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Thirteenth Meeting of Focal Points for Specially Protected Areas

Alexandria, Egypt, 9-12 May 2017

Agenda item 9: Assistance in the implementation of the first phase of the Integrated Monitoring and Assessment Programme (IMAP) on biodiversity and non-indigenous species in the framework of the EcAp roadmap

Draft factsheets for the implementation of the Integrated Monitoring and Assessment Programme (IMAP) related to the Ecological Objectives 1 (EO1, Biodiversity) and 2 (EO2, Non-Indigenous Species (NIS)) under the Ecosystem Approach process (EcAp) of the Barcelona Convention.

UNEP/MAP
SPA/RAC - Tunis, 2017

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INTRODUCTION

1. The Contracting Parties to the Barcelona Convention have emphasized the importance of the Ecosystem Approach (EcAp) process to the management of human activities with a view to conserving natural marine heritage and protecting vital ecosystem services. Considerable effort has been devoted since 2008 to implement this vision and strategic goal, through a roadmap including seven key steps.

2. The progress achieved to date in the implementation of the seven step process (identified for moving towards a more effective management) is reflected in several decisions adopted during the last ordinary Meetings of the Contracting Parties (i.e. Decision IG.17/6 of COP 15, Decision IG.20/4 of COP 17, Decision IG.21/3 of COP 18)

3. The 19th ordinary Meeting of the Contracting Parties (COP 19), held in Athens, in February 2016, adopted the Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (Decision IG.22/7). This Decision includes a specific list of good environmental status common indicators and targets, and principles of an integrated Mediterranean Monitoring and Assessment Programme, next to a clear timeline for the implementation of such programme.

4. IMAP, through Decision IG.22/7, lays down the principles for an integrated monitoring, regarding 11 Ecological Objectives and their related 27 common indicators belonging to three clusters: Biodiversity and Fisheries, Pollution and Marine litter, and Coast and Hydrography.

5. The common indicators to be monitored and assessed in relation to biodiversity (EO1), non-indigenous species (EO2) as well as fisheries (EO3) were also detailed in the decision.

6. During the initial phase of IMAP (2016-2019), the Contracting Parties will:

- Update their existing monitoring programmes (2016-2017) in order to cover the IMAP areas, common indicators in line with the IMAP, and, based on the Integrated Monitoring and Assessment Guidance, and Common Indicator Fact Sheets. It has to be noted that a number of Contracting Parties have already developed integrated national monitoring programmes;
- Continue reporting based on their existing national monitoring programmes until they are updated into a national Integrated Monitoring Programme;
- Following the update of their existing monitoring programmes, report quality assured data following a common regional monitoring reporting template;
- During national implementation, the Contracting Parties are encouraged to coordinate within and between each other in order to use resources in an efficient way. Shared

monitoring stations and activities, information, and data could be steps towards this direction.

7. In light of the above, Guidance factsheets and Assessment factsheets were elaborated in order to provide to the Contracting Parties with concrete guidance to (i) support the implementation of their revised national monitoring programme towards the overall goal of implementing the Ecosystem Approach (EcAp) in the Mediterranean Sea and achieving Good Environmental Status (GES), and (ii) evaluate the status of the environment and then distance from EcAp targets, ecological objectives and Good Environmental Status (GES) description, respectively.

8. Guidance factsheets (UNEP(DEPI)/MED WG.430/3) and Assessment factsheets (UNEP(DEPI)/MED WG.430/4) were initially presented and reviewed during the Meeting of the Correspondance Group on Monitoring (CORMON) Biodiversity and Fisheries held in Madrid, Spain, from 28 February to 1 March 2017.

9. Participants to the CORMON meeting on Biodiversity and Fisheries provided suggestions, comments and recommendations pertaining to further work on indicators with a view to revising and finalizing the factsheets for consideration by the EcAp Coordination Group, the MAP Focal Points meeting and eventually COP 20.

10. Due to the tight time frame between the CORMON and the SPA Focal Point meetings, Guidance and Assessment factsheets, presented in the present document, were only partially reviewed taking into consideration the recommenadtaions and conclusions of the CORMON meeting. Further work is needed in order to have the final draft of theses factsheets.

11. For this aim, the present draft will be shared online (into an owncloud portal) before the SPA Focal Points meeting for any comment or suggestion from the Parties. The ensuing draft will be presented to the EcAp Coordination Group meeting (late May 2017), then to the MAP Focal Points meeting (mid-September 2017) for endorsement, and ventually to COP 20 (December 2017) for adoption. The adopted Guidance and Assessment factsheets will be used as basis for future reporting.

I. Common indicators guidance factsheets

1. Common Indicator 1: Habitat distributional range (EO 1)

<table>
<tr><td>Indicator Title</td><td colspan="3">Common Indicator 1: Habitat distributional range</td></tr>
<tr><td>Relevant GES definition</td><td>Related Operational Objective</td><td colspan="2">Proposed Target(s)</td></tr>
<tr><td rowspan="2">The habitat is present in all its natural distributional range</td><td rowspan="2">Coastal and marine habitats are not being lost</td><td>State</td><td>Pressure</td></tr>
<tr><td>The ratio Natural / Observed distributional range tends to 1</td><td>Decrease in the main human causes of the habitat decline</td></tr>
<tr><td colspan="4">Rationale</td></tr>
<tr><td colspan="4">Justification for indicator selection
The loss of habitat extent i.e. from infrastructure developments and by damage from physical activities such as trawling and possibly damage from pollution is an important factor to monitor and assess. The indicator is in principle applicable to all habitat types across the Mediterranean region and it is considered to be highly sensitive to physical pressures.</td></tr>
<tr><td colspan="4">Scientific References
List (author(s), year, Ref: journal, series, etc.) and url's
Andersen et al., 2013
• Coggan, R., Populis, J., White, J., Sheehan, K., Fitzpatrick, F., Peil, S. (eds) (2007) Review of standards and protocols for seabed habitat mapping, 192pp.
• Coll, M., Piroddi, C., Albouy, C., Lasram, F.B.R., Cheung, W.W.L., et al. 2012. The Mediterranean Sea under siege: spatial overlap between marine biodiversity, cumulative threats and marine reserves. Glob. Ecol. Biogeogr. 21, 465–480.
• Giakoumi, S., Sini, M., Gerovasileiou, V., Mazor, T., Beher, J., et al. 2013. Ecoregion-based conservation planning in the Mediterranean: dealing with large-scale heterogeneity. PLoS ONE 8(10): e76449. doi:10.1371/journal.pone.0076449.
• Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., et al., 2008. A global map of human impact on marine and coastal ecosystems. Science 319, 948–952.
• Halpern, B.S., Kappel, C.V., Selkoe, K.A., Micheli, F., Ebert, C.M., et al. 2009. Mapping cumulative human impacts to California current marine and coastal ecosystems. Conserv. Lett. 2, 138–148.
• Kappel, C.V., Halpern, B.S., Napoli, N., 2012. Mapping Cumulative Impacts of Human Activities on Marine and coastal ecosystems. Coastal and Marine Spatial Planning Research Report 03.NCEAS.12). Sea Plan, Boston. 109pp.
• Korpinen S., Meidinger M., Laamanen, M., 2013. Cumulative impacts on seabed habitats: An indicator.for assessments of Good Environmental Status. Mar. Poll. Bull., 74: 311–319.
• Micheli F, Halpern BS, Walbridge S, Ciriaco S, Ferretti F, et al. 2013. Cumulative Human Impacts on Mediterranean and Black Sea Marine and coastal ecosystems: Assessing Current Pressures and Opportunities. PLoS ONE 8(12): e79889.
• ,</td></tr>
<tr><td colspan="4">Policy Context and targets (other than IMAP)</td></tr>
<tr><td colspan="4">Policy context description
The CORMON Biodiversity and Fisheries Meeting (Ankara 26-27 July, 2014) recommended that loss of habitat extent is typically more important/at higher risk, with loss of distributional range only secondarily at risk.</td></tr>
<tr><td colspan="4">Indicator/Targets
This indicator is an area-related indicator, i.e. proportion of the area of habitats that are permanently or for a long-lasting period lost or subject to change in habitat-type due to anthropogenic pressures. As a target, the damaged or lost area per habitat type, especially for physically defined and not biogenic habitats could be set as to not exceed an acceptable percentage of the baseline value. As an example, this target was derived from OSPAR to not exceed 15% of the baseline value and was similarly proposed by HELCOM.
For habitats under protective regulations (such as those listed under the SPA/Biodiversity Protocol, EU Nature directives) the target could be set as habitat loss stable or decreasing and not greater than the baseline value. As an example, as regards the EU guidance for the assessment of conservation status under the Habitats Directive, Member States have generally adopted a 5% tolerance above the baseline to represent "stable". However, in</td></tr>
</table>

Indicator Title	*Common Indicator 1: Habitat distributional range*

some cases a more stringent <1% tolerance has been attached to the maintenance of habitat extent.

A list of the basic marine habitat types – at higher level – to be considered within this indicator is given below (supralittoral habitats are excluded). This list is based on the RAC/SPA Reference List of Marine and Coastal Habitat Types in the Mediterranean (see the RAC/SPA Reference List for a more detailed classification).

II.1 Mediolittoral muds, sandy muds and sands
II.2. Mediolittoral sands
II.3. Mediolittoral stones and pebbles
II.4. Mediolittoral hard beds and rocks
III.1. Infralittoral sandy muds, sands, gravels and rocks in euryhaline and eurythermal environment
III.2. Infralittoral fine sands with more or less mud
III.3. Infralittoral coarse sands with more or less mud
III.4. Infralittoral stones and pebbles
III.5. Infralittoral *Posidonia oceanica* meadows
III.6. Infralittoral hard beds and rocks
IV.1. Circalittoral muds
IV.2. Circalittoral sands
IV.3. Circalittoral hard beds and rocks
V.1. Bathyal muds
V.2. Bathyal sands
V.3. Hard beds and rocks
VI.1 Abyssal muds

Specific attention should be given to the types of marine habitats (defined at different levels) covered by the Updated Reference List of Marine Habitat Types for the Selection of Sites to be included in the National Inventories of Natural Sites of Conservation Interest in the Mediterranean (UNEP/MAP-RAC/SPA 2017) and EU Nature directives. Marine habitat types in *Annex I* of the EU Habitats Directive (92/43/EEC), based on MSFD Common Implementation Strategy (2012), with the exclusion of estuarine habitats, is given below:

1110 – Sandbanks which are slightly covered by sea water all the time
1120* – *Posidonia* beds (*Posidonion oceanicae*)
1140 – Mudflats and sandflats not covered by seawater at low tide
1160 – Large shallow inlets and bays
1170 – Reefs
1180 – Submarine structures made by leaking gasses
8330 – Submerged or partially submerged sea caves
** Priority habitats*

Policy documents
List and url's

- SPA/Biodiversity Protocol (http://www.rac-spa.org/protocol)
- EU Nature directives (http://ec.europa.eu/environment/nature/info/pubs/directives_en.htm)
- OSPAR (http://www.ospar.org/)

Indicator analysis methods

Indicator Definition

This area-related indicator could be described as the proportion of the area of habitats that are permanently or for a long-lasting period lost or subject to change in habitat-type due to anthropogenic pressures, and is closely linked to condition elements (i.e., if a habitat condition is sufficiently poor and irrecoverable, it is lost).

Methodology for indicator calculation

Three options have been identified for the assessment of this indicator:

1. The use of condition indices and a representative sampling and assessment in a restricted number of areas with subsequent extrapolation into the larger area
2. Modelling habitats and mapping against impacts and spatial pressure intensity data. It may also be possible to combine options 1 and 2.
3. Direct monitoring of habitats

Indicator units

The parameter/metric for the assessment of this indicator is the surface area of lost habitat for each habitat type.

<table>
<tr><td>Indicator Title</td><td>Common Indicator 1: Habitat distributional range</td></tr>
<tr><td colspan="2">It is suggested to largely use cumulative impact data derived from knowledge of anthropogenic pressures.</td></tr>
<tr><td colspan="2">List of Guidance documents and protocols available
• RAC/SPA Protocol for the Posidonia meadows monitoring networks[1]
• RAC/SPA Protocol for the monitoring of coralligenous community[2]</td></tr>
<tr><td colspan="2">Data Confidence and uncertainties
The identification of habitat sites in marine areas away from the coast has to be based on more general geological, hydrological, geomorphological and biological data than is the case for coastal or terrestrial areas. Where the location of sub-littoral habitat types is not already known, they can be located in two steps using available data: (1) broad scale geophysical or oceanographic information is often available for large sea areas, and can be used as the first step in the selection of sites by helping to identify the location of potential habitats; (2) step two then involves focused information gathering or new surveys, directed to those specific areas where existing information indicates that a habitat type is present or is likely to be present. This approach is particularly useful for Contracting Parties with large sea areas and deep waters, where detailed biological information is likely to be sparsely distributed. Collation of data should involve examination of scientific archives and data from relevant academic, government, NGO, and industry stakeholders. This information can include historical charts of relevant seabed features and fishing grounds.
Data regarding human activities causing habitat loss have been usually produced by projects requiring licensing procedures and Environmental Impact Assessments (e.g. wind farm constructions, sediment extraction). Therefore, relevant data should be available to Contracting Parties. A range of activity data regarding habitat damage caused by other activities (e.g. fishing) is also available from various sources (e.g. VMS or log book data for larger fishing vessels that undertake bottom trawling). On the basis of these data it should then be decided on a case by case basis, applying a risk based approach, where to focus monitoring/sampling efforts to validate, extrapolate or measure habitat area.</td></tr>
<tr><td colspan="2">Methodology for monitoring, temporal and spatial scope</td></tr>
<tr><td colspan="2">Available data sources
Sources and url's
UKSeaMap 2010 - predictive mapping of seabed habitats : http://jncc.defra.gov.uk/ukseamap
EMODnet Seabed Habitats (EUSeaMap) project : http://jncc.defra.gov.uk/euseamap
EMODnet Human Activities : http://www.emodnet.eu/human-activities
Recent European projects have produced updated habitat lists and catalogues with habitat map resources (e.g. CoCoNet, NETMED, MAREA-Mediseh, MERCES).</td></tr>
<tr><td colspan="2">Spatial scope guidance and selection of monitoring stations
Considering that the monitoring under IMAP should follow a risk-based approach, the reference sites to be monitored should be located in zones with infrastructure developments or significant physical activities having the potential to generate damages to the marine habitats (dredging, trawling activities, etc.). Possible damage from pollution should be also considered.

For the marine areas located away from the coast, the identification of monitoring sites has to be based on general geological, hydrological, geomorphological and biological data.

The monitoring programmes of each Contracting Party should cover the reference habitat in at least two monitoring areas :
- low pressure area (e.g. marine protected area/Specially Protected Area of Mediterranean Importance)
- high pressure area from human activity

The monitoring sites should be selected among those which can showcase the relationship between environmental pressures and their main impacts on the marine environment.[3]</td></tr>
</table>

[1] Pergent G., 2007. Protocol for the setting up of Posidonia meadows monitoring systems. «MedPosidonia» Programme / RAC/SPA - TOTAL Corporate Foundation for Biodiversity and the Sea; Memorandum of Understanding N°21/2007/RAC/SPA_MedPosidonia Nautilus-Okianos: 24p + Annexes.

[2] RAC/SPA - UNEP/MAP, 2014. Monitoring Protocol for Reefs - Coralligenous Community. By Garrabou J, Kipson S, Kaleb S, Kruzic P, Jaklin A, Zuljevic A, Rajkovic Z, Rodic P, Jelic K, and Zupan D. Ed. RAC/SPA - MedMPAnet Project, Tunis. 35 pages + annexes.

[3] Criteria for the selection of representative monitoring sites:

Indicator Title	*Common Indicator 1: Habitat distributional range*	
Temporal Scope guidance Consistent scales and methods will be necessary for mapping a given habitat in a sub-region. The time of sampling should be synchronised for a sub-region so as to standardize the influence of seasonal, inter-annual or climate-related changes on results. Intervals of 3-6 years are probably appropriate when non-invasive surveys (e.g. side scan sonar, video) or models (to be validated by optimized sampling) are used for mapping.		
Data analysis and assessment outputs		
Statistical analysis and basis for aggregation No statistical analyses are needed for this assessment.		
Expected assessments outputs *I.e. trend analysis, distribution maps etc, and methods used* In general terms, the following steps should be part of the indicator's assessment: • Generate maps of the marine habitats in each Contracting Party's marine areas; • Attribute a specific sensitivity to physical pressures to different habitat types; • Collate spatial and temporal pressure intensity data (e.g. VMS or log book data for fisheries, activity data from approved plans and projects); • If vulnerability is addressed in the first three points, deduce impacts from either (i) known pressure/impact relationships, using reference sites and risk based monitoring of selected stations (link to condition indices), or (ii) mapping cumulative impact models (with ground- truthing); • If vulnerabilities are not addressed in first three points, derive measures of habitat extent; • Determine whether the target is reached (i.e. proportion of lost or damaged area, related to total area the habitat type, above which GES is not achieved).		
Known gaps and uncertainties in the Mediterranean Information sources on the distribution of habitats are substantially greater for the northern than the southern coasts of the Mediterranean Sea.		
Contacts and version Date		
Key contacts within UNEP for further information		
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V.2	14/04/2017	SPA/RAC

- Where pressures to and risks to/effects on biodiversity are most strongly associated, following a risk based approach(vulnerable habitats and species locations);
- Where most information/historic data are available;
- Where well established monitoring (in general, not only for biodiversity) is already undertaken
- Sites of high biodiversity importance and conservation interest (according to national, regional or international regulations);
- Expert opinion.

2. Common indicator 2: Condition of the habitat's typical species and communities (EO 1)

Indicator Title	*Common indicator 2: Condition of the habitat's typical species and communities*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The population size and density of the habitat-defining species, and species composition of the community, are within reference conditions ensuring the long term maintenance of the habitat	Coastal and marine habitats are not being lost	**State:** -No human induced significant deviation of population abundance and density from reference conditions -The species composition shows a positive trend towards reference condition over an increasing proportion of the habitat (for recovering habitats)
Rationale		
Justification for indicator selection The concept of "typical species" emerges from the conservation status of natural habitats to their long-term natural distribution, structure and functions, as well as to the long-term persistence of their typical species within the territory. Therefore, typical species composition should be near/close to natural conditions for their habitat to be considered in natural condition.		
Scientific References *List (author(s), year, Ref: journal, series, etc.) and url's* • Pérès JM, Picard J (1964) Nouveau manuel de Bionomie benthique de la Mer Méditerranée. Recueil des Travaux de la Stations Marine d'Endoume, 47: 3-137. • Templado, J., Ballesteros, E., Galparsoro, I., Borja, A., Serrano, A., Marín, L., Brito, A., 2012. Inventario español de Hábitats y Especies Marinos. Guía Interpretativa: Inventario Español de Hábitats Marinos. Ministerio de Agricultura, Alimentación y Medio Ambiente. 229 pp. • UNEP/MAP-RAC/SPA, 2015. Handbook for interpreting types of marine habitat for the selection of sites to be included in the national inventories of natural sites of conservation interest. Bellan-Santini, D., Bellan, G., Bitar, G., Harmelin J-G., Pergent, G. Ed. RAC/SPA, Tunis. 168 pp. + Annexes (Orig. pub. 2002). • UNEP-MAP-RAC/SPA, 2017. Draft Updated Reference List of Marine Habitat Types for the Selection of Sites to be included in the National Inventories of Natural Sites of Conservation Interest in the Mediterranean. Ed. RAC/SPA, Tunis. in press.		
Policy Context and targets (other than IMAP)		
Policy context description Typical species have already been identified by several Contracting Parties for listed habitat types to fulfill the assessment requirements under the Habitats Directive. Additionally, the coastal area out to 1 nautical mile offshore has already been covered by these Contracting Parties under the Water Framework Directive. Therefore, the indicator is available for considerable benthic habitats within these areas and is already covered by monitoring efforts and has been assessed using appropriate metrics. Soft-bottom benthic invertebrates and seagrasses are traditionally used in the Mediterranean Sea for environmental quality assessment and several indices have already been widely applied by Mediterranean Contracting Parties, Member States of the EU and compared in the framework of the Mediterranean Geographical Intercalibration Group of the EU Water Framework Directive (MED GIG), while two indices have also been based on macroalgae and compared in the framework of MED GIG. Already in 2009, the Meeting of UNEP/MAP MED POL experts on Biological Quality Elements (UNEP/DEPI/MED WG. 342/3) recommended the application of benthic indices developed and tested under the Water Framework Directive for use by all Contracting Parties. Recent European projects have focused on MSFD indicators and monitoring aspects for various habitats (e.g. DEVOTES, PERSEUS, IRIS-SES). To this end, the 2015 PERSEUS Project specific training course targeting Southern Mediterranean countries could be utilized.		
Indicator/Targets		

Indicator Title	*Common indicator 2: Condition of the habitat's typical species and communities*
In order to assess the state/condition of a habitat (i.e. its typical species composition and their relative abundance, absence pr particularly sensitive or fragile species or species providing a key function, size structure of species), the Contracting Parties need to define lists of typical and/or characteristic species (or groups of species) and to set targets to determine their presence. It is also important to compile typical species lists consistently per biogeographical region, to allow for the consistent assessment of state/condition. Typical species composition includes both macrozoobenthos and macrophytes, depending on the type of habitat (i.e. macrophytes do not occur in aphotic habitats). Long-lived species and species with high structuring or functional value for the community should preferably be included; however, the typical species list might also contain small, short-lived species if they characteristically occur in the habitat under natural conditions. The general target of this indicator is to reach a ratio of typical and/or characteristic species similar to baseline conditions as defined above, for all considered habitats. With regard to plankton communities, a recommended target might be: "Plankton community not significantly influenced by anthropogenic drivers". This target allows unmanageable climate change but triggers management action if linked to an anthropogenic pressure and could be used with all datasets across all Contracting Parties. Monitoring of important pelagic habitats should be considered in the future.	
Policy documents *List and url's* UNEP/DEPI/MED WG. 342/3 http://www.unepmap.org/index.php http://195.97.36.231/dbases/MEETING_DOCUMENTS/09WG342_3_eng.pdf EU Water Framework Directive (MED GIG) http://ec.europa.eu/environment/water/water-framework/index_en.html http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/10473/1/3010_08-volumecoast.pdf	
Indicator analysis methods	
Indicator Definition This indicator should be implemented as a state condition indicator, with respect to baseline conditions, by using a list of typical and/or characteristic species in the communities of different habitats per sub-region.	
Methodology for indicator calculation The calculation of this indicator involves simple comparison of typical and/or characteristic species (or groups of species) per habitat and sub-region with respect to baseline conditions, for all considered communities. Within this process, an acceptable deviation from baseline conditions would need to be defined. This deviation might be implemented by setting a certain percentage value to define GES. However, for baseline setting, the use of current state might be inappropriate if the considered habitats actually underlie high human pressure and no reference sites are available. The definition of a reference state of Mediterranean Sea habitats may be problematic and the use of past state may be more appropriate. This cut-off value has to be habitat-specific and regionally adapted in view of the natural variability of species composition by habitat type and bioregion. The required methods and effort strongly depend on the habitat type (and selected species) to be addressed. Detailed overviews presenting the basic guidelines and methodologies for the inventorying and monitoring of various Mediterranean key habitats (seagrass meadows, coralligenous and rhodolith beds and "dark habitats", i.e. marine caves and deep sea assemblages) have been recently produced by UNEP/MAP-RAC/SPA in the framework of MedKeyHabitats project. Large attached epibenthic species on hard substrates are preferably monitored using optical, non-destructive methods, such as underwater-video while endobenthic communities are sampled using standardized grabs or corers, which are commonly used in marine monitoring programmes. Several specific benthic biotic indices have been developed and have become operational, in particular to fulfill MED GIG requirements. They are all well methodologically defined but the way to combine these parameters in sensitivity/tolerance classification or depending on structural, functional and physiological attributes is heterogeneous, depending on the issue (pressure type), habitat types or sub-region. Qualified personnel, in particular experienced taxonomists, are required for both field and laboratory work to guarantee quality in sampling accuracy, consistency of data over time, meaningful data analyses and interpretation of the results. The following resources are usually required for the calculation of this indicator: • Research vessels, suited to work from sublittoral to bathyal zones, depending on the sub-region; • Scuba diving sampling to infralittoral • Adequate equipment (box core samplers, grabs, dredges, underwater camera systems, etc.) for sample collection from intertidal to bathyal zones;	

Indicator Title	*Common indicator 2: Condition of the habitat's typical species and communities*

- Laboratory infrastructure to analyze samples (e.g. microscopes, weighing scales).
- Qualified personnel for data processing, analysis and interpretation.
- Good taxonomy skills are essential for the adequate assessment of this indicator.

Indicator units

This indicator could be calculated as a ratio of typical and/or characteristic species for every habitat type with respect to baseline conditions for this sub-region. Within this process, an acceptable deviation from baseline conditions should be defined. This cut-off value has to be habitat-specific and regionally adapted in view of the natural variability of species composition by habitat type and bioregion. Furthermore, several specific well-defined benthic biotic indices have been developed and have become operational. The selection of the relevant parameters and the development of metrics strongly depend on the selected habitat.

List of Guidance documents and protocols available

- Lepidochronology and phenology protocols for *Posidonia oceanica*[4]
- ISO 16665: 2014 Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna (http://www.iso.org/iso/catalogue_detail.htm?csnumber=54846) These guidelines provide standard methodology for collection and processing of subtidal soft-bottom macrofaunal samples in marine waters, in particular:
    - the development of the sampling programme;
    - the requirements for sampling equipment;
    - sampling and sample treatment in the field;
    - sorting and species identification;
    - storage of collected and processed material.
- ISO 19493: 2007 Guidance for marine biological surveys of supralittoral, eulittoral and sublittoral hard substrate for environmental impact assessment and monitoring in coastal areas (http://www.iso.org/iso/catalogue_detail.htm?csnumber=39107): It covers:
    - the development of the sampling programme,
    - survey methods,
    - species identification,
    - storage of data and collected material

Data Confidence and uncertainties

For baseline setting of GES per habitat type, the use of current state might be inappropriate if the habitats actually underlie high human pressure and no reference sites are available. The use of past state may be more appropriate, as the definition of a reference state of Mediterranean Sea habitats may be problematic. In order to verify comparability and reproducibility, (a) descriptions of the followed methodology should be provided, and (b) biogeographic regions with common species compositions per habitat must be identified in advance.

Methodology for monitoring, temporal and spatial scope

Scientific literature*Sources and url's*

The monitoring techniques depend on the species to monitor and the related habitat. Non-destructive optical methods are recommended for the monitoring of large benthic species such as epibenthic species on hard substrates, while endobenthic species can be monitored using standardized grabs, drill sampling or corers.

- UNEP/MAP-RAC/SPA, 2015. Guidelines for Standardization of Mapping and Monitoring Methods of

[4] Pergent G., 2007. Protocol for the setting up of Posidonia meadows monitoring systems. «MedPosidonia» Programme / RAC/SPA - TOTAL Corporate Foundation for Biodiversity and the Sea; Memorandum of Understanding N°21/2007/RAC/SPA_MedPosidonia Nautilus-Okianos: 24p + Annexes.

Indicator Title	*Common indicator 2: Condition of the habitat's typical species and communities*	
Marine Magnoliophyta in the Mediterranean. Pergent-Martini, C., Ed., RAC/SPA publ., Tunis: 48 p. + Annexes. • UNEP-MAP-RAC/SPA, 2015. Standard methods for inventorying and monitoring coralligenous and rhodoliths assemblages. Pergent, G., Agnesi, S., Antonioli, P.A., Babbini, L., Belbacha, S., Ben Mustapha, K., Bianchi, C.N, Bitar, G., Cocito, S., Deter, J., Garrabou, J., Harmelin, J-G., Hollon, F., Mo, G., Montefalcone, M., Morri, C., Parravicini, V., Peirano, A., Ramos-Espla, A., Relini, G., Sartoretto, S., Semroud, R., Tunesi, L., Verlaque, M. Ed. RAC/SPA, Tunis. 20 pp. + Annex. • UNEP-MAP-RAC/SPA, 2017. Draft Guidelines for Inventorying and Monitoring Dark Habitats. Aguilar, R., Pilar, M., Gerovasileiou, V. and contributors. Ed. RAC/SPA, Tunis. in press. • Zamboukas, N., Palialexis, A. (eds.), Duffek, A., Graveland, J., Giorgi, G., Hagebro, C., Hanke, G., Korpinen, S., Tasker, M., Tornero, V., Abaza, V., Battaglia, P., Caparis, M., Dekeling, R., Vegas, M. F., Haarich, M., Katsanevakis, S., Klein, H., Krzyminski, W., Laamanen, M., Jean, LG., Leppänen, J.-M., Urmas, L. 2014. Technical guidance on monitoring for the marine strategy framework directive. Luxembourg, European Union. 166 p. JRC Scientific and Policy Reports; 2014, 26499 EN.		
Spatial scope guidance and selection of monitoring stations This indicator is applicable in all regions provided that typical and/or characteristic species lists, including both macrozoobenthos and macrophytes, will be developed for every type of habitat, at a sub-regional scale (or bioregion within each sub-region). Benthic biotic indices are also conceptually applicable in all sub-regions but appropriate adjustments might be still needed to cover biogeographic heterogeneity.		
Temporal Scope guidance Natural variability in species composition in space and time must be considered for this indicator and the list of typical and/or characteristic species must be defined and updated every 6 years per habitat type in particular geographic areas. The ideal temporal scale for this indicator is once per year while the minimum required sampling frequency is at least twice per period of 6 years.		
Data analysis and assessment outputs		
Statistical analysis and basis for aggregation Data analysis for this indicator involved simple comparison of typical and/or characteristic species with respect to baseline conditions for the considered habitat in a given region. A number of tools and software have been developed for the calculation of benthic biotic indices.		
Expected assessments outputs Assessments outputs for this indicator include (1) a list of typical and/or characteristic species per habitat of a given region, recorded following a well-described methodology and/or values of the appropriate benthic biotic indices for the considered habitats and (2) comparison with baseline/past data to indicate trends in the habitat conditions/state.		
Known gaps and uncertainties in the Mediterranean Information about the typical and/or characteristic species of some habitats and their past state/conditions is often unavailable for southern and eastern sub-regions of the Mediterranean. The limited data availability may restrict the number of habitats that can be assessed with sufficient statistical confidence at present. Although benthic biotic indices are conceptually applicable in all sub-regions, adjustments might be required in order to cover biogeographic heterogeneity.		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

3. Common indicator 3: Species distributional range (marine mammals) (EO 1)

<table>
<tr><td>Indicator Title</td><td colspan="2">Common indicator 3: species distributional range (marine mammals)</td></tr>
<tr><td>Relevant GES definition</td><td>Related Operational Objective</td><td>Proposed Target(s)</td></tr>
<tr><td>The species are present in all their natural distributional range.</td><td>Species distribution is maintained</td><td>The distribution of marine mammals remains stable or expanding and the species that experienced reduced distribution in the past are in favourable status of conservation and can recolonise areas with suitable habitats</td></tr>
<tr><td colspan="3">Rationale</td></tr>
<tr><td colspan="3">Justification for indicator selection
The objective of this indicator is to focus on the species distributional range of marine mammals within the Mediterranean waters, with a special emphasis to those species selected by the Parties.
Differences and shifts in distribution may reflect changes in the occurrence of suitable habitats, availability of food resources, selective pressures from human-related activities, as well as climate change. With increasing concern about species conservation, quantitative descriptions of species’ range structure and extent of geographical distribution - both for single species or groups of species - together with detailed information on the location of breeding/feeding areas, can provide crucial information for management purposes.

Eleven species of cetaceans are considered to regularly occur in the Mediterranean area: short-beaked common dolphin (Delphinus delphis), striped dolphin (Stenella coeruleoalba), common bottlenose dolphin (Tursiops truncatus), harbour porpoise (Phocoena phocoena), long-finned pilot whale (Globicephala melas), rough-toothed dolphin (Steno bredanensis), Risso’s dolphin (Grampus griseus), fin whale (Balaenoptera physalus), sperm whale (Physeter macrocephalus), Cuvier’s beaked whale (Ziphius cavirostris) and killer whale (Orcinus orca). Two of these species have very limited ranges: the harbour porpoise, possibly representing a small remnant population in the Aegean Sea, and the killer whale, present only as a small population of a few individuals in the Strait of Gibraltar.

The Mediterranean is also hosting habitats for pinniped species as the Mediterranean monk seal (Monachus monachus). The species occurs regularly in the eastern basin, mainly along the coasts of Greece and Turkey. Some individuals have been sigthed during the last decade in the western basin.

Knowledge about the distribution, abundance and habitat use and preferences of some of these species, including the most abundant ones, is in part scant and limited to specific sectors of the Mediterranean Sea, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution.
The conservation status of marine mammels in the Mediterranean Sea has been a source of concern for many years. Marine mammals living in the Mediterranean Sea find themselves in precarious conditions due to the intense human presence and activities in the region; these are the source of a variety of pressures that are threatening these species’ survival. These animals are highly mobile and are usually not confined within single nations’ jurisdictions, stressing the need for basin-wide conservation and protection effort. Several threats affect marine mammals in the Mediterranean Sea and their effect on the population, distributional range and survival may act in a synergistic manner. Threats include interaction with fisheries, disturbance, injuries and fatal collisions from shipping, habitat loss and degradation, chemical pollution, anthropogenic noise, direct killings and climate change.
The geographical distribution of marine mammals in the Mediterranean Sea is affected by several factors, which should all be taken into consideration when monitoring these species. Ocean currents, abundance of food, sea temperature, morphology of the coastline, seabed topography, as well as human activities, seem to interact and influence which areas are preferred habitats for cetaceans and seals. Certain habitats have a particular key value in the life cycles of different species, in that they are used as foraging grounds due to prey abundance, for breeding or as migration corridors between areas. Besides in the case of the Mediterranean monk seal, the species needs form terrestrial coastal habitat for hauil out, rest, pupping and rearing thir pups.</td></tr>
<tr><td colspan="3">Scientific References
Azzellino A., Fossi M.C., Gaspari S., Lanfredi C., Lauriano G., Marsili L., Panigada S., Podesta M. 2014. An index based on the biodiversity of cetacean species to assess the environmental status of marine ecosystems. Marine Environmental Research, 100: 94 – 111.</td></tr>
</table>

Indicator Title	*Common indicator 3:* species distributional range (marine mammals)
Bearzi, G. et al. 2004. The role of historical dolphin takes and habitat degradation in shaping the present status of northern Adriatic cetaceans. - Aquat. Conserv. Mar. Freshw. Ecosyst. 14: 363–379. Coll, M. et al. 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. - PLoS ONE 5: e11842. Fossi, M. C. and Marsili, L. 2003. Effects of endocrine disruptors in aquatic mammals. - Pure Appl. Chem. 75: 2235–2247. Fossi, M. C. et al. 2013. The Pelagos Sanctuary for Mediterranean marine mammals: Marine Protected Area (MPA) or marine polluted area? The case study of the striped dolphin (Stenella coeruleoalba). - Mar Pollut Bull 70: 64–72. Fossi, M. C. et al. 2014. Large filter feeding marine organisms as indicators of microplastic in the pelagic environment: The case studies of the Mediterranean basking shark (Cetorhinus maximus) and fin whale (Balaenoptera physalus). - Mar. Environ. Res. 100: 17–24. Frantzis, A. 1998. Does acoustic testing strand whales? - Nature 392: 29–29. Gaston, K. J. 2003. The Structure and Dynamics of Geographic Ranges. - Oxford University Press. Gómez de Segura, A. et al. 2008. Influence of environmental factors on small cetacean distribution in the Spanish Mediterranean. - J. Mar. Biol. Assoc. U. K. in press. Hoffmann, A. A. and Blows, M. W. 1994. Species borders: ecological and evolutionary perspectives. - Trends Ecol. Evol. 9: 223–227. IUCN 2012. Marine mammals and sea turtles of the Mediterranean and Black Seas. - IUCN. Lawton, J. H. 1993. Range, population abundance and conservation. - Trends Ecol. Evol. 8: 409–413. Lauriano, G., Pierantonio, N., Donovan, G., Panigada, S. 2014. Abundance and distribution of Tursiops truncatus in the Western Mediterranean Sea: an assessment towards the Marine Strategy Framework Directive requirements, Marine Environmental Research, 100: 86–93. Notarbartolo di Sciara, G. and Birkun, A., Jr 2010. Conserving whales, dolphins and porpoises in the Mediterranean and Black Seas: an ACCOBAMS status report, 2010: 212. Notarbartolo di Sciara, G. et al. 2013. Is the Pelagos Sanctuary sufficiently large for the cetacean populations it is intended to protect? - Rapp Comm Int Mer Médit: 623. Panigada, S. et al. 2006. Mediterranean fin whales at risk from fatal ship strikes. - Mar Pollut Bull 52: 1287–1298. Reese, G. C. et al. 2005. Factors Affecting Species Distribution Predictions: A Simulation Modeling Experiment. - Ecol. Appl. 15: 554–564. UNEP-MAP-RAC/SPA, 2012. Action Plan for the conservation/management of the Monk seal in low density areas of the Mediterranean. by Gazo M., Mo G. Contract RAC/SPA, MoU n. 34/RAC/SPA_2011. 29 p. UNEP-MAP-RAC/SPA, 2013. Regional strategy for the conservation of monk seals in the mediterranean (2014-2019)Simmonds, M. P. et al. 2012. Climate change effects on Mediterranean Cetaceans: Time for action. - In: Life in the Mediterranean Sea: A Look at Habitat Changes. pp. 685–701.	
Policy Context and targets (other than IMAP)	
Policy context description Mediterranean fin whales and sperm whales are protected by the International Whaling Commission's moratorium on commercial whaling that entered into force in 1986. The Mediterranean cetaceans' populations are also protected under the auspices of ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area), under the auspices of the UNEP Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS). The Corso-Ligurian-Provençal Basin and the Tyrrhenian Sea, where most cetacean species find suitable habitats, lie within the Pelagos Sanctuary established by France, Italy and Monaco, thus potentially benefitting from its conservation regime. All cetacean species in the Mediterranean Sea are protected under the Annex II of the SPA-BD Protocol under the Barcelona Convention; under the Appendix I of the Bern Convention; under the Annex II of the Washington Convention (CITES); under the Appendix II of the Bonn Convention (CMS). The short-beaked common dolphin, the sperm whale and the Cuvier's beaked whale and the Mediterranean monk seal are also listed under the Appendix I of the Bonn Convention (CMS). The common bottlenose dolphin, the harbor porpoise and the Mediterranean monk seal are also listed under the Annex II and all marine mammals are in Annex IV of the EU Habitats Directive and considered strictly protected.	
Indicator/Targets Aichi Biodiversity Target 1, 3 EU Regulation 812/2004 concerning incidental catches of cetaceans in fisheries EU MSFD Descriptor 1 and 4 EU Habitats Directive	

Indicator Title	*Common indicator 3:* species distributional range (marine mammals)

The obligations under ACCOBAMS

Policy documents

- Aichi Biodiversity Targets - https://www.cbd.int/sp/targets/
- EU Biodiversity Strategy - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN
- EU Regulation 1143/2014 - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN
- Marine Strategy Framework Directive - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN
- Commission Decision on criteria and methodological standards on good environmental status of marine waters - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010D0477(01)&from=EN
- Pan-European 2020 Strategy for Biodiversity - https://www.google.no/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiP1J-v_P7NAhWHjSwKHZfoBRIQFggtMAE&url=https%3A%2F%2Fcapacity4dev.ec.europa.eu%2Fsystem%2Ffiles%2Ffile%2F08%2F10%2F2012_-_1535%2Fpan-european_2020_strategy_for_biodiversity.pdf&usg=AFQjCNGa4NkkljA4x3l9WDO49uwrdYafMg
- Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the Mediterranean Region - http://sapbio.rac-spa.org/
- Draft Updated Action Plan for the conservation of Cetaceans in the Mediterranean Sea - http://rac-spa.org/nfp12/documents/working/wg.408_08_eng.pdf
- National Biodiversity Strategies and Action Plans (NBSAPs) - https://www.cbd.int/nbsap/
  ACCOBAMS Agreement Text - http://www.accobams.org/images/stories/Accord/anglais_text%20of%20the%20agreement%20english.pdf

ACCOBAMS STRATEGY (PERIOD 2014 – 2025) - https://accobams.org/images/stories/MOP/MOP5/Documents/Resolutions/mop5.res5.1_accobams%20strategy.pdf

Indicator analysis methods

Indicator Definition

This indicator is aimed at providing information about the geographical area in which marine mammal species occur. It is intended to determine the species range of cetaceans and seals that are present in Mediterranean waters, with a special focus on the species selected by the Parties.

Methodology for indicator calculation

The range of a given species is commonly represented by a distribution map. The main outputs of the monitoring under this common indicator will be therefore maps of species presence, distribution and occurrence. The use of Geographical Information Systems (GIS) is required for the compilation of the monitoring data collected and the elaboration of the species distributional range maps.
Information on distribution of marine mammals may be obtained through dedicated ship and aerial surveys, acoustic surveys, platform of opportunities (e.g., whale watching operators, ferries, cruise ships, military ships, coastal cave surveys for monk seal pupping and haul out shelters).

ACCOBAMS is currently planning to undertake a regional synoptic survey covering most of the Mediterranean waters to estimate cetacean species density and abundance. This initiative – known as the ACCOBAMS Survey Initiative (ASI) - is expected to start in 2017 and be implemented during summer 2018. This will provide useful, robust and reliable data concerning population abundance of cetaceans in the Mediterranean area. Data on all the cetacean species present in the Mediterranean will be collected and will provide important baseline data to liaise with national and international requirements, such as those by the Ecosystem Approach and the MSFD.
When a global approach such as that currently ppproposed by ACCOBAMS is unfeasible or too ambitious, small scale monitoring programmes should be established, adapting to MSFD macro-regions or UNEP-MAP-RAC/SPA (2010) marine eco-regions (Fig. 1), according to specific needs.
In any case, once dealing with a subregional implementation approach for cetacean surveying campaigns, this should be carried out in line with agreed common, regional methodologies, using existing and shared Protocols, with the facilitation, as appropriate, of ACCOBAMS.

Indicator Title	*Common indicator 3:* species distributional range (marine mammals)

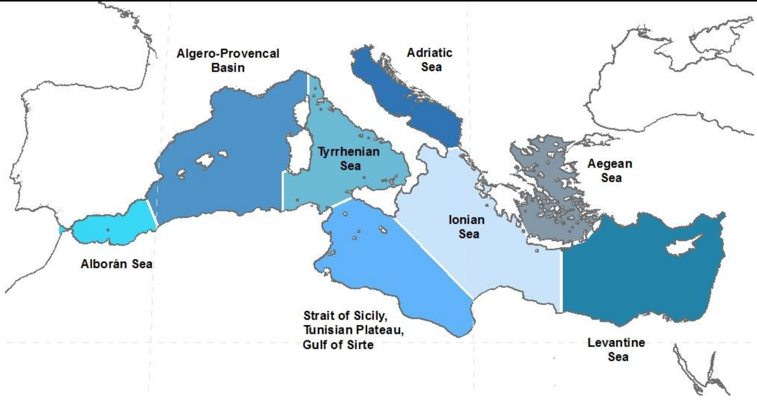

Figure 1. Mediterranean Sea with 7 sub-divided marine ecoregions. These include Alborán Sea; Algero-Provencal Basin; Tyrrhenian Sea; Adriatic Sea; Strait of Sicily, Tunisian Plateau, Gulf of Sirte; Ionian Sea/Central Mediterranean; Aegean Sea; Levantine Sea. Based on those divisions presented in UNEP-MAP-RAC/SPA, 2010.

Indicator units

The Integrated Monitoring and Assessment Guidance provided in document UNEP(DEPI)/MED WG.420/4 recommended to use for recording the presence/absence of each species, the standardized 30 x 30 nautical mile grid map produced by FAO/GFCM or the 50 x 50 km grids used by the European Bird Census Council.

According to specific needs, a finer scale map can be used, to provide finer information. Exisiting standard protocols, such as those suggested by the Marine Strategy Framework Directive and the Habitat Directive should be applied and followed.

List of Guidance documents and protocols available

A document on ‘Monitoring Guidelines to assess Cetaceans’ Distributional Range, Population Abundance and Population Demographic Characteristics’ has been produced by ACCOBAMS and should be considered as guidance when establishing monitoring programmes.

Data Confidence and uncertainties

Distribution maps are generally qualitative. It is important to consider the highly mobility of cetaceans and the driving forces (mainly prey availability) which affect their distribution. In case of trends in distribution over time, appropriate statistical tools and analytical framework, such as habitat prediction modelling, should be applied. As an example, standard regression methods (simple linear regression, generalized linear or additive models, etc.) provide estimates of uncertainty (standard errors and confidence intervals of estimated trends). Such uncertainty estimates should accompany all reported trends.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Several protocols are available using different monitoring platforms and approaches and Countries should select the most appropriate one based on available resources and conservation needs. Some methods could be combined to provide more robust information, such as visual and acoustic census, for example. The available mothods include, *inter alia*, the following :

- Dedicated ships or aerial surveys
- By-catch data
- Beached and stranded specimens monitoring
- Opportunistic data collected from platform of opportunities
- Citizen science data (only if verified by experts)
- Tagging (capture-mark-recapture – artificial tags & photo-identification)
- Telemetry: satellite tracking, GPS/GSM tracking, radio tracking and the use of data loggers
- Acoustic data collection
- Automatic infrared camera

Available data sources

OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, is a spatially referenced online database, aggregating marine mammal, seabird, sea turtle and ray & shark observation data from across the globe (http://seamap.env.duke.edu/).

Spatial scope guidance and selection of monitoring stations

Current spatial distributional range of marine mammals in the Mediterranean Sea is largely affected by available data, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution. Priority should be given to the less

Indicator Title	*Common indicator 3:* species distributional range (marine mammals)	
known areas, using online data sources, such as Obis SeaMap and published data and reports as sources of information.		
Temporal Scope guidance Fine scale distribution of marine mammels may vary on annual, seasonal or monthly basis. Ideally, monitoring programmes should be conducted focusing breeding and feeding seasons. Temporal scale is largely affected by the conservation questions and expected outputs. International regulation suggests a six-year interval between large scale monitoring programmes, but smaller intervals are recommended. Long-term projects provide robust indications on trends in distribution over time and space is selected areas. The European Union Habitats Directive requires Member States to take action to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora specified as being in need of strict protection (Council Directive 92/43/EEC). Member States are also required to undertake surveillance of these habitats and species and to report every 6 years on whether their conservation status is favourable and on the implementation of measures taken to ensure this. Links with other relevant directives and initiaves, such as the MSFD and the Ecosystem Approach under the framework of the Barcelona Convention should be established.		
Data analysis and assessment outputs		
Statistical analysis and basis for aggregation Standard regression methods (simple linear regression, generalized linear or additive models), power analysis for detecting trends should be applied.		
Expected assessments outputs I.e. trend analysis (monthly, seasonally, yearly), distribution maps, statistical frameworks applied.		
Known gaps and uncertainties in the Mediterranean Data in the Mediterranean Sea are characterized by their uneven distribution, both geographical and spatial. The summer months are the most representative ones and very few information have been provided for the winter months, when conditions to conduct off-shore research campaigns are particularly hard due to meteorological adversity. Ongoing effort is targeting the identification of Cetacean Critical Habitats (CCHs) and Important Marine Mammal Areas (IMMAs) in the entire Mediterranean Sea. A gap analysis is also been conducted within the Mediterranean Sea by Duke University, to provide an inventory of available data and to select areas where more information should be collected in terms of area, effort and time of the year.		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

4. Common indicator 3: Species distributional range (Reptiles) (EO 1)

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The species continues to occur in all its natural range in the Mediterranean, including nesting, mating, feeding and wintering and developmental (where different to those of adults) sites	Species distribution is maintained	State Turtle distribution is not significantly affected by human activities Turtles continue to nest in all known nesting sites Pressure/Response Protection of known nesting, mating, foraging, wintering and developmental turtle sites. Human activities[5] having the potential to exclude marine turtles from their range area are regulated and controlled. The potential impact of climate change is assessed
Rationale		
Justification for indicator selection In biology, the range of a given species is the geographical area in which that occurs (i.e. the maximum extent). A commonly used representation of the total areal extent (i.e. the range) of a species is a range map (with dispersion being shown by variation in local population densities within that range). Species distribution is represented by the spatial arrangement of individuals of a given species within a geographical area. Therefore, the objective of this indicator is to determine the species range of sea turtles that are present in Mediterranean waters, especially the species selected by the Parties. Sea turtles are an ideal model species to assess the selected indicator, as their populations are dispersed throughout the entire Mediterranean, as discrete breeding, foraging, wintering and developmental habitats, making the two sea turtle species a reliable indicator on the status of biodiversity across this region. Green turtles are primarily herbivores, whereas loggerheads are primarily omnivores, resulting in their occupying important components of the food chain; thus, changes to the status in sea turtles, will be reflected at all levels of the food chain. However, the extent of knowledge on the occurrence, distribution, abundance and conservation status of Mediterranean marine species is uneven. In general, the Mediterranean states have lists of species, but knowledge about the locations used by these species is not always complete, with major gaps existing for other associated information. Even some of the most important programmes on this topic have significant gaps (e.g. Global databases do not reflect actual current knowledge in the Mediterranean region). It is therefore necessary to establish minimum information standards to reflect the known distribution of all selected species. Species distribution ranges can be gauged at local (i.e. within a small area like a national park) or regional (i.e. across the entire Mediterranean basin) scales using a variety of approaches. Given the breadth of the Mediterranean, it is not feasible to obtain adequate information about the entire surface (plus, the marine environment is 3 dimensional, with many vertebrate species only being present at the surface briefly to breathe, e.g. sea turtles), so it is necessary to choose sampling methods that allow adequate knowledge of the distribution range of each species. Such sampling involves high effort for areas that have not been fully surveyed to date. Monitoring effort should be long term and should cover all seasons to ensure that the information obtained is as complete as possible.		
Scientific References Bevan E, Wibbels T, Navarro E, Rosas M, Najera BMZ, Sarti L, Illescas F, Montaro J, Pena LJ, Burchfield P. 2016. Using Unmanned Aerial Vehicle (UAV) Technology for Locating, Identifying, and Monitoring Courtship and Mating Behavior in the Green Turtle (*Chelonia mydas*). Herpetological Review, 47(1), 27–32. Casale P. and Margaritoulis D. (Eds.) 2010. Sea Turtles in the Mediterranean: Distribution, Threats and Conservation Priorities. IUCN/SSC Marine Turtle Specialist Group. Gland, Switzerland: IUCN, 294 pp. http://iucn-mtsg.org/publications/med-report/		

[5] Uncontrolled use of turtle nesting sites, fishing, maritime traffic, etc.

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*

Casale P., G. Abbate, D. Freggi, N. Conte, M. Oliverio, R. Argano. 2008. Foraging ecology of loggerhead sea turtles *Caretta caretta* in the central Mediterranean: evidence for a relaxed life history model. Marine Ecology Progress Series 372: 265-276.

Demography Working Group of the Conference. Demography of marine turtles nesting in the Mediterranean Sea: a gap analysis and research priorities - 5th Mediterranean Conference on Marine Turtles, Dalaman, Turkey, 19-23 April 2015. Document T-PVS/Inf(2015)15E Presented at the Convention on the conservation of European wildlife and natural habitats - 35th meeting of the Standing Committee - Strasbourg, 1 - 4 December 2015 (2015)

Groombridge, B. 1990. Marine turtles in the Mediterranean: distribution, population status, conservation. A report to the Council of Europe, Environment and Management Division. Nature and Environment Series, Number 48. Strasbourg 1990

Margaritoulis, D., Argano, R., Baran, I., Bentivegna, F., Bradai, M.N., Caminas, J.A., Casale, P., Metrio, G.D., Demetropoulos, A., Gerosa, G., Godley, B.J., Haddoud, D.A., Houghton, J., Laurent, L. & Lazar, B. (2003) Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives. Loggerhead sea turtles (ed. by B.E. Witherington), pp. 175–198. Smithsonian Institution, Washington.

Mazaris AD, Almpanidou V, Wallace B, Schofield G. 2014. A global gap analysis of sea turtle protection coverage. 2014. Biological Conservation. 173, 17–23

Schofield, G., A. Dimadi, S. Fossette, K.A. Katselidis, D. Koutsoubas, M.K.S. Lilley, A. Luckman, J.D. Pantis, A.D. Karagouni, G.C. Hays. 2013b. Satellite tracking large numbers of individuals to infer population level dispersal and core areas for the protection of an endangered species. Diversity and Distributions doi: 10.1111/ddi.12077.

Policy Context and targets (other than IMAP)

Policy context description

Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes GES definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years.

The MSFD includes Descriptor 1: Biodiversity: "The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions." Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them.

The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned".

Indicator/Targets

Commission Decision 2010/477/EU sets out the MSFD's criteria and methodological standards and under Descriptor 1 includes criteria "1.1.Species distribution" and indicators "Distributional range (1.1.1)", "Distributional pattern within the latter, where appropriate (1.1.2)", and "Area covered by the species (for sessile/benthic species) (1.1.3)".

At a country scale, the following targets have been selected by member states.

Source: [Evaluation of] National Reports on Article 12 Technical Assessment of the MSFD 2012 obligations
http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/pdf/national_reports.zip

GREECE (*page 15)*

Environmental targets:

*[…]*2) Census of marine turtle *Caretta caretta* reproducing in the Greek coasts and conservation of spawning areas.

Associated indicators:

*[…]*2) Breeding area of the Mediterranean monk seal *Monachus monachus* and the sea turtle *Caretta caretta*

ITALY (*page 18)*

Italy has provided six targets and associated indicators *[…]* The second target focuses on the loggerhead turtle, and has the aim of decreasing accidental mortalities by regulating fishing practices. *[…]* No targets or threshold values are otherwise given.

[…]

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*
T2: By-catch reduction in the areas of aggregation of *Caretta caretta* It is proposed that the operative target for the mitigation of *Caretta caretta* by-catch be articulated as follows: 1) Spatial identification of the areas with highest use of pelagic long line (southern Tyrrhenian and southern Ionian sea) and trawling (northern Adriatic) 2) Completion of the spatial definition of *Caretta caretta* aggregation areas based on an approach capable of assessing temporal and seasonal distribution differences for each aggregation area (based on indicator 1.1.2 completion) so as to provide a final definition of the operative target 3) Monitoring of accidental captures in the areas subjected to operational target 4) Application of by-catch reduction measures in areas listed in point 3), through one or more of the following activities: - Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling nest through structural modifications to the gear (i.e. circle hooks, TEDs etc.) and application of best practices for the reduction of mortality following capture (percentage). Note: in order to allow an immediate reduction of the pressure it is advised that best practices be applied in the geographic areas where preliminary knowledge already defines the presence of an aggregation area, before defining the incidence of total capture in the specific gear. - Reduction of fishing pressure (percentage) SPAIN (*Page 25)* A.1.4: Reduce the main causes of mortality and of reduction of the populations of groups of species at the top of the trophic web (marine mammals, reptiles, sea birds, pelagic and demersal elasmobranchs), such as accidental capture, collisions with vessels, intaking of litter at sea, introduced terrestrial predators, pollution, habitat destruction, overfishing. *[…]* A.1.7: Establish a national coordination system of the accidental catch monitoring programmes of birds, reptiles, marine mammals, and mammal and reptile stranding and bird tracking. *[…]* A.3.4: Maintain positive or stable trends for the populations of key species or apex predators (marine mammals, reptiles, seabirds and fish) and maintain commercially exploited species within safe biological limits. *[…]* C.1.2: Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles) SLOVENIA - No information on Targets *page 10: (I. Good Environmental Status (GES), 1.1 Descriptor 1)* In the accompanying text to the GES definition, Slovenia provides a list of the species that are covered by the GES definition. This includes the bottlenose dolphin (*Tursiops truncatus*), the loggerhead sea turtle (*Caretta caretta*). *(II. Initial assessment, 2.2 Biological features)* Slovenia indicates that *[…]* turtles are covered under the reporting obligations of the Habitats Directive *[…]*. Each of these groups is briefly described and their state in relation to natural conditions is reported. CYPRUS - No information on Targets *page 11: (II. Initial assessment, 2.2 Biological features)* *[…] Chelonia mydas* and *Monachus monachus* are considered stable but the situation of *Caretta caretta* is actually improving.	
Policy documents http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010D0477(01) http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm http://ec.europa.eu/environment/marine/pdf/1-Task-group-1-Report-on-Biological-Diversity.pdf http://ec.europa.eu/environment/marine/pdf/9-Task-Group-10.pdf	
Indicator analysis methods	
Indicator Definition Variation in the total area (trends in the number of occupied grid cells) occupied by the selected species for breeding, wintering and feeding areas. The distributional range of a species is an important indicator that may be obtained through the georeferencing species observations, assuming objective techniques are used. To determine the distribution range of a species, it is necessary to know where individuals of the species are located from sampling information. It is therefore	

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*

necessary to establish minimum information standards to reflect the known distribution of all selected species. Species distribution ranges can be gauged at local (i.e. within a small area like a national park) or regional (i.e. across the entire Mediterranean basin) scales using a variety of approaches. Long-term monitoring of these areas provides information on the temporal evolution in species distributions.

Methodology for indicator calculation

The European (ETRS) 10x10km² grid is used for mapping the distribution and range, accounting each known location along the Mediterranean coast. Three different maps (grids) are produced yearly for each species accounting for breeding sites, wintering sites and feeding/developmental sites of loggerheads (*Caretta caretta*) and greens (*Chelonia mydas*).

For all species information on spatial distribution within the assessment would be transferred in a 10 × 10 km (or finer for small countries, 1 x 1 km or 5 x 5 km) grid; filled cells show presence of the species. The distribution area is the sum of area of the cells where the species is “present”.

For the reporting on the range of a species, considering that it is a suitable parameter for assessing the spatial aspects of GES, and to describe and detect changes in the extent of the distribution, a tool to calculate the range size from the map of the actual breeding (or wintering or feeding) distribution is required (i.e. occurrences). The Range Tool software and algorithm will provide a standardised process that will help to ensure repeatability of the range calculation in different reporting rounds. After automated calculation of the range it is possible to correct the gaps to obtain a complete overview of the data following a standardised protocol. The resulting range map will then be a combination of the automated procedure completed by expert judgement.

Indicator units

Number of 10 x 10 km cells (presence/absence) occupied for breeding or wintering or feeding/developmental areas along the Mediterranean (or subregional) coast and in all pelagic marine areas.

Annually – Total number of new locations (breeding, wintering, feeding); total number of 10 x 10 km newly occupied cells;

Annually – Total number of lost locations; total number of 10 x 10 km lost cells

List of Guidance documents and protocols available

Eckert, K. L., Bjorndal, K. A., Abreu-Grobois, F. A. and Donnelly, M. (Eds.) 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4. Washington, DC: 235 pp. https://mtsg.files.wordpress.com/2010/11/techniques-manual-full-en.pdf

Gerosa, G. (1996). Manual on Marine Turtle Tagging in the Mediterranean. –Mediterranean Action Plan - UNEP, RAC/SPA, Tunis, 48 pp.

