6th Meeting of the Ecosystem Approach Coordination Group

Athens, Greece, 11 September 2017

Agenda item 3 Review of proposed IMAP Common Indicator Guidance Facts Sheets (Biodiversity and Fisheries)

IMAP Common Indicator Guidance Facts Sheets (Biodiversity and Fisheries)

Note by the Secretariat

1.   The 19th Meeting of Contracting Parties (COP 19), held in February 2016, adopted the Integrated Monitoring and Assessment Programme (IMAP) of the Meditrerranean Sea and Coast and Related Assessment Criteria (Decision IG. 22/7), with a list of regionally agreed good environmental status descriptions, common indicators and targets, with principles and clear timeline for its implementation.

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. As such, IMAP aims to facilitate the implementation of article 12 of the Barcelona Convention and several other monitoring related provisions under different Protocols with the main objective to assess GES. Its backbone are the 11 Ecological Objectives and their 27 common indicators as presented in Decision IG. 22/7.

3.   The UNEP/MAP Programme of Work (PoW) adopted at COP 19, includes 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.*

4.   In line with the above, guidance factsheets have been developed for each Common Indicator to ensure coherent monitoring, with specific targets defined and agreed in order to deliver the achievement of Good Environmental Status (GES) and as such, provide concrete guidance and references to Contracting Parties to support implementation of their revised national monitoring programmes towards the overall goal of implementing the Ecosystem Approach (EcAp) in the Mediterranean Sea and achieveing GES.

5.   In this context, this document outlines the Indicator Guidance Factsheets for the Ecological Objectives Ecological Objectives 1 (Biodiversity), 2 (Non-Indigenous Species) and 3 (Fisheries).

6.   The structure of a Common Indicator Factsheets can be summarized looking at the different organization levels of the developed factsheet templates. A common set of relevant policy and science-based information is required on each (ie. Indicator Title, Rational, Policy Context and Targets, Indicator analysis methods and Methodolgy for monitoring (temporal and spatial scope), Contacts and Document Registration). In each, detailed definitions, methodologies, references, gaps, uncertainties, data analysis approaches, basis for aggregation (if applies) and outputs complete the guidance factsheets, as described under, in Table 1.

7.   The Meeting of the Correspondence Group on Monitoring (CORMON), Biodiversity and Non Indigenous Species (Madrid, Spain, 28 February- 1 March) and the Meeting of the SPA RAC Focal Points (Alexandria, Egypt, 9-12 May 2017) reviewed these factsheets and provided comments and suggestions for their revision. This document reflects comments received in the sessions and after the sessions, as appropriate.

Table 1: Scheme of IMAP Factsheet Template:

Indicator Title		
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**
Rationale		
Justification for indicator selection		
Scientific References		
Policy Context and targets		
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 analysis and assessment outputs		
Statistical analysis and basis for aggregation		
Expected assessments outputs		
Known gaps and uncertainties in the Mediterranean		
Contacts and version Date		
Key contacts within UNEP for further information		
Version No	**Date**	**Author**

IMAP Reference No and definition

Scientific rationale and marine policy context (including relevant references)

Agreed scientific methodologies in use, including detailed monitoring requirements

Data reporting, analysis and aggregation (outpout)

Document Registration

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

Indicator Title	Common Indicator 1: Habitat distributional range		
Relevant GES definition	Related Operational Objective	Proposed Target(s)	
The habitat is present in all its natural distributional range	Coastal and marine habitats are not being lost	**State**	**Pressure**
		The ratio Natural / Observed distributional range tends to 1	Decrease in the main human causes of the habitat decline
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 *List (author(s), year, Ref: journal, series, etc.) and url's* Andersen et al., 2013 - Coggan, R., Populus, J., White, J., Sheehan, K., Fitzpatrick, F., Peil, S. (eds) (2007) Review of standards and protocols for seabed habitat mapping, 192pp. - Coll, M., Piroddi, C., Albouy, C., Lasram, F.B.R., Cheung, W.W.L., et al. 2012. The Mediterranean Sea under siege: spatial overlap between marine biodiversity, cumulative threats and marine reserves. Glob. Ecol. Biogeogr. 21, 465–480. - Giakoumi, S., Sini, M., Gerovasileiou, V., Mazor, T., Beher, J., et al. 2013. Ecoregion-based conservation planning in the Mediterranean: dealing with large-scale heterogeneity. PLoS ONE 8(10): e76449. doi:10.1371/journal.pone.0076449. - Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., et al., 2008. A global map of human impact on marine and coastal ecosystems. Science 319, 948–952. - Halpern, B.S., Kappel, C.V., Selkoe, K.A., Micheli, F., Ebert, C.M., et al. 2009. Mapping cumulative human impacts to California current marine and coastal ecosystems. Conserv. Lett. 2, 138–148. - Kappel, C.V., Halpern, B.S., Napoli, N., 2012. Mapping Cumulative Impacts of Human Activities on Marine and coastal ecosystems. Coastal and Marine Spatial Planning Research Report 03.NCEAS.12). Sea Plan, Boston. 109pp. - Korpinen S., Meidinger M., Laamanen, M., 2013. Cumulative impacts on seabed habitats: An indicator.for assessments of Good Environmental Status. Mar. Poll. Bull., 74: 311–319. - Micheli F, Halpern BS, Walbridge S, Ciriaco S, Ferretti F, et al. 2013. Cumulative Human Impacts on Mediterranean and Black Sea Marine and coastal ecosystems: Assessing Current Pressures and Opportunities. PLoS ONE 8(12): e79889. ,			
Policy Context and targets (other than IMAP)			
Policy context description The CORMON Biodiversity and Fisheries Meeting (Ankara 26-27 July, 2014) recommended that loss of habitat extent is typically more important/at higher risk, with loss of distributional range only secondarily at risk.			
Indicator/Targets This indicator is an area-related indicator, i.e. proportion of the area of habitats that are permanently or for a long-lasting period lost or subject to change in habitat-type due to anthropogenic pressures. As a target, the damaged or lost area per habitat type, especially for physically defined and not biogenic habitats could be set as to not exceed an acceptable percentage			

Indicator Title	*Common Indicator 1: Habitat distributional range*

of the baseline value. As an example, this target was derived from OSPAR to not exceed 15% of the baseline value and was similarly proposed by HELCOM.

