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Agenda item 7: Addressing Interrelation of Pressures-Impacts for Biodiversity cluster

Methodological Approach for mapping the interrelations between Pressures-Impacts and the Status of Marine Ecosystem Components for Biodiversity Cluster

SPA/RAC
Tunis, 2021

Note by the Secretariat

The Contracting Parties to the Barcelona Convention committed at their 15th Ordinary Meeting (COP15, Almeria, Spain, 15-18 January 2008) to implement the Ecosystem Approach for the management of human activities in the Mediterranean (Decision IG. 17/6), with the overall objective to achieve the Good Environmental Status (GES) of the Mediterranean Sea. Altogether 11 Ecological Objectives (EO) were set together with related Common Indicators, which describe what the environment will look like when GES has been achieved.

At their 19th Ordinary Meeting (COP 19, Athens, Greece, 9-12 February 2016), the Contracting Parties adopted in Decision IG.22/7 the Integrated Monitoring and Assessment Programme and related Assessment Criteria (IMAP).

At the 20th Ordinary Meeting (COP20, Tirana, Albania, 17-20 December 2017), the Contracting Parties endorsed in Decision IG.23/6 the key findings of the 2017 Mediterranean Quality Status Report (the MED QSR Decision); underlined the gaps of the 2017 MED QSR; and requested the Secretariat to overcome them.

The Regional Meeting on IMAP Implementation: Best Practices, Gaps and Common Challenges (IMAP Best Practices Meeting, Rome, Italy, 10-12 July 2018) welcomed the work undertaken by the Secretariat and MAP Components to support the implementation of IMAP at regional, sub-regional and national levels, including several cross-cutting issues, as provided in UNEP/MED WG. 450/3. The Meeting further requested the Secretariat to more in-depth discussion on the better interlinkages between activities/pressure/impacts and clarification of definition of impacts noting that such a definition should primarily focus on biodiversity.

The present document reviews the suitable tools to show the environmental status of the Biodiversity Ecological Objectives across the Mediterranean Sea and Coasts, and pressures/impacts/state interactions. It specifically provides inputs on identifying most significant economic sectors as sources of pressures and addressing interrelations of pressures and impacts on the biodiversity cluster, covering the following Common Indicators (CI) of the IMAP's EO1 Biodiversity and EO2 Non-indigenous species:

- *Common Indicator 1* "Habitat distributional range to also consider habitat extent as a relevant attribute";
- *Common Indicator 2* "Condition of the habitat's typical species and communities";
- *Common Indicator 3* "Species distributional range (related to marine mammals, seabirds, marine reptiles)";
- *Common Indicator 4* "Population abundance of selected species (related to marine mammals, seabirds, marine reptiles)";
- *Common Indicator 5* "Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles)"; and
- Common Indicator 6 "Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas".

The basis for selection of assessment **methodologies** were the approaches elaborated in the *UNEP/MED WG. 450/3 (2018): Progress report on the implementation of Decision IG.22/7 on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP).* The selection of assessment approach is linked to existence and availability of data. Namely, there is still limitation of knowledge about pressures, impacts and state of coastal and marine biodiversity (further in text referred as biodiversity), with geographical disbalance of level of knowledge, as already documented in the 2017 MED QSR. Hence, the qualitative assessment was mainly carried out, using the GRID/Table approach. In addition, an attempt was made to quantify interrelations of pressures and impacts on biodiversity, using a variation of semi-quantitative scoreboard method.

This analysis was submitted for comments to the Integrated Meetings of the Ecosystem Approach Correspondence Groups on IMAP Implementation (CORMONs), held by Videoconference, between 1 and 3 December 2020. The Meeting congratulated the Secretariat on the quality of the document and the importance of its content to elaborate a GES-integrated assessment and recommended to consider this work as a dynamic and living document that should be therefore updated continually as required.

The present document is an updated version, taking into consideration the comments submitted in writing by the Contracting Parties. In order to highlight the proposed changes and facilitate the review by the meeting, these are reported in highlighted text for added text and in strikethrough for deletion.

The meeting is expected to discuss and endorse the proposal, as appropriate, and make recommendations on the way forward with regards to its use for the purpose of IMAP implementation and the delivery of the 2023 Mediterranean Quality Status Report (2023 MED QSR), prior to being examined by the SPA/BD Focal Points Meeting, in June 2021.

