



UNITED
NATIONS

EP

UNEP(DEPI)/MED WG.430/3



UNEP



UNITED NATIONS
ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN

31 January 2017
Original: English

Meeting of the Correspondence Group on Monitoring (CORMON), Biodiversity and Fisheries

Madrid, Spain, 28th February – 1st March 2017

Agenda item 4: Common indicator factsheets for biodiversity (EO1), NIS (EO2) and Fisheries (EO3)

Draft of Common indicator factsheets for Biodiversity (EO1), NIS (EO2) and Fisheries (EO3)

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1. Introduction

1. The 19th Meeting of Contracting Parties (COP 19), held in February 2016, adopted the Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria. In its Decision IG. 22/7, 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 this Programme were detailed.

2. IMAP, through Decision IG.22/7 lays down the principles for an integrated monitoring, which will, for the first time, monitor biodiversity and non-indigenous species, pollution and marine litter, coast and hydrography in an integrated manner. The IMAP aims to facilitate the implementation of article 12 of the Barcelona Convention and several monitoring related provisions under different protocols with the main objective to assess GES. Its backbone is the 11 Ecological Objectives and their 27 common indicators as presented in the decision.

3. In the context of the Barcelona Convention, a common indicator is an indicator that summarizes data into a simple, standardized, and communicable figure and is ideally applicable in the whole Mediterranean basin, or at least on the level of sub-regions, and is monitored by all Contracting Parties. A common indicator is able to give an indication of the degree of threat or change in the marine ecosystem and can deliver valuable information to decision makers.

4. The UN Environment/MAP Programme of Work (PoW) adopted at COP 19, includes the Output 1.4.3 for the Implementation of IMAP (the EcAp-based integrated monitoring and assessment programme) coordinated, including GES common indicators fact sheets, and supported by a data information centre to be integrated into Info/MAP platform.

5. Therefore, the draft guidance factsheets within each Common Indicator needs to be developed for coherent monitoring, as well as their targets defined and agreed in order to deliver the achievement of Good Environmental Status (GES), In this context, this document outlines the Indicator Factsheets for the Ecological Objectives 1 (Biodiversity), 2 (Non-Indigenous Species) and 3 (Fisheries) as follows:

- Common indicator 1: Habitat distributional range (EO1) to also consider habitat extent as a relevant attribute;
- Common indicator 2: Condition of the habitat's typical species and communities (EO1);
- Common indicator 3: Species distributional range (EO1 related to marine mammals, seabirds, marine reptiles);
- Common indicator 4: Population abundance of selected species (EO1, related to marine mammals, seabirds, marine reptiles);
- 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, seabirds, marine reptiles);
- 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);
- Common indicator 7: Spawning stock Biomass (EO3);
- Common indicator 8: Total landings (EO3);
- Common indicator 9: Fishing Mortality (EO3)
- Common indicator 10: Fishing effort (EO3)

- Common indicator 11: Catch per unit effort (CPUE) (EO3)
- Common indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)

6. The main purpose of this draft Indicator Factsheets is to provide concrete guidance and references to Contracting Parties to support implementation of their revised national monitoring programme towards the overall goal of implementing the Ecosystem Approach (EcAp) in the Mediterranean Sea and achieving GES.

7. Common Indicator Factsheets were structured based on the following main sections (scheme below):

- A common set of relevant policy and science-based information (ie. Indicator Title, Rational, Policy Context and Targets,
- Indicator analysis methods and methodology for monitoring (temporal and spatial scope),
- Data analysis and assessment outputs,
- Contacts and Document Registration.
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IMAP reference No and definition	Indicator Title	Related Operational objective	Proposed Target
	Relevant GES definition		
Scientific rationale and marine policy context (including relevant references)	Rationale		
	Justification for indicator selection Scientific References		
	Policy Context and targets		
Agreed scientific methodologies in use, including details monitoring requirements	Policy context description Targets Policy documents		
	Indicator analysis methods		
	Indicator Definition Methodology for indicator calculation Indicator units List of Guidance documents and protocols available Data Confidence and uncertainties		
	Methodology for monitoring, temporal and spatial scope		
	Available Methodologies for Monitoring and Monitoring Protocols Available data sources Spatial scope guidance and selection of monitoring stations Temporal Scope guidance		
Data reporting, analysis and aggregation (output)	Data analysis and assessment outputs		
	Statistical analysis and basis for aggregation Expected assessments outputs Known gaps and uncertainties in the Mediterranean		
	Contacts and version Date		
Document Registration	Key contacts within UNEP for further information		
	Version No	Date	Author

2. Common indicator Factsheet

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

Indicator Title	<i>Common Indicator 1: Habitat distributional range</i>	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Reference condition/reference state is recommended as the preferred approach to setting baselines for benthic habitats. Where possible, the reference conditions should be determined e.g. using historical maps/data, modelling results. If the determination of reference conditions is not possible, then expert judgement should be used giving particular consideration to the current state.	The ECAP Operational Objective of the indicator for habitat distributional range is that key coastal and marine habitats are not being lost.	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. 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.
Rationale		
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.		
Scientific References <i>List (author(s), year, Ref: journal, series, etc.) and url's</i>		
Andersen et al., 2013		
<ul style="list-style-type: none"> • Ban N.C., Alidina, H.M., Ardron, J.A., 2010. Cumulative impact mapping: advances, relevance and limitations to marine management and conservation, using Canada's Pacific waters as a case study. <i>Mar. Policy</i> 34, 876–886. • 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., Christensen, V., Karpouzi, V.S., Guilhaumon, F., Mouillot, D., Paleczny, M., Palomares, M.L., Steenbeek, J., Trujillo, P., Watson, R., Pauly, D., 2012. The Mediterranean Sea under siege: spatial overlap between marine biodiversity, cumulative threats and marine reserves. <i>Glob. Ecol. Biogeogr.</i> 21, 465–480. • Giakoumi, S., Sini, M., Gerovasileiou, V., Mazor, T., Beher, J., Possingham, H.P., Abdulla, A., Çınar, M.E., Dendrinos, P., Gucu, A.C., Karamanlidis, A.A., Rodic, P., Panayotidis, P., Taskin, E., Jaklin, A., Voultsiadou, E., Webster, C., Zenetos, A. & S. Katsanevakis (2013). Ecoregion-based conservation planning in the Mediterranean: dealing with large-scale heterogeneity. <i>PLoS ONE</i> 8(10): e76449. doi:10.1371/journal.pone.0076449. • Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D'Agrosa, C., Bruno, J.F., et al., 2008. A global map of human impact on marine and coastal ecosystems. <i>Science</i> 319, 948–952. • Halpern, B.S., Kappel, C.V., Selkoe, K.A., Micheli, F., Ebert, C.M., Kontgis, C., Crain, C.M., Martone, R.G., Shearer, C., Teck, S.J., 2009. Mapping cumulative human impacts to California current marine and coastal ecosystems. <i>Conserv. Lett.</i> 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., Meski L., Andersen A., Laamanen M., 2012. Human pressures and their potential impact on the Baltic Sea ecosystem. <i>Ecological Indicators</i>, 15:105–114. • Korpinen S., Meidinger M., Cumulative impacts on seabed habitats: An indicator Laamanen M., 2013. for assessments of GES. <i>Mar. Poll. Bull.</i>, 74: 311–319. • Micheli F, Halpern BS, Walbridge S, Ciriaco S, Ferretti F, Frascchetti S., Lewison R., Nykjaer L, 		

Indicator Title	<i>Common Indicator 1: Habitat distributional range</i>
<p>Rosenberg AA., 2013. Cumulative Human Impacts on Mediterranean and Black Sea Marine and coastal ecosystems: Assessing Current Pressures and Opportunities. PLoS ONE 8(12): e79889. doi:10.1371/journal.pone.0079889.</p> <ul style="list-style-type: none"> Selkoe, K.A., Halpern, B.S., Ebert, C.M., Franklin, E.C., Selig, E.R., Casey, K.S., Bruno, J., Toonen, R.J., 2009. A map of human impacts to a pristine coral reef ecosystem, the Papahānaumokuākea Marine National Monument. Coral Reefs 28, 635–650. 	
Policy Context and targets (other than IMAP)	
<p>Policy context description</p> <p>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.</p>	
<p>Indicator/Targets</p> <p>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.</p> <p>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 some cases a more stringent <1% tolerance has been attached to the maintenance of habitat extent.</p>	
<p>Policy documents</p> <p>List and url's</p> <ul style="list-style-type: none"> 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	
<p>Indicator Definition</p> <p>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).</p>	
<p>Methodology for indicator calculation</p> <p>Three options have been identified for the assessment of this indicator:</p> <ol style="list-style-type: none"> The use of condition indices and a representative sampling and assessment in a restricted number of areas with subsequent extrapolation into the larger area Modelling habitats and mapping against impacts using sensitivity maps in combination with construction footprint data and spatial pressure intensity data. It may also be possible to combine options 1 and 2. Direct monitoring of habitats 	
<p>Indicator units</p> <p>The parameter/metric for the assessment of this indicator is the surface area of lost habitat for each habitat type. It is suggested to largely use cumulative impact data derived from knowledge of construction and other anthropogenic pressures.</p>	
<p>List of Guidance documents and protocols available</p> <p>Coggan, R., Populis, J., White, J., Sheehan, K., Fitzpatrick, F., Peil, S. (eds) (2007) Review of standards and protocols for seabed habitat mapping, 192pp.</p> <p>Recommended Operating Guidelines (http://www.emodnet-seabedhabitats.eu/default.aspx?page=1915)</p>	
<p>Data Confidence and uncertainties</p> <p>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,</p>	

Indicator Title	<i>Common Indicator 1: Habitat distributional range</i>
<p>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.</p> <p>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.</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available data sources <i>Sources and url's</i></p> <p>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 Marine Observation and Data Network (EMODnet) : http://www.emodnet-mediterranean.eu/project/ Distribution of <i>Posidonia oceanica</i> meadows in the Mediterranean Sea (GIS shapefile) : http://lifewww-00.her.hcmr.gr:8080/medobis/resource.do?r=posidonia Distribution of coralligenous formations in the Mediterranean Sea (GIS shapefile) : http://lifewww-00.her.hcmr.gr:8080/medobis/resource.do?r=coralligenous</p>	
<p>Spatial scope guidance and selection of monitoring stations</p> <p>The spatial basis for assessment should be according to the Mediterranean biogeographic sub-areas in order to reflect changes in the biological character of each habitat type across the Mediterranean and its sub-regions. Each Contracting Party should assess each habitat across their national maritime waters. However, it is recommended to assess on a smaller scale if they belong to different biogeographical sub-regions or differences in pressure intensity are obvious between sub-basins.</p>	
<p>Temporal Scope guidance</p> <p>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.</p>	
<p>Data analysis and assessment outputs</p>	
<p>Statistical analysis and basis for aggregation</p> <p>No statistical analyses are needed for this assessment.</p>	
<p>Expected assessments outputs</p> <p><i>I.e. trend analysis, distribution maps etc, and methods used</i></p> <p>In general terms, the following steps should be part of the indicator's assessment:</p> <ul style="list-style-type: none"> • Generate maps of the marine habitats in each Contracting Party's marine areas; • Attribute a specific sensitivity to physical pressures to each habitat type; • Collate construction footprint data for seabed habitats and apply spatial and temporal pressure intensity data (e.g. VMS or log book data for fisheries, activity data from approved plans and projects); • If vulnerabilities are addressed in 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 construction footprints and impact models (with ground-truthing); 	

Indicator Title	<i>Common Indicator 1: Habitat distributional range</i>	
	<ul style="list-style-type: none"> • 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). 	
<p>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.</p>		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC

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

Indicator Title	<i>Common indicator 2: Condition of the habitat's typical species and communities</i>	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Typical and/or characteristic species composition should be close to baseline conditions for their habitat to be considered in natural condition.	The ECAP Operational Objective of the indicator that key coastal and marine habitats remain in natural condition, in terms of structure and functions.	The general target is to reach a ratio of typical and/or characteristic species similar to baseline conditions for all considered communities.
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 <i>List (author(s), year, Ref: journal, series, etc.) and url's</i>		
<ul style="list-style-type: none"> • Pearson, T. H., Rosenberg, R. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. <i>Oceanogr. Mar. Biol. Ann. Rev.</i> 16,229-311. • Pérès JM, Picard J (1964) Nouveau manuel de Bionomie benthique de la Mer Méditerranée. <i>Recueil des Travaux de la Stations Marine d'Endoume</i>, 47: 3-137. 		
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 Inter-calibration 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. To this end, the 2015 PERSEUS Project specific training course targeting Southern Mediterranean countries could be utilized.		
Indicator/Targets In order to assess the state/condition of a habitat's typical species, the Contracting Parties need to define lists of typical and/or characteristic 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.		
Policy documents <i>List and url's</i> UNEP/DEPI/MED WG. 342/3 http://www.unepmap.org/index.php http://195.97.36.231/dbases/MEETING_DOCUMENTS/09WG342_3_eng.pdf		

Indicator Title	<i>Common indicator 2: Condition of the habitat's typical species and communities</i>
<p>EU Water Framework Directive (MED GIG)</p> <p>http://ec.europa.eu/environment/water/water-framework/index_en.html</p> <p>http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/10473/1/3010_08-volumecoast.pdf</p>	
Indicator analysis methods	
<p>Indicator Definition</p> <p>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.</p>	
<p>Methodology for indicator calculation</p> <p>The calculation of this indicator involves simple comparison of typical and/or characteristic 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.</p> <p>The required methods and effort strongly depend on the habitat type (and selected species) to be addressed. 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.</p> <p>The following resources are usually required for the calculation of this indicator:</p> <ul style="list-style-type: none"> • 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; • 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. 	
<p>Indicator units</p> <p>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.</p>	
<p>List of Guidance documents and protocols available</p> <ul style="list-style-type: none"> • EN ISO 16665:2014. Water quality - Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna. • EN ISO 19493:2007 Water quality - Guidance on marine biological surveys of hard-substrate communities • GIG, 2013a. Intercalibration of biological elements for transitional and coastal water bodies. Mediterranean Sea GIG: Coastal waters - Benthic Invertebrate fauna. https://circabc.europa.eu/sd/a/2a0a9f86-e281-4bb8-a6ba-6e659b54e554/Med-Sea_CW_Benthic-Invertebrate-Fauna.pdf • GIG, 2013b. Intercalibration of biological elements for transitional and coastal water bodies. Mediterranean Sea GIG: Coastal waters - Seagrasses. https://circabc.europa.eu/sd/a/893d2fa4-9089-4765- 	

Indicator Title	<i>Common indicator 2: Condition of the habitat's typical species and communities</i>
<p>8d42-c914a91b71e1/Med-Sea_CW_Seagrasses.pdf</p> <ul style="list-style-type: none"> GIG, 2013c. Intercalibration of biological elements for transitional and coastal water bodies. Mediterranean Sea GIG: Coastal waters - Macroalgae. https://circabc.europa.eu/sd/a/655bf0ef-370b-4737-8a48-f4adee0f4889/Med-Sea_CW_Macroalgae.pdf 	
<p>Data Confidence and uncertainties</p> <p>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.</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available data sources</p> <p>Sources and url's</p> <ul style="list-style-type: none"> Ballesteros, E., Torras, X., Pinedo, S., Garcia, M., Mangialajo, L., de Torres, M., 2007. A new methodology based on littoral community cartography dominated by macroalgae for the implementation of the European Water Framework Directive. <i>Marine Pollution Bulletin</i> 55: 172–180. Borja, A., Franco, J., Perez, V., 2000. Marine Biotic Index to establish the ecological quality of soft bottom benthos within European estuarine and coastal environments. <i>Mar. Poll. Bull.</i>, 40 (12): 1100-1114. Borja, A., Franco, J., Valencia, V., Bald, J., Muxika, I., Belzunce, M. J., Solaun, O., 2004. Implementation of the European Water Framework Directive from the Basque Country (northern Spain): a methodological approach. <i>Marine Pollution Bulletin</i> 48 (3–4), 209–218. Dauvin, J. C., Rouellet, T., 2007. Polychaete/amphipod ratio revisited. <i>Marine Pollution Bulletin</i> 55: 215-224. Gatti, G., Bianchi, C.N., Morri, C., Montefalcone, M., Sartoretto, S. (2015). Coralligenous reefs state along anthropized coasts: Application and validation of the COARSE index, based on a rapid visual assessment (RVA) approach. <i>Ecological Indicators</i> 52: 567-576. Gatti, G., Montefalcone, M., Rovere, A., Parravicini, V., Morri, C., Albertelli, G., Bianchi C.N. (2012): Seafloor integrity down the harbor waterfront: the coralligenous shoals off Vado Ligure (NW Mediterranean), <i>Advances in Oceanography and Limnology</i>, 3:1, 51-67. Gobert, S., Sartoretto, S., Rico-Raimondino, V., Andral, B., Chery, A., Lejeune, P., Boissery, P., 2009. Assessment of the ecological status of Mediterranean French coastal waters as required by the water framework directive using the <i>Posidonia oceanica</i> rapid easy index: PREI. <i>Mar. Pol. Bull.</i> 58: 1727–1733. Gowen, R.J. McQuatters-Gollop, A. Tett, P. Best, M. Bresnan, E. Castellani, C. Cook, K. Forster, R. Scherer, C. McKinney, A. 2011. The Development of UK Pelagic (Plankton) Indicators and Targets for the MSFD, Belfast, 2011. Lopez y Royo C., Casazza G., Pergent-Martini C., Pergent G., 2010. A biotic index using the seagrass <i>Posidonia oceanica</i> (BiPo), to evaluate ecological status of coastal waters. <i>Ecological Indicators</i>. 10: 380–389. Muxika I., Borja A., Bald J., 2007. Using historical data, expert judgement and multivariate analysis in assessing reference conditions and benthic ecological status, according to the European water framework Directive. <i>Mar. Poll. Bull.</i>, 55: 16-29. Oliva, S., Mascaro, O., Llagostera, I., Perez, M., Romero, J., 2011. Selection of metrics based on the seagrass <i>Cymodocea nodosa</i> and development of a biotic index (CYMOX) for assessing ecological status of coastal and transitional waters. <i>Estuarine, Coastal and Shelf Science</i> xx, 1–11. Orfanidis, S., Panayotidis, P., Ugland, K.I., 2011. Ecological Evaluation Index continuous formula (EEI-c) application: a step forward for functional groups, the formula and reference condition values. <i>Mediterranean Marine Science</i>, 12(2): 199–231. Orfanidis, S., Panayotidis, P., Stamatis, N., 2001. Ecological evaluation of transitional and coastal waters: a marine benthic macrophytes-based model. <i>Mediterranean Mar. Res.</i> 2 (2), 45–65. 	