For habitats under protective regulations (such as those listed under the SPA/Biodiversity Protocol, EU Nature directives) the target could be set as habitat loss stable or decreasing and not greater than the baseline value. As an example, as regards the EU guidance for the assessment of conservation status under the Habitats Directive, Member States have generally adopted a 5% tolerance above the baseline to represent "stable". However, in some cases a more stringent <1% tolerance has been attached to the maintenance of habitat extent.

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

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

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

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

Policy documents
List and url's

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

Indicator analysis methods

Indicator Title	*Common Indicator 1: Habitat distributional range*

Indicator Definition

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

Methodology for indicator calculation

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

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

Indicator units

The parameter/metric for the assessment of this indicator is the surface area of lost habitat for each habitat type. It is suggested to largely use cumulative impact data derived from knowledge of anthropogenic pressures.

List of Guidance documents and protocols available

- RAC/SPA Protocol for the Posidonia meadows monitoring networks[1]
- RAC/SPA Protocol for the monitoring of coralligenous community[2]

Data Confidence and uncertainties

The identification of habitat sites in marine areas away from the coast has to be based on more general geological, hydrological, geomorphological and biological data than is the case for coastal or terrestrial areas. Where the location of sub-littoral habitat types is not already known, they can be located in two steps using available data: (1) broad scale geophysical or oceanographic information is often available for large sea areas, and can be used as the first step in the selection of sites by helping to identify the location of potential habitats; (2) step two then involves focused information gathering or new surveys, directed to those specific areas where existing information indicates that a habitat type is present or is likely to be present. This approach is particularly useful for Contracting Parties with large sea areas and deep waters, where detailed biological information is likely to be sparsely distributed. Collation of data should involve examination of scientific archives and data from relevant academic, government, NGO, and industry stakeholders. This information can include historical charts of relevant seabed features and fishing grounds.

Data regarding human activities causing habitat loss have been usually produced by projects requiring licensing procedures and Environmental Impact Assessments (e.g. wind farm constructions, sediment extraction). Therefore, relevant data should be available to Contracting Parties. A range of activity data regarding habitat damage caused by other activities (e.g. fishing) is also available from various sources (e.g. VMS or log book data for larger fishing vessels that undertake bottom trawling). On the basis of these data it should then be decided on a case by case basis, applying a risk based approach, where to focus monitoring/sampling efforts to validate, extrapolate or measure habitat area.

Methodology for monitoring, temporal and spatial scope

Available data sources

Sources and url's

UKSeaMap 2010 - predictive mapping of seabed habitats : http://jncc.defra.gov.uk/ukseamap

EMODnet Seabed Habitats (EUSeaMap) project : http://jncc.defra.gov.uk/euseamap

EMODnet Human Activities : http://www.emodnet.eu/human-activities

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

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

Indicator Title	*Common Indicator 1: Habitat distributional range*

Recent European projects have produced updated habitat lists and catalogues with habitat map resources (e.g. CoCoNet, NETMED, MAREA-Mediseh, MERCES).

Spatial scope guidance and selection of monitoring stations
Considering that the monitoring under IMAP should follow a risk-based approach, the reference sites to be monitored should be located in zones with infrastructure developments or significant physical activities having the potential to generate damages to the marine habitats (dredging, trawling activities, etc.). Possible damage from pollution should be also considered.

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

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

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

Temporal Scope guidance
Consistent scales and methods will be necessary for mapping a given habitat in a sub-region. The time of sampling should be synchronised for a sub-region so as to standardize the influence of seasonal, inter-annual or climate-related changes on results. Intervals of 3-6 years are probably appropriate when non-invasive surveys (e.g. side scan sonar, video) or models (to be validated by optimized sampling) are used for mapping.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation
No statistical analyses are needed for this assessment.

Expected assessments outputs
I.e. trend analysis, distribution maps etc, and methods used
In general terms, the following steps should be part of the indicator's assessment:
- Generate maps of the marine habitats in each Contracting Party's marine areas;
- Attribute a specific sensitivity to physical pressures to different habitat types;
- Collate spatial and temporal pressure intensity data (e.g. VMS or log book data for fisheries, activity data from approved plans and projects);
- If vulnerability is addressed in the first three points, deduce impacts from either (i) known pressure/impact relationships, using reference sites and risk based monitoring of selected stations (link to condition indices), or (ii) mapping cumulative impact models (with ground-truthing);
- If vulnerabilities are not addressed in first three points, derive measures of habitat extent;

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

Indicator Title	*Common Indicator 1: Habitat distributional range*
• Determine whether the target is reached (i.e. proportion of lost or damaged area, related to total area the habitat type, above which GES is not achieved).	
Known gaps and uncertainties in the Mediterranean Information sources on the distribution of habitats are substantially greater for the northern than the southern coasts of the Mediterranean Sea.	
Contacts and version Date	
Key contacts within UNEP for further information	

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

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

Indicator Title	*Common indicator 2: Condition of the habitat's typical species and communities*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The population size and density of the habitat-defining species, and species composition of the community, are within reference conditions ensuring the long term maintenance of the habitat	Coastal and marine habitats are not being lost	**State:** -No human induced significant deviation of population abundance and density from reference conditions -The species composition shows a positive trend towards reference condition over an increasing proportion of the habitat (for recovering habitats)

Rationale
Justification for indicator selection The concept of "typical species" emerges from the conservation status of natural habitats to their long-term natural distribution, structure and functions, as well as to the long-term persistence of their typical species within the territory. Therefore, typical species composition should be near/close to natural conditions for their habitat to be considered in natural condition.