Table of Contents

List of tables

List of figures

List of Abbreviations / Acronyms

2017 MED QSR	2017 Mediterranean Quality Status Report
ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area
Barcelona Convention	Convention for the Protection of the Mediterranean Sea against the pollution
CAMP MNE	Coastal Area Management Programme of Montenegro
CI	Common Indicator of the IMAP
COP	Conference of the Parties (in this document, Parties to the Barcelona Convention)
CORMON	Ecosystem Approach Correspondence Group on Monitoring
CP	Contracting Parties
CRF	Common Regional Framework
DPSIR	Driver-Pressure-State-Impact-Response
EcAp	Ecosystem approach
EO	Ecological Objective
EU	European Union
GES	Good Environmental Status
GFCM	General Fisheries Commission for the Mediterranean
IAS	Invasive alien species
ICZM	Integrated Coastal Zone Management
IMAP	Integrated Monitoring and Assessment Programme and related Assessment Criteria
MAP	Mediterranean Action Plan
MED QSR	Mediterranean Quality Status Report
MSFD	Marine Strategy Framework Directive
NCEAS	National Centre for Ecological Analysis and Synthesis
NIS	Non-indigenous species
PAP/RAC	Priority Actions Programme Regional Activity Centre
SPA/BD Protocol	Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean, under Barcelona Convention
SPA/RAC	Specially Protected Areas Regional Activity Centre
UNEP or UN Environment	United Nations Environment Programme

Methodological Approach for mapping the interrelations between Pressures-Impacts and the Status of Marine Ecosystem Components for Biodiversity Cluster

1. General overview of economic sectors and pressures to biodiversity

1. The Matrix of interactions between the EcAp Ecological Objectives (EOs) and the economic activities and natural and cultural elements that have great relevance for the coastal areas, according to the content of the Integrated Coastal Zone Management (ICZM) Protocol was discussed and endorsed by the Contracting Parties (UNEP/MED WG.461/23).

2. The matrix is based on the principle of ecosystem-based management to reach GES, as well as on the principles of integration and cumulative impact, and consists on cross-check elements of the ICZM Protocol with the EOs organised in four clusters: 1. Biodiversity, 2. Fisheries, 3. Coast and Hydrography, 4. Pollution and Litter.

3. The matrix will be directly utilized as an assessment tool supporting decision-making mechanisms at the different levels (regional, sub-regional, national, sub-national): the identification of the spatial and temporal (short, medium and long-term) scales is therefore an essential initial step of the overall analysis, including the elaboration of the matrix of interactions.

4. Altogether, 6 main economic sectors that challenge the health of the biodiversity in the Mediterranean region could be identified: agriculture, fishery, tourism, energy sector, maritime transport, urbanization and industry (Table 1). The starting point for identification of these economic sectors has been elaborated in Article 9 of the ICZM protocol, with some applied modifications. Namely, one additional sector was included, due to the presence and intensity in the Mediterranean region, as well as already known impacts to the environment: urbanization and industry. Linking urbanization and industry in one sector reflects the fact that industry is usually most intensive in the urbanization areas.

5. The understanding of sectors themselves, including their present state and anticipated future trends, represents an important first step for identification of pressures and impacts (Table 2) and their further assessment. Such an insight indicates what could be anticipated in terms of impacts of sectors to the marine biodiversity.

6. Based on existing assessment best practices, a two-step process for assessments may be recommended:

- First, an assessment of the predominant pressures and their impacts on the marine environment, including a mapping of the uses and activities in the marine environment, when appropriate, is necessary.

- Secondly, the assessment will concern the environmental status of marine ecosystems (including species and habitats), informed by the pressure and impact assessments under the first step.

7. There are different possible approaches to support the integrated assessment of predominant pressures and their impacts on the marine and coastal environment.

8. The purpose of this document is to provide a review of suitable tools to show the environmental status of the Biodiversity Ecological Objectives across the Mediterranean Sea and coasts, and pressures/impacts/state interactions.

Table 1. Snapshot of present state and anticipated future trends of the main economic sectors - sources of pressures to the coastal and marine biodiversity in the Mediterranean region. *Based on the FAO-GFCM (2018)[1], 2017 MED QSR[2], UNEP/MAP (2012)[3], UNEP/MAP1 (2016)[4] and Štrbenac (2017[5])*

Sector	Economic sectors' main features	Anticipated future trends
Agriculture	- Agriculture is mainly rain-fed - Over 85% -cereals, vegetable and citrus production (2,5 times increase of production when compared to 1960s) - Dependency on food import - Total surface of cultivated land is stable - Agriculture is still important part of the GDP	- Increase in human populations means increased need for food. Hence intensive agriculture is expected. On the other hand, climate change poses a threat to agriculture in the future and may affect agricultural yields.
Fishery	- Source of employment and cultural identity - Over 85% of fishing boats – small-scale fisheries - 89% of fish production is attributable to 8 countries (Italy, Tunisia, Algeria, Spain, Croatia, Greece, Turkey and Egypt) - 49% of catches – small pelagic fish - About 78% of fish stocks both in the Mediterranean and Black Sea are fished at unsustainable levels (however, decrease since 2014); The volume of fishery discards amounts to around 230 000 tonnes per year in the Mediterranean (around 18 percent of total catch) - Fish production meets one third of actual needs	- As in the case of agriculture, increased need for sea harvesting is expected. However, it is questionable whether this will be possible, due to already significant over-exploitation of the resources.
Tourism	- The largest global tourism destination – attracts 1/3 of tourists (306 million tourists) - Tourism is a vital part of the Mediterranean economy and important source of employment - Still spatial and seasonal concentration of the activity - Mass tourism predominantly	- By 2030 an increase to 500 million tourists is expected - Unsustainable development of mass tourism – more pressures to natural habitats
Energy sector	- The oil and gas exploration and production are still very active in the Mediterranean Basin - Use of renewables still modest	- Increase in fossil fuels exploration and exploitation is expected – new prospects in the Eastern Mediterranean, potentially in the southern Adriatic Sea etc. - Use of renewables is expected to increase – obligations from Paris Agreement

