exceeding 20 mm, while in the summer months there is no expected change in evaporation, except in the coast.

75. http://www.haop.hr/sites/default/files/uploads/dokumenti/04_zasticena/Izvjesce%20o%20stanju%20prirode%20RH%202013-2017_finalno.pdf
76. https://prilagodba-klimi.hr/wp-content/uploads/2019/05/Procijenja-ranjivosti-na-klimatske-promjene-po-pojedinim-sektorima.pdf

Humidity

By 2040, humidity is expected to increase throughout the year, mostly in summer on the Adriatic. In the period 2041-2070, humidity is expected to increase uniformly throughout Croatia, slightly higher in summer on the Adriatic.

Solar radiation

By 2040, solar radiation is expected to decrease in winter. The increase will be smaller on the southern islands, and largest in northern Croatia, the spring decrease of solar radiation is highest in the Adriatic and mountainous Croatia while the increase in solar radiation will be registered in summer and autumn. In the period 2041-2070, winter decrease in the amount of solar radiation is expected, mostly in northern Croatia. Spring, summer, and autumn increases will affect mostly mountainous and central Croatia, and especially central Dalmatia.

According to the Vulnerability report, we can expect a complex and lasting impact of climate change with the following changes: the sinking of coastal habitats, the increase of salinity of terrestrial and freshwater habitats along the seashore, rivers and deeper with the formation of estuaries; the exertion of moist terrestrial habitats; increase in the arid area; reduction and changes in the proportion and eventual disappearance of some habitats and species, hence the decline in biodiversity and the emergence and spread of some invasive species. Changes in ecosystems, directly point to the most comprehensive effects of climate change in the Mediterranean coastal zone.

Table 2

Expected basic consequences of the impact of climate change on the sea and islands

Increase in air temperature	Reducing rainfall and changing rainfall schedules	The emergence of climate extremes	Sea level rise
- Warming - Invasive species	Salinization	Destruction of coastal ecosystems	Sinking of coastal ecosystems

The identified and foreseen effects of climate change on shore include:

- Sea level rise
- Increase in sea surface temperature
- Increase in acidity of the sea
- Migration of marine species to the north
- Changes in fisheries
- Changes in phytoplankton communities
- Increase in the number of deaths in marine areas
- Increase of the risk of transmission of diseases across the sea

Table 3

Potential impact of climate change by 2040 with a view to 2070 and the degree of vulnerability

Potential impact	Possibility of occurrence[77]	Degree of impact[78]	Degree of vulnerability
Changes in climate characteristics: Increase in the average air temperature			
Reduction and splitting of distribution area of cryophilic and stenotherm species with the spread of invasive ones	4	4	Medium
Expansion of the distribution area of thermophilic species	5	5	High
Changing climate characteristics: Sea level rise			
Reduction and disappearance of halophilic species due to sinking of coastal habitats	5	3	Medium
Reduction and disappearance of freshwater species of the Adriatic basin due to the salinization of coastal habitats	5	4	High
Expansion of marine littoral species (both positive and negative)	3	2	Low
Changes in climate characteristics: Increasing sea temperature			
Spread of marine species to the north and the emergence of thermophilic (tropical) invasive marine species	4	5	High

It is particularly important to note that the effects of climate change affecting natural ecosystems and biodiversity have a consequential impact on all other sectors, and the impact on the fisheries sector resulting from a decline in fish catches due to changes in the sea ecosystem is particularly important. Furthermore, they have a negative impact on tourism, as they generate the loss of valuable natural ecosystems and biodiversity and the sinking of coastal ecosystems and the decline in the quality of the seas that are the basis of the tourist attractiveness of the Republic of Croatia and its summer marine tourism (Vulnerability Report).

As already stated in section 2.1.3, the significance of climate change to vulnerable habitats and species is the least known driver of biodiversity loss but is expected that this will be an important issue to tackle in the future. This is especially true for vulnerable marine vertebrates other than fish: marine mammals including cetaceans, sea turtles and seabirds.

77. 5 = more than 90%, 4 = more than 66%, 3 = more than 50%, 2 = more than 33%, 1 = less than 33%
78. 5 = very high, 4 = high, 3 = medium high, 2 = low, 1 = very low

The application of an ecosystem-based management approach could reduce the adverse impacts of different maritime sectors. This approach should be preceded by resource status assessments of ecosystem components, that is by mapping of marine and coastal ecosystem services. The economic value of ecosystem services should be assessed in marine pilot areas. More generally, considering that climate change is an important present and future driver of biodiversity loss, exploring synergies between climate action and actions to protect, sustainably manage and restore biodiversity could be strengthened.

The Commission staff working document "Climate change adaptation, coastal and marine issues"[79] that accompanies the "EU strategy on adaptation to climate change"[80] stresses that an adaptation effort to climate change is the integrated coastal management. The integrated coastal management aims for the coordinated application of the different policies affecting the coastal zone and related to activities such as nature protection, aquaculture, fisheries, agriculture, industry, off shore wind energy, shipping, tourism, development of infrastructure and mitigation and adaptation to climate change. It contributes to sustainable development of coastal zones by the application of an approach that respects the limits of natural resources and ecosystems, the so-called 'ecosystem based approach'. In March 2013, the European Commission adopted a proposal for a Directive establishing a framework for maritime spatial planning and integrated coastal management[81]. The proposal (it has not been adopted) aims to ensure that the growth of increasing maritime activities at sea and the use of resources at sea and on coasts remain sustainable. The proposed action should require Member States to establish maritime spatial plans and Integrated Coastal Zone Management (ICZM) strategies by applying an ecosystem-based approach that, among others, should contribute to ensuring climate resilient coastal and marine areas. The ICZM strategies should build on the principles and elements set out in the 2002 Recommendation on Integrated Coastal Zone Management[82] and the ICZM Protocol to the Barcelona Convention[83] (the Convention on the Protection of the Mediterranean Sea against Pollution), the first legally-binding international instrument specifically dedicated to integrated coastal management and ratified by the EU in 2010 and by the Republic of Croatia in 2012[84].

An example of good practice in Croatia is the "Integrated Coastal Zone Management Plan of Šibenik-Knin County – Coastal Plan"[85] that was developed within the project "Integration of the effects of climate variability and changes in national strategies for the implementation of the Protocol on Integrated Coastal Zone Management" that is part of activities of the Priority Actions Program/Regional Activity Centre (PAP/RAC)[86].

79. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX: 52013SC0133&from=EN
80. Communication from the Commission to the European parliament, the Council, the European economic and social committee and the Committee of the regions „An EU Strategy on adaptation to climate change", COM/2013/0216 final
81. https://ec.europa.eu/environment/iczm/index_en.htm
82. Council Recommendation of the European Parliament and the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe. Recommendation 2002/413/EC
83. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ: L: 2009: 034: 0019: 0028: EN: PDF
84. Law on the confirmation of the Protocol on Integrated Coastal Zone Managemeng of the Mediterranean (OG 8/2012)
85. http://sibensko-kninska-zupanija.hr/stranica/obalni-plan-ibensko-kninske-upanije/209
86. http://paprac.org/

Relevant for maritime spatial planning is the Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning[87]. The SAB responsible for the implementation of this Directive is the Ministry responsible for spatial planning, construction and state property. In accordance with the Directive maritime spatial plans shall be established as soon as possible, and at the latest by 31 March 2021. To protect and conserve marine and coastal biodiversity, all relevant sectors should be involved in the development of future national maritime spatial plans (continental shelf and EFPZ of the Republic of Croatia). This means that there is the need to ensure and effective stakeholder consultation process for the development of marine spatial plans. All interactions between the sectors, in terms of changes in the purpose and use of the maritime area, should be considered from an environmental point of view. Cumulative pressures must be assessed to support development of maritime spatial plans that respect the limits of ecosystems and support sustainable "blue growth".

Relevant Italian and Croatian institutions are part of the project " AdriaClim – Climate change information, monitoring and management tools for adaptation strategies in Adriatic coastal areas" that is financed within the Interreg V-A Italy-Croatia Program. The project aim is to support the development of scientifically sound local and regional actions plan for the adaptation to climate change. Furthermore Brijuni National park was one of the partners of the project "MPA – Adapt" and whose objectives were to encourage the application of standardized tools for research, monitoring and assessment of vulnerabilities and the definition of a climate change adaptation plan; to increase capacity to strengthen cooperation and coordination for climate change monitoring through approaches that favour stakeholder engagement and to develop policies and concrete measures to mitigate and adapt to climate change in the Mediterranean. Croatian institutions are also partner in the project "MPA – Engage" that aims primarily to support Mediterranean MPAs to adapt to and mitigate the ongoing climate change effects in the Mediterranean Sea. Through a participatory approach, MPA-Engage actions include monitoring the climate change impacts, elaboration of vulnerability assessments and development of climate change adaptation action plans in 7 MPAs located in 6 Mediterranean countries (Croatia, Albania, France, Greece, Italy, Malta, Spain).

87. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX: 32014L0089&from=EN

3.3.2. Marine pollution including litter

Waste at sea is one of the fastest growing threats to nature with major environmental and economic consequences, and a large proportion of waste quantities relate to plastic waste, which due to its longevity poses a major threat to marine life, the environment and human health. It is important to note that waste is produced by human activities on land or sea, i.e.,, due to deficiencies in the waste management system. Due to unconscious behaviour, waste reaches the marine environment and can thus be found:

- as floating on the surface of the sea,
- under the surface of the sea (in the water column),
- on the seabed
- flooded on the beaches.

It is estimated that about 80% of the waste in the sea comes from inland sources and activities from the mainland, such as municipal waste from improper landfills, flushing in sea of stormwaters, as a by-product of extensive and uncontrolled tourist activities, etc. About 20% of the waste ends in the sea as a result of irresponsible activities in maritime transport and fisheries. Trends of plastic production are constantly increasing, an additional problem of plastic waste, as the most prevalent in nature, is that it does break down over time into small pieces, so-called microplastics. It poses an exceptional and far-reaching threat to the environment and living things as it can potentially reach the food chain. It is thought that as much as 80% of the total waste in the Mediterranean is made up of microplastics resulting from the decomposition and shredding of plastic waste already present in the sea.

The problem of waste in the sea is becoming more visible and obvious in the Republic of Croatia. Although the problem of waste in the sea has been recognized as one of the main threats to marine ecosystems in the Mediterranean due to its ecological, economic, security, health and cultural impacts, the Croatian Adriatic is faced with a lack of adequate data from systematic research. Occasionally, actions of cleaning waste from the beaches and sea bottom were carried out, but without a harmonized methodology that could allow analysis of the quantities collected. Therefore, data collected in different initiatives are not comparable, so it is difficult to draw valid conclusions about the previous or present situation, and it is not possible to clearly follow trends. In addition to waste that reaches the sea in different ways and through different activities, a particular problem is the intake of cross-border waste that reaches through sea and wind currents from neighbouring Adriatic countries during extremely adverse meteorological and hydrological conditions.

Knowledge of the condition, quantities and properties, and the impacts of waste on the marine environment are currently insufficient and unsatisfactory. It is therefore necessary to develop indicators and methodological approaches to monitor the quantities and trends of waste and micro-waste/micro-plastics on the seabed, in the water column, on the coast, and in the stomach content of marine organisms, as well as the levels of impact on marine ecosystems and humans. In addition, the Republic of Croatia unfortunately does not currently have a systematic model of sea waste management, and we are also unable to determine the amount of waste that arrives in Croatia from neighbouring countries (Updated Documents, 2019).

Croatian institutions are partners in the project "DeFishGear – towards litter-free Adriatic and Ionian coasts and seas"[88], financed by the Interreg IPA-Adriatic Program. The objective of the project were: to address the knowledge gaps and research needs to facilitate effective decision making against marine litter and its impacts; to address the emerging threat of microplastics; to pilot prevention and mitigation measures to combat marine litter in the Adriatic-Ionian macroregion; to enhance sub-regional cooperation in order to ensure a coordinated, coherent and integrated approach to achieve the good environmental status of the marine environment and effectively design and implement measures to address marine litter; to implement coordinated and harmonized actions on the science-policy-society interface for litter- free Adriatic and Ionian Seas.

According to the Updated Documents, 2019, until the beginning of the DefishGear project, scientific research on the problem of waste in the sea on the Croatian side of the Adriatic was not systematically carried out, and therefore we do not have quality scientific data. It was only with the implementation of the DefishGear project that adequate zones were identified and testing of methodology begun. Methodology that could correspond to the specific requirements of data collection on the project, i.e., its parameters[89]. However, since mid-2017, the Republic of Croatia has implemented a systematic model of monitoring all elements of waste in the sea. The following parameters are followed:

- quantity and composition of waste on seashore,
- quantity and composition of waste on the sea surface and on the seabed,
- quantity, distribution and composition of microplastics on beaches and the surface of the sea,
- quantity and composition of swallowed marine litter.

Quantity and composition of waste on seashore

A total of 1,889 different pieces of waste were recorded, classified, and removed in 2018 during monitoring of the quantity and composition of waste charged on seashores. In all the areas researched, most of the recorded items were made of artificial polymer materials (plastics), which made up 98.02% of the total recorded items. The second most represented category included wood (1.58%), followed by categories of glass/ceramics (0.94%), metal (0.84%), tires (0.59%), textiles (0.39%), and paper (0.29%). Of the total cases recorded, only about 0.1% were classified as unidentified and/or chemicals (Updated documents, 2019)

Composition, quantity and spatial distribution of waste in the surface layer of the water column

To monitor floating waste on the surface of the sea, research was carried out at three locations. Plastics is the most represented category of floating waste with 88.88% at all single stations, followed by textiles with 6.66%, and paper with 4.44% of the total share at

88. http://www.defishgear.net/index.php
89. https://mio-ecsde.org/wp-content/uploads/2017/02/Final-MLA-pages_final.pdf

all stations. The most represented category is styrofoam fragments with 42.22%, followed by plastic foil with 22.22% and pieces of plastic with 11.11%. The average density of floating waste for the Hvar Channel location is 130,208 N/km², Mljet 483,870 N/km², and for Dugi otok 691,823 N/km² (Updated documents, 2019)

Composition, quantity and spatial distribution of waste on the seabed

Monitoring of waste deposited on the seabed was carried out in a total on 3 locations (northern, middle and southern Adriatic), collecting waste from trawling catches within the framework of the MEDITS project. During 2018, waste was present at all stations and in all trawler's net catches, but its values were few and low. The total weight of the waste collected was about 7 kg. Artificial polymer materials (plastics) is the total most represented category of waste with 96%, followed by metal with 4% of the total share on all stations. The most represented category were bottles with 30%, while other categories were evenly present with one item (bag, cellophane, bottles, industrial gloves, monofilament fishing gear, plastic building material). The amount of waste on the seabed for the northern Adriatic is 6.66 N/km², the middle Adriatic is 50 N/km², and for the southern Adriatic 42.55 N/km² (Updated documents, 2019).