Scientific References
List (author(s), year, Ref: journal, series, etc.) and url's • Pérès JM, Picard J (1964) Nouveau manuel de Bionomie benthique de la Mer Méditerranée. Recueil des Travaux de la Stations Marine d'Endoume, 47: 3-137. • Templado, J., Ballesteros, E., Galparsoro, I., Borja, A., Serrano, A., Marín, L., Brito, A., 2012. Inventario español de Hábitats y Especies Marinos. Guía Interpretativa: Inventario Español de Hábitats Marinos. Ministerio de Agricultura, Alimentación y Medio Ambiente. 229 pp. • UNEP/MAP-RAC/SPA, 2015. Handbook for interpreting types of marine habitat for the selection of sites to be included in the national inventories of natural sites of conservation interest. Bellan-Santini, D., Bellan, G., Bitar, G., Harmelin J-G., Pergent, G. Ed. RAC/SPA, Tunis. 168 pp. + Annexes (Orig. pub. 2002). • UNEP-MAP-RAC/SPA, 2017. Draft Updated Reference List of Marine Habitat Types for the Selection of Sites to be included in the National Inventories of Natural Sites of Conservation Interest in the Mediterranean. Ed. RAC/SPA, Tunis. in press.

Policy Context and targets (other than IMAP)
Policy context description Typical species have already been identified by several Contracting Parties for listed habitat types to fulfill the assessment requirements under the Habitats Directive. Additionally, the coastal area out to 1 nautical mile offshore has already been covered by these Contracting Parties under the Water Framework Directive. Therefore, the indicator is available for considerable benthic habitats within these areas and is already covered by monitoring efforts and has been assessed using appropriate metrics. Soft-bottom benthic invertebrates and seagrasses are traditionally used in the Mediterranean Sea for environmental quality assessment and several indices have already been widely applied by Mediterranean Contracting Parties, Member States of the EU and compared in the framework of the Mediterranean Geographical Intercalibration Group of the EU Water Framework Directive (MED GIG), while two indices have also been based on macroalgae and compared in the framework of MED GIG. Already in 2009, the Meeting of UNEP/MAP MED POL experts on Biological Quality Elements (UNEP/DEPI/MED WG. 342/3) recommended the

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

application of benthic indices developed and tested under the Water Framework Directive for use by all Contracting Parties. Recent European projects have focused on MSFD indicators and monitoring aspects for various habitats (e.g. DEVOTES, PERSEUS, IRIS-SES). To this end, the 2015 PERSEUS Project specific training course targeting Southern Mediterranean countries could be utilized.

Indicator/Targets

In order to assess the state/condition of a habitat (i.e. its typical species composition and their relative abundance, absence pr particularly sensitive or fragile species or species providing a key function, size structure of species), the Contracting Parties need to define lists of typical and/or characteristic species (or groups of species) and to set targets to determine their presence. It is also important to compile typical species lists consistently per biogeographical region, to allow for the consistent assessment of state/condition. Typical species composition includes both macrozoobenthos and macrophytes, depending on the type of habitat (i.e. macrophytes do not occur in aphotic habitats). Long-lived species and species with high structuring or functional value for the community should preferably be included; however, the typical species list might also contain small, short-lived species if they characteristically occur in the habitat under natural conditions. The general target of this indicator is to reach a ratio of typical and/or characteristic species similar to baseline conditions as defined above, for all considered habitats. With regard to plankton communities, a recommended target might be: "Plankton community not significantly influenced by anthropogenic drivers". This target allows unmanageable climate change but triggers management action if linked to an anthropogenic pressure and could be used with all datasets across all Contracting Parties. Monitoring of important pelagic habitats should be considered in the future.

Policy documents
List and url's
UNEP/DEPI/MED WG. 342/3
http://www.unepmap.org/index.php
http://195.97.36.231/dbases/MEETING_DOCUMENTS/09WG342_3_eng.pdf
EU Water Framework Directive (MED GIG)
http://ec.europa.eu/environment/water/water-framework/index_en.html
http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/10473/1/3010_08-volumecoast.pdf

Indicator analysis methods

Indicator Definition

This indicator should be implemented as a state condition indicator, with respect to baseline conditions, by using a list of typical and/or characteristic species in the communities of different habitats per sub-region.

Methodology for indicator calculation

The calculation of this indicator involves simple comparison of typical and/or characteristic species (or groups of species) per habitat and sub-region with respect to baseline conditions, for all considered communities. Within this process, an acceptable deviation from baseline conditions would need to be defined. This deviation might be implemented by setting a certain percentage value to define GES. However, for baseline setting, the use of current state might be inappropriate if the considered habitats actually underlie high human pressure and no reference sites are available. The definition of a reference state of Mediterranean Sea habitats may be problematic and the use of past state may be more appropriate. This cut-off value has to be habitat-specific and regionally adapted in view of the natural variability of species composition by habitat type and bioregion.
The required methods and effort strongly depend on the habitat type (and selected species) to be addressed.

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

Detailed overviews presenting the basic guidelines and methodologies for the inventorying and monitoring of various Mediterranean key habitats (seagrass meadows, coralligenous and rhodolith beds and "dark habitats", i.e. marine caves and deep sea assemblages) have been recently produced by UNEP/MAP-RAC/SPA in the framework of MedKeyHabitats project. Large attached epibenthic species on hard substrates are preferably monitored using optical, non-destructive methods, such as underwater-video while endobenthic communities are sampled using standardized grabs or corers, which are commonly used in marine monitoring programmes. Several specific benthic biotic indices have been developed and have become operational, in particular to fulfill MED GIG requirements. They are all well methodologically defined but the way to combine these parameters in sensitivity/tolerance classification or depending on structural, functional and physiological attributes is heterogeneous, depending on the issue (pressure type), habitat types or sub-region. Qualified personnel, in particular experienced taxonomists, are required for both field and laboratory work to guarantee quality in sampling accuracy, consistency of data over time, meaningful data analyses and interpretation of the results.