Gerosa, G. and M. Aureggi. 2001. Sea Turtle Handling Guidebook for Fishermen. UNEP Mediterranean Action Plan, Regional Activity Centre for Specially Protected Areas. Tunis. http://www.rac-spa.org

McClellan DB. 1996. Aerial surveys for sea turtles, marine mammals and vessel activity along the south east Florida coast 1992-1996. NOAA Technical Memorandum NMFS-SEFSC-390 42pp

SWOT Scientific Advisory Board. 2011. The State of the World’s Sea Turtles (SWOT) Minimum Data Standards for Nesting Beach Monitoring, version 1.0. Handbook, 28 pp

Data Confidence and uncertainties

Presence/absence information is used only, because the different methods used to detect the presence/absence of turtles range from coarse to highly accurate (within metres), along with heavy sighting/detection bias to certain key regions/sites.

The quality of the source should be assigned scores (i.e. 3, Good; 2, Moderate; 1, Poor; 0, Uncertain). Following the CI for seabirds: A helpful rule for assessing the quality of the range calculation could consist of a scaling system, combining the reliability of the distribution at the time it was mapped, how recently it was mapped, and the method used to map it. The result would be 3 = reliable (accurate to within 10%); 2 = incomplete (accurate to within 50%); or 1 = poor (definitely not accurate to within 50%)

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Monitoring effort should be long term and should cover all seasons to ensure that the information obtained is as complete as possible.

- Aerial surveys: plane transects in marine areas (monitoring CI 3 & 4 in marine areas) (presence/potential absence at broad scales, requiring local confirmation of absence)
- Land based surveys: Nesting monitoring (breeding areas) and stranding monitoring (coastal areas) (CI 3-5) (presence/absence)

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*
- In-water surveys: Diving/snorkeling transects, capture-mark-recapture (CI 3-5 in marine areas) (presence/absence, but at very localized scales) - Satellite remote sensing: Nesting, in-water, bycatch surveys (CI 3-5 in marine & breeding areas) (presence, possible absence at broad scales, requiring local scale confirmation of absence) In-water monitoring can be done via: - Dedicated ship and aerial (plane and drone) transect surveys to confirm the presence/absence and spread of individuals in marine and coastal habitats (presence only) - Bycatch data from fisheries records and onboard researchers, which are invaluable for obtaining data in deep/open waters (presence/absence, but in focused areas) - Beached and stranded specimen monitoring, with dedicated stranding networks already existing for sea turtles in several Mediterranean countries, and stranding information being confirmed to reflect distribution patterns based on satellite telemetry studies (potential presence) - Opportunistic data, on non-dedicated platforms (ferries, merchant marine ships or amateurs/yachts, use of citizen science), by-catch data (where dedicated research programs do not exist, for sea turtles and shearwaters in long-lines and other types of fishing gear, and small cetaceans in fishing various types of fishing gear). (potential presence, requiring confirmation by dedicated surveys) - Tagging (capture-mark-recapture – artificial tags & photo-identification). Confirmed identification of presence of individuals from different populations at different locations based on external tags (plastic/metal), PIT tags and photo-id. (confirmed presence and absence) - Telemetry. Satellite tracking, GPS/GSM tracking, radio tracking and the use of loggers. Provides detailed information about the movements of small numbers of individuals within a population. Increasingly small transmitter size means it can be attached to juveniles; however, at least 50 individuals from a single population must be tracked to obtain population level movement/dispersal/distribution patterns. (confirmed presence/absence, but limited to small numbers of individuals) Beach monitoring can be done via: - Direct monitoring of nesting beaches - Detection of tracks of turtles on beaches potentially used for nesting. (confirmed presence/absence but only where monitoring is conducted) - Aerial surveys (drones/planes) or foot patrols may be used to confirm the use of beaches for nesting activity (confirmed presence/absence over broad scales, but possibly limited temporally) - Use of high resolution remote sensing satellite imagery to detect the presence/absence of tracks on difficult to access areas (i.e. due to distance from roads or lack of national security) (confirmed presence/absence over broad scales but possibly limited temporally) - Use of aerial surveys by planes or drones once key areas are identified by satellite imagery where possible or as an alternative (confirmed presence/absence, but possibly limited temporally). Bibliographic sources: The location of sea turtle nesting beaches, wintering, feeding and developmental areas, may be achieved by checking existing bibliographic information, surveys by different groups (fishermen, NGOs, guides, articles) of already known sites, probability of occurrence models (that indicate areas where a species is likely to occur based on statistical models that relate habitat variables to the presence/absence of a species) and regional expert knowledge (confirmed presence).	
Available data sources Adriatic Sea Turtle Database. http://www.adriaticseaturtles.eu/ Casale P. and Margaritoulis D. (Eds.) 2010. Sea Turtles in the Mediterranean: Distribution, Threats and Conservation Priorities. IUCN/SSC Marine Turtle Specialist Group. Gland, Switzerland: IUCN, 294 pp. http://iucn-mtsg.org/publications/med-report/ Halpin, P.N., Read, A.J., Fujioka, E., et al., 2009. OBIS-SEAMAP the world data center for marine mammal, sea bird, and sea turtle distributions. Oceanography 22, 104–115. The state of the World's Sea Turtles online database: data provided by the SWOT team and hosted on OBIS-SEAMAP (Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations). In: Oceanic Society, Conservation International, IUCN Marine Turtle Specialist Group (MTSG), and Marine Geospatial Ecology Lab, Duke University. <http://seamap.env.duke.edu/swot>. Margaritoulis, D., Argano, R., Baran, I., Bentivegna, F., Bradai, M.N., Caminas, J.A., Casale, P., Metrio, G.D., Demetropoulos, A., Gerosa, G., Godley, B.J., Haddoud,D.A., Houghton, J., Laurent, L. & Lazar, B. (2003) Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives. Loggerhead sea turtles (ed. by B.E. Witherington), pp. 175–198. Smithsonian Institution, Washington Seaturtle.org – Global Sea Turtle Network. Sea turtle tracking. Sea turtle nest monitoring. http://www.seaturtle.org/ The Reptile Database: Location of juvenile loggerheads and greens in the Eastern Mediterranean. http://reptile-database.reptarium.cz/species?genus=Caretta&species=caretta UNEP/MAP-RAC/SPA projects and publications http://www.rac-spa.org/publications	

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*
Mediterranean marine research centres, NGOs, universities and institutions, local and national sea turtle monitoring projects. Governmental Ministries International Union for Conservation of Nature (IUCN) specialists (Marine Turtle Specialist Group - MTSG)	
Spatial scope guidance and selection of monitoring stations The presence of the two species should be monitored all along the Mediterranean coast and in the known breeding, wintering, and feeding/developmental areas. The spatial basis for assessment should be according to the Mediterranean biogeographical sub-areas to reflect changes in the abundance of sea turtles in each habitat type across the Mediterranean and its sub-regions. Each Contracting Party should assess all marine (coastal and oceanic) and beach habitats across their national maritime waters. However, it is recommended that these areas are assessed at a smaller scale if they belong to different biogeographical sub-regions or if differences in pressure intensity are obvious between sub-basins.	
Temporal Scope guidance Yearly for each of the species and areas (breeding, wintering, feeding/developmental). Seasonality to be determined by the local experts as i.e. breeding season can vary along and across the Mediterranean. The widest known range for nesting is April/May to September/October, with the hatching period extending 45 to around 70 days after this (depending on sand composition, sand temperature and season). For wintering, this period extends from October to March/April in the Ionian/north Aegean for loggerheads, and lasts from November to March/April along the north coast of Africa for greens, and is limited to 1-2 months for loggerheads in this region. Furthermore, the quantity of wintering habitats in the northern parts of the Mediterranean may increase with climate change. Foraging and developmental sites are expected to be inhabited year-round, but with seasonal fluctuations.	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation The assessment should focus on whether the total area of a species distribution range is maintained or not. To assess the variation in breeding, wintering and feeding/developmental ranges, annual comparisons should be made with an emphasis on new or disappearing areas of use, expressing the range trends over the grids. This objective requires the use of different but widely available GIS geoprocessing techniques and geodatabases tools (ArcGis, QGis, R platform, etc). Annual comparison of distributional ranges. The trends in the number of occupied cells or area occupied is a basic and immediate parameter for which the significance may be statistically assessed.	
Expected assessments outputs Temporal trends in distributional range. Maps showing the evolution of the distributional range for the two species at different scales.	
Known gaps and uncertainties in the Mediterranean • Location of all breeding/nesting sites • Location of all wintering, feeding, developmental sites of adult males, females, juveniles • Connectivity among the various sites in the Mediterranean. • Vulnerability/resilience of these sites in relation to physical pressures; • Analysis of pressure/impact relationships for these sites and definition of qualitative GES; • Identification of extent (area) baselines for each site and the habitats they encompass; • Criteria for the risk based approach to monitoring and develop harmonized sampling instructions where appropriate; • Common computing methodologies and data collection instructions, specifying the accuracy (spatial resolution or grid) of the determination of extent (area) a priori; • Appropriate assessment scales; • Standardized data flows for spatial pressure data; • GES baselines for sites that cannot be inferred from contemporary records of pressure or construction; • Harmonised sampling, cartographic, data collation and GIS protocols • Generate or update databases and maps of known nesting, feeding, wintering habitats in each Contracting Party • Identify possible baselines and index sites. • Identify monitoring capacities and gaps in each Contracting Party • Develop a guidance manual to support the monitoring programme, which will provide more detailed	

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*	
information, tools, and advice on survey design, monitoring methodology and techniques that are most cost-effective and applicable to each of the selected sea turtle species, in order to ultimately ensure standardised monitoring, comparable data sets, reliable estimates and trend information. • Identify techniques to monitor and assess the impacts of climate change. • Develop monitoring synergies in collaboration with GFCM for- EO3 (Harvest of commercially exploited fish and shellfish), to collect data via sea turtle by-catch • Investigate monitoring synergies with other relevant EOs that will include coast-based fieldwork, in relation to monitoring of new/unknown sea turtle nesting beaches, and of beached/stranded animals, to obtain more widespread information • Any minimal valid assessment of changes in species distribution or distributional pattern requires both spatially explicit reporting of animal abundances (coordinates of locations) and an estimate or measure of sampling effort. This caveat calls for a very careful and restrictive use of modelling at a regional scale. Locally, and when high quality data is available, could be worth to try a density surface modelling approach such as GAM or machine learning models (MARMONI, 2015). Other common techniques used for representation of data in maps as such as Kernels are not recommended as distribution of the areas is not a continuous phenomenon.		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/7/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

5. Common indicator 3: Species distributional range (Seabirds) (EO 1)

Indicator Title	Common indicator 3: Species distributional range (Seabirds)	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The distribution of seabird species continues to occur in all their Mediterranean natural habitat Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions. (EO1, Biodiversity)	Distribution of selected species is maintained.	- No significant reduction in the population distribution in the Mediterranean in all indicator species. - New colonies are established and the population is encouraged to spread among alternative breeding sites.

Rational

Justification for indicator selector: Species distributional range and distributional pattern.

The objective of this indicator is to determine the species range of the seabirds that are present in Mediterranean waters; especially the species selected by the Parties (see Priorities below).

Change of breeding/wintering distribution of population reflects the habitat changes, availability of food resources, and pressures related to human activity and climate change. This indicator could be based in a set of single species indicators that reflects distribution pattern of breeding/wintering populations of the selected species.

Range is defined for the reporting under de Nature Directives as 'the outer limits of the overall area in which a species is found at present. It can be considered as an envelope within which areas actually occupied occur. For the application of the IUCN Red List criteria range (EOO) is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the sites of present occurrence, while distribution (AOO) is defined as the area within the EOO that is actually occupied.

The monitoring of the distribution should be accomplished over a complete scale approach to be truly reliable since range concept does not make sense for small areas. Whereas other indicators can have a tricky approach (vg. uneven or lack of knowledge on abundance, population, patterns or trends among the different Contract Parties, henceforth CP) the spatial distribution of the selected seabird species during the breeding and the wintering seasons are relatively well know, at least in terms of absence / presence. We suggest the scale of "National part of subdivision" as the basis working scale, by using a grid of 10x10 km square cells in the multipurpose Pan-European mapping standard (ETRS89 Lambert Azimuthal Equal-Area 52-10 projection coordinate reference system). For the reporting of small contracting parties such as Malta or Cyprus, maps of 5x5 km or 1x1 km grids could be advised because these will then be aggregated to 10x10 km for visualisation at the Regional or subregional level.

Thus the indicator for breeding/wintering range would consist in the variation of occupied / lost areas an ETRS89-LAEA5210_10K grid in 6 years. This proposal has multiple advantages as can be easily aggregated for the analysis at a subdivision level or higher or for a differentiated analysis between functional groups.

Scientific References

UNEP/MAP - RAC/SPA, 2012. Guidelines for Management and Monitoring Threatened Population of Marine and Coastal Bird Species and their Important Areas in the Mediterranean. By Joe Sultana. Ed. RAC/SPA, Tunis. 24pp.
ICES. 2016. Report of the Joint OSPAR/HELCOM/ICES Working Group on Seabirds (JWGBIRD), 9–13 November 2015, Copenhagen, Denmark. ICES CM 2015/ACOM:28. 196 pp.
Fric, J., Portolou, D., Manolopoulos, A. and Kastritis, T. (2012) Important Areas for Seabirds in Greece. LIFE07 NAT/GR/000285. Hellenic Ornithological Society (HOS / BirdLife Greece), Athens
Celada, C., Gaibani, G., Cecere, I.G., Calabrese, L. and Piovani, P. (2009) *Aree importanti per gli uccelli dalla terra al mare. Studio preliminare per l'individuazione delle IBA* (Important Bird Areas) *in ambiente marino*. LIPU, Ministero Dell'Ambiente and DPN.

<table>
<tr><td>Indicator Title</td><td colspan="2">Common indicator 3: Species distributional range (Seabirds)</td></tr>
<tr><td colspan="3">- Arcos, J.M., J. Bécares, B. Rodríguez y A. Ruiz. (2009) Áreas Importantes para la Conservación de las Aves marinas en España. LIFE04NAT/ES/000049-Sociedad Española de Ornitología (SEO/BirdLife). Madrid.
Bourgeois, K., & Vidal, E. (2008). The endemic Mediterranean yelkouan shearwater Puffinus yelkouan: Distribution, threats and a plea for more data. Oryx, 42(2), 187-194. doi:10.1017/S0030605308006467</td></tr>
<tr><td colspan="3">Policy Context and targets</td></tr>
<tr><td colspan="3">Policy context description</td></tr>
<tr><td>EU Marine Strategy Framework Directive</td><td>In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years.
The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning “cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies” […] “thereby facilitating achievement of good environmental status in the marine region or subregion concerned”.</td><td><u>Descriptor 1: Biodiversity</u>
The natural range and extent of seabird species are stable in the Mediterranean, or otherwise in line with the physiographic and climatic conditions, taking into consideration the sustainable use of the marine environment.

<u>Parameters and trends:</u>
Distribution (range)</td></tr>
<tr><td>UE Nature Directives (Birds and Habitats Directives)</td><td>The conservation status of a species “will be taken as ‘favourable’ when:
1. population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
2.the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
3.there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis”; (Article 1i)

Every six years, all EU Member States are required to report on the implementation of the directives

There is a methodology for the assessment of conservation status and has been widely used for the compulsory reporting by EU member states for Habitats Directive (HD). This approach has been extended also to Birds Directive (BD) reporting (N2K Group 2011).</td><td><u>Parameters and trends:</u>
Distribution (range)</td></tr>
<tr><td colspan="3">Targets
EU Marine Strategy Framework Directive: National and international efforts are undertaken, applying conservation measures or procedures to ensure that the distributional range of breeding and sites of the seabirds is stable, with no loss of breeding sites due to anthropogenic disturbance.
UE Nature Directives:</td></tr>
<tr><td colspan="3">Policy documents
List and url’s</td></tr>
</table>

Indicator Title	Common indicator 3: Species distributional range (Seabirds)

1. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance): http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1401265930445&uri=CELEX:32008L0056
2. http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm
3. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm
4. Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm
5. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities.

Indicator analysis methods

Indicator Definition

Variation in the total area (trends in the number of occupied grid cells) occupied by selected species at sea during the breeding and wintering seasons.

Methodology for indicator calculation

The European (ETRS) 10x10km² grid is used for mapping the distribution and range, accounting each known location along the Mediterranean coast. Three different maps (grids) are produced yearly for each species accounting for breeding sites as well as at sea during the breeding and wintering seasons.

For all species information on spatial distribution within the assessment would be transferred in a 10 × 10 km (or finer for small countries, 1 x 1 km or 5 x 5 km) grid; filled cells show presence of the species. The distribution area is the sum of area of the cells where the species is “present”.

For the reporting on the range of a species, considering that it is a suitable parameter for assessing the spatial aspects of GES, and to describe and detect changes in the extent of the distribution, a tool to calculate the range size from the map of the actual distribution on land (breeding sites) or at sea (i.e. occurrences). By using the Range Tool software and algorithm will provide of a standardised process that will help to ensure repeatability of the range calculation in different reporting rounds. After automated calculation of range it is possible to correct the gaps resulting from in completeness of data following and standardised protocol. The resulting range map will then be a combination of the automated procedure completed by expert judgement.

Indicator units

Number of 10 x 10 km cells occupied for breeding or wintering or feeding areas along the Mediterranean (or subregional) coast.
Annually – Total number of new locations (breeding, wintering, feeding); total number of 10 x 10 km newly occupied cells;
Annually – Total number of lost locations; total number of 10 x 10 km lost cells;

Priority species

The following species should be prioritised for the monitoring of distributional range given their role as indicators of the general state of the marine environment in the Mediterranean region:

- *Falco eleonorae*
- *Hydrobates pelagicus*
- *Larus audouinii*
- *Larus genei*
- *Pandion haliaetus*
- *Phalacrocorax aristotelis*
- *Calonectris diomedea*

Indicator Title	Common indicator 3: Species distributional range (Seabirds)
- *Puffinus yelkouan* - *Puffinus mauretanicus* - *Sterna bengalensis* *Sterna sandvicensis*	
List of Guidance documents and protocols available General protocols - Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm - Auniņš, A., and Martin, G. (eds.) (2015). Biodiversity Assessment of MARMONI Project Areas. Project report, 175. Available online at: http://marmoni.balticseaportal.net/wp/project-outcomes/ - Camphuysen CJ & Garthe S 2004. Recording foraging seabirds at sea: standardised recording and coding of foraging behaviour and multi-species associations. Atlantic Seabirds 6: 1 – 32. - http://bd.eionet.europa.eu/activities/Reporting/Article_17/reference_portal - ICES (2013). OSPAR Special Request on Review of the Technical Specification and Application of Common Indicators under D1, D2, D4, and D6. Copenhagen: International Council for the Exploration of the Sea. - ICES. 2015. Report of the Working Group on Marine Mammal Ecology (WGMME), 9–12 February 2015, London, UK. ICES CM 2015/ACOM: 25. 114 pp. - MARMONI (2015). The MARMONI approach to marine biodiversity indicators. Volume II: list of indicators f or assessing the state of marine biodiversity in the Baltic Sea developed by the life MARMONI project. Estonian Marine Institute Report Series No. 16. Available online at: http://marmoni.balticseaportal.net/wp/project-outcomes/ The "Range Tool" ETC/BD. 2012. User Manual for Range Tool for Article 12 (Birds Directive) & Article 17 (Habitats Directive). Prepared by Brian Mac Sharry (MNHN). http://bd.eionet.europa.eu/activities/Reporting_Tool/Documents - ETC/BD. 2011. Assessment and reporting under Article 12 of the Birds Directive. Explanatory Notes & Guidelines for the period 2008-2012 (Final version). Compiled by Compiled by the N2K Group under contract to the European Commission. Avalaible online: https://circabc.europa.eu/sd/a/4fc954f6-61e3-4a0b-8450-ca54e5e4dd53/Art.12%20guidelines%20final%20Dec%2011.pdf - ETC/BD. 2011. Assessment and reporting under Article 17 of the Habitats Directive. Explanatory Notes & Guidelines for the period 2007-2012 (Final version). Compiled by Douglas Evans and Marita Arvela (European Topic Centre on Biological Diversity). Avalaible online: https://circabc.europa.eu/sd/a/2c12cea2-f827-4bdb-bb56-3731c9fd8b40/Art17%20-%20Guidelines-final.pdf - Peifer, H. 2011. About the EEA reference grid. http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2/	
Data Confidence and uncertainties Quality 3 = Good. Complete survey or a statistically robust estimate Quality 2 = Moderate. Estimate based on partial data with some extrapolation and/or modelling Quality 1 = Poor. Estimate based on expert opinion with no or minimal sampling 0 = Uncertain (absent data, as in cases when newly arriving species has not yet established distribution). A helpful rule for assessing the quality of the range calculation could consist in a judgement combining the *reliability* of the distribution at the time it was mapped, how *recently* it was mapped, and the *method* used to map it The result would be 3 = reliable (accurate to within 10%); 2 = incomplete (accurate to within 50%) or 1 = poor (definitely not accurate to within 50%)	
Methodology for monitoring, temporal and spatial scope	

Indicator Title	Common indicator 3: Species distributional range (Seabirds)

Available Methodologies for Monitoring and Monitoring Protocols

Distribution of breeding/wintering/feeding areas including: location of breeding colonies on the coast
Breeding distribution map and range size: Map plotted on the selected ETRS grid showing occurrence (presence/absence)
Monitoring effort should be long term and should cover all seasons to ensure that the information obtained is as complete as possible.
The location of many bird colonies, as well as their wintering, feeding and developmental areas, may be achieved by checking existing bibliographic information (which can be of particular interest is assessing the basal stage), surveys conducted by different groups, observations (fishermen, citizen science), and regional expert knowledge.
For breeding / wintering areas:

Data collection : using any of the standard methods designed for breeding bird surveys such as bird count data, breeding/wintering bird atlases

Dedicated ship or aerial surveys (including the use of drones), opportunistic data: sea-bird watching whale-watching observations, fisheries sightings (logbooks), surveys on non-dedicated platforms (ferries, merchant marine ships or amateurs/yachts, use of citizen science), by-catch data (where dedicated research programs do not exist, for sea turtles and shearwaters in long-lines and other types of fishing gear). Telemetry: Satellite tracking, GPS/GSM tracking, radio tracking and the use of loggers.

Available data sources *Sources and url's*

OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, http://seamap.env.duke.edu/
http://www.birdlife.org/datazone/home
UNEP/MAP-RAC/SPA projects and publications http://www.rac-spa.org/publications
Birdlife partners in the Mediterranean
Mediterranean marine research centres, universities and institutions
Medmaravis
Governmental ministries
IUCN specialists

Spatial scope guidance and selection of monitoring stations

The presence of the selected species should be monitored all along the Mediterranean coast and in the known breeding colonies or wintering or feeding areas.

Temporal Scope guidance

Yearly for each of the species and areas (breeding, wintering, feeding). Seasonality to be determined by the local experts as i.e. breeding season can vary along and across the Mediterranean.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

The assessment should focus on whether the total area of a species' distribution range is maintained or not. To assess the variation in breeding, wintering and feeding ranges, annual comparisons should be made with an emphasis on new or disappearing colonies, expressing the range trends over the grids. This implies using different but widely available GIS geoprocessing techniques and and geodatabases tools (ArcGis, QGis, R plataform, etc). Annual comparison of distributional ranges.
The trends in the number of occupied cells or area occupied is a basic and immediate parameter wich signification can be statistically assessed. The assessment of the conservation status of a bird species in the Nature 2000 Directives is defined as "Unfavorable" when they undergo a large decline estimated as the "equivalent to a loss of more than 1% per year within period specified by MS OR more than 10% below favourable reference range".
As we are dealing with conspicuous species the range data (whatever would be decided size of area occupied or number of grid cells occupied) could be regressed against time with standard linear regression models. This approach assumes that the complete range is surveyed on each occasion and that the probability of detecting the species or habitat within any grid cell is one, if it is present in that grid cell. A long series (12 years?) would be

Indicator Title	Common indicator 3: Species distributional range (Seabirds)

necessary to detect clear tendencies.
A decreased range shouldn't be a major concern as far as other indicators, in particular the species indicator abundance, shows an acceptable trend.
But if the trends show a negative balance and a decrement on the occupied area, there are some techniques for change detection using grids (rasters). We suggest to explore the Map Comparison Kit (http://mck.riks.nl) a free software developed by the Netherlands Environmental Assessment Agency (MNP) which includes a range of algorithms for the comparison of raster maps similarities and dissimilarities and spatio-temporal analysis, and focus on 'categorical' or 'nominal' maps (H. Visser and T. de Nijs, 2006).

References (to be checked):

- Marine e-Atlas developed by the Fame Project and the Protocols of the Spanish Cetacean Society methods to analyse range trends in grids.

- Visser, H., & de Nijs, T. (2006). The Map Comparison Kit. Environmental Modelling & Software, 21, 346e358.

Expected assessments outputs
Temporal trends in distributional range.
Maps showing the evolution of the distributional range for the selected species at different scales and also by functional groups of species.

Known gaps and uncertainties in the Mediterranean
Any minimal valid assessment of changes in species distribution or distributional pattern requires both spatially explicit reporting of animal abundances (coordinates of locations) and an estimate or measure of sampling effort. This caveat calls for a very careful and restrictive use of modelling at a regional scale. Locally, and when high quality data is available, could be worth to try a density surface modelling approach such as GAM or machine learning models (MARMONI, 2015). Other common techniques used for representation of data in maps as such as Kernels are not recommended as distribution of the areas is not a continuous phenomenon.

Contacts and version Date
Key contacts within UNEP for further information

Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

6. Common indicator 4: Species population abundance (marine mammals) (EO 1)

<table>
<tr><td>Indicator Title</td><td colspan="2">Common indicator 4: Species population abundance (marine mammals)</td></tr>
<tr><td>Relevant GES definition</td><td>Related Operational Objective</td><td>Proposed Target(s)</td></tr>
<tr><td>The species population has abundance levels allowing qualifying to Least Concern Category of IUCN Red List or has abundance levels that are improving and moving away from the more critical IUCN category.</td><td>Population size of selected species is maintained, or, if depleted, it recovers to natural levels</td><td>No human-induced mortality is causing a decrease in breeding population size or density.
Populations recover towards natural levels.</td></tr>
<tr><td colspan="3">Rationale</td></tr>
<tr><td colspan="3">Justification for indicator selection

This indicator focuses on population abundance estimates for those marine mammal species within the Mediterranean Basin, particularly for the species selected by the Parties.

Population abundance refers to the total number of individuals of selected species in a specified area in a given timeframe, to inform about the growth or decline of a population. The systematic monitoring of the abundance and distribution of wild species constitutes a crucial element of any conservation strategy, but it is often neglected in many regions, including much of the Mediterranean. Population trends can be caused to both man-made pressures as well as natural fluctuations and environmental dynamics and climate changes. Hence, species abundance should be systematically monitored at regular intervals to inform effective conservation or review the efficacy of measures already in place.

Eleven species of cetaceans are considered to regularly occur in the Mediterranean area: short-beaked common dolphin (Delphinus delphis), striped dolphin (Stenella coeruleoalba), common bottlenose dolphin (Tursiops truncatus), harbour porpoise (Phocoena phocoena), long-finned pilot whale (Globicephala melas), rough-toothed dolphin (Steno bredanensis), Risso’s dolphin (Grampus griseus), fin whale (Balaenoptera physalus), sperm whale (Physeter macrocephalus), Cuvier’s beaked whale (Ziphius cavirostris) and killer whale (Orcinus orca). Two of these species have very limited ranges: the harbour porpoise, possibly representing a small remnant population in the Aegean Sea, and the killer whale, present only as a small population of a few individuals in the Strait of Gibraltar.

The Mediterranean is also the habitat for the pinniped species, like the Mediterranean monk seal (Monachus monachus). This species species occur regularly only in the eastern basin, mainly along the coasts of Greece and Turkey, some indivuiduals have been sigthed during the last decade in the western basin. Knowledge about the distribution, abundance and habitat use and preferences of some of these species, including the most abundant ones, is in part scant and limited to specific sectors of the Mediterranean Sea, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the Basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution.

The conservation status of marine mammels in the Mediterranean Sea has been a source of concern for many years. Marine mammals living in the Mediterranean Sea find themselves in precarious conditions due to the intense human presence and activities in the region; these are the source of a variety of pressures that are threatening these species’ survival. These animals are highly mobile and are usually not confined within single nations’ jurisdictions, stressing the need for basin-wide conservation and protection effort. Several threats affect marine mammals in the Mediterranean Sea and their effect on the population, distributional range and survival may act in a synergistic manner. Threats include interaction with fisheries, disturbance, injuries and fatal collisions from shipping, habitat loss and degradation, chemical pollution, anthropogenic noise, direct killings and climate change.</td></tr>
<tr><td colspan="3">Scientific References
Aarsland, A. et al. 2012. List of Contributors. - In: Herndon, D. N. (ed), Total Burn Care (Fourth Edition). W.B. Saunders, pp. xi–xvii.
Barlow, J. and Reeves, R. R. 2009. Population Status and Trends A2 - Thewissen, William F. PerrinBernd WürsigJ.G.M. - In: Encyclopedia of Marine Mammals (Second Edition). Academic Press, pp. 918–920.
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Buckland, S. T. and York, A. E. 2009. A - Abundance Estimation A2 - Thewissen, William F. PerrinBernd</td></tr>
</table>

Indicator Title	*Common indicator 4: Species population abundance (marine mammals)*
WürsigJ.G.M. - In: Encyclopedia of Marine Mammals (Second Edition). Academic Press, pp. 1–5. Butchart, S. H. M. et al. 2010. Global biodiversity: indicators of recent declines. - Science 328: 1164–1168. Conroy, M. J. and Noon, B. R. 1996. Mapping of Species Richness for Conservation of Biological Diversity: Conceptual and Methodological Issues. - Ecol. Appl. 6: 763–773. Davidson, A. D. et al. 2012. Drivers and hotspots of extinction risk in marine mammals. - Proc. Natl. Acad. Sci. 109: 3395–3400. Forcada, J. et al. 1995. Abundance of fin whales and striped dolphins summering in the Corso-Ligurian Basin. - Mammalia 59: 127–140. Forcada, J. et al. 1996. Distribution and abundance of fin whales (Balaenoptera physalus) in the western Mediterranean sea during the summer. - J. Zool. 238: 23–34. Forney, K. A. 2000. Environmental models of cetacean abundance : Reducing uncertainty in population Trends : Better policy and management decisions through explicit analysis of uncertainty: New approaches from marine conservation. - Conserv. Biol. 14: 1271–1286. Gaston, K. J. et al. 2000. Abundance–occupancy relationships. - J. Appl. Ecol. 37: 39–59. Gerrodette, T. 1991. Models for Power of Detecting Trends: A Reply to Link and Hatfield. - Ecology 72: 1889. He, F. and Gaston, K. J. 2000. Estimating Species Abundance from Occurrence. - Am. Nat. 156: 553–559. IUCN 2012. Marine mammals and sea turtles of the Mediterranean and Black Seas. - IUCN. Kunin, W. E. 1998. Extrapolating Species Abundance Across Spatial Scales. - Science 281: 1513–1515. Lawton, J. H. 1993. Range, population abundance and conservation. - Trends Ecol. Evol. 8: 409–413. Lawton, J. H. 1996. Population abundances, geographic ranges and conservation: 1994 Witherby Lecture. - Bird Study 43: 3–19. Lotze, H. K. and Worm, B. 2009. Historical baselines for large marine animals. - Trends Ecol Evol Amst 24: 254–262. Lotze, H. K. et al. 2011. Recovery of marine animal populations and ecosystems. - Trends Ecol. Evol. 26: 595–605. MacLeod, R. et al. 2011. Rapid monitoring of species abundance for biodiversity conservation: Consistency and reliability of the MacKinnon lists technique. - Biol. Conserv. 144: 1374–1381. Magera, A. M. et al. 2013. Recovery Trends in Marine Mammal Populations. - PLoS ONE in press. Martínez-Meyer, E. et al. 2013. Ecological niche structure and rangewide abundance patterns of species. - Biol. Lett. 9: 20120637. Maynou, F. et al. 2011. Estimating Trends of Population Decline in Long-Lived Marine Species in the Mediterranean Sea Based on Fishers' Perceptions. - PLoS ONE 6: e21818. Notarbartolo di Sciara, G. and Birkun, A., Jr 2010. Conserving whales, dolphins and porpoises in the Mediterranean and Black Seas: an ACCOBAMS status report, 2010.: 212. Panigada, S. et al. 2011. Monitoring winter and summer abundance of cetaceans in the Pelagos Sanctuary (northwestern Mediterranean Sea) through aerial surveys. - PloS One 6: e22878. Pauly, D. 2015. Marine Historical Ecology in Conservation: Applying the Past to Manage for the Future (JN KITTINGER, L MCCLENACHAN, KB GEDAN, and LK BLIGHT, Eds.). - University of California Press. Pearce, J. and Ferrier, S. 2001. The practical value of modelling relative abundance of species for regional conservation planning: a case study. - Biol. Conserv. 98: 33–43. Stier, A. C. et al. 2016. Ecosystem context and historical contingency in apex predator recoveries. - Sci. Adv. in press. Taylor, B. L. et al. 2007. Lessons from Monitoring Trends in Abundance of Marine Mammals. - Mar. Mammal Sci. 23: 157–175. Ureña-Aranda, C. A. et al. 2015. Using Range-Wide Abundance Modeling to Identify Key Conservation Areas for the Micro-Endemic Bolson Tortoise (Gopherus flavomarginatus). - PLoS ONE in press. Yu, J. and Dobson, F. S. 2000. Seven forms of rarity in mammals. - J. Biogeogr. 27: 131–139.	
Policy Context and targets (other than IMAP)	
Policy context description Mediterranean fin whales and sperm whales are protected by the International Whaling Commission's moratorium on commercial whaling that entered into force in 1986. The Mediterranean cetaceans' populations are also protected under the auspices of ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area), under the auspices of the UNEP Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS). The Corso-Ligurian-Provençal Basin and the Tyrrhenian Sea, where most cetacean species find suitable habitats, lie within the Pelagos Sanctuary established by France, Italy and Monaco, thus benefitting from its conservation regime. All cetacean species in the Mediterranean Sea are protected under the Annex II of the SPA-BD Protocol under the Barcelona Convention; under the Appendix I of the Bern Convention; under the Annex II of the Washington	

Indicator Title	*Common indicator 4: Species population abundance (marine mammals)*
Convention (CITES); under the Appendix II of the Bonn Convention (CMS). The short-beaked common dolphin, the sperm whale and the Cuvier's beaked whale and the Mediterranean monk seal are also listed under the Appendix I of the Bonn Convention (CMS). The common bottlenose dolphin, the harbor porpoise and the Mediterranean monk seal are also listed under the Annex II and all marine mammals are in Annex IV of the EU Habitats Directive and considered strictly protected.	
Indicator/Targets Aichi Biodiversity Target 1, 3 EU Regulation 812/2004 concerning incidental catches of cetaceans in fisheries EU MSFD Descriptor 1 and 4 - Marine Strategy Framework Directive requests regular reports on the population dynamics, range and status of cetacean species in Europe's waters. EU Habitats Directive - The European Habitat Directive not only requires the monitoring of the Good Environmental Status (GES) of species and habitats of community interest, but also requires reporting on this status every 6 years. The obligations under ACCOBAMS.	
Policy documents • Aichi Biodiversity Targets - https://www.cbd.int/sp/targets/ • EU Biodiversity Strategy - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN • EU Regulation 1143/2014 - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN • Marine Strategy Framework Directive - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN • Commission Decision on criteria and methodological standards on good environmental status of marine waters - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010D0477(01)&from=EN • Pan-European 2020 Strategy for Biodiversity - https://www.google.no/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiP1J-v_P7NAhWHjSwKHZfoBRIQFggtMAE&url=https%3A%2F%2Fcapacity4dev.ec.europa.eu%2Fsystem%2Ffiles%2Ffile%2F08%2F10%2F2012_-_1535%2Fpan-european_2020_strategy_for_biodiversity.pdf&usg=AFQjCNGa4NkkljA4x3l9WDO49uwrdYafMg • Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the Mediterranean Region - http://sapbio.rac-spa.org/ • Draft Updated Action Plan for the conservation of Cetaceans in the Mediterranean Sea - http://rac-spa.org/nfp12/documents/working/wg.408_08_eng.pdf • National Biodiversity Strategies and Action Plans (NBSAPs) - https://www.cbd.int/nbsap/ • ACCOBAMS Agreement Text - http://www.accobams.org/images/stories/Accord/anglais_text%20of%20the%20agreement%20english.pdf • ACCOBAMS STRATEGY (PERIOD 2014 – 2025) - https://accobams.org/images/stories/MOP/MOP5/Documents/Resolutions/mop5.res5.1_accobams%20strategy.pdf Common Fisheries Policy (CFP) and its reform - http://ec.europa.eu/fisheries/cfp/index_en.htm and http://ec.europa.eu/fisheries/reform/ and http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:354:0022:0061:EN:PDF Council Regulation (EC) No 812/2004 of 26.4.2004 laying down measures concerning incidental catches of cetaceans in fisheries and amending Regulation (EC) No 88/98 - http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32004R0812 Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning - http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.257.01.0135.01.ENG Regulatory and Governance Gaps in the International Regime for the Conservation and Sustainable Use of Marine Biodiversity in Areas beyond National Jurisdiction - https://cmsdata.iucn.org/downloads/iucn_marine_paper_1_2.pdf International Convention for the Prevention of Pollution from Ships (MARPOL) - http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx United Nations Convention on the Law of the Sea -	

Indicator Title	*Common indicator 4: Species population abundance (marine mammals)*
http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm UNEP Regional Seas Programme - http://www.unep.org/ecosystemmanagement/water/regionalseas40/ https://global.oup.com/academic/product/marine-mammal-conservation-and-the-law-of-the-sea-9780190493141?cc=us&lang=en&	
Indicator analysis methods	
Indicator Definition This indicator is aimed at providing information about the abundance of marine mammel's population. It is intended to determine the abundance and density of cetaceans and seals species that are present in Mediterranean waters, with a special focus on the species selected by the Parties. The rationale behind the organisation of systematic surveys is that the knowledge of baseline information, such as abundance and density, is fundamental to address many questions of ecological importance and for the implementation of conservation measures. This is particularly true for the Mediterranean Sea, in light of the fact that most of the marine mammels populations occurring in the area are threatened by human activities and their conservation status requires effective protection actions.	
Methodology for indicator calculation Line transect surveys (both aerial and ship-based) have proved to be particularly effective in estimating the abundance and density of many marine mammal species, and to provide robust data with low CVs and narrow CIs. Distance Sampling comprises a family of methods to estimate natural populations' parameters, the use of which is widespread and applied to various animal and plant taxa. The principle of this method is to search for objects (individuals or groups) along pre-defined fixed routes (transects). The result is a density value for the objects, calculated by the ratio between the area surveyed and the number of observations made. Data are elaborated through dedicated software (Distance 6.x). The use of Geographical Information Systems (GIS) is required for the compilation of the monitoring data collected and the elaboration of the predictions of species density and abundance. Information on density and abundance of cetaceans may be obtained through dedicated ship and aerial surveys, acoustic surveys, platform of opportunities (e.g., whale watching operators, ferries, cruise ships, military ships), as well as mark-recapture methodologies. As for the Mediterranean monk seal, information on density and abundance may be obtained through coastal cave surveys, counting of animals and pups, mark/recapture using photoid when possible. For pinnipedes, the better methodology to obain the information about density and abundance is to perceed when they reach the coast (hasul out / resting/ nursing sites) rather than out at sea. In the case of monk seal, any information from fishermen/tourists... i.e. citizen science considered valuable to determine potential presence individual ID thus counting. To ensure a comprehensive coverage of the ecosystem, the indicator species should be selected taking into account their functional role. In this context the Contracting Parties agreed to monitor the following indicator species (Decision IG.22/7): Marine mammals: <u>Pinnipeds</u>: *Monachus monachus* <u>Baleen whales</u>: *Balaenoptera physalus* <u>Toothed whales:</u> - deep diving species: *Physeter macrocephalus* *Ziphius cavirostris* - epipelagic species: *Delphinus delphis* *Tursiops truncatus* *Stenella coeruleoalba* *Globicephala melas* *Grampus griseus* Methods for estimating density and abundance are generally species-specific and ecological characteristics of a target species should be considered carefully when planning a research campaign. For example, visual surveys may be particularly appropriate for large whales, but may be inappropriate for deep diving species such as sperm whales. In this latter case, passive acoustic monitoring is by far the most robust data collection methodology. When a global approach such as that currently ppproposed by ACCOBAMS is unfeasible or too ambitious, small scale monitoring programmes should be established, adapting to MSFD macro-regions or UNEP-MAP-RAC/SPA (2010) marine eco-regions (Fig. 1), according to specific needs. In any case, once dealing with a subregional implementation approach for cetacean surveying campaigns, this	

Indicator Title	*Common indicator 4: Species population abundance (marine mammals)*

should be carried out in line with agreed common, regional methodologies, using existing and shared Protocols, with the facilitation, as appropriate, of ACCOBAMS.

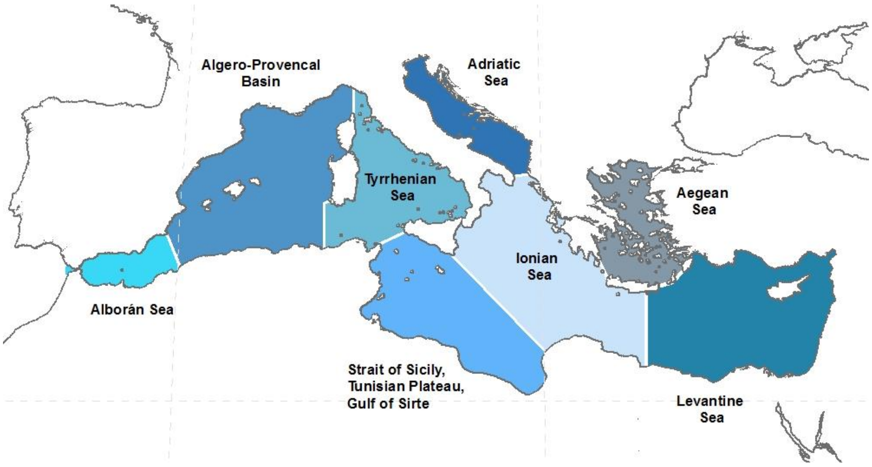

Figure 1. Mediterranean Sea with 7 sub-divided marine ecoregions. These include Alborán Sea; Algero-Provencal Basin; Tyrrhenian Sea; Adriatic Sea; Strait of Sicily, Tunisian Plateau, Gulf of Sirte; Ionian Sea/Central Mediterranean; Aegean Sea; Levantine Sea. Based on those divisions presented in UNEP-MAP-RAC/SPA, 2010.

Indicator units

The Integrated Monitoring and Assessment Guidance provided in document UNEP(DEPI)/MED WG.420/4 recommended to use for recording the presence/absence of each species, the standardized 30 x 30 nautical mile grid map produced by FAO/GFCM or the 50 x 50 km grids used by the European Bird Census Council.

Exisiting standard protocols, such as those suggested by the Marine Strategy Framework Directive and the Habitat Directive should be applied and followed.

According to specific needs, a finer scale map can be used, to provide finer information.

List of Guidance documents and protocols available

A document on 'Monitoring Guidelines to Assess Cetaceans' Distributional Range, Population Abundance and Population Demographic Characteristics' has been produced by ACCOBAMS and should be considered as guidance when establishing monitoring programmes.

Protocols for large scale surveys (Scans I, II, III, CODA) are also available.

Data Confidence and uncertainties

Estimates of density and abundance are particularly 'data-hungry' and a minimum of 40-60 sightings for each species should be available to maintain low Coefficients of Variation (CVs) and narrow Confidence Intervals Cis). This may be easy to achieve with some cetacean species, such as fin whales, striped or bottlenose dolphins, while may be very hard to achieve for beaked or pilot whales, for example. It is important to consider the highly mobility of cetaceans and the driving forces (mainly prey availability) which affect their distribution. In case of trends over time, appropriate statistical tools and analytical framework, such as density prediction modelling and power analysis should be applied.

Aerial surveys proved to be a very cost-effective methodology to collect significant data, to obtain robust abundance and density estimates for cetaceans and other large marine vertebrates, and to provide preliminary evidence of population trends over time.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Several protocols are available using different monitoring platforms and approaches such as:

- dedicated ships or aerial surveys,
- tagging, artificial tags & photo-identification to facilitate capture-mark-recapture analysis.
- passive acoustic data collection,
- automatic infrared cameras to allow mark-racapture analysis.
- Coastal cave surveys

Available data sources

OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, is a spatially referenced online database, aggregating marine mammal, seabird, sea turtle and ray & shark observation data from across the globe. http://seamap.env.duke.edu/

Spatial scope guidance and selection of monitoring stations

<table>
<tr><td colspan="2">Indicator Title</td><td colspan="2">Common indicator 4: Species population abundance (marine mammals)</td></tr>
<tr><td colspan="4">Current spatial distributional range of marine mammals in the Mediterranean Sea is largely affected by available data, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution. Priority should be given to the less known areas, using online data sources, such as Obis SeaMap and published data and reports as sources of information.
Most of the species selected as indicator species in relation to this common indicator are migratory species, whose range extends over wide areas in the Mediterranean. It is therefore recommended to consider monitoring these species at regional or sub-regional scales for the assessment of their population abundance.
ACCOBAMS is currently planning to undertake a regional synoptic survey covering most of the Mediterranean waters to estimate cetacean species density and abundance. This initiative – known as the ACCOBAMS Survey Initiative (ASI) - is expected to start in 2017 and to provide useful, robust and reliable data concerning population abundance of cetaceans in the Mediterranean area. Data on all the cetacean species present in the Mediterranean will be collected.</td></tr>
<tr><td colspan="4">Temporal Scope guidance
Estimates of density of abundance relate to a specific time and area, and may vary on annual, or seasonal basis. Ideally, seasonal monitoring programmes should be conducted, although winter and summer campaigns should provide enough information. As for monk seals, campaigns during the fall (breeding periode) should be considered. Temporal scale is largely affected by the conservation questions and expected outputs. International regulation suggests a six-year interval between large scale monitoring programmes, but smaller intervals are recommended. Long-term projects provide robust indications on trends over time and space in selected areas and are important project for photo-identification programmes.</td></tr>
<tr><td colspan="4">Data analysis and assessment outputs</td></tr>
<tr><td colspan="4">Statistical analysis and basis for aggregation
Values of density and abundance of cetaceans and other large marine vertebrates can be estimated using design-based and model-based methodologies. Both methods present very similar and comparable results. Power analysis for detecting trends in density or abundance should be also applied.</td></tr>
<tr><td colspan="4">Expected assessments outputs
I.e. trend analysis (monthly, seasonally, yearly), density maps, statistical frameworks applied.</td></tr>
<tr><td colspan="4">Known gaps and uncertainties in the Mediterranean
Data in the Mediterranean Sea are characterized by their uneven distribution, both geographical and spatial. The summer months are the most representative ones and very few information have been provided for the winter months, when conditions to conduct off-shore research campaigns are particularly hard due to meteorological adversity.Ongoing effort by ACCOBAMS will provide estimates of density and abundance for the entire Mediterranean Sea.

ACCOBAMS is currently planning to undertake a regional synoptic survey covering most of the Mediterranean waters to estimate cetacean species density and abundance. This initiative – known as the ACCOBAMS Survey Initiative (ASI) - is expected to be implemented during summer 2018. This will provide useful, robust and reliable data concerning population abundance of cetaceans in the Mediterranean area. Data on all the cetacean species present in the Mediterranean will be collected and will provide important baseline data to liaise with national and international requirements, such as those by the Ecosystem Approach and the MSFD.

Aerial surveys supported by the Italian Ministry of the Environment and by the French Agency for Marine Protected Areas targeted the seas around Italy, France, the whole Pelagos Sanctuary and the Strait of Sicily, both in winter and summer months.</td></tr>
<tr><td colspan="4">Contacts and version Date</td></tr>
<tr><td colspan="4">Key contacts within UNEP for further information</td></tr>
<tr><td>Version No</td><td colspan="2">Date</td><td>Author</td></tr>
<tr><td>V.1</td><td colspan="2">20/07/2016</td><td>SPA/RAC</td></tr>
<tr><td>V.2</td><td colspan="2">14/04/2017</td><td>SPA/RAC</td></tr>
</table>

7. Common Indicator 4: Population abundance (Reptiles) (EO 1)

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The population size allows to achieve and maintain a favorable conservation status taking into account all life stages of the population	Population size of selected species is maintained	State No human induced decrease in population abundance Population recovers towards natural levels where depleted
Rationale		
Justification for indicator selection Measurements of biological diversity are often used as indicators of ecosystem functioning, as several components of biological diversity define ecosystem functioning, including richness and variety, distribution and abundance. Abundance is a parameter of population demographics, and is critical for determining the growth or decline of a population. The objective of this indicator is to determine the population status of selected species by medium-long term monitoring to obtain population trends for these species. This objective requires a census to be conducted in breeding, migratory, wintering, developmental and feeding areas.		
Scientific References Bevan E, Wibbels T, Navarro E, Rosas M, Najera BMZ, Sarti L, Illescas F, Montaro J, Pena LJ, Burchfield P. 2016. Using Unmanned Aerial Vehicle (UAV) Technology for Locating, Identifying, and Monitoring Courtship and Mating Behavior in the Green Turtle (*Chelonia mydas*). Herpetological Review, 47(1), 27–32. Broderick, A.C., F. Glen, B.J. Godley BJ, G.C. Hays. 2002. Estimating the number of green and loggerhead turtles nesting annually in the Mediterranean. Oryx 36:227-235. Broderick, A.C., M.S. Coyne, W.J. Fuller, F. Glen, B.J. Godley. 2007. Fidelity and over-wintering of sea turtles. Proceedings of the Royal Society, Vol. 274 no. 1617 1533-1539. Casale P. and Margaritoulis D. (Eds.) 2010. Sea Turtles in the Mediterranean: Distribution, Threats and Conservation Priorities. IUCN/SSC Marine Turtle Specialist Group. Gland, Switzerland: IUCN, 294 pp. http://iucn-mtsg.org/publications/med-report/ Casale P., G. Abbate, D. Freggi, N. Conte, M. Oliverio, R. Argano. 2008. Foraging ecology of loggerhead sea turtles *Caretta caretta* in the central Mediterranean: evidence for a relaxed life history model. Marine Ecology Progress Series 372: 265-276. Demography Working Group of the Conference. Demography of marine turtles nesting in the Mediterranean Sea: a gap analysis and research priorities - 5th Mediterranean Conference on Marine Turtles, Dalaman, Turkey, 19-23 April 2015. Document T-PVS/Inf(2015)15E Presented at the Convention on the conservation of European wildlife and natural habitats - 35th meeting of the Standing Committee - Strasbourg, 1 - 4 December 2015 (2015) Groombridge, B. 1990. Marine turtles in the Mediterranean: distribution, population status, conservation. A report to the Council of Europe, Environment and Management Division. Nature and Environment Series, Number 48. Strasbourg 1990 Margaritoulis, D., Argano, R., Baran, I., Bentivegna, F., Bradai, M.N., Caminas, J.A., Casale, P., Metrio, G.D., Demetropoulos, A., Gerosa, G., Godley, B.J., Haddoud, D.A., Houghton, J., Laurent, L. & Lazar, B. (2003) Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives. Loggerhead sea turtles (ed. by B.E. Witherington), pp. 175–198. Smithsonian Institution, Washington. Schofield, G., K.A. Katselidis, P. Dimopoulos, J.D. Pantis. 2008. Investigating the viability of photo-identification as an objective tool to study endangered sea turtle populations. Journal of Experimental Marine Biology & Ecology 360:103-108		
Policy Context and targets (other than IMAP)		
Policy context description Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes GES definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD includes Descriptor 1: Biodiversity: “The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.”		

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Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them.

The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned".

Indicator/Targets

Commission Decision 2010/477/EU sets out the MSFD's criteria and methodological standards and under Descriptor 1 includes criteria 1.2. Population size and indicator "Population abundance and/or biomass, as appropriate (1.2.1)".

At a country scale, the following targets have been selected by member states.

Source: [Evaluation of] National Reports on Article 12 Technical Assessment of the MSFD 2012 obligations
http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/pdf/national_reports.zip

GREECE (*page 15)*

Environmental targets:

*[…]*2) Census of marine turtle *Caretta caretta* reproducing in the Greek coasts and conservation of spawning areas.

Associated indicators:

*[…]*2) Breeding area of the Mediterranean monk seal *Monachus monachus* and the sea turtle *Caretta caretta*

ITALY (*page 18)*

Italy has provided six targets and associated indicators *[…]* The second target focuses on the loggerhead turtle, and has the aim of decreasing accidental mortalities by regulating fishing practices. *[…]* No targets or threshold values are otherwise given.

[…]

T2: By-catch reduction in the areas of aggregation of *Caretta caretta*

It is proposed that the operative target for the mitigation of *Caretta caretta* by-catch be articulated as follows:

1) Spatial identification of the areas with highest use of pelagic long line (southern Tyrrhenian and southern Ionian sea) and trawling (northern Adriatic)

2) Completion of the spatial definition of *Caretta caretta* aggregation areas based on an approach capable of assessing temporal and seasonal distribution differences for each aggregation area (based on indicator 1.1.2 completion) so as to provide a final definition of the operative target

3) Monitoring of accidental captures in the areas subjected to operational target

4) Application of by-catch reduction measures in areas listed in point 3), through one or more of the following activities:

- Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling nest through structural modifications to the gear (i.e. circle hooks, TEDs etc.) and application of best practices for the reduction of mortality following capture (percentage). Note: in order to allow an immediate reduction of the pressure it is advised that best practices be applied in the geographic areas where preliminary knowledge already defines the presence of an aggregation area, before defining the incidence of total capture in the specific gear.
- Reduction of fishing pressure (percentage)

SPAIN (*Page 25)*

A.1.4: Reduce the main causes of mortality and of reduction of the populations of groups of species at the top of the trophic web (marine mammals, reptiles, sea birds, pelagic and demersal elasmobranchs), such as accidental capture, collisions with vessels, intaking of litter at sea, introduced terrestrial predators, pollution, habitat destruction, overfishing.

[…]

A.1.7: Establish a national coordination system of the accidental catch monitoring programmes of birds, reptiles, marine mammals, and mammal and reptile stranding and bird tracking.

[…]

A.3.4: Maintain positive or stable trends for the populations of key species or apex predators (marine mammals, reptiles, seabirds and fish) and maintain commercially exploited species within safe biological limits.

[…]

C.1.2: Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles)

SLOVENIA - No information on Targets

page 10: (I. Good Environmental Status (GES), 1.1 Descriptor 1)

In the accompanying text to the GES definition, Slovenia provides a list of the species that are covered by the

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GES definition. This includes the bottlenose dolphin (*Tursiops truncatus*), the loggerhead sea turtle (*Caretta caretta*).
(II. Initial assessment, 2.2 Biological features)
Slovenia indicates that *[…]* turtles are covered under the reporting obligations of the Habitats Directive *[…]*. Each of these groups is briefly described and their state in relation to natural conditions is reported.
CYPRUS - No information on Targets
page 11: (II. Initial assessment, 2.2 Biological features)
[…] Chelonia mydas and *Monachus monachus* are considered stable but the situation of *Caretta caretta* is actually improving.

Policy documents

http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010D0477(01)

http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm

http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm
http://ec.europa.eu/environment/marine/pdf/1-Task-group-1-Report-on-Biological-Diversity.pdf
http://ec.europa.eu/environment/marine/pdf/9-Task-Group-10.pdf

Indicator analysis methods

Indicator Definition
The index of population abundance reflects the variation over time of the total population size (counted or estimated) of selected species. Population size is the number of individuals present in a population at the appropriate scale.
Population Size:
The number of individuals within a population (population size) is defined as the number of individuals present in an animal aggregation (permanent or transient) in a subjectively designated geographical range.
Population density:
Population density is the size of a population in relation to the amount of space that it occupies, and represents a complementary description of population size. Density is usually expressed as the number of individuals per unit area.
Index of population abundance:
The index of population abundance is a single species indicator that reflects the temporal variation in the breeding or the non-breeding (wintering/feeding/developmental) population of selected species compared to a base year (or reference level). This indicator can be added into multi-species indices to reflect the variation over time of functional groups of species.

Methodology for indicator calculation

The choice of the most appropriate methodology to calculate the index of population abundance will depend on the temporal pattern of the available data. The methods to obtain the data used in the calculations are described in the monitoring methods below.

For data available on an annual basis, site and year, specific counts of individuals of the two species can be related to site and year effects (factors) and missing values can be imputed from the data of all surveyed sites.

Indicator units

The index of population abundance is a numerical value of species population abundance relative to the population size at base time. The average breeding population size during at least a decade is suggested as the base level (based on International Union for Conservation of Nature Red List minimal criteria for sea turtles). However, the breeding population in a given year excludes non-breeding adults and all juveniles; thus, a more comprehensive database is required.

For the base data used to calculate the index of population abundance, the following units are suggested:

- for population size at breeding colonies, number of females, number of nests or number of tracks, with appropriate modelling to extrapolate population numbers depending on the method used
- for total number of nesting sites, number of sites (n)
- for average nesting site size, size of the nesting area versus number of females, number of nests or

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number of tracks, with appropriate modelling to extrapolate population numbers depending on the method used (i.e. to obtain density/km) (n)

- for non-breeding animals at wintering/foraging/developmental sites, number of individuals (n) with appropriate modelling to extrapolate population numbers taking into account individuals that are not observed due to low surfacing frequency in the marine environment.
- For all size/age classes that are being injured/killed, the number of individuals (n) will be documented via the stranding network/bycatch data

Marine area surveys
Numbers of individuals based on the number of individuals, separated where possible according to:

1. Size class categories (as the sex of juveniles can only be determined by laparoscopy)
2. Sex of adult individuals: males can generally be distinguished from females by a longer tail

Beach area surveys

1. Counts of the number of females that emerge on the beach using identifiers (external flipper tags/PIT tags/Photo id) where possible
2. Counts of the numbers of tracks and/or nests on nesting beaches, from which an estimate of female population size can be made

List of Guidance documents and protocols available

Bevan E, Wibbels T, Rosas M, Najera BMZ, Sarti L, Montano J, Pena LJ, Burchfield P. Herpetological Review, 2016, 47(1), 27–32.

Eckert, K. L., Bjorndal, K. A., Abreu-Grobois, F. A. and Donnelly, M. (Eds.) 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4. Washington, DC: 235 pp. https://mtsg.files.wordpress.com/2010/11/techniques-manual-full-en.pdf

Gerosa, G. (1996). Manual on Marine Turtle Tagging in the Mediterranean. –Mediterranean Action Plan - UNEP, RAC/SPA, Tunis, 48 pp.

Gerosa, G. and M. Aureggi. 2001. Sea Turtle Handling Guidebook for Fishermen. UNEP Mediterranean Action Plan, Regional Activity Centre for Specially Protected Areas. Tunis. http://www.rac-spa.org

McClellan DB. 1996. Aerial surveys for sea turtles, marine mammals and vessel activity along the south east Florida coast 1992-1996. NOAA Technical Memorandum NMFS-SEFSC-390 42pp

Schofield, G., K.A. Katselidis, P. Dimopoulos, J.D. Pantis. 2008. Investigating the viability of photo-identification as an objective tool to study endangered sea turtle populations. Journal of Experimental Marine Biology & Ecology 360:103-108

SWOT Scientific Advisory Board. 2011. The State of the World's Sea Turtles (SWOT) Minimum Data Standards for Nesting Beach Monitoring, version 1.0. Handbook, 28 pp

Data Confidence and uncertainties

Reliable index population abundance requires good census data, obtained regularly over a pre-defined spatial scale that is maintained through time. The index calculation methods allow for some gaps in the data series, but it is important to maintain the spatial scale so that data can be comparable across years.