Composition, quantity and spatial distribution of micro-waste along the coast (in sand sediment on beaches)

Samples of micro-waste/microplastics from sediment on sandy beaches were taken from four locations along the eastern coast of the Adriatic Sea. A total of 167 microplastic particles of 1-5 mm were recorded in sediment samples. In all locations, the most numerous are 50-56% sleek plastic fragments, and there are also films and filaments. On two beaches, the presence of different types of pellets used as raw materials in the production of plastics is curious, since there is no direct source of such waste near the mentioned beaches, so the causes could be sea currents and winds to which these beaches are directly exposed (Updated documents, 2019).

Composition, quantity and spatial distribution of micro-waste in the surface layer of the water column

From samples from the sea surface a total of 93 microplastic particles were recorded and their concentration was 13,021 N/km² in the Hvar Channel, 19,231 N/km² behind Dugi otok and 24359 N/km² behind the island of Mljet. On all transects, the most represented are sleek plastic fragments with an 80-92% share. The samples also include fragments and small pellets (Updated Documents, 2019).

The MESD is partner in the Interreg Mediterranean funded project "Plastic Busters MPAs"[90] aiming to maintain biodiversity and preserve natural ecosystems in pelagic and coastal MPAs by consolidating Mediterranean efforts against marine litter. The project entails actions addressing the whole management cycle of marine litter, from monitoring and assessment to prevention and mitigation; it also foresees actions to strengthen networking between and among coastal and pelagic MPAs in the Mediterranean.

The MESD is also partner in the Interreg V-A Italy-Croatia funded project "MARLESS – Cross-border awareness and innovation actions in solving the problem of marine litter". The project aim is to carry out joint activities in the fight against marine litter, including monitoring, prevention, disposal and mitigation while raising public awareness of the issue.

The MESD is financing the project for the development of the marine waste management plan. The project includes an in-depth analysis of regulations related to marine litter, collection and analysis of available data on marine litter, analysis of international experiences and discussions with stakeholders, proposals for a network for the collection and acceptance of marine litter, a proposal for a model for reducing and preventing the introduction of marine litter into the sea and a proposal for the reuse and disposal of marine litter.

Furthermore, as stated in previous chapters of this document, marine litter including plastic ingestion are of the most impacting threats that were identified for vulnerable species such as those of marine mammals, marine turtles and seabirds, and it is a threat that has not yet been researched enough in Croatia.

3.3.3. Noise

MSFD requires that Member States in EU marine waters take necessary measures by 2020 to achieve or maintain the good environmental status, which also include underwater noise among the descriptors (descriptor 11).

Through anthropogenic noise the natural environment (with natural sources of sound) changes, becomes unnatural, so that marine organisms can suffer harmful effects that may be softer (e.g.,, temporary loss or decrease in hearing, behavioural disorders) or severe (e.g.,, worst-case death). The intake of anthropogenic sound energy into the marine environment takes place in a wide spatial and time domain. Anthropogenic sounds (noise) can be of a short (pulse) or long (continuous) duration. Pulse noise can cause marine organisms to avoid feeding or mating areas, can cause psychological effects, and at very high noise levels even death. Continuous noise can degrade habitat, mask biologically important signals like echolocation clicks, causing difficulties in mating, finding food or detecting predators. The main sources of impulse underwater noise are the operation of ultrasonic devices (sonar, geological and seismic surveys) explosions and underwater works (the impaling of pylons, etc.) which are limited in duration and in a limited area, and that through certain legal regulations can be planned and monitored (e.g., by passing the Law on the Register of impulse noise occurrences). The register can be understood as a spatial – time display of all human activities that produce strong impulse noise. The register should provide information on the number of days within an area where the pulse level or noise pulse level exceeded a certain threshold. (Updated Documents, 2019).

90. https://plasticbustersmpas.interreg-med.eu/

The main source of anthropogenic continuous noise of low and medium frequencies is ship traffic consisting of regular ship traffic (freight traffic that goes longitudinal from the southern to northern Adriatic as well as local, passenger traffic that takes place on the usual waterways), fishing boats and various vessels that contribute to the high seasonal variability of anthropogenic underwater noise due to a large increase in their number during the tourist season, which is especially related to some attractive tourist areas. According to "Monitoring Guidance for Underwater Noise in European Seas" it is necessary to know the actual noise levels and trend. Therefore, it is necessary to carry out noise monitoring and preferably perform its numerical modelling. It is assumed that multi-annual noise monitoring will be required to make the trends be considered reliable. As so far in Croatia there were no possibilities or necessary data for modelling the spread of sound (noise) in the sea, but measurements of continuous noise during and outside the tourist season in 2017 and 2018 were performed at four stations (Split, Žirje, Kornati, west of Rovinj) during 7 to 15 days, which was not enough to determine the trend of continuous noise. The implementation of the Interreg V-A Italy-Croatia funded Project "SOUNDSCAPE – Impact of Anthropogenic undersea noise on biological sources in the Northern Adriatic[91]" will measure continuous underwater noise at 9 stations in the northern part of the Adriatic for 12 months during 2019/2020. It is expected that very valuable data on the spatial and temporal distribution of noise will be obtained. As the project also provides for a simulation of continuous noise with a numerical model, the resulting data will be used for model calibration and spatial time reconstruction of continuous noise in the northern part of the Adriatic during different seasons. As part of the soundscape project, an experimental investigation will be carried out on the impact of continuous noise on the biological world, so the hope is that this experiment will help determine the limit values of the impact of continuous noise on marine organisms, both on the most sensitive species (dolphins and turtles), and on important economic species. Knowledge of the impact of impulse and continuous noise on marine organisms, primarily on highly sensitive organisms (dolphins and turtles) and economically important fish species in the Croatian part of the Adriatic are insufficient at the current level (Updated documents, 2019).

As stated in section 2.1.3. underwater noise is one of the threats identified for marine vulnerable species such as species of marine mammals, marine turtles, and seabirds. It is a threat that has not yet been researched enough in Croatia. The MESD is preparing guidelines for mitigation of anthropogenic underwater noise on marine mammals and sea turtles.

The project "QUIETMED2 – Joint program for GES assessment on D11 – noise in the Mediterranean Marine Region"[92] aims to support Member States Competent Authorities in the Assessment of the extent to which GES on Descriptor 11-Underwater noise has been achieved in the Mediterranean Region by providing practical outcomes to implement the new GES Decision through:

- A joint proposal of a candidate for an impulsive noise indicator in the Mediterranean Region.
- A common methodology for Competent Authorities to establish threshold values, together with associated lists of elements and integration rules.
- A data and information tool to support the implementation of the monitoring programs of impact of impulsive noise based on the current ACCOBAMS joint register which will be demonstrated on.
- An operational pilot of the tool.
- Several activities to boost current regional cooperation efforts of the Barcelona Convention developing new Mediterranean Region cooperation measures.

Considering the above it is important to:

- Finalize national guidelines for mitigation of anthropogenic noise on marine mammals and sea turtles.
- Development of national maritime spatial plans through involvement of all relevant sectors and by considering their interaction on an environmental point of view (also connected with driver Climate change).
- Establish a register that would record and assess the spatial and temporal distribution of pulsed anthropogenic noise sources.
- Continue measurements of continuous underwater noise and establish spatial-temporal reconstruction of noise using a numerical model, and monitor noise level trends.

91. https://www.italy-croatia.eu/web/soundscape
92. https://quietmed2.eu/

4.

Current response measures

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4.1. Marine protected areas and other area-based conservation measures

4.1.1. Protected and Natura 2000 areas

Croatia has a long tradition of designation of protected areas, with the aim of their long-term protection within national and/or international Categories of protection, and sustainable use of natural resources. The basic legal instrument governing the conservation of Protected Areas in Croatia is the Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19) (NPA).

The ecological network of the Republic of Croatia, which is part of the EU Natura 2000 ecological network, was proclaimed in 2013. It includes 36.67% of land territory, 16.26% internal waters and territorial sea and 9.62 km² of areas outside the territorial sea and under national jurisdiction and consists of 735 SCIs, 38 SPAs, 5 Special area of Conservation (SAC) and 5 proposed Sites of Community Importance (pSCIs) and 38 SPAs. The national network of Protected Areas (PAs) consists of 412 protected areas in Croatia, classified in nine national categories and covering 8.63% of the total surface of Croatia (including the internal waters and territorial sea); specifically 12.33% of land territory and 1.96% of internal waters and territorial sea. There is a substantial overlapping of nationally designated PAs and Natura 2000 network: 87% of all areas protected in one of the national categories are also a part of Natura 2000 ecological network i.e., 26% of Natura 2000 is also covered by national categories of PAs. Taking into account both national categories and Natura 2000 sites, total protected surface in Croatia covers 38.26% of terrestrial and 8.54% marine territory under the national jurisdiction (internal waters, territorial sea and Protected Ecological Fishery Zone) (CBD, 6th report Croatia).

Enlarging protected areas

The New EU Biodiversity Strategy by 2030[93] has set a goal to legally protect of at least 30% of terrestrial and 30% of marine ecosystems in the EU[94]. Considering that Croatia has almost 37% of the continental part in the Natura 2000 network, which ranks it at the very top of the EU, further efforts should be made to achieve the same at the sea.

Scientific data suggest that 30% of protected areas is the minimum that has to be protected if we are to ensure the preservation of ecosystems in the long term.

Also considering regional specificities has to be respected involving different valuable habitats, and the benefits that protection brings, not just in terms of the surface of the protected area. In practice, this means that representative protected areas, irrespective of their surface, can be highly efficient and have an impact on a much wider area and therefore the surface should not be the sole criterion. Regarding the establishment of 10% of strictly protected areas, focus should be in those areas whose importance and role in

93. Communication from the Commission to the European parliament, the council, the European economic and social committee and the committee of the regions – EU Biodiversity Strategy for 2030 Bringing nature back into our lives. COM/2020/380 final

94. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/eu-biodiversity-strategy-2030_hr

preserving biodiversity is scientifically unquestionable. When defining the concept of strict protection, it is necessary to maintain high criteria and so the term could be defined as “no take/no management” of IUCN categories I and II or, as the least desirable but acceptable variant, “fully/highly protected areas”. By implementing the target for the establishment of 10% of strictly protected areas, it is important to stress that the restoration and protection of particularly valuable marine habitats that contribute to biodiversity conservation also supports sustainable fish stocks and can include important spawning grounds and nursery areas. It is therefore necessary to intensify work on the identification of such areas so that the protection can be properly targeted and have maximum impact. It is well known that long-term no-take zones for all or for a specific types of fisheries are the most effective mechanism for the recovery of all components of marine biodiversity including the commercially important fish stocks, and in this regard it is worth recalling the Area Jabuka/Pomo pit, whose protection is effectively implemented with the active support and commitment of the fishermen themselves. Research into the state of coastal fish communities in the area of national parks has shown that the abundance of species in protected areas is higher compared to areas where fish is economically exploited, the same is true for the abundance and biomass that are significantly higher as well as for the average length of the prevailing species and the proportion of large, adult individuals.

In the NPA, the development of management plans for Natura 2000 sites is an obligation. Management plans are defined as planning documents which contain conservation objectives and measures. Management plans are being implemented on annual basis through Annual programs for protection, maintenance, conservation, promotion and use of the protected area for each Public Institution of National and Nature Park since 2003. Management plans for two MPAs (National Park Mljet and Nature Park Lastovo archipelago) have been adopted in April 2017. Now all marine national and nature parks in Croatia have adopted management plans. Three management plans for the National Parks Brijuni and Mljet and Nature Park Lastovo archipelago, also represent management plans for the Natura 2000 areas, as they consider objectives and measures for conservation of target species and habitat types of ecological network area. In 2017, under the OPCC the strategic project "Development of Natura 2000 management framework“ was financed. The aim of the project is to further develop effective management framework for Natura 2000 network, including preparation of management plans for at least 90 Natura 2000 marine sites on the coastal area. These management plans include also protected areas, among which Telašćica Nature Park and Malostonski Bay Special Reserve (SPA/BD protocol reporting, 2017).

During the Biogeographical Seminar held in 2014, the European Commission determined the Scientific Reserve (SR) for certain species and habitat types that should be furtherly researched: *Caretta caretta* (for the marine Mediterranean biogeographical region), *Tursiops truncatus* (for marine area outside of territorial seas under the national jurisdiction, *Posidonion oceanicae* – 1120 for the region and Reefs – 1170 for the marine area outside of territorial seas under the national jurisdiction). This has been addressed within national strategic project “Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction”. Pending on the results new Natura 2000 sites will be potentially designated for *Posidonion oceanicae* – 1120 and Reefs – 1170.

The issue of imprecisely defined boundaries and only partial inclusion of protected area boundaries in cadastre and land registry is being tackled within the project “Recording the special regime legal as a contribution to more efficient management of protected areas” whose aim is the registration of a special legal regime in all strict reserves, national parks, and nature parks, which are also areas of the Natura 2000 network, the creation of preconditions for the registration of pre-emption rights within national parks and increasing availability of information on protected boundaries areas and legal regimes in order to strengthen public awareness of areas of particular importance to the Republic of Croatia. The project is funded by EU funds, within the OPCC.

Under the OPCC, other projects relevant to the management of protected and Natura 2000 areas were funded: Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction (basis for the designation of new Natura 2000 marine sites) and Development of a system for monitoring the conservation status of species and habitat types (framework for monitoring and reporting Articles under 12 and 17 of the HD. In accordance with the data obtained from those projects and on the basis of the criteria laid down in the Regulation on the ecological network and on the responsibilities of public institutions for the management of the ecological network (OG 80/2019)[95] an additional assessment of the sufficiency of Natura 2000 in the sea under national jurisdiction will be made, primarily with a focus on areas outside the territorial sea.