Indicator Title	<i>Common indicator 2: Condition of the habitat's typical species and communities</i>	
	<ul style="list-style-type: none"> Orfanidis, S., Papathanasiou, V., Gounaris, S., Theodosiou, T., 2010. Size distribution approaches for monitoring and conservation of coastal <i>Cymodocea</i> habitats. <i>Aquatic Conserv: Mar. Freshw. Ecosyst.</i> 20: 177–188. Pinedo, S., Jordana, E., Ballesteros, E., 2014. A Critical analysis on the response of macroinvertebrate communities along disturbance gradients: description of MEDOCC (MEDiterranean OCCidental) index. Rastorgueff PA, Bellan-Santini D, Bianchi CN, Bussotti S, Chevaldonné P, et al. (2015) An ecosystem-based approach to evaluate the ecological quality of Mediterranean undersea caves. <i>Ecological Indicators</i>, 54: 137-152. Romero, J., Martinez-Crego, B., Alcoverro, T., Perez, M., 2007. A multivariate index based on the seagrass <i>Posidonia oceanica</i> (POMI) to assess ecological status of coastal waters under the Water Framework Directive (WFD). <i>Marine Pollution Bulletin</i> 55: 196–204. Simboura, N., Zenetos, A., 2002. Benthic indicators to use in ecological quality classification of Mediterranean soft bottom marine and coastal ecosystems, including a new Biotic index. <i>Mediterranean Marine Science</i>, 3/2:77-111. Tett, P., Carreira, C., Mills, D.K., van Leeuwen, S., Foden, J., Bresnan, E., Gowen, R.J. 2008. Use of a phytoplankton community index to assess the health of coastal waters. <i>ICES J. Mar. Sci.</i> 65(8), 1475-1482. Orfanidis, S., Panayotidis, P., Stamatis, N., 2003. An insight to the ecological evaluation index (EEI). <i>Ecological Indicators</i> 3: 27-33. 	
	<p>Spatial scope guidance and selection of monitoring stations</p> <p>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.</p>	
	<p>Temporal Scope guidance</p> <p>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 recommended sampling frequency for this indicator is once per year at assessed sites and once every 5 years at reference-baseline condition sites (at least 2 replicates per monitoring station).</p>	
	<p>Data analysis and assessment outputs</p>	
	<p>Statistical analysis and basis for aggregation</p> <p>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.</p>	
	<p>Expected assessments outputs</p> <p>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.</p>	
	<p>Known gaps and uncertainties in the Mediterranean</p> <p>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.</p>	
	<p>Contacts and version Date</p>	
	<p>Key contacts within UNEP for further information</p>	
Version No	Date	Author
V.1	20/07/2016	SPA/RAC

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

Indicator Title		
Common indicator 3: species distributional range (marine mammals)		
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The species are present in all their natural distributional range	Species distribution is maintained	The distribution of marine mammals remains stable or expanding and the species are recolonising areas with suitable habitats
Rationale		
<p>Justification for indicator selection</p> <p>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.</p> <p>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.</p> <p>Eleven species of cetaceans are considered to regularly occur in the Mediterranean area: short-beaked common dolphin (<i>Delphinus delphis</i>), striped dolphin (<i>Stenella coeruleoalba</i>), common bottlenose dolphin (<i>Tursiops truncatus</i>), harbour porpoise (<i>Phocoena phocoena</i>), long-finned pilot whale (<i>Globicephala melas</i>), rough-toothed dolphin (<i>Steno bredanensis</i>), Risso's dolphin (<i>Grampus griseus</i>), fin whale (<i>Balaenoptera physalus</i>), sperm whale (<i>Physeter macrocephalus</i>), Cuvier's beaked whale (<i>Ziphius cavirostris</i>) and killer whale (<i>Orcinus orca</i>). 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.</p> <p>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.</p> <p>The conservation status of cetaceans 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.</p> <p>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.</p>		
<p>Scientific References</p> <p>Bearzi, G. et al. 2004. The role of historical dolphin takes and habitat degradation in shaping the present status of northern Adriatic cetaceans. - <i>Aquat. Conserv. Mar. Freshw. Ecosyst.</i> 14: 363–379.</p> <p>Coll, M. et al. 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. - <i>PLoS ONE</i> 5:</p>		

Indicator Title	Common indicator 3: species distributional range (marine mammals)
<p>e11842.</p> <p>Fossi, M. C. and Marsili, L. 2003. Effects of endocrine disruptors in aquatic mammals. - Pure Appl. Chem. 75: 2235–2247.</p> <p>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 (<i>Stenella coeruleoalba</i>). - Mar Pollut Bull 70: 64–72.</p> <p>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 (<i>Cetorhinus maximus</i>) and fin whale (<i>Balaenoptera physalus</i>). - Mar. Environ. Res. 100: 17–24.</p> <p>Frantzis, A. 1998. Does acoustic testing strand whales? - Nature 392: 29–29.</p> <p>Gaston, K. J. 2003. The Structure and Dynamics of Geographic Ranges. - Oxford University Press.</p> <p>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.</p> <p>Hoffmann, A. A. and Blows, M. W. 1994. Species borders: ecological and evolutionary perspectives. - Trends Ecol. Evol. 9: 223–227.</p> <p>IUCN 2012. Marine mammals and sea turtles of the Mediterranean and Black Seas. - IUCN.</p> <p>Lawton, J. H. 1993. Range, population abundance and conservation. - Trends Ecol. Evol. 8: 409–413.</p> <p>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.</p> <p>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.</p> <p>Panigada, S. et al. 2006. Mediterranean fin whales at risk from fatal ship strikes. - Mar Pollut Bull 52: 1287–1298.</p> <p>Reese, G. C. et al. 2005. Factors Affecting Species Distribution Predictions: A Simulation Modeling Experiment. - Ecol. Appl. 15: 554–564.</p> <p>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.</p>	
Policy Context and targets (other than IMAP)	
<p>Policy context description</p> <p>Mediterranean fin whales and sperm whales are protected by the International Whaling Commission's moratorium on commercial whaling that entered into force in 1986.</p> <p>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.</p> <p>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</p>	

Indicator Title	<i>Common indicator 3: species distributional range (marine mammals)</i>
<p>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 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.</p>	
<p>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</p>	
<p>Policy documents</p> <ul style="list-style-type: none"> • 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&usq=AFQjCNGa4NkkljA4x3I9WDO49uwrYafMg • 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	
<p>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.</p>	
<p>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).</p>	
<p>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.</p>	
<p>List of Guidance documents and protocols available A document on 'Monitoring Guidelines to assess Cetaceans' Distributional Range, Population Abundance and</p>	

Indicator Title	<i>Common indicator 3: species distributional range (marine mammals)</i>
Population Demographic Characteristics' has been produced by ACCOBAMS and should be considered as guidance when establishing monitoring programmes.	
<p>Data Confidence and uncertainties</p> <p>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.</p>	
<p>Methodology for monitoring, temporal and spatial scope</p> <p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>Several protocols are available using different monitoring platforms and approaches such as:</p> <ul style="list-style-type: none"> - Dedicated ships or aerial surveys - By-catch data - Beached and stranded specimens monitoring - Opportunistic data collected from platform of opportunities - Citizen science data - 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 	
<p>Available data sources</p> <p>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/</p>	
<p>Spatial scope guidance and selection of monitoring stations</p> <p>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.</p> <p>Ongoing effort by Dr. Jean-Noël DRUON, European Commission, DG Joint Research Centre, Maritime Affairs Unit on mapping potential foraging areas for fin whales in near real-time may provide baseline data and facilitate the analysis of distributional trends over time and space (https://fishreg.jrc.ec.europa.eu/fish-habitat).</p>	
<p>Temporal Scope guidance</p> <p>Fine scale distribution of cetaceans may vary on annual, seasonal or monthly basis. Ideally, seasonal monitoring programmes should be conducted; winter and summer campaigns should provide enough information. 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 in selected areas.</p>	
<p>Data analysis and assessment outputs</p> <p>Statistical analysis and basis for aggregation</p> <p>Standard regression methods (simple linear regression, generalized linear or additive models), power analysis for detecting trends should be applied.</p>	
<p>Expected assessments outputs</p> <p>I.e. trend analysis (monthly, seasonally, yearly), distribution maps, statistical frameworks applied.</p>	
<p>Known gaps and uncertainties in the Mediterranean</p> <p>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.</p> <p>Ongoing effort is targeting the identification of Cetacean Critical Habitats (CCHs) and Important Marine</p>	

Indicator Title	<i>Common indicator 3: species distributional range (marine mammals)</i>	
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.		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC

2.4. 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 ¹ having the potential to exclude marine turtles from their range area are regulated and controlled. The potential impact of climate change is assessed
Rationale		
<p>Justification for indicator selection</p> <p>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.</p> <p>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.</p> <p>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).</p> <p>It is therefore necessary to establish minimum information standards to reflect the known distribution of all selected species.</p> <p>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.</p> <p>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.</p>		
<p>Scientific References</p> <p>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 (<i>Chelonia mydas</i>). <i>Herpetological Review</i>, 47(1), 27–32.</p> <p>Casale P. and Margaritoulis D. (Eds.) 2010. <i>Sea Turtles in the Mediterranean: Distribution, Threats and Conservation Priorities</i>. IUCN/SSC Marine Turtle Specialist Group. Gland, Switzerland: IUCN, 294 pp.</p>		

¹ Uncontrolled use of turtle nesting sites, fishing, maritime traffic, etc.

Indicator Title	Common indicator 3: Species distributional range – Reptiles
<p>http://iucn-mtsg.org/publications/med-report/</p> <p>Casale P., G. Abbate, D. Freggi, N. Conte, M. Oliverio, R. Argano. 2008. Foraging ecology of loggerhead sea turtles <i>Caretta caretta</i> in the central Mediterranean: evidence for a relaxed life history model. Marine Ecology Progress Series 372: 265-276.</p> <p>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)</p> <p>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</p> <p>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.</p> <p>Mazaris AD, Alpanidou V, Wallace B, Schofield G. 2014. A global gap analysis of sea turtle protection coverage. 2014. Biological Conservation. 173, 17–23</p> <p>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.</p>	
Policy Context and targets (other than IMAP)	
<p>Policy context description</p> <p>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.</p> <p>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.</p> <p>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”.</p>	
<p>Indicator/Targets</p> <p>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)”.</p> <p>At a country scale, the following targets have been selected by member states.</p> <p>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</p> <p>GREECE (page 15)</p> <p>Environmental targets:</p> <p>[...]2) Census of marine turtle <i>Caretta caretta</i> reproducing in the Greek coasts and conservation of spawning areas.</p> <p>Associated indicators:</p>	

Indicator Title	Common indicator 3: Species distributional range – Reptiles
<p>[...]2) Breeding area of the Mediterranean monk seal <i>Monachus monachus</i> and the sea turtle <i>Caretta caretta</i> ITALY (page 18)</p> <p>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.</p> <p>[...]</p> <p>T2: By-catch reduction in the areas of aggregation of <i>Caretta caretta</i></p> <p>It is proposed that the operative target for the mitigation of <i>Caretta caretta</i> by-catch be articulated as follows:</p> <p>1) Spatial identification of the areas with highest use of pelagic long line (southern Tyrrhenian and southern Ionian sea) and trawling (northern Adriatic)</p> <p>2) Completion of the spatial definition of <i>Caretta caretta</i> 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</p> <p>3) Monitoring of accidental captures in the areas subjected to operational target</p> <p>4) Application of by-catch reduction measures in areas listed in point 3), through one or more of the following activities:</p> <ul style="list-style-type: none"> - Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling net 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) <p>SPAIN (Page 25)</p> <p>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.</p> <p>[...]</p> <p>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.</p> <p>[...]</p> <p>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.</p> <p>[...]</p> <p>C.1.2: Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles)</p> <p>SLOVENIA - No information on Targets</p> <p>page 10: (I. Good Environmental Status (GES), 1.1 Descriptor 1)</p> <p>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 (<i>Tursiops truncatus</i>), the loggerhead sea turtle (<i>Caretta caretta</i>).</p> <p>(II. Initial assessment, 2.2 Biological features)</p> <p>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.</p> <p>CYPRUS - No information on Targets</p> <p>page 11: (II. Initial assessment, 2.2 Biological features)</p> <p>[...] <i>Chelonia mydas</i> and <i>Monachus monachus</i> are considered stable but the situation of <i>Caretta caretta</i> is actually improving.</p>	
<p>Policy documents</p> <p>http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010D0477(01)</p> <p>http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm</p> <p>http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm</p>	

Indicator Title	<i>Common indicator 3: Species distributional range – Reptiles</i>
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	
<p>Indicator Definition</p> <p>Variation in the total area (trends in the number of occupied grid cells) occupied by the selected species for breeding, wintering and feeding areas.</p> <p>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 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.</p>	
<p>Methodology for indicator calculation</p> <p>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 (<i>Caretta caretta</i>) and greens (<i>Chelonia mydas</i>).</p> <p>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”.</p> <p>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.</p>	
<p>Indicator units</p> <p>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.</p> <p>Annually – Total number of new locations (breeding, wintering, feeding); total number of 10 x 10 km newly occupied cells;</p> <p>Annually – Total number of lost locations; total number of 10 x 10 km lost cells</p>	
<p>List of Guidance documents and protocols available</p> <p>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</p> <p>Gerosa, G. (1996). Manual on Marine Turtle Tagging in the Mediterranean. –Mediterranean Action Plan - UNEP, RAC/SPA, Tunis, 48 pp.</p> <p>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</p> <p>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</p> <p>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</p>	
<p>Data Confidence and uncertainties</p> <p>Presence/absence information is used only, because the different methods used to detect the</p>	

Indicator Title	<i>Common indicator 3: Species distributional range – Reptiles</i>
<p>presence/absence of turtles range from coarse to highly accurate (within metres), along with heavy sighting/detection bias to certain key regions/sites.</p> <p>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%)</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>Monitoring effort should be long term and should cover all seasons to ensure that the information obtained is as complete as possible.</p> <ul style="list-style-type: none"> - Aerial surveys: plane transects in marine areas (monitoring CI 3 & 4 in marine areas) - Land based surveys: Nesting monitoring (breeding areas) and stranding monitoring (coastal areas) (CI 3-5) - In-water surveys: Diving/snorkeling transects, capture-mark-recapture (CI 3-5 in marine areas) - Satellite remote sensing: Nesting, in-water, bycatch surveys (CI 3-5 in marine & breeding areas) <p>Inwater monitoring can be done via</p> <ul style="list-style-type: none"> - Dedicated ship and aerial (plane and drone) transect surveys to confirm the presence/absence and spread of individuals in marine and coastal habitats - Bycatch data from fisheries records and onboard researchers, which are invaluable for obtaining data in deep/open waters - 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 - 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). - 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. - 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. <p>Beach monitoring can be done via</p> <ul style="list-style-type: none"> - Direct monitoring of nesting beaches - Detection of tracks of turtles on beaches potentially used for nesting. Aerial surveys (drones/planes) or foot patrols may be used to confirm the use of beaches for nesting activity - 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) - Use of aerial surveys by planes or drones once key areas are identified by satellite imagery where possible or as an alternative. <p>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.</p>	
<p>Available data sources</p> <p>Adriatic Sea Turtle Database. http://www.adriaticseaturtles.eu/</p> <p>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/</p> <p>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. <i>Oceanography</i> 22, 104–115.</p>	

Indicator Title	<i>Common indicator 3: Species distributional range – Reptiles</i>
	<p>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 Megavertebate 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>.</p> <p>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</p> <p>Seaturtle.org – Global Sea Turtle Network. Sea turtle tracking. Sea turtle nest monitoring. http://www.seaturtle.org/</p> <p>The Reptile Database: Location of juvenile loggerheads and greens in the Eastern Mediterranean. http://reptile-database.reptarium.cz/species?genus=Caretta&species=caretta</p> <p>UNEP/MAP-RAC/SPA projects and publications http://www.rac-spa.org/publications</p> <p>Mediterranean marine research centres, NGOs, universities and institutions, local and national sea turtle monitoring projects.</p> <p>Governmental Ministries</p> <p>International Union for Conservation of Nature (IUCN) specialists (Marine Turtle Specialist Group - MTSG)</p>
	<p>Spatial scope guidance and selection of monitoring stations</p> <p>The presence of the two species should be monitored all along the Mediterranean coast and in the known breeding, wintering, and feeding/developmental areas.</p> <p>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.</p> <p>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.</p>
	<p>Temporal Scope guidance</p> <p>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.</p>
	<p>Data analysis and assessment outputs</p>
	<p>Statistical analysis and basis for aggregation</p> <p>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.</p> <p>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.</p>
	<p>Expected assessments outputs</p> <p>Temporal trends in distributional range.</p> <p>Maps showing the evolution of the distributional range for the two species at different scales.</p>
	<p>Known gaps and uncertainties in the Mediterranean</p> <ul style="list-style-type: none"> • 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.