The calculation methods provide a confidence interval which, in turn, is dependent on the level of confidence of the original census data. To reduce uncertainty, it is important that the individuals obtaining the data have received proper training and are maintained over extensive periods.
In-water surveys
It is not possible to count all individuals in a given habitat/population. Transects must be corrected for the likelihood of observing surfacing animals, according to species. For instance, sea turtles are much smaller (particularly juveniles) and spend less time at the surface than sea birds or mammals. Furthermore, animals are more likely to be sighted in shallow waters (<10 m depth) versus deeper waters. All of these issues need to be incorporated into the survey techniques and subsequent extrapolation/analyses.
Male numbers can only be inferred from in-water surveys.
Aerial surveys
These techniques may be used for sea turtles; however, due to their small size (particularly for juvenile stages) and brief surfacing time, the appropriate statistical analyses would be required to assess the collected data objectively. These techniques are best applied in shallow areas where sea turtles are known to aggregate and where they could be detected underwater too.
Beach-based surveys

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It is not possible to count all females that nest in a nesting area, as some may emerge before the onset of monitoring or may emerge on beaches that are not monitored. Thus, it is important to document tracks too.
On beaches where remote techniques are used to count tracks/nests, there is a risk of double counting the same tracks if monitoring is infrequent; frequent monitoring could use the proximity of the track to the sea to guide track freshness. This issue needs careful consideration.
Extrapolating female numbers from track/nest counts must be treated with caution, as the number of nests laid by females varies with the sea temperature (i.e. fewer nests are laid by the same females at <25 °C versus >25 °C). Various models exist to extrapolate this information. However, ultimately track/nest counts should be used to infer female numbers and inter-annual changes in female numbers with extreme caution.
Male numbers cannot be obtained from beach surveys, as they do not emerge on beaches.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

To estimate and monitor the number of breeding turtles, the proposed field methods are:

a) direct counts of females at the nesting sites at the appropriate time in the breeding season to estimate the total number of breeding females

b) when performing the surveys above, the number and distribution of nesting colonies should be recorded so as to be able to estimate the total number of breeding nuclei, and their average size

To estimate and monitor the number of turtles in-water at breeding, wintering, foraging, and developmental sites, the following methodologies are proposed:

a) direct counts of individuals during the appropriate seasons (potentially year-round at certain foraging/developmental sites), with appropriate modeling to estimate the number of missed individuals not counted due to low surfacing intervals.

To estimate and monitor the number of animals that are injured or die in areas near or within breeding, wintering, foraging and developmental sites

a) direct counts of individuals caught by fishing vessels as bycatch or stranded on beaches throughout the Mediterranean, with appropriate modelling to estimate the site where the animal was traumatized (i.e. how it was carried by sea currents) in cases of stranding, and how these losses impact the Mediterranean sea turtle population as a whole, along with individual population and sub-population units.

Breeding areas census (rookeries):
Once breeding areas have been identified it is possible to obtain counts (individuals, nests, etc.) during the most appropriate period. The method used depends on the species and their characteristics. Counting the number of nests or crawls during the early morning is used to infer the number of females in a seasonal sea turtle breeding population, but does not provide information on the number of males present. In water photo-id or drone surveys can be used to detect males (males swim with their tails protruded).
Wintering areas census: To determine the state of populations during the winter, it is necessary to use a standardized sampling method. For sea turtles, wintering areas of adults (but not juveniles) could be identified from existing and new satellite tracking studies, allowing focused effort at these sites. However, as wintering turtles surface less frequently than during breeding or foraging, underwater survey techniques may need to be developed (or drone survey techniques). In addition, for sea turtles, juvenile wintering grounds are not necessarily in the same location as those of adults; therefore, dedicated surveys of areas used by juvenile life stages are also required.
Foraging census: Once identified, individuals in feeding areas are counted at different periods throughout the year. For most species, feeding areas may be located by aerial surveys, bycatch data, telemetry data and the study of the distribution of prey species. For sea turtles, direct counts at foraging areas may require the development of underwater techniques, due to their low surfacing frequency, in parallel to emerging (drone) techniques. This would be particularly important in major feeding areas that are not coastal, such as in the central Adriatic, Gulf of Gabes, etc. In addition, for sea turtles, juvenile foraging grounds are not necessarily in the same location as those of adults; therefore, dedicated surveys of areas used by juvenile life stages are also required.
Ship and aerial surveys (from ships, planes, helicopters or drones): Visual census (sightings) by a stratified/linear transect method. Two types of sampling techniques are proposed: in coastal (neritic) waters and in remote oceanic (pelagic) waters. Coastal transects consistently cover the same area of coastline uniformly (but transects linking caves along the coastline would be selected for monk seal boat surveys), while pelagic

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surveys would be variable, but generally straight and perpendicular to the coast. Transects should be conducted at different times of the year, to cover all aspects of marine animal phenology. When sea turtles are located, as much information is recorded as possible about the species, position, number of individuals and social structure. These techniques may be used for sea turtles; however, due to their small size (particularly for juvenile stages) and brief surfacing time, the appropriate statistical analyses would be required to assess the collected data objectively. These techniques are best applied in shallow areas where sea turtles are known to aggregate and where they could be detected underwater too.

Platforms-of-opportunity (POP) surveys: Trained observers would be placed on host ships and aircraft to survey remote pelagic waters. In such cases, data must be extrapolated to infer trends in abundance, as sightings become opportunistic.

Tagging (capture-mark-recapture – artificial tags & photo-identification): at focal coastal marine areas where turtles aggregate in the water (breeding, foraging, wintering, developmental areas) or of females on the nesting beaches.

Telemetry: Tracked individuals can be used to identify hotspots to make counts of aggregated populations.

Beached and stranded specimens monitoring

Creating a network of stranding and beached individual census' to obtain important information, usually with the help of volunteers and officials. This is a good indicator of seabirds after storms. It is also a good indicator for the presence/absence of cetaceans, seals and dolphins in different geographical regions. Dedicated stranding networks already exist for sea turtles/marine mammals in several Mediterranean countries, with stranding information being confirmed to reflect distribution patterns based on satellite telemetry studies. Sea turtle stranding represent a useful index of population abundance and can be used if data are appropriately collected and standardized. Specific tracts of coast can be selected as index zones for this purpose, or coastlines may be opportunistically surveyed with the assistance of the general public.

Beach-based surveys

Counts of females on beaches and/or tracks/nests are used to infer population size in many sea turtle populations. Foot patrols are limited to specific areas; whereas drones/planes can be used to survey vast tracts of beach repeatedly to obtain counts of tracks (with methods existing to extrapolate approximate turtle numbers). High resolution remote sensing satellite imagery could also be used to count tracks on difficult to access beaches; however, this remains extremely expensive.

Sea turtles: Various devices can be attached or implanted to sea turtles to uniquely identify individuals: artificial flipper tags, PIT tags, photo-identification (facial scute patterns, notches and scars). Epibionts should not be used, as they can fall off after very short periods.

In addition, high-resolution telemetry (satellite, GPS/GSM, radio) should be used to determine the frequency that female turtles nest in years with different environmental conditions, to obtain accurate indices of nest frequency, from which to infer female numbers with greater accuracy.

Existing techniques include:

- Aerial or boat surveys (line transects) under specific circumstances, with the appropriate modelling techniques to account for missed animals (i.e. due to low surfacing time and low frequency of time spent at the surface)
- Artificial external flipper tagging (metal and plastic on flippers),
- Photo-identification
- PIT tagging of flippers, Telemetry (satellite, GPS/GSM, radio telemetry) and loggers, capture-mark-recapture studies
- Shipboard, aerial (including drone), or diver-based/video (potential)
- Swimming/snorkelling surveys with photo-id and GPS in densely populated areas (e.g. certain breeding sites)
- CPUE (bycatch), Direct mortality rate, Post-release mortality rate
- Nest counts, Photo-id of individuals, Time-Depth-Recorder tags
- Beach stranding

Available data sources

Adriatic Sea Turtle Database. http://www.adriaticseaturtles.eu/

Casale P. and Margaritoulis D. (Eds.) 2010. Sea Turtles in the Mediterranean: Distribution, Threats and Conservation Priorities. IUCN/SSC Marine Turtle Specialist Group. Gland, Switzerland: IUCN, 294 pp. http://iucn-mtsg.org/publications/med-report/

Halpin, P.N., Read, A.J., Fujioka, E., et al., 2009. OBIS-SEAMAP the world data center for marine mammal, sea bird, and sea turtle distributions. Oceanography 22, 104–115.

I3S. Sea turtle photo identification database. http://www.reijns.com/i3s/

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The state of the World's Sea Turtles online database: data provided by the SWOT team and hosted on OBIS-SEAMAP (Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations). In: Oceanic Society, Conservation International, IUCN Marine Turtle Specialist Group (MTSG), and Marine Geospatial Ecology Lab, Duke University. <http://seamap.env.duke.edu/swot>.

Margaritoulis, D., Argano, R., Baran, I., Bentivegna, F., Bradai, M.N., Cami~nas, J.A., Casale, P., Metrio, G.D., Demetropoulos, A., Gerosa, G., Godley, B.J., Haddoud,D.A., Houghton, J., Laurent, L. & Lazar, B. (2003) Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives. Loggerhead sea turtles (ed. by B.E. Witherington), pp. 175–198. Smithsonian Institution, Washington

PITMAR. Sea turtle photo-identification database. http://www.pitmar.net/index.php/en/

Seaturtle.org – Global Sea Turtle Network. Sea turtle tracking. Sea turtle nest monitoring. http://www.seaturtle.org/

The Reptile Database: Location of juvenile loggerheads and greens in the Eastern Mediterranean. http://reptile-database.reptarium.cz/species?genus=Caretta&species=caretta

Mediterranean marine research centres, NGOs, universities and institutions, local and national sea turtle monitoring projects.

Governmental Ministries

IUCN specialists (MTSG)

Spatial scope guidance and selection of monitoring stations

For counts carried out on an annual basis, a number of sites should be selected that represent a sufficiently large proportion of the subregional or national population, with criteria being delineated by expert groups[1]

The "Demography Working Group" suggests that comprehensive surveys should be carried out every 5 years, with the aim of covering all breeding, foraging, wintering and developmental sites. However, here, it is recommended that the whole coastal and marine area is covered on a national or subregional scale to take into account changes in population distribution (and hence counts) in relation to climate change.

[1]*Demography Working Group of the Conference. (2015) Demography of marine turtles nesting in the Mediterranean Sea: a gap analysis and research priorities - 5th Mediterranean Conference on Marine Turtles, Dalaman, Turkey, 19-23 April 2015. Document T-PVS/Inf(2015)15E Presented at the Convention on the conservation of European wildlife and natural habitats - 35th meeting of the Standing Committee - Strasbourg, 1 - 4 December 2015*

Temporal Scope guidance

Annual – breeding surveys at selected sites to estimate the number of breeding females from nest counts (April to September) and the number of breeding males and females from direct counts of in-water surveys (April-July)

Annual – winter censuses at selected sites to estimate no. of wintering individuals (October to April)

Annual – foraging/developmental censuses at selected sites to estimate no. of foraging/developmental individuals (January-December)

Every year – comprehensive breeding surveys at index beaches (included all beaches that are monitored annually through various programs) to estimate the no. of breeding individuals, number of breeding sites and average size. Monitoring every 5 years[1] of the entire coastline of all countries to detect changes in sporadic beach use or the use of new sites driven by climate change or changes to the habitat at existing sites (e.g. erosion or development)

Every year – comprehensive censuses of index winter, foraging, developmental sites to estimate no. of wintering, foraging and developmental individuals at coastal and marine sites. At present, knowledge of these sites remains limited, particularly identifying those that are likely to have the greatest impact on multiple breeding populations. Thus, in the first two years, all oceanic and coastal areas must be uniformly monitored, followed by a meeting of experts to decide index sites for the different categories (foraging, wintering, developmental) within each country (the marine area all countries of the Mediterranean are used by sea turtles, so a set number per country should be selected). At this point, index sites should be monitored annually, while all other sites should be monitored every 5 years.

[1]*Demography Working Group of the Conference. (2015) Demography of marine turtles nesting in the Mediterranean Sea: a gap analysis and research priorities - 5th Mediterranean Conference on Marine Turtles, Dalaman, Turkey, 19-23 April 2015. Document T-PVS/Inf(2015)15E Presented at the Convention on the conservation of European wildlife and natural habitats - 35th meeting of the Standing Committee - Strasbourg, 1 - 4 December 2015*

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

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It is not possible to survey all individuals in a turtle population either through in-water or beach-based surveys; thus, various models must be established and validated for the different targets (breeding, foraging, wintering and developmental sites).

At present a number of analyses exist to infer population size based on the metric being counted, e.g. on nesting beaches, different groups count female numbers, nest numbers or track numbers from which population size is inferred. In the water, turtles do not surface regularly, so a number of individuals are always missed from population surveys. The statistics used depends on the monitoring method used, as well as the seabed depths surveyed and in-water visibility.

A number of models are available for estimating population abundance based on nest-counts or sighting information; however, limitations exist, with various complimentary methods being required to improve robustness.
The assessment of the conservation status of a sea turtle species by the IUCN is defined “endangered” and “critically endangered” when there is over 50% and 80% decline in a population, respectively, over the most recent 10 year period (or 3 generations). These decisions are actually based on extrapolations nest-associated data, either counts of females, their nests or tracks, and do not actually take into account adult males or the juvenile component of the population. Thus, the level of detectability in different habitats (coastal and oceanic) and under different conditions (sea depths, sea state, sea visibility) needs to be incorporated into analyses. A long series (at least 10 years, to conform with IUCN criteria) would be necessary to detect clear tendencies.

Expected assessments outputs

This indicator will be largely built on establishing counts of sea turtles of different size/age classes and sexes (adults only) at nesting (breeding), wintering, foraging/developmental habitats. The main output of the monitoring will be therefore:
- Models providing estimates of abundance in all areas where turtle presence is detected
- Changes (trends) in the number of individuals in each habitat over time

In addition to national or subregional indices, trends can be computed to indicate whether long term changes in turtle populations are strongly increasing, moderately increasing, stable, uncertain, moderately declining or steep declining.

Known gaps and uncertainties in the Mediterranean

- Number of males and females frequenting all breeding/nesting sites each year (operational sex ratio), and the total number of individuals in the breeding populations.
- Number of adults and juveniles frequenting wintering, feeding, developmental sites, along with how numbers vary across the season as individuals enter and leave different sites.
- Vulnerability/resilience of these populations/sub-populations in relation to physical pressures;
- Analysis of pressure/impact relationships for populations/sub-populations and definition of qualitative GES;
- Identification of extent (area) baselines for each population/subpopulation and the habitats they encompass;
- Criteria for the risk based approach to monitoring and develop harmonized sampling instructions where appropriate;
- Common computing methodologies and data collection instructions, specifying the accuracy (spatial resolution or grid) of the determination of extent (area) a priori;
- Appropriate assessment scales;
- Standardized data flows for spatial pressure data;
- GES baselines for sites that cannot be inferred from contemporary records of pressure or construction;
- Harmonised sampling, cartographic, data collation and GIS protocols
- Generate or update databases and maps of known nesting, feeding, wintering habitats in each Contracting Party
- Identify possible baselines and index sites.
- Identify monitoring capacities and gaps in each Contracting Party
- Develop a guidance manual to support the monitoring programme, which will provide more detailed information, tools, and advice on survey design, monitoring methodology and techniques that are most

<table>
<tr><td>Indicator Title</td><td colspan="2">Common Indicator 4: Population abundance (Reptiles)</td></tr>
<tr><td colspan="3">cost-effective and applicable to each of the selected sea turtle species, in order to ultimately ensure standardised monitoring, comparable data sets, reliable estimates and trend information.
• Identify techniques to monitor and assess the impacts of climate change.
• Develop monitoring synergies in collaboration with GFCM for- EO3 (Harvest of commercially exploited fish and shellfish), to collect data via sea turtle by-catch
• Investigate monitoring synergies with other relevant EOs that will include coast-based fieldwork, in relation to monitoring of new/unknown sea turtle nesting beaches, and of beached/stranded animals, to obtain more widespread information
• Neither turtle populations nor monitoring capacity are distributed equally across the Mediterranean and, for this reason, it may be advisable to plan a phased development of pan-Mediterranean indices of population abundance for sea turtles. The best approach is to build on the existing national biodiversity monitoring units, and to homogenise methodologies as initial steps. The extension of equivalent programmes across the whole of the Mediterranean region may be achieved in a second phase.</td></tr>
<tr><td colspan="3">Contacts and version Date</td></tr>
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<tr><td>Version No</td><td>Date</td><td>Author</td></tr>
<tr><td>V.1</td><td>20/7/2016</td><td>SPA/RAC</td></tr>
<tr><td>V.2</td><td>14/04/2017</td><td>SPA/RAC</td></tr>
</table>

8. Common indicator 4: Species population abundance (Seabirds) (EO 1)

<table>
<tr><td>Indicator Title</td><td colspan="2">Common indicator 4: Species population abundance (Seabirds)</td></tr>
<tr><td>Relevant GES definition</td><td>Related Operational Objective</td><td>Proposed Target(s)</td></tr>
<tr><td>Population size of selected species (of seabirds) is maintained.

The species population has abundance levels allowing to qualify to Least Concern Category of IUCN (less than 30% variation over a time period equivalent to 3 generation lengths)</td><td>Breeding population size of selected species is maintained or, where depleted, it recovers to natural levels</td><td>No human-induced decrease in breeding population size or density.

Breeding populations recover towards natural levels where depleted.

The total number of individuals is sparse enough in different spots.

Local declines are balanced out by increases elsewhere, so that overall numbers of breeding birds are maintained at the appropriate scale</td></tr>
<tr><td colspan="3">Rational</td></tr>
<tr><td colspan="3">Justification for indicator selector

Abundance is a parameter of population demographics, and is critical for determining the growth or decline of a population.

The number of individuals within a population (population size) is defined as the number of individuals present in an animal aggregation (permanent or transient) in a subjectively designated geographical range.

Population density is the size of a population in relation to the amount of space that it occupies, and represents a complementary description of population size. Density is usually expressed as the number of individuals per unit area.

The index of population abundance is a single species indicator that reflects the temporal variation in the breeding or the non-breeding (wintering) population of selected species compared to a base year (or reference level). This indicator can be added into multi-species indices to reflect the variation over time of functional groups of species.

The objective of this indicator is to determine the population status of selected species by medium-long term monitoring to obtain population trends for these species. This objective requires a census to be conducted in breeding, migratory, wintering, developmental and feeding areas.</td></tr>
<tr><td colspan="3">Scientific References

Parsons, M., Mitchell, I., Butler, A., Ratcliffe, N., Frederiksen, M., Foster, S., & Reid, J. B. (2008). Seabirds as indicators of the marine environment. ICES Journal of Marine Science: Journal du Conseil, 65(8), 1520-1526.</td></tr>
<tr><td colspan="3">Policy Context and targets</td></tr>
<tr><td colspan="3">Policy context description

EU MSFD; UE Nature Directives; Red List, AEWA</td></tr>
</table>

<table>
<tr><td colspan="2">Indicator Title</td><td>Common indicator 4: Species population abundance (Seabirds)</td></tr>
<tr><td>EU Marine Strategy Framework Directive</td><td>In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years.

The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned".</td><td><u>Descriptor 1: Biodiversity</u>

The population abundance of key marine species is stable and their population dynamics are indicative of long-term viability

<u>Parameters and trends:</u></td></tr>
<tr><td>UE Nature Directives (Birds and Habitats Directives)</td><td>The conservation status of a species "will be taken as 'favourable' when:

1. population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats […].
Every six years, all EU Member States are required to report on the implementation of the directives.

There is a methodology for the assessment of conservation status and has been widely used for the compulsory reporting by EU member states for Habitats Directive (HD). This approach has been extended also to Birds Directive (BD) reporting (N2K Group 2011).</td><td><u>Parameters and trends:</u>

Distribution (range)</td></tr>
<tr><td>UICN Red List</td><td></td><td></td></tr>
<tr><td colspan="3">Targets

EU Marine Strategy Framework Directive: Population abundance of breeding seabirds is stable over a period of twelve years, taking into consideration the natural variability of the species population and their ecology.

UE Nature Directives: Population(s) not lower than 'favourable reference population' AND reproduction, mortality and age structure not deviating from normal (if data available)

IUCN: The overall target must be to prevent any significant decline in the population abundance of any of the selected species. For species in a Least Concern (LC) IUCN status, the specific target must be to maintain them within the stable category (no significant increase or decline, and most probable trends are less than 5% per year). For globally threatened species (IUCN: VU, EN or CR), the conservation objective must be to restore them to LC status so the population abundance target must be for the population to achieve a significant increase before levelling off at a higher (safer) population level.</td></tr>
<tr><td colspan="3">Policy documents

List and url's
9. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a</td></tr>
</table>

Indicator Title	*Common indicator 4: Species population abundance (Seabirds)*

framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance): http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1401265930445&uri=CELEX:32008L0056

10. http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm
11. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm
12. Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm
13. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities.

Indicator analysis methods

Indicator Definition

The index of population abundance reflects the variation over time of the total population size (counted or estimated) of selected species. Population size is the number of individuals present in a population at the appropriate scale.

Methodology for indicator calculation

The choice of the most appropriate methodology to calculate the index of population abundance will depend on the temporal pattern of the available data. The methods to obtain the data used in the calculations are described in the monitoring methods below.

For data available on an annual basis, site and year specific counts of individuals of particular species can be related to site and year effects (factors) and missing values can be imputed from the data of all surveyed sites.

To calculate an index of population abundance, the Species Trends Analysis Tool for birds (BirdSTATs) is the standard software used across Europe by the European Bird Census Council (EBCC). This is an open source Microsoft Access database for the preparation and statistical analysis of bird counts data in a standardised way. The BirdSTATs tool is programmed to use and automatically run the program TRIM (TRends and Indices for Monitoring data) in batch mode to perform the statistical analysis for series of bird counts in the dataset. In this way it is suitable for use in all European countries participating in the Pan European Common Bird Monitoring Scheme (PECBMS). The BirdSTATs tool is developed at the request of the Pan European Common Bird Monitoring Scheme (PECBMS) by Bioland Informatie. Designing and programming of the tool is funded by the European Commission through British Royal Society for the Protection of Birds (RSPB).

The BirdSTATs tool is an open source database that can downloaded from the European Bird Census Council website (http://www.ebcc.info/wpimages/video/BirdSTATS21.zip); it allows users to adapt or expand the tool to their own demands. The tool is also usable for other species groups.

For data available at lower frequencies (e.g., every 6 years), a linear trend can be estimated using simple arithmetic methods. This option increases the level of uncertainty, so an extra warning of caution must be added when making interpretations based on this kind of data.

Indicator units

The index of population abundance is a numerical value of species population abundance relative to the population size at base time. The average breeding population size during at least a decade is suggested as the base level.

For the base data used to calculate the index of population abundance, the following units are suggested:

- for population size at nesting colonies, number of breeding pairs (bp)
- for total number of nesting colonies, number of colonies (n)
- for average colony size, number of individuals (n)
- for non-breeding birds at wintering sites, number of individuals (n)
- for total number of birds estimated on migration, number of individuals (n)

Indicator Title	*Common indicator 4: Species population abundance (Seabirds)*

Priority species

The following species should be prioritised for the monitoring of population abundance given their role as indicators of the general state of the marine environment in the Mediterranean region:

- *Falco eleonorae*
- *Hydrobates pelagicus*
- *Larus audouinii*
- *Larus genei*
- *Pandion haliaetus*
- *Phalacrocorax aristotelis*
- *Calonectris diomedea*
- *Puffinus yelkouan*
- *Puffinus mauretanicus*
- *Sterna bengalensis*
- *Sterna sandvicensis*

List of Guidance documents and protocols available

- Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm
- Auniņš, A., and Martin, G. (eds.) (2015). Biodiversity Assessment of MARMONI Project Areas. Project report, 175. Available online at: http://marmoni.balticseaportal.net/wp/project-outcomes/
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Indicator Title	*Common indicator 4: Species population abundance (Seabirds)*

University Press, Oxford: 17-56. PDF

- http://bd.eionet.europa.eu/activities/Reporting/Article_17/reference_portal
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Data Confidence and uncertainties

Reliable index population abundance requires good census data, obtained regularly over a pre-defined spatial scale that is maintained through time. The index calculation methods allow for some gaps in the data series, but it is important to maintain the spatial scale so that data can be comparable across years.

The calculation methods provide a confidence interval which, in turn, is dependent on the level of confidence of the original census data. To reduce uncertainty, it is important that the individuals obtaining the data have received proper training and are maintained over extensive periods.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

In order to estimate and monitor the number of breeding birds, the proposed field methods are:

a) direct counts at the nesting colonies at the appropriate time in the breeding season to estimate the total number of breeding birds

b) when performing the surveys above, the number and distribution of nesting colonies should be recorded so as to be able to estimate the total number breeding nuclei, and their average size

To estimate and monitor the number of birds during the non-breeding (wintering) season, the following methodologies are proposed for coastal species:direct counts at known wetland and coastal sites during the peak of the wintering season (for example, as part of the well-established International Waterbird Census, IWC, coordinated by Wetlands International) to estimate the total number of wintering birds

Indicator Title	*Common indicator 4: Species population abundance (Seabirds)*

In addition, monitoring the numbers of birds passing through migration bottlenecks or prominent headlands can be used to estimate the total size of the populations entering or leaving the region or subregions, and their trends over time:

- Direct counts at known migration bottlenecks or prominent headlands (e.g., in the areas of Gibraltar, Bosphorus, Dardanelles, northern Tunisia, strait of Otranto, etc.) to estimate the total number of birds flying through or past those areas on a yearly basis.

Available data sources

OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Mega Vertebrate Populations, http://seamap.env.duke.edu/
http://www.birdlife.org/datazone/home
UNEP/MAP-RAC/SPA projects and publications http://www.rac-spa.org/publications
Birdlife partners in the Mediterranean
Mediterranean marine research centres, universities and institutions
Medmaravis
Governmental ministries
IUCN specialists

Spatial scope guidance and selection of monitoring stations

For counts carried out on an annual basis as described below, a number of sites should be selected that represent a sufficiently large proportion of the subregional or national population; this should be at least 40% and in no case less than 10%.

The comprehensive surveys to be carried out every 6 years should aim at covering the whole area on a national or subregional scale.

Temporal Scope guidance

Annual – breeding surveys at selected sites to estimate the number of breeding pairs
Annual – winter censuses at selected coastal & wetland sites to estimate no. of wintering individuals
Annual – mid-winter census (IWC) at important wintering sites
Annual – migration counts at key bottlenecks or prominent headlands
Every 6 years – comprehensive breeding surveys to estimate no. of breeding pairs, no. of colonies and average size
Every 6 years – comprehensive winter censuses to estimate no. of wintering individuals at coastal & wetland sites

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

The multiplicative overall slope estimate in TRIM is converted into one of the following categories. The category depends on the overall slope as well as its 95% confidence interval (= slope +/- 1.96 times the standard error of the slope).

- Strong increase - increase significantly more than 5% per year (5% would mean a doubling in abundance within 15 years). Criterion: lower limit of confidence interval > 1.05.
- Moderate increase - significant increase, but not significantly more than 5% per year. Criterion: 1.00 < lower limit of confidence interval < 1.05.
- Stable - no significant increase or decline, and most probable trends are less than 5% per year. Criterion: confidence interval encloses 1.00 but lower limit > 0.95 and upper limit < 1.05.
- Uncertain - no significant increase or decline, and unlikely trends are less than 5% per year. Criterion: confidence interval encloses 1.00 but lower limit < 0.95 or upper limit > 1.05.
- Moderate decline - significant decline, but not significantly more than 5% per year. Criterion: 0.95 < upper limit of confidence interval < 1.00.
- Steep decline - decline significantly more than 5% per year (5% would mean a halving in abundance within 15 years). Criterion: upper limit of confidence interval < 0.95.

<table>
<tr><td>Indicator Title</td><td colspan="2">Common indicator 4: Species population abundance (Seabirds)</td></tr>
<tr><td colspan="3">Expected assessments outputs

The outputs of BirdSTATs are imputed yearly indices and totals for each species, together with their standard errors and covariance.

In addition to national or subregional indices, trends can be computed to indicate whether long term changes in bird populations are strongly increasing, moderately increasing, stable, uncertain, moderately declining or steep declining.</td></tr>
<tr><td colspan="3">Known gaps and uncertainties in the Mediterranean

Neither bird populations nor monitoring capacity are distributed equally across the Mediterranean and, for this reason, it may be advisable to plan a phased development of pan-Mediterranean indices of population abundance for seabirds. The best approach is to build on the existing national biodiversity monitoring units, and to homogenise methodologies as initial steps. The extension of equivalent programmes across the whole of the Mediterranean region may be achieved in a second phase.

In terms of methodology, surveying colonies of nocturnal species situated in areas of difficult access may prove challenging. In these cases, it may be advisable to select certain areas or subsections of the total colony in order to obtain data on their abundance.</td></tr>
<tr><td colspan="3">Contacts and version Date</td></tr>
<tr><td colspan="3">Key contacts within UNEP for further information</td></tr>
<tr><td>Version No</td><td>Date</td><td>Author</td></tr>
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<tr><td>V.2</td><td>14/04/2017</td><td>SPA/RAC</td></tr>
</table>

9. Common Indicator 5: Population demographic characteristics (marine mammals) (EO 1)

Indicator Title	*Common Indicator 5: Population demographic characteristics*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Cetaceans: species populations are in good condition: low human induced mortality, balanced sex ratio and no decline in calf production. Monk seal: species populations are in good condition: low human induced mortality, appropriate pupping seasonality, high annual pup production, balanced reproductive rate and sex ratio.	Population condition of selected species is maintained	Cetaceans: preliminary assessment of incidental catch, prey depletion and other human induced mortality followed by implementation of appropriate measures to mitigate these threats Monk seal: decreasing trends in human induced mortality (e.g., direct killings,pupping/resting habitat occupation)
Rationale		

Justification for indicator selection

The objective of this indicator is to focus on the population demographic characteristics of marine mammals within the Mediterranean waters, with a special emphasis to those species selected by the Parties.

Demographic characteristics of a given population may be used to assess its conservation status by analysing demographic parameters as the age structure, age at sexual maturity, sex ratio and rates of birth (fecundity) and of death (mortality). These data are particularly difficult to obtain for marine mammals, thus relying on demographic models, which imply several assumptions which may be violated.

The populations of long-lived and slow reproducing cetaceans are among the most critical conservation units; a demographic approach can be therefore very useful for their management and conservation.

Eleven species of cetaceans are considered to regularly occur in the Mediterranean area: short-beaked common dolphin (*Delphinus delphis*), striped dolphin (*Stenella coeruleoalba*), common bottlenose dolphin (*Tursiops truncatus*), harbour porpoise (*Phocoena phocoena*), long-finned pilot whale (*Globicephala melas*), rough-toothed dolphin (*Steno bredanensis*), Risso's dolphin (*Grampus griseus*), fin whale (*Balaenoptera physalus*), sperm whale (*Physeter macrocephalus*), Cuvier's beaked whale (*Ziphius cavirostris*) and killer whale (*Orcinus orca*). Two of these species have very limited ranges: the harbour porpoise, possibly representing a small remnant population in the Aegean Sea, and the killer whale, present only as a small population of a few individuals in the Strait of Gibraltar. The Mediterranean is also the original habitat from a pinniped species, the Mediterranean monk seal (*Monachus monachus*) although the species occur only regularly in the eastern basin, mainly along the coasts of Greece and Turkey, some indivuiduals have been sigthed during the last decade in the western basin. Knowledge about the distribution, abundance and habitat use and preferences of some of these species, including the most abundant ones, is in part scant and limited to specific sectors of the Mediterranean Sea, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution.

The conservation status of marine mammels in the Mediterranean Sea has been a source of concern for many years. Marine mammals living in the Mediterranean Sea find themselves in precarious conditions due to the intense human presence and activities in the region; these are the source of a variety of pressures that are threatening these species' survival. These animals are highly mobile and are usually not confined within single nations' jurisdictions, stressing the need for basin-wide conservation and protection effort. Several threats affect marine mammals in the Mediterranean Sea and their effect on the population, distributional range and survival may act in a synergistic manner. Threats include interaction with fisheries, disturbance, injuries and fatal collisions from shipping, habitat loss and degradation, chemical pollution, anthropogenic noise, direct killings and climate change.

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Indicator Title	*Common Indicator 5: Population demographic characteristics*

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Policy Context and targets (other than IMAP)

Policy context description

Mediterranean fin whales and sperm whales are protected by the International Whaling Commission’s moratorium on commercial whaling that entered into force in 1986.
The Mediterranean cetaceans’ populations are also protected under the auspices of ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area), under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS). The Corso-Ligurian-Provençal Basin and the Tyrrhenian Sea, where most cetacean species find suitable habitats, lie within the Pelagos Sanctuary established by France, Italy and Monaco, thus benefitting from its conservation regime.
All cetacean species in the Mediterranean Sea are protected under the Annex II of the SPA-BD Protocol under the Barcelona Convention; under the Appendix I of the Bern Convention; under the Annex II of the Washington Convention (CITES); under the Appendix II of the Bonn Convention (CMS).
The short-beaked common dolphin, the sperm whale and the Cuvier’s beaked whale and the Mediterranean monk seal are also listed under the Appendix I of the Bonn Convention (CMS).
The common bottlenose dolphin, the harbor porpoise and the Mediterranean monk seal are also listed under the Annex II and all marine mammals are in Annex IV of the EU Habitats Directive and considered strictly protected..

Indicator/Targets

Aichi Biodiversity Target 1, 3
EU Regulation 812/2004 concerning incidental catches of cetaceans in fisheries
EU MSFD Descriptor 1 and 4
EU Habitats Directive
The obligations under ACCOBAMS

Policy documents

- Aichi Biodiversity Targets - https://www.cbd.int/sp/targets/
- EU Biodiversity Strategy - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN
- EU Regulation 1143/2014 - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN

Indicator Title	*Common Indicator 5: Population demographic characteristics*

- Marine Strategy Framework Directive - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN
- Commission Decision on criteria and methodological standards on good environmental status of marine waters - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010D0477(01)&from=EN
- Pan-European 2020 Strategy for Biodiversity - https://www.google.no/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiP1J-v_P7NAhWHjSwKHZfoBRIQFggtMAE&url=https%3A%2F%2Fcapacity4dev.ec.europa.eu%2Fsystem%2Ffiles%2Ffile%2F08%2F10%2F2012_-_1535%2Fpan-european_2020_strategy_for_biodiversity.pdf&usg=AFQjCNGa4NkkljA4x3l9WDO49uwrdYafMg
- Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the Mediterranean Region - http://sapbio.rac-spa.org/
- Draft Updated Action Plan for the conservation of Cetaceans in the Mediterranean Sea - http://rac-spa.org/nfp12/documents/working/wg.408_08_eng.pdf
- National Biodiversity Strategies and Action Plans (NBSAPs) - https://www.cbd.int/nbsap/
- ACCOBAMS –Agreement Text - http://www.accobams.org/images/stories/Accord/anglais_text%20of%20the%20agreement%20english.pdf
- ACCOBAMS STRATEGY (PERIOD 2014 – 2025) - https://accobams.org/images/stories/MOP/MOP5/Documents/Resolutions/mop5.res5.1_accobams%20strategy.pdf

Indicator analysis methods

Indicator Definition

This indicator is aimed at providing information about the population demographic characteristics of marine mammals in the Mediterranean Sea. Monitoring effort should be directed to collect long-term data series covering the various life stages of the selected species. This would involve the participation of several teams using standard methodologies and covering sites of particular importance for the key life stages of the target species.

While some demographic studies have been conducted using industrial whaling data on Northeast Atlantic populations, little is known about the demography of their counterparts in the Mediterranean, where industrial whaling has never occurred.

The preliminary classical tools for demographic analyses are life tables, accounting for the birth rates and probabilities of death for each vital stage or age class in the population. A life table can be set out in different ways:

1) following an initial age class (i.e. cohort) from birth to the death of the last individual; this approach allows to set out a cohort life table and is generally applied on sessile and short-lived populations;

2) counting population individuals grouped by age or by stages in a given time period; this approach allows to obtain a static life table, that is appropriate with long-lived or mobile species;

3) analysing the age or stage distribution of individuals at death; this approach allows to develop a mortality table, using carcasses from stranding data.

Methodology for indicator calculation

The monitoring effort to address this Common Indicator is expected to provide data allowing the assessment at regional or sub-regional scales of the selected species. The main outputs of the monitoring will be data about:

- Age structure
- Sex ratio
- Fecundity
- Mortality

Photo-identification is one of the most powerful techniques to investigate marine mammels populations. Information on group composition, area distribution, inter-individual behaviour and short and long-term movement patterns can be obtained by the recognition of individual animals. Long-term datasets on photo-identified individuals can provide information on basic life-history traits, such as age at sexual maturity, calving interval, reproductive and total life span. The mark-recapture technique can also be applied to obtain estimates of population size.

In any case, once dealing with a subregional implementation approach for cetacean surveying campaigns, this should be carried out in line with agreed common, regional methodologies, using existing and shared Protocols, with the facilitation, as appropriate, of ACCOBAMS.

Indicator units

The main demographic parameters are defined in the following units:

- adult survival probability: range between 0 and 1

Indicator Title	*Common Indicator 5: Population demographic characteristics*
- juvenile survival probability: range between 0 and 1 - fecundity, or breeding productivity: average no. of young produced per breeding pair per year - age class distribution: percentage of each age class - sex ratio: percentage	
List of Guidance documents and protocols available • A document on 'MONITORING GUIDELINES TO ASSESS CETACEANS' DISTRIBUTIONAL RANGE, POPULATION ABUNDANCE AND POPULATION DEMOGRAPHIC CHARACTERISTICS' has been produced by ACCOBAMS and should be considered as guidance when establishing monitoring programmes. • Guidelines for monitoring threatened population of marine and coastal bird species in the Mediterranean[6]. • RAC/SPA-ACCOBAMS Guidelines for the Development of National Networks of Cetacean Strandings Monitoring[7].	
Data Confidence and uncertainties Sex and length at death may come from stranded animals. This information may be uneven, since in many cases sex and exact size measurements may be unprecise due animal decomposition. Dealing with stranded data implies several assumptions; the main one being that stranding data represent a faithful description of the real mortality by different life stages. This assumption, however, is true only if the probability of stranding is equal in all life stages. Estimating age and length from free-ranging individuals may be rather difficult and increase the uncertainties in the models. Long-term data sets on known individuals through photo-identification may overcome some of the biases.	
Methodology for monitoring, temporal and spatial scope	
Available Methodologies for Monitoring and Monitoring Protocols Several protocols are available using different monitoring platforms and approaches such as: - Direct observation - Stranded animal monitoring - Dedicated ships surveys - By-catch data - Photo-identification (mark-recapture models) - Automatic infrared camera - Direct killings	
Available data sources • OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, is a spatially referenced online database, aggregating marine mammal, seabird, sea turtle and ray & shark observation data from across the globe. http://seamap.env.duke.edu/ • When existing, the databases from the National Stranding Networks, such as in Italy the CSC (Cetacean Study Centre) database, available online at http://www-3.unipv.it/cibra/spiaggiamenti.html or in France, the Pelagis Observatory database (http://www.observatoire-pelagis.cnrs.fr/les-donnees/). • The Mediterranean Database of Cetacean Strandings (MEDACES), has been set-up to co-ordinate all national and regional efforts for riparian countries. Cetacean stranding data are organized into a spatially referenced database of public access. • International Whaling Commission List of Stranding Networks (as at 13 April 2011) https://iwc.int/private/downloads/fECe-nYMEKa7G5C8RRCqKg/WHALE%20STRANDING%20NETWORKS%20LIST_2011.pdf	
Spatial scope guidance and selection of monitoring stations Current knowledge of spatial distributional range of marine mammals in the Mediterranean Sea is largely affected by available data, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution. Priority should be given to the less known areas, using online data sources, such as Obis SeaMap and published data and reports as sources of information.	

[6] UNEP/MAP - RAC/SPA, 2012. Guidelines for Management and Monitoring Threatened Population of Marine and Coastal Bird Species and their Important Areas in the Mediterranean. By Joe Sultana. Ed. RAC/SPA, Tunis. 24pp.

[7] http://www.rac-spa.org/sites/default/files/doc_cetacean/stranding.pdf

Indicator Title	*Common Indicator 5: Population demographic characteristics*	
Temporal Scope guidance Demographic studies on marine mammals, which are long-living species, require long-term projects, to allow robust indications on trends in population size and demographic parameters over time.		
Data analysis and assessment outputs		
Statistical analysis and basis for aggregation Simple demographic models based on the pre-defined life-tables can be used to create a complete mortality table for the population under examination. Continuous age distribution and constant mortality rates within each stage, under the assumption of population stationarity (i.e. the population is assumed to be constant in number and age structure over time) can be used.		
Expected assessments outputs Demographic studies can supply useful tools to the management and the conservation of threatened and overexploited species. Population models, based on life-history tables and transition matrices, allow to assess population performance, to project population trends overtime and thus to foster the conservation of the studied populations, suggesting specific measures for their protection.		
Known gaps and uncertainties in the Mediterranean Data in the Mediterranean Sea are characterized by their uneven distribution, both geographical and spatial. The summer months are the most representative ones and very few information have been provided for the winter months, when conditions to conduct off-shore research campaigns are particularly hard due to meteorological adversity. Ongoing effort is targeting the identification of Cetacean Critical Habitats (CCHs) and Important Marine Mammal Areas (IMMAs) in the entire Mediterranean Sea. A gap analysis is also ongoing at regional scale in order to provide an inventory of available data and to select areas where more information should be collected.		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

10. Common indicator 5: Population demographic characteristics (Reptiles) (EO1)

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Low mortality induced by incidental catch, Favorable sex ratio and no decline in hatching rate	Population condition of selected species is maintained	Response Measures to mitigate incidental catches in turtles implemented
Rationale		
Justification for indicator selection Demography is used in ecology (particularly population and evolutionary ecology) as the basis for population studies. Demography information: - helps to identify the stage(s) in the life cycle that affect(s) most population growth. - may be applied to conservation/exploitation (e.g. fisheries management). - may be used to assess potential competitive abilities, colonization. - may be used as a basis for understanding the evolution of life history traits. - may be used to indicate fitness with respect to the surrounding environment		
Scientific References Bevan E, Wibbels T, Navarro E, Rosas M, Najera BMZ, Sarti L, Illescas F, Montaro J, Pena LJ, Burchfield P. 2016. Using Unmanned Aerial Vehicle (UAV) Technology for Locating, Identifying, and Monitoring Courtship and Mating Behavior in the Green Turtle (*Chelonia mydas*). Herpetological Review, 47(1), 27–32. Casale, P., D. Freggi, R. Basso, R. Argano. 2005. Size at male maturity, sexing methods and adult sex ratio in loggerhead turtles (*Caretta caretta*) from Italian waters investigated through tail measurements. J. Herpetol. 15, 145–148 Casale P. 2010. Sea turtle by-catch in the Mediterranean. Fish and Fisheries. doi:10.111/j. 1467-2979.2010.00394 Demography Working Group of the Conference. Demography of marine turtles nesting in the Mediterranean Sea: a gap analysis and research priorities - 5th Mediterranean Conference on Marine Turtles, Dalaman, Turkey, 19-23 April 2015. Document T-PVS/Inf(2015)15E Presented at the Convention on the conservation of European wildlife and natural habitats - 35th meeting of the Standing Committee - Strasbourg, 1 - 4 December 2015 (2015) Gerosa, G. and P. Casale. 1999. Interaction of marine turtles with fisheries in the Mediterranean. UNEP/MAP, RAC/SPA: Tunis, Tunisia. 59pp Groombridge, B. 1990. Marine turtles in the Mediterranean: distribution, population status, conservation. A report to the Council of Europe, Environment and Management Division. Nature and Environment Series, Number 48. Strasbourg 1990 Hays GC, Mazaris AD, Schofield G. 2014. Different male versus female breeding periodicity helps mitigate offspring sex ratio skews in sea turtles. Frontiers in Marine Science 1, 43 doi: 10.3389/fmars.2014.00043 Laurent, L., E. M. Abd El-Mawla, M. N. Bradai, F. Demirayak, A. Oruc. 1996. Reducing sea turtle mortality induced by Mediterranean fisheries. Trawling activity in Egypt, Tunisia and Turkey. Report for the WWF International Mediterranean Program. WWF project 9E0103. Laurent, L., P. Casale, M.N. Bradai, B.J. Godley, G. Gerosa, A.C. Broderick, W. Schroth, B. Schierwater, A.M. Levy, D. Freggi, E.M. Abd El-Mawla, D.A. Hadoud, H.E. Gomati, M. Domingo, M. Hadjichristophorou, L. Kornaraky, F. Demirayak and Ch. Gautier. 1998. Molecular resolution of marine turtle stock composition in fishery bycatch: a case study in the Mediterranean. Mol. Ecol., 7: 1529-1542. Rees, A.F., D. Margaritoulis, R. Newman, T.E. Riggall, P. Tsaros, J.A. Zbinden, B.J Godley. 2013. Ecology of loggerhead marine turtles *Caretta caretta* in a neritic foraging habitat: movements, sex ratios and growth rates. MarBiol 160:519-529.		
Policy Context and targets (other than IMAP)		
Policy context description Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes GES definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD includes Descriptor 1: Biodiversity: "The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions."		

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*
Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them. The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned".	

Indicator/Targets

Commission Decision 2010/477/EU sets out the MSFD's criteria and methodological standards and under Descriptor 1 includes criteria "1.3. Population condition" and indicators "Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)" and "Population genetic structure, where appropriate (1.3.2)".

At a country scale, Descriptor 1 criteria have been applied:

Greece

*page 15: (Section 3. D1, D4 and D6 (Biodiversity), III. Environmental targets, 1. Descriptor 1*Environmental targets:

*[…]*2) Census of marine turtle *Caretta caretta* reproducing in the Greek coasts and conservation of spawning areas.

Associated indicators:

*[…]*2) Breeding area of the Mediterranean monk seal *Monachus monachus* and the sea turtle *Caretta caretta*

Italy

page 18: (Section 3.D1, D4 and D6 (Biodiversity), III. Environmental targets, 3.1 Descriptor 1

Italy has provided six targets and associated indicators *[…]* The second target focuses on the loggerhead turtle, and has the aim of decreasing accidental mortalities by regulating fishing practices. The target has several components which aim to acquire increased knowledge and to implement regulatory practices (it is not clear whether these practices are already in place). No targets or threshold values are otherwise given. The target is stated as being based on the completion of indicator 1.1.2 (which is not addressed for GES but is included in the initial assessment).

[…]

T2: By-catch reduction in the areas of aggregation of *Caretta caretta*

It is proposed that the operative target for the mitigation of *Caretta caretta* by-catch be articulated as follows:

1) Spatial identification of the areas with highest use of pelagic long line (southern Tyrrhenian and southern Ionian sea) and trawling (northern Adriatic)

2) Completion of the spatial definition of *Caretta caretta* aggregation areas based on an approach capable of assessing temporal and seasonal distribution differences for each aggregation area (based on indicator 1.1.2 completion) so as to provide a final definition of the operative target

3) Monitoring of accidental captures in the areas subjected to operational target

4) Application of by-catch reduction measures in areas listed in point 3), through one or more of the following activities:

- Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling nest through structural modifications to the gear (i.e. circle hooks, TEDs etc.) and application of best practices for the reduction of mortality following capture (percentage). Note: in order to allow an immediate reduction of the pressure it is advised that best practices be applied in the geographic areas where preliminary knowledge already defines the presence of an aggregation area, before defining the incidence of total capture in the specific gear.
- Reduction of fishing pressure (percentage)

Spain

Page 25: Section 3. D1, D4 and D6 (Biodiversity), III. Environmental targets

A.1.4: Reduce the main causes of mortality and of reduction of the populations of groups of species at the top of the trophic web (marine mammals, reptiles, sea birds, pelagic and demersal elasmobranchs), such as accidental capture, collisions with vessels, intaking of litter at sea, introduced terrestrial predators, pollution, habitat destruction, overfishing.

[…]

A.1.7: Establish a national coordination system of the accidental catch monitoring programmes of birds, reptiles, marine mammals, and mammal and reptile stranding and bird tracking.

[…]

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*

A.3.4: Maintain positive or stable trends for the populations of key species or apex predators (marine mammals, reptiles, seabirds and fish) and maintain commercially exploited species within safe biological limits.
[…]
C.1.2: Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles)

Slovenia
No information on Targets
page 10: (Section 3. D1, D4 and D6 (Biodiversity), I. Good Environmental Status (GES), 1.1 Descriptor 1)
In the accompanying text to the GES definition, Slovenia provides a list of the species that are covered by the GES definition. This includes the bottlenose dolphin (*Tursiops truncatus*), the loggerhead sea turtle (*Caretta caretta*).
Section 3. D1, D4 and D6 (Biodiversity), II. Initial assessment, 2.2 Biological features)
Species/functional groups
Slovenia indicates that *[…]* turtles are covered under the reporting obligations of the Habitats Directive *[…]*. Each of these groups is briefly described and their state in relation to natural conditions is reported.

Cyprus
No information on Targets
page 11: (Section 3. D1, D4 and D6 (Biodiversity), II. Initial assessment, 2.2 Biological features)
[…] Chelonia mydas and *Monachus monachus* are considered stable but the situation of *Caretta caretta* is actually improving.

Source: National Reports on Article 12 Technical Assessment of the MSFD 2012 obligations
http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/pdf/national_reports.zip

Policy documents

http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010D0477(01)

http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm

http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm
http://ec.europa.eu/environment/marine/pdf/1-Task-group-1-Report-on-Biological-Diversity.pdf
http://ec.europa.eu/environment/marine/pdf/9-Task-Group-10.pdf

Indicator analysis methods

Indicator Definition
Demography is the study of various population parameters. Demography provides a mathematical description of how such parameters change over time. Demographics may include any statistical factors that influence population growth or decline, but several parameters are particularly important: population size, density, age structure, fecundity (birth rates), mortality (death rates), and sex ratio.

Methodology for indicator calculation
The same methods should be used as those described in "*Common Indicator 4: Population abundance (Reptiles)"*; however, additional data are required to assess demography, such as age at sexual maturity, growth rate and age structure, fecundity (clutch size and numbers of hatchlings that emerge from nests and then reach the sea), mortality (death rates) for each stage/age class, sex ratios (in turtles: hatchling, juveniles, and adults), number of offspring (e.g. eggs and hatchlings).

The choice of the most appropriate methodology to calculate the different types of demographic information will depend on the temporal pattern of the available data. The methods to obtain the data used in the calculations are described in the monitoring methods below.

For data available on an annual basis, site and year specific data of each species can be related to site and year effects (factors) and missing values can be imputed from the data of all surveyed sites.

Indicator units

A variety of population demography values will be compiled for different components of the populations of the two species. Analyses should be based on at least a decade of information as the base level (following

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*

International Union for Conservation of Nature Red List minimal criteria for sea turtles).

Number of individuals in relation to population estimates per population range or management unit, per year, per age and per sex
- Mortality rate from by-catch, stranding
- Breeding success/failure of marine turtles (Number of eggs that fail to hatch at marine turtle nesting sites per year. Number of emergences versus successful nests)
- Annual survival probability of adults and juveniles (i.e. different age/size classes) at different sites (breeding, feeding, wintering, developmental)
- Sex ratio of turtles of all age/size classes from hatchings to juveniles to breeding and non breeding adults at wintering, breeding, foraging and developmental sites.

Sex ratios within different components of a population
Physical health indicators
Genetic health indicators
Numbers of individuals entering and leaving different components of populations through dispersal/migration or birth/mortality.
Numbers of individuals killed through causes that are not natural in parallel to information on the age/size class of individuals and sex to determine sex/age/size specific mortality.

List of Guidance documents and protocols available

Bevan E, Wibbels T, Rosas M, Najera BMZ, Sarti L, Montano J, Pena LJ, Burchfield P. Herpetological Review, 2016, 47(1), 27–32.

Eckert, K. L., Bjorndal, K. A., Abreu-Grobois, F. A. and Donnelly, M. (Eds.) 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4. Washington, DC: 235 pp. https://mtsg.files.wordpress.com/2010/11/techniques-manual-full-en.pdf

Gerosa, G. (1996). Manual on Marine Turtle Tagging in the Mediterranean. –Mediterranean Action Plan - UNEP, RAC/SPA, Tunis, 48 pp.

Gerosa, G. and M. Aureggi. 2001. Sea Turtle Handling Guidebook for Fishermen. UNEP Mediterranean Action Plan, Regional Activity Centre for Specially Protected Areas. Tunis. http://www.rac-spa.org

McClellan DB. 1996. Aerial surveys for sea turtles, marine mammals and vessel activity along the south east Florida coast 1992-1996. NOAA Technical Memorandum NMFS-SEFSC-390 42pp

Phelan, Shana M. and Karen L. Eckert. 2006. Marine Turtle Trauma Response Procedures: A Field Guide. Wider Caribbean Sea Turtle Conservation Network (WIDECAST) Technical Report No. 4. Beaufort, North Carolina.71 pp

Schofield, G., K.A. Katselidis, P. Dimopoulos, J.D. Pantis. 2008. Investigating the viability of photo-identification as an objective tool to study endangered sea turtle populations. Journal of Experimental Marine Biology & Ecology 360:103-108

SWOT Scientific Advisory Board. 2011. The State of the World's Sea Turtles (SWOT) Minimum Data Standards for Nesting Beach Monitoring, version 1.0. Handbook, 28 pp

Data Confidence and uncertainties

Life history studies and demographic analyses need extensive and, often, long-term data accumulation from either carcass collection or capture-mark-recapture (tagging or photo-id) histories, or a combination of several different techniques. In general, these studies may be implemented by different research teams that use different sampling and analysing processes. However, demographic parameters must be collected in a standard way among different research groups.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

- Shipboard, aerial (including drone), or diver-based/video/acoustic (potential). Aerial or boat line transects surveys under specific circumstances, with the appropriate modelling techniques to account for missed animals (i.e. due to low surfacing time and low frequency of time spent at the surface)
- Artificial external flipper tagging (metal and plastic on flippers),
- Photo-identification
- Genetic sampling identification within the metapopulation
- PIT tagging of flippers, Telemetry (satellite, GPS/GSM, radio telemetry) and loggers, capture-mark-recapture studies
- Swimming/snorkeling surveys with photo-id and GPS in densely populated areas (e.g. certain breeding sites)
- CPUE (bycatch), Direct mortality rate Post-release mortality rate
- Nest counts, Photo-id of individuals, Time-Depth-Recorder tags

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*

- Stranding on beaches

Aerial or boat surveys (line transects) under specific circumstances, with the appropriate modelling techniques to account for missed animals (i.e. due to low surfacing time and low frequency of time spent at the surface)
Artificial external flipper tagging (metal and plastic on flippers),
Photo-identification
PIT tagging of flippers, Telemetry (satellite, GPS/GSM, radio telemetry) and loggers, capture-mark-recapture studies
Shipboard, aerial (including drone), or diver-based/video/acoustic (potential)
Swimming/snorkelling surveys with photo-id and GPS in densely populated areas (e.g. certain breeding sites)

Stranding and beached individual census':
Provide biometrics, tissue sampling and analysis (necropsies or biopsies). Such studies may determine the cause of mortality, contamination, age, sex, health and size measurement. Live and (fresh) dead animals that are captured/located should be subjected to a standardised program to confirm sex (laporoscopy where necessary, e.g. non-adult stages of sea turtles), collect blood, skin and tissue samples for genetic analyses and determine origin within the meta-population, the health and presence of any contaminants in animals, along with other micro-biological techniques. Such information would help determine the genetic origin and diversity. This is particularly important to prioritise populations, because turtles from different rookeries in the Mediterranean belong to several genetically isolated groups, leading to some being highly isolated and at threat of loss. Also, stranded animals potentially serve as indicators of ocean health due to the effects of toxins building in the bodies of animals from higher trophic classes.

Biometrics:
Body size of sea turtles can be indicative of the health status or age structure of populations. For adult sea turtles, tail length may be used as an indicator of sex. Measurements are obtained by:
Estimates made from photos.
Measurement of stranded specimens.
Measurement in case of capture-recapture.
For turtles, also, measurements of females during nesting on beaches, or of all size classes during capture at in water or by-catch surveys at breeding/foraging/wintering/developmental grounds, which also allows individuals to be sexed.

Age structure:
Individuals could be sorted into age-specific categories called cohorts or age/stage classes (such as "juveniles" or "sub-adults"). Then, a profile of the abundance and different age classes can be created. The demographic structure may provide an estimate of the annual survival probability and/or reproductive potential of that population, which is critical information along with other parameters, from which current and future growth may be estimated.

- Age class identification in censuses and transects (based on size class estimates).
- Aging of stranded specimens (skeletochronology and/or age-size correlation sea turtles).
- Aging of beached specimens (skeletochronology and/or age-size correlation sea turtles).
- Aging of tagged (capture and recapture) specimens: size correlation for sea turtles.

Sex ratio:
The sex ratio is the ratio between the number of males and females within a population and across all age (size) classes, and may help researchers predict population growth or decline. Much like population size, sex ratio is a simple concept with major implications for population dynamics.

- Sex identification of adults in census and transects (juveniles and sub-adults require other techniques such as laparoscopy, blood analysis, genetic analysis).
- Sexing of stranded specimens (size, blood or genetic analysis, laparoscopy).
- Sexing of tagged (capture and recapture) (size, blood or genetic analysis, laparoscopy).
- Sexing of offspring before leaving the nest, and at different growth stages until maturity (blood or genetic analysis)

Fecundity (birth/hatch rates):
This parameter describes the number of offspring an individual or a population is able to produce during a given period of time. Fecundity is calculated in age-specific birth/hatch rates, which may be expressed as the number of births per unit of time, the number of births/hatchlings per female per unit of time, or the number of births/hatchlings per individuals per unit of time.

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*

For sea turtles, the ability of females to create nests also serves as an indicator of female fitness; thus, the number of emergences versus successful nests on beaches also represents an important indicator.

Mortality (death rates):
This parameter is the measure of individual deaths in a population and serves as the counterbalance to fecundity, and is usually expressed as the number of individuals that die in a given period (deaths per unit time) or the proportion of the population or an age-class group that dies in a given period (percent deaths per unit time). The parameter should also give an indication on the type of mortality if it is natural, due to fishing or bycatch etc. In cases of collecting and analysing biological samples to determine sex and health status, studies should be coordinated with the proposed sampling for EO10.

Available data sources

Adriatic Sea Turtle Database. http://www.adriaticseaturtles.eu/

Casale P. and Margaritoulis D. (Eds.) 2010. Sea Turtles in the Mediterranean: Distribution, Threats and Conservation Priorities. IUCN/SSC Marine Turtle Specialist Group. Gland, Switzerland: IUCN, 294 pp. http://iucn-mtsg.org/publications/med-report/

Halpin, P.N., Read, A.J., Fujioka, E., et al., 2009. OBIS-SEAMAP the world data center for marine mammal, sea bird, and sea turtle distributions. Oceanography 22, 104–115.