WWF Mediterranean and PAP/RAC are partners in the project “PHAROS4MPAS – blue economy and marine conservation: safeguarding Mediterranean MPAs to achieve good environmental status” that is financed by the Interreg Mediterranean program. Within this project WWF Adria has produced an overview study called “Is coexistence possible between MPAs and sectors that use marine resources in Croatia”[96]. In the study WWF analysed the impacts of growing blue economy activities on MPAs in the Mediterranean and provided a set of practical advice for regional stakeholders on how to prevent or reduce the environmental impacts of major sectors (tourism, fishing, shipping, cruise industry, etc). By encouraging international cooperation of administrative, economic and other actors within the network of MPAs, the study aims to increase the efficiency of MPA management and improve the protection of marine ecosystems within the Mediterranean.

The main conclusions include the following:

- avoiding new pressures on existing MPAs through prudent maritime spatial planning (MSP), for example avoiding offshore wind farms within MPA boundaries, establishing protection zones around MPAs to avoid pressure on their boundaries, etc.,
- protection of ecosystems on a larger scale, not only within MPAs,
- in areas where activities take place, their impact needs to be reduced in an acceptable way, taking into account the cumulative effects and the total carrying capacity of local ecosystems,

95. https://narodne-novine.nn.hr/clanci/sluzbeni/2019_08_80_1669.html

96. Translation from Croatian: “Je li moguć suživot između zaštićenih morskih područja i sektora koji koriste morske resurse u Hrvatskoj”

- transferring knowledge about sustainable MPA management measures to the rest of the unprotected sea: MPA managers can change our views on sustainability,
- identifying the state of the sector and sustainable practices to enable the setting of specific guidelines and standards for sustainable blue growth.

In line with all of the above it is important to:

- Continue development of Natura 2000 management framework
- Continue inclusion of protected area boundaries in cadastre and land registry
- Continue mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction
- Continue further work in identifying important areas for biodiversity including spawning areas particularly in EFPZ as geographically and spatially clearly defined areas with adequate conservation measures
- If the result of research show the need, consider designation of new marine Natura 2000 sites
- Ensure efficient management of marine protected and Natura 2000 sites
- Develop efficient and coherent system of protected areas, including of strictly protected areas.
- Identify and propose candidate MPAs to be listed in regionally and globally recognized protected areas networks: SPAMI List, FRAs, Biosphere Reserves and World Heritage sites, Ramsar sites, IMO PSSAs
- Promote co-management of MPAs including involvement and synergies between different stakeholders (protected areas authorities, decision makers, local communities, fishermen, scientists, civil society organizations)
- Promote collaborative approaches for managing MPAs based on an ecosystem approach and ICZM and integrate them in the marine spatial planning process, particularly the land and sea link and their interfaces (coastal, wetlands)
- Continue cooperation on conducting analyses and assessment of possible negative impacts of bottom fisheries gear on marine Natura 2000, primarily through Ecological Network impact assessment for management plans of the fisheries sector (primarily management plans of fisheries gear)
- Perform audit of protected areas

Protected and Natura 2000 areas are visible on the following web site: http://www.bioportal.hr/gis/

MAPAMED (MArine Protected Areas in the MEDiterranean) is a GIS database that gathers information on marine protected areas of the Mediterranean, where also spatial and attribute data for protected areas and Natura 2000 areas in Croatia could be find. http://www.mapamed.org/.

MAPAMED is developed and jointly administered by the Specially Protected Areas Regional Activity Centre (SPA/RAC) and the network of Marine Protected Areas managers in the Mediterranean (MedPAN).

4.1.2. Other area based conseration measures

Apart from Protected Areas there are various approaches to area-based conservation measures, one of them being other effective area-based conservation measures (OECMs). The definition of OECM which could also be applied for the marine environment is based on Convention on biological diversity 14th Conference of the Parties (COP 14) definition from 2018:

"A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio-economic, and other locally relevant values".

There is clear distinction between protected areas which should have a primary conservation objective and OECMs, which should deliver effective *in situ* conservation of biodiversity, regardless of their primary management objectives. OECM must ensure effective *in situ* biodiversity conservation, even if its main objectives are other.

In May 2019 the Food and Agriculture Organization of the United Nations (FAO), organized a workshop in collaboration with Fisheries Expert Group of the IUCN which aimed at drafting advice on the implementation of OECMs in the marine capture fishery sector.

So far, there is no recognition of OECMs in Croatia. In Croatia those could be related to fisheries and FRA areas. Although the fishery management require temporary fishery closures which are time bound, and in place for a specific time period, which limits their ability to meet the criteria for the identification of an OECM, (to be "in place for the long term").

Croatia reached an agreement with Italy to apply a bilateral joint management scheme to protect spawning and nursery grounds in the areas of Jabuka/Pomo Pit as FRA[97]. It was implemented in a form of a no-take zone which was bilaterally enforced by the Republic of Croatia and Italian Republic in extraterritorial waters in the Jabuka/Pomo Pit area over the surface of 2,500 km² over a three-year period and was enforced in Croatia in accordance to the Marine Fisheries Act (OG 62/17, 14/19)[98] in 2017 (by way of national Ordinance on particular management regime in the part of the Jabuka/Pomo Pit area published on September 8, 2017 in OG 90/17[99]). The protection of the area has also been transposed into European legislation through Regulation (EU) 2019/982[100].

However, management efficiency will be reviewed based on results from annual monitoring, with the possibility to prolong a declaration of this type of management regime.

97. http://www.fao.org/gfcm/data/reporting/frajabukapomopit/en/
98. https://narodnenovine.nn.hr/clanci/sluzbeni/2019_02_14_282.html
99. https://narodnenovine.nn.hr/clanci/sluzbeni/2017_09_90_2120.html
100. Regulation (EU) 2019/982 of the European Parliament and of the Council on 5 June 2019 amending regulation (EU) No 1343/2011 on certain provisions for fishing in the General Fisheries Commission for the Mediterranean Agreement area.

The Convention on Biological Diversity has adopted scientific criteria in annex I of decision IX/20 for the identification of Ecologically and Biologically Significant Areas (EBSA)[101]. In the Adriatic Sea, based on available data, analysis was done through regional workshop in 2014., where tree areas were recognized to meet the EBSA criteria:

- Northern Adriatic,
- Jabuka/Pomo Pit
- South Adriatic Ionian Strait.

Convention on migratory species, has adopted the tool "Important Marine Mammal Area" (IMMA) which can be used when considering the management of human activities in relation to aquatic mammal species. It's based on expert classification and in Northern Adriatic IMMA area has been qualified for Common bottlenose dolphin[102].

Marine Fishing Act and The Ordinance on the regulation of fishing in protected areas (OG 125/2020) in a special way are also recognized mouths of the rivers as an extremely important habitats for the young fish, and on most of them within a special habitat category it is forbidden to perform fishing, while on few is allowed to perform fishing in very limited proportions using exclusively selective passive gear (CBD, 6th report Croatia).

The Republic of Croatia has joined the International Initiative for the Protection of 30% of the world's Oceans by 2030, which advocates the protection of marine areas through the mechanism of protected areas, including other effective conservation measures (OECM). Croatia believes that significant progress could be made in identifying the OECM, in particular its implementation in marine areas.

Considering the above it is important to:

- Prolong declaration FRA management regime of Jabuka/Pomo Pit
- Achieve significant progress in the identification of OECMs, in particular its implementation in marine areas.

101. https://www.cbd.int/decision/cop/?id=11663

102. https://www.marinemammalhabitat.org/imma-eatlas/

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

4.2.1. Institutional actors in relation to marine and coastal biodiversity

Nature protection affairs

Nature protection affairs in the Republic of Croatia and direct implementation of the Nature Protection Act are under the competence of:

- Ministry of Economy and Sustainable Development (formerly Ministry of Environment and Energy),
- Institute for Environment and Nature Protection (formerly the State Institute for Nature Protection, i.e., Croatian Agency for the Environment and Nature) (expert service)
- administrative bodies of regional self-government units competent for nature protection,
- public institutions competent for the management of national parks and nature parks, established by the Republic of Croatia, and
- public institutions for the management of other protected areas and/or parts of nature, established by regional and local self-government bodies.

In the Ministry, the nature protection affairs are under the competence of the Nature Protection Directorate. In accordance with the Decree on the Internal Organization of the Ministry of the Economy and Sustainable Development (OG 97/2020)[103], the Directorate for Nature Protection performs administrative and professional tasks related to biodiversity conservation, ecological network impact assessment, conservation of protected areas and areas of ecological network; ensures the fulfilment of obligations under international treaties, laws and other regulations; ensures and monitors the implementation of protection and conservation measures in accordance with regulations on nature protection, transboundary movement and trade in wild species, genetically modified organisms and transboundary transfer of genetically modified organisms, access to and use of genetic diversity and treatment of alien, including invasive alien species; participates in the administrative supervision over the work of public institutions for the management of protected areas and / or other parts of nature, i.e., the ecological network; performs tasks related to the development, standardization and monitoring of the management of protected areas and areas of the ecological network, strengthening the capacity of public institutions that manage protected areas and areas of the ecological network, harmonizes and supervises the financing of nature protection activities; performs activities of international cooperation, implementation of international agreements and European affairs related to biodiversity conservation and nature protection; coordinates the development of strategic and planning documents in nature protection; encourages informing the public about nature protection and conservation; participates in determining the strategic plan that contains a general overview of the tasks and tasks of the Ministry in a given year and in accordance with the scope performs tasks related to defining strategic

103. https://narodnenovine.nn.hr/clanci/sluzbeni/full/2020_08_97_1816.html

goals, performance indicators, risk assessment, monitoring implementation and reporting on the implementation of goals and furthermore, and performs other tasks within its scope of work.

Nature protection expert tasks in the Republic of Croatia are performed by the Institute for Environmental and Nature Protection. The IENP performs professional and analytical work in the field of nature and environmental protection, which includes the development and management of environmental and nature information systems in the Republic of Croatia, development and maintenance of appropriate databases, collecting and monitoring of data and assuring conditions to access to the information at its disposal, development of a national list of indicators, monitoring of the state of nature and environmental components, as well as data analysis and preparation of environmental and nature reports; collection and analysis of data for documents and reports related to environmental protection and sustainable development, preparation of expert bases, opinions and documents on environmental protection and sustainable development, and reports provided in connection with the implementation of these documents; the Institute performs monitoring and reporting on the impact of the environment on health in cooperation with the Croatian Institute of Public Health; performs professional and analytical tasks of assessing the endangerment of biodiversity components, including the preparation of red lists of endangered wild species; develops and standardizes methodologies and protocols for monitoring the state of conservation of biodiversity and geodiversity and develops and tests measures for their conservation; evaluates the natural values of the area, prepares the expert basis for the protection and preservation of protected parts of nature and the area of the ecological network; determines conservation objectives and measures and prepares proposals for management documents for wild species; participates in the preparation of management documents for the areas; prepares expert bases for the needs of preparation of spatial plans of special features of national parks and nature parks; performs professional and analytical work related to impact assessment, control of spread and removal of alien species; assessing the impact of reintroduction and repopulation of wild species into the wild through the ecological network impact assessment procedure and in relation to transboundary movement and trade in wild species; develops the capacities of the nature protection sector through systematic education of employees; organizes and conducts education of stakeholders in the environment and nature, as well as educational and popularization activities of public awareness and sensitization for the topics of preservation of the environment and nature and sustainability of the use of natural resources; implements, i.e., participates in the implementation of international treaties and agreements in the field of environmental protection and nature protection to which the Republic of Croatia is a party, especially in the part related to reporting on undertaken obligations; plans, implements and participates in the implementation of projects and programs in the field of environmental and nature protection, performs the functions of beneficiaries and / or partners within projects co-financed from the OPCC and performs other tasks within its scope of work.

One part of administrative and nature protection expert tasks is also performed by administrative bodies of regional self-government competent for nature protection.

Protected areas are managed by public institutions. Public institutions implement activities pertaining to the protection, maintenance and promotion of protected area with the aim of protecting and conserving the original state of nature, ensuring undisturbed flow of natural processes and sustainable use of natural resources; they also supervise the implementation of nature protection requirements and measures in the areas that they are managing, and they participate in the collection of data with the aim of monitoring the status of nature conservation.

Regarding the implementation of the documents of Marine environment and coastal zone management strategy, the article 10 of the Regulation on the preparation and implementation of documents under the Marine environment and coastal zone management strategy (OG 112/14, 39/17, 112/18) through which the MSFD was transposed into national law, defines two bodies responsible for the implementation of the Regulation:

- Coordination Commission (Ministers of the competent ministries listed in Annex VII)
- Expert National Committee for the Execution of Tasks Regulated by the Regulation and Development and Implementation of the Strategy (National Committee) (representatives of the competent authorities listed in Annex VII of the Regulation).

Through these two bodies, the ministry responsible for environmental protection coordinates the cooperation with other competent bodies defined in Annex VII. In order to achieve the coordination with other countries in the region (Mediterranean Sea) and sub-region (Adriatic Sea) regarding the Strategy elaboration and implementation, the Regulation also includes the obligation of regional and sub-regional cooperation (Article 9). As an existing coordination mechanisms the Regulation stipulates the Barcelona Convention on the regional level and the Agreement on cooperation for the protection of waters of the Adriatic Sea and coastal areas from pollution on the level of the sub-region. Furthermore, the Ministry coordinates the national participation of the Republic of Croatia and participates in the implementation of the MSFD through implementation of MSFD Common Implementation Strategy (MSFD – CIS) and through work of Marine Directors, Marine Strategy Coordination Group (MSCG) and working and technical groups related to specific MSFD topics. The Ministry also both, participates and supports participation of the Croatian institutions in the EU projects in line the implementation of MSFD on the level of the Adriatic sub-region.” .

Croatian Marine Referral Centre

The consortium made of the Institute of Oceanography and Fisheries in Split as lead partner Croatian Marine Referral Centre (RCmore) and the institute Ruđer Bošković Institute as partner constitute the Croatian Marine Referral Centre (RC-more) performs systematic monitoring, observation and assessment of the state of the marine environment, fisheries and mariculture, collects and analyses of related data including indicators from the National List of Indicators for the MESD. RC-more performs activities in six areas of work. The first area of work encompasses monitoring of the various marine environmental parameters needed to describe the status of the eleven descriptors (D1-D11) within the framework of the implementation of the EU MSFD.