Indicator Title	<i>Common indicator 3: Species distributional range – Reptiles</i>	
<ul style="list-style-type: none"> • 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 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

2.5. 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)
<p>The distribution of seabird species continues to occur in all their Mediterranean natural habitat</p> <p>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)</p>	<p>Distribution of selected species is maintained.</p>	<ul style="list-style-type: none"> - 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		
<p>Justification for indicator selector: Species distributional range and distributional pattern.</p> <p>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</p> <p>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.</p> <p>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.</p> <p>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 distribution of breeding or wintering areas for the selected seabird species is 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.</p> <p>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.</p>		
<p>Scientific References</p> <p>Monbailliu, X. (Ed.). (2013). Mediterranean marine avifauna: population studies and conservation (Vol. 12). Springer Science & Business Media.</p> <p>Life projects Spain, Malta, Greece</p> <p>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.</p> <p>ICES. 2016. Report of the Joint OSPAR/HELCOM/ICES Working Group on Seabirds (JWGBIRD), 9–13 November</p>		

Indicator Title		Common indicator 3: Species distributional range (Seabirds)
2015, Copenhagen, Denmark. ICES CM 2015/ACOM:28. 196 pp.		
Policy Context and targets		
Policy context description		
EU Marine Strategy Framework Directive	<p>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.</p> <p>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”.</p>	<p><u>Descriptor 1: Biodiversity</u></p> <p>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.</p> <p><u>Parameters and trends:</u></p>
UE Nature Directives (Birds and Habitats Directives)	<p>The conservation status of a species “will be taken as ‘favourable’ when:</p> <ol style="list-style-type: none"> 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) <p>Every six years, all EU Member States are required to report on the implementation of the directives</p> <p>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).</p>	<p><u>Parameters and trends:</u></p> <p>Distribution (range)</p>
<p>Targets</p> <p><i>EU Marine Strategy Framework Directive:</i> 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.</p> <p><i>UE Nature Directives:</i></p>		
<p>Policy documents</p> <p>List and url's</p> <ol style="list-style-type: none"> 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- 		

Indicator Title	Common indicator 3: Species distributional range (Seabirds)
<p>content/EN/TXT/?qid=1401265930445&uri=CELEX:32008L0056</p> <ol style="list-style-type: none"> 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	
<p>Indicator Definition</p> <p>Variation in the total area (trends in the number of occupied grid cells) occupied by selected species for breeding, wintering and feeding areas.</p>	
<p>Methodology for indicator calculation</p> <p>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 sites.</p> <p>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”.</p> <p>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 (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 incompleteness of data following and standardised protocol. The resulting range map will then be a combination of the automated procedure completed by expert judgement.</p>	
<p>Indicator units</p> <p>Number of 10 x 10 km cells occupied for breeding or wintering or feeding areas along the Mediterranean (or subregional) coast.</p> <p>Annually – Total number of new locations (breeding, wintering, feeding); total number of 10 x 10 km newly occupied cells;</p> <p>Annually – Total number of lost locations; total number of 10 x 10 km lost cells;</p>	
<p>List of Guidance documents and protocols available</p> <p>General protocols</p> <ul style="list-style-type: none"> - 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, 	

Indicator Title	Common indicator 3: Species distributional range (Seabirds)
<p>London, UK. ICES CM 2015/ACOM: 25. 114 pp.</p> <ul style="list-style-type: none"> - MARMONI (2015). The MARMONI approach to marine biodiversity indicators. Volume II: list of indicators for 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/ <p>The “Range Tool”</p> <p>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</p> <ul style="list-style-type: none"> - 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. Available 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). Available 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/ 	
<p>Data Confidence and uncertainties</p> <p>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 <i>reliability</i> of the distribution at the time it was mapped, how <i>recently</i> it was mapped, and the <i>method</i> 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%)</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>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. <u>For breeding / wintering areas:</u></p> <p>Data collection : using any of the standard methods designed for breeding bird surveys such as bird count data, breeding/wintering bird atlases</p> <p>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.</p>	

Indicator Title	Common indicator 3: Species distributional range (Seabirds)
<p>Available data sources <i>Sources and url's</i></p> <p>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</p>	
<p>Spatial scope guidance and selection of monitoring stations</p> <p>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.</p>	
<p>Temporal Scope guidance</p> <p>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.</p>	
Data analysis and assessment outputs	
<p>Statistical analysis and basis for aggregation</p> <p>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.</p> <p>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".</p> <p>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 necessary to detect clear tendencies.</p> <p>A decreased range shouldn't be a major concern as far as other indicators, in particular the species indicator abundance, shows an acceptable trend.</p> <p>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).</p> <p><u>References (to be checked):</u></p> <ul style="list-style-type: none"> - 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. 	
<p>Expected assessments outputs</p> <p>Temporal trends in distributional range.</p> <p>Maps showing the evolution of the distributional range for the selected species at different scales and also by</p>	

Indicator Title	Common indicator 3: Species distributional range (Seabirds)	
functional groups of species.		
<p>Known gaps and uncertainties in the Mediterranean</p> <p>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.</p>		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC

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

Indicator Title	<i>Common indicator 4: Species population abundance (marine mammals)</i>	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The species population has abundance levels allowing to qualify to Least Concern Category of IUCN Red List	Population size of selected species is maintained, or, if depleted, it recovers to natural levels	No human-induced decrease in breeding population size or density. Populations recover towards natural levels.
Rationale		
<p>Justification for indicator selection</p> <p>This indicator focuses on population abundance estimates for those marine mammal species within the Mediterranean Basin, particularly for the species selected by the Parties.</p> <p>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.</p> <p>Eleven species of cetaceans are considered to regularly occur in the Mediterranean area: short-beaked common dolphin (<i>Delphinus delphis</i>), striped dolphin (<i>Stenella coeruleoalba</i>), common bottlenose dolphin (<i>Tursiops truncatus</i>), harbour porpoise (<i>Phocoena phocoena</i>), long-finned pilot whale (<i>Globicephala melas</i>), rough-toothed dolphin (<i>Steno bredanensis</i>), Risso's dolphin (<i>Grampus griseus</i>), fin whale (<i>Balaenoptera physalus</i>), sperm whale (<i>Physeter macrocephalus</i>), Cuvier's beaked whale (<i>Ziphius cavirostris</i>) and killer whale (<i>Orcinus orca</i>). 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.</p> <p>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.</p> <p>The conservation status of cetaceans 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.</p>		
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Indicator Title	<i>Common indicator 4: Species population abundance (marine mammals)</i>
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Indicator Title	<i>Common indicator 4: Species population abundance (marine mammals)</i>
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Policy Context and targets (other than IMAP)	
<p>Policy context description</p> <p>Mediterranean fin whales and sperm whales are protected by the International Whaling Commission's moratorium on commercial whaling that entered into force in 1986.</p> <p>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.</p> <p>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).</p> <p>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).</p> <p>The common bottle dolphin, the harbor porpoise and the monk seal are also listed under the Annex II of the EU Habitats Directive.</p>	
<p>Indicator/Targets</p> <p>Aichi Biodiversity Target 1, 3</p> <p>EU Regulation 812/2004 concerning incidental catches of cetaceans in fisheries</p> <p>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.</p> <p>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.</p> <p>The obligations under ACCOBAMS.</p>	
<p>Policy documents</p> <ul style="list-style-type: none"> • 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 - 	

Indicator Title	<i>Common indicator 4: Species population abundance (marine mammals)</i>
<p>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&usq=AfQjCNGa4NkkljA4x3l9WDO49uwrdYafMg</p> <ul style="list-style-type: none"> • 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 <p>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</p> <p>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</p> <p>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</p> <p>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</p> <p>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</p> <p>United Nations Convention on the Law of the Sea - http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm</p> <p>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&</p>	
Indicator analysis methods	
Indicator Definition	
<p>This indicator is aimed at providing information about the abundance of cetacean'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.</p> <p>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 cetacean populations occurring in the area are threatened by human activities and their conservation status requires effective protection actions.</p>	
Methodology for indicator calculation	
<p>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</p>	

Indicator Title	<i>Common indicator 4: Species population abundance (marine mammals)</i>
<p>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).</p> <p>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.</p> <p>Information on density and abundance 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), as well as mark-recapture methodologies.</p> <p>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):</p> <p>Marine mammals:</p> <p><u>Pinnipeds:</u> <i>Monachus monachus</i></p> <p><u>Baleen whales:</u> <i>Balaenoptera physalus</i></p> <p><u>Toothed whales:</u></p> <p>- deep diving species: <i>Physeter macrocephalus</i> <i>Ziphius cavirostris</i></p> <p>- epipelagic species: <i>Delphinus delphis</i> <i>Tursiops truncatus</i> <i>Stenella coeruleoalba</i> <i>Globicephala melas</i> <i>Grampus griseus</i></p> <p>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.</p>	
<p>Indicator units</p> <p>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.</p>	
<p>List of Guidance documents and protocols available</p> <p>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.</p> <p>Protocols for large scale surveys (Scans I, II, III, CODA) are also available.</p>	
<p>Data Confidence and uncertainties</p> <p>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.</p> <p>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.</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>Several protocols are available using different monitoring platforms and approaches such as:</p> <ul style="list-style-type: none"> • dedicated ships or aerial surveys, • beached and stranded specimens monitoring, • opportunistic data, 	

Indicator Title		<i>Common indicator 4: Species population abundance (marine mammals)</i>	
<ul style="list-style-type: none"> • tagging (capture-mark-recapture – artificial tags & photo-identification), • passive acoustic data collection, • automatic infrared cameras. 			
<p>Available data sources</p> <p>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/</p>			
<p>Spatial scope guidance and selection of monitoring stations</p> <p>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.</p> <p>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.</p>			
<p>Temporal Scope guidance</p> <p>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. 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.</p>			
<p>Data analysis and assessment outputs</p> <p>Statistical analysis and basis for aggregation</p> <p>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.</p>			
<p>Expected assessments outputs</p> <p>I.e. trend analysis (monthly, seasonally, yearly), density maps, statistical frameworks applied.</p>			
<p>Known gaps and uncertainties in the Mediterranean</p> <p>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.</p> <p>Ongoing effort by ACCOBAMS will provide estimates of density and abundance for the entire Mediterranean Sea. 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.</p>			
<p>Contacts and version Date</p>			
<p>Key contacts within UNEP for further information</p>			
Version No	Date	Author	
V.1	20/07/2016	SPA/RAC	

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

Indicator Title	<i>Common Indicator 4: Population abundance (Reptiles)</i>	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The population size allows to achieve and maintain a favourable 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		
<p>Justification for indicator selection</p> <p>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.</p>		
Scientific References		
<p>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 (<i>Chelonia mydas</i>). <i>Herpetological Review</i>, 47(1), 27–32.</p> <p>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. <i>Oryx</i> 36:227-235.</p> <p>Broderick, A.C., M.S. Coyne, W.J. Fuller, F. Glen, B.J. Godley. 2007. Fidelity and over-wintering of sea turtles. <i>Proceedings of the Royal Society</i>, Vol. 274 no. 1617 1533-1539.</p> <p>Casale P. and Margaritoulis D. (Eds.) 2010. <i>Sea Turtles in the Mediterranean: Distribution, Threats and Conservation Priorities</i>. IUCN/SSC Marine Turtle Specialist Group. Gland, Switzerland: IUCN, 294 pp. http://iucn-mtsg.org/publications/med-report/</p> <p>Casale P., G. Abbate, D. Freggi, N. Conte, M. Oliverio, R. Argano. 2008. Foraging ecology of loggerhead sea turtles <i>Caretta caretta</i> in the central Mediterranean: evidence for a relaxed life history model. <i>Marine Ecology Progress Series</i> 372: 265-276.</p> <p>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)</p> <p>Groombridge, B. 1990. <i>Marine turtles in the Mediterranean: distribution, population status, conservation</i>. A report to the Council of Europe, Environment and Management Division. Nature and Environment Series, Number 48. Strasbourg 1990</p> <p>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) <i>Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives</i>. <i>Loggerhead sea turtles</i> (ed. by B.E. Witherington), pp. 175–198. Smithsonian Institution, Washington.</p> <p>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. <i>Journal of Experimental Marine Biology & Ecology</i> 360:103-108</p>		
Policy Context and targets (other than IMAP)		
<p>Policy context description</p> <p>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.</p>		

Indicator Title	<i>Common Indicator 4: Population abundance (Reptiles)</i>
<p>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.</p> <p>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”.</p>	
<p>Indicator/Targets</p> <p>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)”.</p> <p>At a country scale, the following targets have been selected by member states.</p> <p>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</p> <p>GREECE (page 15)</p> <p>Environmental targets:</p> <p>[...]2) Census of marine turtle <i>Caretta caretta</i> reproducing in the Greek coasts and conservation of spawning areas.</p> <p>Associated indicators:</p> <p>[...]2) Breeding area of the Mediterranean monk seal <i>Monachus monachus</i> and the sea turtle <i>Caretta caretta</i></p> <p>ITALY (page 18)</p> <p>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.</p> <p>[...]</p> <p>T2: By-catch reduction in the areas of aggregation of <i>Caretta caretta</i></p> <p>It is proposed that the operative target for the mitigation of <i>Caretta caretta</i> by-catch be articulated as follows:</p> <ol style="list-style-type: none"> 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 <i>Caretta caretta</i> 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: <ul style="list-style-type: none"> - Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling net 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) <p>SPAIN (Page 25)</p> <p>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.</p> <p>[...]</p> <p>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.</p> <p>[...]</p> <p>A.3.4: Maintain positive or stable trends for the populations of key species or apex predators (marine</p>	

Indicator Title	Common Indicator 4: Population abundance (Reptiles)
	<p>mammals, reptiles, seabirds and fish) and maintain commercially exploited species within safe biological limits. [...]</p> <p>C.1.2: Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles)</p> <p>SLOVENIA - No information on Targets</p> <p>page 10: (I. Good Environmental Status (GES), 1.1 Descriptor 1)</p> <p>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 (<i>Tursiops truncatus</i>), the loggerhead sea turtle (<i>Caretta caretta</i>).</p> <p>(II. Initial assessment, 2.2 Biological features)</p> <p>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.</p> <p>CYPRUS - No information on Targets</p> <p>page 11: (II. Initial assessment, 2.2 Biological features)</p> <p>[...] <i>Chelonia mydas</i> and <i>Monachus monachus</i> are considered stable but the situation of <i>Caretta caretta</i> is actually improving.</p>
	<p>Policy documents</p> <p>http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010D0477(01)</p> <p>http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm</p> <p>http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm</p> <p>http://ec.europa.eu/environment/marine/pdf/1-Task-group-1-Report-on-Biological-Diversity.pdf</p> <p>http://ec.europa.eu/environment/marine/pdf/9-Task-Group-10.pdf</p>
	<p>Indicator analysis methods</p>
	<p>Indicator Definition</p> <p>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.</p> <p>Population Size:</p> <p>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.</p> <p>Population density:</p> <p>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.</p> <p>Index of population abundance:</p> <p>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.</p>
	<p>Methodology for indicator calculation</p> <p>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.</p> <p>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.</p>
	<p>Indicator units</p> <p>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).</p>