[1] 3. FAO (2018) The State of Mediterranean and Black Sea Fisheries. General Fisheries Commission for the Mediterranean. Rome. 172 pp. Licence: CC BY-NC-SA 3.0 IGO.
[2] 11. UNEP/MAP (2017). 2017 Mediterranean Quality Status Report (2017 MED QSR).
[3] 13. UNEP/MAP (2012). State of the Mediterranean Marine and Coastal Environment. UNEP/MAP – Barcelona Convention. Athens. 92 p
[4] 12. UNEP/MAP1 (2016). Mediterranean Strategy for Sustainable Development 2016-2025. Valbonne. Plan Bleu, Regional Activity Centre: 83 p.
[5] 7. Štrbenac, A. (2017). Overview of underwater anthropogenic noise, impacts on marine biodiversity and mitigation measures in the south-eastern European part of the Mediterranean, focussing on seismic surveys. A Report commissioned by OceanCare. Croatia and Switzerland. 75 p

Maritime transport	- Mediterranean is one of the busiest waterways – 10 - 15% of global shipping activities - Almost 2/3 of traffic is internal - Increase of size and capacities of merchant vessels - Oil and gas transport – largest vessels. Major transport axis - from east to west	- The forecast is an increase in traffic, linked in part to increased exports of crude oil from the Caspian region and the Black Sea. - Improved infrastructure in Central and Eastern Europe could lead to an increase in bulk cargo through the Adriatic ports
Urbanization and industry	- The Mediterranean is home to 480 million people, of which 1/3 is concentrated in coastal region, - Urban population growth has increased over last 60 years, - Industry is frequently located along the region's coasts in areas with high population density,	- Increase of urban population is expected (by 33 million until 2025, accompanied with industry development

Table 2. General overview of sectors with most adverse impacts on marine ecosystem components, focussing on species and habitats listed in the annexes of the SPA-BD Protocol and those with adopted conservation Action plans. *Based on threats identified in 9 species and habitats conservation Action Plans adopted in the framework of MAP and 2017 MED QSR*

Sectors – sources of pressures	Relevant activities/pressures and impacts to environment	Specific impacts on marine biodiversity	Affected species groups and habitats (SPA-BD Protocol)
Agriculture	Activities - pressures: • Intensive use of pesticides and fertilizers – agricultural runoffs • Watercourses regulation (for irrigation etc.) • Intensive use of plastics and storage bags (e.g.in areas with high concentration of greenhouses) Impacts: • Soil and sea-water pollution (eutrophication) • Physical destruction of environment	• Habitat loss and degradation (pelagic and benthic habitats), • Reduces species resilience to other threats • Reduction of population abundance • Incidental mortality of non-targeted and vulnerable species (e.g. through ingestion of plastics)	• Birds • Cetaceans • Coralligenous and maerl habitats • Dark habitats communities • Marine turtles • Marine vegetation (refers to macroalgae and seagrass) ~~(Algae)~~
Fishery	Activities - pressures: *Fishing* • Over-exploitation of marine resources • Bottom trawling (dredging) • Disposal of used fishing gear (ghost nets) • Illegal, unreported and unregulated fishing (IUU) *Aquaculture* • Nutrient build-up • Introduction of Non-indigenous species (NIS) • Wastewater dumping Impacts: • Physical destruction of environment • Depletion of food resources (both for humans and biodiversity) (fishing) or mitigation of pressures on natural resources (aquaculture) • Sea-water pollution (eutrophication) • Solid waste pollution • Facilitates spreading of invasive alien species (IAS)	• Habitat loss and degradation (particularly benthic habitats) • Reduction of food resources, • Incidental mortality of non-targeted and vulnerable species (bycatch) • Reduction of population abundance	• Birds • Cetaceans • Coralligenous and maerl habitats • Dark habitats communities • Fish (particularly cartilaginous f.) • Marine turtles • Marine vegetation • Monk seals • Non-indigenous Species
Tourism	Activities - pressures: • Touristic related infrastructure building – residential, recreational, roads • Intensive whale-watching • Increased wastewaters quantities and wastewater discharges • Increased use of water, electricity etc. • Intensive speed boats traffic (yachting) • Anchorage in sensitive areas • Increased solid waste production and disposal, particularly of plastic • Collection of threatened species specimen Impacts:	• Habitat loss and degradation (pelagic and benthic habitats) • Species populations disturbance • Incidental mortality (collisions) • Reduction of population abundance	• Birds • Cetaceans • Coralligenous and maerl habitats • Dark habitats communities • Marine turtles • Marine vegetation • Monk seals