Fisheries affairs

The Fisheries Directorate harmonizes the fisheries policy of the Republic of Croatia with the EU Common Fisheries Policy and enables its implementation and coordination, which includes monitoring activities and indicators in the fisheries sector, fisheries management, planning and development measures, structural policy measures and market policy measures financed from the EU budget and state budget and inspection and control measures; manages EU fisheries funds, monitors their implementation and develops a strategic, programmatic and technical framework for implementation; actively participates in the development of the Common Strategic Framework for the use of EU funds; performs the functions of the Managing Authority of the Operational Program for Fisheries and the Operational Program for Maritime Affairs and Fisheries; proposes measures to improve fisheries, conserve natural resources, ecological balance and biodiversity; issues appropriate permits for non-commercial and permits for commercial fishing activities; performs operational activities related to the collection of fees for fishing in accordance with regulations; organizes and conducts examinations to verify professional competence in the field of fisheries; prepares draft proposals and expert bases for defining and implementing structural and market measures in fisheries.

Regarding scientific research activities in marine areas, and in order to issue the approval for scientific research activities, the Ministry has to obtain permissions from the Ministry of Maritime Affairs, Transport and Infrastructure and seeks the approvement of the Ministry of Defence, Ministry of the Interior, Ministry of Culture and Media, Ministry of Science and Education in accordance with the Maritime Law.

The Ministry of Maritime Affairs, Transport and Infrastructure is also to be considered mainly regarding its work on maritime traffic and protection of the Adriatic. It oversees implementing The Maritime Domain and Seaports Act (OG 158/03, 100/04, 141/06, 38/09, 123/11, 56/16, 98/19).

The Ministry of Construction and Physical Planning is the central state administrative body responsible for the implementation of The Physical Planning Act (OG 153/13, 65/17, 114/18, 39/19, 98/19). System of physical planning, the Protected coastal area, location and building permits and related supervision all fall under competence of this Ministry.

Furthermore there is the Ministry of Regional Development and EU funds whose task is the sustainable development of the Adriatic Sea, islands and coast; proposing development policy and establish an integrated system of planning, programming, management and funding of coastal area development, planning, development and implementation of strategic documents and projects for transport, utilities and social infrastructure on the islands and coast, starting, coordination and supervision of activities of certain laws and regulations that govern the development of the island and coast.

The Environmental Protection and Energy Efficiency Fund (EPEFF) was established in 2004 by the Act on the Environmental Protection and Energy Efficiency Fund (OG 107/03, 144/12) with the aim to strengthen environmental financing of conservation, sustainable use, protection and improvement of the environment and also for financing of energy efficiency and renewable energy sources. EPEEF is an extra-budgetary fund. The revenues of EPEEF are generated from pollution charges, waste charges, and special environmental charges for motor vehicles. Which are being used to finance programs and projects determined in accordance with the country's strategic and policy documents related to the environment and energy.

4.2.2. Legal text of relevance to marine and coastal biodiversity

- Act on the Organization and Scope of State Administration Bodies (OG 85/20)
- Ordinance on the internal organization of the Ministry of the Economy and Sustainable Development (OG 97/2020)
- Ordinance on the internal organization of the Ministry of Agriculture (OG 35/19)
- Regulation on the preparation and implementation of documents under the marine environment and coastal zone management Strategy (OG 112/14, 39/17, 112/18)
- Decision on the appointment of the Expert National Committee for the performance of the tasks governed by the Regulation on the drafting and implementation of the documents of the Marine environment and coastal zone management strategy and the design and implementation of the Strategy (OG 31/17, 42/18).
- Decision on the Determination of the Reference Center for the Sea (OG 91/18)
- Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19)
- Act on the prevention and management of the introduction and spread of alien and invasive alien species (OG 15/18, 14/19)
- Ordinance on strictly protected species (OG 144/13, 73/16)
- Regulation on Ecological Network the Competence of Public Institutions for Management of the Areas of Ecological Network (OG 80/19).
- Ordinance on the conservation objectives and main measures for bird conservation in the area of the ecological network (OG 25/20, 38/20)
- Ordinance on the conditions for holding, methods of marking – keeping records on protected animals in captivity (OG 70/09 of 19/06/09)
- Act on Transboundary Movement and Trade in Wild Species (OG 94/13, 14/19)
- Ordinance on the list of habitat types, habitat maps, and threatened and rare habitat types (OG 88/14)

- Environment protection act (OG 80/13, 153/13, 78/15, 12/18, 118/18)
- Regulation on the quality of the sea for bathing (OG 73/08)
- Regulation on information and participation of the public and public concerned in environmental matters (OG 64/08)
- Regulation on the Strategic Environmental Impact Assessment of the strategy, plan and program (OG 64/08)
- Law on climate change and protection of the ozone layer (Official Gazette, No. 127/19).
- Marine Fishery Act (OG 62/17,130/17,14/19) (Ministry of Agriculture)
- Regulation on amending the Regulation on the form, content and manner of keeping and submitting of data on catch in commercial fishing at sea (OG 85/15, 35/20)
- Regulation on spatial and temporal cessation on the performance of commercial fishing at sea by bottom trawl – 2020 (OG 101/20)
- Decision to ban the collection of Bivalvia, Gastropoda, Spongia and Echinodermata in the Pag Bay (OG 111/20)
- Ordinance on fishing opportunities in commercial fishing using purse seine net srdelara (OG 8/19, 101/19, 115/19, 16/20, 28/20 and 84/20)
- Ordinance on fishing ban of Holothuroidea (OG 29/18)
- Regulation on fishing opportunities and allocation of the state quota in 2020 for bluefin tuna fishing (*Thunnus thynnus*) (OG 7/20)
- Regulation on amending Regulations on Fishing Opportunities of Swordfish (*Xiphias gladius*) (OG 37/20),
- Regulation on the protection of fish and other marine organisms (OG 42/16)
- Act on Maritime Domain and Seaports (OG 158/03, 100/04, 141/06, 38/09, 123/11, 56/16, 98/19)
- Physical Planning Act (OG 153/13, 65/17, 114/18, 39/19, 98/19)
- Maritime Code (OG 181/04,76/07,146/08, 61/11, 56/13, 26/15, 17/19)

4.2.3. Strategies, other regulations or plans, such as a national plan for species

- Nature Protection Strategy and Action Plan (2017-2025) (OG 72/2017)
- Climate Change Adaptation Strategy (OG 46/20)
- Decision on the adoption of the Program of measures for the protection and management of the marine environment and of the coastal zone of the Republic of Croatia (OG 97/17)
- Decision on the adoption of the Action program of the Marine Environment and coastal zone management strategy: Monitoring and observation system for the continuous assessment of the state of the Adriatic Sea (OG 153/14)
- Operational Program "Competitiveness and Cohesion 2014-2020"
- Operational Program for Maritime Affairs and Fisheries of the Republic of Croatia 2014-2020

Important international strategies/frameworks

- EU Biodiversity Strategy for 2030[104]
- Post-2020 Global Biodiversity Framework[105]

4.2.4. Relevant International Agreement on Which the Country Is a Party

- Decision on the publication of multilateral international agreements to which the Republic of Croatia is a party on the basis of notifications of succession (OG-IT 12/93.)which includes, among other international regulations (Art 1. points 46.-50.)
  - Convention for the Protection of the Mediterranean Sea Against Pollution, 1976
  - Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft, 1976
  - Protocol Concerning Cooperation in Combating Pollution of the Mediterranean Sea by Oil and other Harmful Substances in Case of Emergency, 1976
  - Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources 1980
  - Protocol Concerning Mediterranean Specially Protected Areas, 1982

104. In 2015, the European economic and social committee and the committee of the regions EU biodiversity strategy for 2030 bringing nature back into our lives (COM/2020/380 final)
105. Zero draft of the Post-2020 global biodiversity framework available: https://www.cbd.int/conferences/post2020/wg2020-02/documents

- Law on ratification of amendments of the Convention for the Protection of the Mediterranean Sea Against Pollution and the Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft (OG-IT 17/98)

- Law on ratification amendments of the Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources OG-IT 12/93, 3/06)

- Law on the ratification of the Protocol Concerning Cooperation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea (OG-IT 12/03)

- Law on the ratification of the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (OG-IT 11/01)

- Law on the ratification of the Protocol on Integrated Coastal Zone Management in the Mediterranean (OG-IT 8/12)

- Convention on the Protection of World Cultural and Natural Heritage (OG-IT 12/93). Adopted: PARIS, 1972. The Republic of Croatia is Party to the Convention based on the succession notice of October 8, 1991. Entered into force in relation to the Republic of Croatia: October 8, 1991

- Law on The Affirmation of the Convention on Biological Diversity (OG-IT 6/96). Adopted: RIO DE JANEIRO, 1992 Entered into force: 29 December 1993 Entered into force in relation to the Republic of Croatia: October 7, 1996

- Law on the ratification of the Protocol on Biological Safety (Carthage Protocol) in addition to the Convention on Biological Diversity (OG-IT 7/02). Adopted: MONTREAL, 2000. Entered into force: September 11, 2003 The Republic of Croatia signed the Protocol in New York in 2000. Entered into force in relation to the Republic of Croatia: September 11, 2003 (OG-IT 13/03).

- Law on the ratification of the Nagoya Protocol on access to genetic resources and fair and equitable profit sharing arising from their use under the Convention on Biological Diversity (OG – IC 5/15). Adopted: NAGOYA, 2010. Entered into force: October 12, 2014. Entered into force in respect of the Republic of Croatia: December 1, 2015 (OG-IT 6/15)

- Law on the ratification of the Convention on International Trade in Endangered Species of Wild Animals and Plants (CITES), (OG-IT 12/99). Adopted: WASHINGTON, 1973. Entered into force: July 1, 1975 Entered into force in relation to the Republic of Croatia: June 12, 2000 (OG-IT 5/00).

- Law on the ratification of the Convention on the Protection of European Wild Species and Natural Habitats (Bern Convention), (OG-IT 6/00). Adopted: BERN, 1979 Entered into application? June 1, 1982. Entered into application? in relation to the Republic of Croatia: November 1, 2000 (OG-IT 11/00).

- Law on the ratification of the Convention on the Protection of Migratory Species of Wild Animals (Bonn Convention), (OG-IT 6/00). Adopted: BONN, 1979 Entered into force: December 1, 1983 Entered into force in relation to the Republic of Croatia: October 1, 2000.

- Law on the ratification of the Agreement on The Protection of Whales (Cetacea) in the Black Sea, Mediterranean Sea and The Adjacent Atlantic Region (ACCOBAMS), (NN-IC 6/00). Adopted: MONACO, 1996 Entered into force: June 1, 2001 Entered into force in relation to the Republic of Croatia: June 1, 2001 (NN-IC 10/01).

- Law on ratification of the International Convention for the Regulation of Whaling (OG-IT 6/06). Adopted: WASHINGTON, 1946. Entered into force with respect to the Republic of Croatia on January 10, 2007 (NN-IC 2/07).

- Law on the ratification of the Protocol on Specially Protected Areas and Biodiversity in the Mediterranean (OG-IT 11/01). Adopted: BARCELONA, 1995 Entered into force: December 12, 1999. Entered into force with respect to the Republic of Croatia: May 12, 2002 (NN-IC 11/04)

- The Law on The Affirmation of the Paris Agreement (OG-IT 3/17)

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

The alarming situation connected to mass death of *Pinna nobilis* requires joint, regional approaches and actions, in particular a transboundary exchange of knowledge between scientific and expert institutions, particularly on monitoring results and implementation of protection and conservation measures.

Certain seabirds, as well as marine mammals and sea turtles are a shared endangered natural heritage which cannot be managed by a single state in isolation. As more knowledge on occurrence, demography, behavior and threats is available, the conservation of protected species can only be achieved through international cooperation. Due to the migratory nature of these species and the joint responsibility of Adriatic states, collaboration at transboundary level is essential to planning effective long-term conservation strategies.

In line with this, for the sea bird species it would be important to conduct cross-border research, especially on their migration pathways, monitor the population and implement joint conservation activities, especially those that are targeting the most important threats during migration: incidental bycatch, poisoning and illegal killing. Another threat that does not know borders and that should be researched in terms of its impact on seabird populations is marine litter (intentional and unintentional consumption), the presence of environmental toxins in food and poisoning (including during migration). Furthermore, research on feeding and resting areas for seabirds and their condition throughout the year is needed too.

More research has to be conducted on marine mammals, especially cetaceans, in order to gain knowledge on their distribution and habitat use in the Adriatic Sea. Anthropogenic pressures, such as noise derived from transport, can have a negative impact at the level of population living in the Adriatic Sea – so their pressures at the cross-border level need to be assessed and cross-border, joint management actions developed in accordance with this assessment. Transboundary cooperation is needed also to research the impact on cetaceans of the following derivers of biodiversity loss: marine pollution, including litter (especially plastic and microplastic) and climate change. Furthermore, revision of cross-border draft management and action plans for marine species (cetaceans) and implementation of specific activities from those plans is needed.

More research has to be conducted also on marine turtles, in order to improve data availability on their distribution and habitat use in the Adriatic Sea. Improving the cooperation between scientist and fishermen that should report incidental bycatch as well as work to increase awareness of fishermen on the importance of the protection and restoration of marine biodiversity is an action that can benefit from a cross-border approach and best practices sharing. Transboundary cooperation for knowledge exchange regarding impact of marine litter and for analyzing impact of marine litter on marine turtles is also needed, as marine litter is a transboundary threat. Furthermore, revision of cross-border draft management and action plans for marine species (marine turtles) and implementation of specific activities from those plans is needed. Furthermore, the impact of climate change is not well known in Croatia – transboundary cooperation could have a positive impact in terms of knowledge and data exchange.

Croatian demersal (trawl) fishing takes place in the entire territorial sea of the Republic of Croatia, and in part in the EFPZ. However, most of the fishing originates from the inland fishing sea and the territorial sea, as most of the livestock exploited in the Adriatic belongs to the group of “divisible stocks”, biologically unique populations, which are economically exploited by fleets of different countries. In such conditions, the precondition for the establishment of long-term sustainable management is the establishment of a dialogue between all participants in fishing with the aim of agreeing, establishing and harmonizing measures for fisheries regulation and protection of resources (Initial assessment). In 2017, Croatia reached an agreement with Italy to apply bilaterally a joint management scheme to protect spawning and nursery grounds in the areas of Jabuka/Pomo Pit as FRA. With a view to achieve sustainable exploitation of marine resources it is extremely important to prolong declaration of this type of management regime to the Jabuka/Pomo Pit area after the end of the first three years (after 2020). Furthermore, as above already stated, it is important to asses and exchange knowledge on the impact of fisheries and the accidental bycatch of endangered species. To actively work, on a transboundary level, to increase awareness of fishermen on the importance of the protection and restoration of marine biodiversity as their understanding and acceptance is the key for the sustainability of protection and conservation measures.