Indicator Title	<i>Common Indicator 4: Population abundance (Reptiles)</i>
<p>However, the breeding population in a given year excludes non-breeding adults and all juveniles; thus, a more comprehensive database is required.</p>	
<p>For the base data used to calculate the index of population abundance, the following units are suggested:</p>	
<ul style="list-style-type: none"> - for population size at breeding colonies, <u>number of females, number of nests or number of tracks</u>, with appropriate modelling to extrapolate population numbers depending on the method used - for total number of nesting sites, <u>number of sites</u> (n) - for average nesting site size, <u>size of the nesting area</u> versus <u>number of females, number of nests or number of tracks</u>, 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, <u>number of individuals</u> (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 <u>number of individuals</u> (n) will be documented via the stranding network/bycatch data 	
<p>Marine area surveys</p>	
<p>Numbers of individuals based on the number of individuals, separated where possible according to:</p>	
<ol style="list-style-type: none"> 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 	
<p>Beach area surveys</p>	
<ol style="list-style-type: none"> 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 	
<p>List of Guidance documents and protocols available</p>	
<p>Bevan E, Wibbels T, Rosas M, Najera BMZ, Sarti L, Montano J, Pena LJ, Burchfield P. Herpetological Review, 2016, 47(1), 27–32.</p> <p>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</p> <p>Gerosa, G. (1996). Manual on Marine Turtle Tagging in the Mediterranean. –Mediterranean Action Plan - UNEP, RAC/SPA, Tunis, 48 pp.</p> <p>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</p> <p>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</p> <p>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</p> <p>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</p>	
<p>Data Confidence and uncertainties</p>	
<p>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.</p>	
<p>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.</p>	
<p>In-water surveys</p>	
<p>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</p>	

Indicator Title	<i>Common Indicator 4: Population abundance (Reptiles)</i>
<p>(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.</p> <p>Male numbers can only be inferred from in-water surveys.</p> <p>Beach-based surveys</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Male numbers cannot be obtained from beach surveys, as they do not emerge on beaches.</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>To estimate and monitor the number of breeding turtles, the proposed field methods are:</p> <ol style="list-style-type: none"> 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 <p>To estimate and monitor the number of turtles in-water at breeding, wintering, foraging, and developmental sites, the following methodologies are proposed:</p> <ol style="list-style-type: none"> 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. <p>To estimate and monitor the number of animals that are injured or die in areas near or within breeding, wintering, foraging and developmental sites</p> <ol style="list-style-type: none"> 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. <p>Existing techniques include:</p> <ul style="list-style-type: none"> • 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 <p>Breeding areas census (rookeries):</p> <p>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</p>	

Indicator Title	<i>Common Indicator 4: Population abundance (Reptiles)</i>
	<p>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).</p> <p>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.</p> <p>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.</p> <p>Migration monitoring: For sea turtles, it is difficult to make counts of migratory animals. However, opportunistic counts from sightings may be made of resident/passing turtles, which could be followed up in areas where turtles have not previously been documented from stranding/tracking studies.</p> <p>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 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.</p> <p>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.</p> <p>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.</p> <p>Telemetry: Tracked individuals can be used to identify hotspots to make counts of aggregated populations.</p> <p>Beached and stranded specimens monitoring</p> <p>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.</p> <p>Beach-based surveys</p> <p>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.</p> <p>Sea turtles: telemetry (satellite, GPS/GSM, radio), artificial flipper tags, PIT tags, photo-identification (facial</p>

Indicator Title	<i>Common Indicator 4: Population abundance (Reptiles)</i>
scute patterns, notches and scars). Epibionts should not be used, as they can fall off after very short periods.	
<p>Available data sources</p> <p>Adriatic Sea Turtle Database. http://www.adriaticseaturtles.eu/</p> <p>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/</p> <p>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. <i>Oceanography</i> 22, 104–115.</p> <p>I3S. Sea turtle photo identification database. http://www.reijns.com/i3s/</p> <p>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.</p> <p>Margaritoulis, D., Argano, R., Baran, I., Bentivegna, F., Bradai, M.N., Camiñas, 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. <i>Loggerhead sea turtles</i> (ed. by B.E. Witherington), pp. 175–198. Smithsonian Institution, Washington</p> <p>PITMAR. Sea turtle photo-identification database. http://www.pitmar.net/index.php/en/</p> <p>Seaturtle.org – Global Sea Turtle Network. Sea turtle tracking. Sea turtle nest monitoring. http://www.seaturtle.org/</p> <p>The Reptile Database: Location of juvenile loggerheads and greens in the Eastern Mediterranean. http://reptile-database.reptarium.cz/species?genus=Caretta&species=caretta</p> <p>Mediterranean marine research centres, NGOs, universities and institutions, local and national sea turtle monitoring projects.</p> <p>Governmental Ministries</p> <p>IUCN specialists (MTSG)</p>	
Spatial scope guidance and selection of monitoring stations	
<p>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 groups¹</p> <p>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.</p> <p>¹<i>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</i></p>	
Temporal Scope guidance	
<p>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)</p> <p>Annual – winter censuses at selected sites to estimate no. of wintering individuals (October to April)</p> <p>Annual – foraging/developmental censuses at selected sites to estimate no. of foraging/developmental individuals (January-December)</p> <p>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 years¹ 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)</p> <p>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</p>	

Indicator Title	<i>Common Indicator 4: Population abundance (Reptiles)</i>
<p>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.</p>	
<p>¹<i>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</i></p>	
<p>Data analysis and assessment outputs</p>	
<p>Statistical analysis and basis for aggregation</p> <p>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).</p> <p>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.</p> <p>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.</p> <p>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.</p>	
<p>Expected assessments outputs</p> <p>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:</p> <ul style="list-style-type: none"> - 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 <p>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.</p>	
<p>Known gaps and uncertainties in the Mediterranean</p> <ul style="list-style-type: none"> • 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. 	

Indicator Title	<i>Common Indicator 4: Population abundance (Reptiles)</i>	
	<ul style="list-style-type: none"> • 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 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. 	
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
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2.8. Common indicator 4: Species population abundance (Seabirds) (EO 1)

Indicator Title		
<i>Common indicator 4: Species population abundance (Seabirds)</i>		
Relevant GES definition	Related Operational Objective	Proposed Target(s)
<p>Population size of selected species (of seabirds) is maintained.</p> <p>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)</p>	<p>Breeding population size of selected species is maintained or, where depleted, it recovers to natural levels</p>	<p>No human-induced decrease in breeding population size or density.</p> <p>Breeding populations recover towards natural levels where depleted.</p> <p>The total number of individuals is sparse enough in different spots.</p> <p>Local declines are balanced out by increases elsewhere, so that overall numbers of breeding birds are maintained at the appropriate scale</p>
Rational		
<p>Justification for indicator selector</p> <p>Abundance is a parameter of population demographics, and is critical for determining the growth or decline of a population.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>		
<p>Scientific References</p> <p><i>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.</i></p>		
Policy Context and targets		
<p>Policy context description</p> <p>EU MSFD; UE Nature Directives; Red List, AEWa</p>		

Indicator Title		<i>Common indicator 4: Species population abundance (Seabirds)</i>
EU Marine Strategy Framework Directive	<p>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.</p> <p>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”.</p>	<p><u>Descriptor 1: Biodiversity</u></p> <p>The population abundance of key marine species is stable and their population dynamics are indicative of long-term viability</p> <p><u>Parameters and trends:</u></p>
UE Nature Directives (Birds and Habitats Directives)	<p>The conservation status of a species “will be taken as ‘favourable’ when:</p> <ol style="list-style-type: none"> 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 [...]. <p>Every six years, all EU Member States are required to report on the implementation of the directives.</p> <p>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).</p>	<p><u>Parameters and trends:</u></p> <p>Distribution (range)</p>
IUCN Red List		
<p>Targets</p> <p><i>EU Marine Strategy Framework Directive:</i> 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.</p> <p><i>UE Nature Directives:</i> Population(s) not lower than ‘favourable reference population’ AND reproduction, mortality and age structure not deviating from normal (if data available)</p> <p><i>IUCN:</i> 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.</p>		

Indicator Title	<i>Common indicator 4: Species population abundance (Seabirds)</i>
<p>Policy documents</p> <p>List and url's</p> <ol style="list-style-type: none"> 6. 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 7. http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm 8. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm 9. Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm 10. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities. 	
<p>Indicator analysis methods</p>	
<p>Indicator Definition</p> <p>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.</p>	
<p>Methodology for indicator calculation</p> <p>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.</p> <p>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.</p> <p>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).</p> <p>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.</p> <p>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.</p>	
<p>Indicator units</p> <p>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.</p> <p>For the base data used to calculate the index of population abundance, the following units are suggested:</p> <ul style="list-style-type: none"> - for population size at nesting colonies, <u>number of breeding pairs</u> (bp) - for total number of nesting colonies, <u>number of colonies</u> (n) - for average colony size, <u>number of individuals</u> (n) - for non-breeding birds at wintering sites, <u>number of individuals</u> (n) 	

Indicator Title	<i>Common indicator 4: Species population abundance (Seabirds)</i>
- for total number of birds estimated on migration, <u>number of individuals</u> (n)	
List of Guidance documents and protocols available	
<ul style="list-style-type: none"> - 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/ - Bibby, C., Jones, M., Marsden, S. (1998): Expedition Field Techniques. Bird Surveys. Expedition Advisory Centre, Royal Geographical Society, London. PDF - Bibby, C.J., Burgess, N.D. et Hill, D.A. (2000): Bird Census Techniques. Academic Press, London, 2nd edition. - Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L. et Borchers, D.L. (2001): Introduction to Distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford. - Camphuysen CJ & Garthe S 2004. Recording foraging seabirds at sea: standardised recording and coding of foraging behavior and multi-species associations. Atlantic Seabirds 6: 1 – 32. - Cardoso, A. C., Cochrane, S., Doerner, H., Ferreira, J. G., Galgani, F., Hagebro, C., ... & Olenin, S. (2010). Scientific Support to the European Commission on the Marine Strategy Framework Directive. Management Group Report. EUR, 24336, 57. http://www.ices.dk/news-and-events/Documents/Themes/MSFD/Management%20Group%20Report_Final_vii.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). Available online: https://circabc.europa.eu/sd/a/2c12cea2-f827-4bdb-bb56-3731c9fd8b40/Art17%20-%20Guidelines-final.pdf - Gibbons, D.W. et Gregory, R.D. (2005): Birds. In: Sutherland W.J. [ed.]: Ecological Census Techniques: a handbook. Cambridge University Press, Cambridge, 2nd edition. - Gilbert, G., Gibbons, D.W. et Evans, J. (1998): Bird Monitoring Methods - a manual of techniques for key UK species. RSPB, Sandy. - Greenwood, J.J.D. (2005): Basic techniques. In: Sutherland W.J. [ed.]: Ecological Census Techniques: a handbook. Cambridge University Press, Cambridge, 2nd edition. - Gregory, R.D., Gibbons, D.W. et Donald, P.F. (2004): Bird census and survey techniques. In: Sutherland W.J., Newton I. et Green R. E. [eds.]: Bird Ecology and Conservation; a Handbook of Techniques. Oxford University Press, Oxford: 17-56. PDF 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. - IUCN. (2009). Seabird Indicator (Caucasus). Edited by IUCN Programme Office for the Southern Caucasus. http://www.iucn.org/sites/dev/files/import/downloads/seabird_indicator_caucasus.pdf - Javed, S. et Kaul, R. (2002): Field methods for bird surveys. Bombay Natural History Society, Department of Wildlife Sciences, Aligarh Muslim University and World Pheasant Association, New Delhi India. - Komdeur, J., Bertelsen, J. et Cracknell, G. (1992): Manual for aeroplane and ship surveys of waterfowl and seabirds. IWRB Special Publication 19. Slimbridge, U.K. - MARMONI (2015). The MARMONI approach to marine biodiversity indicators. Volume II: list of indicators for 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/ 	

Indicator Title	<i>Common indicator 4: Species population abundance (Seabirds)</i>
<ul style="list-style-type: none"> - Robinson, R. A., & Ratcliffe, N. (2010). The Feasibility of Integrated Population Monitoring of Britain's Seabirds. British Trust for Ornithology. - Steinkamp, M., Peterjohn, H., Bryd, V., Carter, H. et Lowe, R. (2003): Breeding season survey techniques for seabirds and colonial waterbirds throughout North America - Underhill, L. et Gibbons, D. (2002): Mapping and monitoring bird populations; their conservation uses. In: Norris K. et Pain D. [eds.]: Conserving bird biodiversity; general principles and their application. Cambridge University Press, Cambridge: 34-60. - Van Strien, A.J., Soldaat, L.L., Gregory, R.D. (2011): Desirable mathematical properties of indicators for biodiversity change. Ecological Indicators 14: 202-208. PDF - Walsh, P.M., Halley, D.J., Harris, M.P., del Nevo, A., Sim, I.M.W. et Tasker, M.L. (1995): Seabird Monitoring Handbook for Britain and Ireland. - JNCC, Peterborough. 	
<p>Data Confidence and uncertainties</p> <p>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.</p> <p>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.</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>In order to estimate and monitor the number of breeding birds, the proposed field methods are:</p> <ol style="list-style-type: none"> 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 <p>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</p> <p>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:</p> <ul style="list-style-type: none"> - 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. 	
<p>Available data sources</p> <p>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</p>	

Indicator Title	<i>Common indicator 4: Species population abundance (Seabirds)</i>
<p>Spatial scope guidance and selection of monitoring stations</p> <p>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%.</p> <p>The comprehensive surveys to be carried out every 6 years should aim at covering the whole area on a national or subregional scale.</p>	
<p>Temporal Scope guidance</p> <p>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</p>	
<p>Data analysis and assessment outputs</p>	
<p>Statistical analysis and basis for aggregation</p> <p>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).</p> <ul style="list-style-type: none"> - 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. 	
<p>Expected assessments outputs</p> <p>The outputs of BirdSTATs are imputed yearly indices and totals for each species, together with their standard errors and covariance.</p> <p>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.</p>	
<p>Known gaps and uncertainties in the Mediterranean</p> <p>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</p>	

Indicator Title		<i>Common indicator 4: Species population abundance (Seabirds)</i>	
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.			
Contacts and version Date			
Key contacts within UNEP for further information			
Version No	Date	Author	
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2.9. Common Indicator 5: Population demographic characteristics (marine mammals) (EO 1)

Indicator Title		<i>Common Indicator 5: Population demographic characteristics</i>	
Relevant GES definition	Related Operational Objective	Proposed Target(s)	
<u>Cetaceans</u> : species populations are in good condition: low human induced mortality, balanced sex ratio and no decline in calf production. <u>Monk seal</u> : 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	<u>Cetaceans</u> : appropriate measures are implemented to mitigate incidental catch, prey depletion and other human induced mortality. <u>Monk seal</u> : decreasing trends in human induced mortality (e.g., direct killings).	

Rationale	
<p>Justification for indicator selection</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Eleven species of cetaceans are considered to regularly occur in the Mediterranean area: short-beaked common dolphin (<i>Delphinus delphis</i>), striped dolphin (<i>Stenella coeruleoalba</i>), common bottlenose dolphin (<i>Tursiops truncatus</i>), harbour porpoise (<i>Phocoena phocoena</i>), long-finned pilot whale (<i>Globicephala melas</i>), rough-toothed dolphin (<i>Steno bredanensis</i>), Risso's dolphin (<i>Grampus griseus</i>), fin whale (<i>Balaenoptera physalus</i>), sperm whale (<i>Physeter macrocephalus</i>), Cuvier's beaked whale (<i>Ziphius cavirostris</i>) and killer whale (<i>Orcinus orca</i>). 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.</p> <p>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.</p> <p>The conservation status of cetaceans 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</p>	

Indicator Title	<i>Common Indicator 5: Population demographic characteristics</i>
<p>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.</p>	
<p>Scientific References</p> <p>Chiquet, R. A. et al. 2013. Demographic analysis of sperm whales using matrix population models. - <i>Ecol. Model.</i> 248: 71–79.</p> <p>Coll, M. et al. 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. - <i>PLoS ONE</i> 5: e11842.</p> <p>Estes, J. A. et al. 2009. Causes and consequences of marine mammal population declines in southwest Alaska: a food-web perspective. - <i>Philos Trans R Soc Lond B Biol Sci</i> 364: 1647–1658.</p> <p>Fossi, M. C. and Marsili, L. 2003. Effects of endocrine disruptors in aquatic mammals. - <i>Pure Appl. Chem.</i> 75: 2235–2247.</p> <p>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 (<i>Cetorhinus maximus</i>) and fin whale (<i>Balaenoptera physalus</i>). - <i>Mar. Environ. Res.</i> 100: 17–24.</p> <p>Fujiwara, M. and Caswell, H. 2001. Demography of the endangered North Atlantic right whale. - <i>Nature</i> 414: 537–541.</p> <p>Gaston, K. J. 2003. <i>The Structure and Dynamics of Geographic Ranges.</i> - Oxford University Press.</p> <p>Hoffmann, A. A. and Blows, M. W. 1994. Species borders: ecological and evolutionary perspectives. - <i>Trends Ecol. Evol.</i> 9: 223–227.</p> <p>Horning, M. and Mellish, J.-A. E. 2012. Predation on an Upper Trophic Marine Predator, the Steller Sea Lion: Evaluating High Juvenile Mortality in a Density Dependent Conceptual Framework. - <i>PLoS ONE</i> in press.</p> <p>IUCN 2012. <i>Marine mammals and sea turtles of the Mediterranean and Black Seas.</i> - IUCN.</p> <p>Jackson, J. A. et al. 2016. An integrated approach to historical population assessment of the great whales: case of the New Zealand southern right whale. - <i>Open Sci.</i> 3: 150669.</p> <p>Lande, R. 1988. Genetics and demography in biological conservation. - <i>Science</i> 241: 1455–1460.</p> <p>Lawton, J. H. 1993. Range, population abundance and conservation. - <i>Trends Ecol. Evol.</i> 8: 409–413.</p> <p>McDonald-Madden, E. et al. 2016. Using food-web theory to conserve ecosystems. - <i>Nat. Commun.</i> in press.</p> <p>New, L. F. et al. 2013. Using Energetic Models to Investigate the Survival and Reproduction of Beaked Whales (family Ziphiidae). - <i>PLoS One</i> 8(7): e68725. doi:10.1371/journal.pone.0068725.</p> <p>Notarbartolo di Sciarra, G. and Birkun, A., Jr 2010. <i>Conserving whales, dolphins and porpoises in the Mediterranean and Black Seas: an ACCOBAMS status report, 2010:</i> 212.</p> <p>Phillips, C. D. et al. 2012. Molecular insights into the historic demography of bowhead whales: understanding the evolutionary basis of contemporary management practices. - <i>Ecol. Evol.</i> 3: 18–37.</p> <p>Reese, G. C. et al. 2005. <i>Factors Affecting Species Distribution Predictions: A Simulation Modeling Experiment.</i> -</p>	