The following resources are usually required for the calculation of this indicator:

- Research vessels, suited to work from sublittoral to bathyal zones, depending on the sub-region;
- Scuba diving sampling to infralittoral
- Adequate equipment (box core samplers, grabs, dredges, underwater camera systems, etc.) for sample collection from intertidal to bathyal zones;
- Laboratory infrastructure to analyze samples (e.g. microscopes, weighing scales).
- Qualified personnel for data processing, analysis and interpretation.
- Good taxonomy skills are essential for the adequate assessment of this indicator.

Indicator units

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

List of Guidance documents and protocols available

- Lepidochronology and phenology protocols for *Posidonia oceanica*[4]
- ISO 16665: 2014 Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna (http://www.iso.org/iso/catalogue_detail.htm?csnumber=54846) These guidelines provide standard methodology for collection and processing of subtidal soft-bottom macrofaunal samples in marine waters, in particular:
  - the development of the sampling programme;
  - the requirements for sampling equipment;
  - sampling and sample treatment in the field;
  - sorting and species identification;
  - storage of collected and processed material.

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

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

- ISO 19493: 2007 Guidance for marine biological surveys of supralittoral, eulittoral and sublittoral hard substrate for environmental impact assessment and monitoring in coastal areas (http://www.iso.org/iso/catalogue_detail.htm?csnumber=39107): It covers:
  - the development of the sampling programme,
  - survey methods,
  - species identification,
  - storage of data and collected material

Data Confidence and uncertainties

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

Methodology for monitoring, temporal and spatial scope

Scientific literature*Sources and url's*

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

- UNEP/MAP-RAC/SPA, 2015. Guidelines for Standardization of Mapping and Monitoring Methods of Marine Magnoliophyta in the Mediterranean. Pergent-Martini, C., Ed., RAC/SPA publ., Tunis: 48 p. + Annexes.
- UNEP-MAP-RAC/SPA, 2015. Standard methods for inventorying and monitoring coralligenous and rhodoliths assemblages. Pergent, G., Agnesi, S., Antonioli, P.A., Babbini, L., Belbacha, S., Ben Mustapha, K., Bianchi, C.N, Bitar, G., Cocito, S., Deter, J., Garrabou, J., Harmelin, J-G., Hollon, F., Mo, G., Montefalcone, M., Morri, C., Parravicini, V., Peirano, A., Ramos-Espla, A., Relini, G., Sartoretto, S., Semroud, R., Tunesi, L., Verlaque, M. Ed. RAC/SPA, Tunis. 20 pp. + Annex.
- UNEP-MAP-RAC/SPA, 2017. Draft Guidelines for Inventorying and Monitoring Dark Habitats. Aguilar, R., Pilar, M., Gerovasileiou, V. and contributors. Ed. RAC/SPA, Tunis. in press.
- Zamboukas, N., Palialexis, A. (eds.), Duffek, A., Graveland, J., Giorgi, G., Hagebro, C., Hanke, G., Korpinen, S., Tasker, M., Tornero, V., Abaza, V., Battaglia, P., Caparis, M., Dekeling, R., Vegas, M. F., Haarich, M., Katsanevakis, S., Klein, H., Krzyminski, W., Laamanen, M., Jean, LG., Leppänen, J.-M., Urmas, L. 2014. Technical guidance on monitoring for the marine strategy framework directive. Luxembourg, European Union. 166 p. JRC Scientific and Policy Reports; 2014, 26499 EN.

Spatial scope guidance and selection of monitoring stations

This indicator is applicable in all regions provided that typical and/or characteristic species lists, including both macrozoobenthos and macrophytes, will be developed for every type of habitat, at a sub-regional scale (or bioregion within each sub-region). Benthic biotic indices are also conceptually applicable in all sub-regions but appropriate adjustments might be still needed to cover biogeographic heterogeneity.

Temporal Scope guidance

Indicator Title	*Common indicator 2: Condition of the habitat's typical species and communities*
Natural variability in species composition in space and time must be considered for this indicator and the list of typical and/or characteristic species must be defined and updated every 6 years per habitat type in particular geographic areas. The ideal temporal scale for this indicator is once per year while the minimum required sampling frequency is at least twice per period of 6 years.	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation Data analysis for this indicator involved simple comparison of typical and/or characteristic species with respect to baseline conditions for the considered habitat in a given region. A number of tools and software have been developed for the calculation of benthic biotic indices.	
Expected assessments outputs Assessments outputs for this indicator include (1) a list of typical and/or characteristic species per habitat of a given region, recorded following a well-described methodology and/or values of the appropriate benthic biotic indices for the considered habitats and (2) comparison with baseline/past data to indicate trends in the habitat conditions/state.	
Known gaps and uncertainties in the Mediterranean Information about the typical and/or characteristic species of some habitats and their past state/conditions is often unavailable for southern and eastern sub-regions of the Mediterranean. The limited data availability may restrict the number of habitats that can be assessed with sufficient statistical confidence at present. Although benthic biotic indices are conceptually applicable in all sub-regions, adjustments might be required in order to cover biogeographic heterogeneity.	
Contacts and version Date	
Key contacts within UNEP for further information	

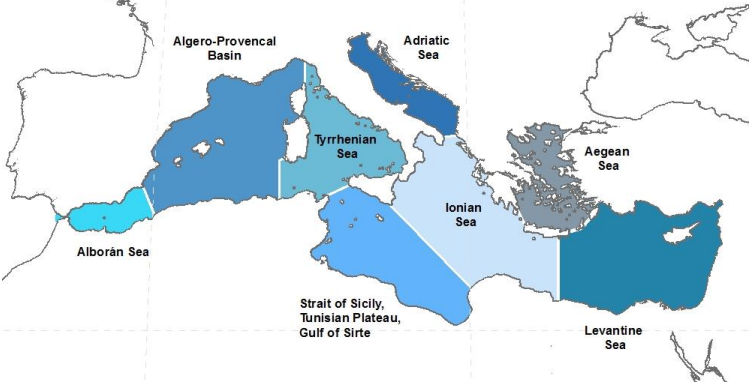| Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

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

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 that experienced reduced distribution in the past are in favourable status of conservation and can recolonise areas with suitable habitats
Rationale		

Justification for indicator selection
The objective of this indicator is to focus on the species distributional range of marine mammals within the Mediterranean waters, with a special emphasis to those species selected by the Parties. Differences and shifts in distribution may reflect changes in the occurrence of suitable habitats, availability of food resources, selective pressures from human-related activities, as well as climate change. With increasing concern about species conservation, quantitative descriptions of species' range structure and extent of geographical distribution - both for single species or groups of species - together with detailed information on the location of breeding/feeding areas, can provide crucial information for management purposes.