Even though the IAS issue transcends state borders, current regional cooperation is insufficiently developed, and it is not coordinated, which poses an additional problem for IAS management. Considering that it is important to establish a transboundary platform for gathering and data exchange on distribution, invasion pathways and eradication methods of IAS on regional level, to develop a platform for transboundary IAS management system and to continue to map, define pathways of introduction routes and establish monitoring management system for (marine) IAS at the cross-border level.

Regarding marine noise, upgrade of existing transboundary cooperation assessing impact of underwater noise on the marine ecosystem is extremely important for the conservation of marine mammals and turtles, but also for other marine organisms.

Marine litter knows no boundaries and represents a pervasive and persistent problem that expands beyond borders away from the source of origin. Transboundary, coordinated and multi-sectoral action is key to combating marine litter. It is important to continue to conduct transboundary research on the sources and locations of marine litter as well as winds and marine currents that transport it and continue to monitor the state of marine litter in the Adriatic Sea. Furthermore, establishing transboundary cooperation for knowledge exchange regarding impact of marine litter on marine biodiversity can have a positive impact as knowledge can help in the design of more efficient conservation actions.

Climate change is the driver of biodiversity loss whose impacts on ecosystem still must be fully understood and researched. Transboundary cooperation can significantly improve research on sensitivity, threat status and resilience of coastal and marine ecosystems on climate change and help identifying management priorities. Transboundary approach is a positive factor for the improvement of knowledge and creation of databases to assess the vulnerability of natural ecosystems, habitats, wild species, protected areas and ecological network areas in order to improve predictive models. As some habitat types, ecosystems as well as population of protected species are transboundary, it is important to have this kind of approach also for the monitoring of the most vulnerable ones.

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 to national marine and coastal areas

The phytoplankton community in the Adriatic is characterized by high biodiversity. Abundancies of phytoplankton species and their composition are common to the Adriatic region. Two non-indigenous species of phytoplankton were recorded in the Adriatic, but they did not adversely affect other phytoplankton species (groups) and/or ecosystem in general. The Zooplankton of the Adriatic Sea is characterized by high biodiversity and the presence of various types of zooplankton communities. In the period from 2013 to 2018, the total abundance of mesozooplankton in the researched areas of the Croatian part of the Adriatic follows the expected gradient coast-open sea, and the recorded values do not deviate significantly from the multiannual ranges recorded in the same areas under previous projects and multi-year monitoring. The composition of species within groups is common for each type of pelagic habitat and reflects the natural composition of communities. Data for some groups of zooplankton (Ameboida, Foraminifera, Rotatoria, meroplankton larvae) are still scarce, mainly due to a lack of taxonomy specialists.

Monitoring programs of conservation status of species and habitats that are listed in the Annexes of EU Nature Directives and Annexes of SPA/BD Protocol are being developed within the EU strategic project “Development of a system for monitoring the conservation status of species and habitat types”. Furthermore, data are being collected within other EU strategic projects “Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction”. Both projects will end in 2023. This is one of the reasons why the knowledge on the status of some species of Crustacea (such as *Scyllarides latus*), Bivalvia (such as *Pinna nobilis*), Echinodermata (such as *Asterina pancerii, Centrostephanus longispinus*), Cnidaria (such as *Corallium rubrum*), vascular plants (such as *Posidonia oceanica*) and non-vascular plants (such as *Phymatholithon calcareum* and *Lithothamnium coralloides*) as well as on some marine habitat types (such as *Posidonion oceanicae – 1120*, Reefs – 1170) are limited.

During the autumn of 2016, deaths of *Pinna nobilis* were recorded on the coast of Spain. The first confirmation of a disease outbreak in the Croatian part of the Adriatic Sea was confirmed in May 2019. The disease spread to Istria, which confirms the fact that the disease has affected the entire Croatian part of the Adriatic. The cause of the death of *Pinna nobilis* is not completely known. Possible causes could be *Haplosporidium pinnae*, a parasite from the group of Sporozoa and the bacterium *Mycobacterium sp*. However, it has not yet been confirmed that these are the causes of a 100% mortality rate in certain locations. The situation is alarming, and it requires joint, regional approaches and actions, in particular a transboundary exchange of knowledge between scientific and expert institutions, on monitoring results and implementation of protection and conservation measures.

Vulnerability status and distribution of *Posidonia oceanica* (specie and habitat type) is not knownd. *Posidonia oceanica* is found where the pressure of human activities is high, it is threatened by nautical activities (anchoring of vessels), wastewater pollution, IAS (such as the green algae of the genus *Caulerpa*), marinas, ports, fish and shell cultivation facilities as well as some fishing gears like the bottom trawl nets. Specific approach for monitoring *P. oceanica* beds in the scope of the MSFD in Croatia will be aligned with the monitoring

methodology which is being developed under two national strategic projects financed by the EU and aligned with HD.

In Article 17 reporting for Estuaries – 1130 the range is favourable; the area and the specific structure and functions are unknown. Future prospects and the overall assessment of conservation status is unfavourable-inadequate.

Data on the distribution of corals in the Adriatic Sea exist only for some protected areas (National Parks and Nature Parks) and for some very limited areas. Data on characteristic species and their abundancy in different aspects of a coralligenous are also limited to small areas, mainly on corals that develop at depths up to 50 m (or maximum depths up to 70 m). For deeper coralligenous habitats there is almost no data. Main threats are marine fish and shellfish harvesting; shipping lanes, ferry lanes and anchorage infrastructure; mixed source marine water pollution; modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas. Medium threat are industrial, commercial or residential and recreational activities and structures generating marine pollution; sports, tourism and leisure activities; IAS, natural processes of eutrophication and acidification.

Seabirds that can well demonstrate the state of the marine environment because they nest in Croatia in the coastal area, feed exclusively at sea and have a relatively wide distribution area in the Adriatic Sea are: *Calonectris diomedea*, *Puffinus yelkouan*, *Larus audouinii* and *Phalacrocorax aristotelis desmarestii*. These species are listed in Annex I of the BD and are qualifying species of several SPA areas in Croatia and therefore there is an obligation to monitor population numbers, distributions and threats. Protocols for monitoring the above species will be developed and tested within the national strategic EU project "Developing a system for monitoring the conservation status of species and habitat types". Completion of the project, as well as developed monitoring programs and protocols, are planned for 2023. As a result, we do not have much data for these species, such as available scientific knowledge to assess whether the extent and condition of the species' habitats can support different stages of the life cycle. Activities that are beyond the scope of the BD and that are linked to the monitoring of marine production and the state of fisheries are those connected to scientific research on the diet and selection of habitats for seabirds and the availability of prey. The data are needed to identify and potentially designate new marine SPAs that will be completely at sea. Furthermore, seabird species that are protected should be managed through the adoption and/or revision of an existing draft management plan with action plans.

The Ministry responsible for fisheries is collecting data on incidental bycatch of vulnerable species of whales, seals, cartilaginous fishes, seabirds and sea turtles within the Croatian national data collection program. The establishment of systemic data collection has not been completed yet, so the death rate of these vulnerable species has not been estimated yet.

All marine mammal species naturally occurring in the Adriatic Sea are strictly protected under the Ordinance of strictly protected species (OG, 144/2013, 73/2016) and are listed in Annex II to SPA/BD protocol.

To this date, 10 species of whales (Cetacea) have been recorded in the Adriatic. Of the recorded species, *Tursiops truncatus* and *Stenella coeruleoalba* are permanently inhabited in the Adriatic, while the Cuvier's beaked whale (*Ziphius cavirostris*) and *Grampus griseus* are probably constantly present but in small numbers. In the Article 17 reporting the specie *Tursiops truncatus* is not considered as sensitive and the overall assessment of conservation status is favourable. For *Stenella coeruleoalba* the range, population size, the sufficiency of area and quality of occupied habitat (habitat for the species), future prospects and the overall assessment of conservation status are unknown. Aerial monitoring of cetaceans is conducted during the summer season. However, data on the abundance and on the distribution of species during the winter period, still do not exist. In the future, it is necessary to conduct aerial research during the winter months to determine the patterns of distribution, abundance, and possible migration of individual species. To assess the anthropogenic impact on the status of populations of whale species in the Adriatic and to determine appropriate management measures, additional research is needed.

Regarding the depredation of fish by dolphins, the Ministry responsible for fisheries adopted an Ordinance regulating compensation to fishermen in the form of non-repayable grants for damages that are caused by dolphins on certain commercial fish species caught using single and triple static nets and trawls. The management plan with action plan for the conservation of cetacean species was drafted within the scope of NETCET project. The project implementation period ended in September 2015, so the draft national management plan with action plan should be revised (updated) and specific activities from the plan implemented.

Three species of sea turtles were recorded in the Adriatic: *Caretta caretta*, *Chelonia mydas* and *Dermochelys coriacea*. *Caretta caretta* is the only species of sea turtle that constantly uses the Adriatic Sea. Although it does not reproduce in the Adriatic, the Adriatic is one of the two most important areas of nutrition and wintering of this species throughout the Mediterranean Sea. The shallow water of the northern Adriatic, with depths of up to 100 m, rich in bottom communities, is one of the two largest and most important neritic feeding habitats for *Caretta caretta* in the Mediterranean. To assess the anthropogenic impact on the status of populations of turtles in the Adriatic and to determine appropriate management measures, additional research is needed. The national management plan with action plan for the conservation of turtles was drafted within the scope of NETCET project. The project implementation period ended in September 2015, so the draft national management plan with an action plan should be revised (updated) and specific activities from the plan implemented.

In 2017, the national list of non-indigenous species was updated with the data available on the EASIN portal. The list consists of 80 non-indigenous marine species recorded in the waters of the Croatian part of the Adriatic until 2012. Through the implementation of MSFD monitoring it was confirmed that tuna farms and the port of Split area "hot-spot" places of occurrence and development of non-indigenous species. The most intense negative influence is given by the red algae *Womersleyella setacea*, which is spread almost everywhere between the depths of 10 to 30 m, on the rocky bottoms and in the *Posidonia oceanica* beds. Among the most invasive algae is *Caulerpa cylindracea*, which is spread almost everywhere from the surface to the depths of almost 50 m and seems to have a particularly significant influence in the coralligenous community. The algae

Caulerpa taxifolia was known as an extremely invasive species around the year 2000, but it experienced an inexplicable retreat throughout the Mediterranean. At the end of 2017 it was recorded only around 30 m², while at the end of 2018 it was no longer present. According to the Updated Documents, 2019, possible pathways of introduction into Croatia are: ships and encrustations on the hull, ballast waters, sea currents, anthropogenic (direct) introduction. There are currently 66 species of IAS on the Union List, of which 23 are recorded in Croatia. In order to increase knowledge on alien species and IAS, the MESD, implements the project "Establishing a national IAS monitoring system" in which it is planned to collect data and understand the actual situation of foreign and IAS in Croatia. Furthermore, with the purpose of developing the IAS management and control system, the Ministry is implementing the project "Developing the Management and Control System of Invasive Alien Species" through which planning acts for IAS (action plans and management plans) will be developed and the capacities of the staff of the authorities responsible for implementing the IAS Regulation strengthened. As part of the project, it is planned to develop the management plan for mongoose (*Herpestes javanicus*) which is present on the Adriatic islands and is identified as a threat to seabirds.

The following commercial fish species can be found on Annex II SPA/BD Protocol: *Thunnus thynnus* and *Xiphias gladius*. Given the biomass of small pelagic fish, the Adriatic Sea is one of the most important habitats for the growth of tunas, which according to the literature data, spawn in the Mediterranean. The tuna and tuna-like species populations (*Thunnus thynnus*, *Thunnus albacore*, *Xiphias gladius*) that reside in the Adriatic Sea are under the supervision of the ICCAT. The species *Palinurus elephas* and *Scyllarides latus* are also found on Annex III of the SPA/BD Protocol. The total quantity of *Palinurus elephas* caught in 2018 was 679.00 tons while there was no data on the catch of *Scyllarides latus*. Between 2013 and 2018, biomass and abundance indexes for *Merluccius merluccius* in the northern and central Adriatic show oscillating values with a general positive trend and stable frequency. Biomass and density indexes in the Croatian territorial sea has a positive trend compared to the rest of the Adriatic Sea. The results of the stock assessment show that the *Mullus barbatus* is in a state of overfishing with relatively high biomass and it is recommended to reduce fishing mortality and move toward a progressive reduction of fishing effort. The results of *Nephrops norvegicus* biomass estimate show a continuous decrease especially since the mid-1990s. The stock in the Adriatic Sea is overfished and it is recommended to reduce fishing efforts. The biomass of the sardines population in the Adriatic Sea is 161,297 tones. The level of exploitation is slightly higher than the desired value. During the period from 2013 to 2016 (when the last official biomass assessment was made), the biomass was within limits, without a significant trend or change, while the juvenile index in the same period showed a slight increase. In view of all the above, the population of sardines in the Adriatic Sea is under excessive exploitation. The biomass of the anchovies population in the Adriatic Sea (according to the last official estimate) was 57,469 t. The level of exploitation is slightly higher than the desired value. In the period from 2013 to 2016, the level of biomass as well as the level of juvenile index for the anchovies population in the Adriatic Sea showed a slight decline, which is why this population in the Adriatic Sea is considered overfished and under overexploitation. Data collected as part of the national data collection program indicate that there has been a decrease in the biomass index and abundance for the species *Pecten jacobaeus* (Updated documents, 2019).

Under the OPCC the strategic project "Development of Natura 2000 management framework" began with the implementation. The aim of the project is to develop an effective management framework for the Natura 2000 network, including preparation of management plans for at least 90 Natura 2000 marine sites on the coastal area. In the future it is important to continue the development of the Natura 2000 management framework and management capacities. Other projects relevant to the management of protected and Natura 2000 areas are "Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction" and "Development of a system for monitoring the conservation status of species and habitat types". In accordance with the data obtained from those projects and on the basis of the criteria laid down in the Organic Network Regulation, an additional assessment of the sufficiency of Natura 2000 in the sea under national jurisdiction will be made, primarily with a focus on areas outside the territorial sea.