Indicator Title	<i>Common Indicator 5: Population demographic characteristics</i>
<p>Ecol. Appl. 15: 554–564.</p> <p>Saracco, J. F. et al. 2013. Population Dynamics and Demography of Humpback Whales in Glacier Bay and Icy Strait, Alaska. - Northwest. Nat. 94: 187–197.</p> <p>Schick, R. S. et al. 2013. Estimating resource acquisition and at-sea body condition of a marine predator. - J Anim Ecol 82(6):1300-15.</p> <p>Schwarz, L. K. et al. 2013. Top-down and bottom-up influences on demographic rates of Antarctic fur seals <i>Arctocephalus gazella</i>. - J. Anim. Ecol. 82: 903–911.</p> <p>Torres, L. G. et al. 2016. Demography and ecology of southern right whales <i>Eubalaena australis</i> wintering at sub-Antarctic Campbell Island, New Zealand. - Polar Biol.: 1–12.</p> <p>van den Hoff, J. et al. 2014. Bottom-up regulation of a pole-ward migratory predator population. - Proc. Biol. Sci. 281: 20132842.</p> <p>Villegas-Amtmann, S. et al. 2015. A bioenergetics model to evaluate demographic consequences of disturbance in marine mammals applied to gray whales. - Ecosphere 6: 1–19.</p> <p>Wang, J. et al. 2016. A framework for the assessment of the spatial and temporal patterns of threatened coastal delphinids. - Sci. Rep. in press.</p> <p>Whitehead, H. and Gero, S. 2014. Using social structure to improve mortality estimates: an example with sperm whales. - Methods Ecol. Evol. 5: 27–36.</p> <p>Whitehead, H. and Gero, S. 2015. Conflicting rates of increase in the sperm whale population of the eastern Caribbean: positive observed rates do not reflect a healthy population. - Endanger. Species Res. 27: 207–218.</p>	
<p>Policy Context and targets (other than IMAP)</p>	
<p>Policy context description</p> <p>Mediterranean fin whales and sperm whales are protected by the International Whaling Commission’s moratorium on commercial whaling that entered into force in 1986.</p> <p>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.</p> <p>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).</p> <p>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).</p> <p>The common bottle dolphin, the harbor porpoise and the monk seal are also listed under the Annex II of the EU Habitats Directive.</p>	
<p>Indicator/Targets</p> <p>Aichi Biodiversity Target 1, 3</p> <p>EU Regulation 812/2004 concerning incidental catches of cetaceans in fisheries</p> <p>EU MSFD Descriptor 1 and 4</p> <p>EU Habitats Directive</p> <p>The obligations under ACCOBAMS</p>	
<p>Policy documents</p> <ul style="list-style-type: none"> Aichi Biodiversity Targets - https://www.cbd.int/sp/targets/ 	

Indicator Title	<i>Common Indicator 5: Population demographic characteristics</i>
	<ul style="list-style-type: none"> • 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&usq=AFQjCNGa4NkkljA4x3I9WDO49uwrdYafMg • 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	
<p>Indicator Definition</p> <p>This indicator is aimed at providing information about the population demographic characteristics of marine mammals in the Mediterranean Sea. It is intended to assess trends in abundance and density over time and space of cetaceans and seals that are present in Mediterranean waters, with a special focus on the species selected by the Parties.</p> <p>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.</p> <p>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.</p> <p>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:</p> <ol style="list-style-type: none"> 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. 	
<p>Methodology for indicator calculation</p> <p>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:</p> <ul style="list-style-type: none"> - Age structure - Sex ratio - Fecundity - Mortality <p>Photo-identification is one of the most powerful techniques to investigate cetacean 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</p>	

Indicator Title	<i>Common Indicator 5: Population demographic characteristics</i>
population size.	
Indicator units The main demographic parameters are defined in the following units: <ul style="list-style-type: none"> - 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 	
List of Guidance documents and protocols available <ul style="list-style-type: none"> • 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 Mediterranean². • RAC/SPA-ACCOBAMS Guidelines for the Development of National Networks of Cetacean Strandings Monitoring³. 	
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: <ul style="list-style-type: none"> - Direct observation - Stranded animal monitoring - Dedicated ships surveys - By-catch data - Photo-identification (mark-recapture models) - Automatic infrared camera 	
Available data sources <ul style="list-style-type: none"> • OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebate 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	

² 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.

³ http://www.rac-spa.org/sites/default/files/doc_cetacean/stranding.pdf

Indicator Title	<i>Common Indicator 5: Population demographic characteristics</i>	
<p>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.</p>		
<p>Temporal Scope guidance</p> <p>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.</p>		
Data analysis and assessment outputs		
<p>Statistical analysis and basis for aggregation</p> <p>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.</p>		
<p>Expected assessments outputs</p> <p>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.</p>		
<p>Known gaps and uncertainties in the Mediterranean</p> <p>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.</p> <p>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, to provide an inventory of available data and to select areas where more information should be collected.</p>		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC

2.10. Common indicator 5: Population demographic characteristics (Reptiles) (EO 1)

Indicator Title		
<i>Common indicator 5: Population demographic characteristics (Reptiles)</i>		
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		
<p>Justification for indicator selection</p> <p>Demography is used in ecology (particularly population and evolutionary ecology) as the basis for population studies. Demography information:</p> <ul style="list-style-type: none"> - 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		
<p>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 (<i>Chelonia mydas</i>). <i>Herpetological Review</i>, 47(1), 27–32.</p> <p>Casale, P., D. Freggi, R. Basso, R. Argano. 2005. Size at male maturity, sexing methods and adult sex ratio in loggerhead turtles (<i>Caretta caretta</i>) from Italian waters investigated through tail measurements. <i>J. Herpetol.</i> 15, 145–148</p> <p>Casale P. 2010. Sea turtle by-catch in the Mediterranean. <i>Fish and Fisheries</i>. doi:10.1111/j. 1467-2979.2010.00394</p> <p>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)</p> <p>Gerosa, G. and P. Casale. 1999. Interaction of marine turtles with fisheries in the Mediterranean. UNEP/MAP, RAC/SPA: Tunis, Tunisia. 59pp</p> <p>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</p> <p>Hays GC, Mazaris AD, Schofield G. 2014. Different male versus female breeding periodicity helps mitigate offspring sex ratio skews in sea turtles. <i>Frontiers in Marine Science</i> 1, 43 doi: 10.3389/fmars.2014.00043</p> <p>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.</p> <p>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. <i>Mol. Ecol.</i>, 7: 1529-1542.</p> <p>Rees, A.F., D. Margaritoulis, R. Newman, T.E. Riggall, P. Tsaros, J.A. Zbinden, B.J Godley. 2013. Ecology of loggerhead marine turtles <i>Caretta caretta</i> in a neritic foraging habitat: movements, sex ratios and growth rates. <i>MarBiol</i> 160:519-529.</p>		
Policy Context and targets (other than IMAP)		
<p>Policy context description</p> <p>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</p>		

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Reptiles)</i>
<p>every 6 years.</p> <p>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.</p> <p>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”.</p>	
<p>Indicator/Targets</p> <p>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)”.</p> <p>At a country scale, Descriptor 1 criteria have been applied:</p> <p>Greece <i>page 15: (Section 3. D1, D4 and D6 (Biodiversity), III. Environmental targets, 1. Descriptor 1 Environmental targets:</i> <i>[...]2) Census of marine turtle <i>Caretta caretta</i> reproducing in the Greek coasts and conservation of spawning areas.</i></p> <p>Associated indicators: <i>[...]2) Breeding area of the Mediterranean monk seal <i>Monachus monachus</i> and the sea turtle <i>Caretta caretta</i></i></p> <p>Italy <i>page 18: (Section 3.D1, D4 and D6 (Biodiversity), III. Environmental targets, 3.1 Descriptor 1</i> 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). <i>[...]</i> T2: By-catch reduction in the areas of aggregation of <i>Caretta caretta</i> It is proposed that the operative target for the mitigation of <i>Caretta caretta</i> 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 <i>Caretta caretta</i> 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 net 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)</p> <p>Spain <i>Page 25: Section 3. D1, D4 and D6 (Biodiversity), III. Environmental targets</i></p>	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Reptiles)</i>
<p>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. [...]</p> <p>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. [...]</p> <p>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. [...]</p> <p>C.1.2: Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles)</p> <p>Slovenia No information on Targets <i>page 10: (Section 3. D1, D4 and D6 (Biodiversity), I. Good Environmental Status (GES), 1.1 Descriptor 1)</i> 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 (<i>Tursiops truncatus</i>), the loggerhead sea turtle (<i>Caretta caretta</i>). <i>Section 3. D1, D4 and D6 (Biodiversity), II. Initial assessment, 2.2 Biological features)</i> 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.</p> <p>Cyprus No information on Targets <i>page 11: (Section 3. D1, D4 and D6 (Biodiversity), II. Initial assessment, 2.2 Biological features)</i> [...] <i>Chelonia mydas</i> and <i>Monachus monachus</i> are considered stable but the situation of <i>Caretta caretta</i> is actually improving.</p> <p>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</p>	
<p>Policy documents</p> <p>http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010D0477(01)</p> <p>http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm</p> <p>http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm</p> <p>http://ec.europa.eu/environment/marine/pdf/1-Task-group-1-Report-on-Biological-Diversity.pdf</p> <p>http://ec.europa.eu/environment/marine/pdf/9-Task-Group-10.pdf</p>	
<p>Indicator analysis methods</p>	
<p>Indicator Definition</p> <p>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.</p>	
<p>Methodology for indicator calculation</p> <p>The same methods should be used as those described in “<i>Common Indicator 4: Population abundance (Reptiles)</i>”; 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).</p>	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Reptiles)</i>
<p>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.</p> <p>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.</p>	
<p>Indicator units</p> <p>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 International Union for Conservation of Nature Red List minimal criteria for sea turtles).</p> <p>Number of individuals in relation to population estimates per population range or management unit, per year, per age and per sex</p> <ul style="list-style-type: none"> - 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 hatchlings to juveniles to breeding and non breeding adults at wintering, breeding, foraging and developmental sites. <p>Sex ratios within different components of a population</p> <p>Physical health indicators</p> <p>Genetic health indicators</p> <p>Numbers of individuals entering and leaving different components of populations through dispersal/migration or birth/mortality.</p> <p>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.</p>	
<p>List of Guidance documents and protocols available</p> <p>Bevan E, Wibbels T, Rosas M, Najera BMZ, Sarti L, Montano J, Pena LJ, Burchfield P. Herpetological Review, 2016, 47(1), 27–32.</p> <p>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</p> <p>Gerosa, G. (1996). Manual on Marine Turtle Tagging in the Mediterranean. –Mediterranean Action Plan - UNEP, RAC/SPA, Tunis, 48 pp.</p> <p>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</p> <p>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</p> <p>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</p> <p>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</p> <p>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</p>	
<p>Data Confidence and uncertainties</p> <p>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.</p>	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Reptiles)</i>
Methodology for monitoring, temporal and spatial scope	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <ul style="list-style-type: none"> • 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 • Stranding on beaches <p>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)</p> <p>Artificial external flipper tagging (metal and plastic on flippers),</p> <p>Photo-identification</p> <p>PIT tagging of flippers, Telemetry (satellite, GPS/GSM, radio telemetry) and loggers, capture-mark-recapture studies</p> <p>Shipboard, aerial (including drone), or diver-based/video/acoustic (potential)</p> <p>Swimming/snorkelling surveys with photo-id and GPS in densely populated areas (e.g. certain breeding sites)</p> <p>Stranding and beached individual census':</p> <p>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 (laparoscopy 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.</p> <p>Biometrics:</p> <p>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:</p> <p>Estimates made from photos.</p> <p>Measurement of stranded specimens.</p> <p>Measurement in case of capture-recapture.</p> <p>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.</p> <p>Age structure:</p> <p>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.</p> <ul style="list-style-type: none"> - 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). 	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Reptiles)</i>
<p data-bbox="236 241 1193 271">- Aging of tagged (capture and recapture) specimens: size correlation for sea turtles.</p> <p data-bbox="188 309 296 338">Sex ratio:</p> <p data-bbox="188 340 1407 432">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.</p> <ul data-bbox="236 434 1407 629" style="list-style-type: none"> - 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) <p data-bbox="188 667 517 696">Fecundity (birth/hatch rates):</p> <p data-bbox="188 698 1407 824">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.</p> <p data-bbox="188 826 1407 891">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.</p> <p data-bbox="188 929 448 958">Mortality (death rates):</p> <p data-bbox="188 960 1407 1151">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.</p>	
<p data-bbox="188 1155 437 1184">Available data sources</p> <p data-bbox="188 1187 852 1216">Adriatic Sea Turtle Database. http://www.adriaticseaturtles.eu/</p> <p data-bbox="188 1218 1407 1310">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/</p> <p data-bbox="188 1312 1407 1377">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. <i>Oceanography</i> 22, 104–115.</p> <p data-bbox="188 1379 959 1408">I3S. Sea turtle photo identification database. http://www.reijns.com/i3s/</p> <p data-bbox="188 1411 1407 1536">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 Megavertebate Populations). In: Oceanic Society, Conservation International, IUCN Marine Turtle Specialist Group (MTSG), and Marine Geospatial Ecology Lab, Duke University. http://seamap.env.duke.edu</p> <p data-bbox="188 1538 1407 1664">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. <i>Loggerhead sea turtles</i> (ed. by B.E. Witherington), pp. 175–198. Smithsonian Institution, Washington</p> <p data-bbox="188 1666 1123 1695">PITMAR. Sea turtle photo-identification database. http://www.pitmar.net/index.php/en/</p> <p data-bbox="188 1697 1407 1762">Seaturtle.org – Global Sea Turtle Network. Sea turtle tracking. Sea turtle nest monitoring. http://www.seaturtle.org/</p> <p data-bbox="188 1765 1407 1830">The Reptile Database: Location of juvenile loggerheads and greens in the Eastern Mediterranean. http://reptile-database.reptarium.cz/species?genus=Caretta&species=caretta</p> <p data-bbox="188 1832 1407 1897">Mediterranean marine research centres, NGOs, universities and institutions, local and national sea turtle monitoring projects. Governmental Ministries</p> <p data-bbox="188 1899 453 1928">IUCN specialists (MTSG)</p> <p data-bbox="188 1930 1407 1995">Sea Turtle Tag Inventory. Archie Carr Center for Sea Turtle Research, University of Florida https://accstr.ufl.edu/resources/tag-inventory</p> <p data-bbox="188 1998 1407 2040">Marine Turtle DNA Sequences Database. Archie Carr Center for Sea Turtle Research, University of Florida. https://accstr.ufl.edu/resources/mtdna-sequences</p>	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Reptiles)</i>
Spatial scope guidance and selection of monitoring stations	
<p>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.</p> <p>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.</p>	
Temporal Scope guidance	
<p>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.</p> <p>Annual – winter 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 (October to April)</p> <p>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).</p>	
Data analysis and assessment outputs	
<p>Statistical analysis and basis for aggregation</p> <p>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.</p>	
Expected assessments outputs	
<p>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.</p>	
Known gaps and uncertainties in the Mediterranean	
<ul style="list-style-type: none"> • 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; 	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Reptiles)</i>	
<ul style="list-style-type: none"> • 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 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

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

Indicator Title		
<i>Common indicator 5: Population demographic characteristics (Seabirds)</i>		
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		
<p>Justification for indicator selector</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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).</p> <p>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.</p>		
<p>Scientific References</p> <p><i>List and url's</i></p> <p>Genovart, M., Arcos, J. M., Álvarez, D., McMinn, M., Meier, R., B. Wynn, R., Guilford, T. and Oro, D. (2016), Demography of the critically endangered Balearic shearwater: the impact of fisheries and time to extinction. <i>J Appl Ecol</i>, 53: 1158–1168. doi:10.1111/1365-2664.12622</p> <p>Tavecchia, G., Pradel, R., Genovart, M. and Oro, D. (2007), Density-dependent parameters and demographic equilibrium in open populations. <i>Oikos</i>, 116: 1481–1492. doi: 10.1111/j.0030-1299.2007.15791.x</p> <p>Sanz-Aguilar, A., Igual, J. M., Oro, D., Genovart, M., & Tavecchia, G. (2016). Estimating recruitment and survival in partially monitored populations. <i>Journal of Applied Ecology</i>, 53(1), 73-82.</p>		