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

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

Knowledge about the distribution, abundance and habitat use and preferences of some of these species, including the most abundant ones, is in part scant and limited to specific sectors of the Mediterranean Sea, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution.
The conservation status of marine mammals 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,

Indicator Title	*Common indicator 3:* species distributional range (marine mammals)
habitat loss and degradation, chemical pollution, anthropogenic noise, direct killings and climate change. The geographical distribution of marine mammals in the Mediterranean Sea is affected by several factors, which should all be taken into consideration when monitoring these species. Ocean currents, abundance of food, sea temperature, morphology of the coastline, seabed topography, as well as human activities, seem to interact and influence which areas are preferred habitats for cetaceans and seals. Certain habitats have a particular key value in the life cycles of different species, in that they are used as foraging grounds due to prey abundance, for breeding or as migration corridors between areas. Besides in the case of the Mediterranean monk seal, the species needs form terrestrial coastal habitat for haul out, rest, pupping and rearing their pups.	

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Indicator Title	*Common indicator 3:* species distributional range (marine mammals)
Policy Context and targets (other than IMAP)	

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

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

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

Indicator Title	*Common indicator 3:* species distributional range (marine mammals)
ACCOBAMS STRATEGY (PERIOD 2014 – 2025) - https://accobams.org/images/stories/MOP/MOP5/Documents/Resolutions/mop5.res5.1_accobams%20strategy.pdf	
Indicator analysis methods	

Indicator Definition

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

Methodology for indicator calculation

The range of a given species is commonly represented by a distribution map. The main outputs of the monitoring under this common indicator will be therefore maps of species presence, distribution and occurrence.

The use of Geographical Information Systems (GIS) is required for the compilation of the monitoring data collected and the elaboration of the species distributional range maps.

Information on distribution of marine mammals may be obtained through dedicated ship and aerial surveys, acoustic surveys, platform of opportunities (e.g., whale watching operators, ferries, cruise ships, military ships, coastal cave surveys for monk seal pupping and haul out shelters).

ACCOBAMS is currently planning to undertake a regional synoptic survey covering most of the Mediterranean waters to estimate cetacean species density and abundance. This initiative – known as the ACCOBAMS Survey Initiative (ASI) - is expected to start in 2017 and be implemented during summer 2018. This will provide useful, robust and reliable data concerning population abundance of cetaceans in the Mediterranean area. Data on all the cetacean species present in the Mediterranean will be collected and will provide important baseline data to liaise with national and international requirements, such as those by the Ecosystem Approach and the MSFD.

When a global approach such as that currently pproposed by ACCOBAMS is unfeasible or too ambitious, small scale monitoring programmes should be established, adapting to MSFD macro-regions or UNEP-MAP-RAC/SPA (2010) marine eco-regions (Fig. 1), according to specific needs. In any case, once dealing with a subregional implementation approach for cetacean surveying campaigns, this should be carried out in line with agreed common, regional methodologies, using existing and shared Protocols, with the facilitation, as appropriate, of ACCOBAMS.

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

Indicator units

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

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

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

List of Guidance documents and protocols available
A document on 'Monitoring Guidelines to assess Cetaceans' Distributional Range, Population Abundance and Population Demographic Characteristics' has been produced by ACCOBAMS and should be considered as guidance when establishing monitoring programmes.

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

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols
Several protocols are available using different monitoring platforms and approaches and Countries should select the most appropriate one based on available resources and conservation needs. Some methods could be combined to provide more robust information, such as visual and acoustic census, for example. The available mothods include, *inter alia*, the following :
- Dedicated ships or aerial surveys
- By-catch data
- Beached and stranded specimens monitoring
- Opportunistic data collected from platform of opportunities
- Citizen science data (only if verified by experts)
- Tagging (capture-mark-recapture – artificial tags & photo-identification)
- Telemetry: satellite tracking, GPS/GSM tracking, radio tracking and the use of data loggers
- Acoustic data collection
- Automatic infrared camera

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

Spatial scope guidance and selection of monitoring stations
Current spatial distributional range of marine mammals in the Mediterranean Sea is largely affected by available data, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution. Priority should be given to the less known areas, using online data sources, such as Obis SeaMap and published data and reports as sources of information.

Temporal Scope guidance
Fine scale distribution of marine mammals may vary on annual, seasonal or monthly basis. Ideally, monitoring programmes should be conducted focusing breeding and feeding seasons. Temporal scale is largely affected by the conservation questions and expected outputs. International regulation suggests a six-year interval between large scale monitoring programmes, but smaller intervals are recommended. Long-term projects provide robust indications on trends in distribution over time and space is selected areas.
The European Union Habitats Directive requires Member States to take action to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora

Indicator Title	*Common indicator 3:* species distributional range (marine mammals)
specified as being in need of strict protection (Council Directive 92/43/EEC). Member States are also required to undertake surveillance of these habitats and species and to report every 6 years on whether their conservation status is favourable and on the implementation of measures taken to ensure this. Links with other relevant directives and initiatives, such as the MSFD and the Ecosystem Approach under the framework of the Barcelona Convention should be established.	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation Standard regression methods (simple linear regression, generalized linear or additive models), power analysis for detecting trends should be applied.	
Expected assessments outputs I.e. trend analysis (monthly, seasonally, yearly), distribution maps, statistical frameworks applied.	
Known gaps and uncertainties in the Mediterranean Data in the Mediterranean Sea are characterized by their uneven distribution, both geographical and spatial. The summer months are the most representative ones and very few information have been provided for the winter months, when conditions to conduct off-shore research campaigns are particularly hard due to meteorological adversity. Ongoing effort is targeting the identification of Cetacean Critical Habitats (CCHs) and Important Marine Mammal Areas (IMMAs) in the entire Mediterranean Sea. A gap analysis is also been conducted within the Mediterranean Sea by Duke University, to provide an inventory of available data and to select areas where more information should be collected in terms of area, effort and time of the year.	
Contacts and version Date	
Key contacts within UNEP for further information	