5.2. Critical impacts and effects on marine and coastal biodiversity

Major threats to the seabirds include the presence of predators on islands where the birds land for nesting. The most threatening ones are ship rats (*Rattus rattus*), domestic cats (*Felis catus*) and Javan Mongoose (*Herpestes javanicus*). Another threat is habitat competition with other, more aggressive species, bycatch during fishing, reduction of food availability due to large exploitation of fish, increase of tourist activities as cruises and boat trip breeding near sites greatly affect the success of breeding seabirds (noise, excessive use of light). Another pressure is the marine litter including plastic indigestion.

Of the 41 cetaceans whose death was recorded in 2017, for 82.93% of cases (34 individuals), it was not possible to determine the cause of mortality. For only seven individuals the causes of death are known. Two individuals died due to drowning in the fishing net, four died from unknown fishing gear while one individual died due to disease, i.e., from the consequences of parasite infestation. Other than the incidental bycatch, pressures include anthropogenic noise from oil and gas exploitation, seismic survey, shipping, military activities, and construction (including physical/physiological effects and behavioural changes potentially leading to direct and indirect mortality), the anthropogenic noise from tourism (with seasonal occurrence) impacting in terms of behavioural change, acting as a trigger to displace the local population of dolphins. Marine debris/litter is also a pressure as in terms of plastic ingestion, fecal contamination due to poor waste management systems and pollution from agriculture.

Within the scope of the NETCET project partners developed a report on the causes of mortality of sea turtles in Adriatic Sea. In the report, although the data do not have a statistical significance due to the low number of samples analysed, the impact of bycatch together with the bacterial presence in the water seems to be the greater threats for sea turtles in the Adriatic Sea. Incidental capture in fishing gear has been recognized as a major threat with bycatch ranging between 2000–2500 turtle captures in the bottom

trawls per year and at least 400–600 captures in set nets per year in The Croatian Adriatic (LIFE Euroturtle project). Threats are also marine litter (plastic), collision with boats and climate change, whose significance is the least known.

The direct effect of fishing is achieved through the fishing of commercially important organisms with the aim of retaining them (as catches) for further sale or consumption. However, fishing has other, indirect effects on marine organisms. In fact, there is also a significant proportion of organisms that are incidental bycatch due to the indiscriminateness of fishing gears. Human activities that lead to physical disturbances on the natural seabed are those connected with the use of trawling bottom gear such as bottom brakes and shore seines nets and fish farms that permanently overshadow the seabed with their infrastructure.

The impact of climate change on species, habitats and ecosystems in Croatia has not yet been sufficiently investigated although climate change is a real threat to their long-term conservation, especially given the latest estimates on the likely increase of the average global temperature by 1.5° C. The impact will depend largely on the size and speed of the changes, geographical location, sensitivity, and selection of appropriate mitigation measures. While some shifts in the assessment of the current state and sensitivity of ecosystems to climate change have been made, the inclusion of analyses of the potential impacts of climate change in all segments of the conservation of natural resources should be encouraged in the coming period. According to the Vulnerability Report, the most important climate changes directly affecting natural ecosystems and biodiversity in The Republic of Croatia are: Changes in average air temperatures; reduction of quantities and changes in rainfall; occurrence of climate extremes (heatwaves, droughts, floods, strong winds); sea level rise.

According to the Vulnerability report, we can expect a complex and lasting impact of climate change with the following changes: the sinking of coastal habitats, the increase of salinity of terrestrial and freshwater habitats along the seashore, rivers and deeper with the formation of estuaries; the exertion of moist terrestrial habitats; increase in the arid area; reduction and changes in the proportion and eventual disappearance of some habitats and species, hence the decline in biodiversity and the emergence and spread of some invasive species. Changes in ecosystems, directly point to the most comprehensive effects of climate change in the Mediterranean coastal zone. The significance of climate change to vulnerable habitats and species is the least known driver of biodiversity loss but is expected that this will be an important issue to tackle in the future. This is especially true for vulnerable marine vertebrates other than fish: marine mammals including cetaceans, sea turtles and seabirds. The application of an ecosystem-based management approach could reduce the adverse impacts of different maritime sectors. This approach should be preceded by resource status assessments of ecosystem components, that is by mapping of marine and coastal ecosystem services. The economic value of ecosystem services should be assessed in marine pilot areas. More generally, considering that climate change is an important present and future driver of biodiversity loss, exploring synergies between climate action and actions to protect, sustainably manage and restore biodiversity could be strengthened.

Waste at sea is one of the fastest growing threats to nature with major environmental and economic consequences. It is estimated that about 80% of the waste in the sea comes from inland sources and activities from the mainland, such as municipal waste from improper landfills, flushing in sea of storm waters, as a by-product of extensive and uncontrolled tourist activities, etc. About 20% of the waste ends in the sea as a result of irresponsible activities in maritime transport and fisheries. The problem of waste in the sea is becoming more visible and obvious in the Republic of Croatia. Although the problem of waste in the sea has been recognized as one of the main threats to marine ecosystems in the Mediterranean due to its ecological, economic, security, health and cultural impacts, the Croatian Adriatic is faced with a lack of adequate data from systematic research. A particular problem is the intake of cross-border waste that reaches through sea and wind currents from neighbouring Adriatic countries during extremely adverse meteorological and hydrological conditions. Knowledge of the condition, quantities and properties, and the impacts of waste on the marine environment are currently insufficient and unsatisfactory.

Through anthropogenic noise the natural environment (with natural sources of sound) changes, becomes unnatural, so that marine organisms can suffer harmful effects. The intake of anthropogenic sound energy into the marine environment takes place in a wide spatial and time domain. Anthropogenic sounds (noise) can be of a short (pulse) or long (continuous) duration. It is necessary to carry out noise monitoring and preferably perform its numerical modelling. It is assumed that multi-annual noise monitoring will be required to in order the trends to be reliable. Knowledge of the impact of pulse and continuous noise on marine organisms, primarily highly sensitive organisms (dolphins and turtles) and economically important fish species in the Croatian part of the Adriatic are insufficient at the current level.

According to the paper “Cumulative Impact Index for the Adriatic Sea: Accounting for interactions among climate and anthropogenic pressures” (Furlan *et al*., 2019)[106] the growth of maritime activities is taking place without the full understanding of the complex interactions between natural and human induced changes, leading to a progressive decline of biodiversity, and consequently, the degradation of marine ecosystems. Moreover, if pressures are considered individually, they may appear to be at sustainable levels, while their overall impact may be considerable if they take place in the same area, acting on the same vulnerable habitats. So, improving capacity to model and evaluate the combined effects of multiple stressors, in decisional contexts characterized by high uncertainty linked to natural dynamics difficult to predict, is therefore essential to address the future planning and management of our seas (Furlan *et al*., 2019). As an example, cumulative pressures are assessed in the vulnerability assessment within the National strategy for integrated coastal zone management of Montenegro[107]. In the future mapping of more vulnerable areas of the Adriatic Sea under national jurisdiction should be performed, taking into consideration cumulative pressures on biodiversity.

106. https://papthecoastcentre.org/pdfs/Strategy%20Montenegro_Lessons.pdf
https://www.researchgate.net/publication/331484107_Cumulative_Impact_Index_for_the_Adriatic_Sea_Accounting_for_interactions_among_climate_and_anthropogenic_pressures/link/5ca46523a6fdcc12ee8ef18c/download

107. https://papthecoastcentre.org/pdfs/Obalno%20Podrucje_Web_Engl.pdf

6.

Assessment of national priority needs and response actions

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6.1. Needs

Additional research is needed on species and habitat types where insufficient data exist to identify the most suitable sites for their preservation. This has been addressed as the remaining scientific reserves for the Natura 2000 network in the Republic of Croatia, that are mainly related to the mapping of marine habitat types (1120* Posidonia beds and 1170 Reefs) and species (*Tursiops truncatus* and *Caretta caretta*) as well as possible proposals of new special protection areas (SPA) for marine birds. Depending on the results from the ongoing project new Natura 2000 sites could be designated. The map of marine habitats under national jurisdiction of the Republic of Croatia (including the map of threatened and rare habitat types and of habitat types listed in Annex I of the HD) is under development. The system for monitoring of the conservation status of species and habitat types (the framework for monitoring and reporting under Article 12 of BD and Article 17 of HD) is under development and the comprehensive Natura 2000 management framework (incl. preparation of the management plans for Natura 2000 sites) is ongoing. According to Report on progress and implementation of Article 17. there is need to increase knowledge on the distribution and conservation status of habitat *Posidonion oceanicae – 1120* and Reefs – 1170, on the distribution and conservation status of Cnidaria that are listed in the Annexes of EU Nature Directives and/or SPA/BD Protocol Annexes such as *Corallium ruburum*, on the distribution and conservation status of marine molluscs that are listed in the Annexes of EU Nature Directives and/or SPA/BD Protocols such as *Lithophaga lithophaga* and *Pinna nobilis*. Furthermore there is the need to increase knowledge on the distribution and conservation status of marine non vascular plants that are listed in the Annexes of EU Nature Directives and/or SPA/BD Protocol Annexes (such as *Phymatholithon calcareum* and *Lithothamnium coralloides*), as well as crustaceans (such as *Scyllarides latus*) and of Echinodermata (as *Asterina pancerii, Centrostephanus longispinus* and others).

Considering their high mortality due to pathogen, it is extremely important to exchange knowledge between scientific and expert institution, monitoring data, test and implementation of protection and (in situ and ex situ) conservation measures for the species *Pinna nobilis*, listed in the Annex II of SPA/BD Protocol.

What is common for the protection of vulnerable species such as marine mammals, marine turtles and certain seabirds is that there is the need to assess the impact of fisheries and the incidental bycatch of those endangered species. To accomplish this, it is important to improve cooperation between scientists and fishermen, who should report incidental bycatch. More active work is needed to increase awareness of fishermen on the importance of the protection and restoration of marine biodiversity as their understanding and acceptance is the key for the ability of sustainability of protection and conservation measures. There is also need for continuous improvement of the Croatian national data collection program conducted by the Ministry responsible for fisheries. Furthermore, the improvement of the cooperation of the Ministry responsible for nature protection with the Ministry responsible for fisheries and stakeholders can significantly contribute to the efficient protection of marine biodiversity. Additionally, there is the need to improve data availability and conduct research on vulnerable species, distribution and habitat use in the Adriatic Sea in order to asses anthropogenic impact and improve of management of existing/new protected marine areas, to revise of draft/proposal of management and action

plans and to implement specific activities from those plans and to perform education on human dimension in management of species, conflict resolution, harmonized coexistence of humans, public involvement in management plan development. Furthermore, it is important to improve knowledge and assess the vulnerability of species and habitat types to climate change – as it is a direct driver of biodiversity loss, the effects of which have not been researched yet.

The drafted species proposals of management plans with action plans (for seabirds, marine mammals and sea turtles) should be adopted and/or revised. Detected need is also to perform research on seabird species, on their migration pathways, monitor their populations and conduct necessary conservation activities targeting the most important threats during migration, define and implement mitigation methods for bycatch and over exploitation of fish in feeding and resting areas, research nutrition of seabirds including the impact of marine litter, the presence of environmental toxins in food and poisoning (including during migration), study important feeding and resting areas for seabirds and develop methodology to determine and monitor their condition throughout the year. A protection and conservation project on the seabird species *Phalacrocorax aristotelis desmarestii* should be developed and implemented.

For pressures associated with alien and IAS the need is to establish a transboundary platform for gathering and data exchange on distribution, invasion pathways and eradication methods of IAS on regional level, develop a platform for trans boundary management system and to continue to map, define pathways of introduction routes and establish monitoring management system for (marine) IAS.

Regarding the pressure of marine pollution and marine litter, the need is to analyse the impact of marine litter on marine species, establish transboundary cooperation for knowledge exchange regarding the impact of marine litter on marine biodiversity. It is also important to conduct research on the sources and locations of marine litter as well as winds and marine currents that transport it. It is also necessary to develop protocols for the implementation of waste cleaning actions (from beaches and the sea), in order to obtain data on collected waste, develop indicators and methodological approaches for monitoring the quantities and trends of waste, especially plastics and microplastics on the seabed, water column, on the coast and in marine organisms. In order to reduce marine pollution, it is also necessary to continue to develop and improve infrastructure systems for drainage and wastewater disposal in the coastal area.

Regarding marine noise, there is the need finalize the development of national guidelines for mitigation of anthropogenic noise on marine mammals and sea turtles. Also to continue existing transboundary cooperation for assessing the impact of underwater noise on the marine ecosystem, establish a register that would record and assess the spatial and temporal distribution of impulse anthropogenic noise sources (Register of pulses) and continue measurements of continuous underwater noise, establish spatial-temporal reconstruction of noise using a numerical model, and monitor noise level trends.

It is also important to further strengthen implementation of Ecological Network Impact Assessment, this includes improvement of cooperation with all entities that are responsible for adopting sectoral or spatial planning documents , improvement of controls, preparation of thematic manual, creation of databases, improvement of knowledge of competent bodies.

Furthermore, it is important that the FRA management regime of Jabuka/Pomo Pit is prolonged after the end of 2020 due to positive effects this mechanism had to the overall protection of the marine resources and at the same time ensuring sustainability of fisheries.

As little has been done regarding assessment of ecosystem services, it is important to map and analyse coastal and marine ecosystem services, developing methodologies to measure their value.

7.

Funding problems and opportunities

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

Additional resources for biodiversity financing in the period 2014-2020 have been secured mainly referring to the increase of Cohesion funding (EU funds) availability in relation to total national funding. Improvement is also seen in developing further national innovative financial mechanisms (IFM) as an additional potential to scale up finance mechanisms for biodiversity. These opportunities and achievements contributed to increase in financial sustainability of the nature protection system and have more than doubled the total nature protection funding in the last five years.

Financing of nature protection, to a large extent still relies on State Budget (that embeds EU funding) and to a lesser extent on the budgets of regional and/or local self-governments. Individual public institutions for management of PA/Natura 2000 are additionally funded by own revenue to a larger or lesser degree. With increased opportunities for usage of funding for “nature projects” co-financing of projects has become an increasingly prominent challenge.