I3S. Sea turtle photo identification database. http://www.reijns.com/i3s/

The state of the World's Sea Turtles online database: data provided by the SWOT team and hosted on OBIS-SEAMAP (Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations). In: Oceanic Society, Conservation International, IUCN Marine Turtle Specialist Group (MTSG), and Marine Geospatial Ecology Lab, Duke University. http://seamap.env.duke.edu

Margaritoulis, D., Argano, R., Baran, I., Bentivegna, F., Bradai, M.N., Caminas, J.A., Casale, P., Metrio, G.D., Demetropoulos, A., Gerosa, G., Godley, B.J., Haddoud,D.A., Houghton, J., Laurent, L. & Lazar, B. (2003) Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives. Loggerhead sea turtles (ed. by B.E. Witherington), pp. 175–198. Smithsonian Institution, Washington

PITMAR. Sea turtle photo-identification database. http://www.pitmar.net/index.php/en/

Seaturtle.org – Global Sea Turtle Network. Sea turtle tracking. Sea turtle nest monitoring. http://www.seaturtle.org/

The Reptile Database: Location of juvenile loggerheads and greens in the Eastern Mediterranean. http://reptile-database.reptarium.cz/species?genus=Caretta&species=caretta

Mediterranean marine research centres, NGOs, universities and institutions, local and national sea turtle monitoring projects. Governmental Ministries

IUCN specialists (MTSG)

Sea Turtle Tag Inventory. Archie Carr Center for Sea Turtle Research, University of Florida https://accstr.ufl.edu/resources/tag-inventory

Marine Turtle DNA Sequences Database. Archie Carr Center for Sea Turtle Research, University of Florida. https://accstr.ufl.edu/resources/mtdna-sequences

Spatial scope guidance and selection of monitoring stations

A number of sites should be selected that represent a sufficiently large proportion of the subregional or national population for demographic data to be collected (reflecting the breeding, wintering, foraging and developmental populations that are representative of the region). If possible, populations should be selected where animals have been tracked with a sufficient number of units (i.e. >50 individuals), from which the connectivity among these different habitat types can be established. The selected breeding sites should aim to be genetically diverse, so as this diversity can be detected at foraging/wintering/developmental grounds where different populations diverge. This will facilitate the selection of marine areas for protection that support the highest genetic diversity (i.e. the greatest accumulation of different breeding populations), as well as those that support single breeding populations, which may be of equal importance.

Opportunistic data should be collected from all possible sources, wherever possible, and compiled into a single database, which might be used to provide an overview of the entire area.

Temporal Scope guidance

Annual – breeding surveys at selected sites to determine adult male and female sex ratios (operational sex ratios), recruitment, mortality and longevity of breeding, as well as genetic structure and physical health indices (April-July). In parallel, data on offspring should also be collected (July to October), to determine the number of individuals and ratio of offspring entering the population. This is the only point until adulthood that the offspring are in a single place and not mixed with other breeding populations at developmental/feeding sites.

Annual – winter censuses at selected sites to estimate the age/size class, sex ratio of adults, recruitment and

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*

dispersal of individuals, as well as genetic structure and physical health indices (expect mixing of turtles from different breeding populations) of individuals (October to April)

Annual – foraging/developmental censuses at selected sites to estimate the age/size class, sex ratio of adults, recruitment and dispersal of individuals, as well as genetic structure and physical health indices (expect mixing of turtles from different breeding populations) of individuals (January-December).

Data analysis and assessment outputs

Statistical analysis and basis for aggregation
At present, specific demographic parameters are not regularly assessed to a similar level of female/nest counts, due to the data intensive nature of this component. Many programs assess clutch success (i.e. the number of eggs that hatch from a clutch); however, this represents a small component. Research on offspring sex ratios, juvenile sex ratios, adult (operational) sex ratios is intermittent and based on different fieldwork approaches/methods and analytical techniques depending on the objective (usually, aiming towards a journal publication). Most studies that do exist are focused on the breeding areas; thus, greater focus is required at foraging, wintering and developmental areas, with in-water limitations needing to be accounted for in analyses. Therefore, set analyses need to be established that are applicable within and/or across the different habitat types to allow comparison at the Mediterranean level.

Expected assessments outputs
Knowledge about the sex, health and genetic structure of the different populations/subpopulations will be obtained, by understanding recruitment and mortality within different parts of a population and across populations. This information is important to understand whether there are sex-specific mortality risks at different age/size classes, which is important towards aiding population recovery. Also, knowledge on the physical health and genetic health of populations will be obtained, which will indicate the capacity for resilience to human activities, including climate change.

Known gaps and uncertainties in the Mediterranean

- Knowledge on the sex ratios within different components (breeding, foraging, wintering, developmental habitats), age classes and overall within and across populations.
- Knowledge about the physical and genetic health status of these groups.
- Vulnerability/resilience of these populations/sub-populations in relation to physical pressures;
- Analysis of pressure/impact relationships for populations/sub-populations and definition of qualitative GES;
- Identification of extent (area) baselines for each population/subpopulation and the habitats they encompass;
- Criteria for the risk based approach to monitoring and develop harmonized sampling instructions where appropriate;
- Common computing methodologies and data collection instructions, specifying the accuracy (spatial resolution or grid) of the determination of extent (area) a priori;
- Appropriate assessment scales;
- Standardized data flows for spatial pressure data;
- GES baselines for sites that cannot be inferred from contemporary records of pressure or construction;
- Harmonised sampling, cartographic, data collation and GIS protocols
- Generate or update databases and maps of known nesting, feeding, wintering habitats in each Contracting Party
- Identify possible baselines and index sites.
- Identify monitoring capacities and gaps in each Contracting Party
- Develop a guidance manual to support the monitoring programme, which will provide more detailed information, tools, and advice on survey design, monitoring methodology and techniques that are most cost-effective and applicable to each of the selected sea turtle species, in order to ultimately ensure standardised monitoring, comparable data sets, reliable estimates and trend information.
- Identify techniques to monitor and assess the impacts of climate change.
- Develop monitoring synergies in collaboration with GFCM for- EO3 (Harvest of commercially exploited fish and shellfish), to collect data via sea turtle by-catch
- Investigate monitoring synergies with other relevant EOs that will include coast-based fieldwork, in relation to monitoring of new/unknown sea turtle nesting beaches, and of beached/stranded animals, to obtain more widespread information
- Neither turtle populations nor monitoring capacity are distributed equally across the Mediterranean and, for this reason, it may be advisable to plan a phased development of pan-Mediterranean indices of

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*	
population demography for sea turtles. The best approach is to build on the existing national biodiversity monitoring units, and to homogenise methodologies as initial steps. The extension of equivalent programmes across the whole of the Mediterranean region may be achieved in a second phase.		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/7/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

11. Common indicator 5: Population demographic characteristics (Seabirds) (EO 1)

Indicator Title	*Common indicator 5: Population demographic characteristics (Seabirds)*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Species populations are in good conditions: Natural levels of breeding success & acceptable levels of survival of young and adult birds.	Population condition of selected species is maintained	Populations of all taxa, particularly those with IUCN threatened status are maintained long term and their average growth rate (λ) is equal or higher than 1 as estimated by population models. Incidental catch mortality is at negligible levels, particularly for species with IUCN threatened status.

Rational

Justification for indicator selector

Demography is the study of various population parameters and it is used in ecology (particularly population and evolutionary ecology) as the basis for population studies. Demography provides a mathematical description of how such parameters change over time. Demographics may include any statistical factors with a potential to influence population growth or decline, with several parameters being particularly important: population size, density, age structure, fecundity (birth rates), mortality (death rates), and sex ratios. When applied in population viability models, demographic parameters allow estimating the extinction risk of any given population.

Successful analysis of population conditions requires the implementation of standardised protocols, to enable valid assessments at the appropriate spatial scale. The data obtained must provide reliable information not only on the parameters sought but also on demographic anomalies such as failures in recruitment, age-specific mortality and other uncommon events. The detection of breeding failures can warn against changes in the environmental conditions, regardless of their natural or anthropic origin.

Some population demographic parameters such as survival require long-term monitoring and there is a lack of such accumulated information for several species and/or groups. This kind of monitoring is highly demanding on training and personnel so it is probably unrealistic to expect widespread implementation on a regional scale. However, demographic data from near, equivalent (sub) populations can be used by analogy when local data are not available. Equally, initiatives for long-term monitoring of seabirds in the region should be welcomed and supported across the Mediterranean.

The most important demographic parameters are individual survival and fecundity (no. of young produced per female of breeding age per year), as they provide the essential information to be used in population viability analysis (PVA).

In other biogeographical regions, information on events of complete breeding failure is also compiled but such phenomena are relatively rare in the Mediterranean. Instead, good information on average breeding success spanning a sufficient number of years is probably more appropriate.

Scientific References

List and url's

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Tavecchia, G., Pradel, R., Genovart, M. and Oro, D. (2007), Density-dependent parameters and demographic equilibrium in open populations. Oikos, 116: 1481–1492. doi: 10.1111/j.0030-1299.2007.15791.x

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Parsons, M., Mitchell, I., Butler, A., Ratcliffe, N., Frederiksen, M., Foster, S., and Reid, J. B. 2008. Seabirds as indicators of the marine environment. – ICES Journal of Marine Science, 65: 1520–1526.

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ICES. 2016. Report of the Joint OSPAR/HELCOM/ICES Working Group on Seabirds (JWGBIRD), 9–13 November 2015, Copenhagen, Denmark. ICES CM 2015/ACOM:28. 196 pp.

Yésou, P., Sultana, J., Walmsley, J. and Azafzaf, H. (Eds.) 2016. Conservation of Marine and Coastal Birds in the Mediterranean. Proceedings of the UNEP-MAP-RAC/SPA Symposium, Hamammet 20 to 22 February 2015, Tunisia. 176 P

Policy Context and targets

Policy context description

	Birds Directive	Bern Convention	Barcelona Convention	Bonn Convention	AEWA
Inshore Benthic feeders					
Phalacrocorax aristotelis (Linnaeus, 1761)	Annex I	App.II	Annex II	-	-
Offshore surface feeders					
Larus audouinii (Payraudeau, 1826)	Annex I	App. II	Annex II	App. I & II	Annex II
Inshore surface feeders					
Sterna albifrons (Pallas, 1764)	Annex I	App. II	Annex II	App. I & II	Annex II
S. nilotica (Gmelin, JF, 1789)	Annex I	App. II	Annex II	App. I & II	Annex II
S. sandvicensis, (Latham, 1878)	Annex I	App. II	Annex II	App. I & II	Annex II
Offshore feeders					
Puffinus mauretanicus (Lowe, PR, 1921)	Annex I	-	-	App. I & II	-
Puffinus yelkouan (Brünnich, 1764)	Annex I	App. II	Annex II	-	-

EU Marine Strategy Framework Directive		
	In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning “cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies” […] “thereby facilitating achievement of good environmental status in the marine region or subregion concerned”.	Descriptor 1: Biodiversity The population abundance of key marine species is stable and their population dynamics are indicative of long-term viability Criteria: population condition Parameters and trends: Population demographic characteristics (e. g. body size or age class structure, sex ration, fecundity rate, survival and mortality rates) Population genetic structure, where appropriate

<table>
<tr><td>Indicator Title</td><td colspan="2">Common indicator 5: Population demographic characteristics (Seabirds)</td></tr>
<tr><td>UE Nature Directives
(Birds and Habitats Directives)</td><td>The conservation status of a species “will be taken as ‘favourable’ when:

Article 1(i)). Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats […].

[…] to take measures to maintain the population of wild bird species at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements or to adapt the population of these species to that level. Birds Directive, Art.2.

Every six years, all EU Member States are required to report on the implementation of the directives.

There is a methodology for the assessment of conservation status and has been widely used for the compulsory reporting by EU member states for Habitats Directive (HD). This approach has been extended also to Birds Directive (BD) reporting (N2K Group 2011).</td><td><u>Parameters and trends:</u>

<u>Favourable</u>: Population of the species above 'favourable reference population’ AND reproduction, mortality and age structure not deviating from normal (if data available)

<u>Unfavourable – Inadequate</u>: Any combination other than those described under ‘Green’ or ‘Red’.

<u>Unfavourable – Bad</u>: Large decline in population (equivalent to a loss of more than 1% per year within the period specified by MS; other thresholds can be used but must be explained on Annex B) AND below ‘favourable reference population

OR population more than 25% below ‘favourable reference population’

OR reproduction, mortality and age structure strongly deviating from normal (if data available)

Unknown: No or insufficient reliable information available.</td></tr>
<tr><td colspan="3">Targets

EU Marine Strategy Framework Directive: Population abundance of breeding seabirds is stable over a period of twelve years, taking into consideration the natural variability of the species population and their ecology.

UE Nature Directives: The result will be “favourable” if population of the species above 'favourable reference population’ AND reproduction, mortality and age structure not deviating from normal (if data available).

IUCN: The overall target must be to prevent any significant decline in the population abundance of any of the selected species. For species in a Least Concern (LC) IUCN status, the specific target must be to maintain them within the stable category (no significant increase or decline, and most probable trends are less than 5% per year). For globally threatened species (IUCN: VU, EN or CR), the conservation objective must be to restore them to LC status so the population abundance target must be for the population to achieve a significant increase before levelling off at a higher (safer) population level</td></tr>
<tr><td colspan="3">Policy documents

List and url’s

14. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance): http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1401265930445&uri=CELEX:32008L0056

15. http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm

16. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

17. Article 12 – National reporting on status and trends of bird species.</td></tr>
</table>

Indicator Title	*Common indicator 5: Population demographic characteristics (Seabirds)*

http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm

18. McConville, A.J. & Tucker, G.M. 2015. Review of Favourable Conservation Status and Birds Directive Article 2 interpretation within the European Union. Natural England Commissioned Reports, Number 176.
19. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities.
20. Links between the Marine Strategy Framework Directive (MSFD 2008 /56/EC) and the Nature Directives (Birds Directive 2009/ 147 /EEC (BD) and Habitats Directive 92/43/EEC (HD).
21. Cochrane, S.K.J., Connor, D.W., Nilsson, P., Mitchell, I., Reker, J., Franco, J., Valavanis, V., Moncheva, S., Ekebom, J., Nygaard, K., Santos, R.S., Naberhaus, I., Packeiser, T., Bund, W. Van De & A.C. Cardoso. 2010. Marine Strategy Framework Directive. Guidance on the interpretation and application of Descriptor 1: Biological diversity. Report by Task Group 1 on Biological diversity for the European Commission’s Joint Research Centre. Ispra, Italy,
22. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities

Indicator analysis methods

Indicator Definition

The indicator is population growth. Its simplest conceptual model is the equation

$N(t+1) = \lambda N(t)$,

Where N(t) is the number of individuals in the population in year t, and λ is the population growth rate, or the amount by which the population multiplies each year (the Greek symbol “lambda” is commonly used). If there is no variation in the environment from year to year, then the population growth rate λ is a constant, and only three qualitative types of population growth are possible: if λ is greater than one, the population grows geometrically; if λ is less than one, the population declines geometrically to extinction; and if λ exactly equals one, the population neither increases nor declines, but remains at its initial size in all subsequent years.

In the real world, variation in the environment causes survival and reproduction to vary from year to year, so the population growth rate λ tends to vary over some range of values as a result. Moreover, if the environmental fluctuations driving changes in population growth include an element of unpredictability (as factors such as rainfall and temperature are likely to do), it is not possible to predict with certainty what the exact sequence of future population growth rates will be.

Population growth λ results from the combined effects of reproduction (which adds individuals to the population), survival (which determines how many individuals remain in the population from one year to the next) and mortality (which subtracts individuals from the population). Survival and mortality are mutually inverse, so if we can estimate survival, mortality can be calculated by subtraction.

Methodology for indicator calculation

Individual (interannual) survival is a principal component of any demographic study. It is based on the individual life histories of marked animals, almost invariably through the use of capture-recapture methods. To calculate the parameters, Lebreton et al. (1992) recommend the following procedure:

(1) start from a global model compatible with the biology of the species studied and with the design of the study, and assess its fit;

(2) select a more parsimonious model using Akaike's Information Criterion to limit the number of formal tests;

(3) test for the most important biological questions by comparing this model with neighboring ones using likelihood ratio tests; and

(4) obtain maximum likelihood estimates of model parameters with estimates of precision.

Computer software is critical, as few of the models available have parameter estimators that are in closed form. The most widely used software program is MARK (available for download at http://warnercnr.colostate.edu/~gwhite/mark/mark.htm), which provides parameter estimates from marked animals

Indicator Title	*Common indicator 5: Population demographic characteristics (Seabirds)*

when they are re-encountered at a later time. Re-encounters can be from dead recoveries (e.g., the animal is harvested), live recaptures (e.g., the animal is re-trapped or re-sighted), radio tracking, or from some combination of these sources of re-encounters. The basic input to program MARK is the encounter history for each animal.

Program MARK computes the estimates of model parameters via numerical maximum likelihood techniques. The number of estimable parameters is used to compute the quasi-likelihood AIC value (QAICc) for the model.

To estimate fecundity, it is necessary to compile breeding data in order to calculate the average number of young produced annually per female of breeding age. It is difficult to estimate the number of females that do not attempt breeding in any given year, so the default calculation will be based on the average annual breeding success, i.e. the number of fledged young per breeding attempt (≈ no. of fledged young per nest).

Complementary information, such as detailed data on direct mortality (e.g., through by-catch or beach strandings) can be obtained directly in the field and calculated using simple arithmetic methods.

Indicator units

The main demographic parameters are defined in the following units:

- adult survival probability: range between 0 and 1
- juvenile survival probability: range between 0 and 1
- fecundity, or breeding productivity: average no. of young produced per breeding pair per year
- age class distribution: percentage of each age class
- sex ratio: percentage

Priority species

The following species should be prioritised for the monitoring of demographic parameters given their role as indicators of the general state of the marine environment in the Mediterranean region:

- *Falco eleonorae*
- *Hydrobates pelagicus*
- *Larus audouinii*
- *Larus genei*
- *Pandion haliaetus*
- *Phalacrocorax aristotelis*
- *Calonectris diomedea*
- *Puffinus yelkouan*
- *Puffinus mauretanicus*
- *Sterna bengalensis*
- *Sterna sandvicensis*

List of Guidance documents and protocols available

- http://www.phidot.org/, especially the online discussion forum *Analysis of Data from Marked Individuals* found at: http://www.phidot.org/forum/index.php
- http://warnercnr.colostate.edu/~gwhite/mark/mark.htm
- http://www.capturerecapture.co.uk/

Data Confidence and uncertainties

Seabirds are long-lived, and any robust study on their demography must include enough individuals in order to

Indicator Title	*Common indicator 5: Population demographic characteristics (Seabirds)*

be representative of the whole population and it must extend over a sufficient number of years to account for any natural variability in the environment. The average study involves several hundreds, if not thousands, of individually-marked birds, and it extends over one or several decades. A large sample size and a long time series provide the best confidence in the estimation of the parameters.

Where certain data are not available for the population under study, it is common practice to use parameter values estimated elsewhere. However, this must be taken into account when drawing conclusions or proposing management measures, as it is possible that local factors affect the results.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Perrins, C.M., Lebreton, J.D., and Hirons, G.J.M. (eds.) (1991). *Bird population studies: relevance to conservation and management*, New York: Oxford University Press

Beissinger, Steven R. and McCullough, Dale R. (2002). *Population Viability Analysis*, Chicago: University of Chicago Press.

Morris, W., Doak, D., Groom, M., Kareiva, P., Fieberg, J., Gerber, L., & Thomson, D. (1999). *A practical handbook for population viability analysis*. The Nature Conservancy.

Sanderson, F.J., Pople, R.G., Ieronymidou, C., Burfield, I.J., Gregory, R.D., Willis, S.G., Howard, C., Stephens, P.A., Beresford, A.E. and Donald, P.F., 2015. Assessing the performance of EU nature legislation in protecting target bird species in an era of climate change. *Conservation Letters*. , May/June 2016, 9(3), 172–180

Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm

ETC/BD. 2011. Assessment and reporting under Article 17 of the Habitats Directive. Explanatory Notes & Guidelines for the period 2007-2012 (Final version). Compiled by Douglas Evans and Marita Arvela (European Topic Centre on Biological Diversity). Avalaible online: https://circabc.europa.eu/sd/a/2c12cea2-f827-4bdb-bb56-3731c9fd8b40/Art17%20-%20Guidelines-final.pdf

Available data sources
Sources and url's:
OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Mega Vertebrate Populations, http://seamap.env.duke.edu/
BirdLife Datazone: http://www.birdlife.org/datazone/home
Seabirds at sea survey methods: http://jncc.defra.gov.uk/page-4514
UNEP/MAP-RAC/SPA projects and publications http://www.rac-spa.org/publications
Birdlife partners in the Mediterranean
Mediterranean marine research centres, universities and institutions
Medmaravis
Governmental ministries
IUCN specialists: http://www.iucn.org/species/ssc-specialist-groups/about/ssc-specialist-groups-and-red-list-authorities-directory/birds

Spatial scope guidance and selection of monitoring stations

The study of demography requires a long-term commitment and it must be done where this essential condition can be met with confidence. Ideally, data must be collected over the same time period from a few colonies that are representative of the environmental and anthropic conditions encountered by the species across its range. This includes sites with protected status, where conditions are likely to be favourable and more stable, and those with the lowest levels of protection. Practical aspects, such as accessibility and potential impact of the presence of the researchers, must also be taken into account when selecting the study sites.

Temporal Scope guidance

As discussed above, demographic studies of seabird species should ideally extend over several decades. This way, the period of study has a better chance of encompassing most of the environmental and stochastic variability in the system. For the study of survival, the absolute minimum length is 4 study seasons; this provides the minimum 3 data points required to draw a curve of interannual survival.

Indicator Title	*Common indicator 5: Population demographic characteristics (Seabirds)*

Every year, a survey season is needed to obtain capture-recapture data on the presence of the individually-marked birds and to mark a new cohort of individuals. In parallel, data on breeding performance must be obtained for every breeding season (not necessarily at the same site).

Where additional data (e.g., on by-catch mortality or beach stranding) are compiled, it is important to do so on a yearly basis as well.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

Where detailed demographic information is available, PVA most often rely upon population projection matrices based on data from individuals of known age and origin. Matrix models predict long-term population growth rates, transient population dynamics, and probabilities of extinction over time.

Projection matrix models make it possible to assess the influence that the vital rates of particular classes have on the growth of the population as a whole. They also allow predicting future population trends for long-lived species that have undergone either recent changes in one or more vital rates (e.g. due to a novel human impact, or a recently-imposed management plan) or a perturbation in the population structure (i.e. the distribution of individuals among classes). They are particularly well suited to evaluating management alternatives, provided demographic data from contrasting situations exist.

The most laborious and time-intensive step in matrix-based modelling is the collection of demographic data on known individuals over a number of years. Once enough raw data on individuals is available, the basic steps to produce a projection matrix and to use the matrix to predict future population sizes are:

1. Determine what feature of individuals (age, size, or life stage) best predicts differences in vital rates. Then divide the population into classes based upon the feature chosen.
2. Use demographic data on known individuals to estimate the vital rates for each class, and use them to construct a population matrix.
3. Construct a population vector by specifying the initial number of individuals in each class in the population. A population vector is a list of the number of individuals in each class; the sum of the elements in the vector equals the total population size.
4. Use the matrix and the population vector to project the population forward in time, thus predicting the future size of the population, the long-term population growth rate, λ, and the risk of future extinction. This step involves simple rules of linear algebra.

Expected assessments outputs

The most commonly used way to present the results of PVA is to display both the average population size and the 95% confidence limits for a series of population realizations over some time interval of interest, say the next 20, 50 or 100 years. In this way, population size projections can be compared with new data from ongoing population censuses; deviations between actual and predicted trajectories would then suggest that changes in vital rates or population structure have occurred, or that there are errors in the model that need to be corrected.

In addition to projecting future population size, stochastic matrix models can also be used to quantify extinction risk. For a deterministic matrix model, only three outcomes are possible (population remains stable, it grows to infinity or it declines to extinction). If the population is declining deterministically, it is a simple matter to project the population until the number of individuals falls below the threshold, thus determining the predicted time to extinction. For models that incorporate variation in vital rates, extinction is a stochastic event, and its probability will be related both to the average value of λ and to its variance. Just as in the simpler count models, when λ is more variable the risk of extinction tends to rise, even in populations whose average growth rate is greater than 1.

Known gaps and uncertainties in the Mediterranean

The Mediterranean region is far from homogeneous and, as a result, the distribution of some seabird species is very asymmetric. Despite occurring throughout the Mediterranean, the numbers of species like Audouin´s Gull *Larus audouinii* and Eleonora´s Falcon *Falco eleonorae*, for example, are highly concentrated on a subregional scale. Local densities are much higher in those core areas compared to rest of the Mediterranean, and the demographical processes studied in dense colonies will probably be affected by different processes to those in

Indicator Title	*Common indicator 5: Population demographic characteristics (Seabirds)*	
areas of low density. It is therefore recommended that demographic studies are carried out in parallel in colonies with different characteristics, and that their results are compared.		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

12. Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS) (EO 2)

Indicator Title	*Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Decreasing abundance of introduced NIS in risk areas	Invasive NIS introductions are minimized	Abundance of NIS introduced by human activities reduced to levels giving no detectable impact
Rationale		

Justification for indicator selection

Marine invasive alien species are regarded as one of the main causes of biodiversity loss in the Mediterranean, potentially modifying all aspects of marine and other aquatic ecosystems. They represent a growing problem due to the unprecedented rate of their introduction and the unexpected and harmful impacts that they have on the environment, economy and human health. According to the latest regional reviews, more than 6% of the marine species in the Mediterranean are now considered non-native species as around 1000 alien marine species have been identified , while their number is increasing at a rate of one new record every 2 weeks (Zenetos et al., 2012). Of these species, 13.5% are classified as being invasive in nature, with macrophytes (macroalgae and seagrasses) as the dominant group in the western Mediterranean and Adriatic Sea, and polychaetes, crustaceans, molluscs and fishes in the eastern and central Mediterranean (; Zenetos et al., 2010, 2012). Although the highest alien species richness occurs in the eastern Mediterranean, ecological impact shows strong spatial heterogeneity with hotspots in all Mediterranean sub-basins (Katsanevakis et al. 2016).

To mitigate the impacts of NIS on biodiversity, human health, ecosystem services and human activities there is an increasing need to take action to control biological invasions. With limited funding, it is necessary to prioritise actions for the prevention of new invasions and for the development of mitigation measures. This requires a good knowledge of the impact of invasive species on ecosystem services and biodiversity, their current distributions, the pathways of their introduction, and the contribution of each pathway to new introductions.

Common indicator 6 is an indicator that summarizes data related to biological invasions in the Mediterranean into simple, standardized and communicable figures and is able to give an indication of the degree of threat or change in the marine and coastal ecosystem. Furthermore, it can be a useful indicator to assess on the long-run the effectiveness of management measures implemented for each pathway but also, indirectly, the effectiveness of the different existing policies targeting alien species in the Mediterranean Sea.

Scientific References

Katsanevakis, S., Tempera, F., Teixeira, H., 2016. Mapping the impact of alien species on marine ecosystems: the Mediterranean Sea case study. Diversity and Distributions 22, 694–707.

Zenetos A., Gofas, S., Verlaque, M., Cinar, M. E., García Raso, E., et al., 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union‘s Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. Mediterranean Marine Science, 11, 2, 381-493.

Zenetos A., Gofas, S., Morri, C., Rosso, A., Violanti, D., et al., 2012. Alien species in the Mediterranean Sea by 2012. A contribution to the application of European Union‘s Marine Strategy Framework Directive (MSFD). Part 2. Introduction trends and pathways. Mediterranean Marine Science, 13/2, 328-352.

Policy Context and targets (other than IMAP)

Policy context description

The Convention on Biological Biodiversity (CBD) recognised the need for the “compilation and dissemination of information on alien species that threaten ecosystems, habitats, or species to be used in the context of any prevention, introduction and mitigation activities”, and calls for “further research on the impact of alien invasive species on biological diversity” (CBD, 2000). The objective set by Aichi Biodiversity Target 9 is that “by 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment”. This is also reflected in Target 5 of the EU Biodiversity Strategy (EU 2011). The new EU Regulation 1143/2014 on the management of invasive alien species seeks to address the problem of IAS in a comprehensive manner so as to protect native biodiversity and ecosystem services, as well as to minimize and mitigate the human health or economic impacts that these species can have. The Regulation foresees three types of interventions; prevention, early detection and rapid eradication, and management.

The Marine Strategy Framework Directive (MSFD), which is the environmental pillar of EU Integrated

Indicator Title	*Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)*
Maritime Policy, sets as an overall objective to reach or maintain "Good Environmental Status" (GES) in European marine waters by 2020. It specifically recognizes the introduction of marine alien species as a major threat to European biodiversity and ecosystem health, requiring Member States to include alien species in the definition of GES and to set environmental targets to reach it. Hence, one of the 11 qualitative descriptors of GES defined in the MSFD is that "non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem" (Descriptor 2). Among the indicators adopted to assess this descriptor are "trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species". Ecological Objective 2 and the Common Indicator 6 are in agreement with the MSFD objectives and targets.	
Indicator/Targets Aichi Biodiversity Target 9 EU Biodiversity Strategy Target 5 EU Regulation 1143/2014 targets MSFD Descriptor 2 and related criteria and indicators	
Policy documents Aichi Biodiversity Targets - https://www.cbd.int/sp/targets/ EU Biodiversity Strategy - http://eurlex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN EU Regulation 1143/2014 - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN Marine Strategy Framework Directive - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN Commission Decision on criteria and methodological standards on good environmental status of marine waters - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010D0477(01)&from=EN	
Indicator analysis methods	
<u>General definitions</u> (according to UNEP(DEPI)/MED WG.420/4) 'Non-indigenous species' (NIS; synonyms: alien, exotic, non-native, allochthonous) are species, subspecies or lower taxa introduced outside of their natural range (past or present) and outside of their natural dispersal potential. This includes any part, gamete or propagule of such species that might survive and subsequently reproduce. Their presence in the given region is due to intentional or unintentional introduction resulting from human activities. Natural shifts in distribution ranges (e.g. due to climate change or dispersal by ocean currents) do not qualify a species as a NIS. However, secondary introductions of NIS from the area(s) of their first arrival could occur without human involvement due to spread by natural means. 'Invasive alien species' (IAS) are a subset of established NIS which have spread, are spreading or have demonstrated their potential to spread elsewhere, and have an effect on biological diversity and ecosystem functioning (by competing with and on some occasions replacing native species), socioeconomic values and/or human health in invaded regions. Species of unknown origin which cannot be ascribed as being native or alien are termed cryptogenic species. They also may demonstrate invasive characteristics and should be included in IAS assessments. Indicator Definition For the needs of Common Indicator 6, the following definitions apply: 'Trend in abundance' is defined as the interannual change in the estimated total number of individuals of a non-indigenous species population in a specific marine area. 'Trend in temporal occurrence' is defined as the interannual change in the estimated number of new introductions and the total number of non-indigenous species in a specific country or preferably the national part of each subdivision, preferably disaggregated by pathway of introduction. 'Trend in spatial distribution' is defined as the interannual change of the total marine 'area' occupied by a non-indigenous species.	
Methodology for indicator calculation To estimate Common Indicator 6, a trend analysis (time series analysis) of the available monitoring data needs to be performed, aiming to extract the underlying pattern, which may be hidden by noise. A formal regression analysis is the recommended approach to estimate such trends. This can be done by a simple linear regression analysis or by more complicated modelling tools (when rich datasets are available), such as generalized linear or additive models. To monitor trends in temporal occurrence, two parameters [A] and [B] should be calculated on a yearly basis. Parameter [A] provides an indication of the introductions of "new" species (in comparison with the prior year),	

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and parameter [B] gives an indication of the increase or decrease of the total number of non-indigenous species:
[A]: The number of non-indigenous species at T_n that was not present at T_{n-1}. To calculate this parameter the non-indigenous species lists of both years are compared to check which species were recorded in year *n*, but were not recorded in year *n-1* regardless of whether or not these species was present in earlier years. To calculate this parameter the total number of non-indigenous species is used in the comparison.
[B]: The total number of known non-indigenous species at T_n minus the corresponding number of non-indigenous species at T_{n-1}. Hereby T_n stands for the year of reporting.

Indicator units
'Trends in abundance': % change per year
'Trends in temporal occurrence': % change in new introductions or % change in the total number of alien species per year or per decade
'Trends in spatial distribution': % change in the total marine surface area occupied or % change in the length of the occupied coastline (in the case of shallow-water species that are present only in the coastal zone)

List of Guidance documents and protocols available
There are no established standard protocols for the monitoring of NIS. However, sampling methods are used by monitoring activities implemented in many Mediterranean countries, in particular in relation to the Ballast Water Convention, the EU Water Framework Directive, and the Marine Strategy Framework Directive. These methods may be useful for the estimation of Common Indicator 6.
Some guidance on the monitoring of biodiversity (including non-indigenous species) for the needs of the MSFD is provided in: *Zampoukas et al. (2014) Technical guidance on monitoring for the Marine Stategy Framework Directive. JRC Scientific and Policy Reports (EUR collection), Publications Office of the European Union, EUR 25009 EN – Joint Research Centre, doi: 10.2788/70344, ISBN: 978-92-79-35426-7, 166p.*
The EU Project BALMAS has provided guidelines for the monitoring of NIS in ballast water (https://www.balmas.eu/).

Data Confidence and uncertainties
The trend analysis should be accompanied by an evaluation of confidence and uncertainties. Standard regression methods (simple linear regression, generalized linear or additive models, etc) provide estimates of uncertainty (standard errors and confidence intervals of estimated trends). Such uncertainty estimates should accompany all reported trends.
Furthermore, the issue of imperfect detectability should be properly addressed, as it may cause an underestimation of the relevant state variables (abundance, occupancy, geographical range, species richness). There are many available methods that properly tackle the issue of imperfect detection when monitoring biodiversity, by jointly estimating detectability (see Katsanevakis et al. 2012 for a review).

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols
It is recommended to use standard monitoring methods traditionally being used for marine biological surveys, including, but not limited to plankton, benthic and fouling studies described in relevant guidelines and manuals. However, specific approaches may be required to ensure that alien species are likely to be found, e.g. in rocky shores, port areas and marinas, offshore areas and aquaculture areas.
As a complimentary measure and in the absence of an overall NIS targeted monitoring programme,
rapid assessment studies may be undertaken, usually but not exclusively at marinas, jetties, and fish farms
(e.g. Pederson et al. 2003).
The compilation of citizen scientists input, validated by taxonomic experts, can be useful to assess the geographical ranges of established species or to early record new species.
For the estimation of Common Indicator 6, it is important that the same sites are surveyed each monitoring period, otherwise the estimation of the trend might be biased by differences among sites.
Standard methods for monitoring marine populations include plot sampling, distance sampling, mark-recapture, removal methods, and repetitive surveys for occupancy estimation (see Katsanevakis et al. 2012 for a review specifically for the marine environment).
Katsanevakis S, et al., 2012. Monitoring marine populations and communities: review of methods and tools dealing with imperfect detectability. Aquatic Biology 16: 31–52.
Pederson J, et al., 2003 Marine invaders in the northeast: Rapid assessment survey of non-native and native marine species of floating dock communities, August 2003 (available in https://dspace.mit.edu/bitstream/handle/1721.1/97032/MITSG_05-3.pdf?sequence=1)

Available data sources
Marine Mediterranean Invasive Alien Species database (MAMIAS) - http://www.mamias.org/
European Alien Species Information Network (EASIN) - http://easin.jrc.ec.europa.eu/
CIESM Atlas of Exotic Species in the Mediterranean - http://www.ciesm.org/online/atlas/

Indicator Title	*Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)*	
World Register of Introduced Marine Species (WRIMS) - http://www.marinespecies.org/introduced/		
Spatial scope guidance and selection of monitoring stations The monitoring of NIS generally should start on a localised scale, such as "hot-spots" and "stepping stone areas" for alien species introductions. Such areas include ports and their surrounding areas, docks, marinas, aquaculture installations, heated power plant effluents sites, offshore structures. Areas of special interest such as marine protected areas, lagoons etc. may be selected on a case by case basis, depending on the proximity to alien species introduction "hot spots". The selection of the monitoring sites should therefore be based on a previous analysis of the most likely "entry" points of introductions and "hot spots" expected to contain elevated numbers of alien species. It is important to establish a network of monitoring sites at regional level in which common protocols are applied so that Common Indicator 6 can be assessed at both national and regional level. The use of Habitat Suitability Models and Ecological Niche Modelling (ENM) may be considered at a later stage of IMAP to identify priority monitoring sites and to predict the spread of NIS.		
Temporal Scope guidance Monitoring at "hot-spots" and "stepping stone areas" for alien species introductions would typically involve more intense monitoring effort, e.g. sampling at least once a year at ports and their wider area and once every two years in smaller harbours, marinas, and aquaculture sites.		
Data analysis and assessment outputs		
Statistical analysis and basis for aggregation Standard statistics for regression analysis should be applied to estimate trends and their related uncertainties.		
Expected assessments outputs - Graphs of the time series of the calculated metrics (abundance, occurrence, etc), including confidence intervals - Distribution maps of the selected species, depicting temporal changes in their spatial distribution - National inventories (and also by the national part of each marine subdivision, if relevant) of non-indigenous species by year		
Known gaps and uncertainties in the Mediterranean NIS identification is of crucial importance, and the lack of taxonomical expertise has already resulted in several NIS having been overlooked for certain time periods. The use of molecular approaches including bar-coding are sometimes needed to confirm traditional species identification. Sampling effort currently greatly varies among Mediterranean countries and thus on a regional basis current assessments and comparisons may be biased.		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

II. Common indicator assessment factsheets

1. EO1: Common Indicators 1 and 2. CI 1: Habitat distributional range. CI 2: Condition of the habitat's typical species and communities

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO1: Biological diversity is maintained or enhanced. The quality and occurrence of_coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions**.
IMAP Common Indicator	Write the exact text, number	**CI 1: Habitat distributional range** **CI 2:Condition of the habitat's typical species and communities**
Indicator Assessment Factsheet Code	Text	**EO1 CI1** **EO1 CI2**
Rationale/Methods		
Background (short)	Text (250 words)	**Background and rationale for habitats and seafloor integrity, key pressures and drivers** In the list of EcAp Ecological Objectives and Common Indicators, *Habitat distributional range* and *Condition of the habitat's typical species and communities* belong to the Ecological Objective EO1 Biodiversity. The objective *Seafloor Integrity* is also included but, still, the common indicators need further development. "Seafloor" includes the physical and chemical variables of the seabed and the biotic composition of the benthic assemblages. "Integrity", besides covering the physical and biological components of the sea bottom, requires also that habitats are not artificially fragmented. However, there is no single scientific consensus on what constitutes "good environmental status" for Sea Floor Integrity. Baseline information are extremely scant so that also a consensus around the meaning of "integrity" is lacking. Habitat destruction is one of the most pervasive threats to the diversity, structure, and functioning of Mediterranean marine coastal ecosystems and to the goods and services they provide (1,2,3,4,5,6,7,8,9). The 20% of the entire basin and 60-99% of the territorial waters of EU member states are heavily impacted by multiple interacting threats, less than 20% has low impact and very few areas, less than 1% remain relatively unaffected by human activities (10,11,12). The Alboran Sea, the Gulf of Lyons, the Sicily Channel and Tunisian Plateau, the Adriatic Sea, off the

		coasts of Egypt and Israel, along the coasts of Turkey, and within the Marmara and Black Sea are highly impacted. Low cumulative human impacts were found in offshore areas, and in several small coastal areas of some countries. These areas represent important opportunities for conservation aimed at preventing future degradation. Pollution, fisheries, urbanisation and invasive alien species (increasing temperature and UV, and acidification) are the most frequently cited pressures in the Red List of European Habitats (https://www.researchgate.net/publication/311772198_European_Red_List_of_Habitats_Part_1_Marine_habitats) affecting the distribution range and the conditions of habitats. Climate change is also affecting some mediolittoral and infralittoral habitats, especially by altering the thermal structure of the water column, with extensive mass mortalities (13). The proliferation of coastal and marine infrastructures, such as breakwaters, ports, seawalls and offshore installations call for special concern, all being associated with loss of natural habitats and alteration of hydrographic conditions (14). New strategies aimed at elevating the ecological and biological value of coastal infrastructures are urgent. Seabed trawling causes the loss of shallow habitats such as *Posidonia* seagrass meadows and deeper soft bottom habitats. The continuous stirring, mixing, and resuspension of surface sediments by intensive and chronic trawling activities changes sediment dynamics and have permanently smoothed the seafloor morphology of the continental slope over large spatial scales. Commercial interest in deep-sea mining is increasing, relating to the future exploitation of seafloor resources. The environmental impacts of deep-sea mining could be significant, including physical disturbance, the creation of suspended sediment plumes, water mixing effects, and the impacts of mining ships and other infrastructure (15). **Policy Context and Targets** Marine Protected Areas (MPAs) are one of the most important tools for protecting marine-coastal habitats and seafloor integrity. Several institutions (e.g. RAC/SPA, MedPAN, WWF, local NGOs, IUCN, research organisations) are working together to set conservation priorities establishing an ecological network of MPAs to protect at least 10% of the marine and coastal waters (Aichi Target 11), made up of ecologically interconnected and well managed MPAs that are representative of Mediterranean biodiversity, in accordance with the latest guidelines from the Convention on Biological Diversity and the Barcelona Convention (see also the recent document http://www.europarc.org/news/2016/12/tangier-declaration/). MPAs are generally instituted because of the presence of remarkable benthic seascapes. The Birds and Habitats Directives (BHD) have led to the establishment of the Natura 2000 network of sites where species and habitats (9 marine habitats) of European interest must be maintained in a favourable conservation condition. The Ramsar Convention includes member states throughout the Mediterranean Basin and focuses on a single threatened habitat, coastal wetlands. Other Eurocentric policies include the Marine Strategy Framework Directive (MSFD), which requires the European States of the Mediterranean to prepare national strategies to manage and monitor their seas to achieve or maintain Good Environmental Status by 2020 in all their national waters. The definition of Good Environmental Status (GES) is based on two pillars: Biodiversity and Ecosystem Functioning (BEF). The conceptual revolution of GES overcomes the limits of both the Habitats Directive and the Landscape Convention, widening conservation not only to structure (biodiversity) but also to function (ecosystem functioning), considering many phenomena that do occur in the water column (16). In this framework, *habitat distribution*, *extent* and *condition* are included in Descriptor 1, while Descriptor 6 deals directly with *seafloor integrity*. Finally, there are other institutional mandates such as the EU Directive establishing a framework for Maritime Spatial Planning (MSP) and the EU Blue Growth strategy requiring that areas and actions are prioritized to ensure that conservation and management efforts will produce biological and socioeconomic long-term benefits. However, at present, the lack of concrete application of MSP, even at small scale, limits the

		potential to solve hot spots of conflicts with consequent effects on marine biodiversity and the services it provides. EcAp extends the vision of the MSFD to the whole Mediterranean, while taking into account its peculiarities.
Background (*extended)*	Text (no limit), images, tables, references	
Assessment methods	Text (200-300 words), images, formulae, URLs	
Results		NOTE: If the assessment has been performed at different geographical scales, include the results and conclusions accordingly.
Results and Status, including trends (brief)	Text (500 words), images	
Results and Status, including trends (extended)	Text(no limit), figures, tables	A total of 257 benthic marine habitat types were assessed in a recent overview of the degree of endangerment of marine, terrestrial and freshwater habitats in the European Union (EU28) and adjacent regions (EU28+) (The European Red List of Habitats, 2016). In total, 19% (EU28) and 18% (EU28+) of the evaluated habitats were assessed as threatened in categories Critically Endangered, Endangered and Vulnerable. The highest proportion of threatened habitats in the EU28 is in the Mediterranean Sea (32%), followed by the North-East Atlantic (23%), the Black Sea (13%) and then the Baltic Sea (8%). This report provides also an overview of the risk of collapse for 47 benthic habitats in the Mediterranean. Almost half of the Mediterranean habitats (23 habitats, 49%) were Data Deficient in EU28 countries. Of the remainder (24 habitats) 83% were of conservation concern (NT-CR) with 63% threatened to some degree (42% Vulnerable and 21% Endangered). A good proportion of habitats in infralittoral and mediolittoral environments were either Vulnerable or Endangered. They include algal-dominated communities on infralittoral sediments, and circalittoral sediments and rocks together with mussel and oyster beds. The criteria under which habitats were most frequently assessed as threatened in both the EU28 and EU28+ were *decline in extent* and a *decline in quality*. The brown algae ***Cystoseira* spp**. form dense canopies along rocky intertidal and subtidal rocky coasts. Conspicuous historical declines in extent and quality, for at least a century and especially of species thriving in rock-pools and in the infralittoral zone, are documented in many regions of the Mediterranean Sea (Adriatic Sea, France, Ligurian Sea, Strait of Sicily). Algal turfs replace canopies, with a shift from high- to low-diversity habitats. In many coastal rocky bottoms a shift from canopy-forming algae dominated system to overgrazed sea urchin-dominated barrens (*Paracentrotus lividus* and *Arbacia lixula*) can also occur, mainly in consequence of the illegal destructive fishing of the rock-boring mollusk *Lithophaga lithophaga* and the overfishing of primary sea-urchin predator fishes. Despite the progressive expansion of **barren areas** replacing algal canopies and other rocky bottom assemblages is currently widely acknowledged (Western and Eastern Mediterranean Sea), no published work has been aimed at the assessment of the extension of barren (1). **Kelps** such as *Laminaria rodriguezii* are now confined to very deep areas of the Mediterranean Sea (Balearic and Alboran Islands). The few available temporal data from the Adriatic Sea, obtained in surveys undertaken between 1948–1949 and 2002, showed that this species has become exceptionally rare or has completely disappeared from this area. Repeated surveys in 2010 showed no recovery of the species. These losses have been linked to intensive trawling. In other areas of France, Italy and Tunisia the species records date back mainly to the 1960–1970s, while in this work recent accessible information on the status of

		these populations was not found. Only two habitats were assessed as threatened considering the *area of occupancy*: **biogenic habitats of Mediterranean mediolittoral rock** represented by vermetid molluscs and by red algae such as *Lithophyllum byssoides* and *Neogoniolithon brassica-florida*, and **photophilic communities** dominated by calcareous, habitat forming algae, as they are found at only a few sites on the European side of the Mediterranean Sea. The distribution of **nursery areas** of 11 important commercial species of demersal fish and shellfish was assessed in the European Union Mediterranean waters using time series of bottom trawl survey data with the aim of identifying the most persistent recruitment areas (17). A high interspecific spatial overlap between nursery areas was mainly found along the shelf break of many sectors of the Northern Mediterranean, indicating a high potential for the implementation of conservation and management measures. The new knowledge on the distribution and persistence of demersal nurseries can further inform the application of spatial conservation measures, such as the designation of new no-take MPAs in EU Mediterranean waters and their inclusion in a conservation network. The establishment of no-take zones has to be consistent with the objectives of the Common Fisheries Policy applying the ecosystem approach to fisheries management and with the requirements of the MSFD to maintain or achieve seafloor integrity and good environmental status. The first continuous maps of **coralligenous and maërl habitats** across the Mediterranean Sea has been produced across the entire basin, by modelling techniques (5). Important new information was gained from Malta, Italy, France (Corsica), Spain, Croatia, Greece, Albania, Algeria, Tunisia and Morocco, making the present datasets the most comprehensive to date. Still, there were areas of the Mediterranean Sea where data are scarce (Albania, Algeria, Cyprus, Israel, Libya, Montenegro, Morocco, Syria, Tunisia and Turkey) or totally absent (Bosnia and Herzegovina, Egypt, Lebanon and Slovenia). Knowledge on maërl beds was somewhat limited compared to what was available for coralligenous outcrops; a significant update was nevertheless achieved. Previously unknown spatial information on maërl distribution became available for Greece, France (Corsica), Cyprus, Turkey, Spain and Italy. Malta and Corsica, in particular, had significant datasets for this habitat as highlighted by fine-scale surveys in targeted areas. A fine-scale assessment of (i) the current and historical known distribution of ***P. oceanica***, (ii) the total area of meadows and (iii) the magnitude of regressive phenomena in the last decades is also available (6). The outcomes showed the current spatial distribution of *P. oceanica*, covering a known area of 1,224,707 ha, and highlighted the lack of relevant data in part of the basin (21,471 linear km of coastline). The estimated regression of meadows amounted to 34% in the last 50 years, showing that this generalised phenomenon had to be mainly ascribed to cumulative effects of multiple local stressors. Considerable efforts have also been carried out to address the issue of **alien species** at basin scale (18,19). There are considerable differences among the Mediterranean countries in the number of recorded alien species. Far more alien species have been documented in the Levantine Basin than the entire western Mediterranean, when considering multicellular taxa. More specifically, a total of 986 alien species in the Mediterranean have been recorded (775 in the eastern Mediterranean, 249 in the central Mediterranean, 190 in the Adriatic Sea and 308 in the western Mediterranean) (19). A total of 338 alien species was found only for the 180 km long coast of Israel, individuated as a hot spot for invasive species also (12,18), whereas 112 alien species were reported off the 2300 km long Mediterranean coast of continental France and Spain. Our knowledge about the **deep-sea habitats** on the scale of the whole Mediterranean Basin is extremely scant and limited only to sites in the western Mediterranean which received much attention in the last decades (e.g., Cap de Creus Canyon, South Adriatic Sea, Santa Maria di Leuca Coral Province, Alboran

		Sea). The lack of information about deep-sea habitats in the north African and in the eastern side of the Mediterranean Sea is particularly evident.
Conclusions		
Conclusions (brief)	Text (200 words)	
Conclusions (extended)	Text (no limit)	● Regional expertise, research and monitoring programmes over the last few decades have tended to concentrate their attention on only a few specific Mediterranean habitats. The exploration of habitats such as bioconstructions from very shallow to the deep-sea should be further supported. ● Despite the scientific importance of time series studies, the funding for many monitoring programmes is in jeopardy, and much the Mediterranean Sea remains not just under-sampled but unsampled. Monitoring should be coordinated and standardized so that results can be easily comparable at least for some, decided *a priori*, variables. ● Beside criteria such as reduction in quantity and in quality and the geographical distribution, more research should focus on processes leading to low diversity habitats. Regime shifts are ubiquitous in marine ecosystems, ranging from the collapse of individual populations, such as commercial fish, to the disappearance of entire habitats, such as macroalgal forests and seagrass meadows. Lack of a clear understanding of the feedbacks involved in these processes often limits the possibility of implementing effective restoration practices. ● To make the descriptor Sea Floor Integrity operational 8 attributes of the seabed system have been suggested to provide adequate information to meet requirements of the MSFD: (i) substratum, (ii) bioengineers, (iii) oxygen concentration, (iv) contaminants and hazardous substances, (v) species composition, (vi) size distribution, (vii) trophodynamics and (viii) energy flow and life history traits. An important issue is to select the to select the proper spatial and temporal scales ● Increase the geographical coverage of protection, establishing new arrays of MPAs (and then Networks of MPAs) in the southern and eastern parts of the Mediterranean Sea (most MPAs are concentrated in the north-central Mediterranean Sea) since Descriptors 1, 3, 4 and 6 have been shown to evolve favourably in Mediterranean MPAs. The use of MPA networks as a reference volume where to assess the attainment of GES should be taken into account. The GES should be achieved in all Mediterranean waters by 2020. In addition, Establish Exclusive Economic Zones (EEZ) in EU countries and encourage other non-EU states to do so as well. This will minimize or eliminate the High Seas in the Mediterranean. Outside the EEZs, in fact, the seas are a “no man’s land” and regulations are weak, especially for deep-sea mining and fisheries. ● The coastal states are currently formulating their criteria and the associated monitoring protocols for recognising GES. This is leading to quite wide disparities of the interpretations of the Descriptors/Indicators among coastal states, not least in the ecological terminology used: this is particularly evident in the definition of Sea Floor Integrity (Descriptor 6) largely differing across countries such as Spain, Italy, Slovenia, Croatia, Cyprus and Bulgaria (1). The monitoring programmes also suffer of the same inconsistencies. The consequence is that, in most EU countries, the criteria for implementing GES are still unclear, with lack of harmonization of methods between countries. ● Large-scale analyses have been critical to expand our knowledge about the *extent* of habitats and threats but are often biased by the extrapolation of either a few small-scale studies or low-resolution large-scale assessments. This limits very much the potential to assess the condition and the trajectories of change in Mediterranean habitats ● Ocean warming, acidification, extreme climate events and biological invasions are expected to increase in the next years. These are difficult to be assessed and managed. More attention should be directed to those threats that can be more easily mitigated such as trawling, maritime traffic and nutrient loading from some land-based activities. In this framework, improve knowledge of the distribution and intensity of threats (e.g. fishery, bioinvasions, marine

		litter, seabed mining, coastal and non coastal infrastructures) to reduce uncertainties on their effects should be also increased. ● Promote open access to data is very critical, especially those deriving from EU projects, through institutional databases sustained under rules and protocols endorsed by EU. The data ensuing from EU projects are still much fragmented and are not stored in a single repository where data are available in a standard format with a stated access protocol. ● The process of Maritime Spatial Planning (MSP) across the Mediterranean should be largely supported, considering activities that are expected to increase in the future (e.g. aquaculture, maritime traffic, seabed mining).
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	
List of references	Text DELETE: (10 pt, Cambria style	http://www.coconet-fp7.eu/ http://www.perseus-net.eu/site/content.php Bazairi C.H., Ben Haj, S., Boero, F., Cebrian, D. 2010. The Mediterranean Sea Biodiversity: state of the ecosystems, pressures, impacts and future priorities. RAC/SPA, Tunis Danovaro R., J. B. Company, C. Corinaldesi, G. D'Onghia, B. Galil, C. Gambi, A. J. Gooday, N. Lampadariou, G. M. Luna, C. Morigi, K. Olu, P. Polymenakou, E. Ramirez-Llodra, A. Sabbatini, and Sard. 2010. Deep-sea biodiversity in the Mediterranean Sea: The known, the unknown, and the unknowable. Plos One 5. Martin C.S., Giannoulaki M., De Leo F., Scardi M., Salomidi M., Knitweiss L., Pace ML., Garofalo G., Gristina M., Ballesteros E., Bavestrello G., Belluscio A., Cebrian E., Gerakaris V., Pergent G., Pergent-Martini C., Schembri PJ., Terribile K., Rizzo L., Ben Souissi J., Bonacorsi M., Guarnieri G., Krzelj M., Macic V., Punzo E., Valavanis V., and Fraschetti S. 2014. Coralligenous and maërl habitats: predictive modelling to identify their spatial distributions across the Mediterranean Sea. Scientific Reports 4, 5073. DOI: 10.1038/srep05073 Telesca L., Belluscio A., Criscoli A., Ardizzone G., Apostolaki E.T., Fraschetti S., Gristina M., Knittweis L., Martin C.S., Pergent G., Alagna A., Badalamenti F., Garofalo G., Gerakaris V., Pace M.L., Pergent-Martini C., and Salomidi M. Seagrass meadows (*Posidonia oceanica*) distribution and trajectories of change. 2015. Scientific Reports, 5: 12505 Boero F. 2003. State of knowledge of marine and coastal biodiversity in the Mediterranean Sea. UNEP, SPA-RAC: Tunis, Tunisia Claudet J., and S. Fraschetti. 2010. Human-driven impacts on marine habitats: A regional meta analysis in the Mediterranean Sea. Biological Conservation **143**: 2195-2206. Airoldi L., and M. W. Beck. 2007. Loss, status and trends for coastal marine habitats of Europe. Oceanography and Marine Biology, 45: 345-405. Micheli F., Halpern B.S., Walbridge S., Ciriaco S., Ferretti F., Fraschetti S., Lewison R., Nykjaer L., and Rosenberg A.A. 2013. Cumulative human impacts on Mediterranean and Black Sea marine ecosystems: assessing current pressures and opportunities. PLoS ONE 8 (12), e79889. Coll M., C. Piroddi, and C. a. Albouy. 2012. The Mediterranean Sea under siege: Spatial overlap between marine biodiversity, cumulative threats and marine reserves. Global Ecology and Biogeography 21:465-480. Coll M., C. Piroddi, J. Steenbeek, K. Kaschner, F. B. Lasram, J. Aguzzi, E. Ballesteros, C. N. Bianchi, J. Corbera, T. Dailianis, R. Danovaro, M. Estrada, C. Froglia, B. S. Galil, J. M. Gasol, R. Gertwagen, J. Gil, F. Guilhaumon, K. Kesner-Reyes, M. S. Kitsos, A. Koukouras, N. Lampadariou, E. Laxamana, C. M. L. F. de la Cuadra, H. K. Lotze, D. Martin, D. Mouillot, D. Oro, S. Raicevich, J. Rius-Barile, J. I. Saiz-Salinas, C.

		San Vicente, S. Somot, J. Templado, X. Turon, D. Vafidis, R. Villanueva, and E. Voultsiadou. 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. Plos One 5 Rivetti I., S. Fraschetti, P. Lionello, E. Zambianchi, and F. Boero. 2014. Global warming and mass mortalities of benthic invertebrates in the Mediterranean Sea. Plos One 9: 1-22 Perkol-Finkel S., Ferrario F., Nicotera V., Airoldi L. 2012. Conservation challenges in urban seascapes: promoting the growth of threatened species on coastal infrastructures. Journal of Applied Ecology 49: 1457-1466 Williamson, P., Smythe-Wright, D., and Burkill, P., Eds. 2016. Future of the Ocean and its Seas: a non-governmental scientific perspective on seven marine research issues of G7 interest. ICSU-IAPSO-IUGG-SCOR, Paris. Boero et al. 2015. The future of the Mediterranean Sea Ecosystem: towards a different tomorrow. Rend. Fis. Acc. Lincei 26: 3-12 Colloca F, Garofalo G, Bitetto I, Facchini MT, Grati F, Martiradonna A, et al. (2015) The Seascape of Demersal Fish Nursery Areas in the North Mediterranean Sea, a First Step Towards the Implementation of Spatial Planning for Trawl Fisheries. PLoS ONE 10(3): e0119590 Galil B., 2012. Truth and consequences: the bioinvasion of the Mediterranean Sea. Integrative Zoology 7: 299-311 Zenetos A., et al. 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. Mediterranean Marine Science 11: 381-493

2. EO1: Common Indicator 3. Species distributional range (related to marine mammals)

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Underline appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Underline appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO1. Biological diversity is maintained or enhanced. The quality and occurrence of coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.**
IMAP Common Indicator	Write the exact text, number	**CI 3. Species distributional range (related to marine mammals)**
Indicator Assessment Factsheet Code	Text	**EO1CI3**
Rationale/ Methods		
Background (short)	Text	**Background and rationale for the indicator, key pressures and drivers** The aim of this indicator is to provide information about the geographical area where marine mammal species occur, and to determine the range of cetaceans and seals that are present in the Mediterranean waters. The distribution of a given marine mammal species is usually described by a map, describing the species presence, distribution and occurrence. Geographical Information Systems (GIS) are commonly used to graphically represent monitoring data and species distributional range maps. Data on distribution of marine mammals are usually collected during dedicated ship and aerial surveys, acoustic surveys, or opportunistically by whale watching operators, ferries, cruise ships, military ships. Twelve species of marine mammals — one seal and 11 cetaceans — are regularly present in the Mediterranean Sea; all these 12 species belong to populations (or sub-populations, *sensu* IUCN) that are genetically distinct from their North Atlantic conspecifics. The Mediterranean monk seal (*Monachus monachus*) and the 11 cetacean species (fin whale, *Balaenoptera physalus*; sperm whale, *Physeter macrocephalus*; Cuvier's beaked whale, *Ziphius cavi*rostris; short-beaked common dolphin, *Delphinus delphis*; long-finned pilot whale, *Globicephala melas*; Risso's dolphin, *Grampus griseus*; killerwhale, *Orcinus orca*; striped dolphin, *Stenella coeruleoalba*; rough-toothed dolphin, *Steno bredanensis*; common bottlenose dolphin, *Tursiops truncatus*;

		harbour porpoise, *Phocoena phocoena relicta*) face several threats, due to heavy anthropogenic pressures throughout the entire Mediterranean basin. The conservation status of marine mammals in the region is jeopardised by numerous human impacts, such as: (1) deliberate killing (mainly due to interactions with fisheries), naval sonar, ship strikes, epizootics, fisheries bycatch, chemical pollution and ingestion of solid debris; (2) short-term habitat displacement as a consequence of naval exercises using sonars, seismic surveys, vessel disturbance and noise; and (3) long-term relocation caused by food depletion due to over fishing, coastal development and possibly climate change. Two of these species have very limited ranges: the harbour porpoise, possibly representing a small remnant population in the Aegean Sea, and the killer whale, present only as a small population of a few individuals in the Strait of Gibraltar. Out of the 12 marine mammal species listed above, seven are listed under a Threat category on the IUCN's Red List, three are listed as Data Deficient and two need to be assessed. **Policy Context and Targets** The Mediterranean cetaceans' populations are protected under the framework of ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area), under the auspices of the UNEP Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS). The Pelagos Sanctuary is a large marine protected area, established by France, Italy and Monaco in the Corso-Ligurian-Provençal Basin and the Tyrrhenian Sea, where most cetacean species are regularly observed and benefit from its conservation regime. All cetacean species in the Mediterranean Sea are also protected under the Annex II of the SPA-BD Protocol of the Barcelona Convention; under the Appendix I of the Bern Convention; under the Annex II of the Washington Convention (CITES); and under the Appendix II of the Bonn Convention (CMS). The short-beaked common dolphin, the sperm whale and the Cuvier's beaked whale and the monk seal are also listed under the Appendix I of the Bonn Convention (CMS). The common bottle dolphin, the harbor porpoise and the monk seal are also listed under the Annex II of the EU Habitats Directive.
Background (*extended)*	Text (no limit), images, tables, references	
Assessment methods	Text (200-300 words), images, formulae, URLs	
Results		
Results and Status, including trends (brief)	Text (500 words), images	
Results and Status, including trends (extended)	Text(no limit), figures, tables	**Mediterranean monk seal** – Regularly present only in the Ionian, Aegean and Levantine Seas, the Mediterranean monk seas breeds in Greece and parts of Turkey and Cyprus. Deliberate killing, habitat loss and degradation, disturbance and potentially by-catch in fishing gear are the main threats. **Fin whale** – This species is observed throughout the Mediterranean Sea, mainly in the western Basin. True Mediterranean fin whales range from the Balearic Islands to the Ionian and southern Adriatic seas, while North East North Atlantic (NENA) whales seasonally enter through the Strait of Gibraltar (Fig. 1). The main anthropogenic threats include collisions with ships, disturbance, chemical and acoustical pollution.