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Seabirds)</i>					
<p>Fernández-Chacón, A., Genovart, M., Pradel, R., Tavecchia, G., Bertolero, A., Piccardo, J., Forero, M. G., Afán, I., Muntaner, J. and Oro, D. (2013), When to stay, when to disperse and where to go: survival and dispersal patterns in a spatially structured seabird population. <i>Ecography</i>, 36: 1117–1126. doi: 10.1111/j.1600-0587.2013.00246.x</p> <p>Parsons, M., Mitchell, I., Butler, A., Ratcliffe, N., Frederiksen, M., Foster, S., and Reid, J. B. 2008. Seabirds as indicators of the marine environment. – <i>ICES Journal of Marine Science</i>, 65: 1520–1526.</p> <p>Cook, A. S., Dadam, D., Mitchell, I., Ross-Smith, V. H., & Robinson, R. A. (2014). Indicators of seabird reproductive performance demonstrate the impact of commercial fisheries on seabird populations in the North Sea. <i>Ecological indicators</i>, 38, 1-11.</p> <p>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.</p> <p>UNEP - MAP (RAC-SPA), 2006. Proceedings of the joint MEDMARAVIS - S.E.O. - UNEP-MAP Symposium on the Mediterranean Action Plan for the Conservation of Marine and Coastal Birds, held at Vilanova i la Geltru, Spain. Aransay M, Ed. UNEP RAC-SPA, Tunis. 103 pages.</p> <p>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</p>						
Policy Context and targets						
Policy context description						
		Birds Directive	Bern Convention	Barcelona Convention	Bonn Convention	AEWA
Inshore Benthic feeders						
<i>Phalacrocorax aristotelis</i> (Linnaeus, 1761)	Annex I	App.II	Annex II	-	-	
Offshore surface feeders						
<i>Larus audouinii</i> (Payraudeau, 1826)	Annex I	App. II	Annex II	App. I & II	Annex II	
Inshore surface feeders						
<i>Sterna albifrons</i> (Pallas, 1764)	Annex I	App. II	Annex II	App. I & II	Annex II	
<i>S. nilotica</i> (Gmelin, JF, 1789)	Annex I	App. II	Annex II	App. I & II	Annex II	
<i>S. sandvicensis</i> , (Latham, 1878)	Annex I	App. II	Annex II	App. I & II	Annex II	
Offshore feeders						
<i>Puffinus mauretanicus</i> (Lowe, PR, 1921)	Annex I	-	-	App. I & II	-	
<i>Puffinus yelkouan</i> (Brünnich, 1764)	Annex I	App. II	Annex II	-	-	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Seabirds)</i>	
EU Marine Strategy Framework Directive	<p>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.</p> <p>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”.</p>	<p><u>Descriptor 1: Biodiversity</u></p> <p>The population abundance of key marine species is stable and their <u>population dynamics</u> are indicative of long-term viability</p> <p>Criteria: population condition</p> <p><u>Parameters and trends:</u></p> <p>Population demographic characteristics (e. g. body size or age class structure, sex ration, fecundity rate, survival and mortality rates)</p> <p>Population genetic structure, where appropriate</p>
UE Nature Directives (Birds and Habitats Directives)	<p>The conservation status of a species “will be taken as ‘favourable’ when:</p> <p>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 [...].</p> <p>[...] 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.</p> <p>Every six years, all EU Member States are required to report on the implementation of the directives.</p> <p>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).</p>	<p><u>Parameters and trends:</u></p> <p><u>Favourable:</u> Population of the species above ‘favourable reference population’ AND reproduction, mortality and age structure not deviating from normal (if data available)</p> <p><u>Unfavourable – Inadequate:</u> Any combination other than those described under ‘Green’ or ‘Red’.</p> <p><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</p> <p>OR population more than 25% below ‘favourable reference population’</p> <p>OR reproduction, mortality and age structure strongly deviating from normal (if data available)</p> <p>Unknown: No or insufficient reliable information available.</p>

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Seabirds)</i>
<p>Targets</p> <p><i>EU Marine Strategy Framework Directive:</i> 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.</p> <p><i>UE Nature Directives:</i> 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).</p> <p><i>IUCN:</i> 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</p>	
<p>Policy documents</p> <p><i>List and url's</i></p> <ol style="list-style-type: none"> 11. 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 12. http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm 13. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm 14. Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm 15. 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. 16. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities. 17. 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). 18. 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, 19. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities 	
<p>Indicator analysis methods</p>	
<p>Indicator Definition</p> <p>The indicator is population growth. Its simplest conceptual model is the equation</p> $N(t+1) = \lambda N(t),$ <p>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</p>	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Seabirds)</i>
<p>one, the population neither increases nor declines, but remains at its initial size in all subsequent years.</p> <p>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.</p> <p>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.</p>	
<p>Methodology for indicator calculation</p> <p>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:</p> <ol style="list-style-type: none"> (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. <p>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 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.</p> <p>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.</p> <p>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 (\approx no. of fledged young per nest).</p> <p>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.</p>	
<p>Indicator units</p> <p>The main demographic parameters are defined in the following units:</p> <ul style="list-style-type: none"> - 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 	

Indicator Title	Common indicator 5: Population demographic characteristics (Seabirds)
<p>List of Guidance documents and protocols available</p> <ul style="list-style-type: none"> ▪ http://www.phidot.org/, especially the online discussion forum <i>Analysis of Data from Marked Individuals</i> found at: http://www.phidot.org/forum/index.php ▪ http://warnercnr.colostate.edu/~gwhite/mark/mark.htm ▪ http://www.capturecapture.co.uk/ 	
<p>Data Confidence and uncertainties</p> <p>Seabirds are long-lived, and any robust study on their demography must include enough individuals in order to 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.</p> <p>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.</p>	
Methodology for monitoring, temporal and spatial scope	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>Perrins, C.M., Lebreton, J.D., and Hiron, G.J.M. (eds.) (1991). <i>Bird population studies: relevance to conservation and management</i>, New York: Oxford University Press</p> <p>Beissinger, Steven R. and McCullough, Dale R. (2002). <i>Population Viability Analysis</i>, Chicago: University of Chicago Press.</p> <p>Morris, W., Doak, D., Groom, M., Kareiva, P., Fieberg, J., Gerber, L., & Thomson, D. (1999). <i>A practical handbook for population viability analysis</i>. The Nature Conservancy.</p> <p>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. <i>Conservation Letters</i>, May/June 2016, 9(3), 172–180</p> <p>Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm</p> <p>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). Available online: https://circabc.europa.eu/sd/a/2c12cea2-f827-4bdb-bb56-3731c9fd8b40/Art17%20-%20Guidelines-final.pdf</p>	
<p>Available data sources</p> <p>Sources and url's:</p> <p>OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Mega Vertebrate Populations, http://seamap.env.duke.edu/</p> <p>BirdLife Datazone: http://www.birdlife.org/datazone/home</p> <p>Seabirds at sea survey methods: http://jncc.defra.gov.uk/page-4514</p> <p>UNEP/MAP-RAC/SPA projects and publications http://www.rac-spa.org/publications</p> <p>Birdlife partners in the Mediterranean</p> <p>Mediterranean marine research centres, universities and institutions</p> <p>Medmaravis</p> <p>Governmental ministries</p> <p>IUCN specialists: http://www.iucn.org/species/ssc-specialist-groups/about/ssc-specialist-groups-and-red-list-authorities-directory/birds</p>	
<p>Spatial scope guidance and selection of monitoring stations</p>	

Indicator Title	<i>Common indicator 5: Population demographic characteristics (Seabirds)</i>
<p>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.</p>	
<p>Temporal Scope guidance</p> <p>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.</p> <p>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).</p> <p>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.</p>	
<p>Data analysis and assessment outputs</p>	
<p>Statistical analysis and basis for aggregation</p> <p>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.</p> <p>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.</p> <p>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:</p> <ol style="list-style-type: none"> 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. 	
<p>Expected assessments outputs</p> <p>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</p>	

Indicator Title		<i>Common indicator 5: Population demographic characteristics (Seabirds)</i>	
<p>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.</p> <p>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.</p>			
<p>Known gaps and uncertainties in the Mediterranean</p> <p>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 <i>Larus audouinii</i> and Eleonora's Falcon <i>Falco eleonora</i>, 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 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.</p>			
Contacts and version Date			
Key contacts within UNEP for further information			
Version No	Date	Author	
V.1	20/07/2016	SPA/RAC	

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

Indicator Title	<i>Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)</i>	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Decreasing abundance of introduced NIS in risk areas	Invasive non-indigenous species introductions are minimized	Abundance of NIS introduced by human activities reduced to levels giving no detectable impact
Rationale		
<p>Justification for indicator selection</p> <p>Marine invasive species are regarded as one of the main causes of biodiversity loss in the Mediterranean (Galil, 2007; Coll et al., 2010), potentially modifying all aspects of marine and other aquatic ecosystems. They represent a growing problem due to the unprecedented rate of their introduction (Zenetos et al., 2010) and the unexpected and harmful impacts that they have on the environment, economy and human health (Galil, 2008; Katsanevakis et al. 2014). 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 having been identified (Zenetos et al., 2012), 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) the dominant group in the western Mediterranean and Adriatic Sea, and polychaetes, crustaceans, molluscs and fishes in the eastern and central Mediterranean (Galil, et al., 2009; 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).</p> <p>To mitigate the impacts of invasive alien species 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 (Katsanevakis et al. 2013, 2014; Galil et al. 2014).</p> <p>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.</p>		
Scientific References		
<p>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.</p> <p>Galil, B., 2007. Loss or gain? Invasive aliens and biodiversity in the Mediterranean Sea. Marine Pollution Bulletin 55, 314–322.</p> <p>Galil, B.S., 2008. Alien species in the Mediterranean Sea - which, when, where, why? Hydrobiologia 597(1): 105-116.</p> <p>Galil BS, Marchini A, Occhipinti-Ambrogi A, Minchin D, Narščius A, Ojaveer H, Olenin S (2014) International arrivals: widespread bioinvasions in European Seas. Ethology Ecology and Evolution 26(2-3): 152–171.</p> <p>Katsanevakis, S., Zenetos, A., Belchior, C., Cardoso, A.C., 2013. Invading European Seas: assessing pathways of introduction of marine aliens. Ocean and Coastal Management 76, 64–74.</p> <p>Katsanevakis, S., Wallentinus, I., Zenetos, A., Leppäkoski, E., Çinar, M.E., Oztürk, B., Grabowski, M., Golani, D., Cardoso, A.C., 2014. Impacts of marine invasive alien species on ecosystem services and biodiversity: a pan-European review. Aquatic Invasions 9(4), 391–423.</p> <p>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.</p> <p>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.</p> <p>Zenetos A., Gofas, S., Morri, C., Rosso, A., Violanti, D., et al., 2012. Alien species in the Mediterranean Sea by</p>		

Indicator Title	<i>Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)</i>
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)	
<p>Policy context description</p> <p>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.</p> <p>The Marine Strategy Framework Directive (MSFD), which is the environmental pillar of EU Integrated 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.</p>	
<p>Indicator/Targets</p> <p>Aichi Biodiversity Target 9 EU Biodiversity Strategy Target 5 EU Regulation 1143/2014 targets MSFD Descriptor 2 and related criteria and indicators</p>	
<p>Policy documents</p> <p>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</p>	
Indicator analysis methods	
<p>Indicator Definition</p> <p>For the needs of Common Indicator 6, the following definitions apply:</p> <p>‘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.</p> <p>‘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.</p> <p>‘Trend in spatial distribution’ is defined as the interannual change of the total marine ‘area’ occupied by a non-indigenous species.</p>	
<p>Methodology for indicator calculation</p> <p>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</p>	

Indicator Title	<i>Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)</i>
<p>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.</p> <p>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), and parameter [B] gives an indication of the increase or decrease of the total number of non-indigenous species:</p> <p>[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.</p> <p>[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.</p>	
<p>Indicator units</p> <p>‘Trends in abundance’: % change per year</p> <p>‘Trends in temporal occurrence’: % change in new introductions or % change in the total number of alien species per year or per decade</p> <p>‘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)</p>	
<p>List of Guidance documents and protocols available</p> <p>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.</p> <p>Some guidance on the monitoring of biodiversity (including non-indigenous species) for the needs of the MSFD is provided in: <i>Zampoukas et al. (2014) Technical guidance on monitoring for the Marine Strategy 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.</i></p>	
<p>Data Confidence and uncertainties</p> <p>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.</p> <p>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).</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>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.</p> <p>As a complimentary measure and in the absence of an overall IAS targeted monitoring programme, rapid assessment studies may be undertaken, usually but not exclusively at marinas, jetties, and fish farms (e.g. Minchin, 2007, Pedersen, 2005, Ashton et al., 2006).</p> <p>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.</p> <p>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.</p> <p>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).</p>	

Indicator Title	<i>Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)</i>	
<i>Katsanevakis S, et al., 2012. Monitoring marine populations and communities: review of methods and tools dealing with imperfect detectability. Aquatic Biology 16: 31–52.</i>		
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/ World Register of Introduced Marine Species (WRIMS) - http://www.marinespecies.org/introduced/		
Spatial scope guidance and selection of monitoring stations The monitoring of IAS 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. 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 IAS.		
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 <ul style="list-style-type: none"> - 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

2.13. Common Indicator 7: Spawning Stock Biomass (EO 3)

Indicator Title	<i>Common Indicator 7: Spawning Stock Biomass</i>	
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		
<p>Justification for indicator selection</p> <p>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 “<i>Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area</i>”. 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 <i>Total Biomass or Spawning Stock Biomass</i>, while suitable indicators for exploitation can be either <i>Fishing mortality or Exploitation rate</i> (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.</p> <p>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.</p> <p><u>Spawning Stock Biomass</u></p> <p>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).</p> <p>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 $B_{thr} = 2 * B_{lim}$.</p> <p>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).</p>		
<p>Scientific References</p> <p>-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).</p> <p>-FAO. 1996. Precautionary approach to fisheries. Part 2: scientific papers. Prepared for the Technical</p>		

Indicator Title	Common Indicator 7: Spawning Stock Biomass
<p>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.</p> <p>-GFCM, 2002. Recommendation GFCM/27/2002/1: Management of selected demersal and small pelagic species.</p> <p>-GFCM, 2006. Recommendation. GFCM/30/2006/1: Management of certain fisheries exploiting demersal and small pelagic.</p> <p>-GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area.</p> <p>-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.</p> <p>-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.</p> <p>-Sparre, P.; Venema, S.C. Introduction to tropical fish stock assessment. Part 1. Manual. <i>FAO Fisheries Technical Paper</i>. No. 306.1, Rev. 2. Rome, FAO. 1998. 407p.</p> <p>-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.</p> <p>-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995</p>	
Policy Context and targets (other than IMAP)	
<p>Policy context description</p> <p>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.</p>	
<p>Indicator/Targets</p> <ul style="list-style-type: none"> • SAC 2014: <i>“Provides definitions for stock status and management advice on stocks for which reference points related to indicators of biomass and/or exploitation are available.”</i> • Common Fisheries Policy: <i>“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”</i> • EU-MSFD Descriptor 3: <i>“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”</i> 	
<p>Policy documents</p> <p>- 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</p> <p>- 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</p> <p>-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</p> <p>- 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</p> <p>- 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</p> <p>- 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,</p>	

Indicator Title	<i>Common Indicator 7: Spawning Stock Biomass</i>
<p>Malta, 17-20 March 2014. 18 pp.</p> <p>-GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries.</p> <p>- 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</p> <p>- 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</p> <p>- 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.</p>	
Indicator analysis methods	
<p>Indicator Definition</p> <p><i>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.</i></p> <p>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.</p> <p>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).</p>	
<p>Methodology for indicator calculation</p> <p>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).</p> <p>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.</p>	
<p>Indicator units (<i>under development</i>)</p> <ul style="list-style-type: none"> • 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 	
<p>List of Guidance documents and protocols available</p> <p>- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp.</p> <p>- GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets</p>	

Indicator Title	<i>Common Indicator 7: Spawning Stock Biomass</i>
<p>for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp.</p> <p>- GFCM 2016. GFCM-DCRF, Data Collection Reference Framework. GFCM Secretariat. 116 pp.</p> <p>- Stock Assessment Form version 1.0 (January 2014 - http://www.fao.org/gfcm/data-reporting/data-reporting-stock-assessment/en/)</p>	
Data Confidence and uncertainties	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>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.</p>	
<p>Available data sources</p> <p>- 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/</p> <p>- 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/</p> <p>- 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/</p> <p>- 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/</p> <p>- 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/</p> <p>- 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</p> <p>- 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</p>	
<p>Spatial scope guidance and selection of monitoring stations</p> <p>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.</p>	
Temporal Scope guidance (<i>under development</i>)	
<p>Data analysis and assessment outputs</p>	
Statistical analysis and basis for aggregation (<i>under development</i>)	
<p>Expected assessments outputs</p> <ul style="list-style-type: none"> • Monitoring trend of SSB • Monitoring the stock(s) performance 	