	• Physical destruction of the environment • Sea-water and soil pollution, including solid waste pollution (microplastics) • Underwater noise pollution • Disturbance		
Energy sector	Activities- pressures: • In general, promotion of use of fossil fuels (gas and oil) • Exploration of fossil fuels (use of sonar) • Fossil fuels exploitation (sea-bed mining), processing and storage infrastructure (on and offshore), cables and pipelines, • Onshore and offshore renewables structures • Oil spills Impacts: • Promotes climate change • Climate change facilitates spreading of invasive alien species (IAS) • Underwater noise pollution • Sea-water pollution	• Habitat loss and degradation (pelagic and benthic habitats) induced by climate change • Species populations disturbance • Population relocations • Incidental mortality	• Birds • Cetaceans • Coralligenous and maerl habitats • Dark habitats communities • Marine turtles • Marine vegetation
Maritime transport	Activities-pressures: • Intensive maritime traffic, particularly in sensitive areas with use of higher speed • Maritime transport infrastructure (e.g. ports, corridors for spreading of IAS, etc.) • Possible accidents • Ballast water discharges Impacts: • Facilitates spreading of invasive alien species (IAS) • Underwater noise pollution, • Sea-water pollution	• Habitat loss and degradation (particularly pelagic habitats) • Species populations disturbance • Populations relocations • Incidental mortality (collisions)	• Cetaceans • Marine turtles • Marine vegetation • Molluscs
Urbanization and industry	Activities - pressures: • Change of land use • Infrastructure building - residential and business, roads etc. • Extraction of construction materials (sand, minerals) • Watercourses regulation • Desalinization • Intensive use of water, electricity and other resources • Intensive traffic • Increased wastewater quantities and wastewater discharges • Increased solid waste production and disposal (microplastics) Impacts: • Physical destruction of environment • Sea-water pollution (eutrophication), including solid waste pollution • Increased traffic promotes climate change • Facilitates spreading of invasive alien species (IAS) • Light pollution	• Habitat loss and degradation (pelagic and benthic habitats), • Species populations disturbance • Incidental mortality • Reduction of population abundance (for sedentary species) or populations relocations	• Birds • Coralligenous and maerl habitats • Dark habitats communities • Marine turtles • Marine vegetation

2. Assessing interrelations of pressures and impacts on the biodiversity cluster

2.1. Methodological approaches and assessment

9. There are several methodological approaches to assess interrelations of predominant pressures and impacts on the biodiversity, which reflect on the health/state of environment, and to support the integrated assessment under IMAP. For the purpose of this document, altogether 3 concrete methodological approaches are considered, all based on Driver-Pressure-State-Impact-Response (DPSIR) assessment. These approaches are already acknowledged and approved for pollution related Ecological Objectives by the Meeting of CORMON on Pollution Monitoring in 2019:

1. GRID/Table – qualitative approach
2. SCOREBOARDS/SCORECARDS METHOD – semi-quantified approach
3. NEAT approach – quantified approach

2.1.1. GRID/Table approach

10. Pressures can be considered in two ways: (i) at source, i.e. the activity generating the pressure; this aspect is relevant for setting environmental targets and defining measures aiming at reducing the pressures in order to achieve or maintain GES; and (ii) at sea, i.e. the level of pressure in the marine environment to which the different elements of the ecosystem are subjected; this aspect is particularly relevant for determining GES for both IMAP pressure-based and status based Common Indicators.

11. The GRID/Table is qualitative methodological approach, where relation of pressure to particular IMAP's Common Indicator is assessed against descriptive criteria, based on available data and best experts judgement. As such, this approach is appropriate when precise, quantitative data are limited or not available, which is the case with biodiversity data, but also with data on intensity and impacts of some pressures. This scarcity of data is particularly evident during state of environment assessments, such as 2017 Mediterranean Quality Status Report. Indeed, one of the major gaps identified in the 2017 MED QSR is a lack of baseline data.