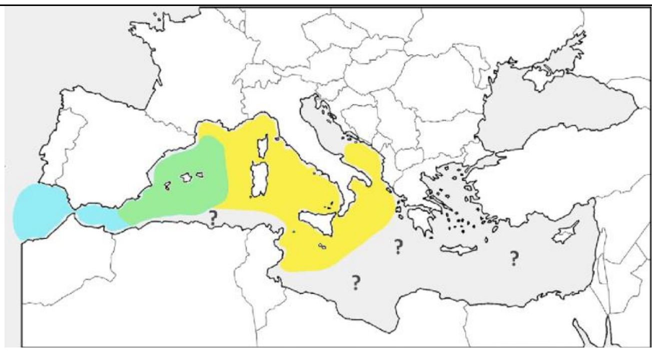

Fig. 1 - Presumed distribution of fin whale (Balaenoptera physalus) populations in the Mediterranean Sea. Blue: north-east North Atlantic population (NENA whales). Yellow: Mediterranean population (MED whales). In green the presumed overlap between the two populations (from: Notarbartolo di Sciara, G., Castellote, M., Druon , J.N., Panigada, S. 2016. Fin whales: at home in a changing Mediterranean Sea? Advances in Marine Biology Series, 75:75-101).

Sperm whale – Sperm whales prefer slope and deep waters all over the Basin, with localized hot spots in the Hellenic Trench, the Ligurian Sea, the Balearic area and the Gibraltar Strait. Human threats include ship strikes, occasional entanglement in driftnets, ingestion of plastic debris, anthropogenic noise and chemical contaminants.

Cuvier's beaked whale – This species is distributed throughout the Mediterranean Sea, mainly along the deep continental slope, in presence of underwater canyons. Cuvier's beaked whales are particularly vulnerable to military and industrial sonars, bycatch in fishing gears, ingestion of plastics.

Short-beaked common dolphin – Common dolphins significantly declined in the Mediterranean Sea over the last few decades and are now present in specific locations within the Alborán Sea, the Sardinian Sea, the Strait of Sicily, the eastern Ionian Sea, the Aegean Sea and the Levantine Sea. Prey depletion from overfishing and incidental mortality in fishing gear seem to be the main current threats for this species in the Mediterranean Sea.

Long-finned pilot whale – This species in present only in the western Basin only, mainly in offshore waters. Current threats include bycatch in driftnets, ship strikes, disturbance from military sonar and chemical pollution.

Risso's dolphin – Risso's dolphins are present – in relatively low numbers – throughout the Mediterranean Sea, with a preference for slope waters. Known distributional range includes the Alborán, Ligurian, Tyrrhenian, Adriatic, Ionian, Aegean and Levantine seas and the Strait of Sicily.

Killer whale – This species is seasonally present in the Strait of Gibraltar and adjacent Atlantic waters only and it is very rare in the rest of the Mediterranean Sea. Strong negative interactions with local artisanal bluefin tuna fisheries have been described.

Striped dolphin – The most common cetacean species in the Mediterranean Sea, mainly using offshore deep waters, from the Levantine Basin to the Strait of Gibraltar. Subject to a wide range Different threats affect the Mediterranean population, such as morbillivirus epizootics and high levels of chemical pollutants.

Rough-toothed dolphin – It is regular in the eastern Mediterranean only, particularly in the Levantine Sea, at very low densities and limited range. Subject to similar human impacts as other dolphins, including bycatch, acoustic and chemical pollution.

Common bottlenose dolphin – This is the most common species all over the Mediterranean Sea, mainly found on the continental shelf. Human threats include mortality in fishing gear, occasional direct killings, habitat loss or degradation including coastal development, overfishing of prey and high levels of contamination.

Harbour porpoise – This cetacean subspecies, typically found in the Black Sea, is occasionally observed in the northern Aegean Sea. Main threats in the Black Sea include severe levels of bycatch in fishing gears, mortality events and habitat degradation.

Conclusions		
Conclusions (brief)	Text (200 words)	Current knowledge about the presence, distribution, habitat use and preferences of Mediterranean marine mammals is limited and regionally biased, due to an unbalanced distribution of research effort during the last decades, mainly focused on specific areas of the Basin. Throughout the Mediterranean Sea, the areas with less information and data on presence, distribution and occurrence of marine mammals are the south-eastern portion of the basin, including the Levantine basin, and the North Africa coasts. In addition, the summer months are the most representative ones and very few information have been provided for the winter months, when conditions to conduct off-shore research campaigns are particularly hard due to meteorological adversity. Marine mammals presence and distribution is mainly related to suitable habitats and availability of food resources; anthropogenic pressures, as well as climate change, may cause changes and shifts in the occurrence of marine mammals, with potential detrimental effects at the population levels. Accordingly, in order to enhance conservation effort and inform management purposes, it is crucial to obtain detailed and robust descriptions of species' range, movements and extent of geographical distribution, together with detailed information on the location of breeding and feeding areas. Ongoing effort by ACCOBAMS is planning a synoptic region-wide survey, the so-called ACCOBAMS Survey Initiative, to assess presence and distribution and to estimate density and abundance of cetaceans in the summer of 2018. Concurrently, local scientists are working on the identification of Cetacean Critical Habitats (CCHs) and Important Marine Mammal Areas (IMMAs) in the entire Mediterranean Sea. A gap analysis is also been conducted within the Mediterranean Sea, to provide an inventory of available data and to select areas where more information should be collected.
Conclusions (extended)	Text (no limit)	
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	
List of references	Text (10 pt, Cambria style)	

3. EO1: Common Indicator 3. Species distributional range (EO1 related to marine turtles)

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO1. Biological diversity is maintained or enhanced. The quality and occurrence of_coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.**
IMAP Common Indicator	Write the exact text, number	**CI3.Species distributional range (EO1 related to marine turtles)**
Indicator Assessment Factsheet Code	Text	**EO1CI3**
Rationale/ Methods		
Background (short)	Text (250 words)	**Background and rationale** In biology, the range of a given species is the geographical area in which that occurs (i.e. the maximum extent). A commonly used visual representation of the total areal extent (i.e. the range) of a species is a range map (with dispersion being shown by variation in local population densities within that range). Species distribution is represented by the spatial arrangement of individuals of a given species within a geographical area. Therefore, the objective of this indicator is to determine the species range of sea turtles that are present in Mediterranean waters, especially the species selected by the Parties. Sea turtles are an ideal model species to assess the selected indicator, as their populations are dispersed throughout the entire Mediterranean, as discrete breeding, foraging, wintering and developmental habitats (Casale & Margaritoulis 2010), making the two sea turtle species a reliable indicator on the status of biodiversity across this region. Three sea turtle species are found in the Mediterranean (leatherback, *Dermochelys coriacea*; green, *Chelonia mydas*; and loggerhead, *Caretta caretta*), but only green and loggerhead turtles breed in the basin and have limited gene flow with those from the Atlantic, even though, turtles from the Atlantic do enter the western part of the basin (confirmed by genetic analyses: Encalada et al. 1998; Laurent et al. 1998). Green turtles are primarily herbivores, whereas loggerheads are primarily omnivores, resulting in their occupying important components of the food chain; thus, changes to the

		status in sea turtles, will be reflected at all levels of the food chain. However, the extent of knowledge on the occurrence, distribution, abundance and conservation status of Mediterranean marine species is uneven. In general, the Mediterranean states have lists of species, but knowledge about the locations used by these species is not always complete, with major gaps existing (Groombridge 1990; Margaritoulis et al. 2003; Casale & Margaritoulis 2010; Mazaris et al. 2014; Demography Working Group 2015). Even some of the most important programmes on this topic have significant gaps (e.g. Global databases do not reflect actual current knowledge in the Mediterranean region). It is therefore necessary to establish minimum information standards to reflect the known distribution of the two selected species. Species distribution ranges can be gauged at local (i.e. within a small area like a national park) or regional (i.e. across the entire Mediterranean basin) scales using a variety of approaches. Given the breadth of the Mediterranean, it is not feasible to obtain adequate information about the entire surface (plus, the marine environment is 3 dimensional, with sea turtles being present only briefly to breathe), so it is necessary to choose sampling methods that allow adequate knowledge of the distribution range of each species. Such sampling involves high effort for areas that have not been fully surveyed to date. Monitoring effort should be long term and should cover all seasons to ensure that the information obtained is as complete as possible. **Key pressures and drivers** Both nesting and foraging areas of marine turtles are vulnerable to anthropogenic pressures in the Mediterranean Sea, including an increase in the exploitation of resources (including fisheries), use and degradation of habitats (including coastal development), pollution and climate change (UNEP/MAP/BLUE PLAN, 2009; Mazaris et al. 2009, 2014; Witt et al. 2011; Katselidis et al. 2012, 2013, 2014). These issues might reduce the resilience of this group of species, negatively impacting the ability of populations to recover (e.g. Mazaris et al. 2009, 2014; Witt et al. 2011; Katselidis et al. 2012, 2013, 2014). The risk of extinction is particularly high in the Mediterranean because the breeding populations of both loggerhead and green turtles in this basin are demographically distinct to other global populations (Laurent et al., 1998; Encalada et al., 1998), and might not be replenished. The main threats to the survival of loggerhead and green turtles in the Mediterranean have been identified as incidental catch in fishing gear, collision with boats, and intentional killing (Casale & Margaritoulis 2010). Casale (2011) estimated that there are more than 132,000 incidental captures per year in the Mediterranean, of which more than 44,000 are predicted to be fatal, although very little is known about post-release mortality (Álvarez de Quevedo et al. 2013). Wallace et al. (2010, 2011) grouped all species of sea turtles globally into regional management units (RMUs), which are geographically distinct population segments, to determine the population status and threat level. These regional population units are used to assimilate biogeographical information (i.e. genetics, distribution, movement, demography) of sea turtle nesting sites, providing a spatial basis for assessing management challenges. A total of 58 RMUs were originally delineated for the seven sea turtle species. The Mediterranean contains 2 RMUs for loggerheads and 1 RMU for green turtles (Figure 1).

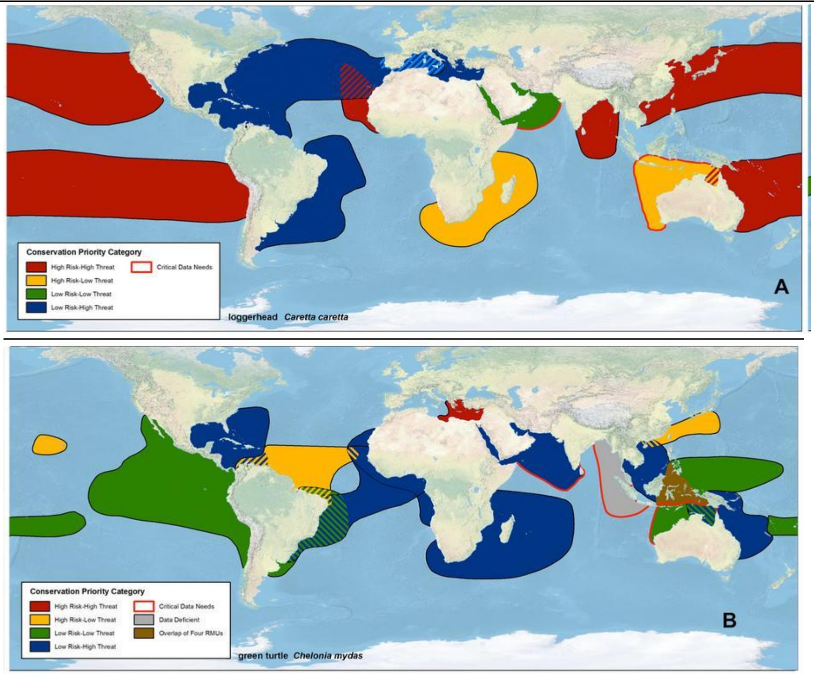

Figure 1Regional Management Units of sea turtle populations globally (extracted from Wallace et al. 2010, 2011). (A) Showing the 2 loggerhead RMUs in the Mediterranean and (B) showing the 1 green turtle RMU in the Mediterranean.

These analyses showed that the Mediterranean has the highest average threats score out of all ocean basins, particularly for marine turtle bycatch (Wallace et al. 2011). However, compared to all RMUs globally, the Mediterranean also has the lowest average risk score (Wallace et al. 2011).

Other key threats to sea turtles in the Mediterranean include the destruction of nesting habitat for tourism and agriculture, beach erosion and pollution, direct exploitation, nest predation and climate change (Casale & Margaritoulis 2010; Mazaris et al. 2014; Katselidis et al. 2012, 2013 2014). Coll et al. (2011) also identified critical areas of interaction between high biodiversity and threats for marine wildlife in the Mediterranean. Within this analysis, the authors delineated high risk areas to both species, with critical areas extending along most coasts, except the south to east coastline (from Tunisia to Turkey) (Figures 2-4).

Figure 2.Main biogeographic regions of the Mediterranean Sea (extracted from Coll et al. 2011)

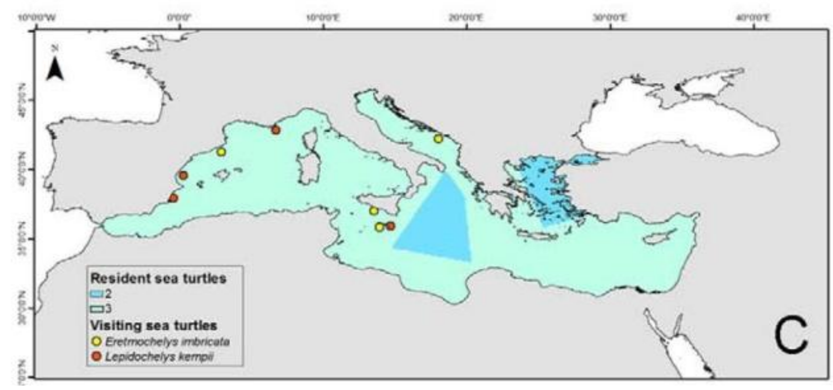

Figure 3. Modelled resident and sea turtle species richness (n = 3 species) in the Mediterranean (extracted from Coll et al. 2011)

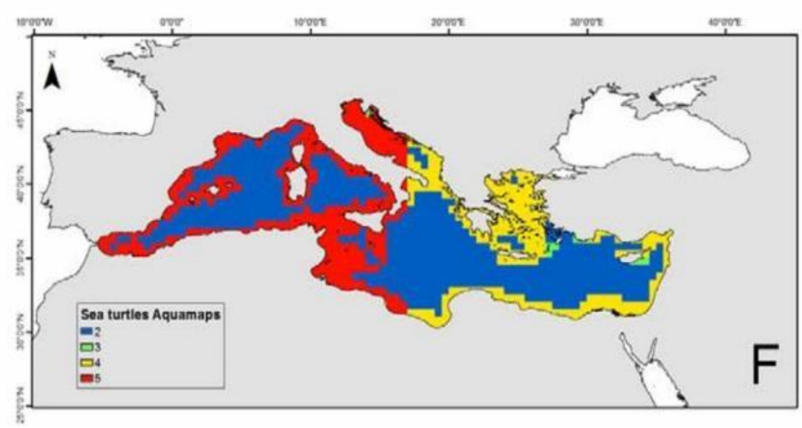

Figure 4. Aqua Map model of sea turtle distribution in the Mediterranean Sea (extracted from Coll et al. 2011). Note, this is primarily based on nesting beach data.

Policy Context and Targets

Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes Good Environment Status (GES) definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years.

The MSFD includes Descriptor 1: Biodiversity: "The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions." Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them.

The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned". Commission Decision 2010/477/EU sets out the MSFD's criteria and methodological standards and under Descriptor 1 includes criteria "1.1.Species distribution" and indicators "Distributional range (1.1.1)", "Distributional pattern within the latter, where appropriate (1.1.2)", and "Area covered by the species (for sessile/benthic

<table>
<tr><td></td><td></td><td>species) (1.1.3)”. At a country scale, Greece, Italy, and Spain have selected targets for marine turtles (Breeding areas are included as an MSFD target in Greece); Cyprus and Slovenia mention marine turtles in their Initial assessment, but do not set targets (Milieu Ltd Consortium. 2014) See UNEP/MAP 2016 for more details.</td></tr>
<tr><td>Assessment methods</td><td>Text (200-300 words), images, formulae, URLs</td><td></td></tr>
<tr><td>Background (extended)</td><td>Text (no limit), images, tables, references</td><td></td></tr>
<tr><td>Results</td><td></td><td></td></tr>
<tr><td>Results and Status, including trends (brief)</td><td>Text (500 words), images</td><td></td></tr>
<tr><td>Results and Status, including trends (extended)</td><td>Text(no limit), figures, tables</td><td>

Loggerhead sea turtles
Nesting sites
Over 100 sites around the Mediterranean have scattered to stable (i.e. every year) nesting (Halpin et al., 2009; Kot et al. 2013; SWOT, 2006a, 2006b, 2008, 2009, 2010, 2011, 2012). Most sites are located in the eastern and central basins of the Mediterranean (Figure 5).

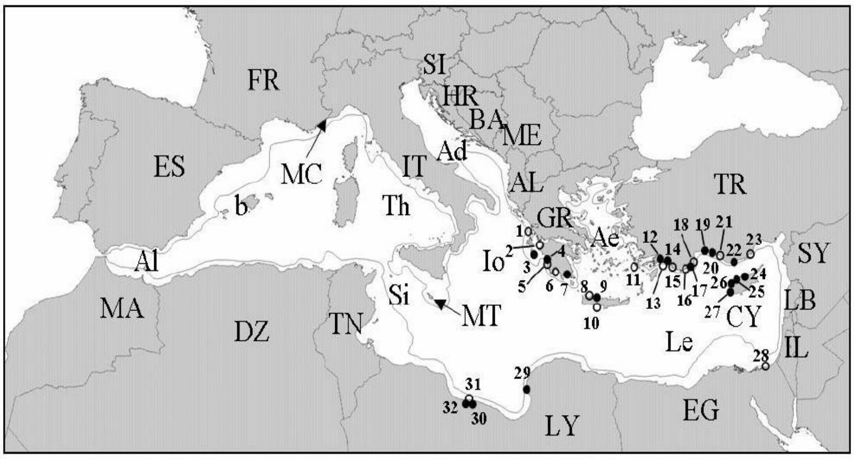

Figure 5. Map of the major loggerhead nesting sites in the Mediterranean (extracted from Casale & Margaritoulis)
Major nesting sites (>50 nests/year) of Loggerheads in the Mediterranean. 1 Lefkas; 2 Kotychi; 3 Zakynthos; 4 Kyparissia; 5 beaches adjacent to Kyparissia town; 6 Koroni; 7 Lakonikos Bay; 8 Bay of Chania; 9 Rethymno; 10 Bay of Messara; 11 Kos; 12 Dalyan; 13 Dalaman; 14 Fethiye; 15 Patara; 16 Kale; 17 Finike-Kumluca; 18 Cirali; 19 Belek; 20 Kizilot 21 Demirtas; 22 Anamur; 23 Gosku Delta; 24 Alagadi; 25 Morphou Bay; 26 Chrysochou; 27 Lara/Toxeftra; 28 Areash; 20 Al-Mteafla; 30 Al-Ghbeba; 31 Al-thalateen; 32 Al-Arbaeen. Closed circles >100 nests/year; open circles 50-100 nests/year. Country codes: AL Albania; DZ Algeria; BA Bosnia and Hersegovina; HR Croatia; CY Cyprus; EG Egypt; FR France; GR Greece; IL Israel; IT Italy; LB Lebanon; LY Libya; MT Malta; MC Monaco; ME Montenegro; MA Morocco; SI Slovenia; ES Spain; SY Syria; TN Tunisia; TR Turkey; Ad Adriatic; Ae Aegean; Al Alboran Sea; Io Ionian; Le Levantine basin; Si Sicily Strait; Th Thyrrenian; b Balearic.
Sporadic to regular nesting has been recorded in Cyprus, Egypt, Greece, Israel, Italy, Lebanon, Libya, Malta, Syria, Tunisia and Turkey (Margaritoulis et al. 2003; Casale & Margaritoulis 2010). Surveys have been conducted for tracks in Algeria (last surveyed 1980s), Croatia (last surveyed 1990s), France (last</td></tr>
</table>

surveyed 1990s), Morocco (last surveyed 1980s), Spain (last surveyed 1990s) (Margaritoulis et al. 2003; Casale & Margaritoulis 2010). Information on nesting has not been gathered for Albania, Montenegro, Monaco, Slovenia or Bosnia (Margaritoulis et al. 2003; Casale & Margaritoulis 2010). A recent IUCN analysissuggests that, when all Loggerhead nesting sites in the Mediterranean are considered together, the geographic distribution of loggerheads in the Mediterranean is broad, and is considered of Least Concern though conservation dependent, under current IUCN Red List criteria (Casale 2015).

Most nests are laid in Greece, Turkey, Cyprus and Libya (Margaritoulis 2003; Casale & Margaritoulis 2010; Almpanidou et al. 2016). An average of 7200 nests are made per year across all sites (Casale & Margaritoulis 2010), which are estimated to represent 2,280–2,787 females based on clutch frequency assumptions (Broderick et al. 2002). Greece and Turkey alone have more than 75% of the nesting in the Mediterranean; however, the smaller populations at other sites such as Libya and Cyprus are also of regional significance being at the edges of the species range (Demography Working Group, 2015). Of note, the beaches of the countries of North Africa have not been extensively surveyed, particularly Libya, so gaps on the numbers and distribution of nests still remain. Genetic analyses suggest low gene flow among groups of rookeries; thus, it is essential to preserve distinct genetic units (Carreras et al. 2006).

The number of nests held at different sites is not just dependent on climate, but other factors, like predation, sand type/structure etc. (Almpanidou et al. 2016). Thus, a recent study of all Mediterranean nesting sites showed that the climatic suitability of current stable sites will remain suitable in the future (Almpanidou et al. 2016). However, other factors may lead to the loss of these sites, such as sea level rise (e.g. Katselidis 2014). Furthermore, Almpanidou et al. (2016) showed that sites with sporadic nesting might be increasingly used, i.e. such sites might not be past sites that are infrequently used, but may reflect the exploratory nature of turtles to locate new alternative sites (Schofield et al. 2010a). Thus, it is worth ensuring that all current stable nesting sites are fully protected (with their use into the future being likely); however, it is also important to follow how the use of sporadic nesting sites changes over time, to detect new sites of importance in need of protection (Katselidis 2014; Almpanidou et al. 2016).

Foraging (adult and developmental) and wintering sites

Most research has been conducted on nesting beaches; consequently, detailed information about marine habitat use at developmental, foraging and wintering grounds is still missing (Figure 8).

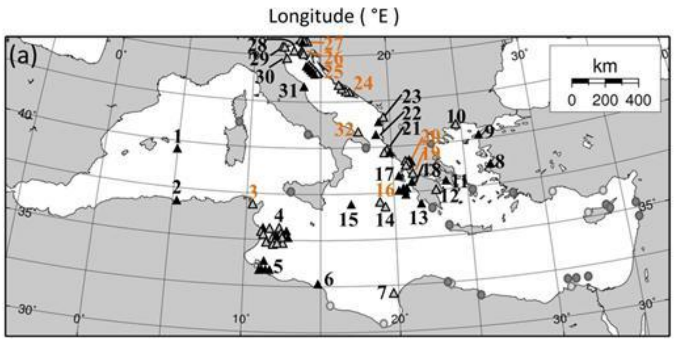

Figure 8. Foraging sites identified across the Mediterranean based on published papers (extracted from Schofield et al. 2013)

Discrete foraging sites frequented by male (black triangles) and female (grey triangles) loggerheads from Zakynthos (with some turtles frequenting more than one site). The foraging sites are indicated and numbered by open circles; orange circles = foraging sites overlapping or in close proximity to existing marine protected areas and/or national parks. Discrete foraging sites are arbitrary, and defined as a single site or group of overlapping sites that are separated from adjacent sites by a minimum distance of 36 km, which reflects the mean migration speed of loggerhead turtles (1.5 km h^{-1}; Schofield *et al.*, 2010) over a 24 h period. In addition, other known loggerhead (filled dark grey circles) and green turtle (filled light grey circles) foraging sites based on published datasets (Bentivegna, 2002; Margaritoulis *et al.*, 2003; Broderick *et al.*, 2007; Hochscheid *et al.*, 2007; Casale *et al.*, 2008). Note: solely juvenile foraging sites of the West Mediterranean have not been included here. The table below lists the different foraging sites, including the species, size class and genetic populations detected at these sites in various papers.

The way in which adult and newly hatched turtles disperse from breeding sites has been explored using a range of techniques in the Mediterranean, including genetics, stable isotope, satellite tracking, particle tracking and stable isotopes (e.g. Zbinden et al 2008, 2011; UNEP(DEPI)/MED. 2011; Schofield et al. 2013; Patel 2013; Luschi & Casale 2014; Casale & Patrizio 2014; Hays et al. 2014; Snape et al. 2016). These studies indicate that loggerheads probably forage throughout all oceanic and neritic marine areas of the west and east basins of the Mediterranean (Hays et al. 2014; Casale & Marianni 2014). Most satellite tracking studies have been conducted in Spain (of juvenile turtles), Italy (a mix of juvenile and adult turtles) and Greece (adult males and females) and Cyprus (adult females) (UNEP(DEPI)/MED. 2011; Casale & Patrizio 2014). Due to these biases, the results of tracking studies alone should be treated with caution.

Through combining studies using various techniques, loggerheads do not appea to be uniformly distributed (Clusa et al. 2014), with foraging in different sub basins affecting remigration rates, body size and fecundity (Zbinden et al. 2011; Cardona et al. 2014; Hays et al 2014). While most turtles that breed in the eastern basin tend to forage in the eastern and central areas, increasing numbers of satellite studies are showing that some individuals do disperse to and use the western basin too (Bentivegna 2002; Schofield et al. 2013; Patel 2013). The west Mediterranean primarily supports individuals from the Atlantic (Laurent et al. 1998; Carreras et al. 2006; Casale et al. 2008). Tracking studies of juvenile loggerheads in the western Mediterrnaean show that they are widely distributed throughout the entire region (UNEP(DEPI)/MED. 2011). As information on the distribution is not available on juvenile loggerheads in the central and east Mediterranean, it is likely that similarly ubiquitous distribution exists, but needs confirming (UNEP(DEPI)/MED. 2011).

The two most important neritic loggerhead foraging grounds for adults and juveniles appear to be the Adriatic Sea and the Tunisian Continental Shelf (including Gulf of Gabés) (Zbinden et al. 2010; Casale et al. 2012; Schofield et al. 2013; Snape et al. 2016). Important oceanic areas include the Alboran Sea, the Balearic Sea and different parts of the North African coasts, as well as the Sicily Channel. Large numbers of juvenile loggerheads have been documented in the south Adriatic too (Casale et al. 2010; Snape et al. 2016). Aerial and fishery bycatch data indicate that the highest density of turtles occur in the western basin Alboran Sea and Balearic islands, the Sicily Strait, the Ionian Sea, the north Adriatic, off Tunisia, Libya, Egypt and parts of the Aegean (Gómez de Segura et al. 2003, 2006; Cardona et al. 2005; Lauriano et al. 2011; Casale & Margaritoulis 2010). In Egypt, Bardawil Lake has been identified as an important foraging area for adult and juvenile loggerheads based on stranding records and tracking studies of turtles from Cyprus (Nada et al. 2013, Snape et al. 2016).

However, establishing the distribution of, even coastal, foraging sites has yet to be achieved. Certain sites, where high numbers of turtles of all size classes from different populations aggregate in confined areas, have been identified, such as Amvrakikos Bay, Greece (Rees & Margaritoulis 2008) and Drini Bay, Albania (White et al 2011). However, tracking studies also show that the foraging areas of individual turtles may extend from <10 km2 up to 1000 km2 in the open waters of the Adriatic and Gulf of Gabés (Schofield et al. 2013). Furthermore, knowledge of how foraging habitat differs between adult males and females, as well as how these sites overlap with juvenile developmental habitat remains limited across the various populations (Snape et al. in submission). Particle tracking has suggested that, within the Mediterranean, adults exhibit high fidelity to sites where they established use as juveniles (Hays et al. 2014).

Furthermore, various studies have shown that, while turtles exhibit high fidelity to certain sites (Schofield et al. 2010b), both juvenile and adult loggerheads use more than one foraging site (sometimes up to 5), spanning both neritic and oceanic sites, particularly in the Ionian and Adriatic (Casale et al. 2007, 2012; Schofield et al. 2013). Adults that forage in the Adriatic, tend to use sites seasonally, shifting to alternative sites in winter (Zbinden et al. 2011: Schofield et al. 2013), although some hibernate (Hoscheid et al. 2007). However, juveniles have also been documented shifting into the Adriatic in winter, suggesting that some sites may be used year-round by different components of loggerhead populations (Snape et al. in submission). The use of multiple sites and seasonal shifts in site use need to be documented to understand how different foraging, developmental and wintering sites are connected. In this way, groups of areas should be protected where connections are known to exist.

Green turtles

Nesting sites

Most green turtle nests (99%) are laid in Turkey, Cyprus and Syria, with the remainder being found in Lebanon, Israel and Egypt (Figure 6; Kasparek et al. 2001; Casale & Margaritoulis 2010). An average of 1500 nests are documented each year (range 350 to 1750 nests), from which an annual nesting population of around 339–360 females has been estimated (Broderick et al. 2002), ranging from 115 to 580 females (Kasparek et al. 2001). The five key nesting beaches include: Akyatan, Samadağ, Kazanli (Turkey), Latakia (Syria) and Alagadi (northern Cyprus), with Ronnas Bay also being a priority area (Stokes et al. 2015). This allows the conservation effort of the nesting beaches for this species to be highly focused.

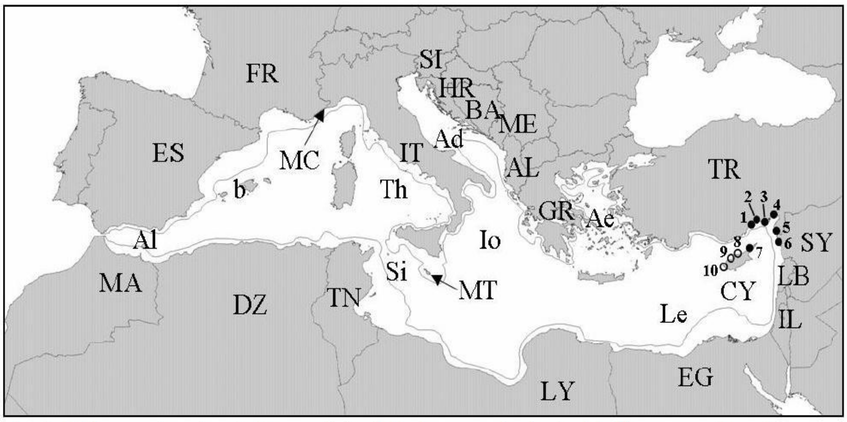

Figure 6. Map of the major green turtle nesting sites in the Mediterranean (extracted from Casale & Margaritoulis)

Major nesting sites (>40 nests/year) of green turtles in the Mediterranean. 1 Alata; 2 Kazanli; 3 Akyatan; 4 Sugozu; 5 Samandag; 6 Latakia; 7 North Karpaz; 8 Alagadi; 9 Morphou Bay; 10 Lara/Toxeftra. Closed circles >100 nests/year; open circles 40-100 nests/year. Country symbols, see previous map.

Foraging (adult and developmental) and wintering sites

As with loggerheads, most information about green turtles is restricted to the nesting habitats, rather than developmental, foraging, and wintering habitats. Green turtles have been primarily documented foraging and wintering along the Levantine basin (Figure 8 and Table 1; Turkey, Syria, Cyprus, Lebanon, Israel, Egypt) (Broderick et al. 2007; Stokes et al. 2015). However, foraging areas have also been documented in Greece (particularly, Lakonikos Bay and Amvrakikos Bay; Margaritoulis & Teneketzis 2003) and along the north coast of Africa, primarily Libya and some sites in Tunisia (see Figure 8 and Table for published sources). Some turtles have been documented in the Adriatic Sea (Lazar et al. 2004) and around Italian waters (Bentivegna et al. 2011), with some records occurring in the western basin (see Figure 8 and Table for published sources). In addition, Broderick et al (2007) detected wintering behaviour for greens off of Libya, with high fidelity to the same sites across years; however, further documentation has not been recorded for the other populations or other areas of the Mediterranean. These wintering sites were detected based on a shift in location to deeper water from early November to March/April and reduced area use compared to summer months, which were assumed to be indicative of reduced activity during the colder months. Lakonikos Bay in Greece and Chrysochou Bay in southern Cyprus represent well documented foraging grounds of juvenile green turtles based on strandings and bycatch databases. Within Egypt, Bardawill Lake has been identified as an important foraging area for adult and juvenile green turtles based on stranding records and tracking studies of turtles from Cyprus (Nada et al. 2013). In Turkey, green turtles have been documented stranded in the Gulf of Iskenderun, and might represent foraging habitat, while juvenile green turtles have been confirmed inhabiting the coast along the Cukurova, with Samandag and Fethiye Bay also representing possible juvenile foraging grounds (see Casale & Margaritoulis 2010 for overview). Overall, the way in which the foraging grounds are distributed and the numbers and size classes that they support, or how frequently green turtles move among sites (i.e. connectivity), remains limited.

Table 1 (extracted from Schofield et al. 2013a).

Published literature used to identify overlap in foraging sites (A) based on tracking datasets and (B) based on genetic data. Foraging category, NO = neritic open sea; NC = neritic coastal. Thermal state, Avail = availability; Use = recorded use; Y-R = year round; S (Wi) = Seasonal (Winter); S (Su) = Seasonal (Summer); Unconf. = unconfirmed. Species, Log = loggerhead; Gre = Green; Gender/Ageclass, M = adult male; F = adult female; Juv = juveniles, with gender not differentiated. Breeding populations, ? = unconfirmed; Zak = Zakynthos, Greece; Kyp = Kyparissia, Greece; Cyp = Cyprus; Syr = Syria; T = Turkey; Lib = Libya; Tunis = Tunisia; Mess = Messina; Cal = Calabria; Is = Israel; It = Italy. Sources: 1 = current study; 2 = Casale *et al.*, (2007, 2010); 3 = Zbinden *et al.*, (2008, 2011); 4 = Margaritoulis *et al.*, (2003); 5 = Bentivegna (2002); 6 = Broderick *et al.*, (2007); 7 = Hochscheid *et al.*, (2007); 8 = Echwikhi *et al.*, (2010); 9 = Chaeib *et al.*, (in press); 10 = Houghton *et al.*, (2000); 11 = Rees *et al.* (2008), Rees & Margaritoulis (2008); 12 = Lazar *et al.*, (2004a,b); 13 = Vallini *et al.*, (2006); 14 = Carreras *et al.*, (2006); 15 = Casale *et al.*, (in press); 16 = Casale *et al.*, 2012 ; 17 = Saied *et al.*, 2012.

Foraging site	Basin	Sea/ gulf	Country	Foraging category	Thermal Avail.	Protection available	Species	Gender /Age class Loggerhead	Gender /Age class Green	Breeding (Log only) No.	Breeding (Log only) Populations	Sources
1	West	Balearic	Majorca	O	S (Su)	No	Log	M / Juv		1	Zak	1,2
2	West	Algerian coast	Algeria	NC	Y-R	No	Log	M		1	Zak	1
3	West	Gulf of Tunis	Tunisia	NC	Y-R	**Yes**	Log	F		1	Zak	1,3
4	Central	Gulf of Gabes	Tunisia	NC/NO	Y-R	No	Log	M /F / Juv		~10	Zak; Kyp; Cyp; Turk; Mess Tunis; Lib; ?Cal; ?Is; ?It	1, 2, 3, 4, 5, 6 7,8,9,15,16
5	Central	Gulf of Gabes	Tunisia	NC/NO	Y-R	No	Log	M /F / Juv		~6	Zak; Kyp; Cyp; Turk; Tunis Tunis; Lib	1,2,3,5, 6 7,8,17
6	Central	Gulf of Sindra	Libya	NC	Y-R	No	Log	F		2	Zak; Cyp	1, 4, 6
7	Central	Gulf of Sindra	Libya	NC	Y-R	No	Log	M /F		1	Zak	
8	East	Gulf of Izmir	Turkey	NC	S (Su)	**Yes**	Log	M		2	Zak; ?Kyp	1, 4
9	East	Straits of Dardanelles	Turkey	NC	S (Su)	No	Log	M		1	Zak	
10	East	Aegean	Greece	NC	S (Su)	No	Log	F		2	Zak; ?Kyp	1, 4
11	East	Aegean	Greece	NC	Y-R	No	Log	M		1	Zak	
12	East	Aegean	Greece	NC	Y-R	No	Log	F		2	Zak; ?Kyp	1, 4
13	Central	Ionian	Greece	NC	Y-R	No	Log	M		1	Zak	
14	Central	Ionian	Greece	NC	Y-R	No	Log	F		1	Zak	1,3
15	Central	Ionian	Greece	O	Y-R	No	Log	M		1	Zak	
16	Central	Ionian	Greece	O	Y-R	**Yes**	Log	M		1	Zak	
17	Central	Ionian	Greece	NC	Y-R	No	Log	M		~3	Zak; Kef; Unkown	1,5,10
18	Central	Ionian	Greece	NC	Y-R	No	Log	M / F		2	Zak; ?Kyp	1, 4
19	Central	Ionian	Greece	NC	Y-R	**Yes**	Log	F		1	Zak	
20	Central	Amvrakikos	Greece	NC	Y-R	**Yes**	Log / Gre	M /F /Juv	Juv	~3	Zak;? Kyp; Syr, Unknown	1, 3, 4, 5,1 1
21	Central	Adriatic	Greece	NC	Y-R	No	Log	M / F /Juv		1	Zak	1,2
22	Central	Adriatic	Albania	O	Y-R	No	Log	M / Juv		1	Zak	1,2
23	Central	Adriatic	Albania	NC	Y-R	No	Log	M / F / Juv		~2	Zak; Unknown	1,2,7
24	Central	Adriatic	Croatia	NC/NO	Y-R	**Yes**	Log / ?Gre	F / Juv	Juv	2	Zak; Kyp	1,2,3,4,12
25	Central	Adriatic	Croatia	NO	S (Su)	**Yes**	Log	M / F / Juv		2	Zak; Kyp	1,2,3,4,14
26	Central	Adriatic	Croatia	NC	S (Su)	**Yes**	Log	F / Juv		3	Zak; Kyp; Lak, Cyp; Turk	1,2,3,4 ,12,14
27	Central	Adriatic	Slovenia	NO	S (Su)	**Yes**	Log	M / F / Juv		1	Zak	1,2,3, 14
28	Central	Adriatic	Italy	NO	S (Su)	No	Log	F / Juv		1	Zak	1,2,3,4
29	Central	Adriatic	Italy	NC	S (Su)	No	Log / ? Gre	F / Juv	Juv	1	Zak	1,2,3,12,13
30	Central	Adriatic	Italy	NC	S (Su)	No	Log / ?Gre	F / Juv	Juv	1	Zak	1,2,3,12
31	Central	Adriatic	Italy	NC	S (Su)	No	Log / ?Gre	F / Juv	Juv	1	Zak	1,2,12
32	Central	Adriatic	Italy	NC	Y-R	**Yes**	Log / ?Gre	F / Juv	Juv	1	Zak	1,2,3,12

Conclusions		
Conclusions (brief)	Text (200 words)	
Conclusions (extended)	Text (no limit)	Due to the importance of both breeding and foraging grounds, parallel mitigation strategies are required to build the resilience of existing populations; such as regulating coastal development at nesting areas and fishery bycatch at

foraging areas. However, foraging grounds tend to be broadly dispersed over a range of 0 to 2000 km from the breeding areas, complicating the identification of key foraging grounds for protection. As a starting point, it is essential to assimilate all research material on sea turtles (e.g. satellite tracking, stable isotope, genetic, strandings aerial surveys) to make a comprehensive overview of the distribution of different species, populations and size classes (Figure 7, represents a starting point).

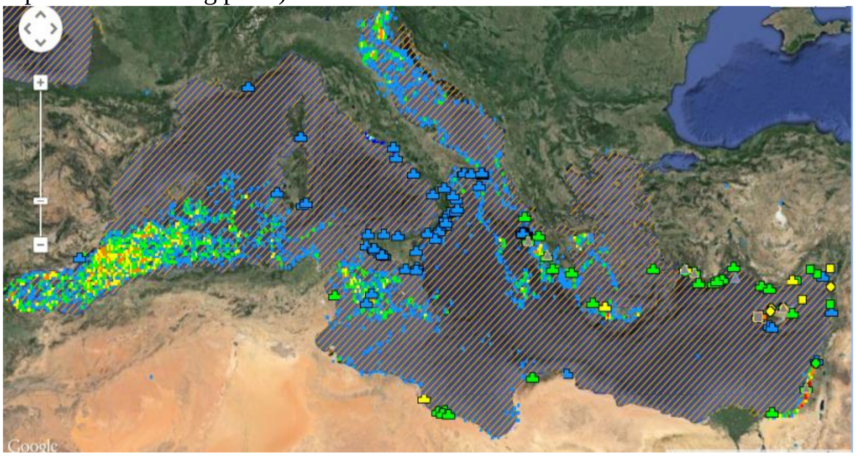

Figure 7. Image from OBIS-SEAMAP: State of the World's Sea Turtle (SWOT). The image presents an example for sea turtles, showing satellite tracking data (dots), nesting sites and genetic sampling sites (shapes) that have been voluntarily submitted to the platform by data holders. Many datasets are missing, including several known nesting sites and a considerable amount of satellite tracking from the eastern, central and western Mediterranean (over 195 routes have been published, and many remain unpublished; Luschi & Casale 2014, Italian Journal of Zoology 81(4): 478-495). The distribution range (lines) of the three sea turtles species present in the Mediterranean encompasses the entire basin. Big gaps exist; yet, this is the only information currently available in the form of an online database and mapping application.

Nesting sites

In general, knowledge about currently used nesting sites of both loggerhead and green turtles in the Mediterranean is good. However, all potential nesting beaches need to be surveyed throughout the Mediterranean to fill gaps in current knowledge (e.g. nesting in north Africa, particularly Libya). This could be done via traditional survey methods, but also by aerial surveys (plane or drone) at the peak period of nesting (July), or even by high resolution satellite imagery, which is becoming commercially available.

Existing stable nesting beaches should be afforded full protection, in parallel to collecting key information on why turtles use them, including geographic location, beach structure, sand composition, sand temperature ranges, coastal sea temperatures etc. In parallel, sporadically used beaches should be monitored at regular intervals (i.e. every 5 years or so), to identify changes in use over time, and pinpoint sites where use changes from sporadic to stable. Again, all these sites should be assessed with respect to geographic location, beach structure, sand composition, sand temperature ranges, coastal sea temperatures etc. on the ground, which will help with identifying future viable beaches for nesting. Ideally, all sandy beaches, whether used or not should be subject to the same analyses, to identify any beaches that might be used in the future by turtles, due to range shifts under climate change, which will alter sand temperatures on beaches and in the water, as well as causing sea level rise, which will alter the viability of current beaches, forcing turtles to shift to alternative sites. In this way, future beaches of importance can be detected and protected from certain human activities.

Foraging (adult and developmental) and wintering sites

It is necessary to determine how to focus protection effort of foraging (adult and developmental) habitats, i.e.

		Protect easy-to-define areas where high numbers of turtles aggregate from different populations and size classes Protect protracted areas of coastline where 10-20 individuals may aggregate at intervals from different populations and size classes, but amounting to representative numbers over a large expanse. The former is easier to design and protect, but the latter may be more representative of sea turtle habitat use in the Mediterranean. The latter is more at risk of loss too, as management studies for the development of e.g. marinas and hotels would assume that the presence of just 10-20 turtles was insignificant; however, if this action was repeated independently across multiple sites, one or more turtle populations could become impacted. Thus, it is essential to determine how developmental, foraging and wintering grounds are distributed throughout the Mediterranean, as well as the numbers of turtles of different size classes and from different populations that frequent these sites, including the seasonality of use and connectivity across sites. Only with this information can we make informed decisions about which sites/coastal tracts to protect that incorporate the greatest size class and genetic diversity. Thus, aerial (plane or drone) surveys are recommended to delineate areas used by sea turtles in marine coastal areas, along with seasonal changes in use, by monitoring these sites at 2-4 month intervals. Following this initial assessment, representative sites should be selected and sampled on the ground (i.e. boat based surveys) to delineate species, size classes and collect genetic samples to determine the extent of population mixing. Where possible, stable isotope and tracking studies should be conducted (including PIT tagging) to establish the connectivity among sites.
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	• Location of all breeding/nesting sites • Location of all wintering, feeding, developmental sites of adult males, females, juveniles • Connectivity among the various sites in the Mediterranean • Vulnerability/resilience of these sites in relation to physical pressures • Analysis of pressure/impact relationships for these sites and definition of qualitative GES • Identification of extent (area) baselines for each site and the habitats they encompass • Appropriate assessment scales • Monitor and assess the impacts of climate change • Assimilation of all research material on sea turtles (e.g. satellite tracking, stable isotope, genetic, strandings aerial surveys) in a single database
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4. EO1: Common Indicator 3. Species distributional range (related to marine seabirds)

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO1. Biological diversity is maintained or enhanced. The quality and occurrence of_coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.**
IMAP Common Indicator	Write the exact text, number	**CI3. Species distributional range (related to marine seabirds)**
Indicator Assessment Factsheet Code	Text	**EO1CI3**
Rationale/Methods		
Background (short)	Text (250 words)	**Background and rationale for the indicator, key pressures and drivers** Understanding the distribution range of a species is the first step to assess its status and potential changes over time. It is also the simplest indicator, but that does not mean that reliable information is available for the whole region. Overall, Mediterranean seabirds have reduced their distribution range across historical times, although there are few reliable sources of data to make a proper assessment of trends. The following factors are considered the main responsible for the changes in distribution range: - The introduction of terrestrial predators in islands has likely shaped the current distribution of many seabirds, particularly the shearwaters and the storm-petrel, restricting them to inaccessible areas of the main islands and to remote islets. Even so, in many cases these seabirds coexist with terrestrial predators (Ruffino et al. 2009), often resulting in population declining trends. - Human development has led to the degradation and destruction of coastal habitats across the Mediterranean basin. Birds breeding in wetlands have been likely the most affected, due to the systematic drying of these habitats. Likewise, birds breeding in beaches and dunes have also experienced a severe decline of available habitat in good condition and free of disturbances, particularly with the boom of tourism in

		the last century. The latter are more acute in the northern side of the region, but the whole basin is affected. - Human persecution and harvesting. This is a threat that has been largely reduced in the last century, particularly in the north, but might have been a major source of change in past centuries, and can be still a threat in some areas. Other relevant pressures to consider are overfishing and climate change, but these might have a major influence on the distribution patterns of seabirds at sea, while their role at shaping breeding distributions is not clear within the Mediterranean region. Species with limited foraging ranges, such as the Mediterranean shag and the terns are the most prone to suffer from these alterations, as they cannot buffer the effects of local alterations of their (breeding) foraging grounds by switching to other (more distant) areas. On this regard, terns (and Audouin's gull) are adapted to cope with fluctuations on prey availability by changing their breeding location between years, if necessary. Even if there are no proven changes in seabirds breeding distribution ranges due to food depletion and/or climate change (or, more widely, environmental change), they are likely to occur in the near future if the levels of fish overexploitation and environment degradation are maintained through time. Nevertheless, lacks of accurate data make it difficult to assess this type of changes, and it is necessary to set in place adequate monitoring programmes across the basin to make possible a proper assessment in the future. **Policy Context and Targets** Processes driving changes in distribution range can work both at local and regional level. For a local level approach, the protection of breeding sites is a first step to ensure the maintenance of the breeding range of seabirds. However, it is important to complement these efforts on land with the protection of the corresponding key habitats at sea. On this regard, the Mediterranean is in the process of building a representative and coherent network of Marine Protected Areas (e.g. Gabrié *et al.* 2012), that under proper management strategies will surely benefit the maintenance of the remaining seabird breeding populations, plus other visiting species. Moreover, promoting the protection of former/potential breeding sites, or even their restoration, could help recovering part of the lost distribution range for some species, through re-colonisation processes. However, local measures might not suffice to fight pressures at sub-regional, regional or global level. Ensuring a healthy marine ecosystem requires sectorial policies adopting an ecosystem-based approach. Fisheries deserve particular attention, given the level of overexploitation of Mediterranean fish stocks. Current commitments by the General Fisheries Commission for the Mediterranean are a promising perspective, as well as the efforts of the EU Common Fisheries Policy in the European countries, but there is a long way ahead. Other issues to address are pollution (UNEP/MAP 2015), river discharges (to ensure marine productivity), and climate/environmental change, which require an even wider approach (UNEP/MAP 2016).
Background (extended)	Text (no limit), images, tables, references	
Assessment methods	Text (200-300 words), images, formulae, URLs	
Results		NOTE: If the assessment has been performed at different geographical scales, include the results and conclusions accordingly.
Results and Status,	Text (500 words),	A summary of the presence/absence of the species selected for monitoring is shown in Table 1, per sub-region and country. As with other biodiversity

including trends (brief)	images	components, seabirds show a higher diversity to the west and north of the Mediterranean basin (cf. Coll et al. 2008). This general pattern is in agreement with the marine productivity patterns in the region, but might also be related to other factors, such as better knowledge/monitoring programmes in the north and west. Species that breed in open nests, such as gulls and terns, seem to be more widely distributed, particularly the little tern. On the other hand, burrowing/crevice breeding species such as the shearwaters tend to concentrate in the north and west. These species might find more suitable habitat in these areas, but also the difficulty of finding their nests and their secretive behaviour near the colonies might have left them overlooked in some low-prospected areas. **Table:** Presence of the different seabird species selected for monitoring per sub-region and country. Orange represents breeding, and blue non-breeding (mainly winter, but this can also reflect the presence of birds during the breeding season and/or migration in countries where they do not breed). Dark colour is for regular and well established species, while light colour is for scarce species. Question marks are introduced when the information deserves further corroboration or refinement.

Sub-regions		P. mauretanicus		P. yelkouan		Ph. aristotelis d.		L. audouinii		S. sandvicensis		S. albifrons		S. nilotica	
	Countries	Br.	Non-br.	Br.	Non-br.	Br.	Non-br.	Br.	Non-br.	Br.	Non-br.	Br.	Non-br.	Br.	Non-br.
Western Mediterranean	Algeria			(?)				(?)				(?)			
	France								(?)						
	Monaco					?					(?)		(?)		
	Morocco														
	Spain														
Central Mediterranean & Ionian	Libya				(?)						(?)		(?)		
	Malta										(?)		(?)		
	Tunisia		?				(?)				(?)		(?)		
	Italy										(?)				
	Greece			(?)					(?)				(?)		
Adriatic Sea	Albania			(?)	(?)		(?)		(?)		(?)				
	Bosnia-Herzegovina				(?)	?	(?)		(?)		(?)		(?)		
	Croatia				(?)				(?)		(?)				
	Italy														
	Montenegro			?	(?)	?	(?)		(?)		(?)		(?)		
	Slovenia					?			(?)						
Eastern Mediterranean	Cyprus				(?)		(?)	(?)			(?)		(?)		
	Egypt				(?)	?	?		(?)		(?)		(?)		(?)
	Greece								(?)				(?)		
	Israel				(?)	?					(?)	(?)	(?)		
	Lebanon					?		(?)			(?)	(?)	(?)		
	Palestinian territories				(?)						(?)	(?)	(?)		
	Syria				(?)		(?)		(?)		(?)				
	Turkey					(?)	(?)	(?)	(?)		(?)		(?)		