Indicator Title		<i>Common Indicator 7: Spawning Stock Biomass</i>	
<ul style="list-style-type: none"> • 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. <p>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.</p> <p>Known gaps and uncertainties in the Mediterranean</p> <p>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.</p> <p>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.</p>			
Contacts and version Date			
GFCM Secretariat (gfc-secretariat@fao.org)			
Version No	Date	Author	
V.1	15-12-2016	GFCM Secretariat	

2.14. Common Indicator 8: Total landing (EO3)

Indicator Title	<i>Common Indicator 8: Total landing</i>	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
<p>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.</p>	<p>Total catch of commercial species does not exceed the Maximum Sustainable Yield (MSY) and the by-catch is reduced.</p>	<p><u>State</u> -Long-Term High Yields -Catch ≤ MSY</p> <p><u>Pressure</u> -Reduction of IUU catch -Minimization of discarding and incidental catch of vulnerable species</p>
<p>Rationale</p>		
<p>Justification for indicator selection</p> <p>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 “<i>Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area</i>”. 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 <i>Total Biomass or Spawning Stock Biomass</i>, while suitable indicators for exploitation can be either <i>Fishing mortality or Exploitation rate</i> (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.</p> <p>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.</p> <p><u>Total landing</u></p> <p>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 (<u>the landed fraction</u>), 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.</p> <p>Therefore, this indicator is fundamental in order to:</p> <ul style="list-style-type: none"> • 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). <p>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</p>		

Indicator Title	<i>Common Indicator 8: Total landing</i>
targeted by fishing activities, as well as inconsistencies in reported catches, might be also responsible in the trend of this indicator.	
<u>Current status</u>	
<p>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 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.</p>	
Scientific References	
<ul style="list-style-type: none"> - FAO, 1999. <i>Guidelines for the routine collection of capture fishery data</i>. Prepared at the FAO/DANIDA Expert Consultation. Bangkok, Thailand (18–30 May), 1998. FAO, Fish. Tech. Pap. 382. Rome, FAO. 113 pp. - FAO, 2016. <i>The State of Mediterranean and Black Sea Fisheries</i>. 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. <i>Reviews in Fish Biology and Fisheries</i>, 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 	

Indicator Title	<i>Common Indicator 8: Total landing</i>
Policy Context and targets (other than IMAP)	
<p>Policy context description</p> <p>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).</p> <p>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.</p>	
<p>Indicator/Targets</p> <ul style="list-style-type: none"> • SAC 2014: <i>“Provides definitions for stock status and management advice on stocks for which reference points related to indicators of biomass and/or exploitation are available.”</i> • Common Fisheries Policy: <i>“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”</i> • EU-MSFD Descriptor 3: <i>“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”</i> 	
<p>Policy documents</p> <ul style="list-style-type: none"> - 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	
<p>Indicator Definition</p> <p><i>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</i></p>	

Indicator Title	<i>Common Indicator 8: Total landing</i>
<p><i>in domestic ports, recreational fishing, bycatch and IUU estimates.</i></p> <p><i>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.</i></p>	
<p>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 fish, stock size, the spawning stock biomass SSB, the recruitment, and to the proportion of the stock harvested by fishing (fishing mortality F).</p>	
<p>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.</p>	
<p>Methodology for indicator calculation</p> <p>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.</p> <p>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.</p>	
<p>Indicator units</p> <ul style="list-style-type: none"> • 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 	
<p>List of Guidance documents and protocols available</p> <ul style="list-style-type: none"> - 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/) 	
<p>Data Confidence and uncertainties</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p>	

Indicator Title	<i>Common Indicator 8: Total landing</i>
<p>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.</p> <p>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.</p>	
<p>Available data sources</p> <ul style="list-style-type: none"> -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 	
<p>Spatial scope guidance and selection of monitoring stations</p> <p>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.</p>	
<p>Temporal Scope guidance (<i>under development</i>)</p>	
<p>Data analysis and assessment outputs</p>	
<p>Statistical analysis and basis for aggregation (<i>under development</i>)</p>	
<p>Expected assessments outputs</p> <ul style="list-style-type: none"> • Monitoring of total annual biomass landed. • Monitoring trends of the catch (by fleet segment, country and area). • Monitoring the stock(s) performance 	

Indicator Title	<i>Common Indicator 8: Total landing</i>	
<ul style="list-style-type: none"> • 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. 		
<p>Known gaps and uncertainties in the Mediterranean</p> <p>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.</p>		
Contacts and version Date		
GFCM Secretariat (gfc-secretariat@fao.org)		
Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

2.15. Common Indicator 9: Fishing mortality (EO 3)

Indicator Title	<i>Common Indicator 9: Fishing mortality</i>	
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 ($F \leq F_{MSY}$).	<u>Pressure</u> - F_{MSY} - $F_{0.1}$ a proxy of F_{MSY} (more precautionary)
Rationale		
<p>Justification for indicator selection</p> <p>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 “<i>Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area</i>”. 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 <i>Total Biomass or Spawning Stock Biomass</i>, while suitable indicators for exploitation can be either <i>Fishing mortality or Exploitation rate</i> (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.</p> <p>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.</p> <p><u>Fishing mortality</u></p> <p>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.</p> <p><u>Current status</u></p> <p>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.</p> <p>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</p>		

Indicator Title	<i>Common Indicator 9: Fishing mortality</i>
<p>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 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.</p>	
<p>Scientific References</p> <ul style="list-style-type: none"> -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. <i>FAO Fisheries Technical Paper</i>. 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. <i>FAO Fisheries Technical Paper</i>. 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 	
<p>Policy Context and targets (other than IMAP)</p>	
<p>Policy context description</p> <p>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).</p> <p>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.</p>	

Indicator Title	Common Indicator 9: Fishing mortality
Indicator/Targets	<ul style="list-style-type: none"> • 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	<p>- 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</p> <p>- 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</p> <p>-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</p> <p>- 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</p> <p>- 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</p> <p>- 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.</p> <p>-GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries.</p> <p>- 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</p> <p>- 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</p> <p>- 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.</p>
Indicator analysis methods	<p>Indicator Definition</p> <p><i>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.</i></p> <p>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.</p>

Indicator Title	<i>Common Indicator 9: Fishing mortality</i>
<p>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).</p>	
<p>Methodology for indicator calculation</p> <p>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.</p>	
<p>Indicator units</p> <ul style="list-style-type: none"> • 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} 	
<p>List of Guidance documents and protocols available</p> <ul style="list-style-type: none"> - 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/) 	
<p>Data Confidence and uncertainties</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>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.</p>	
<p>Available data sources</p> <ul style="list-style-type: none"> - 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/ 	

Indicator Title		<i>Common Indicator 9: Fishing mortality</i>	
<p>-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/</p> <p>-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/</p> <p>-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</p> <p>-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</p>			
<p>Spatial scope guidance and selection of monitoring stations</p> <p>Stock assessment in the GFCM area of application is often conducted by management units, based on GSAs (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.</p>			
<p>Temporal Scope guidance (<i>under development</i>)</p>			
<p>Data analysis and assessment outputs</p>			
<p>Statistical analysis and basis for aggregation (<i>under development</i>)</p>			
<p>Expected assessments outputs</p> <ul style="list-style-type: none"> • 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. 			
<p>Known gaps and uncertainties in the Mediterranean</p> <p>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.</p> <p>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.</p>			
<p>Contacts and version Date</p>			
<p>GFCM Secretariat (gfc-secretariat@fao.org)</p>			
Version No	Date	Author	
V.1	15-12-2016	GFCM Secretariat	

2.16. 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.	(<i>under development</i>)
Rationale		
<p>Justification for indicator selection</p> <p>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 “<i>Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area</i>”. 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 <i>Total Biomass</i> or <i>Spawning Stock Biomass</i>, while suitable indicators for exploitation can be either <i>Fishing mortality</i>, <i>Exploitation rate</i> (ratio between fishing mortality and total mortality) and <i>Fishing effort</i>. 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.</p> <p>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.</p> <p><u>Fishing effort</u></p> <p>“<i>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</i> (FAO, 1997).”</p> <p>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.</p>		
<p>Scientific References</p> <ul style="list-style-type: none"> - FAO. 1997. Fisheries management. FAO Technical Guidelines for Responsible Fisheries No. 4. Rome, FAO. 82p. - FAO, 1999. <i>Guidelines for the routine collection of capture fishery data</i>. Prepared at the FAO/DANIDA Expert Consultation. Bangkok, Thailand (18–30 May), 1998. FAO, Fish. Tech. Pap. 382. Rome, FAO. 113 pp. - FAO, 2016. <i>The State of Mediterranean and Black Sea Fisheries</i>. General Fisheries Commission for the Mediterranean. Rome, Italy. -GFCM, 2002. Recommendation GFCM/27/2002/1: Management of selected demersal and small pelagic 		

Indicator Title	<i>Common Indicator 10: Fishing effort</i>
	<p>species.</p> <p>-GFCM, 2006. Recommendation. GFCM/30/2006/1: Management of certain fisheries exploiting demersal and small pelagic.</p> <p>-GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area.</p> <p>- 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.</p> <p>- 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.</p> <p>- 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.</p> <p>- 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.</p> <p>- GFCM 2014a. Reference points and advice in the SAC ad in other relevant organizations. WKREF-WGSA. Bar, Montenegro, 28th January-1st February 2014.</p> <p>- 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.</p> <p>- 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.</p> <p>- GFCM 2016a. GFCM-DCRF, Data Collection Reference Framework. GFCM Secretariat. 116 pp.</p> <p>- Patterson, K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. <i>Reviews in Fish Biology and Fisheries</i>, 2, pp. 321–338.</p> <p>- 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.</p> <p>- UNEP-MAP & GFCM 2013. Background document on cooperation needs between UNEP-MAP and GFCM. Internal document. 14pp.</p> <p>-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995</p>
	Policy Context and targets (other than IMAP)
	<p>Policy context description</p> <p>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).</p> <p>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.</p> <p>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).</p>
	<p>Indicator/Targets</p> <ul style="list-style-type: none"> • SAC 2014: <i>“Provides definitions for stock status and management advice on stocks for which</i>

Indicator Title	<i>Common Indicator 10: Fishing effort</i>
<p><i>reference points related to indicators of biomass and/or exploitation are available.”</i></p> <ul style="list-style-type: none"> • Common Fisheries Policy: <i>“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”</i> • EU-MSFD Descriptor 3: <i>“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”</i> 	
<p>Policy documents</p> <ul style="list-style-type: none"> - 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	
<p>Indicator Definition</p> <p><i>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.</i></p> <p>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.</p> <p>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).</p>	
<p>Methodology for indicator calculation</p> <p>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.</p> <p>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</p>	

Indicator Title	<i>Common Indicator 10: Fishing effort</i>
<p>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).</p>	
<p>Indicator units</p> <ul style="list-style-type: none"> • Total effort (e.g. GT*fishing days) • Effort by fleet segments and per area • Trends of nominal effort 	
<p>List of Guidance documents and protocols available</p> <ul style="list-style-type: none"> - 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/) 	
<p>Data Confidence and uncertainties</p>	
<p>Methodology for monitoring, temporal and spatial scope</p>	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>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.</p> <p>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.).</p>	
<p>Available data sources</p> <ul style="list-style-type: none"> -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. 	

Indicator Title	<i>Common Indicator 10: Fishing effort</i>	
<p>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</p>		
<p>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.</p>		
<p>Temporal Scope guidance (<i>under development</i>)</p>		
<p>Data analysis and assessment outputs</p>		
<p>Statistical analysis and basis for aggregation (<i>under development</i>)</p>		
<p>Expected assessments outputs</p> <ul style="list-style-type: none"> • 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. 		
<p>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.</p>		
<p>Contacts and version Date</p>		
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Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

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

Indicator Title	<i>Common Indicator 11: Catch per unit effort (CPUE)</i>	
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.	<i>(under development)</i>
Rationale		
<p>Justification for indicator selection</p> <p>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 “<i>Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area</i>”. 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 <i>Total Biomass or Spawning Stock Biomass</i>, while suitable indicators for exploitation can be either <i>Fishing mortality, Exploitation rate</i> (ratio between fishing mortality and total mortality) or <i>Fishing effort</i>. 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.</p> <p>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.</p> <p>CPUE</p> <p>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.</p> <p>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.</p>		

Indicator Title	Common Indicator 11: Catch per unit effort (CPUE)
	<p>Scientific References</p> <ul style="list-style-type: none"> - Bellman, M.A., Heppell, S.A. and Goldfinger, C., 2005. Evaluation of a US west coast groundfish habitat conservation regulation via analysis of spatial and temporal patterns of trawl fishing effort. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> 62, 2886–2900. - Branch, T.A., Hilborn, R., Haynie, A.G. et al., 2006. Fleet dynamics and fishermen behavior: lessons for fisheries managers. <i>Canadian Journal of Fisheries and Aquatic Science</i> 63, 1647–1668. - FAO, 1999. <i>Guidelines for the routine collection of capture fishery data</i>. Prepared at the FAO/DANIDA Expert Consultation. Bangkok, Thailand (18–30 May), 1998. FAO, Fish. Tech. Pap. 382. Rome, FAO. 113 pp. - FAO, 2016. <i>The State of Mediterranean and Black Sea Fisheries</i>. 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 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. <i>Reviews in Fish Biology and Fisheries</i>, 2, pp. 321–338. -Hilborn, R. and C.J. Walters. 1992. <i>Quantitative Fisheries Stock Assessment: Choice, Dynamics, and Uncertainty</i>. Chapman Hall. New York. - 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
	<p>Policy Context and targets (other than IMAP)</p>
	<p>Policy context description</p> <p>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).</p> <p>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</p>

Indicator Title	<i>Common Indicator 11: Catch per unit effort (CPUE)</i>
decisions.	
<p>Indicator/Targets</p> <ul style="list-style-type: none"> • SAC 2014: <i>“Provides definitions for stock status and management advice on stocks for which reference points related to indicators of biomass and/or exploitation are available.”</i> • Common Fisheries Policy: <i>“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”</i> • EU-MSFD Descriptor 3: <i>“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”</i> 	
<p>Policy documents</p> <ul style="list-style-type: none"> - 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	
<p>Indicator Definition</p> <p><i>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.</i></p> <p>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.</p> <p>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</p>	

Indicator Title	<i>Common Indicator 11: Catch per unit effort (CPUE)</i>
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).	
<p>Methodology for indicator calculation</p> <p>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 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.).</p> <p>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.</p>	
<p>Indicator units</p> <ul style="list-style-type: none"> • Total effort (e.g. GT*fishing days) • CPUE by fishing gear and species • Trends of CPUE 	
<p>List of Guidance documents and protocols available</p> <ul style="list-style-type: none"> - 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	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>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.).</p> <p>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 "<i>Effort measurement by fleet segment</i>"). 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 "<i>Effort measurement by fishing gear</i>").</p>	
<p>Available data sources</p> <ul style="list-style-type: none"> -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 	

Indicator Title	<i>Common Indicator 11: Catch per unit effort (CPUE)</i>	
<p>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</p>		
<p>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.</p>		
<p>Temporal Scope guidance (<i>under development</i>)</p>		
<p>Data analysis and assessment outputs</p>		
<p>Statistical analysis and basis for aggregation (<i>under development</i>)</p>		
<p>Expected assessments outputs</p> <ul style="list-style-type: none"> • 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. 		
<p>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.</p>		
<p>Contacts and version Date</p>		
<p>GFCM Secretariat (gfc-secretariat@fao.org)</p>		
Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

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

Indicator Title		
<i>Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)</i>		
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		
<p>Justification for indicator selection</p> <p>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).</p> <p>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 of 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.</p>		
Scientific References		
<p>-Casale, P. and Margaritoulis, D. (Eds.) .2010. Sea turtle in the Mediterranean: Distribution, threats and conservation priorities. Gland, Switzerland: UICN. 294 pp.</p> <p>-Coll, M. et al. 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. - PLoS ONE 5: e11842.</p> <p>-FAO, 2003. The ecosystem approach to fisheries. FAO Technical guidelines for responsible fisheries. Rome. 112 pp.</p> <p>-FAO, 2009. Guidelines to reduce sea turtle mortality in fishing operations. Fisheries Department, Food and Agriculture Organization of the United Nations. Rome. 128 pp.</p> <p>-FAO, 2011. Fisheries management. Marine protected areas and fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 4. Rome. 198 pp.</p> <p>-FAO, 2016. The State of Mediterranean and Black Sea Fisheries. General Fisheries Commission for the Mediterranean. Rome, Italy.</p> <p>-Franzolini C., Genov, T., Tempesta, M., 2013. Cetacean Manual for MPA managers. ACCOBAMS, MedPAN and UNEP/MAP-RAC/SPA. Ed. RAC/SPA, Tunis. 77 pp.</p> <p>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</p>		