12. Table 3 provides a tabular representation of interactions between anthropogenic pressures and impacts on biodiversity, as measured by IMAP Common Indicators grouped under the Ecological Objective 1 – Biodiversity. As such, it represents an example of application of GRID/Table, which is already presented in the 2018 UNEP/MED WG.450/3 report. However, this original Table was amended with economic sectors causing the particular pressures, as a reminder about necessity to address these sectors in order to mitigate pressures and associated impacts. This approach was further refined with assessment at sub-regional level, as shown in Table 4. Taking into account a need to prioritise actions towards particular sectors, this initial assessment is focussed on the most significant interactions identified under Table 3.Sub-region as scale of assessment has been chosen both for species and habitats (although IMAP proposes finer division for certain species and habitats (sub-division), foremostly due to limited knowledge, particularly for the southern and central part of the region.

13. In any case, the results of GRID/Table assessments point out the urbanization and industry as the most problematic sector for the biodiversity (Table 3). Furthermore, the most significant interactions between pressures and impacts are those related to coastal urbanization and climate change. The mostly challenged EO1 Common Indicators are CI1 Habitat distributional range and CI4 Population abundance, whilst CI3 Species distribution is still not significantly affected.

14. At the sub-regional level, the mostly pressured region is the Western Mediterranean (Table 4). On the other hand, Central and Ionian Sea seem to be least affected, which is partly related to lack of solid data from this region. The climate change is the most significant specific pressure relevant for all Common Indicators and in particular in the Adriatic Sea, as semi-enclosed area. However, the results of this initial assessment should be taken with the caution and as a start for further refinement upon improvement of knowledge.

Table 3. Tabular representation of interactions between anthropogenic pressures and impacts to biodiversity as measured by IMAP Common indicators under the EO1 Biodiversity and related to specific economic sectors (GRID/Table tool). *Extracted ~~and adjusted~~ from the 2018 UNEP/MED WG.450/3 and amended with relevant economic sectors*

Main pressures deriving from economic sectors/activities / Common indicators EO1	**Agriculture**	**Fishery**				**Tourism**						**Energy sector**						**Maritime transport**		**Urbanization and industry**						
	Agriculture runoffs	Aquaculture	Dredging (bottom trawling)	Fishing (incl. recreational)	Sea-based food harvesting	Solid waste disposal (used fishing gear, ghost	Coastal artificialization	Coastal urbanization	Damming (demand on water)	Solid waste disposal (communal waste)	Tourism frequentation	Wastewater discharges	Yachting	Cables and pipelines	Climate change	Marine mining	Oil and gas extraction	Offshore structures	Renewable energy	Storage of gases (infrastructure)	Port operations	Shipping	Climate change	Coastal artificialization	Coastal urbanization	Damming (demand on water)	Desalinization	Industry	Solid waste disposal (communal waste)	Wastewater discharges
CI1 Habitat distributional range																														
CI2 Condition of habitats species																														
CI3 Species distribution																														
CI4 Population abundance																														
CI5 Population demography																														

	Significant contribution of pressure to the biodiversity CI
	Minor contribution of the pressure to the biodiversity CI
	No pressure, but possible development of pressure to the biodiversity CI
	No contribution to the biodiversity CI

Table 4. Initial assessment of interrelationships between the most significant anthropogenic pressures (as identified in Table 3) and impacts on biodiversity, as measured by the IMAP Common Indicators under EO1 Biodiversity at sub-regional level (GRID/Table tool).

Based on the 2018 UNEP/MED WG.450/3, 2019 UNEP/MED WG.467/7, 2017 MED QSR

Pressures / **EO 1 Common Indicators**	**SUBREGION**	Climate change	Coastal artification	Coastal urbanization	Dredging	Fishing	Industry	Marine mining	Port operations	Solid waste	Tourism frequentation	Wastewater discharges
CI 1 Habitat distributional range	Western Mediterranean Sea											
	Adriatic Sea											
	Central and Ionian Seas											
	Aegean and Levantine Seas											
CI 2 Condition of habitats species	Western Mediterranean Sea											
	Adriatic Sea											
	Central and Ionian Seas											
	Aegean and Levantine Seas											
CI 3 Species distribution	Western Mediterranean Sea											
	Adriatic Sea											
	Central and Ionian Seas											
	Aegean and Levantine Seas											
CI 4 Population abundance	Western Mediterranean Sea											
	Adriatic Sea											
	Central and Ionian Seas											
	Aegean and Levantine Seas											
CI5 Population demography	Western Mediterranean Sea											
	Adriatic Sea											
	Central and Ionian Seas											
	Aegean and Levantine Seas											

	Significant contribution of pressure to the biodiversity CI
	Minor contribution of the pressure to the biodiversity CI
	No pressure, but possible development of pressure to the biodiversity CI
	No contribution to the biodiversity CI

2.1.2. Scoreboards/scorecards method: Quantifying pressures/impacts relationships; risk-based approach

15. Mapping of pressures/impacts relationships can be done using a risk-based approach. This approach is particularly effective for Ecological Objectives that are spatially patchy and where pressures are applied at specific locations. It is recommended to map the pressures that are most likely to have significant impacts, considering the vulnerability of various elements of the ecosystem.