Results and Status, including trends (extended)	Text(no limit), figures, tables	
Conclusions		
Conclusions (brief)	Text (200 words)	As insinuated above, the southeast to northwest increasing diversity gradient might be partly influenced by prospection/monitoring effort. For many eastern and southern countries, as well as some Adriatic countries, the information on seabird breeding populations or occurrence at sea is patchy or completely lacking. This might be partly because the birds are actually rare or absent there, but could also be related with lack of data. Particularly little information is available for Algeria, Egypt, Israel, Lebanon, Syria, Cyprus and Turkey, as well as Montenegro, and Albania. There is no information from Bosnia-Herzegovina, but this country has extremely limited coastal area, and most likely has no relevant seabird breeding populations. Information from Libya is also patchy, and focuses on terns. The lack of information is not limited to the above countries, however. Most of the remaining countries have some important gaps, particularly at assessing population sizes, but also at properly inventorying all breeding colonies present in their territories, particularly in the case of the the shearwaters. For instance, a colony of over 1,500 Yelkouan shearwaters was recently found in Greece, near Athens, although this area is reasonably well prospected. Likewise, the breeding of the storm-petrel in the Aegean Sea was not confirmed until a few years ago.
Conclusions (extended)	Text (no limit)	
Key messages	Text (2-3	

	sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	
List of references	Text (10 pt, Cambria style)	Abelló, P., Arcos, J. M., & Gil De Sola, L. 2003. Geographical patterns of seabird attendance to a research trawler along the Iberian Mediterranean coast. *Scientia Marina* 67: 69–75. Albores-Barajas, Y. V., Riccato, F., Fiorin, R., Massa, B., Torricelli, P., & Soldatini, C. 2011. Diet and diving behaviour of European Storm Petrels *Hydrobates pelagicus* in the Mediterranean (ssp. *melitensis*). *Bird Study* 58(2), 208–212. Arcos, J.M. (compiler) 2011. International species action plan for the Balearic shearwater, Puffinus mauretanicus. SEO/Bird-life & Bird-life International. http://ec.europa.eu/environment/nature/conservation/wildbirds/action_plans/docs/puffinus_puffinus_mauretanicus.pdf Arcos, J. M., & Oro, D. 2002. Significance of fisheries discards for a threatened Mediterranean seabird, the Balearic shearwater *Puffinus mauretanicus*. *Marine Ecology Progress Series* 239: 209–220. Arcos JM, Oro D, Sol D 2001. Competition between the yellow-legged gull Larus cachinnans and Audouin's gull Larus audouinii associated with commercial fishing vessels: the influence of season and fishing fleet. *Marine Biology* 139:807-816. Arcos, J. M., Louzao, M., & Oro, D. 2008. Fisheries ecosystem impacts and management in the Mediterranean: seabirds point of view. In J. Nielsen, J. Dodson, K. Friedland, T. Hamon, N. Hughes, J. Musick, & E. Verspoor (Eds.), Proceedings of the Fourth World Fisheries Congress: Reconciling Fisheries with Conservation (pp. 587–596). American Fisheries Society, Symposium 49. Arcos, J.M., Bécares, J., Villero, D., Brotons, L., Rodríguez, B. & Ruiz, A. 2012. Assessing the location and stability of foraging hotspots for pelagic seabirds: an approach to identify marine Important Bird Areas (IBAs) in Spain. Biological Conservation 156: 30-42. Arcos, J.M., Bécares, J., Cama, A. & Rodríguez, B. 2012. Estrategias marinas, grupo aves: evaluación inicial y buen estado ambiental. MAGRAMA, IEO & SEO/BirdLife. Bianchi, C.N. & Morri, C. 2000. Marine Biodiversity of the Mediterranean Sea: Situation, Problems and Prospects for Future Research. *Marine Pollution Bulletin* 40: 365-376. BirdLife International. 2016. IUCN Red List for birds. Downloaded from http://www.birdlife.org Boyd, I., Wanless, S. & Camphuysen, C.J. 2006. Top predators in marine ecosystems: their role in monitoring and management. Cambridge University Press. Bourgeois, K. & Vidal, E. 2008. The Endemic Mediterranean shearwater Puffinus yelkouan: distribution, threats and a plea for new data. *Oryx* 42: 187-194. Coll M, Piroddi C, Steenbeek J, Kaschner K, Ben Rais Lasram F, et al. 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. *PLoS ONE* 5(8): e11842. doi:10.1371/journal.pone.0011842 Croxall, J.P., S.H.M. Butchart, B. Lascelles, A.J. Stattersfield, B. Sullivan, A. Symes & P. Taylor. 2012. Seabird conservation status, threats and priority actions: a global assessment. *Bird Conservation International* 22: 1-34. Fric, J., Portolou, D., Manolopoulos, A. & Kastritis, T. 2012. Important Areas for Seabirds in Greece. LIFE07NAT/GR/000285. Hellenic

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5. EO1: Common Indicator 4. Population abundance of selected species (related to marine mammals)

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO1. Biological diversity is maintained or enhanced. The quality and occurrence of_coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.**
IMAP Common Indicator	Write the exact text, number	**CI4. Population abundance of selected species (related to marine mammals)**
Indicator Assessment Factsheet Code	Text	**EO1CI4**
Rationale/Methods		
Background (short)	Text (250 words)	**Background and rationale for the indicator, key pressures and drivers** Population parameters such as abundance and density are essential components of the provision of science-based advice on conservation and management issues, both in terms of determining priorities for action and evaluating the success or otherwise of those actions. Such information is also often necessary to guarantee compliance with regulations at the national and international level. By definition, population abundance refers to the total number of individuals of a selected species in a specific area in a given timeframe; while with density we refer to the number of animals per surface unit (e.g. number of animals per km^2). Monitoring density and abundance of cetaceans is particularly challenging and expensive. Cetaceans generally occur in low densities and are highly mobile; they are difficult to spot and to follow at sea, even during good survey conditions, because they typically only show part of their head, back and dorsal fin while surfacing and spend the majority of their time underwater. In order to be able to assess potential trends over time, it is crucial to plan systematic monitoring programs, which are crucial components of any conservation strategy; unfortunately such approach is neglected in many

		regions, including much of the Mediterranean. Monitoring at the regional level may require data collection throughout the year, to better understand seasonal patterns in distribution, whereas monitoring at the population level would mainly address inter-annual changes. Changes in density and abundance in time and space - known as population trends – are usually caused by anthropogenic pressures and/or natural fluctuations, environmental dynamics and climate changes. It is strongly suggested that marine mammals' abundance is monitored systematically at regular intervals to suggest and apply effective conservation measures and assess and review the efficacy of measures already in place. This indicator aims at providing robust and quantitative indications on population abundance and density estimates for marine mammal species living in the Mediterranean Sea. **Policy Context and Targets** The Mediterranean cetaceans' populations are protected under the framework of ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area), under the auspices of the UNEP Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS). The Pelagos Sanctuary is a large marine protected area established by France, Italy and Monaco in the Corso-Ligurian-Provençal Basin and the Tyrrhenian Sea, where most cetacean species are regularly observed and benefit from its conservation regime. All cetacean species in the Mediterranean Sea are also protected under the Annex II of the SPA-BD Protocol of the Barcelona Convention; under the Appendix I of the Bern Convention; under the Annex II of the Washington Convention (CITES); and under the Appendix II of the Bonn Convention (CMS). The short-beaked common dolphin, the sperm whale and the Cuvier's beaked whale and the monk seal are also listed under the Appendix I of the Bonn Convention (CMS). The common bottle dolphin, the harbor porpoise and the monk seal are also listed under the Annex II of the EU Habitats Directive.
Background (*extended)*	Text (no limit), images, tables, references	
Assessment methods	Text (200-300 words), images, formulae, URLs	
Results		NOTE: If the assessment has been performed at different geographical scales, include the results and conclusions accordingly.
Results and Status, including trends (brief)	Text (500 words), images	
Results and Status, including trends (extended)	Text(no limit), figures, tables	**Mediterranean monk seal** – Currently there are no population estimates for monk seals at the Mediterranean level; genetic analysis suggests that there may be two separate populations – genetically isolated – within the Basin, one in the Ionian Sea and one in the Aegean Sea. Previously listed as Critically Endangered by the IUCN Red List, the Mediterranean monk seal has been recently reassessed as Endangered, following an observed increase in individuals at localized breeding sites. **Fin whale** – Comprehensive basin-wide estimates of density and abundance are lacking for all the species of cetaceans across the Mediterranean Region. Nonetheless, these parameters have been previously obtained for fin whales over large portions of the Central and Western Mediterranean Basin, highlighting seasonal, annual and geographical patterns. Line-transect surveys in 1991 yielded fin whale estimates in excess of 3,500 individuals

		over a large portion of the western Mediterranean (Forcada et al., 1996), where most of the basin's fin whales are known to live. Panigada et al. (2011, in press) reviewed existing density and abundance estimates in the Central and Western parts of the Basin and reported on a series of aerial surveys conducted in the Pelagos Sanctuary and in the seas around Italy, providing evidence of declining numbers in density and abundance since the 1990's surveys. These recent estimates provided values of 330 fin whales in July 2010 in the Pelagos Sanctuary area. Panigada and colleagues also reported on density and abundance estimates on a wider area, including the Pelagos Sanctuary, the Central Tyrrhenian Sea and portion of the sea west of Sardinia, with an estimated abundance of 665 fin whales in summer 2010. **Sperm whale** – There are no robust information on sperm whale population estimates for the entire Mediterranean Sea, while there are estimates obtained through photo-identification and line transect studies in localized specific areas. Given the values obtained in some Mediterranean areas (e.g. the Hellenic Trench, the Balearic islands, the Central Tyrrhenian Sea), it has been suggested that the entire population may be around a few hundred animals only, most likely under one thousand individuals. **Cuvier's beaked whale** – No density and abundance estimates this species are available for the whole Mediterranean Sea. The only available robust sub-regional estimates come from line-transect surveys in the Alborán Sea and from photo-identification studies in the Ligurian Sea. The most recent corrected estimates number 429 individuals (CV=0.22) from the Alborán Sea and around 100 individuals (CV=0.10) in the Ligurian Sea. The lack of other estimates throughout the whole Mediterranean Sea precludes any inference on the numerical consistency of the entire population. **Short-beaked common dolphin** – Common dolphins used to be very common in the Mediterranean Sea, and during the 20th century the species was subject to a large decline, drastically reducing its population levels. No population abundance estimates are available for the Mediterranean Sea, apart from localized areas, such as for example the Gulf of Corinth and the Alborán Sea, thus making it difficult to assess the entire population. **Long-finned pilot whale** – Two populations have been described in the Mediterranean Sea, one living in the Strait of Gibraltar and one in the area between the Alborán and the Ligurian Seas. The Gibraltar population has been estimated at less than 250 individuals, while there are no estimated for the other population, which seems to be declining. **Risso's dolphin** – There are no population estimates for Risso's dolphin in the whole Mediterranean Sea, with information coming only from localized areas. Distance sampling was used to estimate winter and summer abundance of Risso's dolphins in the north-western Mediterranean (N=2550 (95% CI: 849–7658) in winter and N=1783 (95% CI: 849–7658) in summer). Systematic photo-identification studies allowed to estimate, through mark-recapture methods, an average population of about 100 individuals (95% CI: 60–220) summering in the Ligurian Sea. **Killer whale** – The most recent abundance estimate for this species is 39 individuals in 2011, representing one of the lowest levels compared to other killer whales population elsewhere in the world. **Striped dolphin** – Comprehensive basin-wide estimates of density and abundance are lacking for this species across the Mediterranean Region; nonetheless, ship and aerial surveys have provided abundance and density values for striped dolphins over large portions of the Central and Western Mediterranean Basin, highlighting seasonal, annual and geographical patterns. The overall higher density, and hence abundance, observed in the North-Western Mediterranean Sea and estimated at 95,000 individuals (CV=0.11), with values clearly decreasing during the winter months and towards the Southern and Eastern sectors, reflects the general knowledge on the ecology of these species, described as the most abundant one in the Basin. Several estimates of abundance and density for this species have been provided for many areas of the Mediterranean, especially in the west, but no

		baseline data are available for the whole basin. **Rough-toothed dolphin** – The very small number of authenticated records over the last 20 years (12 sightings and 11 strandings/bycatch) render any population estimate impossible and statistically unacceptable. **Common bottlenose dolphin** – There are no density and abundance estimates for the entire Mediterranean Sea, with the only statistically robust estimates obtained from localized, regional research programmes in the Alborán Sea, the Balearic area, the Ligurian Sea, the Tunisian Plateau, the Northern Adriatic, the Western Greece and Israel in the Levantine Basin. The IUCN assessment for the Mediterranean population implies that less than 10,000 common bottlenose dolphins are present in the Basin. **Harbour porpoise** – This cetacean is not regularly present in the Mediterranean Sea except in the Aegean Sea, where individuals from the Black Sea subspecies are occasionally observed and in the Alborán Sea, where individuals from the North Atlantic Ocean are rarely seen. No density and abundance estimates are available.
Conclusions		
Conclusions (brief)	Text (200 words)	The Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS) has been working for several years on defining an exhaustive program for estimating abundance of cetaceans and assessing their distribution and habitat preferences in the Black Sea, Mediterranean Sea and the adjacent waters of the Atlantic (the "ACCOBAMS Survey Initiative"). This initiative consists in a synoptic survey to be carried out in a short period of time across the whole Agreement area and it will combine visual survey methods (boat- and ship-based surveys) and passive acoustic monitoring (PAM). Some of the cetaceans species present in the Mediterranean Sea are migratory species, whit habitat ranges extending over wide areas; it is therefore highly recommended to monitor these species at regional or sub-regional scales for the assessment of their population abundance. Priority should be given to the less known areas, using online data sources, such as Obis Sea Map and published data and reports as sources of information. There is also general consensus among the scientific community that long-term systematic monitoring programmes, using techniques such as the photo-identification, provide robust and crucial data that can be used in assessing abundance at sub-regional levels and inform local conservation and mitigation measures. Establishing international collaborations between different research groups, merging existing data-sets allows to perform robust analysis and estimate population parameters at larger scales.
Conclusions (extended)	Text (no limit)	
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	
List of references	Text (10 pt, Cambria style)	

6. EO1: Common Indicator 4. Population abundance of selected species (related to marine reptiles)

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO1. Biological diversity is maintained or enhanced. The quality and occurrence of coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.**
IMAP Common Indicator	Write the exact text, number	**CI4. Population abundance of selected species (related to marine reptiles)**
Indicator Assessment Factsheet Code	Text	**EO1CI4**
Rationale/ Methods		
Background (short)	Text (250 words)	**Background and rationale** Measurements of biological diversity are often used as indicators of ecosystem functioning, as several components of biological diversity define ecosystem functioning, including richness and variety, distribution and abundance. Abundance is a parameter of population demographics, and is critical for determining the growth or decline of a population. The objective of this indicator is to determine the population status of selected species by medium-long term monitoring to obtain population trends for these species. This objective requires a census to be conducted in breeding, migratory, wintering, developmental and feeding areas. Effective conservation planning requires reliable data on wildlife population dynamics or demography (e.g. population size and growth, recruitment and mortality rates, reproductive success and longevity) to guide management effectively (Dulvy et al. 2003; Crick 2004). However, it is not possible to obtain such data for many species, especially in the marine environment, limiting our ability to infer and mitigate actual risks through targeted management. For sea turtles, nest numbers and/or counts of females are often used to infer population trends and associated extinction risk, because counts of individuals in the sea or when nesting on (often) remote beaches is tricky. Estimates of sea turtle abundance are obtained from foot patrols on nesting beaches counting either the number of females (usually during the peak 2-3 weeks of nesting) and/or their

		nests (Limpus 2005; Katselidis et al. 2013; Whiting et al. 2013, 2014; Pfaller et al. 2013; Hays et al. 2014). However, females may not be detected by foot patrols because they do not all initiate and end nesting at the same time and might not nest on the same beach or section of beach within or across seasons; consequently monitoring effort could fail to detect turtles or miss them altogether on unpatrolled beaches. Consequently, it is assumed that females lay two (Broderick et al. 2001), three (Zbinden et al. 2007; Schofield et al 2013) or possibly as many as 5 or more clutches (Zbinden et al. 2007), depending on the beach being assessed in the Mediterranean. High environmental variability leads to overestimates of female population size in warmer years and under-estimates in cooler years (Hays et al. 2002). This is because sea turtles are ectotherms, with environmental conditions, such as sea temperature and forage resource availability, influencing the seasonality and timing of reproduction (Hays et al. 2002; Broderick et al. 2001, 2003; Fuentes et al. 2011; Schofield et al. 2009; Hamann et al. 2010; Limpus 2005). As a result, concerns have been raised about the reliability of using nest counts of females alone to infer sea turtle population trends (Pfaller et al 2013; Whiting et al. 2013, 2014). Furthermore, nest counts cannot inform us about the number of adult males, the number of juveniles being recruited into the adult population, the longevity of nesting by individuals or mortality rates. Information is lacking on these components of sea turtle populations because males and juveniles remain in the water. Because turtles do not surface regularly, along with detection being difficult in low sea visibility of great sea depth conditions, a number of individuals are always missed from population surveys, requiring the use of certain statistical tools (such as distance sampling, Buckland et al. 1993) to be implemented to make up for the shortfall. Furthermore, for most populations the areas used by males and juveniles remain unknown (see Indicator 1). Yet, it is important to quantify the number of juveniles and males to guarantee successful recruitment into a population, as well as successful breeding activity to ensure population viability and health (i.e. genetic diversity, within Indicator 3) (Limpus 1993; Schofield et al. 2010; Demography Working Group 2015). This is because sea turtles exhibit temperature dependent sex determination, with the warming climate leading to heavily biased female production (Poloczanska et al., 2009; Katselidis et al. 2012; Saba et al., 2012). Therefore, we must quantify all of these parameters to understand sea turtle abundance trends and survival. Furthermore, factors impacting turtle population dynamics in the coming decades will not be detected from nest counts for another 30 to 50 years (Scott et al. 2011), because this is the generation time of this group and nest counts cannot predict how many juveniles are recruiting into the populations until they begin nesting themselves. This timeframe will likely be far too late to save many populations. Gaps remain in assessing population abundance because it is not possible to survey all individuals in a turtle population either through in-water or beach-based surveys. It is therefore necessary to establish minimum information standards at key geographical sites to obtain reliable measures of population abundance of two selected species, taking into account all components of the population. To achieve this, first adequate knowledge about the distribution range of each species is required (Indicator 1). Monitoring effort should be long term and should cover all seasons to ensure that the information obtained is as complete as possible. **Key pressures and drivers** Both nesting and foraging areas of marine turtles are vulnerable to anthropogenic pressures in the Mediterranean Sea, including an increase in the exploitation of resources (including fisheries), use and degradation of habitats (including coastal development), pollution and climate change (UNEP/MAP/BLUE PLAN, 2009; Mazaris et al. 2009, 2014; Witt et al. 2011; Katselidis et al. 2012, 2013, 2014). These issues might reduce the resilience of this group of species, negatively impacting the ability of populations to recover (e.g. Mazaris et al. 2009, 2014; Witt et al. 2011; Katselidis et al. 2012, 2013, 2014). The risk of extinction is particularly high in the Mediterranean because the breeding populations of both loggerhead and green turtles in this basin are

demographically distinct to other global populations (Laurent et al., 1998; Encalada et al., 1998), and might not be replenished.

The main threats to the survival of loggerhead and green turtles in the Mediterranean have been identified as incidental catch in fishing gear, collision with boats, and intentional killing (Casale & Margaritoulis 2010). Casale (2011) estimated that there are more than 132,000 incidental captures per year in the Mediterranean, of which more than 44,000 are predicted to be fatal, although very little is known about post-release mortality (Álvarez de Quevedo et al. 2013). Wallace et al. (2010, 2011) grouped all species of sea turtles globally into regional management units (RMUs), which are geographically distinct population segments, to determine the population status and threat level. These regional population units are used to assimilate biogeographical information (i.e. genetics, distribution, movement, demography) of sea turtle nesting sites, providing a spatial basis for assessing management challenges. A total of 58 RMUs were originally delineated for the seven sea turtle species. The Mediterranean contains 2 RMUs for loggerheads and 1 RMU for green turtles. These analyses showed that the Mediterranean has the highest average threats score out of all ocean basins, particularly for marine turtle bycatch (Wallace et al. 2011). However, compared to all RMUs globally, the Mediterranean also has the lowest average risk score (Wallace et al. 2011).

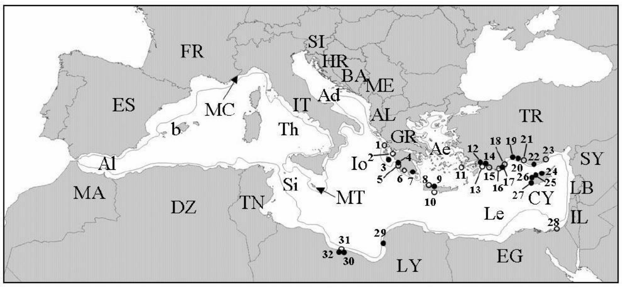
Other key threats to sea turtles in the Mediterranean include the destruction of nesting habitat for tourism and agriculture, beach erosion and pollution, direct exploitation, nest predation and climate change (Casale & Margaritoulis 2010; Mazaris et al. 2014; Katselidis et al. 2012, 2013, 2014). Coll et al. (2011) also identified critical areas of interaction between high biodiversity and threats for marine wildlife in the Mediterranean. Within this analysis, the authors delineated high risk areas to both species, with critical areas extending along most coasts, except the south to east coastline (from Tunisia to Turkey).

Policy Context and Targets

Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes Good Environment Status (GES) definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years.

The MSFD includes Descriptor 1: Biodiversity: "The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions." Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them.

The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned". Commission Decision 2010/477/EU sets out the MSFD's criteria and methodological standards and under Descriptor 1 includes criteria "1.1.Species distribution" and indicators "Distributional range (1.1.1)", "Distributional pattern within the latter, where appropriate (1.1.2)", and "Area covered by the species (for sessile/benthic species) (1.1.3)". At a country scale, Greece, Italy, Spain have selected targets for marine turtles; Cyprus and Slovenia mention marine turtles in their Initial assessment, but do not set targets (Milieu Ltd Consortium. 2014). Italy has an MSFD target to define the spatial distribution of loggerheads and their aggregation areas by

		assessing temporal and seasonal distribution differences for each aggregation area. Spain has an MSFD target to promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution, contributing to a second target of maintaining positive or stable trends for the populations of key species, like marine turtles, and maintain commercially exploited species within safe biological limits. Obtaining census data on nesting beaches is included as an MSFD target in Greece. See UNEP/MAP 2016 for more details.
Background (*extended*)	Text (no limit), images, tables, references	
Assessment methods	Text (200-300 words), images, formulae, URLs	
Results		NOTE: If the assessment has been performed at different geographical scales, include the results and conclusions accordingly.
Results and Status, including trends (brief)	Text (500 words), images	
Results and Status, including trends (extended)	Text(no limit), figures, tables	**Loggerhead sea turtles** **Adult females at breeding areas** Over 100 sites around the Mediterranean have scattered to stable (i.e. every year) nesting (Halpin et al., 2009; Kot et al. 2013; SWOT, 2006a, 2006b, 2008, 2009, 2010, 2011, 2012), of which just 13 sites support more than 100 nests each (Casale & Margaritoulis 2010). Greece and Turkey alone represent more than 75% of the nesting effort in the Mediterranean; for details on nest numbers at the different sites in the Mediterranean see Casale & Margaritoulis (2010) and Figure 1. An average of 7200 nests are made per year across all sites (Casale & Margaritoulis 2010), which are estimated to be made by 2,280–2,787 females assuming 2 or 3 clutches per female (Broderick et al. 2002).  *Figure 1. Map of the major loggerhead nesting sites in the Mediterranean (extracted from Casale & Margaritoulis)* Major nesting sites (>50 nests/year) of Loggerheads in the Mediterranean. 1 Lefkas; 2 Kotychi; 3 Zakynthos; 4 Kyparissia; 5 beaches adjacent to Kyparissia town; 6 Koroni; 7 Lakonikos Bay; 8 Bay of Chania; 9 Rethymno; 10 Bay of Messara; 11 Kos; 12 Dalyan; 13 Dalaman; 14 Fethiye; 15 Patara; 16 Kale; 17 Finike-Kumluca; 18 Cirali; 19 Belek; 20 Kizilot 21 Demirtas; 22 Anamur; 23 Gosku Delta; 24 Alagadi; 25 Morphou Bay; 26 Chrysochou; 27 Lara/Toxeftra; 28 Areash; 20 Al-Mteafla; 30 Al-Ghbeba; 31 Al-thalateen; 32 Al-Arbaeen. Closed circles >100 nests/year; open circles 50-100 nests/year. Country codes: AL Albania; DZ Algeria; BA Bosnia and Hersegovina; HR Croatia; CY Cyprus; EG Egypt; FR France; GR Greece; IL Israel; IT Italy; LB Lebanon; LY Libya; MT Malta; MC Monaco; ME Montenegro; MA Morocco; SI Slovenia; ES Spain; SY Syria; TN Tunisia; TR Turkey; Ad Adriatic; Ae Aegean; Al Alboran Sea; Io Ionian; Le Levantine basin; Si Sicily Strait; Th Thyrrenian; b Balearic. A recent IUCN analysis (Casale 2015) suggests that, when all

		Loggerhead nesting sites in the Mediterranean are considered together, the Mediterranean population size is relatively large, and is considered of Least Concern but conservation dependent under current IUCN Red List criteria. However, refer back to limitations of population analyses in the Introductory section. While tagging programs exist at some of the main nesting sites in the Mediterranean on nesting beaches, the loss of external flipper tags has proven problematic in maintaining long-term records of individuals (but see Stokes et al. 2014). However, these estimates of female numbers should be treated with caution because the Mediterranean represents one of the most temperate breeding regions of the world. Consequently, clutch frequency will vary from season to season depending on the prevailing weather conditions. For instance, in years with prevailing north winds, sea temperatures remain cooler, resulting in longer inter-nesting periods (Hays et al. 2002), and fewer clutches per individual, with the opposite trend being obtained in years with prevailing south winds. Even in tropical nesting sites, with relatively stable temperatures during breeding, clutch frequency can vary by as much as 3-12 clutches (Tucker 2010). Furthermore, the trophic status of foraging sites influences remigration frequency; thus, more turtles may return to breed in some years, again causing nest numbers to fluctuate (Broderick et al. 2001, 2002). Therefore, for programs that elucidate female numbers based on nest counts, the mean clutch frequency and breeding periodicity should be assessed at regular intervals by means of high resolution satellite tracking of individuals across years with different climatic conditions. Of note, knowledge about the numbers of females that nest on the beaches of the countries of North Africa remains limited and requires resolution. **Adult males at breeding areas** To date, no study globally has obtained an estimate of the number of males in a breeding population. This is because males remain in the marine area, making counts difficult to obtain. Within the Mediterranean, only Schofield et al. (2010) have attempted to estimate the numbers of males within a loggerhead rookery (Zakynthos) using photo-identification. Intensive capture-recapture over a three month period indicated a 1:3.5 ratio of males to females (based on a sample size of 154 individuals). Furthermore, Hays et al. (2014) showed that most males in this population breed annually (although some of those that forage off Tunisia/Libya and in western Greece return biannually; Hays et al. 2014; Casale et al. 2013), using a combination of long-term satellite tracking (over 1 year) and multi-year photo-identification records, with similar return rates being recorded in other populations globally (Limpus 1993). Based on this information, just 100 males might breed annually, with the same males breeding every year, in contrast to an estimated 600-800 females for this population (based on nest counts; Casale and Margaritoulis 2010). Therefore, it is imperative to ascertain the rate of recruitment and mortality of males in the population. If we assume 2,280–2,787 adult females loggerheads in the Mediterranean (Broderick et al. 2002), then there may be just 580 to 696 adult loggerhead males in total, with some populations potentially supporting very small numbers of males, especially when considering that Zakynthos is considered one of the largest breeding populations in the Mediterranean (Casale & Margaritoulis 2010; Katselidis et al. 2013; Almpanidou et al. 2016). Thus, counts of males across all breeding populations are required to ascertain the importance of protecting this component of sea turtle populations. **Developmental and adult foraging/wintering habitats** Because loggerheads probably forage throughout all oceanic and neritic marine areas of the west and east basins of the Mediterranean (Hays et al. 2014; Casale & Mariani 2014), combined with the fact that both adults and juveniles may frequent multiple habitats, counts of individuals in specific areas prove difficult. Juvenile and immature turtles represent the greatest component of the population; thus information on the size structure and abundance at foraging grounds is essential to understand changes in nest counts, based on changes in mortality and recruitment into adult breeding populations (Demography Working Group, 2015). However, because the juveniles of each nesting population may be

dispersed across multiple habitats, and appear to use different sites across seasons, obtaining such counts is difficult requiring the complementary use of genetic sampling (Casale & Margaritoulis 2010).

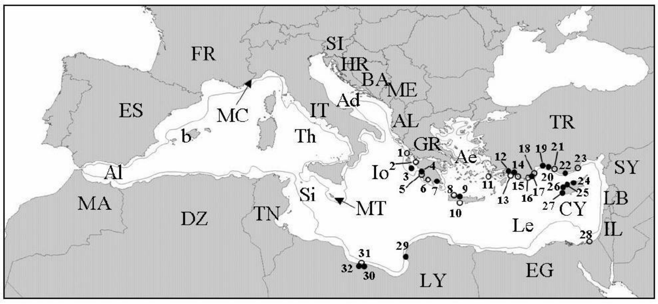
Aerial and fishery bycatch data provide some information on turtle abundance in the western basin Alboran Sea and Balearic islands, the Sicily Strait, the Ionian Sea, the north Adriatic, off Tunisia-Libya, Egypt and parts of the Aegean (Gómez de Segura et al. 2003, 2006; Cardona et al. 2005; Lauriano et al. 2011; Casale & Margaritoulis 2010; Fortuna et al. 2015), with unpublished information existing for the Balearic Sea, the Gulf of Lions, the Tyrrhenian Sea, the Ionian Sea, and the Adriatic Sea (Demography Working Group 2015). There are also bycatch data available providing evidence of turtle numbers (e.g. Casale & Margaritoulis 2010; Casale 2011, 2012). Another source of information is in-water capture at focal sites such as Amvrakikos, Greece (Rees et al. 2013) and Drini Bay, Albania (White et al. 2013). At Drini Bay, Albania, 476 turtles of size class 20 cm to 80 cm were captured primarily May to October (Casale & Margaritoulis 2010). Furthermore, long-term studies (2002-present) have shown the presence of large juvenile to adult loggerheads (46-92 cm) in Amvrakikos Bay, Greece (Rees et al. 2013).

Thus, the data from existing sites needs to be assimilated and assessed for representativeness in providing abundance information on juvenile and adult turtles, so as to determine how to focus effort effectively across foraging and developmental sites across the Mediterranean. In parallel, techniques to obtain counts on a regular basis across a wide range of habitats need to be developed.

Green turtles

Adult male and females in breeding habitats

Most green turtle nests (99%) are laid in Turkey, Cyprus and Syria, with the remainder being found in Lebanon, Israel and Egypt (Figure 2; Kasparek et al. 2001; Casale & Margaritoulis 2010). Out of 30 documented sites, just six host more than 100 nests per season (Stokes et al. 2014), with a maximum of just over 200 nests at two sites (both in Turkey). For details on nest numbers at the different sites in the Mediterranean see Stokes et al (2015) and Figure 2. An average of 1500 nests are documented each year (range 350 to 1750 nests), from which an annual nesting population of around 339–360 females has been estimated assuming two to three clutches (Broderick et al. 2002). Unlike loggerheads, green turtles globally strong exhibit interannual fluctuations in the number of nests, which has been associated with annual changes in forage resource availability (Broderick et al. 2001). Consequently, our knowledge about the population dynamics of green turtles in the Mediterranean remains insufficient.



Map of the major green turtle nesting sites in the Mediterranean (extracted from Casale & Margaritoulis)

Major nesting sites (>40 nests/year) of green turtles in the Mediterranean. 1 Alata; 2 Kazanli; 3 Akyatan; 4 Sugozu; 5 Samandag; 6 Latakia; 7 North Karpaz; 8 Alagadi; 9 Morphou Bay; 10 Lara/Toxeftra. Closed circles >100 nests/year; open circles 40-100 nests/year. Country symbols, see previous map.

Developmental and adult foraging/wintering habitats

Information about the numbers of green turtles in various developmental, foraging and wintering habitats is limited. While the greatest numbers of green turtles have been documented in the Levantine basin (Demography Working Group 2015), there are records of individuals using habitat in the Adriatic Sea (Lazar et al. 2004) and around Italian waters (Bentivegna et al. 2011), with some

		records occurring in the western basin; however, actual numbers, have not been obtained. It is essential to document the numbers of adults and juveniles that frequent developmental, foraging and wintering habitats in order to isolate key sites for management protection.
Conclusions		
Conclusions (brief)	Text (200 words)	Major gaps exist in estimating the population abundance of sea turtles. First, the use of nest counts as a proxy for female numbers must be treated with caution, and variation in climatic factors at the nesting site and trophic factors at foraging sites taken into account. Counts of males at breeding grounds must be incorporated into programs at nesting sites. If just a total of 100 males frequent Zakynthos, which has around 1000 nests/season, then most sites throughout the Mediterranean (of which most have <100 nests) are likely to support very low numbers of males, making the protection of these individuals essential. Finally, with the delineation of developmental, foraging and wintering habitats (Indicator 1), it will be necessary to obtain counts of the number of individuals, particularly juveniles, that frequent these various habitats seasonally and across years. While information on the number of juveniles alone at given habitats does not reflect on any given nesting population, the relative numbers of immature to mature animals will provide baseline information about key juvenile developmental habitats and actual numbers relative to those obtained to adults. Overall, programs at nesting sites need to place a strong focus on ensuring long-term recognition of female individuals and incorporate counts of males. The realisation of Indicator 1, will help with delineating developmental, foraging and wintering sites to make counts of adult vs. juvenile turtles and fluctuations in numbers over time. Information obtained through Indicator 2 will be intrinsically linked with Indicator 3 (see this section).
Conclusions (extended)	Text (no limit)	
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	● Seasonal and total numbers of adult females frequenting breeding sites ● Seasonal and total numbers of adult males frequenting breeding sites ● Numbers of adult males and females frequenting foraging and wintering sites, including seasonal variation in numbers ● Numbers of adult males and females frequenting foraging and wintering sites, including seasonal variation in numbers ● Vulnerability/resilience of documented populations and subpopulations in relation to physical and anthropogenic pressures; ● Analysis of pressure/impact relationships for these populations and subpopulations, and definition of qualitative GES; ● Identification of extent (area) baselines for each population and subpopulation with respect to adult females, adult males and juveniles to maintain the viability and health of these populations ● Appropriate assessment scales; ● Monitor and assess the impacts of climate change on nest numbers (clutch frequency) and breeding periodicity (remigration intervals) of females, as these paramaters are used as proxies for inferring female numbers. ● Monitor and assess the impacts of climate change on the breeding periodicity (remigration intervals) of males, as this provides an indication of total male numbers ● Assimilation of all research material on sea turtles (e.g. satellite tracking, stable isotope, genetic, strandings aerial surveys) in a single database
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7. EO1: Common Indicator 5. Population demographic characteristics (EO1, e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals)

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO1. Biological diversity is maintained or enhanced. The quality and occurrence of_coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.**
IMAP Common Indicator	Write the exact text, number	**CI5. Population demographic characteristics (EO1, e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals)**
Indicator Assessment Factsheet Code	Text	**EO1CI5**
Rationale/Methods		
Background (short)	Text (250 words)	The objective of this indicator is to focus on the population demographic characteristics of marine mammals within the Mediterranean waters. Demographic characteristics of a given population may be used to assess its conservation status by analysing demographic parameters as the age structure, age at sexual maturity, sex ratio and rates of birth (fecundity) and of death (mortality). These data are particularly difficult to obtain for marine mammals, thus relying on demographic models, which imply several assumptions which may be violated. The populations of long-lived and slow reproducing cetaceans are among the most critical conservation units; a demographic approach can be therefore very useful for their management and conservation. While some demographic studies have been conducted using industrial whaling data on Northeast Atlantic populations, little is known about the demography of their counterparts in the Mediterranean, where industrial whaling has never occurred.
Background (*extended*)	Text (no limit), images, tables,	
Assessment methods	Text (200-300 words),	

	images, formulae, URLs	
Results		NOTE: If the assessment has been performed at different geographical scales, include the results and conclusions accordingly.
Results and Status, including trends (brief)	Text (500 words), images	**Fin whale -** Demographic models - commonly used in animal and plant populations - have been applied to marine mammals and cetaceans only in the recent years. Usually, two different approaches are used when dealing with demographic studies, based on static or cohort life-tables. A third approach refers to the use of mortality tables and provides detailed information about size⁄age and sex of dead individuals. This approach, based on stranding data, has for the first time been applied to cetaceans in the Mediterranean Sea, developing a demographic model for the Mediterranean fin whale population based on a life-history table (mortality table) using stranding records. Dealing with stranded data implies several assumptions; the main one being that stranding data represent a faithful description of the real mortality by different life stages. This assumption, however, is true only if the probability of stranding is equal in all life stages. This preliminary study described the structure of the Mediterranean sub-population by analyzing stranding records from the period 1986–2007, showing a strong impact, natural and anthropogenic, on calves and immature animals. These results, while confirm a common pattern to several mammals – characterized by high mortality in the youngest age classes - may prevent reaching sexual maturity, thus severely impacting the species at the population level. Proper conservation plans should therefore consider the discovery of breeding grounds, where calves may benefit from greater protection, to increase survival rates. Similarly, appropriate naval traffic regulations, aimed at reducing mortality rates from ship collisions, could enhance the survival of mature females and calves. In addition, mitigating other sources of mortality and stress, such as chemical and acoustic pollution, whale-watching activities and habitat loss and degradation, could further improve the population’s chances of survival. **Common bottlenose dolphin -** The only Mediterranean area with quantitative historical information that can be used to infer population trends over time scales of more than a couple of decades is the northern Adriatic Sea. There, bottlenose dolphin numbers likely declined by at least 50% in the second half of the 20th century, largely as a consequence of deliberate killing initially, followed by habitat degradation and overfishing of prey species. For some other parts of the northern Mediterranean, e.g. Italy and southern France, the available information is less precise but suggests similar trends. In an area off southern Spain where the species has been studied intensively, abundance estimates have shown variability but no trend since the early 1990s. Since there are no historical data on the density and abundance of bottlenose dolphins in the Pelagos Sanctuary, it is not possible to infer possible increase or decrease over time. The Groupe d’Etudes des Cétacés de Méditerranée has estimated – through direct counting and photo-identification - around 198–242 dolphins around the island of Corsica in 2000, and 130–173 in 2003. These estimates appear to be lower than those assessed through mark recapture analysis in the same area in 2006, but any inference on potential trends is purely speculative, as a different approach has been used to for these estimated and this may lead to significant biases.
Results and Status, including trends (extended)	Text(no limit), figures, tables	
Conclusions		

Conclusions (brief)	Text (200 words)	Monitoring effort should be directed to collect long-term data series covering the various life stages of the selected species. This would involve the participation of several teams using standard methodologies and covering sites of particular importance for the key life stages of the target species. The preliminary classical tools for demographic analyses are life tables, accounting for the birth rates and probabilities of death for each vital stage or age class in the population. A life table can be set out in different ways: 1) following an initial age class (i.e. cohort) from birth to the death of the last individual; this approach allows to set out a cohort life table and is generally applied on sessile and short-lived populations; 2) counting population individuals grouped by age or by stages in a given time period; this approach allows to obtain a static life table, that is appropriate with long-lived or mobile species; 3) analysing the age or stage distribution of individuals at death; this approach allows to develop a mortality table, using carcasses from stranding data. Photo-identification is one of the most powerful techniques to investigate cetacean populations. Information on group composition, area distribution, inter-individual behavior and short and long-term movement patterns can be obtained by the recognition of individual animals. Long-term datasets on photo-identified individuals can provide information on basic life-history traits, such as age at sexual maturity, calving interval, reproductive and total life span. Nevertheless, estimating age and length from free-ranging individuals may be rather difficult and increase the uncertainties in the models. Long-term data sets on known individuals through photo-identification may overcome some of the potential biases.
Conclusions (extended)	Text (no limit)	
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	
List of references	Text (10 pt, Cambria style)	

8. EO1: Common Indicator 5. Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine reptiles).

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO1. Biological diversity is maintained or enhanced. The quality and occurrence of_coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.**
IMAP Common Indicator	Write the exact text, number	**CI5. Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine reptiles)**
Indicator Assessment Factsheet Code	Text	**EO1CI5**
Rationale/ Methods		
Background (short)	Text (250 words)	**Background and rationale** Effective conservation planning requires reliable data on wildlife population dynamics or demography (e.g. population size and growth, recruitment and mortality rates, reproductive success and longevity) to guide management effectively (Dulvy et al. 2003; Crick 2004). However, it is not possible to obtain such data for many species, especially in the marine environment, limiting our ability to infer and mitigate actual risks through targeted management. Yet, demographic information helps to identify the stage(s) in the life cycle that affect(s) most population growth, and may be applied to (1) quantify the effectiveness of conservation measures or extent of exploitation (e.g. fisheries management), (2) understand the evolution of life history traits and (3) indicate fitness with respect to the surrounding environment. For sea turtle populations, some measures of demography are well documented, such as nest and/or female numbers (see Indicator 2), from which population trends are currently applied to infer population growth (or recovery) and, hence, threat status. Yet, without information about the number of juveniles recruiting into the population (e.g. Dutton et al. 2005; Stokes et al. 2014), or reliable estimates of mortality rates of both juveniles and adults, it is very difficult to predict future trends. For instance, factors impacting turtle population dynamics in the coming decades will not be detected from nest counts for another

		30 to 50 years (Scott et al. 2011), because this is the generation time of this group and nest counts cannot predict how many juveniles are recruiting into the populations until they begin nesting themselves. Another parameter that is well established is the emergence success rate of hatchlings from the nests, along with offspring sex ratios at hatching. Globally, highly female-biased offspring sex ratios have been predicted (Witt et al. 2010; Hays et al. 2014). This high female bias is of concern because sea turtles exhibit temperature dependent sex determination, with the warming climate ultimately leading to even more biased female production (Poloczanska et al., 2009; Saba et al., 2012; Katselidis et al. 2012). Thus, it is essential to determine how the offspring sex ratio transforms into the adult sex ratio, to determine the minimum number of males needed to keep a population viable and genetically healthy, which are not necessarily the same. Because males tend to breed more frequently than females (i.e. every 1-2 years versus 2 or more years by females; Casale et al. 2013; Hays et al. 2014), fewer males might be needed in the population to mate with all females. However, biased sex ratios can induce deleterious genetic effects within populations with a decline in the effective population size and increasing the odds of inbreeding and random genetic drift (Bowen & Karl 2007; Girondot et al. 2004; Mitchell et al. 2010). However, most sea turtle populations exhibit high multiple paternity (i.e. the eggs of individual females are fathered by multiple males; for review see Lee et al. in submission). This behaviour is considered to be a strategy to enhance genetic diversity; thus, if male numbers further declined, this could have deleterious effects on the population (Girondot et al. 2004). Furthermore, differences in survival between the sexes might occur in different age classes (Sprogis et al. 2016); thus, it is essential to quantify sex ratios and sex-specific mortality across the different size/age classes. Strandings provide a useful source of information on the causes of mortality, but do not necessarily reflect the actual numbers of animals that are dying (Epperly et al. 1996; Hart et al. 2006). Bycatch data have also been used to estimate mortality rates (for overview see, Casale 2011), which are predicted to be around 44000 turtles/year in the Mediterranean. However, these values need confirmation. Consequently, these knowledge gaps hinder our ability to generate representative demographic models to provide accurate assessments of the conservation status of loggerhead and green turtles in the Mediterranean. Yet, such information is vital to implement the most appropriate measures to conserve sea turtles. **Key pressures and drivers** Both the nesting and foraging areas of marine turtles are vulnerable to anthropogenic pressures in the Mediterranean Sea, including an increase in the exploitation of resources (including fisheries), use and degradation of habitats (including coastal development), pollution and climate change (UNEP/MAP/BLUE PLAN, 2009; Mazaris et al. 2009, 2014; Witt et al. 2011; Katselidis et al. 2012, 2013, 2014). These issues might reduce the resilience of this group of species, negatively impacting the ability of populations to recover (e.g. Mazaris et al. 2009, 2014; Witt et al. 2011; Katselidis et al. 2012, 2013, 2014). The risk of extinction is particularly high in the Mediterranean because the breeding populations of both loggerhead and green turtles in this basin are demographically distinct to other global populations (Laurent et al., 1998; Encalada et al., 1998), and might not be replenished. The main threats to the survival of loggerhead and green turtles in the Mediterranean have been identified as incidental catch in fishing gear, collision with boats, and intentional killing (Casale & Margaritoulis 2010). Casale (2011) estimated that there are more than 132,000 incidental captures per year in the Mediterranean, of which more than 44,000 are predicted to be fatal, although very little is known about post-release mortality (Álvarez de Quevedo et al. 2013). Wallace et al. (2010, 2011) grouped all species of sea turtles globally into regional management units (RMUs), which are geographically distinct population segments, to determine the population status and threat level. These regional population units are used to assimilate biogeographical information (i.e. genetics, distribution, movement, demography) of sea turtle nesting sites, providing a

		spatial basis for assessing management challenges. A total of 58 RMUs were originally delineated for the seven sea turtle species. The Mediterranean contains 2 RMUs for loggerheads and 1 RMU for green turtles. These analyses showed that the Mediterranean has the highest average threats score out of all ocean basins, particularly for marine turtle bycatch (Wallace et al. 2011). However, compared to all RMUs globally, the Mediterranean also has the lowest average risk score (Wallace et al. 2011). Other key threats to sea turtles in the Mediterranean include the destruction of nesting habitat for tourism and agriculture, beach erosion and pollution, direct exploitation, nest predation and climate change (Casale & Margaritoulis 2010; Mazaris et al. 2014; Katselidis et al. 2012, 2013, 2014). Coll et al. (2011) also identified critical areas of interaction between high biodiversity and threats for marine wildlife in the Mediterranean. Within this analysis, the authors delineated high risk areas to both species, with critical areas extending along most coasts, except the south to east coastline (from Tunisia to Turkey). **Policy Context and Targets** Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes Good Environment Status (GES) definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD includes Descriptor 1: Biodiversity: “The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.” Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them. The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning “cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or sub-region, for the purpose of developing and implementing marine strategies” […] “thereby facilitating achievement of good environmental status in the marine region or sub-region concerned”. Commission Decision 2010/477/EU sets out the MSFD’s criteria and methodological standards and under Descriptor 1 includes criteria “1.1.Species distribution” and indicators “Distributional range (1.1.1)”, “Distributional pattern within the latter, where appropriate (1.1.2)”, and ”Area covered by the species (for sessile/benthic species) (1.1.3)”. At a country scale, Greece, Italy, and Spain have selected targets for marine turtles; Cyprus and Slovenia mention marine turtles in their Initial assessment, but do not set targets (Milieu Ltd Consortium. 2014; UNEP/MAP 2016). Italy has an MSFD target of reducing fishing pressure by decreasing accidental mortalities by regulating fishing practices, along with by-catch reduction in areas where loggerhead sea turtles aggregate and delineating the spatial distribution of turtles in areas with highest use of pelagic long line (southern Tyrrhenian and southern Ionian sea) and trawling (northern Adriatic). One of the MSFD targets of Spain is to reduce the main causes of mortality and reduction of turtle populations, such as accidental capture, collisions with vessels, intaking of litter at sea, introduced terrestrial predators, pollution, habitat destruction, overfishing.
Background (*extended)*	Text (no limit), images, tables, references	

Assessment methods	Text (200-300 words), images, formulae, URLs	
Results		NOTE: If the assessment has been performed at different geographical scales, include the results and conclusions accordingly.
Results and Status, including trends (brief)	Text (500 words), images	
Results and Status, including trends (extended)	Text(no limit), figures, tables	**Loggerhead and green sea turtles** For this indicator, both species have been combined as the same gaps exist for both. Specific details for green turtles on Cyprus are provided by Broderick et al. (2002) and Stokes et al. (2014), with published data lacking for most other sites in the Mediterranean. **Population size and growth (breeding grounds)** See Indicator 2 for details on this topic. **Internesting intervals of adult females (breeding grounds)** It is essential to quantify the internesting interval within and across years because this influences clutch frequency and will influence estimates of population size (see Indicator 2). The nesting interval is regulated by sea temperature (Hays et al. 2002), being longer when the sea temperature is cooler. Ranges from 12 to over 20 days have been detected within and across nesting sites in the Mediterranean (see Demography Working Group 2015 and Casale & Margaritoulis 2010 for ranges across Mediterranean populations). **Remigration intervals of adult males and females (breeding grounds)** Knowledge on remigration rates (breeding periodicity) of known females and how this changes with time (i.e. maturation of younger nesters or aging of older nesters) is essential as this will affect our ability to predict the total adult sex ratio of populations. Knowledge on female remigration intervals is again limited to Greece, Turkey and Cyprus. Females in Greece and Cyprus tend to have remigration intervals of approximately 2 years (Demography Working Group 2015 and Casale & Margaritoulis 2010), but can be 1-3, or more years (Schofield et al. 2009). For males, remigration intervals have only been documented for males on Zakynthos, which are primarily 1 year, but with some individuals that forage near Tunisia/Libya and the western basin returning every 2 years (Hays et al. 2014; Casale et al. 2013). To determine the total number of adults in the population, clear knowledge about remigration frequency is required. **Clutch frequency (breeding grounds)** This parameter is difficult to quantify due to difficulty in detection rates. Clutch frequencies of 1.2-2.2 have been suggested for green and loggerhead turtles on Cyprus (Broderick et al. 2002). However, on Zakynthos, loggerhead turtles have mean clutch frequencies of 2-3 nests, with up to 5 occurring, based on satellite tracking studies (Zbinden et al. 2011; Schofield et al. 2013a). As this parameter is critical for inferring the numbers of females at breeding sites, as most estimates of females are estimated from nest counts divided by the assumed clutch frequency, it is essential to understand this parameter. Furthermore, clutch frequency will vary with internesting period; i.e. in warmer years, a female could lay more clutches due to shorter internesting periods and vice versa. Again, this information will influence population estimates. **Sex ratios of adult male and females (breeding grounds)** Once information on clutch frequency and remigration interval is robust, then estimates of the numbers of females can be obtained. However, to quantify adult sex ratios at the breeding grounds and overall for the adult component of sea turtle populations, counts of males in the marine environment during breeding must be made. Thus, at present, knowledge about the number of males that frequent breeding areas is non-existent. Therefore, we do not know how many males are currently breeding with females or what the sex ratios are for adults.

Only on Zakynthos has a prediction been made of 1:3.3 males to females based on in-water photo-id surveys of a portion of the breeding population (Schofield et al. 2009). Thus, efforts are needed to quantify the number of males (See indicator 2 for more on this issue) in order to understand adult sex ratios and their potential implications on the conservation and persistence of the species.

Offspring sex ratios at breeding sites, including incubation (breeding grounds)

Estimated hatchling sex ratios exist for a number of nesting sites in Greece, Turkey and North Cyprus, as well as Tunisia (Hays et al. 2014) (Figure 1), with all being strongly female biased. For all the other nations there are no published accounts of estimated sex ratios (see Demography Working Group 2015). It is possible to infer offspring sex ratio from sand temperatures and incubation duration (e.g. Godley et al. 2001; Katselidis et al. 2012), which is relatively straight forward. Incubation duration has been recorded in most countries (see Demography Working Group 2015 and Casale & Margaritoulis 2010 for details).

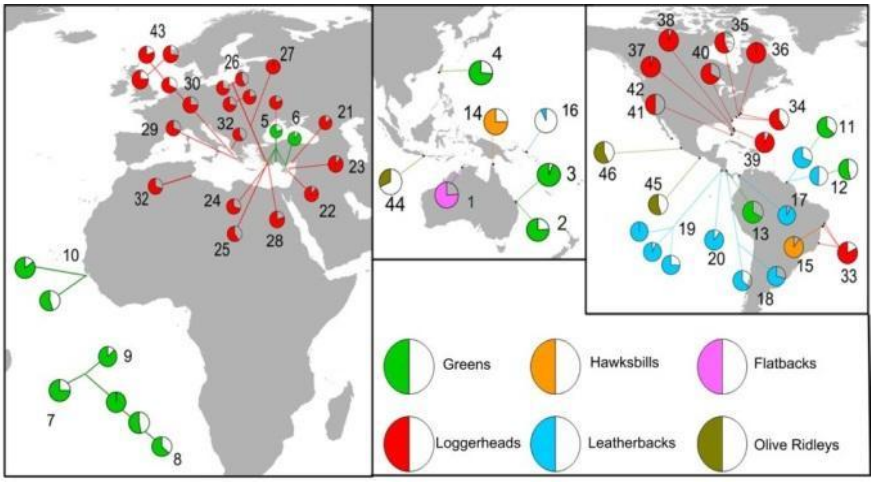

Figure 1 Offspring sex ratios globally, including the Mediterranean (extracted from Hays et al. 2014)

Breeding success of adult males and females (breeding grounds)

Less is known regarding the breeding success of individual females and males. For females, breeding success should be measured generally and for individuals. General measures include the total number of female emergences versus successful nests. This information is generally collected by established beach-based monitoring programs in Greece, Turkey and North Cyprus. Furthermore, breeding success by females is reflected in fecundity (birth rates), i.e. the number of offspring an individual in a population produces. While information on emergence and hatching success is available for established beach-based monitoring programs in Greece, Turkey and North Cyprus, it is not linked to individual turtles in these programs. This is due to issues with tags falling off, knowledge about the successful production of offspring within and across years by individuals is not known, but could help towards indicating the fitness of individuals which could be used to infer the general health of the population.

With respect to males, just one study on multiple paternity has been conducted (Zbinden et al. 2007) on Zakynthos, showing higher than expected multiple paternity levels. Thus, some males might be more successful at mating with females than other males. Therefore, baseline data on the reproductive activity and success of individual males needs to be documented, again to ascertain their reproductive health and how this transforms to their contribution to the clutch (i.e. number of eggs represented by each male).

Hatchling success and emergence success (breeding grounds)

Hatchling success (i.e. number of eggs that hatch; 60-80%) and hatchling emergence success (the number of hatchlings that make it out of the nest; 60-70%) has been documented for the major nesting countries of Greece, Turkey and

		Cyprus, but more information is required from the other countries (for more details see, Demography Working Group 2015 and Casale & Margaritoulis 2010). **Recruitment, mortality, longevity of breeding (breeding grounds)** With the use of reliable tagging methods (i.e. use of 2 or more complementary techniques to ensure information on individuals is not lost; see Indicator 2), this information should be available for some nesting populations with long-term tagging programs (for example see, Dutton et al. 2005 and Stokes et al. 2014). At present recruitment is inferred by most tagging programs (i.e. in Greece, Turkey and Cyprus) from the absence of scars on flippers; however, this technique is not reliable. However, it is essential for existing and new programs to ensure continuous records of individual females, so that these key parameters can be assessed, which will help improve predictions of population recovery or decline. **Growth rates** A study of juvenile loggerheads sampled along the coast of Italy showed that growth rates differ between individuals of Atlantic and Mediterranean origin (Piovano et al. 2011). Casale et al. (2009, 2011) has assessed growth rates using skeletochronology and length-frequency analyses around Italian waters in the Adriatic. Studies of the growth rates of juveniles from different areas of the Mediterranean, however, are required, as these rates will vary depending on forage type. For instance, the size ranges of adult turtles tracked to the Adriatic, Ionian and Gulf of Gabes showed that those that migrated to the Adriatic were the largest, while those from the Ionian were intermediate in size and those from the Gulf of Gabes were the smallest (Schofield et al. 2013, supplementary literature); thus, the location of foraging sites likely influences the growth rates of juveniles. Because there is strong overlap in foraging site used by different populations, genetics analyses should be made in parallel to studies on growth rates. Genetic sampling is required to distinguish origin, with skeletochronology being the advised method to assess growth rates (Demography Working Group 2015); although, this can only be done on dead individuals at present. Studies of growth rate and age at first maturity of loggerhead sea turtles of Mediterranean origin are needed in the Adriatic Sea, the Aegean Sea, the Libyan Sea, the Levantine Sea, the Tyrrhenian Sea and the Balearic Sea (Demography Working Group 2015). **Sex ratios of juveniles and adults (developmental and foraging grounds)** Estimates of juvenile and adult sex ratios at foraging grounds have been completed by only a few studies in the Mediterranean using capture-recapture or bycatch. Different adult sex ratios might be associated with different neritic areas; thus estimates should be made at the level first, then at regional level. Generally balanced adult sex ratios have been documented for adults, ranging from 40-60% female bias, while 52-60% female bias has been documented for females (for overview see Casale et al. 2014). Studies on adults have been limited to the central Mediterranean, Italy, Greece (north-west section of Amvrakikos Gulf) and the southeast Tyrrhenian Sea to date (Casale et al. 2005, 2014; Rees et al. 2013). For juveniles, studies have been conducted at sites in the northwest Mediterranean, southwest Adriatic, north-east Adriatic and southeast Tyrrhenian (Casale et al. 1998, 2006; Maffucci et al. 2013). Of note, satellite tracking studies indicate that male loggerheads that breed on Zakynthos (Greece) forage along the entire Peloponnese mainland, whereas most females migrate at least 100 km away from the site (up to 1000 km) (Schofield et al. 2013b); thus, the Peloponnese might exhibit a strong male bias in terms of foraging habitat use. Furthermore, within the breeding area of Zakynthos, resident males occupied distinctly different foraging sites compared to breeding females (Schofield et al. 2013a), showing that sex specific differences might even occur on very small scales. Therefore, existing values on sex ratios should be treated with caution. For instance, satellite tracking studies of turtles from Zakynthos (Greece) to Amvrakikos Gulf (Greece) (Zbinden et al. 2011; Schofield et al. 2013b) showed that males and females forage in all parts of the gulf, with females particularly using the southern and south-western areas. However, the study by Rees et al. (2013) was focused in a north-west section of the gulf, and so is not necessarily representative of the male:female ratios of this foraging ground. Thus, extensive

		surveys are required in most areas of the Mediterranean, with clarification on the area sampled related to the region and justification of its representativeness. **Physical parameters (breeding and foraging grounds)** The carapace dimensions (curved [(CCL)] and straight [(SCL)] length and width [(CCW and SCW)]) tend to be measured in all programs that tag females on nesting beaches, as well as capture-recapture and bycatch studies of juveniles and adults in the marine environment. This information has shown that female loggerheads nesting in the Mediterranean are the smallest in the world, with those nesting on Cyprus being the smallest (Broderick and Godley 1996; Margaritoulis et al. 2003). However, variation in body size within populations has also been documented, and might be associated to foraging site use (Zbinden et al. 2011; Schofield et al. 2013b; Patel et al. 2015). For morphometric measurements across the different breeding sites see Casale & Margaritoulis (2010). Furthermore, capture-recapture studies of juvenile and adult turtles have shown that turtles in the Mediterranean mature at >70 cm CCL, respectively (Casale et al. 2005, 2013, Rees et al. 2013), with visual differentiation at <75-80 cm CCL (for smaller turtles, other techniques must be used to distinguish between males and females). However, White et al. (2013) found that in the Drini Bay population (Albania), tail elongation began at 60cm CCL. In Amvrakikos Gulf, which hosts loggerheads of similar demographic groups that also originate in Greek rookeries, tail elongation was considered to begin at 64.6 to 69.8cm CCL (Rees et al. 2013), with nesting females of 70 cm CCL regularly nest on beaches in Greece and Cyprus (Margaritoulis et al. 2003). However, measures of biomass are less common, but are of importance. Furthermore, documenting the frequency of carapace injury to known individuals could provide an important means of inferring their exposure to boats. Indices of body fat status are rare (Heithaus et al. 2007). Furthermore, blood and tissue samples are only collected under certain conditions; thus, information on the actual health of individuals remains sparse. This information could be used for genetic analysis to determine the source population of individuals and stable isotope analyses to indicate general foraging areas used by the individuals. **Genetic parameters (breeding and foraging grounds)** A large quantity of genetic information has been collected on sea turtles in the Mediterranean; however, information at specific foraging and breeding grounds is required. This information could be applied towards distinguishing the breeding site origin of mixed foraging and developmental stocks. At present, genetic studies indicate the existence of six distinct loggerhead populations in the Mediterranean: Libya, Dalyan, Dalaman, Calabria, Western Greece and Crete and the Levant (central and eastern Turkey, Cyprus, Israel and Lebanon, and possibly Egypt) (Carreras et al. 2014; Saied et al. 2012; Yilmaz et al. 2012; Clusa et al. 2013; Demography Working Group 2015). In contrast, turtles nesting in Tunisia are not genetically distinct (Chaieb et al. 2010). No major genetic structuring has been detected for green turtles in the Mediterranean to date; however, as analyses evolve, updates may arise (Tikochinski et al. 2012). Genetic analyses (e.g. mixed stock analysis and microsatellites) has shown the origin of turtles recorded at several Mediterranean foraging grounds (Maffucci et al. 2013; Giovannotti et al. 2010; Carreras et al. 2014; Yilmaz et al. 2012; Garofalo et al. 2013; Clusa et al. 2013). When combined with tracking datasets, these data reinforce the fact that turtles from different populations mix in the same foraging grounds (see Schofield et al. 2013b for overview; and details in Indicator 1). However, at present it is difficult to assign individuals of unknown origin to distinct nesting populations using current genetic markers. Future studies need to build on this issue. Furthermore, it is important to establish the genetic diversity within breeding populations, for both males and females, to evaluate health and potential changes in status. It is generally assumed that females and males return to breed at natal sites (Bowen et al. 2004). However, males have been shown to frequent multiple sites during the breeding period (Schofield et al. 2013; Casale et al.

		2013). Moreover, genetic studies indicate high levels of multiple paternity on Zakynthos, which might be a mechanism to help enhance the genetic diversity of the population (Lee et al. in submission); although further examination of this phenomenon across different populations with different ratios of males and females and encounter rates (linked to how aggregated populations are) is needed. **Mortality including bycatch (breeding and foraging grounds)** Several countries in the Mediterranean have stranding networks and rescue centres (MEDASSET 2016). Gaps exist in the Middle East and North Africa. Within this framework, genetic, blood and tissue samples are collected, as well as information on animal morphometrics, including skeletochronology, and cause of trauma. However, strandings represent a minimum estimate of mortality because carcasses decompose rapidly while drifting in currents and eddies and eventually sink (Epperly et al., 1996; Hart et al. 2006); consequently, many dead turtles probably never reach shore. By-catch information from different regions of the Mediterranean has been assimilated (for details see Demography Working Group 2015). Casale (2011) suggesting more than 132,000 incidental captures per year in the Mediterranean, of which more than 44,000 are predicted to be fatal; however, current knowledge on post-release mortality is restricted and needs further quantification (Álvarez de Quevedo et al. 2013). Of note, at least, 50% of small scale fisheries fleets are concentrated in the Aegean Sea, Gulf of Gabès, Adriatic and Eastern Ionian Sea, which represent the four major foraging grounds for loggerhead and green turtles in the region (for details see Demography Working Group 2015).
Conclusions		
Conclusions (brief)	Text (200 words)	At present our knowledge on sea turtle demography is patchy at best for each component, with certain information being more widely available than other information. To understand the demography of loggerhead and green turtle populations in the Mediterranean, greater effort needs to be placed on filling existing gaps. Only then can we predict with any certainty the future viability of sea turtle populations in the Mediterranean.
Conclusions (extended)	Text (no limit)	
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	• Knowledge on the sex ratios within different components (breeding, foraging, wintering, developmental habitats), age classes and overall within and across populations. • Knowledge about recruitment and mortality into different components of the population • Knowledge about the physical and genetic health status of these groups. • Vulnerability/resilience of these populations/sub-populations in relation to physical pressures; • Analysis of pressure/impact relationships for populations/sub-populations and definition of qualitative GES; • Identification of extent (area) baselines for each population/subpopulation and the habitats they encompass; • Monitor and assess the impacts of climate change on offspring sex ratios.
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9. EO2: Common Indicator 6. Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (EO2, in relation to the main vectors and pathways of spreading of such species).