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

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

Indicator Title	Common indicator 3: Species distributional range – Reptiles	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The species continues to occur in all its natural range in the Mediterranean, including nesting, mating, feeding and wintering and developmental (where different to those of adults) sites	Species distribution is maintained	State Turtle distribution is not significantly affected by human activities Turtles continue to nest in all known nesting sites Pressure/Response Protection of known nesting, mating, foraging, wintering and developmental turtle sites. Human activities[5] having the potential to exclude marine turtles from their range area are regulated and controlled. The potential impact of climate change is assessed
Rationale		
Justification for indicator selection In biology, the range of a given species is the geographical area in which that occurs (i.e. the maximum extent). A commonly used representation of the total areal extent (i.e. the range) of a species is a range map (with dispersion being shown by variation in local population densities within that range). Species distribution is represented by the spatial arrangement of individuals of a given species within a geographical area. Therefore, the objective of this indicator is to determine the species range of sea turtles that are present in Mediterranean waters, especially the species selected by the Parties. Sea turtles are an ideal model species to assess the selected indicator, as their populations are dispersed throughout the entire Mediterranean, as discrete breeding, foraging, wintering and developmental habitats, making the two sea turtle species a reliable indicator on the status of biodiversity across this region. Green turtles are primarily herbivores, whereas loggerheads are primarily omnivores, resulting in their occupying important components of the food chain; thus, changes to the status in sea turtles, will be reflected at all levels of the food chain. However, the extent of knowledge on the occurrence, distribution, abundance and conservation status of Mediterranean marine species is uneven. In general, the Mediterranean states have lists of species, but knowledge about the locations used by these species is not always complete, with major gaps existing for other associated information. Even some of the most important programmes on this topic have significant gaps (e.g. Global databases do not reflect actual current knowledge in the Mediterranean region). It is therefore necessary to establish minimum information standards to reflect the known distribution of all selected species. Species distribution ranges can be gauged at local (i.e. within a small area like a national park) or regional (i.e. across the entire Mediterranean basin) scales using a variety of approaches. Given the breadth of the Mediterranean, it is not feasible to obtain adequate information about the entire surface (plus, the marine environment is 3 dimensional, with many vertebrate species only being present at the surface briefly to breathe, e.g. sea turtles), so it is necessary to choose sampling methods that allow adequate knowledge of the distribution range of each species. Such sampling involves high effort for areas that have not been fully surveyed to date. Monitoring effort should be long term and should cover all seasons to ensure that the information obtained is as complete as possible.		

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

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

Scientific References

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Policy Context and targets (other than IMAP)

Policy context description

Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes GES definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD includes Descriptor 1: Biodiversity: "The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions." Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them.

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

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

Indicator/Targets

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

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

Source: [Evaluation of] National Reports on Article 12 Technical Assessment of the MSFD 2012 obligations

http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/pdf/national_reports.zip

GREECE (*page 15)*

Environmental targets:

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

Associated indicators:

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

ITALY (*page 18)*

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

[...]

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

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

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

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

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

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

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

- Reduction of fishing pressure (percentage)

SPAIN (*Page 25)*

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

[...]

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

[...]

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

[...]

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*
C.1.2: Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles) SLOVENIA - No information on Targets *page 10: (I. Good Environmental Status (GES), 1.1 Descriptor 1)* In the accompanying text to the GES definition, Slovenia provides a list of the species that are covered by the GES definition. This includes the bottlenose dolphin (*Tursiops truncatus*), the loggerhead sea turtle (*Caretta caretta*). *(II. Initial assessment, 2.2 Biological features)* Slovenia indicates that *[…]* turtles are covered under the reporting obligations of the Habitats Directive *[…]*. Each of these groups is briefly described and their state in relation to natural conditions is reported. CYPRUS - No information on Targets *page 11: (II. Initial assessment, 2.2 Biological features)* *[…] Chelonia mydas* and *Monachus monachus* are considered stable but the situation of *Caretta caretta* is actually improving.	

Policy documents
http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010D0477(01) http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm http://ec.europa.eu/environment/marine/pdf/1-Task-group-1-Report-on-Biological-Diversity.pdf http://ec.europa.eu/environment/marine/pdf/9-Task-Group-10.pdf

Indicator analysis methods
Indicator Definition Variation in the total area (trends in the number of occupied grid cells) occupied by the selected species for breeding, wintering and feeding areas. The distributional range of a species is an important indicator that may be obtained through the georeferencing species observations, assuming objective techniques are used. To determine the distribution range of a species, it is necessary to know where individuals of the species are located from sampling information. It is therefore necessary to establish minimum information standards to reflect the known distribution of all selected species. Species distribution ranges can be gauged at local (i.e. within a small area like a national park) or regional (i.e. across the entire Mediterranean basin) scales using a variety of approaches. Long-term monitoring of these areas provides information on the temporal evolution in species distributions.
Methodology for indicator calculation The European (ETRS) 10x10km² grid is used for mapping the distribution and range, accounting each known location along the Mediterranean coast. Three different maps (grids) are produced yearly for each species accounting for breeding sites, wintering sites and feeding/developmental sites of loggerheads (*Caretta caretta*) and greens (*Chelonia mydas*). For all species information on spatial distribution within the assessment would be transferred in a 10×10 km (or finer for small countries, 1 x 1 km or 5 x 5 km) grid; filled cells show presence of the species. The distribution area is the sum of area of the cells where the species is "present". For the reporting on the range of a species, considering that it is a suitable parameter for assessing the spatial aspects of GES, and to describe and detect changes in the extent of the distribution, a tool to calculate the range size from the map of the actual breeding (or wintering or feeding) distribution is required (i.e. occurrences). The Range Tool software and algorithm will provide a standardised process that will help to ensure repeatability of the range calculation in different reporting rounds. After automated calculation of the range it is possible to correct the gaps to obtain a complete overview of the data following a standardised protocol. The resulting range map will then be a combination of the automated procedure completed by expert judgement.
Indicator units