To address this challenge funding collected from different IFMs is mostly directed to project co-financing. Positive experience (in place for many years) is fiscal reform through the system of fees payable by environmental polluters and users in the private and public sector on the basis of the polluter pays principle, where Environmental Protection and Energy Efficiency Fund part of the collected funds directs to projects contributing to biodiversity conservation. Further development of innovative financial mechanisms is ongoing. Additional funds for the co-financing of EU funded projects are ensured through EU Emissions Trading System (EU ETS) in Croatia, where biodiversity has been recognized as one of the priorities for financing since implementation of projects aimed at preserving biodiversity and ecosystem services contributes to adaptation and mitigation activities to climate change. The new legal mechanism of financial solidarity between national and nature parks is established in 2017 and named Joint Funds of Croatian Parks, which now functions as a shared service centre for the parks. Public institutions of nature and national parks finance the joint fund with 3% of their annual revenues. That gives Croatian parks two distinct advantages, low-income parks will now be able to apply for co-financing of various projects, and all parks will receive additional support in common services, such as legal support, public procurement and joint marketing (CBD 6th Report, Croatia).

According to Article 8 of the Habitats Directive, there is an obligation to develop Prioritized action framework (PAF), which presents strategic multiannual planning tools aimed at providing a comprehensive overview of the measures needed to implement Natura 2000 network and its associated green infrastructure, specifying the financing needs for the necessary conservation measures. This obligation was transposed into Nature Protection Act (Article 204) proscribing that PAF should be adopted by the Government based on the proposal of the MESD. Preparation of PAF is ongoing as one of the activities of the national strategic project "Development of management framework for Natura 2000 network”. The document is in its final stages of development, but the definitive version in expected after the outline of the national operational programmes are known to connect the needs with the funding.

7.2. Other sources (private, public, partnership)

There is a lack of systematic records, as well as absence of data or insufficient data from the private and the non-governmental sector, and from research institutions. The data on national funds earmarked for biodiversity and assessments of costs necessary to implement activities and achieve resource mobilization targets are neither collected nor processed at the system level (CBD 6th report, Croatia).

One of the globally accepted mechanisms being applied in the Republic of Croatia for a long period is the mobilization of additional funds in protected areas through the improvement of services and content, and through entry ticket sales (CBD, 6th Report). Revenues from PIs' own activity for managing national parks and nature parks, are invested in nature protection (PAF draft, 2020).

The introduction of positive biodiversity incentives, such as agri-environment incentives or subsidies for temporary suspension of activities in fisheries in order to ensure the recovery of fish stock, as well as the introduction of new financial mechanisms, point to the presence of fiscal reform efforts and to the implementation of a system of incentives and financial mechanisms. In order to mitigate or eliminate negative impacts on biodiversity, the forthcoming period will could include an analysis of subsidies harmful to biodiversity, and as needed, reform and/or elimination of those subsidies that may cause the biggest negative impact on biodiversity (CBD 6th Report, Croatia)

7.3. International funds, projects, programs, national eligibility for international programs/funds

In the 2014-2020 multiannual financial framework (MFF) nature conservation priorities have been embedded across all European structural and investment funds. The eligibility of expenditure for the European structural and investments funds in Croatia follows the n+3 rule, that is December 2023. But the eligibility of expenditure at project level can change as it relates to the project implementation period. For "nature projects" that represent the 85% or the EU contribution, while the remaining 15% is financed by public or private funds.

Operational Program Competitiveness and Cohesion 2014-2020 (OPCC)

The OPCC is the main program document for implementing EU's Cohesion policy.

Through the OPCC (Investment priority: Protecting and restoring biodiversity and soil and promoting ecosystem services, including through Natura 2000, and green infrastructure) activities financed that are relevant or connected to marine and coastal biodiversity are:

- Development of Natura 2000 management framework
- Development of proposals for management plans for strictly protected species (with action plans)
- Establishment of a national system for monitoring IAS
- Developing a management and control system for invasive alien species
- Mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction
- Development of a system for monitoring the conservation status of species and habitat types
- Recording the special legal regime as a contribution to more efficient management of protected areas
- Increasing the attractiveness, educational capacity, and sustainable management of natural heritage destinations (mostly related to investments in visitor infrastructure)

Operational Program for Maritime Affairs and Fisheries 2014-2020

Within the Operational Program for Maritime Affairs and Fisheries, priority axis dedicated to the Promotion of environmentally sustainable, resource efficient, innovative, competitive, knowledge-based fisheries envisage measures related to biodiversity that includes:

- Protection and restoration of marine biodiversity and ecosystems and compensation regimes in the framework of sustainable fishing activities (Measure I. 17 and I.18). The measure is intended to protect and restore biodiversity and ecosystems in the framework of sustainable fishing activities, including: management, conservation and monitoring of Natura 2000 sites and MPAs; mapping and action to prevent, control or eliminate invasive alien species; preparation of protection and management plans for fisheries-related activities and more; tenders are in preparation.
- Aquaculture providing environmental services (Measure II. 10). The measure provides compensation for the additional costs and/or income forgone resulting from the application of aquaculture methods that meet the specific environmental needs and are subject to specific management requirements arising from the designation of Natura 2000 sites in accordance with the Habitats and Birds Directives; tenders are in preparation.
- Protection of the marine environment, sustainable use of resources and advancement of knowledge (Measure VIII.2/VIII.3). Consumption so far relates to the following activities: educational and informational materials to promote the protection of the marine environment and the sustainable use of marine resources, primarily protected and endangered species such as marine mammals, sea turtles and cartilaginous fish; monitoring populations of sea urchins and sea cucumbers; development of expert baseline for the red coral (*Corallium rubrum*) management plan.

European territorial Cooperation

In the current financial period, the Republic of Croatia can fully participate in all three parts of the European Territorial Cooperation:

— Interregional cooperation

- ESPON,
- INTERACT III
- Interreg VC
- URBACT)

— Cross-border cooperation

- Interreg V-A Italy-Croatia 2014 - 2020.
- Interreg V-A Hungary – Croatia 2014 - 2020
- Interreg V-A Slovenia – Croatia 2014 - 2020
- Interreg IPA Croatia – Bosnia and Hercegovina and Montenegro 2014 - 2020
- Interreg IPA Croatia – Serbia 2014 - 2020.

— Transnational cooperation

- Mediterranean Area (Interreg V-B Mediterranean Cooperation Program 2014 - 2020)
- Danube Area (Interreg V-B Danube Cooperation Program 2014 - 2020)
- Adriatic Ionian Area (Interreg V-B Adriatic-Ionian Cooperation Program 2014 - 2020)
- Central Europe (Interreg V-B Central Europe Cooperation Program 2014 - 2020)

In this MFF, Interreg has financed a number of projects in which institutions and NGOs from the Republic of Croatia are their leaders or partners: cross-border projects (INTERREG V-A Italy-Croatia, INTERREG V-A Hungary-Croatia, INTERREG V-A Slovenia-Croatia, INTERREG IPA Croatia-Serbia) and transnational projects (Interreg V-B Danube, INTERREG V-B Adriatic-Ionian, Interreg V-B Mediterranean and INTERREG V-B Central Europe). In most of the projects, public institutions for the management of protected areas are involved as partners (PAF draft, 2020).

The use of LIFE in current MFF is restricted due to uncertain national co-financing. The EPEEF has become more involved in the last two years and is expected to provide systematic co-financing for LIFE projects in the next MFF. Given that new LIFE has the possibility to finance strategic nature projects (SNAPs) in the new MFF, it is likely that the Croatia will make greater use of LIFE in the future for nature protection (PAF draft, 2020). Up to now, there are no HORIZON project relevant for marine and coastal biodiversity with Croatian partners in the period 2014 – 2020.

Projects financed from international sources

A key strategic project of the MESD that was largely implemented in this MFF (project duration: 2011-2017) is the "EU NATURA 2000 Integration Project – NIP", financed by a World Bank loan of 140 m HRK (18.9 m EUR, of which 14.7 m EUR in this MFF). The results of the project include strengthening the capacity of public institutions to manage protected areas, including substantial investment in the construction of visitor infrastructure; collecting and integrating existing data on Croatia's biodiversity; development of the Nature Protection Information System; development of a map of non-forest terrestrial habitats of the Republic of Croatia; drafting of the measure Agriculture, Environment and Climate Change under the Rural Development Program; preparation of strategic projects for financing from the OPCC for 2104-2020. and others. Also significant was the United Nations Development Program – Global Environmental Finance Unit (UNDP-GEF) project "Strengthening the Institutional and Financial Sustainability of the National Protected Area System – PARCS" (4.4 m EUR – GEF Grant) (PAF draft, 2020)

The new Cohesion Policy 2021 – 2027

For the next long-term EU budget 2021-2027, the Commission proposes to modernise Cohesion Policy, the EU's main investment policy. The focus is on five investment priorities, where the EU is best placed to deliver. Regional development investments will strongly focus on objectives 1 and 2. 65% to 85% of ERDF and Cohesion Fund resources will be allocated to these priorities, depending on Member States' relative wealth.

The focus areas are:

— Smarter Europe, through innovation, digitisation, economic transformation and support to small and medium-sized businesses

— a Greener, carbon free Europe, implementing the Paris Agreement and investing in energy transition, renewables and the fight against climate change

— a more Connected Europe, with strategic transport and digital networks

— a more Social Europe, delivering on the European Pillar of Social Rights and supporting quality employment, education, skills, social inclusion, and equal access to healthcare

— a Europe closer to citizens, by supporting locally led development strategies and sustainable urban development across the EU.

Improved climate and biodiversity tracking methodologies will be implemented in order to make sure that at least 30% of the amount of the Union budget and Next Generation EU expenditures will support climate objectives, and to ensure 7.5% of annual spending is dedicated to biodiversity objectives from 2024 and 10% from 2026 onwards.

European Maritime and Fisheries Fund 2021 – 2027

As part of the next EU budget framework for the 2021-2027 period, the European Commission proposed a new regulation on the EMFF to continue the support to the common fisheries policy and the integrated maritime policy. The new fund would give the Member States more flexibility in the implementation of the priorities. Small-scale coastal fisheries and outermost regions would receive greater preferential treatment. Support for permanent cessation and temporary cessation would be supported under strict conditions. It further proposes increased support for international ocean governance and stronger synergies with other EU policies. The fund is also expected to contribute to the development of the blue economy and support the EU's climate objectives.

8.

Conclusions and recommendations

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Activities and Operation as defined within this document (Annex II) are based on the identification of status and pressures that are relevant to marine and coastal areas and of their critical impacts on them. They include biodiversity conservation and protection actions as well as actions aimed at limiting the impact of main pressures and threats, particularly of the most important direct drivers of biodiversity loss: overexploitation, climate changes, IAS and pollution[108].

In order to engage in the implementation of measures aimed at protection and conservation of marine and coastal biodiversity it is particularly important to ensure support of all stakeholders directly or indirectly involved in nature protection. Cooperation and joint solutions are essential to achieve the good ecological state of the marine and coastal biodiversity of the Adriatic Sea, as a priority to allow the development of a sustainable blue economy in the region.

Transboundary cooperation already exists addressing climate change, marine litter, data collection on marine species, their protection and awareness rising as well as development of sustainable fisheries solution. Regional cooperation needs to be furtherly strengthened and improved, and here lies the potential of "Post-2020 Strategic Action Programme for the Conservation of Biodiversity and Sustainable Management of Natural Resources in the Mediterranean Region" (Post-2020 SAPBIO).

Marine pollution is transboundary challenge and addressing it needs regional approach, transboundary coordination and cooperation. Still there is a need to understand more on the adverse impacts it has on marine species.

Invasive alien species are among significant drivers of species decline and ecosystem degradation. It is important to strengthen transboundary collaboration for gathering and data exchange on distribution and invasion pathways.

Climate change is one of the main driver of biodiversity loss. However in order to properly assess its impact more research is needed on sensitivity, threat status and resilience of coastal and marine ecosystems with identifying management priorities. Suggested actions regarding marine ecosystems include the restoration of the carbon-rich ecosystems and mapping of ecosystem services as well as analysis of their state, including of their economic value.

Countries are required according to international and EU obligation to create effective, well-managed and well-connected network of MPAs. New EU Biodiversity Strategy for 2030 (EU BS 2030) adopted by the European Commission in May 2020 includes establishment of a larger EU-wide network of protected areas on land and sea. Objective is to protect at least 30% of marine ecosystems in the EU and within this at least 10% of EU sea should be strictly protected. This is directly contributing to the needed ambition for the post-2020 global biodiversity framework to be adopted during the 15th Conference of the Parties to the Convention on Biological Diversity (CBD).

108. https://ipbes.net/global-assessment

Countries that are "bathed" by the Adriatic, should share the effort in enlarging and managing protected areas. Further discussion is needed how to apply 30% target on Mediterranean level, including all available national and international mechanisams including potential new legally binding International agreement for the protection and sustainable use of marine biodiversity in the areas beyond national jurisdiction (BBNJ).

When establishing strictly protected areas, focus should be in those areas whose importance and role in preserving biodiversity is scientifically unquestionable. In regard to increase the coverage of strictly protected areas it is important to stress that the restoration and protection of particularly valuable marine habitats that contribute to biodiversity conservation should also include important spawning grounds and nursery areas. It is therefore necessary to intensify work on the identification of such areas so that the protection can be properly targeted and have maximum impact.

The Strategic Action Programme for the conservation of Biological Diversity in the Mediterranean Region and its SMART objectives should be aligned with the CBD post-2020 global biodiversity framework and the Sustainable Development Goas (SDGs).

The national and sub-regional reports need to envisage possibility to identify priority actions to achieve the objectives set in the SAPBIO and to monitor progress, while the reporting requerements should be in line and contribute to the post 2020 GBF.

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Annexes

Annex I.

New non-indigenous species in the Croatian part of the Adriatic Sea for the period from 2013 to 2018

Table 1.

Newly introduced non-indigenous phytoplankton species in the Croatian part of the Adriatic in the period 2013-2018 (Updated documents, 2019)

Specie	Taxonomy	Area of introduction	Year	Possible introduction pathway	Reference
Skeletonema grevillei Sarno & Zingone, 2005	Chromista Bacillariophyceae	Northern Adriatic Sea	2014	Ballast waters	Marić at al., 2018
Pseudo-nitzschia multistriata (Takano) Takano, 1995	Chromista Bacillariophyceae	Estuary of the river Krka	2017	Ballast waters	Arapov J., (oral communication)

Table 2.