16. Risk-based scoreboard approach is similar to the GRID/Table approach; however, it uses numeric scores (i.e. assignment of a numeric value by categories) rather than colours alone, to allow calculating derived quantitative information. It is important to stress that scoreboards methodology relies on solid data.

17. There are several scoreboard approaches that may be used for the mapping of distribution of pressures and assessment of their impacts over different ecosystem components, notably the vulnerability assessment of coastal zone, as cumulative assessment already performed in the coastal area of Montenegro in the scope of the Coastal area management programme for Montenegro (CAMP MNE) project, implemented under guidance of PAP-RAC and UN Environment-MAP (Figure 1, Annex 1). This approach could guide next steps to develop the matrixes for quantifying the spatial distribution of pressures and their impacts over different marine ecosystem components

18. Another useful approach is to map interrelations between particular pressures and biodiversity components, which may be further used as one of the layers for cumulative assessment. Such an example is a mapped overview of the noise hotspots in the ACCOBAMS area, assessing pressure of underwater noise from different sources on cetaceans (Figure 2, Annex 1).

19. An attempt was made in this report to quantify to some extent the significance of pressures and their impacts on biodiversity, using variation of scoreboards method. The main criteria for such assessment are the extent of geographical coverage of pressures, as well as severity of potential/anticipated impacts on biodiversity (encompassing all components of biodiversity) (Table 5). The scores are associated to partially quantified values, based on best expert judgement. Again, pressures and impacts are linked to the sectors – drivers and sources of pressures. Such an approach provides a good overall and more tangible indication to decision-makers and other stakeholders to set priorities for concrete nature conservation actions.

20. However, the quality of this particular assessment exercise is also challenged with already mentioned data limitation. Several issues should be pointed out in particular: limited information for the southern part of the region; limited knowledge about some pressures, e.g. extent and severity of solid waste disposal as by-product of from fishery (ghost-nets, discard fishing gear etc.), extent of ballast waters coming from ships etc.; and very limited knowledge about impacts on biodiversity. Still, the results of current assessment indicate that urbanization and industry, tourism and fishery are most significant sectors causing pressures and impacts on biodiversity in the Mediterranean, with building of coastal infrastructure (linked to urbanization and industry) and over-exploitation of marine resources due to fishery as most significant specific pressures.

Table 5. Significance of sectors and pressures affecting biodiversity in the Mediterranean region, based on geographical extent and intensity of pressures and severity of impacts on all biodiversity components (variation of scoreboard method). *Based on data from 2017 MED QSR, UNEP/MAP (2012), UNEP/MAP[1] (2016) and Maglio et al, 2016 and related to Tables 1 and 2 of this report*

Sector – source of pressures	Pressures	Geographical extent of pressure*	Severity of impact**	Probable significance of pressure (sum of assessed pressures and impacts))	Overall significance
Agriculture	Agricultural runoffs	High	Medium to High	Medium to High	**Medium to High**
Fishery	Over-exploitation of marine resources, including dredging	High	Very High	High to Very High	**High**
	Solid waste disposal (fishing gear, ghost nets)	Not known	Medium	Probably Medium	
	Aquaculture	Medium	Low to Medium	Medium	
Tourism	Touristic infrastructure	High	High	High	**High**
	Wastewater discharges	High	High	High	
	Solid waste disposal	High	Medium to High	Medium to High	
	Speed boats and yachting	Medium	Medium	Medium	
Energy sector	Exploration and exploitation of fossil fuels	Medium	Very high***	High	**Medium to High**
	Onshore and offshore infrastructure	Medium to High	Low to Medium	Medium	
Maritime transport	Marine traffic routes	Very High	Medium to High****	High	**Medium**
	Port infrastructure	Medium	Medium	Medium	
	Possible accidents (oil spills)	Medium	Medium	Medium	
	Ballast waters	Probably Medium	Medium to High****	Medium to High	
Urbanization and industry	Coastal infrastructure	Very High	Very High	Very High	**High**
	Wastewater discharges	High	High	High	
	Solid waste	High	High	High	
	Desalinization	Low	Medium	Low to Medium	

*Estimation of geographical presence of pressure: Low - pressure present in less than 20% of coastal and marine area, Medium – 20-50%, High – 50 – 75% and Very high – 75 – 100 %

** Estimation of severity of impacts on biodiversity caused by the pressure: Low – pressure has no impact or barely detectable impact; Medium – pressure has a detectable impact, but impact is still not considered significant; High –pressure already causes significant reduction of biodiversity or it will be if it continues to operate at current level; Very high – pressure already causes severe loss of biodiversity or it will in the foreseeable future, if it continues to operate at current levels