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO2. Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem**
IMAP Common Indicator	Write the exact text, number	**CI6. Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (EO2, in relation to the main vectors and pathways of spreading of such species)**
Indicator Assessment Factsheet Code	Text	**EO2CI6**
Rationale/Methods		
Background (short)	Text (250 words)	**Work undertaken to define indicators, key pressures and drivers** The February 2014 Integrated Correspondence Group on GES and Targets (Integrated CorGest) of the EcAp process of the Barcelona Convention selected the Common Indicator 6 “Trends in the abundance, temporal occurrence and spatial distribution of non-indigenous species, particularly invasive nonindigenous species, notably in risk areas in relation to the main vectors and pathways of spreading of such species” from the integrated list of indicators adopted in the 18th Conference of the Parties (COP 18), as a basis of a common monitoring program for the Mediterranean in relation to non-indigenous species. The Integrated Monitoring and Assessment Programme (IMAP), adopted at the 19th Conference of the Parties to the Barcelona Convention (COP 19) in Athens, included definitions of ecological objectives, operational objectives and related indicators for the implementation of the EcAp, as well as guidelines for monitoring to address Common Indicator 6. Four main pathways, i.e. the Suez Canal, shipping, aquaculture, and aquarium trade, were identified as the main drivers of species introduction in the Mediterranean. **Policy context and targets** The CBD’s Aichi Biodiversity Target 9 is that “by 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment”. This is also reflected in Target 5 of the EU Biodiversity Strategy (EU 2011). The new EU Regulation 1143/2014 on the management of invasive alien species seeks to address the problem of IAS in a comprehensive manner so as to protect native

		biodiversity and ecosystem services, as well as to minimize and mitigate the human health or economic impacts that these species can have. The Regulation foresees three types of interventions: prevention, early detection and rapid eradication, and management. The Marine Strategy Framework Directive (MSFD) specifically recognizes the introduction of marine alien species as a major threat to European biodiversity and ecosystem health, requiring EU Member States to include alien species in the definition of GES and to set environmental targets to reach it. Hence, one of the 11 qualitative descriptors of GES defined in the MSFD is that “non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem” (Descriptor 2). Among the indicators adopted to assess this descriptor are “trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species”. Ecological Objective 2 and the Common Indicator 6 are in agreement with the MSFD objectives and targets.
Background (*extended*)	Text (no limit), images, tables, references	
Assessment methods	Text (200-300 words), images, formulae, URLs	
Results		NOTE: If the assessment has been performed at different geographical scales, include the results and conclusions accordingly.
Results and Status, including trends (brief)	Text (500 words), images	Two basin-wide inventories of the marine alien species of the Mediterranean have been published the last years, by Zenetos et al. (2010, 2012) and Galil (2012). Furthermore, many national lists of marine alien species have been published, most of them the last decade, including Croatia, Cyprus, Greece, Israel, Italy, Libya, Malta, Slovenia, and Turkey. All known alien species introductions have been compiled in the Marine Mediterranean Invasive Alien Species online database (MAMIAS; www.mamias.org), developed by RAC/SPA in collaboration with the Hellenic Centre for Marine Research (HCMR). According to MAMIAS, 1057 non-indigenous species have been reported in the Mediterranean Sea (excluding vagrant species and species that have expanded their range without human assistance through the Straits of Gibraltar), of which 618 are considered as established. Of those established species, 106 have been flagged as invasive. Among the four Mediterranean sub-regions, the highest number of established alien species has been reported in the eastern Mediterranean, whereas the lowest number in the Adriatic Sea (Table 1). In terms of alien species richness, the dominant group is Mollusca, followed by Crustacea, Polychaeta, Macrophyta, and Fish (Fig. 1). The taxonomic identity of alien species differs among the four sub-basins, with macrophytes being the dominant group in the western and central Mediterranean and in the Adriatic Sea (Table 1).

Table 1: Summarized information for each Mediterranean sub-region about the status of alien invasions. Sources: MAMIAS, Zenetos et al. (2012)

	Eastern Mediterranean	**Central Mediterranean**	**Adriatic**	**Western Mediterranean**
number of established alien species	468	183	135	215
most important pathway of introduction	Suez Canal	shipping	shipping	shipping
2nd most important pathway	shipping	Suez Canal	aquaculture	aquaculture
richest taxons in alien biota	Mollusca, Crustacea	Macrophyta, Polychaeta	Macrophyta, Mollusca	Macrophyta, Crustacea
trend in the rate of new introductions (based on the last 3 decades)	increasing	decreasing	decreasing	decreasing

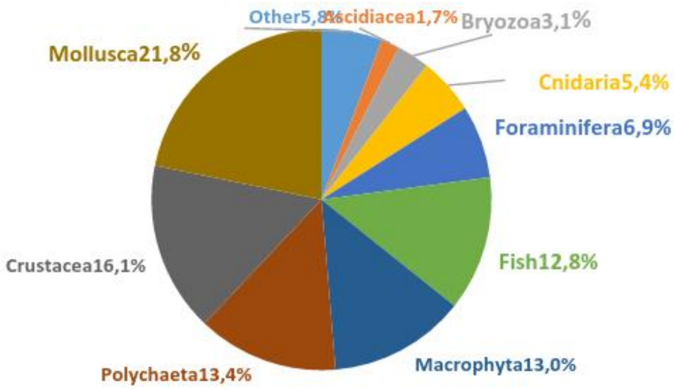

Figure 1: Contribution of the major taxa in the alien marine biota of the Mediterranean Sea. Modified from Zenetos et al. (2012).

Alien species in the Mediterranean Sea are linked to four main pathways of introduction: the Suez Canal, shipping (ballast waters and hull fouling), aquaculture, and aquarium trade. Overall in the Mediterranean, the Suez Canal is the most important pathway, contrary to the situation in Europe, where shipping is the most important (Fig. 2). Nevertheless, the importance of pathways varies among the four Mediterranean sub-regions, with shipping being the most important pathway in the western and central Mediterranean and the Adriatic (Table 1). An assessment of the 'gateways' (i.e. countries of initial introduction) to alien invasions in the European Seas (Nunes et al. 2014) revealed marked geographic patterns depending on the pathway of introduction. The Suez Canal was the predominant pathway of first introductions in Egypt, Lebanon, Israel, Syria and the Palestine Authority (all in the eastern Mediterranean), representing more than 70% of each country's first introduction events. For the other Mediterranean countries, shipping was the predominant pathway of initial introduction.

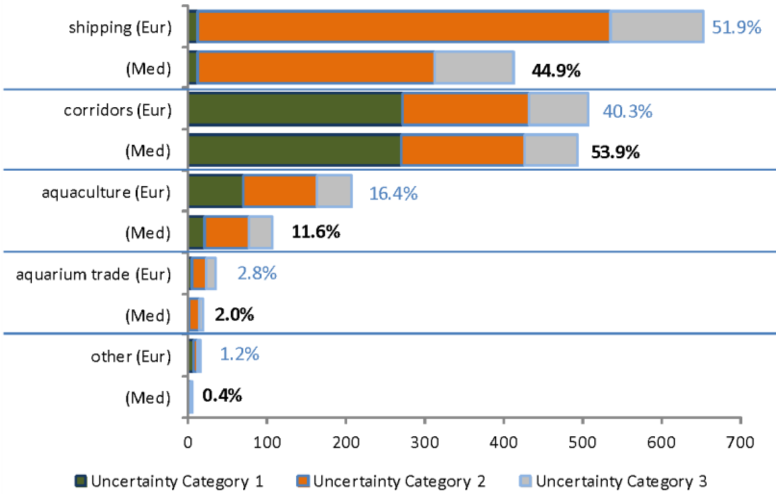

Figure 2: Number of marine alien species known or likely to have been introduced by each of the main pathways, in Europe (Eur) and the Mediterranean (Med). Percentages add to more than 100% as some species are linked to more than one pathway (blue percentages refer to the European total, while black percentages to the Mediterranean total). Uncertainty categories: (1) there is direct evidence of a pathway/vector; (2) a most likely pathway/vector can be inferred; (3) one or more possible pathways/vectors can be inferred; (4) unknown (not shown in the graph). Modified from Katsanevakis et al. (2013), Zenetos et al. (2012).

New introductions of alien species in the Mediterranean Sea have an increasing trend in the rate of new introductions by 30.7 species per decade, and the current (as of the 2000s) rate of new introductions exceeds 200 new species per decade (Fig. 3).

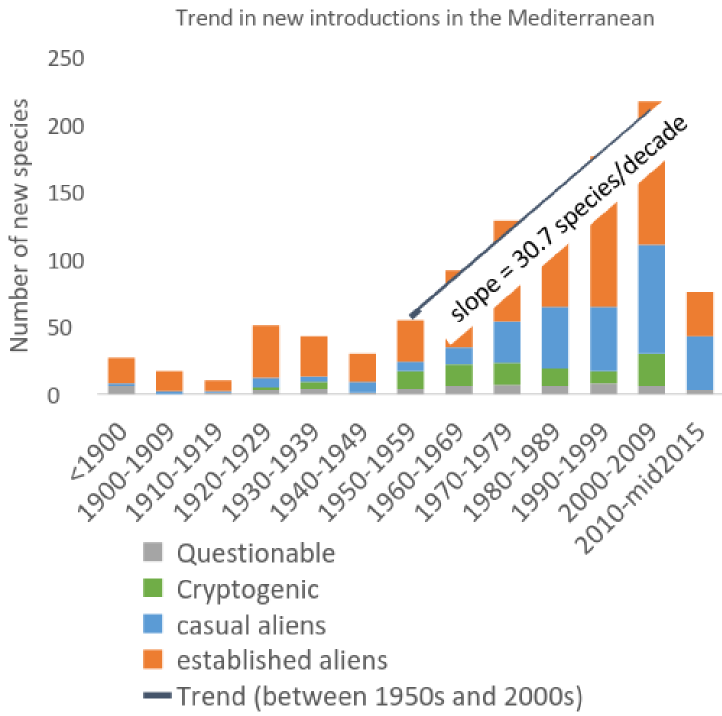

Figure 3: Trend in new introductions of alien marine species per decade in the Mediterranean Sea. Source: MAMIAS

However, this increasing trend in the rate of new introductions mainly reflects new introductions in the eastern Mediterranean, while in the other sub-regions the rate of new introductions is decreasing (Fig. 4).

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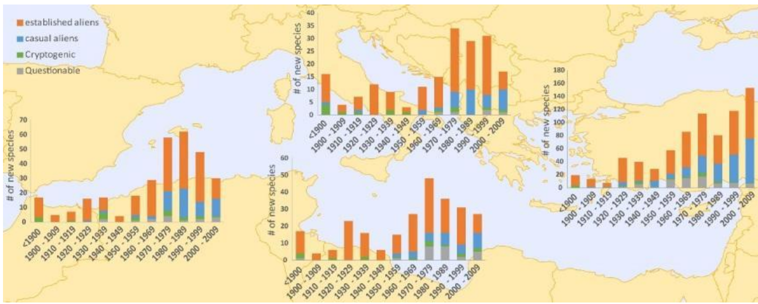

Figure 4: Trend in new introductions of alien marine species per decade in the Mediterranean sub-regions (eastern, central, western Mediterranean, and Adriatic Sea). Source: MAMIAS

The cumulative impact of alien species on the Mediterranean marine habitats was recently assessed and mapped, using the CIMPAL index, a conservative additive model, based on the distributions of alien species and habitats, as well as the reported magnitude of ecological impacts and the strength of such evidence (Katsanevakis et al. 2016). The CIMPAL index showed strong spatial heterogeneity, and impact was largely restricted to coastal areas (Fig. 5).

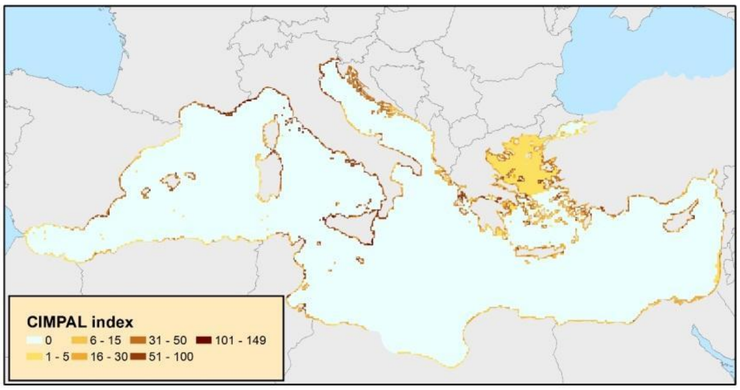

Figure 5: Map of the cumulative impact score (CIMPAL) of invasive alien species to marine habitats. Modified from Katsanevakis et al (2016).
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Important progress has been made the last decade in creating inventories of non-indigenous species, and on assessing pathways of introduction and the impacts of invasive alien species on a regional scale. The development and regular updating of MAMIAS substantially contributes to address Common Indicator 6.

Nevertheless, research effort currently greatly varies among Mediterranean countries and thus on a regional basis current assessments and comparisons may be biased. Evidence for most of the reported impacts of alien species is weak, mostly based on expert judgement; a need for stronger inference is needed based on experiments or ecological modelling. The assessment of trends in abundance and spatial distribution is largely lacking. Regular dedicated monitoring and long time series will be needed so that estimation of such trends is possible in the future. NIS identification is of crucial importance, and the lack of taxonomical expertise has already resulted in several NIS having been overlooked for certain time periods. The use of molecular approaches including bar-coding are often needed to confirm traditional species identification.
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Conclusions (extended)	Text (no limit)	
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	
List of references	Text (10 pt, Cambria style)	Galil BS, 2012. Truth and consequences: the bioinvasion of the Mediterranean Sea. Integrative Zoology 7 (3): 299–311. Katsanevakis S, Zenetos A, Belchior C, Cardoso AC, 2013. Invading European Seas: assessing pathways of introduction of marine aliens. *Ocean and Coastal Management* 76: 64–74. Katsanevakis S, Tempera F, Teixeira H, 2016. Mapping the impact of alien species on marine ecosystems: the Mediterranean Sea case study. *Diversity and Distributions* 22: 694–707. Nunes AL, Katsanevakis S, Zenetos A, Cardoso AC, 2014. Gateways to alien invasions in the European Seas. *Aquatic Invasions* 9(2): 133–144. Zenetos A, Gofas S, Verlaque M, Çinar ME, Garcia Raso JE, *et al*, 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. *Mediterranean Marine Science* 11 (2): 318–493. Zenetos A, Gofas S, Morri C, Rosso A, Violanti D, *et al*, 2012. Alien species in the Mediterranean Sea by 2012. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part 2. Introduction trends and pathways. *Mediterranean Marine Science* 13(2): 328–352.

Annex

Common Indicator Guidance Factsheets related to Fisheries

Common Indicator 7: Spawning Stock Biomass (EO 3)

Indicator Title	*Common Indicator 7: Spawning Stock Biomass*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Achieving or maintaining good environmental status requires that SSB values are equal to or above SSB_{MSY}, the level capable of producing maximum sustainable yield (MSY).	The Spawning Stock Biomass is at a level at which reproduction capacity is not impaired	<u>State</u> -$B > B_{thr}$

Rationale

Justification for indicator selection

In 2012, following several recommendations made on the management of different fisheries in the Mediterranean and Black Sea (e.g. Recommendations GFCM/27/2002/1, GFCM/30/2006/1 and Resolution GFCM 33/2009/1 on the management of certain fisheries exploiting demersal and small pelagic), and on the basis of Scientific Advisory Committee on Fishery (SAC) advice on the need to develop multiannual management plans based on agreed reference points, the GFCM has formulated the "*Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area*". In the GFCM guidelines are included clear indications on suitable objectives and procedures to implement a management plan, and is reported a clear definition of the requirements to provide scientific advice useful for management. The framework is based on the definition of reference points related to key indicators of the status of stocks, such as stock biomass and fishing mortality. Indeed these guidelines, in relation to reference points and stock status, define suitable indicators for biomass either *Total Biomass or Spawning Stock* Biomass, while suitable indicators for exploitation can be either *Fishing mortality or Exploitation rate* (ratio between fishing mortality and total mortality). In all cases, reference points should be defined in relation to the indicator used. Following the recommendations from the SAC, the advice should be based, if possible, on both indicators of biomass and exploitation, and for each indicator ideally target, threshold and limit (e.g. B_{tgt}, B_{thr}, B_{lim}) reference points should be defined. When only one indicator is available, there should be a clear advice to explore the possibility of having indicators for both biomass and exploitation.

In general terms, a suggested target reference point for biomass and exploitation is that value of the indicator at which maximum sustainable yield (MSY) is obtained from the fishery, in accordance with the 1995 UN Fish Stocks Agreement (UNFSA), while limit and threshold reference points should be established based on precautionary principles.

<u>*Spawning Stock Biomass*</u>

Biomass reference points are nearly always based on SSB, which is one of the most important stock status indicators and the primary indicator for the reproductive capacity of the stock. Achieving or maintaining good environmental status requires that SSB values are equal to or above SSB_{MSY} (the level capable of producing Maximum Sustainable Yield-MSY).

B_{thr} (Biomass threshold) is defined as a point at which the probability to be below B_{lim} (Biomass limit) is lower than 5%. In absence of precise estimates of the distribution of the biomass estimate, a lognormal distribution of B_{lim} should be assumed, with a coefficient of variation of 40%. This approximately results in $B_{thr} = 2*B_{lim}$.

Fishing mortality (F) is directly related to the way a stock is being fished. Yield will increase as more fishing capacity is applied (more vessels or fishing effort) until it reaches a maximum level (MSY). If fishing mortality is increased further than this MSY, yield will decrease because smaller size fish (which are too young to reproduce) are being caught, leading to a continuous decline of the SSB (total weight of mature fish). Even if a stock is fished at a constant level of fishing mortality, the SSB can fluctuate due to natural factors. Thus, a stock fished constantly at F_{MSY} (the value of F expected to produce the long-term maximum sustainable yield) should result in the SSB fluctuating around SSB_{MSY} (the spawning-stock biomass expected to produce the long-term maximum sustainable yield).

Scientific References

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

-FAO. 1996. Precautionary approach to fisheries. Part 2: scientific papers. Prepared for the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions). Lysekil, Sweden, 6–13 June 1995. FAO Fisheries Technical Paper. No. 350, Part 2. Rome. 210 pp.

-GFCM, 2002. Recommendation GFCM/27/2002/1: Management of selected demersal and small pelagic species.

-GFCM, 2006. Recommendation. GFCM/30/2006/1: Management of certain fisheries exploiting demersal and

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small pelagic.
-GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area.
-ICES, 2008. Report of the Workshop on Methods to Evaluate and Estimate the Accuracy of Fisheries Data used for Assessment (WKACCU). Bergen, Norway, 27–30 October 2008. ICES CM 2008\ACOM: 32. 41 pp.
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-Sparre, P.; Venema, S.C. Introduction to tropical fish stock assessment. Part 1. Manual. *FAO Fisheries Technical Paper.*No. 306.1, Rev. 2. Rome, FAO. 1998. 407p.
-Sparre P.J., 2000. Manual on sample-based data collection for fisheries assessment. Examples from Vietnam. FAO Fisheries Technical Paper. No. 398. Rome, FAO. 2000. 171 pp.
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Policy Context and targets (other than IMAP)

Policy context description

The overall operational objectives of GFCM are to ensure the conservation and sustainable use, at the biological, social, economic and environmental level, of living marine resources in the area of application.
This means maintain the sustainability of fisheries, in order to prevent overfishing of demersal and small pelagic fish stocks, maintain their stocks at levels that can produce the maximum sustainable yield (MSY) and to facilitate the restoration of stocks to historical levels. GFCM also aims to guarantee a low risk of stocks falling outside safe biological limits and to ensure protection of biodiversity to avoid undermining ecosystems structure and functioning (GFCM, 2013). Fishing mortality must be kept below safe levels to ensure long-term high yields, while limiting the risk of stock collapse and guaranteeing stable and viable fisheries (GFCM, 2012).
To follow these issues and to advance towards its goal of sustainability of fisheries, the GFCM has established a temporal framework and intermediate global objectives through the implementation of both the mid-term strategy (GFCM, 2016b) and the different recommendations as in the Compendium of GFCM decisions.

Indicator/Targets

- SAC 2014: "*Provides definitions for stock status and management advice on stocks for which reference points related to indicators of biomass and/or exploitation are available*."
- Common Fisheries Policy: "*The current policy stipulates that between 2015 and 2020 catch limits should be set that are sustainable and maintain fish stocks in the long term*"
- EU-MSFD Descriptor 3: "*Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock"*

Policy documents

- EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF
- GFCM, 2012a. Report of the Transversal Workshop on Spatial Based Approach to Fisheries Management, Rome, Italy, 6–8 February 2012. 2 March 2016]. https://gfcmsitestorage.blob.core.windows.net/ documents/Reports/2012/GFCM-Report-2012-SAC-SCs-Spatial-Approach.pdf
-GFCM, 2012b. Resolution OTH-GFCM/36/2012/ Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area
- GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis. http://www.fao.org/3/a-ax847e.pdf
- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. http://www.fao.org/3/a-i4381b.pdf
- GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp.
-GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries.
- Recommendation GFCM/33/2009/3, 2009. On the implementation of the GFCM task 1 statistical matrix and repealing resolution GFCM/31/2007/1. www.fao.org/gfcm/decisions
- Regulation (EU) No 1380/2013 of the European parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC
- UNEP-MAP 2012. EcAp-MED Project Document. Implementation of the Ecosystem Approach (EcAp) in the

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Mediterranean by the Contracting parties in the context of the Barcelona Convention for the Protection of the Marine Environment and the Coastal region of the Mediterranean and its Protocols. 34pp.	
Indicator analysis methods	
Indicator Definition *Description: The Spawning Stock Biomass, usually referred to as SSB, is the total weight of the spawning stock. The SSB is available through stock assessment so not all species will have this information. Note that B_{MSY} is currently not considered as a threshold for stock management in European waters and values are not available. When both biomass indices and exploitation indicators are available (only for few species) the most precautionary will be adopted. Only available if the stock has been assessed. This indicator is linked with sustainable fishing.* The spawning stock biomass (SSB) is the combined weight of all individuals in a fish stock that are capable of reproducing. To calculate the spawning stock biomass, it is necessary to have estimates of the number of fish by length/age group, estimates of the average weight of the fish in each length/age group and an estimate of the amount of fish in each length/age group that are mature. SSB and SSB_{MSY} need to be estimated from appropriate quantitative assessments based on the analysis of catch at-age or/and at length (to be taken as all removals from the stock including discards). Where possible, reference points relative to SSB should be established for each stock. Priority species (Group 1, 2 and 3), as reported in Appendix A of the GFCM-Data Collection Reference Framework (GFCM-DCRF, 2016), will be the species considered for the evaluation for this indicator (see attached Appendix A with the list of priority species).	
Methodology for indicator calculation The status of stocks is ideally based on a validated stock assessment model, from which indicators of stock status (e.g. biomass, fishing mortality, recruitment) are obtained, and reference points are agreed for the chosen indicators. When possible, analytical stock assessment models that incorporate both fishery-dependent (e.g. catches) and independent information (e.g. surveys) are used, although direct surveys are used for some stocks. Different stock assessment models are used in the GFCM area of application, including variations of virtual population models (from pseudo-cohort based models, such as VIT, to tuned versions, such as extended survivor analysis – XSA), statistical catch at age analysis (e.g. state-space assessment model – SAM or stock synthesis – SS3) and biomass models (BioDyn, two-stage biomass models, etc.). Some stock assessment methods are only based on information from scientific surveys at sea (e.g. survey-based assessment – SURBA, or acoustic estimates of biomass). When no analytical assessment model or reference points are validated by the Scientific Advisory Committee on Fishery (SAC), advice can still be provided on a precautionary basis, in cases where there is evidence that the stock may be threatened (high fishing pressure, low biomass, habitat loss, etc.). When possible, advice on stock status should be based both on biomass and on fishing pressure, using indicators and reference points for both quantities.	
Indicator units (*under development*) • Number of stocks for which status with respect to SSB_{MSY} is known • The number (and proportion) of stocks above or below SSB_{MSY} • Trends in SSB	
List of Guidance documents and protocols available - GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. - GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp. - GFCM 2016. GFCM-DCRF, Data Collection Reference Framework. GFCM Secretariat. 116 pp. -Stock Assessment Form version 1.0 (January 2014 - http://www.fao.org/gfcm/data-reporting/data-reporting-stock-assessment/en/)	
Data Confidence and uncertainties	
Methodology for monitoring, temporal and spatial scope	
Available Methodologies for Monitoring and Monitoring Protocols Several analytical methods, based on population dynamics of different stocks of demersal and small pelagic species, have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. In the GFCM area, data for the assessment of stocks are collected through stock	

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assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Within the GFCM mandate a series of stocks are assessed on an annual basis. On a yearly basis, Scientific and Advisory Committee (SAC) and the Working for the Black Sea (WGBS) will identify those species/stocks that should be assessed and for which stock assessment form should be provided.	
Available data sources -Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016 http://www.fao.org/gfcm/reports/statutory-meetings/en/ -Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp. http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/ -Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Demersal Species (WGSAD), 2015 (23 November-28 November) GFCM HQ. 60pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1 https://stecf.jrc.ec.europa.eu/meetings/2015 -Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2 https://stecf.jrc.ec.europa.eu/meetings/2015	
Spatial scope guidance and selection of monitoring stations Stock assessment in the GFCM area of application is often conducted by management units, based on GSAs (Resolution GFCM/33/2009/2). This method does not ensure that the whole stock is assessed, since stocks may cover several different management units. In some cases, when there is scientific evidence of a stock spreading through different GSAs existing information is combined across GSAs. Although the concept of their delimitation still needs further consideration, the GSAs, appear as the most appropriate subdivisions for stock assessments for management purposes in the Mediterranean Sea.	
Temporal Scope guidance (*under development*)	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation (*under development*)	
Expected assessments outputs • Monitoring trend of SSB • Monitoring the stock(s) performance • Project the stock(s) trend over time • Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources. The information gathered should be sufficient and reliable enough to review the status of the different resources, to assess the economic and social dimensions of the fleets and to provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.	
Known gaps and uncertainties in the Mediterranean Even if stock assessments and advice are now available for several stocks in the Mediterranean and Black Sea, and the number of stocks for which estimates of MSY-based indicators are available has also increased, still different stocks lack information on spawning stock biomass (SSB) and/or proxies are not available; thus, it is not possible to establish reproductive potential levels relative to MSY. Furthermore, the exploitation of several stocks may be shared, and the available scientific inputs have not been sufficient or have not been organised cohesively at the appropriate scale in view of supporting a regional based decision making process. Some countries have not been kept an acceptable level of accuracy due to different causes including the fragmented nature of smaller size stocks exploited by artisanal multiple-gears fisheries,	

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small fishing fleets dispersed over quite long coastlines and islands, and/or no data collection in place.		
Contacts and version Date		
GFCM Secretariat (gfcm-secretariat@fao.org)		
Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

Common Indicator 8: Total landing (EO3)

Indicator Title	*Common Indicator 8: Total landing*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Populations of selected commercially exploited fish and shellfish are within biologically safe limits, exhibiting a population age and size distribution that is indicative of a healthy stock.	Total catch of commercial species does not exceed the Maximum Sustainable Yield (MSY) and the by-catch is reduced.	State -Long-Term High Yields -Catch $\leq$ MSY Pressure -Reduction of IUU catch -Minimization of discarding and incidental catch of vulnerable species

Rationale

Justification for indicator selection

In 2012, following several recommendations made on the management of different fisheries in the Mediterranean and Black Sea (e.g. Recommendations GFCM/27/2002/1, GFCM/30/2006/1 and Resolution GFCM 33/2009/1 on the management of certain fisheries exploiting demersal and small pelagic), and on the basis of Scientific Advisory Committee on Fishery (SAC) advice, the GFCM has formulated the "*Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area*". In the GFCM guidelines are included clear indications on suitable objectives and procedures to implement a management plan, and is reported a clear definition of the requirements to provide scientific advice useful for management. The framework is based on the definition of reference points related to key indicators of the status of stocks, such as stock biomass and fishing mortality. Indeed these guidelines, in relation to reference points and stock status, define suitable indicators for biomass either *Total Biomass or Spawning Stock Biomass*, while suitable indicators for exploitation can be either *Fishing mortality or Exploitation rate* (ratio between fishing mortality and total mortality). In all cases, reference points should be defined in relation to the indicator used. Following the recommendations from the SAC, the advice should be based, if possible, on both indicators of biomass and exploitation, and for each indicator ideally target, threshold and limit (e.g. F_{tgt}, F_{thr}, F_{lim}) reference points should be defined. When only one indicator is available, there should be a clear advice to explore the possibility of having indicators for both biomass and exploitation.

In general terms, a suggested target reference point for biomass and exploitation is that value of the indicator at which maximum sustainable yield (MSY) is obtained from the fishery, in accordance with the 1995 UN Fish Stocks Agreement (UNFSA), while limit and threshold reference points should be established based on precautionary principles.

Total landing

Managing stocks according to MSY will mean going to fishing rationally on abundant stocks. Based on scientific advice, fishing must be adjusted to bring exploitation to levels that maximise yields (or catch) within the boundaries of sustainability. Catch represents the amount of marine biological resource, taken by the fishing gear, which reaches the deck of the fishing vessel. This includes catches of individuals of the target species, which are usually kept on board and brought ashore (the landed fraction), and bycatch, which refers to catches of species that are not targeted by the fishery, with or without commercial value. Monitoring the landed fraction, it is of paramount importance in order to evaluate the trends in fish populations and, more generally, trends in the fishery. Landing data coupled with information on fishing effort and prices, will make possible to keep track of the state and growth of a fishing fleet, evaluating changes in the status of the resources and performing basic analysis of the economic performance of the fisheries.

Therefore, this indicator is fundamental in order to:

- determine the level at which fisheries resources can be exploited without exhausting them;
- determine the Maximum Sustainable Yield (MSY).
- measuring the level of exploitation or total fishing pressure on an ecosystem (including IUU catch and discards).

Care needs to be taken in interpreting trends in this indicator because variations in total catch/landing are not only the result of fishing: changes over time in the selectivity of fishing gear, changes in the species targeted by fishing activities, as well as inconsistencies in reported catches, might be also responsible in the trend of this indicator.

Current status

In the Mediterranean and Black Sea around 85% of EU fish stocks are overfished. This overfishing, leads to uncertain catches and makes the fishing industry vulnerable. Within the GFCM mandate a series of stocks are

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assessed on an annual basis, and for some fish stocks, no estimates of MSY are currently available. In order to have reliable information to assess the stocks and to determine MSY there is the need to have reliable fishing data. In the GFCM areas, data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Recently, the GFCM has also developed a new specific data requirement in force for data collection and submission: the Data Collection Reference Framework (GFCM-DCRF, 2016). This new framework has been adopted during the GFCM annual Session 2015. The DCRF is the first GFCM comprehensive framework for the collection and submission of the fisheries-related data that are requested as per existing GFCM Recommendations and are necessary for relevant GFCM subsidiary bodies to formulate advice in accordance with their mandate. It encompasses all the necessary indications for the collection of fisheries data (i.e. global figure of national fisheries, catch; incidental catch of vulnerable species; fleet; effort; socio-economics; biological information) by GFCM members in a standardized way, in order to provide the GFCM with the minimum set of data needed to support fisheries management decision-making processes.	
Scientific References - FAO, 1999. *Guidelines for the routine collection of capture fishery data*. Prepared at the FAO/DANIDA Expert Consultation. Bangkok, Thailand (18–30 May), 1998. FAO, Fish. Tech. Pap. 382. Rome, FAO. 113 pp. - FAO, 2016. *The State of Mediterranean and Black Sea Fisheries*. General Fisheries Commission for the Mediterranean. Rome, Italy. -GFCM, 2002. Recommendation GFCM/27/2002/1: Management of selected demersal and small pelagic species. -GFCM, 2006. Recommendation. GFCM/30/2006/1: Management of certain fisheries exploiting demersal and small pelagic. -GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area. - Joint research agreement 2013. A Mediterranean Cooperation for the Sustainable Use of the Marine Biological Resources. A supportive tool for the synergic implementation of the MSFD and the ECAP initiative. Joint Project Agreement between the Ministry of the Environment, Territory and Sea of Italy and the GFCM. - GFCM 2012. Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area. 2012. - GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis. - GFCM 2014a. Reference points and advice in the SAC ad in other relevant organizations. WKREF-WGSA. Bar, Montenegro, 28th January-1st February 2014. - GFCM, 2014b. Report of the First MedSuit Regional Workshop on indicators and targets to ensure GES of commercially exploited marine populations in the GFCM area. FAO HQ, Rome, Italy (6–7 November 2014). 14 pp. - GFCM, 2014c. Report of the Workshop on the implementation of the DCRF in the Mediterranean and the Black Sea. Madrid, Spain (15-16 December) 2014. 22 pp. - GFCM 2016. GFCM-DCRF, Data Collection Reference Framework. GFCM Secretariat. 116 pp. - Patterson, K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. Reviews in Fish Biology and Fisheries, 2, pp. 321–338. - UNEP-MAP, 2012. Support to the Barcelona Convention for the implementation of the ecosystem approach. Including the establishment of MPAs in open seas areas, including deep sea. Contribution Agreement N°21.0401/2008/519114/SUB/D2. Final Report, April 2012. 50pp. - UNEP-MAP & GFCM 2013. Background document on cooperation needs between UNEP-MAP and GFCM. Internal document. 14pp. -United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995	
Policy Context and targets (other than IMAP)	
Policy context description The overall operational objectives of GFCM are to ensure the conservation and sustainable use, at the biological, social, economic and environmental level, of living marine resources in the area of application. This means maintain the sustainability of fisheries, in order to prevent overfishing of demersal and small pelagic fish stocks, maintain their stocks at levels that can produce the maximum sustainable yield (MSY) and to facilitate the restoration of stocks to historical levels. GFCM also aims to guarantee a low risk of	

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stocks falling outside safe biological limits and to ensure protection of biodiversity to avoid undermining ecosystems structure and functioning (GFCM, 2013). Fishing mortality must be kept below safe levels to ensure long-term high yields, while limiting the risk of stock collapse and guaranteeing stable and viable fisheries (GFCM, 2012).
To follow these issues and to advance towards its goal of sustainability of fisheries, the GFCM has established a temporal framework and intermediate global objectives through the implementation of both the mid-term strategy (GFCM, 2016b) and the different recommendations as in the Compendium of GFCM decisions.

Indicator/Targets

- SAC 2014: "P*rovides definitions for stock status and management advice on stocks for which reference points related to indicators of biomass and/or exploitation are available*."
- Common Fisheries Policy: "*The current policy stipulates that between 2015 and 2020 catch limits should be set that are sustainable and maintain fish stocks in the long term*"
- EU-MSFD Descriptor 3: "*Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock"*

Policy documents

- EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF
- GFCM, 2012a. Report of the Transversal Workshop on Spatial Based Approach to Fisheries Management, Rome, Italy, 6–8 February 2012. 2 March 2016]. https://gfcmsitestorage.blob.core.windows.net/ documents/Reports/2012/GFCM-Report-2012-SAC-SCs-Spatial-Approach.pdf
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- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. http://www.fao.org/3/a-i4381b.pdf
- GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp.
-GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries.
- Recommendation GFCM/33/2009/3, 2009. On the implementation of the GFCM task 1 statistical matrix and repealing resolution GFCM/31/2007/1. www.fao.org/gfcm/decisions
- Regulation (EU) No 1380/2013 of the European parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC
- UNEP-MAP 2012. EcAp-MED Project Document. Implementation of the Ecosystem Approach (EcAp) in the Mediterranean by the Contracting parties in the context of the Barcelona Convention for the Protection of the Marine Environment and the Coastal region of the Mediterranean and its Protocols. 34pp.

Indicator analysis methods

Indicator Definition
The total catch is the quantity of fish that is retained by the fishing gear during fishing operations. This should ideally include landings by commercial fleet, national landings in foreign ports, and foreign landings in domestic ports, recreational fishing, bycatch and IUU estimates.
The Maximum Sustainable Yield (MSY) is the theoretical maximum catch that can be extracted from a stock. Due to difficulties to calculate MSY, this should be a limit. This indicator is linked with sustainable fishing and conservation of biodiversity.

MSY is extensively used as indicator for fisheries management and it is, probably, the most important yield indicator of the landed catch over some time-period. The sustainable yield of any fish stock is the amount that can be fished annually without decreasing the stock's ability to yield fish in future years. This is determined by calculating the population weight or biomass that is added every year through recruitment and the growth of young fish, and then deducting its natural mortality. Yield can be highly variable but is related to growth of

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fish, stock size, the spawning stock biomass SSB, the recruitment, and to the proportion of the stock harvested by fishing (fishing mortality F).

This indicator will be assessed according both to the Mediterranean and Black Sea sub-areas (GSA) and GFCM sub-regions (Appendix L; GFCM-DCRF, 2016) in order to reflect spatial changes. Further, priority species (Group 1, 2 and 3 as reported in Appendix A of the GFCM-Data Collection Reference Framework GFCM-DCRF, 2016), and also vulnerable species (Appendix E of the GFCM-DCRF, 2016), will be the species considered for the evaluation of this indicator (see attached Appendix A reporting the list of priority species and Appendix E reporting the vulnerable species). Other biodiversity components such as exploited populations, communities and ecosystem, will be investigated.

Methodology for indicator calculation

Reliable fishing data (i.e. landing and/or catch data), necessary to perform the assessment of the different stocks, may come from different sources and are usually derived from a combination of catch reports, logbooks, observers on board, observers at market and/or at landing place, market and/or landing survey, and landing statistics from port authorities. Landing/catch information can be measured and classified by species, area, fishing gear used, and other information that can be collected during the same sampling process.

Several analytical methods, based on population dynamics of different stocks of demersal and small pelagic species, have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. In the GFCM area, data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Within the GFCM mandate a series of stocks are already assessed on an annual basis. On a yearly basis, Scientific and Advisory Committee (SAC) and the Working for the Black Sea (WGBS) will identify those species/stocks that should be assessed and for which stock assessment form should be provided.

Indicator units

- Total catch/landing (weight in tons)
- Trends of the biomass
- Trends of discards behavior (i.e. weight of discarded target species by fleet segments; total volume discarded)
- The number of stocks for which catch is below MSY

List of Guidance documents and protocols available

- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp.
- GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp.
- Data Collection Reference Framework (GFCM-DCRF, 2016)
-Stock Assessment Form version 1.0 (January 2014 - http://www.fao.org/gfcm/data-reporting/data-reporting-stock-assessment/en/)

Data Confidence and uncertainties

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Information on capture production is collected annually from relevant national offices concerned with fishery statistics, by means of the form GFCM-STATLANT 37A. This form is part of the STATLANT system of questionnaires developed by the Coordinating Working Party on Fishery Statistics (CWP) and dispatched by FAO on behalf of regional fisheries management organizations (RFMO) to the relevant national authorities. This questionnaire covers the reporting of annual catch data, requesting a breakdown of the catches by species and statistical divisions of the FAO Major Fishing Area 37 coinciding with the GFCM area of competence.
Total landing figures can be obtained from different sources and are usually derived from a combination of catch reports, logbooks, observers, market and/or landing survey or landing statistics from port authorities. Landing data can be further measured and classified by species, area, fishing gear used, and other factors.

Available data sources

-GFCM-DCRF, 2016. Data Collection Reference Framework on line platform (under development)
-FAO, 2016. Fisheries and Aquaculture Department FAO Fishery Commodities Global Production and Trade [Database]. [Cited 2 March 2016].

Indicator Title	*Common Indicator 8: Total landing*
http://www.fao.org/fishery/statistics/global-commoditiesproduction/query/en -Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016 http://www.fao.org/gfcm/reports/statutory-meetings/en/ -Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp. http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/ -Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Demersal Species (WGSAD), 2015 (23 November-28 November) GFCM HQ. 60pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1 https://stecf.jrc.ec.europa.eu/meetings/2015 -Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2 https://stecf.jrc.ec.europa.eu/meetings/2015	
Spatial scope guidance and selection of monitoring stations In the Mediterranean and Black Sea the Geographical Sub-Areas (GSA) represent the management units (Resolution GFCM/33/2009/2). The GSA delimitation is mainly based on practical considerations rather than on the stock distribution, and many stocks extend beyond the geographic limits of GSAs. However, although the concept of their delimitation still needs further consideration, the GSAs, as established by GFCM appear as the most appropriate subdivisions for stock assessments for management purposes in the Mediterranean Sea. They are also adopted for assessments at national level.	
Temporal Scope guidance (*under development*)	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation (*under development*)	
Expected assessments outputs • Monitoring of total annual biomass landed. • Monitoring trends of the catch (by fleet segment, country and area). • Monitoring the stock(s) performance • Project the stock(s) trend over time • Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.	
Known gaps and uncertainties in the Mediterranean The limited monitoring of fisheries catch/landing makes it difficult to evaluate the relative contribution of the sector to the exploitation of stocks assessed by the GFCM. There are, several important gaps of knowledge concerning landing data: information are not complete (in terms of species identification, quantities etc.) for several fishing gears; countries or/and subregions and most of the existing studies cover relatively short temporal and small spatial scales; there are significant discrepancies between sub-regions in terms of availability, quality and relevance of data that could be useful for conducting GES assessments in relation to EO 3. The rationale behind the new GFCM-DCRF is to reduce data requirements and encompass them into a single, simple and easy-to-understand manual, providing Members with the necessary indications for the collection and transmission of data related to fisheries to the GFCM Secretariat. Moreover, the information gathered should be sufficient and reliable enough to review the status of the different resources, to assess the economic and social dimensions of the fleets and to provide scientific advice on the status of the resources, as well as to allow Members to prepare recommendations to manage those resources.	

Indicator Title	*Common Indicator 8: Total landing*	
Contacts and version Date		
GFCM Secretariat (gfcm-secretariat@fao.org)		
Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

Common Indicator 9: Fishing mortality (EO 3)

Indicator Title	*Common Indicator 9: Fishing mortality*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Populations of selected commercially exploited fish and shellfish are within biologically safe limits, exhibiting a population age and size distribution that is indicative of a healthy stock	Fishing mortality in the stock does not exceed the level that allows MSY ($F \leq F_{MSY}$).	Pressure -F_{MSY} -F0.1 a proxy of F_{MSY} (more precautionary)
Rationale		

Justification for indicator selection

In 2012, following several recommendations made on the management of different fisheries in the Mediterranean and Black Sea (e.g. Recommendations GFCM/27/2002/1, GFCM/30/2006/1 and Resolution GFCM 33/2009/1 on the management of certain fisheries exploiting demersal and small pelagic), and on the basis of Scientific Advisory Committee on Fishery (SAC) advice on the need to develop multiannual management plans based on agreed reference points, the GFCM has formulated the "*Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area*". In the GFCM guidelines are included clear indications on suitable objectives and procedures to implement a management plan, and is reported a clear definition of the requirements to provide scientific advice useful for management. The framework is based on the definition of reference points related to key indicators of the status of stocks, such as stock biomass and fishing mortality. Indeed these guidelines, in relation to reference points and stock status, define suitable indicators for biomass either *Total Biomass or Spawning Stock Biomass*, while suitable indicators for exploitation can be either *Fishing mortality or Exploitation rate* (ratio between fishing mortality and total mortality). In all cases, reference points should be defined in relation to the indicator used. Following the recommendations from the SAC, the advice should be based, if possible, on both indicators of biomass and exploitation, and for each indicator ideally target, threshold and limit (e.g. F_{tgt}, F_{thr}, F_{lim}) reference points should be defined. When only one indicator is available, there should be a clear advice to explore the possibility of having indicators for both biomass and exploitation.

In general terms, a suggested target reference point for biomass and exploitation is that value of the indicator at which maximum sustainable yield (MSY) is obtained from the fishery, in accordance with the 1995 UN Fish Stocks Agreement (UNFSA), while limit and threshold reference points should be established based on precautionary principles.

Fishing mortality

Fishing mortality, it is considered an essential component of fishery stock status and a fundamental variable in stock assessment. Generally, fishing mortality is defined as the instantaneous rate of the mortality of the number of individuals that die due to fishing, and can be defined in terms either of numbers of fish or in terms of biomass of fish. When fishing mortality is used as an indicator, $F_{0.1}$ (defined as the fishing mortality rate at which the slope of the yield-per-recruit curve is only one-tenth the slope of the curve at its origin) can be used as a proxy for F_{MSY} (i.e. the fishing mortality rate that produces the maximum sustainable yield). The aim of this indicator is to determine the optimum catch that can be harvested from a stock.

Current status

In the Mediterranean and Black Sea, the majority (around 85 percent) of stocks for which a validated assessment exist are fished outside biologically sustainable limits. Biomass reference points are not commonly available for assessed stocks; therefore this percentage is mainly estimated from the level of fishing mortality in relation to the fishing mortality reference point. Current fishing mortality rates can be up to 12 times higher than the target for some stocks (e.g. hake). Most stocks fished within biologically sustainable limits are of small pelagic species (sardine, anchovy or sprat), while only a few stocks of demersal species, such as whiting, some shrimp species, picarel and red mullet, are estimated to be fished at or below the reference point for fishing mortality.

To ensure the highest quality stock assessments, the data used must be accurate and timely evaluated. The Mediterranean fisheries are characterised by fragmented fleets, usually composed by relatively small vessels, use of a large number of landing sites, with multi-species catches. These factors make it difficult and expensive to get extensive and reliable data time series and to get biological samples. In the GFCM areas, data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain

Indicator Title	*Common Indicator 9: Fishing mortality*
information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Further, the GFCM has recently developed a new specific data requirement in force for data collection and submission: the Data Collection Reference Framework (GFCM-DCRF, 2016). This new framework has been adopted during the GFCM annual Session 2015. The DCRF is the first GFCM comprehensive framework for the collection and submission of the fisheries-related data that are requested as per existing GFCM Recommendations and are necessary for relevant GFCM subsidiary bodies to formulate advice in accordance with their mandate. It encompasses all the necessary indications for the collection of fisheries data (i.e. global figure of national fisheries, catch; incidental catch of vulnerable species; fleet; effort; socio-economics; biological information) by GFCM members in a standardized way, in order to provide the GFCM with the minimum set of data needed to support fisheries management decision-making processes.	
Scientific References -EC. Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). -FAO. 1996. Precautionary approach to fisheries. Part 2: scientific papers. Prepared for the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions). Lysekil, Sweden, 6–13 June 1995. FAO Fisheries Technical Paper. No. 350, Part 2. Rome. 210 pp. -GFCM, 2002. Recommendation GFCM/27/2002/1: Management of selected demersal and small pelagic species. -GFCM, 2006. Recommendation. GFCM/30/2006/1: Management of certain fisheries exploiting demersal and small pelagic. -GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area. -ICES, 2008. Report of the Workshop on Methods to Evaluate and Estimate the Accuracy of Fisheries Data used for Assessment (WKACCU). Bergen, Norway, 27–30 October 2008. ICES CM 2008\ACOM: 32. 41 pp. -ICES, 2010e. Report of the Workshop on methods to evaluate and estimate the precision of fisheries data used for assessment (WKPRECISE). Copenhagen, Denmark, 8-11 September 2009. ICES CM 2009/ACOM: 40. 43 pp. -Sparre, P.; Venema, S.C. Introduction to tropical fish stock assessment. Part 1. Manual. *FAO Fisheries Technical Paper.*No. 306.1, Rev. 2. Rome, FAO. 1998. 407p. -Sparre P.J., 2000. Manual on sample-based data collection for fisheries assessment. Examples from Vietnam. FAO Fisheries Technical Paper. No. 398. Rome, FAO. 2000. 171 pp. -United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995	
Policy Context and targets (other than IMAP)	
Policy context description The overall operational objectives of GFCM are to ensure the conservation and sustainable use, at the biological, social, economic and environmental level, of living marine resources in the area of application. This means maintain the sustainability of fisheries, in order to prevent overfishing of demersal and small pelagic fish stocks, maintain their stocks at levels that can produce the maximum sustainable yield (MSY) and to facilitate the restoration of stocks to historical levels. GFCM also aims to guarantee a low risk of stocks falling outside safe biological limits and to ensure protection of biodiversity to avoid undermining ecosystems structure and functioning (GFCM, 2013). Fishing mortality must be kept below safe levels to ensure long-term high yields, while limiting the risk of stock collapse and guaranteeing stable and viable fisheries (GFCM, 2012). To follow these issues and to advance towards its goal of sustainability of fisheries, the GFCM has established a temporal framework and intermediate global objectives through the implementation of both the mid-term strategy (GFCM, 2016b) and the different recommendations as in the Compendium of GFCM decisions.	
Indicator/Targets • SAC 2014: "*Provides definitions for stock status and management advice on stocks for which reference points related to indicators of biomass and/or exploitation are available*." • Common Fisheries Policy: "*The current policy stipulates that between 2015 and 2020 catch limits should be set that are sustainable and maintain fish stocks in the long term*" • EU-MSFD Descriptor 3: "*Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock*"	

Indicator Title	*Common Indicator 9: Fishing mortality*

Policy documents

- EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF
- GFCM, 2012a. Report of the Transversal Workshop on Spatial Based Approach to Fisheries Management, Rome, Italy, 6–8 February 2012. 2 March 2016]. https://gfcmsitestorage.blob.core.windows.net/ documents/Reports/2012/GFCM-Report-2012-SAC-SCs-Spatial-Approach.pdf
-GFCM, 2012b. Resolution OTH-GFCM/36/2012/ Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area
- GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis. http://www.fao.org/3/a-ax847e.pdf
- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. http://www.fao.org/3/a-i4381b.pdf
- GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp.
-GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries.
- Recommendation GFCM/33/2009/3, 2009. On the implementation of the GFCM task 1 statistical matrix and repealing resolution GFCM/31/2007/1. www.fao.org/gfcm/decisions
- Regulation (EU) No 1380/2013 of the European parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC
- UNEP-MAP 2012. EcAp-MED Project Document. Implementation of the Ecosystem Approach (EcAp) in the Mediterranean by the Contracting parties in the context of the Barcelona Convention for the Protection of the Marine Environment and the Coastal region of the Mediterranean and its Protocols. 34pp.

Indicator analysis methods

Indicator Definition

Description: The Maximum Sustainable Yield is, theoretically, the maximum yield that can be obtained from a species, and it is associated with a maximum fishing mortality (F_{MSY}). When F is higher than F_{MSY} the yield decreases. F_{MSY} is considered as a limit due to the consequences of overestimating F. Only available if the stock has been assessed. Fishing mortality (F) reflects all deaths in the stock that are due to fishing per year (not only what is actually landed). It is usually expressed as a rate ranging from 0 (for no fishing) to high values (1.0 or more). It is common practice to refer F as a scalar value but it would be more appropriate to refer to it as a vector. This indicator is linked with sustainable fishing.

The catch should correspond to a fishing mortality (F) that maximises the yield from the stock. This is defined as the MSY, and the fishing mortality rate that generates this is F_{MSY}. F_{MSY} is the F value that will maximise the long-term yield, taking into account natural mortality, growth and the dependence of the abundance of incoming year-classes on the abundance of the spawning stock size. Given the variability and uncertainty inherent in the estimation of fishing mortality reference levels and the difficulty of simultaneously maintaining all stocks in a mixed fishery at their optimum exploitation rate, a range within which the exploitation rate is maintained may be considered appropriate rather than using the exact reference levels as limit or target values.

Priority species (Group 1, 2 and 3) as reported in Appendix A of the GFCM-Data Collection Reference Framework (GFCM-DCRF, 2016), will be the species considered for the evaluation for this indicator (see attached Appendix A reporting the list of priority species).

Methodology for indicator calculation

The status of stocks is ideally based on a validated stock assessment model, from which indicators of stock status (e.g. biomass, fishing mortality, recruitment) are obtained, and reference points are agreed for the chosen indicators. When possible, analytical stock assessment models that incorporate both fishery-dependent (e.g. catches) and independent information (e.g. surveys) are used, although direct surveys are used for some stocks. Different stock assessment models are used in the GFCM area of application, including variations of virtual population models (from pseudo-cohort based models, such as VIT, to tuned versions, such as extended survivor analysis – XSA), statistical catch at age analysis (e.g. state-space assessment model – SAM

<table>
<tr><td>Indicator Title</td><td>Common Indicator 9: Fishing mortality</td></tr>
<tr><td colspan="2">or stock synthesis – SS3) and biomass models (BioDyn, two-stage biomass models, etc.). Some stock assessment methods are only based on information from scientific surveys at sea (e.g. survey-based assessment – SURBA, or acoustic estimates of biomass). When no analytical assessment model or reference points are validated by the Scientific Advisory Committee on Fishery (SAC), advice can still be provided on a precautionary basis, in cases where there is evidence that the stock may be threatened (high fishing pressure, low biomass, habitat loss, etc.). When possible, advice on stock status should be based both on biomass and on fishing pressure, using indicators and reference points for both quantities.</td></tr>
<tr><td colspan="2">Indicator units
• Number of stocks for which status with respect to F_{MSY} is known
• The number (and proportion) of stocks above or below F_{MSY}
• Trends in F/F_{MSY}</td></tr>
<tr><td colspan="2">List of Guidance documents and protocols available
- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian’s, Malta, 17–20 March 2014. 261pp.
- GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian’s, Malta, 17-20 March 2014. 18 pp.
- GFCM-Data Collection Reference Framework (GFCM-DCRF, 2016)
-Stock Assessment Form version 1.0 (January 2014 - http://www.fao.org/gfcm/data-reporting/data-reporting-stock-assessment/en/)</td></tr>
<tr><td colspan="2">Data Confidence and uncertainties</td></tr>
<tr><td colspan="2">Methodology for monitoring, temporal and spatial scope</td></tr>
<tr><td colspan="2">Available Methodologies for Monitoring and Monitoring Protocols
Several analytical methods, based on population dynamics of different stocks of demersal and small pelagic species, have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. In the GFCM area, data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Within the GFCM mandate a series of stocks are assessed on an annual basis. On a yearly basis, Scientific and Advisory Committee (SAC) and the Working for the Black Sea (WGBS) will identify those species/stocks that should be assessed and for which stock assessment form should be provided.</td></tr>
<tr><td colspan="2">Available data sources
-Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016
http://www.fao.org/gfcm/reports/statutory-meetings/en/
-Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp.
http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/
-Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp.
http://www.fao.org/gfcm/reports/technical-meetings/en/
-Report of the Working Group on Stock Assessment of Demersal Species (WGSAD), 2015 (23 November-28 November) GFCM HQ. 60pp.
http://www.fao.org/gfcm/reports/technical-meetings/en/
-Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp.
http://www.fao.org/gfcm/reports/technical-meetings/en/
-Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1
https://stecf.jrc.ec.europa.eu/meetings/2015
-Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2
https://stecf.jrc.ec.europa.eu/meetings/2015</td></tr>
<tr><td colspan="2">Spatial scope guidance and selection of monitoring stations
Stock assessment in the GFCM area of application is often conducted by management units, based on GSAs</td></tr>
</table>

Indicator Title	*Common Indicator 9: Fishing mortality*	
(Resolution GFCM/33/2009/2 and Appendix L of the GFCM-DCRF, 2016 - see attached Appendix). This method does not ensure that the whole stock is assessed, since stocks may cover several different management units. In some cases, when there is scientific evidence of a stock spreading through different GSAs existing information is combined across GSAs. Although the concept of their delimitation still needs further consideration, the GSAs, appear as the most appropriate subdivisions for stock assessments for management purposes in the Mediterranean Sea.		
Temporal Scope guidance (*under development*)		
Data analysis and assessment outputs		
Statistical analysis and basis for aggregation (*under development*)		
Expected assessments outputs • Monitoring trend of fishing mortality • Monitoring the stock(s) performance • Project the stock(s) trend over time • Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources. • The information gathered should be sufficient and reliable enough to review the status of the different resources, to assess the economic and social dimensions of the fleets and to provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.		
Known gaps and uncertainties in the Mediterranean Even if stock assessments and advice are now available for several stocks in the Mediterranean and Black Sea, and the number of stocks for which estimates of MSY-based indicators are available has also increased, still different stocks lack information on F reference points and/or proxies are not available; thus, it is not possible to establish current fishing mortality levels relative to MSY. Furthermore, the exploitation of several stocks may be shared, and the available scientific inputs have not been sufficient or have not been organised cohesively at the appropriate scale in view of supporting a regional based decision making process. Some countries have not been kept an acceptable level of accuracy due to different causes including the fragmented nature of smaller size stocks exploited by artisanal multiple-gears fisheries, small fishing fleets dispersed over quite long coastlines and islands and/or no data collection in place.		
Contacts and version Date		
GFCM Secretariat (gfcm-secretariat@fao.org)		
Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

Common Indicator 10: Fishing effort (EO3)

Indicator Title	*Common Indicator 10: Fishing effort*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Total effort does not exceed the level of effort allowing the Maximum Sustainable Yield (MSY).	Fishing effort should be reduced by means of a multi-annual management plan until there is an evidence for stock recovery.	(*under development*)
Rationale		

Justification for indicator selection

In 2012, following several recommendations made on the management of different fisheries in the Mediterranean and Black Sea (e.g. Recommendations GFCM/27/2002/1, GFCM/30/2006/1 and Resolution GFCM 33/2009/1 on the management of certain fisheries exploiting demersal and small pelagic), and on the basis of Scientific Advisory Committee on Fishery (SAC) advice, the GFCM has formulated the "*Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area*". In the GFCM guidelines are included clear indications on suitable objectives and procedures to implement a management plan, and is reported a clear definition of the requirements to provide scientific advice useful for management. The framework is based on the definition of reference points related to key indicators of the status of stocks, such as stock biomass and fishing mortality. Indeed these guidelines, in relation to reference points and stock status, define suitable indicators for biomass either *Total Biomass or Spawning Stock Biomass*, while suitable indicators for exploitation can be either *Fishing mortality,Exploitation rate* (ratio between fishing mortality and total mortality) and *Fishing effort*. In all cases, reference points should be defined in relation to the indicator used. Following the recommendations from the SAC, the advice should be based, if possible, on both indicators of biomass and exploitation, and for each indicator ideally target, threshold and limit (e.g. F_{tgt}, F_{thr}, F_{lim}) reference points should be defined. When only one indicator is available, there should be a clear advice to explore the possibility of having indicators for both biomass and exploitation.

In general terms, a suggested target reference point for biomass and exploitation is that value of the indicator at which maximum sustainable yield (MSY) is obtained from the fishery, in accordance with the 1995 UN Fish Stocks Agreement (UNFSA), while limit and threshold reference points should be established based on precautionary principles.

<u>*Fishing effort*</u>

"*The amount of fishing gear of a specific type used on the fishing grounds over a given unit of time for example hours trawled per day, number of hooks set per day or number of hauls of a beach seine per day. When two or more kinds of gear are used, the respective efforts must be adjusted to some standard type before being added* (FAO, 1997)."

Fishing effort it is usually approximated by a metric of capacity, such as gross tonnage or engine power, with a measure of activity (e.g. days-at-sea or hours fished), and is therefore an aggregated measure of fishing behaviour (e.g. in which area, in which period etc.). It is an essential parameter in the assessment of fish stocks and their effective management. Effort information are needed to interpret changes in the amount of catch, and to regulate fishing efficiency to maximize profit and minimize overfishing. Especially in Mediterranean and Black Sea, fishing effort is a measure to manage fleet capacity and the amount of time that can be spent at sea by that fleet. It is linked to fishing mortality, through the catchability at length/age of a stock, a term that generally means the extent to which the stock is susceptible to fishing and that would be captured by one unit of effort. All these information (i.e. fishing effort, catchability, fishing mortality), are needed to analyse changes in the amount of catch and are crucial for developing multiannual management plans.