Newly introduced non-indigenous zooplankton species in the Croatian part of the Adriatic in the period 2013-2018 (Updated documents, 2019)

Specie	Taxonomy	Area of introduction	Year	Possible introduction pathway	Reference
Parvocalanus crassirostris	Crustacea Copepoda	Port of Šibenik	2014	Ballast waters	Vidjak *et al*., 2016, 2017
		Port of Rijeka	2015		
Pseudodiaptomus marinus	Crustacea Copepoda	Port of Šibenik	2015	Ballast waters	EUROBUS ICES Report; Uttieri *et al*
		Port of Ploče	2018		
Mnemiopsis leidyi	Ctenophora, Tentaculata	Western coast of Istra	2016	Ballast waters, secondary spread	Malej *et al*., 2017
		Baćina (Near Ploče)	2017	Ballast waters	Malej *et al*., 2017

Table 3.

Non-indigenous species of benthic algae and invertebrates recorded through the implementation of the MSFD and WFD directives and through other projects and extra-project research (Updated documents, 2019)

		Blitvenica	Vis	Pašman	Brač	Hvar	Kaštelanski bay amd Split	Dubrovnik	Palagruža	NP Kornati	Ploče	Šibenik	Mljet	Biograd
	ALGAE													
1	*Caulerpa cylindracea*	+	+		+	+	+	+	+	+				
2	*Caulerpa taxifolia*					+								
3	*Codium fragile*				+									
4	*Acrothamnion preissii*							+		+				
5	*Antithamnion amphigeneum*						+							
6	*Antithamnionella spirographidis*						+							
7	*Aglaothamnion feldmanniae*						+							
8	*Antithamnion nipponicum*				+		+				+			
9	*Antithamnionella elegans*				+		+							
10	*Asparagopsis armata* (tetrasporofit)	+					+	+						
11	*Asparagopsis taxiformis* (gametofit)	+			+		+	+						
12	*Hypnea spinella*	+		+	+	+		+						
13	*Bonnemaisonia hamifera* (tetrasporofit)				+		+							
14	*Colaconema codicola*						+							
15	*Lophocladia lallemandi*	+	+						+					
16	*Polysiphonia atlantica*				+							+		
17	*Womersleyella setacea*	+	+		+	+	+	+	+	+		+		
18	*Dictyota cyanoloma*			+	+		+							
	INVERTEBRATES													
19	*Amphibalanus amphitrite*						+				+	+		+
20	*Amphibalanus eburneus*						+				+	+		
21	*Balanus trigonus*						+				+	+		
22	*Bugula neritina*										+			
23	*Ficopomatus enigmaticus*										+	+		
24	*Melibe viridis*					+	+							
25	*Oculina patagonica*						+							
26	*Siphonaria pectinata*				+		+							
27	*Paraleucilla magna*			+	+		+				+	+		
28	*Percnon gibbesi*		+					+	+					
29	*Haminoea cyanomarginata*												+	
30	*Celleporaria brunnea*													+
31	*Watersipora subtorquata*													+

Table 4.

New non-indigenous benthic species recorded in the period 2013-2018 (Updated documents, 2019)

Specie	Taxonomy	Area of introduction	Year	Possible introduction pathway	Reference
MACROALGAE					
Antithamnion amphigeneum	Rhodophyta	Split	2014 2015	Ships or sea current	Petrocelli isur. 2018.
Aglaothamnion feldmanniae	Rhodophyta	Split	2014 2015	Ships or sea current	Petrocelli isur. 2018.
Antithamnionella elegans	Rhodophyta	Split	2014 2015	Ships or sea current	B Petrocelli i sur. 2018.
Colaconema codicola	Rhodophyta	Split	>2012	Ships or sea current	http://faust.izor.hr/nmon/pocetna
BENTHIC INVERTEBRATES					
Percnon gibbesi	Crustacea	Molunat	2014	Sea current	Dulčić i Dragičević, 2015.
Haminoea cyanomarginata	Gastropoda	Mljet	2016	Sea current	Chartosia isur., 2018.
Celleporaria brunnea	Bryozoa	Biograd na Moru	2014	obraštaj brodova	Marić i sur., 2017.
Watersipora subtorquata	Bryozoa kriptogena vrsta	Biograd na Moru	2014	obraštaj brodova	Marić i sur., 2017.

Table 5.

New non-indigenous species of fish and crustaceans in the Croatian part of the Adriatic in the period 2013-2018 (Updated documents, 2019)

Specie	Taxonomy	Area of introduction	Year	Possible introduction pathway	Reference
Homarus americanus	Crustacea, Decapoda	Savudrija, Istra	2018.	Antropogeni (direktan)	Pavičić isur., 2019
Oplegnathus fasciatus	Pisces, Osteichthyes	Urinj, Rijeka	2015.	Balastne vode	Dulčić isur., 2016
Abudefduf vaiginesis	Pisces, Osteichthyes	Split, uvala Zenta	2018.	Balastne vode	Dragičević i sur., 2019

Annex II.

Urgent action proposed

Activity / Operation	Level of action & Financing sources	Beneficiaries / Stakeholders	Drivers of biodiversity loss	Relevant Strategic document
Further develop efficient management of marine protected and Natura 2000 sites	Action on national level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Climate change IAS Direct exploitation Pollution	The Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017-2025
Prepare new and revise existing management and action plans for marine species (marine mammals, marine turtles, seabirds) and implement specific activities from those plans	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Direct exploitation Changes in land and sea use Pollution Invasion of alien species	The Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017-2025
Continue mapping of coastal and benthic marine habitats in the Adriatic Sea under national jurisdiction, including mapping and assessing cumulative pressures on most vulnerable habitats	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Climate change IAS Direct exploitation Pollution	Action connected to the strategic project that is currently being implemented. Proposal on the basis of gap analyses Parts of this action can be continued within other projects (including transboundary)
Exchange of knowledge at transboundary level between scientific and expert institution, regarding monitoring, implementation of protection and conservation measures (***in situ*** and ***ex situ***) for the species ***Pinna nobilis***, listed in the annex II of SPA/BD Protocol	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Pollution Changes in land and sea use Climate change	Proposal on the basis of gap analyses
Continue developing a system for monitoring the conservation status of species and habitat types, particularly improve data availability on marine mammals, sea turtles, seabirds distribution and habitat use in the Adriatic Sea in order to assess anthropogenic impact	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Climate change IAS Direct exploitation Pollution	Action connected to the strategic project that is currently being implemented. Proposal on the basis of gap analyses Parts of this action can be continued within other projects (including transboundary) Action can be continued within other projects (including transboundary)
Conduct research and data collection on migration pathways on seabird species, monitor populations and develop and conduct necessary conservation activities targeting the most important threats during migration: incidental bycatch, poisoning and illegal killing	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Direct exploitation Changes in land and sea use Pollution	Proposal on the basis of gap analyses
Preparation of protection and conservation project on the seabird species ***Phalacrocorax aristotelis desmarestii***	Action on national/ transboundary level ERDF (Interreg) LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use	Proposal on the basis of gap analyses
Research nutrition of seabirds, their habitats selection and food/prey availability	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use	Proposal on the basis of gap analyses
Continue monitoring of utilization of marine organisms, in particular enhanced monitoring of coral extraction, sponges, crustaceans (species with HD annex V)	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Direct exploitation	The Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017-2025 Proposal on the basis of gap analyses
If the results of research show the need, designate new marine Natura 2000 sites	Action on national level. National funds.	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Climate change IAS Direct exploitation Pollution	Connected to - Scientific reserve for the Natura 2000 network in the Republic of Croatia (for 1120* Posidonia beds and 1170 Reefs and Tursiops truncatus and Caretta caretta)
Perform the analyses for identifying possible PA and OECM for strict protection	Action on national level / transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Climate change IAS Direct exploitation Pollution	New policy requirements (related to EU Biodiversity Strategy to 2030)

Activity / Operation	Level of action & Financing sources	Beneficiaries / Stakeholders	Drivers of biodiversity loss	Relevant Strategic document
Achieve significant progress in the identification of OECM, particularly its implementation in marine areas	Action on national level. / transboundary level National funds.	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Climate change IAS Direct exploitation Pollution	Proposal on the basis of gap analyses
Map ecosystem services and prepare analysis of the state of ecosystems including their economic value assessment	Action on national/ transboundary level EMFF KF ERDF (including INTERREG) LIFE	- SAB climate - SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Climate change Direct exploitation Pollution IAS	The activity is adapted to marine and coastal areas and is based on the action 4.3.1. of NBSAP
Finalize national guidelines for mitigation of anthropogenic noise on marine mammals and sea turtles	Action on national level National funds	- SAB nature - Scientific institutions and experts	Pollution Changes in land and sea use	In relation to threats identified but not researched for: - Marine mammals - Marine turtles - Seabirds Proposal on the basis of gap analyses
Strengthen the capacity of professional, research institutions and competent bodies for nature conservation	Action on national/ transboundary level EMFF KF ERDF (including INTERREG) LIFE	- SAB climate - SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Climate change	Proposal on the basis of gap analyses
Identify and propose candidate MPAs to be listed in regionally and globally recognized protected areas networks (e.g ***SPAMI List, FRAs, Biosphere Reserves and World Heritage sites, Ramsar sites)***	Action on national level KF ERDF	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Climate change IAS Direct exploitation Pollution	The Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017-2025
Strengthen the system for implementation of Ecological Network Impact Assessmentby improving cooperation with all entities that are responsible for adopting sectoral or spatial planning documents, improvement of controls, conducting further research of specific impacts of particular fishing gears	Action on national level. National funds.	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use Climate change IAS Direct exploitation Pollution	Proposal on the basis of gap analyses

Activity / Operation	Level of action & Financing sources	Beneficiaries / Stakeholders	Drivers of biodiversity loss	Relevant Strategic document
Restoration of carbon-rich ecosystems	Action on national/ transboundary level EMFF KF ERDF (including INTERREG) LIFE	- SAB climate - SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Climate change	New policy requirements (related to EU Biodiversity Strategy to 2030)
Assess the impact of fisheries and the accidental bycatch of endangered species including through continuous improvement of Croatian national data collection program conducted by the Ministry responsible for fisheries	Action on national level. National funds. EMFF	- SAB nature - SAB fisheries - Scientific institutions and experts Fishermen and their sectoral organizations	Direct exploitation	In relation to threats identified for: - Marine mammals - Marine turtles - Seabirds Proposal in line with documents analysis, including Program of measures (measure 3.8.1.)
Improve cooperation between scientist and fishermen that should report accidental bycatch and actively work to increase awareness of fishermen on the importance of the protection and restoration of marine biodiversity	Action on national level. Action on national level. National funds. EMFF	- SAB nature - SAB fisheries - Scientific institutions and experts Fishermen and their sectoral organizations	Direct exploitation	In relation to threats identified but not researched for: - Marine mammals - Marine turtles - Seabirds Proposal in line with documents analysis, including Program of measures where it is considered a prerequisite for the assessment of the impact of incidental bycatch (measure 3.8.1.)
Continue further work in identifying and protecting important areas for biodiversity including spawning areas particularly in Ecological and Fisheries Protection Zone as geographically and spatially clearly defined areas with adequate conservation measures	Action on national level. National funds EMFF	SAB nature SAB fisheries Fishermen and their sectoral organizations	Direct exploitation	In relation to threats identified but not researched for: - Marine mammals - Marine turtles - Seabirds - important fish spawning and nursery areas - marine fish stocks Support to efficient management of protected, Natura 2000 and OECM areas. Achieving good environmental status of marine ecosystems
Strengthen transboundary collaboration for gathering and data exchange on distribution, invasion pathways and eradication methods of invasive alien species on regional level.	Action on transboundary level ERDF (INTERREG) LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection PI managing PA and Natura 2000	IAS	Proposal on the basis of gap analyses

Activity / Operation	Level of action & Financing sources	Beneficiaries / Stakeholders	Drivers of biodiversity loss	Relevant Strategic document
Continue to map, define pathways of introduction routes and establish monitoring management system for (marine) IAS and potential IAS	Action on national / transboundary level EMFF KF ERDF (including INTERREG) LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection PI managing PA and Natura 2000	IAS	Proposal in line with document analysis. Reference to current strategic project and Nature protection strategy and Action plan (NBSAP), SG2, SO6
Raise awareness of the role of MPAs as nature-based solutions for enhancing resilience to Climate Change and Biodiversity conservation.	Action on national/ transboundary level EMFF KF ERDF (including INTERREG) LIFE	- SAB climate - SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Climate change Changes in land and sea use	Proposal on the basis of gap analyses
Promote co-management for MPAs based on an ecosystem approach and integrated coastal zones management (ICZM) and integrate them in the marine spatial planning process, particularly coastal and wetlands areas	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection - PI managing PA and Natura 2000	Changes in land and sea use	MPA Roadmap
Risk assessment of pollution and climate change through establishment of monitoring of benthic communities as a prerequisite for the assessment of pressures on biogenic formations and their environmental status.	Action on national/ transboundary level EMFF KF ERDF (including INTERREG) LIFE	- SAB climate - SAB nature - Scientific institutions and experts - CSO nature protection PI managing PA and Natura 2000	Climate change Pollution	Proposal on the basis of gap analyses
Research on sensitivity, threat status and resilience of coastal and marine ecosystems (including marine species and habitat types) on climate change with identifying management priorities	Action on national/ transboundary level EMFF KF ERDF (including INTERREG) LIFE	- SAB climate - SAB nature - Scientific institutions and experts - CSO nature protection PI managing PA and Natura 2000	Climate change	In relation to threats identified but not researched for: - Marine mammals - Marine turtles - Seabirds - Other species / habitats Proposal on the basis of gap analyses (Adaptation strategy to climate change in the Republic of Croatia to 2040 with the vision to 2070) Proposal on the basis of document analysis, deriving from action 2.1.5. NPSAP
Analysis of the impact of marine litter on marine species and establishment of transboundary cooperation for knowledge exchange	Action on national/ transboundary level EMFF KF ERDF INTERREG LIFE	- SAB nature - Scientific institutions and experts - CSO nature protection PI managing PA and Natura 2000	Pollution	In relation to threats identified but not researched for: - Marine mammals - Marine turtles - Seabirds Proposal on the basis of gap analyses

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

Specially Protected Areas

Monitoring

Mediterranean Monk Seal

Cartilaginous fishes
(Chondrichtyans)

Coralligenous and other calcareous bio-concretions

Marine vegetation

Marine and coastal bird species

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

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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