***Major cause of climate change, which further facilitates spreading of invasive alien species

****One of the important vectors of invasive alien species

2.1.3. NEAT approach

21. The Nested Environmental Status Assessment Tool (NEAT) is a pioneering tool and software developed specifically to assess the state of marine environment. NEAT is primarily targeted to the GES assessment under MSFD, but it is applicable for other similar assessments. At the moment, it is focussed on biodiversity assessment. It uses a nested hierarchies of pre-defined spatial assessment units (SAU) and habitats within these units, combined with ecosystem components (such as fish, benthic fauna etc.) and associated indicators. NEAT software already includes a set of over 500 indicators, but it allows a flexibility to expand this list. The final NEAT values is calculated as a weighted mean of all indicator values assigned to certain SAU or combination of SAU and habitats or ecosystem components. NEAT software is freely available at www.devotes-project.eu/neat. NEAT has already been discussed and applied at various scales in the framework of different projects. In the study of Pavlidou et al. (2019 NEAT was able to show clear spatial gradients differentiating the impacted and slightly impacted areas and the response of the ecosystem towards some management measures. As such, NEAT has a potential to be applied at the Mediterranean scale, which is already a subject of the MEDCIS project. However, in order for NEAT to function, it is of vital importance to feed it with adequate quantitative data. This is by far the main challenge in application of this approach.

2.1.4. Other approaches

22. There is a need to link the state of the marine ecosystem with other mankind dimensions, namely, ecosystem services (i.e. food provision, tourism activities, coastal livelihoods, natural resources, etc.) and economic activities beyond the marine ecosystem boundaries; but affecting it. There is also a need to better manage and communicate their status and trends to decision-makers. One solution is to use composite indicators and indices, such as the Ocean Health Index (OHI) or the Environment Vulnerability Index (EVI). This approach is very much encouraged by the United Nations Environment Programme (UNEP) Regional Seas Programme (RSP), Global Environment Facility-Large Marine Ecosystem Projects (GEF-LMEs), as well as the SGD 14 (Agenda 2030).

3. Conclusions and recommendations

Conclusions	Recommendations
• Due to limited knowledge on state of biodiversity, as well as pressures and impacts on biodiversity, only GRID/Table approach, as a qualitative assessment of interrelations between pressures and impacts on state of biodiversity, could be applied more adequately at the Mediterranean level. • Refinement of GRID/Table methodological approach to reflect the situation at the sub-regional level is possible to some extent, although this is particularly challenged with lack of knowledge for the southern part of the Mediterranean Sea • When combined with economic sectors, as drivers of pressures, GRID/Table approach provides a good basis for decision-making and planning priority actions to mitigate pressures to marine environment and addressing specific sectors for that purpose	• The use of GRID/Table methodological approach for assessing interrelations between economic sectors and activities, pressures, impacts on state of marine biodiversity is recommended at the moment as the best applicable methodological approach for the Mediterranean level assessments. Existing assessments (as presented in the Table 3) should be revisited and amended periodically (e.g. after preparation of the MedQSR 2023 report). In this regard, needs to validate scoring system with experts and define more clearly confidence intervals on results should be taken into account. • Further refinement of GRID/Table approach at sub-regional level is recommended • In order to allow better future assessments at more detailed scales, knowledge about pressures and impacts should be improved, based on implementation of the systematic monitoring of state of biodiversity components, adequate data processing and sharing,
• The applied variation of the scoreboard method, as semi-quantitative method, has a potential to provide more concrete insight into interrelations between economic sectors, pressures, impacts and state of marine biodiversity and good tool for decision-makers. However, the current level of knowledge on biodiversity hinders the quality of such assessment. • There are already useful tools for spatial pressure-impact-state analysis, such as vulnerability assessment of coastal zone and mapping of pressure-biodiversity impact hot-spots. • NEAT is a ~~very~~ useful tool and software for spatial level assessments of state of marine environment, but its functionality requires more	• The use of tools for spatial pressure-impact analysis, with focus on analysis of cumulative and synergistic impacts, should be further tested and promoted, • The future interrelations assessments at Mediterranean and sub-regional levels should be aimed at application of more quantitative approaches, such as scoreboard method and NEAT. However, until baseline data are improved at regional level, these methods should be used whenever more data are available; possibly at national levels or sub-levels. Such small-scale level approaches could

precise quantitative data on specific indicators. Hence, its application is not yet possible for Mediterranean level.	be a good opportunity for testing application of these methods at broader level.