Scientific References

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- FAO, 1999. *Guidelines for the routine collection of capture fishery data*. Prepared at the FAO/DANIDA Expert Consultation. Bangkok, Thailand (18–30 May), 1998. FAO, Fish. Tech. Pap. 382. Rome, FAO. 113 pp.
- FAO, 2016. *The State of Mediterranean and Black Sea Fisheries*. General Fisheries Commission for the Mediterranean. Rome, Italy.
-GFCM, 2002. Recommendation GFCM/27/2002/1: Management of selected demersal and small pelagic species.
-GFCM, 2006. Recommendation. GFCM/30/2006/1: Management of certain fisheries exploiting demersal

Indicator Title	*Common Indicator 10: Fishing effort*

and small pelagic.
-GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area.
- Joint research agreement 2013. A Mediterranean Cooperation for the Sustainable Use of the Marine Biological Resources. A supportive tool for the synergic implementation of the MSFD and the ECAP initiative. Joint Project Agreement between the Ministry of the Environment, Territory and Sea of Italy and the GFCM.
- GFCM 2012. Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area. 2012.
- GFCM 2013a. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis.
- GFCM 2013b. Recommendation GFCM/37/2013/1 on a multiannual management plan for fisheries on small pelagic stocks in the GFCM-GSA 17 (Northern Adriatic Sea) and on transitional conservation measures for fisheries on small pelagic stocks in GSA 18 (Southern Adriatic Sea). 10pp.
- GFCM 2014a. Reference points and advice in the SAC ad in other relevant organizations. WKREF-WGSA. Bar, Montenegro, 28th January-1st February 2014.
- GFCM, 2014b. Report of the First MedSuit Regional Workshop on indicators and targets to ensure GES of commercially exploited marine populations in the GFCM area. FAO HQ, Rome, Italy (6–7 November 2014). 14 pp.
- GFCM, 2014c. Report of the Workshop on the implementation of the DCRF in the Mediterranean and the Black Sea. Madrid, Spain (15-16 December) 2014. 22 pp.
- GFCM 2016a. GFCM-DCRF, Data Collection Reference Framework. GFCM Secretariat. 116 pp.
- Patterson, K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. Reviews in Fish Biology and Fisheries, 2, pp. 321–338.
- UNEP-MAP, 2012. Support to the Barcelona Convention for the implementation of the ecosystem approach. Including the establishment of MPAs in open seas areas, including deep sea. Contribution Agreement N°21.0401/2008/519114/SUB/D2. Final Report, April 2012. 50pp.
- UNEP-MAP & GFCM 2013. Background document on cooperation needs between UNEP-MAP and GFCM. Internal document. 14pp.
-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995

Policy Context and targets (other than IMAP)

Policy context description

The overall operational objectives of GFCM is to ensure the conservation and sustainable use, at the biological, social, economic and environmental level, of living marine resources in the area of application.
This means maintain the sustainability of fisheries, in order to prevent overfishing of demersal and small pelagic fish stocks, maintain their stocks at levels that can produce the maximum sustainable yield (MSY) and to facilitate the restoration of stocks to historical levels. GFCM also aims to guarantee a low risk of stocks falling outside safe biological limits and to ensure protection of biodiversity to avoid undermining ecosystems structure and functioning (GFCM, 2013). Fishing mortality must be kept below safe levels to ensure long-term high yields, while limiting the risk of stock collapse and guaranteeing stable and viable fisheries (GFCM, 2012).
To follow these issues and to advance towards its goal of sustainability of fisheries, the GFCM has established a temporal framework and intermediate global objectives through the implementation of both the mid-term strategy (GFCM, 2016b) and the different recommendations as in the Compendium of GFCM decisions.

In the Mediterranean and Black Sea, fishing effort restrictions have been introduced in a number of situations: under multiannual plans for the management of a specific stock or group of stocks, and more generally area-based. Examples of fishing effort restrictions can be found in, for instance, the plan for management of small pelagic stocks in the GFCM-GSA 17 (Northern Adriatic Sea) and on transitional conservation measures for fisheries on small pelagic stocks in GSA 18 (Southern Adriatic Sea) (Recommendation GFCM/37/2013/1).

Indicator/Targets

- SAC 2014: "P*rovides definitions for stock status and management advice on stocks for which reference points related to indicators of biomass and/or exploitation are available*."
- Common Fisheries Policy: "*The current policy stipulates that between 2015 and 2020 catch limits should be set that are sustainable and maintain fish stocks in the long term*"
- EU-MSFD Descriptor 3: "*Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy*

Indicator Title	*Common Indicator 10: Fishing effort*
stock"	
Policy documents - EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF - GFCM, 2012a. Report of the Transversal Workshop on Spatial Based Approach to Fisheries Management, Rome, Italy, 6–8 February 2012. 2 March 2016]. https://gfcmsitestorage.blob.core.windows.net/ documents/Reports/2012/GFCM-Report-2012-SAC-SCs-Spatial-Approach.pdf -GFCM, 2012b. Resolution OTH-GFCM/36/2012/ Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area - GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis. http://www.fao.org/3/a-ax847e.pdf - GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. http://www.fao.org/3/a-i4381b.pdf - GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp. -GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries. - Recommendation GFCM/33/2009/3, 2009. On the implementation of the GFCM task 1 statistical matrix and repealing resolution GFCM/31/2007/1. www.fao.org/gfcm/decisions - Regulation (EU) No 1380/2013 of the European parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC - UNEP-MAP 2012. EcAp-MED Project Document. Implementation of the Ecosystem Approach (EcAp) in the Mediterranean by the Contracting parties in the context of the Barcelona Convention for the Protection of the Marine Environment and the Coastal region of the Mediterranean and its Protocols. 34pp.	
Indicator analysis methods	
Indicator Definition *Fishing effort is the amount of time and/or fishing capacity (e.g. GT) used to harvest fish. Effort measurements therefore allow an estimation of the pressure placed by fishing activities on fish stocks.* Effort indicators are used to measure the impact of the fishery sector on natural resources. Data on the spatial and temporal distribution of fishing effort are crucial requisites for calculating pressure indicators describing the impact of fishing on the seafloor (Piet *et al*., 2007). Effort indicators coupled with catch data, forms the main contribution that the monitoring of commercial fisheries can provide to the assessment of the state of stocks. These indicators are necessary, although certainly not sufficient, to assess the state of the resources in a given geographical area. This indicator will be assessed according both to the Mediterranean and Black Sea sub-areas (GSA) and GFCM sub-regions (see attached Appendix L; GFCM-DCRF, 2016,) in order to reflect spatial changes).	
Methodology for indicator calculation The need to accurately quantify fishing effort has increased in recent years and quantification methods vary greatly among fisheries. To date there has not been a comprehensive review of these methods. In general, quantification methods that are based on information on gear use and spatial distribution offer the best approaches to representing fishing effort on a broad scale. Fishing effort can be calculated through a combination of inputs related to capacity, gear and time: for example multiplying the fishing capacity deployed (i.e. total GT, total kW, number of hooks, etc.) by the period of time (number of hours or days spent fishing). Those inputs, fundamental to estimate effort measurements, can be obtained through various sources (e.g. logbooks, by sampling, by census, port surveys, interviews with fishermen etc.), and can be expressed in a different way on the basis of the fleet segments concerned (see GFCM-DCRF, 2016). Generally, fishing effort measurements are reported as unit of activity (i.e. the number of fishing days at sea) per unit of capacity (i.e. GT) (see attached Appendixes F.1 "*Effort measurement by fleet segment*" and F.2 "*Effort measurement by fishing gear*" from the DCRF-GFCM, 2016).	
Indicator units • Total effort (e.g. GT*fishing days)	

Indicator Title	*Common Indicator 10: Fishing effort*
• Effort by fleet segments and per area • Trends of nominal effort	
List of Guidance documents and protocols available - GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. - GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp. - Data Collection Reference Framework (GFCM-DCRF, 2016) -Stock Assessment Form version 1.0 (January 2014 - http://www.fao.org/gfcm/data-reporting/data-reporting-stock-assessment/en/)	
Data Confidence and uncertainties	
Methodology for monitoring, temporal and spatial scope	
Available Methodologies for Monitoring and Monitoring Protocols Effort information regarding both the units of capacity (e.g. net length, number of lines, GT, number of pots etc.) and the units of activity (e.g. fishing days, number of fishing sets etc.), can be obtained from different sources and are usually derived from a combination of catch reports, logbooks, observers, market and/or landing survey or landing statistics from port authorities. Effort data can be further collected and classified by species, area, fishing gear used, and other factors. Several methods to calculate effort measurements have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. These information, in the GFCM area, are collected through the Data Collection Reference Framework (GFCM-DCRF, 2016) and the stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.).	
Available data sources -GFCM-DCRF, 2016. Data Collection Reference Framework on line platform (under development) -FAO, 2016. Fisheries and Aquaculture Department FAO Fishery Commodities Global Production and Trade [Database]. [Cited 2 March 2016]. http://www.fao.org/fishery/statistics/global-commoditiesproduction/query/en -Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016 http://www.fao.org/gfcm/reports/statutory-meetings/en/ -Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp. http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/ -Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Demersal Species (WGSAD), 2015 (23 November-28 November) GFCM HQ. 60pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1 https://stecf.jrc.ec.europa.eu/meetings/2015 -Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2 https://stecf.jrc.ec.europa.eu/meetings/2015	
Spatial scope guidance and selection of monitoring stations In the Mediterranean and Black Sea the Geographical Sub-Areas (GSA) represent the management units (Resolution GFCM/33/2009/2). The GSA delimitation is mainly based on practical considerations rather than on the stock distribution, and many stocks extend beyond the geographic limits of GSAs. However, although the concept of their delimitation still needs further consideration, the GSAs, as established by GFCM appear	

Indicator Title	*Common Indicator 10: Fishing effort*	
as the most appropriate subdivisions for stock assessments for management purposes in the Mediterranean Sea. They are also adopted for assessments at national level.		
Temporal Scope guidance (*under development*)		
Data analysis and assessment outputs		
Statistical analysis and basis for aggregation (*under development*)		
Expected assessments outputs • Monitoring of total effort. • Monitoring trends of the effort (by fleet segment, country and area). • Monitoring the stock(s) performance • Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.		
Known gaps and uncertainties in the Mediterranean Concerning fishing effort data, information regarding the units of capacity (e.g. net length, number of lines, GT, number of pots etc.) and the units of activity (e.g. fishing days, number of fishing sets etc.), are not complete for several fleet segments and fishing gears. There are significant discrepancies between areas (GSA) and sub-regions in terms of availability, quality and relevance of data that are fundamental for conducting a robust assessment in relation to this ecological indicator.		
Contacts and version Date		
GFCM Secretariat (gfcm-secretariat@fao.org)		
Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

Common Indicator 11: Catch Per Unit Effort (CPUE) (EO3)

Indicator Title	*Common Indicator 11:* Catch per unit effort (CPUE)	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Catch per unit effort (CPUE) is an indirect measure of the abundance of target species. Changes in the catch per unit effort are inferred to signify changes to the target species' abundance.	Stable or positive trend in CPUE Declines in CPUE may mean that the fish population cannot support the level of harvesting. Increases in CPUE may mean that a fish stock is recovering and more fishing effort can be applied.	(*under development*)
Rationale		
Justification for indicator selection In 2012, following several recommendations made on the management of different fisheries in the Mediterranean and Black Sea (e.g. Recommendations GFCM/27/2002/1, GFCM/30/2006/1 and Resolution GFCM 33/2009/1 on the management of certain fisheries exploiting demersal and small pelagic), and on the basis of Scientific Advisory Committee on Fishery (SAC) advice, the GFCM has formulated the "*Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area*". In the GFCM guidelines are included clear indications on suitable objectives and procedures to implement a management plan, and is reported a clear definition of the requirements to provide scientific advice useful for management. The framework is based on the definition of reference points related to key indicators of the status of stocks, such as stock biomass and fishing mortality. Indeed these guidelines, in relation to reference points and stock status, define suitable indicators for biomass either *Total Biomass or Spawning Stock Biomass*, while suitable indicators for exploitation can be either *Fishing mortality, Exploitation rate* (ratio between fishing mortality and total mortality) or *Fishing effort*. In all cases, reference points should be defined in relation to the indicator used. Following the recommendations from the SAC, the advice should be based, if possible, on both indicators of biomass and exploitation, and for each indicator ideally target, threshold and limit (e.g. F_{tgt}, F_{thr}, F_{lim}) reference points should be defined. When only one indicator is available, there should be a clear advice to explore the possibility of having indicators for both biomass and exploitation. In general terms, a suggested target reference point for biomass and exploitation is that value of the indicator at which maximum sustainable yield (MSY) is obtained from the fishery, in accordance with the 1995 UN Fish Stocks Agreement (UNFSA), while limit and threshold reference points should be established based on precautionary principles. CPUE The most commonly reported measure of fisheries production is the amount of catch. Catch data provides important information on the number of individuals harvested, but it does not provide information on the expended effort. Effort information is needed to interpret changes in the amount of catch, and to regulate fishing efficiency to maximize profit and minimize overfishing. When effort is combined with catch one of the most widely used effort indicators is obtained: the catch per unit of effort (CPUE), expressed as the biomass captured for each unit of effort applied to harvest the stock. CPUE is extensively used by biologists to determine variations in biomass and by economists as a measure of the efficiency of the fleet. Accurate estimates of CPUE and fishing effort are essential for accurate stock assessment, tracking of market trends, estimating profitability of a fishery, designation of marine protected areas and estimation of total catch (including discards and incidental catch of vulnerable species), all critical components of promoting sustainable fisheries. Trends in CPUE have been an important means of estimating trends in stock abundance when independent abundance data are not available. As CPUE decreases, it may reflect a decrease in stock abundance. Despite being one of the most common pieces of information used in assessing the status of fish stocks, relative abundance indices based on catch per unit effort data are notoriously problematic. Raw CPUE is seldom proportional to abundance over a whole exploitation history and an entire geographic range, because numerous factors affect catch rates. CPUE values are therefore typically standardized to control for environmental, seasonal, habitat and other factors. Although caution needs to be used when interpreting CPUE as an indicator of stock trends, it is still a useful index of abundance for stock trends.		
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Indicator Title	*Common Indicator 11:* Catch per unit effort (CPUE)

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- GFCM, 2014b. Report of the First MedSuit Regional Workshop on indicators and targets to ensure GES of commercially exploited marine populations in the GFCM area. FAO HQ, Rome, Italy (6–7 November 2014). 14 pp.
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- UNEP-MAP & GFCM 2013. Background document on cooperation needs between UNEP-MAP and GFCM. Internal document. 14pp.
-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995

Policy Context and targets (other than IMAP)

Policy context description

The overall operational objectives of GFCM are to ensure the conservation and sustainable use, at the biological, social, economic and environmental level, of living marine resources in the area of application.

This means maintain the sustainability of fisheries, in order to prevent overfishing of demersal and small pelagic fish stocks, maintain their stocks at levels that can produce the maximum sustainable yield (MSY) and to facilitate the restoration of stocks to historical levels. GFCM also aims to guarantee a low risk of stocks falling outside safe biological limits and to ensure protection of biodiversity to avoid undermining ecosystems structure and functioning (GFCM, 2013). Fishing mortality must be kept below safe levels to ensure long-term high yields, while limiting the risk of stock collapse and guaranteeing stable and viable fisheries (GFCM, 2012).

To follow these issues and to advance towards its goal of sustainability of fisheries, the GFCM has established a temporal framework and intermediate global objectives through the implementation of both the mid-term strategy (GFCM, 2016b) and the different recommendations as in the Compendium of GFCM decisions.

Indicator/Targets

- SAC 2014: "P*rovides definitions for stock status and management advice on stocks for which reference points related to indicators of biomass and/or exploitation are available*."
- Common Fisheries Policy: "*The current policy stipulates that between 2015 and 2020 catch*

Indicator Title	*Common Indicator 11:* Catch per unit effort (CPUE)
limits should be set that are sustainable and maintain fish stocks in the long term" • EU-MSFD Descriptor 3: "*Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock"*	
Policy documents - EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF - GFCM, 2012a. Report of the Transversal Workshop on Spatial Based Approach to Fisheries Management, Rome, Italy, 6–8 February 2012. 2 March 2016]. https://gfcmsitestorage.blob.core.windows.net/ documents/Reports/2012/GFCM-Report-2012-SAC-SCs-Spatial-Approach.pdf -GFCM, 2012b. Resolution OTH-GFCM/36/2012/ Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area - GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis. http://www.fao.org/3/a-ax847e.pdf - GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. http://www.fao.org/3/a-i4381b.pdf - GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp. -GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries. - Recommendation GFCM/33/2009/3, 2009. On the implementation of the GFCM task 1 statistical matrix and repealing resolution GFCM/31/2007/1. www.fao.org/gfcm/decisions - Regulation (EU) No 1380/2013 of the European parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC - UNEP-MAP 2012. EcAp-MED Project Document. Implementation of the Ecosystem Approach (EcAp) in the Mediterranean by the Contracting parties in the context of the Barcelona Convention for the Protection of the Marine Environment and the Coastal region of the Mediterranean and its Protocols. 34pp.	
Indicator analysis methods	
Indicator Definition *The catch per unit of fishing effort (CPUE) is a relative measure of fish stock abundance and can be used to estimate relative abundance indices; it could be an indicator of fishing efficiency, both in terms of abundance and economic value. In its basic form, the CPUE could be expressed as the captured biomass for each unit of effort applied to species/stock (e.g. total catch of a species divided by the total fishing effort: kg/number of fish per long line hook days). Declining trends of this estimator could indicate overexploitation, while unchanging value could indicate sustainable fishing.* Because the effects of a fishery are determined in large part by both the intensity of fishing effort and the habitat where the effort occurs, quantifying and monitoring changes in fishing effort is fundamental for effective fisheries management. In many situations, fishery catch and effort data is often the only information available which may provide an indication of the impact of fishing. Trends in a pressure indicator such as CPUE, when considered in relation to trends in other indices such as changes in mean species size or mean species length may provide insight into fishing impacts at an ecosystem level. For the purpose of this ecological objective, the CPUE should be reported for the priority species belonging to Group 1 and Group 2 (Appendixes A.1 and A.2 – Priority species as reported in the GFCM-Data Collection Reference Framework GFCM-DCRF, 2016). Further, this indicator will be assessed according both to the Mediterranean and Black Sea sub-areas (GSA) and GFCM sub-regions (Appendix L; GFCM-DCRF, 2016) in order to reflect spatial changes (see attached Appendixes A and L).	
Methodology for indicator calculation The catch per unit effort may be considered the most likely indicator to contain information of relative abundance over time. However, should be underlined that there are many factors other than abundance that can influence CPUE, these factors are mainly biotic (e.g. species/stock behaviour, fishing area, etc.) and abiotic (e.g. type fishing gear, fishing power). Despite these recognized limitations CPUE is routinely used in	

Indicator Title	*Common Indicator 11:* Catch per unit effort (CPUE)
stock assessments as index of relative abundance and trends in CPUE are considered to reflect trends in the relative abundance of fish populations. A range of models of varying complexity may be used to estimate population abundance, and reference points (e.g. harvest rate at maximum sustainable yield, biomass relative to carrying capacity, etc.). The calculation of CPUE, requires both catch or landings data and some metric of nominal effort, such as net length, number of lines, number of hooks etc. CPUE by fleet segments and gear categories, often combined with data on fish size at capture, permit a large number of analyses relating to gear selectivity, indices of exploitation and monitoring of economic efficiency.	
Indicator units • Total effort (e.g. GT*fishing days) • CPUE by fishing gear and species • Trends of CPUE	
List of Guidance documents and protocols available - GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. - GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp. - Data Collection Reference Framework (GFCM-DCRF, 2016) -Stock Assessment Form version 1.0 (January 2014 - http://www.fao.org/gfcm/data-reporting/data-reporting-stock-assessment/en/)	
Data Confidence and uncertainties	
Methodology for monitoring, temporal and spatial scope	
Available Methodologies for Monitoring and Monitoring Protocols Several methods to calculate CPUE and different effort measurements have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. These information, in the GFCM area, are collected through the Data Collection Reference Framework (GFCM-DCRF, 2016) and the stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Effort information, necessary for calculating the CPUE, regarding both the units of capacity (e.g. net length, number of lines, GT, number of pots etc.) and the units of activity (e.g. fishing days, number of fishing sets etc.), can be obtained from different sources and are usually derived from a combination of catch reports, logbooks, observers, market and/or landing survey or landing statistics from port authorities (see attached Appendix F.1 of the GFCM-DCRF "*Effort measurement by fleet segment*"). Effort data can be further collected and classified by species, area, fishing gear used, and other factors (see attached Appendix F.2 of the GFCM-DCRF "*Effort measurement by fishing gear*").	
Available data sources -GFCM-DCRF, 2016. Data Collection Reference Framework on line platform (under development) -FAO, 2016. Fisheries and Aquaculture Department FAO Fishery Commodities Global Production and Trade [Database]. [Cited 2 March 2016]. http://www.fao.org/fishery/statistics/global-commoditiesproduction/query/en -Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016 http://www.fao.org/gfcm/reports/statutory-meetings/en/ -Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp. http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/ -Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Demersal Species (WGSAD), 2015 (23 November-28 November) GFCM HQ. 60pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp. http://www.fao.org/gfcm/reports/technical-meetings/en/	

Indicator Title	*Common Indicator 11:* Catch per unit effort (CPUE)

-Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1
https://stecf.jrc.ec.europa.eu/meetings/2015
-Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2
https://stecf.jrc.ec.europa.eu/meetings/2015

Spatial scope guidance and selection of monitoring stations

In the Mediterranean and Black Sea the Geographical Sub-Areas (GSA) represent the management units (Resolution GFCM/33/2009/2). The GSA delimitation is mainly based on practical considerations rather than on the stock distribution, and many stocks extend beyond the geographic limits of GSAs. However, although the concept of their delimitation still needs further consideration, the GSAs, as established by GFCM appear as the most appropriate subdivisions for stock assessments for management purposes in the Mediterranean Sea. They are also adopted for assessments at national level.

Temporal Scope guidance (*under development*)

Data analysis and assessment outputs

Statistical analysis and basis for aggregation (*under development*)

Expected assessments outputs

- Monitoring trends of CPUE (by fishing gear, species, country and area).
- Monitoring the stock(s) performance
- Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.

Known gaps and uncertainties in the Mediterranean

Concerning CPUE and the related information on fishing effort needed to calculate it, there are significant discrepancies between areas (GSA) and sub-regions in terms of availability, time series, quality and relevance of data, which are fundamental for conducting a robust assessment in relation to this ecological indicator. Information regarding total catch, and the effort units of capacity (e.g. net length, number of lines, GT, number of pots etc.)/activity (e.g. fishing days, number of fishing sets etc.), are not complete for several fleet segments and fishing gears.

Contacts and version Date

GFCM Secretariat (gfcm-secretariat@fao.org)

Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)

Indicator Title	*Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The abundance/trends of populations of seabirds, marine mammals, sea turtles and sharks key species (selected according to their actual and total dependence on the marine environment, and to their ecological representativeness) is stable or not reducing in a statistically significant way taking into account the natural variability compared to the current situation.	Incidental catch of vulnerable species (i.e. sharks, marine mammals, seabirds and turtles) are minimized	Work in progress within GFCM
Rationale		
Justification for indicator selection Bycatch is the part of the catch that is unintentionally captured during a fishing operation in addition to target species. It may refer to the catch of other commercial species that are landed, commercial species that cannot be landed (e.g. undersized, damage individuals), non-commercial species that are discarded, as well as to incidental catch of endangered or rare species. Incidental catch of vulnerable species is defined here as a subset of bycatch, which includes species that for some reason are considered vulnerable (i.e. long-lived vertebrates with low reproductive rates such as marine mammals, but also sea turtles, seabirds and elasmobranchs). Bycatch is considered one of the most important threats to the profitability and sustainability of fisheries, and as such has been recently attracting the attention of most regional fisheries management organizations (RFMOs) and other fisheries management bodies. Bycatch costs fishermen time and money, cause problems to endangered and threatened species, affects marine and coastal ecosystems, and makes it more difficult to measure the effect of fishing on the stock's population, and to set sustainable levels for fishing. Preventing and reducing bycatch is an important part of ensuring sustainable living marine resources and coastal communities. However, estimates of bycatch (both discards and incidental catch if vulnerable species) are still lacking and with a not homogenous coverage in all Mediterranean and Black Sea regions. Following this issue, this indicator will focus on the incidental catch of vulnerable species, with a special emphasis on the interaction/impact with fishing activities, monitoring also the spatial and temporal distribution of the catches.		
Scientific References -Casale, P. and Margaritoulis, D. (Eds.) .2010. Sea turtle in the Mediterranean: Distribution, threats and conservation priorities. Gland, Switzerland: UICN. 294 pp. -Coll, M. et al. 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. - PLoS ONE 5: e11842. -FAO, 2003. The ecosystem approach to fisheries. FAO Technical guidelines for responsible fisheries. Rome. 112 pp. -FAO, 2009. Guidelines to reduce sea turtle mortality in fishing operations. Fisheries Department, Food and Agriculture Organization of the United Nations. Rome. 128 pp. -FAO, 2011. Fisheries management. Marine protected areas and fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 4. Rome. 198 pp. -FAO, 2016. The State of Mediterranean and Black Sea Fisheries. General Fisheries Commission for the Mediterranean. Rome, Italy. -Franzosini C., Genov, T., Tempesta, M., 2013. Cetacean Manual for MPA managers. ACCOBAMS, MedPAN and UNEP/MAP-RAC/SPA. Ed. RAC/SPA, Tunis. 77 pp. Reeves R., Notarbartolo di Sciara G. (compilers and editors). 2006. The status and distribution of cetaceans in the Black Sea and Mediterranean Sea. IUCN Centre for Mediterranean Cooperation, Malaga, Spain. 137 pp. -IUCN, 2012. Marine mammals and sea turtles of the Mediterranean and Black Seas.		

<table>
<tr><td>Indicator Title</td><td>Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)</td></tr>
<tr><td colspan="2">-UNEP/MAP-RAC/SPA, 2003. – Action Plan for the conservation of bird species listed in annex II of the Protocol concerning specially protected areas and biological diversity in the Mediterranean. http://rac-spa.org/
-UNEP/MAP- Blue Plan, 2009. State of the environment and development in the Mediterranean. UNEP/MAP-Blue Plan, Athens.
-UNEP, 2013. SAP BIO implementation: The first decade and way forward. UNEP(DEPI)/MED WG.382/5. UNEP RAC/SPA, Tunis.
-UNEP/MAP RAC/SPA, 2007. Action Plan for the conservation of Mediterranean marine turtles. Ed. RAC/SPA, Tunis, 40pp. http://rac-spa.org/
-UNEP/MAP-RAC/SPA, 2013. Action Plan for the Conservation of Cetaceans in the Mediterranean Sea http://rac-spa.org/</td></tr>
<tr><td colspan="2">Policy Context and targets (other than IMAP)</td></tr>
<tr><td colspan="2">Policy context description
The overall operational objectives of GFCM are to ensure the conservation and sustainable use, at the biological, social, economic and environmental level, of living marine resources in the area of application.
This means maintain the sustainability of fisheries, in order to prevent overfishing of demersal and small pelagic fish stocks, maintain their stocks at levels that can produce the maximum sustainable yield (MSY) and to facilitate the restoration of stocks to historical levels. GFCM also aims to guarantee a low risk of stocks falling outside safe biological limits and to ensure protection of biodiversity to avoid undermining ecosystems structure and functioning (GFCM, 2013). Fishing mortality must be kept below safe levels to ensure long-term high yields, while limiting the risk of stock collapse and guaranteeing stable and viable fisheries (GFCM, 2012).
To follow these issues and to advance towards its goal of sustainability of fisheries, the GFCM has established a temporal framework and intermediate global objectives through the implementation of both the mid-term strategy (GFCM, 2016b) and the different recommendations as in the Compendium of GFCM decisions.</td></tr>
<tr><td colspan="2">Indicator/Targets
-EU Regulation 812/2004 “Concerning incidental catches of cetaceans in fisheries”
-EU MSFD Descriptors 1 “The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions” and 4 “All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity”
-EU Habitats Directive
-GFCM Recommendations: GFCM/35/2011/3, GFCM/35/2011/4, GFCM/35/2011/5, GFCM/36/2012/2, GFCM/36/2012/3</td></tr>
<tr><td colspan="2">Policy documents
-Barcelona Convention (Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean).
-EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF
-EU Biodiversity Strategy
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN
-EU Régulation 1143/2014
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN
- GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis. http://www.fao.org/3/a-ax847e.pdf
- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian’s, Malta, 17–20 March 2014. 261pp. http://www.fao.org/3/a-i4381b.pdf
- GFCM-Data Collection Reference Framework (GFCM-DCRF, 2016)
-GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries.
-Marine Strategy Framework Directive
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN
-Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the Mediterranean</td></tr>
</table>

Indicator Title	*Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)*

Region http://sapbio.rac-spa.org/

-Draft Updated Action Plan for the conservation of Cetaceans in the Mediterranean Sea http://rac-spa.org/nfp12/documents/working/wg.408_08_eng.pdf
-Recommendation GFCM/35/2011/3, 2011. On reducing incidental bycatch of seabirds in fisheries in the GFCM Competence Area. www.fao.org/gfcm/decisions
-Recommendation GFCM/35/2011/4, 2011. On the incidental bycatch of sea turtles in fisheries in the GFCM Competence Area. www.fao.org/gfcm/decisions
-Recommendation GFCM/35/2011/5, 2011. On fisheries measures for the conservation of the Mediterranean monk seal (*Monachus monachus*) in the GFCM Competence Area. www.fao.org/gfcm/decisions
-Recommendation GFCM/36/2012/2, 2012. On mitigation of incidental catches of cetaceans in the GFCM area. www.fao.org/gfcm/decisions
-Recommendation GFCM/36/2012/3, 2013. On fisheries management measures for conservation of sharks and rays in the GFCM area. www.fao.org/gfcm/decisions
-Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the Mediterranean Region - http://sapbio.rac-spa.org/

Indicator analysis methods

Indicator Definition
The abundance/trends of populations of seabirds, marine mammals, sea turtles and sharks key species (selected according to their actual and total dependence on the marine environment, and to their ecological representativeness) is stable or not reducing in a statistically significant way taking into account the natural variability compared to the current situation.

This indicator reports on the catch rate of turtles, marine mammals, sharks and seabirds in the Mediterranean and Black Sea. The trends analysis (i.e. occurrence, spatial distribution, abundance etc.) of the incidental catch rates of those vulnerable species, will demonstrate the impact that different fisheries activities have on this component of the marine ecosystem.

Vulnerable species, as reported in Appendix E of the GFCM-DCRF, will be the ones considered for the evaluation of this indicator (see attached Appendix E reporting the list of vulnerable species). Further, other biodiversity components such as abundance of exploited populations, fish communities and other components of the ecosystem will be investigated.

Methodology for indicator calculation
Bycatch data (discards and incidental catch of vulnerable species) can be obtained from different sources and are usually derived from a combination of catch reports, logbooks, observers on board, observed at landing and/or market, dedicated surveys, questionnaires, self-sampling by fishers, market and/or landing survey

Incidental catch of vulnerable species can be sampled through:

1) Direct observation
- a) at-sea monitoring of commercial catches (*by observers on board*);
- b) dedicated survey
- c) fishers (*by self-sampling*) can sample their own bycatch in order that surveys could be made more representative of the whole fleet segment without having to have too many observers.

2) Conducting direct dialogues with fishers (*by questionnaires*), collecting also perspectives on the bycatch issue, which is meant to complement the on board observations data analyses, and to provide an integrated approach toward management.
3) Stranded animal monitoring

Sampling (through observers on board), should be allocated proportionally to the fishing effort (e.g. fishing days) and following a stratification based on the fleet segmentations (e.g. grouping fleet segments which are similar with regard to their fishing activities; based on the GFCM-DCRF schema (see attached Appendix B – "*Fleet Segments*" from GFCM-DCRF, 2016).

Indicator units

- Incidental catch (weight and number) of vulnerable species by main fleet segments and areas
- Trends in abundance
- Trends in spatial distribution
- Trends in temporal occurrence

Indicator Title	*Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)*	
• Identification of risky areas • Record strandings of vulnerable species due to incidental catch		
List of Guidance documents and protocols available - Several protocols, guidelines and technical documents are available, and can be used, to monitor the different abundance/trends in the incidental catches of populations of seabirds, marine mammals, sea turtles and sharks key species. - GFCM-Data Collection Reference Framework (GFCM-DCRF, 2016)		
Data Confidence and uncertainties		
Methodology for monitoring, temporal and spatial scope		
Available Methodologies for Monitoring and Monitoring Protocols Several protocols are available using different monitoring platforms and approaches such as: - Direct observation - Stranded animal monitoring - Landing/market survey - Dedicated surveys - Photo-identification		
Available data sources • Data Collection Reference Framework (GFCM-DCRF, 2016) online platform • ICCAT database https://www.iccat.int/en/ • OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, is a spatially referenced online database, aggregating marine mammal, seabird, sea turtle and ray & shark observation data from across the globe. http://seamap.env.duke.edu/ • The Mediterranean Database of Cetacean Strandings (MEDACES), has been set-up to co-ordinate all national and regional efforts for riparian countries. Cetacean stranding data are organized into a spatially referenced database of public access.		
Spatial scope guidance and selection of monitoring stations This indicator will take into account the spatial (GSA) and temporal (quarterly) variability in order to monitor both the impact of different fishing activities on vulnerable species by area, and to detect seasonal differences in incidental catch.		
Temporal Scope guidance (*under development*)		
Data analysis and assessment outputs		
Statistical analysis and basis for aggregation (*under development*)		
Expected assessments outputs -Identification of the incidental catch (e.g. vulnerable species composition, quantities, period of the year, etc.) of the main fleet segments (per GFCM sub-region, countries and GSA, see attached Appendix L); -Describe the typology of the current fishing practices pertaining to these fisheries that lead to bycatch (e.g. fishing area, seasonality, fishing gears); -Find out the most important factors that could determine the incidental catch amounts (including ecological and technical factors). -Trend analysis (by quarter and year)		
Known gaps and uncertainties in the Mediterranean As highlighted in the report on the “The state of Mediterranean and Black Sea fisheries” (FAO, 2016), studies on bycatch cover only a small portion of the total fishing activity in the Mediterranean and Black Seas. There are several important gaps of knowledge: bycatch studies are absent for many fishing gears, countries or/and subregions and most of the existing studies cover relatively short temporal and small spatial scales. This gap of knowledge highlights the need to expand bycatch surveys and standardize practices in order to compare among fisheries, and test potential methods and, eventually, tools aiming to their mitigation.		
Contacts and version Date		
GFCM Secretariat (gfcm-secretariat@fao.org)		
Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

Appendix A - Priority species (*GFCM-DCRF, 2016*)

A.1 - Group 1 species. Species that drive the fishery and for which assessment is regularly carried out.

	GFCM subregions	**Western Mediterranean Sea**	**Ionian Sea**	**Adriatic Sea**	**Eastern Mediterranean Sea**	**Black Sea**
	GSAs	*1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11*	*12, 13, 14, 15, 16, 19, 20, 21*	*17, 18*	*22, 23, 24, 25, 26, 27*	*28, 29, 30*
	Countries	*Algeria, France, Italy, Monaco, Morocco, Spain*	*Italy, Greece, Libya, Malta, Tunisia*	*Albania, Croatia, Italy, Montenegro, Slovenia*	*Cyprus, Egypt, Greece, Israel, Lebanon, Syrian Arab Republic, Turkey*	*Bulgaria, Romania, Turkey, (Georgia, Russian Federation, Ukraine)***
Scientific name	***FAO 3-alpha code***					
Engraulis encrasicolus	ANE	X	X	X	X	X
Merluccius merluccius	HKE	X	X	X	X	
Mullus barbatus	MUT	X	X	X	X	
Mullus surmuletus	MUR	X	X		X	
Nephrops norvegicus	NEP	X	X	X		
Parapenaeus longirostris	DPS	X	X	X	X	
Psetta maxima	TUR					X
Sardina pilchardus	PIL	X	X	X	X	
Sprattus sprattus	SPR					X
*Squalus acanthias**	DGS					X
Trachurus mediterraneus	HMM					X

** Species included in Appendix III (species whose exploitation is regulated) of the Barcelona Convention (protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean).*

*** All States, including non-members of the GFCM which are known to fish in its competence area, are encouraged to cooperate in joint actions undertaken in accordance with applicable international obligations (i.e. Article 63 UNCLOS).*

A.2 - Group 2 species. Species which are important in terms of landing and/or economic values at regional and subregional level, and for which assessment is not regularly carried out.

	GFCM subregions	**Western Mediterranean Sea**	**Ionian Sea**	**Adriatic Sea**	**Eastern Mediterranean Sea**	**Black Sea**
	GSAs	*1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11*	*12, 13, 14, 15, 16, 19, 20, 21*	*17, 18*	*22, 23, 24, 25, 26, 27*	*28, 29, 30*
	Countries	*Algeria, France, Italy, Monaco, Morocco, Spain*	*Italy, Greece, Libya, Malta, Tunisia*	*Albania, Croatia, Italy, Montenegro, Slovenia*	*Cyprus, Egypt, Greece, Israel, Lebanon, Syrian Arab Republic, Turkey*	*Bulgaria, Romania, Turkey, (Georgia, Russian Federation, Ukraine)**
Scientific name	***FAO 3-alpha code***					
Alosa pontica	SHC					X
Aristaeomorpha foliacea	ARS		X			
Aristeus antennatus	ARA	X				
Boops boops	BOG	X	X	X	X	
Chamelea gallina	SVE			X		
Coryphaena hippurus	DOL		X			
Diplodus annularis	ANN		X			
Eledone cirrhosa	EOI	X		X		
Eledone moschata	EDT			X		
Galeus melastomus	SHO	X				
Lophius budegassa	ANK	X	X			
Merlangius merlangius	WHG					X
Micromesistius poutassou	WHB	X				
Octopus vulgaris	OCC	X	X	X	X	
Pagellus bogaraveo	SBR	X				
Pagellus erythrinus	PAC	X	X	X	X	
Raja asterias	JRS	X				
Raja clavata	RJC	X	X			
Rapana venosa	RPW					X
Sardinella aurita	SAA	X	X		X	
Saurida undosquamis	LIB				X	
Scomber japonicus	MAS	X			X	
Scomber scombrus	MAC	X	X			
Sepia officinalis	CTC	X	X	X		
Siganus luridus	IGU				X	
Siganus rivulatus	SRI				X	
Solea vulgaris	SOL			X	X	
Sphyraena sphyraena	YRS		X			
Spicara smaris	SPC			X	X	
Squilla mantis	MTS			X		
Trachurus mediterraneus	HMM	X				
Trachurus picturatus	JAA	X				
Trachurus trachurus	HOM	X	X		X	

** All States, including non-members of the GFCM which are known to fish in its competence area, are encouraged to cooperate in joint actions undertaken in accordance with applicable international obligations (i.e. Article 63 UNCLOS).*

A.3 - Group 3 species. Species within international/ national management plans and recovery and/or conservation action plans; non-indigenous species with the greatest potential impact.

	GFCM subregions	**Western Mediterranean Sea**	**Ionian Sea**	**Adriatic Sea**	**Eastern Mediterranean Sea**	**Black Sea**
	GSAs	*1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11*	*12, 13, 14, 15, 16, 19, 20, 21*	*17, 18*	*22, 23, 24, 25, 26, 27*	*28, 29, 30*
	Countries	*Algeria, France, Italy, Monaco, Morocco, Spain*	*Italy, Greece, Libya, Malta, Tunisia*	*Albania, Croatia, Italy, Montenegro, Slovenia*	*Cyprus, Egypt, Greece, Israel, Lebanon, Syrian Arab Republic, Turkey*	*Bulgaria, Romania, Turkey, (Georgia, Russian Federation, Ukraine)***
Scientific name	***FAO 3-alpha code***					
Dalatias licha	SCK	X	X	X	X	
Dipturus oxyrinchus	RJO	X	X	X	X	
Etmopterus spinax	ETX	X	X	X	X	
Galeus melastomus	SHO		X	X	X	
Hexanchus griseus	SBL	X	X	X	X	
*Mustelus asterias**	SDS	X	X	X	X	
*Mustelus mustelus**	SMD	X	X	X	X	
*Mustelus punctulatus**	MPT	X	X	X	X	
Myliobatis aquila	MYL	X	X	X	X	
*Prionace glauca**	BSH	X	X	X	X	
Pteroplatytrygon violacea	PLS	X	X	X	X	
Raja asterias	JRS		X	X	X	
Raja clavata	RJC			X	X	X
Raja miraletus	JAI	X	X	X	X	
Scyliorhinus canicula	SYC	X	X	X	X	X
Scyliorhinus stellaris	SYT	X	X	X	X	
*Squalus acanthias**	DGS	X	X	X	X	
Squalus blainvillei	QUB	X	X	X	X	
Torpedo marmorata	TTR	X	X	X	X	
Torpedo torpedo	TTV	X	X	X	X	
Fistularia commersonii	FIO				X	
Lagocephalus sceleratus	LFZ				X	
Marsupenaeus japonicus	KUP				X	
Metapenaeus stebbingi	MNG				X	
Scomberomorus commerson	COM				X	
Corallium rubrum	COL	X	X	X	X	
Anguilla anguilla	ELE	X	X	X	X	

** Species included in Appendix III (species whose exploitation is regulated) of the Barcelona Convention (protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean).*

***All States, including non-members of the GFCM which are known to fish in its competence area, are encouraged to cooperate in joint actions undertaken in accordance with applicable international obligations (i.e. Article 63 UNCLOS).*

Appendix B - Fleet segments (*GFCM-DCRF, 2016*)

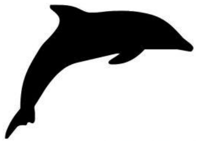
(Combination of vessel groups and length classes)

<table>
<tr><th colspan="3" rowspan="2">Vessel groups</th><th colspan="4">Length classes (LOA)</th></tr>
<tr><th>< 6 m</th><th>6 - 12 m</th><th>12-24 m</th><th>> 24 m</th></tr>
<tr><td rowspan="5">Polyvalent</td><td rowspan="5">P</td><td rowspan="2">Small-scale vessels without engine using passive gears</td><td>P-01</td><td>P-02</td><td rowspan="2">P-03</td><td rowspan="2">P-04</td></tr>
<tr><td colspan="2">P-13</td></tr>
<tr><td>Small-scale vessels with engine using passive gears</td><td>P-05</td><td>P-06</td><td>P-07</td><td>P-08</td></tr>
<tr><td rowspan="2">Polyvalent vessels</td><td rowspan="2">P-09</td><td rowspan="2">P-10</td><td>P-11</td><td>P-12</td></tr>
<tr><td colspan="2">P-14</td></tr>
<tr><td rowspan="4">Seiners</td><td rowspan="4">S</td><td rowspan="2">Purse seiners</td><td rowspan="2">S-01</td><td rowspan="2">S-02</td><td>S-03</td><td>S-04</td></tr>
<tr><td colspan="2">S-09</td></tr>
<tr><td rowspan="2">Tuna seiners</td><td rowspan="2">S-05</td><td rowspan="2">S-06</td><td>S-07</td><td>S-08</td></tr>
<tr><td colspan="2">S-10</td></tr>
<tr><td rowspan="2">Dredgers</td><td rowspan="2">D</td><td rowspan="2">Dredgers</td><td rowspan="2">D-01</td><td>D-02</td><td>D-03</td><td rowspan="2">D-04</td></tr>
<tr><td colspan="2">D-05</td></tr>
<tr><td rowspan="4">Trawlers</td><td rowspan="4">T</td><td>Beam trawlers</td><td>T-01</td><td>T-02</td><td>T-03</td><td>T-04</td></tr>
<tr><td rowspan="2">Pelagic trawlers</td><td rowspan="2">T-05</td><td>T-06</td><td>T-07</td><td>T-08</td></tr>
<tr><td colspan="3">T-13</td></tr>
<tr><td>Trawlers</td><td>T-09</td><td>T-10</td><td>T-11</td><td>T-12</td></tr>
<tr><td rowspan="2">Longliners</td><td rowspan="2">L</td><td rowspan="2">Longliners</td><td rowspan="2">L-01</td><td>L-02</td><td>L-03</td><td>L-04</td></tr>
<tr><td colspan="3">L-05</td></tr>
</table>

Notes:

- *A vessel is assigned to a group on the basis of the dominant gear used in terms of percentage of time: more than 50 percent of the time at sea using the same fishing gear during the year.*
- *"Polyvalent vessels" are defined as all the vessels using more than one gear, with a combination of passive and active gears, none of which exceeding more than 50 percent of the time at sea during the year.*
- *A vessel is considered "active" when it executes at least one fishing operation during the reference year in the GFCM area of application.*
- *The yellow cells contain the codes of reported fleet segments which should be included in the GFCM data submission. If necessary, fleet segments as identified in the orange cells can be used: P-13 (P-01 + P-02), P-14 (P-11 + P-12), S-09 (S-03 + S-04), S-10 (S-07 + S-08), D-05 (D-02 + D-03), T-13 (T-06 + T-07 + T-08) and L-05 (L-02 + L-03 + L-04). Any proposal for a different aggregation of fleet segments should be brought to the attention of the relevant GFCM subsidiary bodies, mentioning the rationale and corresponding references (e.g. existing scientific studies), which in turn should confirm the similarity/homogeneity of the combined cells.*

Appendix E: E.1 – Vulnerable species. List of vulnerable species included in Appendix II (endangered or threatened species) and Appendix III (species whose exploitation is regulated) of the Barcelona Convention (*Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean*). The list also contains the Amendments of Annexes II and III of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (2012/510/EU: *Council Decision of 10 July 2012, establishing the position to be adopted on behalf of the European Union with regard to the amendments to Annexes II and III to the Protocol concerning Specially Protected Areas and Biological Diversity SPA/BD in the Mediterranean of the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, adopted by the seventeenth meeting of the Contracting Parties, Paris, France, 8 - 10 February 2012*).

Group of vulnerable species	Family	Species	Common name
Cetaceans 	Balaenopteridae	*Balaenoptera acutorostrata*	Common minke whale
		Balaenoptera borealis	Sei whale
		Balaenoptera physalus	Fin whale
		Megaptera novaeangliae	Humpback whale
	Balenidae	*Eubalaena glacialis*	North Atlantic right whale
	Physeteridae	*Physeter macrocephalus*	Sperm whale
		Kogia simus	Dwarf sperm whale
	Phocoenidae	*Phocoena phocoena*	Harbour porpoise
	Delphinidae	*Steno bredanensis*	Rough-toothed dolphin
		Grampus griseus	Risso's dolphin
		Tursiops truncatus	Common bottlenose dolphin
		Stenella coeruleoalba	Striped dolphin
		Delphinus delphis	Common dolphin
		Pseudorca crassidens	False killer whale
		Globicephala melas	Long-finned pilot whale
		Orcinus orca	Killer whale
	Ziphiidae	*Ziphius cavirostris*	Cuvier's beaked whale
		Mesoplodon densirostris	Blainville's beaked whale
Seals	Phocidae	*Monachus monachus*	Mediterranean monk seal

Group of vulnerable species	Family	Species	Common name
Sharks, Rays, Chimaeras 	Alopiidae	*Alopias vulpinus*	Common thresher
	Carcharhinidae	*Carcharias taurus*	Sand tiger
		Carcharhinus plumbeus	Sandbar shark
		Carcharodon carcharias	Great white shark
		Prionace glauca	Blue shark
	Centrophoridae	*Centrophorus granulosus*	Gulper shark
	Cetorhinidae	*Cetorhinus maximus*	Basking shark
	Gymnuridae	*Gymnura altavela*	Spiny butterfly ray
	Hexanchidae	*Heptranchias perlo*	Sharpnose sevengill shark
	Lamnidae	*Isurus oxyrinchus*	Shortfin mako
		Lamna nasus	Porbeagle
	Myliobatidae	*Mobula mobular*	Devil fish
	Odontaspididae	*Odontaspis ferox*	Small-tooth sand tiger shark
	Oxynotidae	*Oxynotus centrina*	Angular rough shark
	Pristidae	*Pristis pectinata*	Smalltooth sawfish
		Pristis pristis	Common sawfish
	Rajidae	*Dipturus batis*	Common skate
		Leucoraja circularis	Sandy ray
		Leucoraja melitensis	Maltese skate
		Rostroraja alba	Bottlenose skate
	Rhinobatidae	*Rhinobatos cemiculus*	Blackchin guitarfish
		Rhinobatos rhinobatos	Common guitarfish
	Sphyrnidae	*Sphyrna lewini*	Scalloped hammerhead
		Sphyrna mokarran	Great hammerhead
		Sphyrna zygaena	Smooth hammerhead
	Squatinidae	*Squatina aculeata*	Sawback angel shark
		Squatina oculata	Smoothback angel shark
		Squatina squatina	Angel shark
	Triakidae	*Galeorhinus galeus*	School/Tope shark

Group of vulnerable species	Family	Species	Common name
Sea birds 	Falconidae	*Falco eleonorae*	Eleonora's falcon
	Cerylidae	*Ceryle rudis*	Pied kingfisher
	Charadriidae	*Charadrius alexandrinus*	Kentish plover
		Charadrius leschenaultii columbinus	Greater sand plover
	Halcyonidae	*Halcyon smyrnensis*	White-throated kingfisher
	Hydrobatidae	*Hydrobates pelagicus*	European storm petrel
		Hydrobates pelagicus melitensis	European storm petrel
		Hydrobates pelagicus pelagicus	European storm petrel
	Laridae	*Larus audouinii*	Audouin's gull
		Larus armenicus	Armenian gull
		Larus genei	Slender-billed gull
		Larus melanocephalus	Mediterranean gull
	Pandionidae	*Pandion haliaetus*	Osprey
	Pelecanidae	*Pelecanus crispus*	Dalmatian pelican
		Pelecanus onocrotalus	Great white pelican
	Phalacrocoracidae	*Phalacrocorax aristotelis*	European shag
		Phalacrocorax pygmaeus	Pygmy cormorant
	Phoenicopteridae	*Phoenicopterus ruber*	American flamingo
	Procellariidae	*Calonectris diomedea*	Cory's shearwater
		Puffinus puffinus yelkouan	Yelkouan shearwater
		Puffinus yelkouan	Mediterranean shearwater
		Puffinus muretanicus	Balearic shearwater
	Scolopacidae	*Numenius tenuirostris*	Slender-billed curlew
	Sternidae	*Sterna albifrons*	Little tern
		Sterna bengalensis	Lesser crested tern
		Sterna sandvicensis	Sandwich tern
		Sterna caspia	Caspian tern
		Sterna nilotica	Gull-billed tern

Group of vulnerable species	Family	Species	Common name
Sea turtles 	Cheloniidae	*Caretta caretta*	Loggerhead turtle
		Chelonia mydas	Green turtle
		Eretmochelys imbricata	Hawksbill Turtle
		Lepidochelys kempii	Kemp's ridley sea turtle
	Dermochelyidae	*Dermochelys coriacea*	Leatherback sea turtle
	Trionychidae	*Trionyx triunguis*	African softshell turtle

E.2 –Rare elasmobranchs species. This list reports elasmobranchs species that are considered rare but are present in the Mediterranean and the Black Sea (Bradai et al., 2012).

Group of rare species	Family	Species	Common name
Sharks, Rays, Chimaeras 	Alopiidae	*Alopias superciliosus*	Bigeye thresher
	Hexanchidae	*Hexanchus nakamurai*	Bigeye sixgill shark
	Echinorhinidae	*Echinorhinus brucus*	Bramble shark
	Squalidae	*Squalus megalops*	Shortnose spurdog
	Centrophoridae	*Centrophorus uyato*	Little gulper shark
	Somniosidae	*Centroscymnus coelolepis*	Portugese dogfish
		Somniosus rostratus	Little sleeper shark
	Lamnidae	*Isurus paucus*	Longfin mako
	Scyliorhinidae	*Galeus atlanticus*	Atlantic catshark
	Carcharhinidae	*Carcharhinus altimus*	Bignose shark
		Carcharhinus brachyurus	Bronze whaler shark
		Carcharhinus brevipinna	Spinner shark
		Carcharhinus falciformis	Silky shark
		Carcharhinus limbatus	Blacktip shark
		Carcharhinus melanopterus	Blacktip reef shark
		Carcharhinus obscurus	Dusky shark
		Galeocerdo cuvier	Tiger shark
		Rhizoprionodon acutus	Milk shark
	Torpedinidae	*Torpedo nobiliana*	Great torpedo
		Torpedo sinuspersici	Variable torpedo ray
	Rajidae	*Dipturus nidarosiensis*	Norwegian skate
		Leucoraja fullonica	Shagreen skate
		Leucoraja naevus	Cuckoo skate
		Raja africana	African skate
		Raja brachyura	Blonde skate
		Raja montagui	Spotted skate
		Raja polystigma	Speckled skate
		Raja radula	Rough skate
		Raja undulata	Undulate skate
	Dasyatidae	*Dasyatis centroura*	Roughtail stingray
		Dasyatis marmorata	Marbled stingray
		Dasyatis pastinaca	Common stingray
		Dasyatis tortonesei	Tortonese's stingray
		Himantura uarnak	Honeycomb whipray
		Taeniura grabata	Round fantail stingray
	Myliobatidae	*Pteromylaeus bovinus*	Bullray
	Rhinopteridae	*Rhinoptera marginata*	Lusitanian cownose ray
	Sphyrnidae	*Sphyrna tudes*	Smalleye hammerhead

Appendix L - Geographical subareas (GSA) and GFCM subregions (*GFCM-DCRF, 2016*)

GSA	Name
1	Northern Alboran Sea
2	Alboran Island
3	Southern Alboran Sea
4	Algeria
5	Balearic Islands
6	Northern Spain
7	Gulf of Lion
8	Corsica
9	Ligurian Sea and Northern Tyrrhenian Sea
10	Southern and Central Tyrrhenian Sea
11.1	Western Sardinia
11.2	Eastern Sardinia
12	Northern Tunisia
13	Gulf of Hammamet
14	Gulf of Gabes
15	Malta
16	Southern Sicily
17	Northern Adriatic Sea
18	Southern Adriatic Sea
19	Western Ionian Sea
20	Eastern Ionian Sea
21	Southern Ionian Sea
22	Aegean Sea
23	Crete
24	Northern Levant Sea
25	Cyprus
26	Southern Levant Sea
27	Eastern Levant Sea
28	Marmara Sea
29	Black Sea
30	Azov Sea

GFCM subregions	GSAs	Countries
Western Mediterranean Sea	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	Algeria, France, Italy, Morocco, Spain
Ionian Sea	12, 13, 14, 15, 16, 19, 20, 21	Greece, Italy, Libya, Malta, Tunisia
Adriatic Sea	17, 18	Albania, Croatia, Italy, Montenegro, Slovenia
Eastern Mediterranean Sea	22, 23, 24, 25, 26, 27	Cyprus, Egypt, Greece, Israel, Lebanon, Syria, Turkey
Black Sea	28, 29, 30	Bulgaria, Romania, Turkey, (Georgia, Russia, Ukraine)*

**All States, including non-members of the GFCM which are known to fish in its competence area, are encouraged to cooperate in joint actions undertaken in accordance with applicable international obligations (i.e. Article 63 UNCLOS)*

F.1 – Effort measurement by fleet segment (GFCM-DCRF, 2016)

Fleet segments			Effort measurements		
	Vessel groups	Length classes (LOA)	Unit of capacity	Unit of activity	Nominal effort
P	Small-scale vessels without engine using passive gears Small-scale vessels with engine using passive gears Polyvalent vessels	All	Net length [8] [9]	Fishing days	Net length * Fishing days
			Number of traps/pots [23]	Fishing days	Number of traps/pots * Fishing days
			Number of lines [23]	Fishing days	Number of lines * Fishing days
S	Purse seiners Tuna seiners	All	GT	Number of fishing sets [10] [11]	GT * number of Fishing sets
D	Dredgers	All	GT	Fishing days	GT * Fishing days
T	Beam trawlers Pelagic trawlers Trawlers	All	GT	Fishing days	GT * Fishing days
L	Long liners	All	Number of hooks	Fishing days	Number of hooks * Fishing days

[8] Length of net expressed in 100-metre units (FAO).
[9] Should this information not be available, "GT" may be used as capacity unit upon approval by relevant GFCM subsidiary bodies on a case-by-case basis.
[10] Number of times the gear has been set or shot, whether or not a catch was made (FAO).
[11] Should this information not be available, "fishing days" may be used as activity unit upon approval by relevant GFCM subsidiary bodies on a case-by-case basis.

F.2 – Effort measurement by fishing gear (GFCM-DCRF, 2016)

Fishing gear		Gear code	Unit of capacity	Unit of activity	Nominal effort
Surrounding nets	With purse lines (purse seines)	PS	GT	Number of fishing sets [12] [13]	GT * Number of fishing sets
	One boat operated purse seines	PS1			
	Two boats operated purse seines	PS2			
	Without purse lines (lampara)	LA			
Seine nets	Beach seines	SB	Net length [14] [15]	Fishing days	Net length * Fishing days
	Boat or vessel seines	SV			
	Danish seines	SDN			
	Scottish seines	SSC			
	Pair seines	SPR			
	Seine nets (not specified)	SX			
Trawls	Bottom trawls	TB	GT	Fishing days	GT * Fishing days
	Bottom beam trawls	TBB			
	Bottom otter trawls	OTB			
	Bottom pair trawls	PTB			
	Bottom nephrops trawls	TBN			
	Bottom shrimp trawls	TBS			
	Midwater trawls	TM			
	Midwater otter trawls	OTM			
	Midwater pair trawls	PTM			
	Midwater shrimp trawls	TMS			
	Otter twin trawls	OTT			
	Otter trawls (not specified)	OT			

[12] Number of times the gear has been set or shot, whether or not a catch was made (FAO).
[13] Should this information not be available, “fishing days” may be used as activity capacity upon approval by relevant GFCM subsidiary bodies on a case-by-case basis.
[14] Length of net expressed in 100-metre units (FAO).
[15] Should this information not be available, “GT” may be used as capacity unit upon approval by relevant GFCM subsidiary bodies on a case-by-case basis.

	Fishing gear	Gear code	Unit of capacity	Unit of activity	Nominal effort
	Pair trawls (not specified)	PT	GT	Fishing days	GT * Fishing days
	Other trawls (not specified)	TX			
Dredges	Boat dredges	DRB			
	Mechanised dredges	HMD			
	Hand dredges	DRH			
Gillnets and Entangling Nets	Set gillnets (anchored)	GNS	Net length [7,8]	Fishing days	Net length* Fishing days
	Driftnets	GND			
	Encircling gillnets	GNC			
	Fixed gillnets (on stakes)	GNF			
	Trammel nets	GTR			
	Combined gillnets-trammel nets	GTN			
	Gillnets and entantling nets (not specified)	GEN			
	Gillnets (not specified)	GN			
Traps	Stationary uncovered pound nets	FPN	Number of traps/pots [8]	Fishing days	Number of traps/pots* Fishing days
	Pots	FPO			
	Fyke nets	FYK			
	Stow nets	FSN			
	Barrier, fences, weirs, etc	FWR			
	Aerial traps	FAR			
	Traps (not specified)	FIX			
Hooks and Lines	Handlines and pole-lines (hand operated)	LHP	Number of lines [8]	Fishing days	Number of lines * Fishing days
	Handlines and pole-lines (mechanised)	LHM			
	Trolling lines	LTL			
	Set longlines	LLS	Number of hooks	Fishing days	Number of hooks* Fishing days
	Drifting longlines	LLD			
	Longlines (not specified)	LL			
	Hooks and lines (not specified)	LX			