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

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

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

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

List of Guidance documents and protocols available

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

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

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

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

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

Data Confidence and uncertainties

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

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

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

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

- Aerial surveys: plane transects in marine areas (monitoring CI 3 & 4 in marine areas) (presence/potential absence at broad scales, requiring local confirmation of absence)
- Land based surveys: Nesting monitoring (breeding areas) and stranding monitoring (coastal areas) (CI 3-5) (presence/absence)
- In-water surveys: Diving/snorkeling transects, capture-mark-recapture (CI 3-5 in marine areas) (presence/absence, but at very localized scales)
- Satellite remote sensing: Nesting, in-water, bycatch surveys (CI 3-5 in marine & breeding areas) (presence, possible absence at broad scales, requiring local scale confirmation of absence)

In-water monitoring can be done via:

- Dedicated ship and aerial (plane and drone) transect surveys to confirm the presence/absence and spread of individuals in marine and coastal habitats (presence only)
- Bycatch data from fisheries records and onboard researchers, which are invaluable for obtaining data in deep/open waters (presence/absence, but in focused areas)
- Beached and stranded specimen monitoring, with dedicated stranding networks already existing for sea turtles in several Mediterranean countries, and stranding information being confirmed to reflect distribution patterns based on satellite telemetry studies (potential presence)

Indicator Title	*Common indicator 3: Species distributional range – Reptiles*
- Opportunistic data, on non-dedicated platforms (ferries, merchant marine ships or amateurs/yachts, use of citizen science), by-catch data (where dedicated research programs do not exist, for sea turtles and shearwaters in long-lines and other types of fishing gear, and small cetaceans in fishing various types of fishing gear). (potential presence, requiring confirmation by dedicated surveys)	

- Tagging (capture-mark-recapture – artificial tags & photo-identification). Confirmed identification of presence of individuals from different populations at different locations based on external tags (plastic/metal), PIT tags and photo-id. (confirmed presence and absence)
- Telemetry. Satellite tracking, GPS/GSM tracking, radio tracking and the use of loggers. Provides detailed information about the movements of small numbers of individuals within a population. Increasingly small transmitter size means it can be attached to juveniles; however, at least 50 individuals from a single population must be tracked to obtain population level movement/dispersal/distribution patterns. (confirmed presence/absence, but limited to small numbers of individuals)

Beach monitoring can be done via:
- Direct monitoring of nesting beaches - Detection of tracks of turtles on beaches potentially used for nesting. (confirmed presence/absence but only where monitoring is conducted)
- Aerial surveys (drones/planes) or foot patrols may be used to confirm the use of beaches for nesting activity (confirmed presence/absence over broad scales, but possibly limited temporally)
- Use of high resolution remote sensing satellite imagery to detect the presence/absence of tracks on difficult to access areas (i.e. due to distance from roads or lack of national security) (confirmed presence/absence over broad scales but possibly limited temporally)
- Use of aerial surveys by planes or drones once key areas are identified by satellite imagery where possible or as an alternative (confirmed presence/absence, but possibly limited temporally).

Bibliographic sources: The location of sea turtle nesting beaches, wintering, feeding and developmental areas, may be achieved by checking existing bibliographic information, surveys by different groups (fishermen, NGOs, guides, articles) of already known sites, probability of occurrence models (that indicate areas where a species is likely to occur based on statistical models that relate habitat variables to the presence/absence of a species) and regional expert knowledge (confirmed presence).

Available data sources

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

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

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

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

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

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

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

UNEP/MAP-RAC/SPA projects and publications http://www.rac-spa.org/publications

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

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

Governmental Ministries
International Union for Conservation of Nature (IUCN) specialists (Marine Turtle Specialist Group - MTSG)

Spatial scope guidance and selection of monitoring stations
The presence of the two species should be monitored all along the Mediterranean coast and in the known breeding, wintering, and feeding/developmental areas.
The spatial basis for assessment should be according to the Mediterranean biogeographical sub-areas to reflect changes in the abundance of sea turtles in each habitat type across the Mediterranean and its sub-regions.
Each Contracting Party should assess all marine (coastal and oceanic) and beach habitats across their national maritime waters. However, it is recommended that these areas are assessed at a smaller scale if they belong to different biogeographical sub-regions or if differences in pressure intensity are obvious between sub-basins.

Temporal Scope guidance
Yearly for each of the species and areas (breeding, wintering, feeding/developmental). Seasonality to be determined by the local experts as i.e. breeding season can vary along and across the Mediterranean. The widest known range for nesting is April/May to September/October, with the hatching period extending 45 to around 70 days after this (depending on sand composition, sand temperature and season). For wintering, this period extends from October to March/April in the Ionian/north Aegean for loggerheads, and lasts from November to March/April along the north coast of Africa for greens, and is limited to 1-2 months for loggerheads in this region. Furthermore, the quantity of wintering habitats in the northern parts of the Mediterranean may increase with climate change. Foraging and developmental sites are expected to be inhabited year-round, but with seasonal fluctuations.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

The assessment should focus on whether the total area of a species distribution range is maintained or not. To assess the variation in breeding, wintering and feeding/developmental ranges, annual comparisons should be made with an emphasis on new or disappearing areas of use, expressing the range trends over the grids. This objective requires the use of different but widely available GIS geoprocessing techniques and geodatabases tools (ArcGis, QGis, R platform, etc). Annual comparison of distributional ranges.

The trends in the number of occupied cells or area occupied is a basic and immediate parameter for which the significance may be statistically assessed.

Expected assessments outputs

Temporal trends in distributional range.