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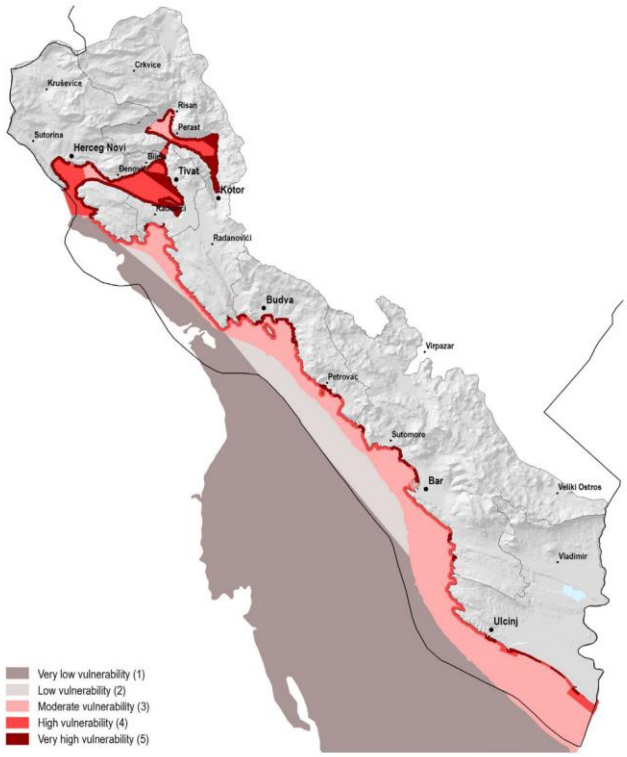

Figure 1. Cumulative vulnerability of the sea in Montenegro (average value). *Extracted from the National strategy on ICZM for Montenegro – CAMP Montenegro, 2015*

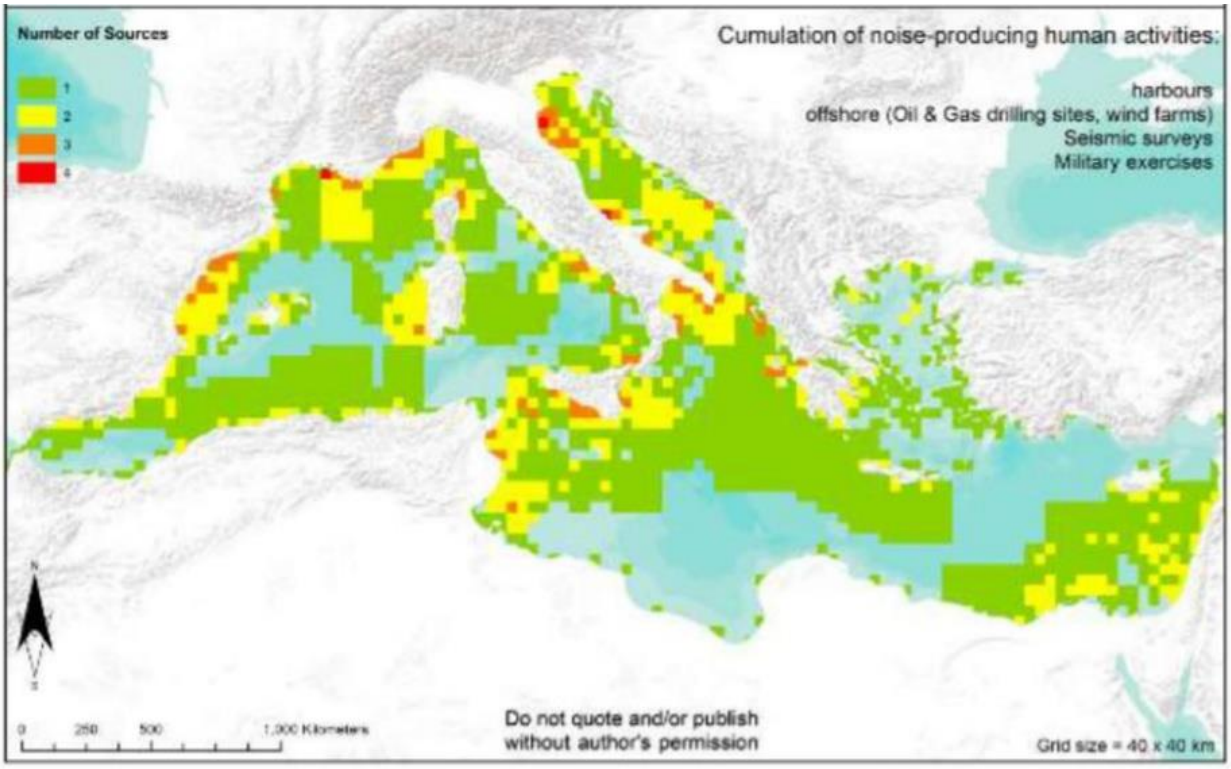

Figure 2. Noise Hotspots: Number of noise-producing human activities over a 40 x 40 km spatial grid.
Extracted from Maglio et al, 2016