Indicator Title	<i>Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)</i>
<p>pp.</p> <p>-IUCN, 2012. Marine mammals and sea turtles of the Mediterranean and Black Seas.</p> <p>-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/</p> <p>-UNEP/MAP- Blue Plan, 2009. State of the environment and development in the Mediterranean. UNEP/MAP-Blue Plan, Athens.</p> <p>-UNEP, 2013. SAP BIO implementation: The first decade and way forward. UNEP(DEPI)/MED WG.382/5. UNEP RAC/SPA, Tunis.</p> <p>-UNEP/MAP RAC/SPA, 2007. Action Plan for the conservation of Mediterranean marine turtles. Ed. RAC/SPA, Tunis, 40pp. http://rac-spa.org/</p> <p>-UNEP/MAP-RAC/SPA, 2013. Action Plan for the Conservation of Cetaceans in the Mediterranean Sea http://rac-spa.org/</p>	
Policy Context and targets (other than IMAP)	
<p>Policy context description</p> <p>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).</p> <p>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.</p>	
<p>Indicator/Targets</p> <p>-EU Regulation 812/2004 “Concerning incidental catches of cetaceans in fisheries”</p> <p>-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”</p> <p>-EU Habitats Directive</p> <p>-GFCM Recommendations: GFCM/35/2011/3, GFCM/35/2011/4, GFCM/35/2011/5, GFCM/36/2012/2, GFCM/36/2012/3</p>	
<p>Policy documents</p> <p>-Barcelona Convention (Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean).</p> <p>-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</p> <p>-EU Biodiversity Strategy http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN</p> <p>-EU Régulation 1143/2014 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN</p> <p>- 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</p> <p>- 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</p>	

Indicator Title	<i>Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)</i>
<p>- 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</p> <p>-Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the Mediterranean Region http://sapbio.rac-spa.org/</p> <p>-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</p> <p>-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 (<i>Monachus monachus</i>) 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/</p>	
Indicator analysis methods	
<p>Indicator Definition</p> <p><i>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.</i></p> <p>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.</p> <p>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.</p>	
<p>Methodology for indicator calculation</p> <p>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</p> <p>Incidental catch of vulnerable species can be sampled through:</p> <ol style="list-style-type: none"> 1) Direct observation <ul style="list-style-type: none"> - a) at-sea monitoring of commercial catches (<i>by observers on board</i>); - b) dedicated survey - c) fishers (<i>by self-sampling</i>) 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 (<i>by questionnaires</i>), collecting also perspectives on the bycatch issue, which is meant to complement the on board observations data analyses, and to 	

Indicator Title	<i>Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)</i>
<p>provide an integrated approach toward management.</p> <p>3) Stranded animal monitoring</p> <p>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 – “<i>Fleet Segments</i>” from GFCM-DCRF, 2016).</p>	
<p>Indicator units</p> <ul style="list-style-type: none"> • 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 • Identification of risky areas • Record strandings of vulnerable species due to incidental catch 	
<p>List of Guidance documents and protocols available</p> <ul style="list-style-type: none"> - 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	
<p>Available Methodologies for Monitoring and Monitoring Protocols</p> <p>Several protocols are available using different monitoring platforms and approaches such as:</p> <ul style="list-style-type: none"> - Direct observation - Stranded animal monitoring - Landing/market survey - Dedicated surveys - Photo-identification 	
<p>Available data sources</p> <ul style="list-style-type: none"> • 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. 	
<p>Spatial scope guidance and selection of monitoring stations</p> <p>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.</p>	
Temporal Scope guidance (<i>under development</i>)	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation (<i>under development</i>)	
<p>Expected assessments outputs</p> <ul style="list-style-type: none"> -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); 	

Indicator Title	<i>Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)</i>	
<p>-Find out the most important factors that could determine the incidental catch amounts (including ecological and technical factors). -Trend analysis (by quarter and year)</p>		
<p>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.</p>		
Contacts and version Date		
GFCM Secretariat (gfc-secretariat@fao.org)		
Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

Annexe
(Common indicators related to Fisheries)

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.

	<i>GFCM subregions</i>	Western Mediterranean Sea	Ionian Sea	Adriatic Sea	Eastern Mediterranean Sea	Black Sea
	<i>GSAs</i>	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
	<i>Countries</i>	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)**
<i>Scientific name</i>	<i>FAO 3-alpha code</i>					
<i>Engraulis encrasicolus</i>	ANE	X	X	X	X	X
<i>Merluccius merluccius</i>	HKE	X	X	X	X	
<i>Mullus barbatus</i>	MUT	X	X	X	X	
<i>Mullus surmuletus</i>	MUR	X	X		X	
<i>Nephrops norvegicus</i>	NEP	X	X	X		
<i>Parapenaeus longirostris</i>	DPS	X	X	X	X	
<i>Psetta maxima</i>	TUR					X
<i>Sardina pilchardus</i>	PIL	X	X	X	X	
<i>Sprattus sprattus</i>	SPR					X
<i>Squalus acanthias</i> *	DGS					X
<i>Trachurus mediterraneus</i>	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.

	<i>GFCM subregions</i>	Western Mediterranean Sea	Ionian Sea	Adriatic Sea	Eastern Mediterranean Sea	Black Sea
	GSA s	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					
<i>Alosa pontica</i>	SHC					X
<i>Aristaeomorpha foliacea</i>	ARS		X			
<i>Aristeus antennatus</i>	ARA	X				
<i>Boops boops</i>	BOG	X	X	X	X	
<i>Chamelea gallina</i>	SVE			X		
<i>Coryphaena hippurus</i>	DOL		X			
<i>Diplodus annularis</i>	ANN		X			
<i>Eledone cirrhosa</i>	EOI	X		X		
<i>Eledone moschata</i>	EDT			X		
<i>Galeus melastomus</i>	SHO	X				
<i>Lophius budegassa</i>	ANK	X	X			
<i>Merlangius merlangius</i>	WHG					X
<i>Micromesistius poutassou</i>	WHB	X				
<i>Octopus vulgaris</i>	OCC	X	X	X	X	
<i>Pagellus bogaraveo</i>	SBR	X				
<i>Pagellus erythrinus</i>	PAC	X	X	X	X	
<i>Raja asterias</i>	JRS	X				
<i>Raja clavata</i>	RJC	X	X			
<i>Rapana venosa</i>	RPW					X
<i>Sardinella aurita</i>	SAA	X	X		X	
<i>Saurida undosquamis</i>	LIB				X	
<i>Scomber japonicus</i>	MAS	X			X	
<i>Scomber scombrus</i>	MAC	X	X			
<i>Sepia officinalis</i>	CTC	X	X	X		
<i>Siganus luridus</i>	IGU				X	
<i>Siganus rivulatus</i>	SRI				X	
<i>Solea vulgaris</i>	SOL			X	X	
<i>Sphyræna sphyraena</i>	YRS		X			
<i>Spicara smaris</i>	SPC			X	X	
<i>Squilla mantis</i>	MTS			X		
<i>Trachurus mediterraneus</i>	HMM	X				
<i>Trachurus picturatus</i>	JAA	X				
<i>Trachurus trachurus</i>	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.

	<i>GFCM subregions</i>	Western Mediterranean Sea	Ionian Sea	Adriatic Sea	Eastern Mediterranean Sea	Black Sea
	GSA s	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					
<i>Dalatias licha</i>	SCK	X	X	X	X	
<i>Dipturus oxyrinchus</i>	RJO	X	X	X	X	
<i>Etmopterus spinax</i>	ETX	X	X	X	X	
<i>Galeus melastomus</i>	SHO		X	X	X	
<i>Hexanchus griseus</i>	SBL	X	X	X	X	
<i>Mustelus asterias</i> *	SDS	X	X	X	X	
<i>Mustelus mustelus</i> *	SMD	X	X	X	X	
<i>Mustelus punctulatus</i> *	MPT	X	X	X	X	
<i>Myliobatis aquila</i>	MYL	X	X	X	X	
<i>Prionace glauca</i> *	BSH	X	X	X	X	
<i>Pteroplatytrygon violacea</i>	PLS	X	X	X	X	
<i>Raja asterias</i>	JRS		X	X	X	
<i>Raja clavata</i>	RJC			X	X	X
<i>Raja miraletus</i>	JAI	X	X	X	X	
<i>Scyliorhinus canicula</i>	SYC	X	X	X	X	X
<i>Scyliorhinus stellaris</i>	SYT	X	X	X	X	
<i>Squalus acanthias</i> *	DGS	X	X	X	X	
<i>Squalus blainvillei</i>	QUB	X	X	X	X	
<i>Torpedo marmorata</i>	TTR	X	X	X	X	
<i>Torpedo torpedo</i>	TTV	X	X	X	X	
<i>Fistularia commersonii</i>	FIO				X	
<i>Lagocephalus sceleratus</i>	LFZ				X	
<i>Marsupenaeus japonicus</i>	KUP				X	
<i>Metapenaeus stebbingi</i>	MNG				X	
<i>Scomberomorus commerson</i>	COM				X	
<i>Corallium rubrum</i>	COL	X	X	X	X	
<i>Anguilla anguilla</i>	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)

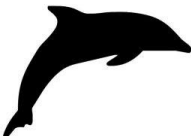
Vessel groups			Length classes (LOA)			
			< 6 m	6 - 12 m	12-24 m	> 24 m
Polyvalent	P	Small-scale vessels without engine using passive gears	P-01	P-02	P-03	P-04
			P-13			
		Small-scale vessels with engine using passive gears	P-05	P-06	P-07	P-08
		Polyvalent vessels	P-09	P-10	P-11	P-12
				P-14		
Seiners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


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 - Vulnerable species (GFCM-DCRF, 2016)

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
<p style="text-align: center;">Cetaceans</p> 	Balaenopteridae	<i>Balaenoptera acutorostrata</i>	Common minke whale
		<i>Balaenoptera borealis</i>	Sei whale
		<i>Balaenoptera physalus</i>	Fin whale
		<i>Megaptera novaeangliae</i>	Humpback whale
	Balenidae	<i>Eubalaena glacialis</i>	North Atlantic right whale
	Physeteridae	<i>Physeter macrocephalus</i>	Sperm whale
		<i>Kogia simus</i>	Dwarf sperm whale
	Phocoenidae	<i>Phocoena phocoena</i>	Harbour porpoise
	Delphinidae	<i>Steno bredanensis</i>	Rough-toothed dolphin
		<i>Grampus griseus</i>	Risso's dolphin
		<i>Tursiops truncatus</i>	Common bottlenose dolphin
		<i>Stenella coeruleoalba</i>	Striped dolphin
		<i>Delphinus delphis</i>	Common dolphin
		<i>Pseudorca crassidens</i>	False killer whale
		<i>Globicephala melas</i>	Long-finned pilot whale
	Ziphiidae	<i>Orcinus orca</i>	Killer whale
		<i>Ziphius cavirostris</i>	Cuvier's beaked whale
<i>Mesoplodon densirostris</i>		Blainville's beaked whale	
Seals	Phocidae	<i>Monachus monachus</i>	Mediterranean monk seal

Group of vulnerable species	Family	Species	Common name
<p data-bbox="264 667 613 699">Sharks, Rays, Chimaeras</p> 	Alopiidae	<i>Alopias vulpinus</i>	Common thresher
	Carcharhinidae	<i>Carcharias taurus</i>	Sand tiger
		<i>Carcharhinus plumbeus</i>	Sandbar shark
		<i>Carcharodon carcharias</i>	Great white shark
		<i>Prionace glauca</i>	Blue shark
	Centrophoridae	<i>Centrophorus granulosus</i>	Gulper shark
	Cetorhinidae	<i>Cetorhinus maximus</i>	Basking shark
	Gymnuridae	<i>Gymnura altavela</i>	Spiny butterfly ray
	Hexanchidae	<i>Heptranchias perlo</i>	Sharpnose sevengill shark
	Lamnidae	<i>Isurus oxyrinchus</i>	Shortfin mako
		<i>Lamna nasus</i>	Porbeagle
	Myliobatidae	<i>Mobula mobular</i>	Devil fish
	Odontaspidae	<i>Odontaspis ferox</i>	Small-tooth sand tiger shark
	Oxynotidae	<i>Oxynotus centrina</i>	Angular rough shark
	Pristidae	<i>Pristis pectinata</i>	Smalltooth sawfish
		<i>Pristis pristis</i>	Common sawfish
	Rajidae	<i>Dipturus batis</i>	Common skate
		<i>Leucoraja circularis</i>	Sandy ray
		<i>Leucoraja melitensis</i>	Maltese skate
		<i>Rostroraja alba</i>	Bottlenose skate
	Rhinobatidae	<i>Rhinobatos cemiculus</i>	Blackchin guitarfish
		<i>Rhinobatos rhinobatos</i>	Common guitarfish
	Sphyrnidae	<i>Sphyrna lewini</i>	Scalloped hammerhead
<i>Sphyrna mokarran</i>		Great hammerhead	
<i>Sphyrna zygaena</i>		Smooth hammerhead	
Squatinaidae	<i>Squatina aculeata</i>	Sawback angel shark	
	<i>Squatina oculata</i>	Smoothback angel shark	
	<i>Squatina squatina</i>	Angel shark	
Triakidae	<i>Galeorhinus galeus</i>	School/Tope shark	

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

Group of vulnerable species	Family	Species	Common name
<p style="text-align: center;">Sea turtles</p> 	Cheloniidae	<i>Caretta caretta</i>	Loggerhead turtle
		<i>Chelonia mydas</i>	Green turtle
		<i>Eretmochelys imbricata</i>	Hawksbill Turtle
		<i>Lepidochelys kempii</i>	Kemp's ridley sea turtle
	Dermochelyidae	<i>Dermochelys coriacea</i>	Leatherback sea turtle
	Trionychidae	<i>Trionyx triunguis</i>	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
<p>Sharks, Rays, Chimaeras</p> 	Alopiidae	<i>Alopias superciliosus</i>	Bigeye thresher
	Hexanchidae	<i>Hexanchus nakamurai</i>	Bigeye sixgill shark
	Echinorhinidae	<i>Echinorhinus brucus</i>	Bramble shark
	Squalidae	<i>Squalus megalops</i>	Shortnose spurdog
	Centrophoridae	<i>Centrophorus uyato</i>	Little gulper shark
	Somniosidae	<i>Centroscymnus coelolepis</i>	Portugese dogfish
		<i>Somniosus rostratus</i>	Little sleeper shark
	Lamnidae	<i>Isurus paucus</i>	Longfin mako
	Scyliorhinidae	<i>Galeus atlanticus</i>	Atlantic catshark
	Carcharhinidae	<i>Carcharhinus altimus</i>	Bignose shark
		<i>Carcharhinus brachyurus</i>	Bronze whaler shark
		<i>Carcharhinus brevipinna</i>	Spinner shark
		<i>Carcharhinus falciformis</i>	Silky shark
		<i>Carcharhinus limbatus</i>	Blacktip shark
		<i>Carcharhinus melanopterus</i>	Blacktip reef shark
		<i>Carcharhinus obscurus</i>	Dusky shark
		<i>Galeocerdo cuvier</i>	Tiger shark
		<i>Rhizoprionodon acutus</i>	Milk shark
	Torpedinidae	<i>Torpedo nobiliana</i>	Great torpedo
		<i>Torpedo sinuspersici</i>	Variable torpedo ray
	Rajidae	<i>Dipturus nidarosiensis</i>	Norwegian skate
		<i>Leucoraja fullonica</i>	Shagreen skate
		<i>Leucoraja naevus</i>	Cuckoo skate
		<i>Raja africana</i>	African skate
		<i>Raja brachyura</i>	Blonde skate
		<i>Raja montagui</i>	Spotted skate
		<i>Raja polystigma</i>	Speckled skate
		<i>Raja radula</i>	Rough skate
		<i>Raja undulata</i>	Undulate skate
	Dasyatidae	<i>Dasyatis centroura</i>	Roughtail stingray
		<i>Dasyatis marmorata</i>	Marbled stingray
		<i>Dasyatis pastinaca</i>	Common stingray
		<i>Dasyatis tortonesei</i>	Tortonese's stingray
		<i>Himantura uarnak</i>	Honeycomb whipray
	<i>Taeniura grabata</i>	Round fantail stingray	
Myliobatidae	<i>Pteromylaeus bovinus</i>	Bullray	
Rhinopteridae	<i>Rhinoptera marginata</i>	Lusitanian cownose ray	
Sphyrnidae	<i>Sphyrna tudes</i>	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	
	Small-scale vessels without engine using passive gears		Net length ^{4 5}	Fishing days	Net length * Fishing days
P	Small-scale vessels with engine using passive gears	All	Number of traps/pots ²³	Fishing days	Number of traps/pots * Fishing days
	Polyvalent vessels		Number of lines ²³	Fishing days	Number of lines * Fishing days
S	Purse seiners Tuna seiners	All	GT	Number of fishing sets ^{6 7}	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

⁴ Length of net expressed in 100-metre units (FAO).

⁵ 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.

⁶ Number of times the gear has been set or shot, whether or not a catch was made (FAO).

⁷ 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 ^{8 9}	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 ^{10 11}	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			
	Pair trawls (not specified)	PT			
Other trawls (not specified)	TX				

⁸ Number of times the gear has been set or shot, whether or not a catch was made (FAO).

⁹ 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.

¹⁰ Length of net expressed in 100-metre units (FAO).

¹¹ 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
Dredges	Boat dredges	DRB	GT	Fishing days	GT * Fishing days
	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 entangling 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			