Maps showing the evolution of the distributional range for the two species at different scales.

Known gaps and uncertainties in the Mediterranean
- Location of all breeding/nesting sites
- Location of all wintering, feeding, developmental sites of adult males, females, juveniles
- Connectivity among the various sites in the Mediterranean.
- Vulnerability/resilience of these sites in relation to physical pressures;
- Analysis of pressure/impact relationships for these sites and definition of qualitative GES;
- Identification of extent (area) baselines for each site and the habitats they encompass;
- Criteria for the risk based approach to monitoring and develop harmonized sampling instructions where appropriate;
- Common computing methodologies and data collection instructions, specifying the accuracy (spatial resolution or grid) of the determination of extent (area) a priori;
- Appropriate assessment scales;

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

- 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
V.2	14/04/2017	SPA/RAC

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

Indicator Title	Common indicator 3: Species distributional range (Seabirds)	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The distribution of seabird species continues to occur in all their Mediterranean natural habitat Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions. (EO1, Biodiversity)	Distribution of selected species is maintained.	- No significant reduction in the population distribution in the Mediterranean in all indicator species. - New colonies are established and the population is encouraged to spread among alternative breeding sites.
Rational		
Justification for indicator selector: Species distributional range and distributional pattern. The objective of this indicator is to determine the species range of the seabirds that are present in Mediterranean waters; especially the species selected by the Parties (see Priorities below). Change of breeding/wintering distribution of population reflects the habitat changes, availability of food resources, and pressures related to human activity and climate change. This indicator could be based in a set of single species indicators that reflects distribution pattern of breeding/wintering populations of the selected species. Range is defined for the reporting under de Nature Directives as 'the outer limits of the overall area in which a species is found at present. It can be considered as an envelope within which areas actually occupied occur. For the application of the IUCN Red List criteria range (EOO) is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the sites of present occurrence, while distribution (AOO) is defined as the area within the EOO that is actually occupied. The monitoring of the distribution should be accomplished over a complete scale approach to be truly reliable since range concept does not make sense for small areas. Whereas other indicators can have a tricky approach (vg. uneven or lack of knowledge on abundance, population, patterns or trends among the different Contract Parties, henceforth CP) the spatial distribution of the selected seabird species during the breeding and the wintering seasons are relatively well know, at least in terms of absence / presence. We suggest the scale of "National part of subdivision" as the basis working scale, by using a grid of 10x10 km square cells in the multipurpose Pan-European mapping standard (ETRS89 Lambert Azimuthal Equal-Area 52-10 projection coordinate reference system). For the reporting of small contracting parties such as Malta or Cyprus, maps of 5x5 km or 1x1 km grids could be advised because these will then be aggregated to 10x10 km for visualisation at the Regional or subregional level. Thus the indicator for breeding/wintering range would consist in the variation of occupied / lost areas an ETRS89-LAEA5210_10K grid in 6 years. This proposal has multiple advantages as can be easily aggregated for the analysis at a subdivision level or higher or for a differentiated analysis between functional groups.		
Scientific References UNEP/MAP - RAC/SPA, 2012. Guidelines for Management and Monitoring Threatened Population of Marine and Coastal Bird Species and their Important Areas in the Mediterranean. By Joe Sultana. Ed. RAC/SPA, Tunis. 24pp.		

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

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

Fric, J., Portolou, D., Manolopoulos, A. and Kastritis, T. (2012) Important Areas for Seabirds in Greece. LIFE07 NAT/GR/000285. Hellenic Ornithological Society (HOS / BirdLife Greece), Athens

Celada, C., Gaibani, G., Cecere, I.G., Calabrese, L. and Piovani, P. (2009) *Aree importanti per gli uccelli dalla terra al mare. Studio preliminare per l'individuazione per le IBA* (Important Bird Areas) *in ambiente marino.* LIPU, Ministero Dell'Ambiente and DPN.

- Arcos, J.M., J. Bécares, B. Rodríguez y A. Ruiz. (2009) Áreas Importantes para la Conservación de las Aves marinas en España. LIFE04NAT/ES/000049-Sociedad Española de Ornitología (SEO/BirdLife). Madrid.

Bourgeois, K., & Vidal, E. (2008). The endemic Mediterranean yelkouan shearwater *Puffinus yelkouan*: Distribution, threats and a plea for more data. *Oryx*, 42(2), 187-194. doi:10.1017/S0030605308006467

Policy Context and targets		
Policy context description		
EU Marine Strategy Framework Directive	In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned".	Descriptor 1: Biodiversity The 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. Parameters and trends: Distribution (range)

Indicator Title	Common indicator 3: Species distributional range (Seabirds)	
UE Nature Directives (Birds and Habitats Directives)	The conservation status of a species "will be taken as 'favourable' when: 1. population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and 2.the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and 3.there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis"; (Article 1i) Every six years, all EU Member States are required to report on the implementation of the directives There is a methodology for the assessment of conservation status and has been widely used for the compulsory reporting by EU member states for Habitats Directive (HD). This approach has been extended also to Birds Directive (BD) reporting (N2K Group 2011).	Parameters and trends: Distribution (range)

Targets
 EU Marine Strategy Framework Directive: National and international efforts are undertaken, applying conservation measures or procedures to ensure that the distributional range of breeding and sites of the seabirds is stable, with no loss of breeding sites due to anthropogenic disturbance.
 UE Nature Directives:

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

Indicator analysis methods

Indicator Definition

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

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

Methodology for indicator calculation

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

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

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

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

Priority species

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

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

List of Guidance documents and protocols available

General protocols

- Article 12 – National reporting on status and trends of bird species. http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm
- Auniņš, A., and Martin, G. (eds.) (2015). Biodiversity Assessment of MARMONI Project Areas. Project report, 175. Available online at: http://marmoni.balticseaportal.net/wp/project-outcomes/
- Camphuysen CJ & Garthe S 2004. Recording foraging seabirds at sea: standardised recording and coding of foraging behaviour and multi-species associations. Atlantic Seabirds 6: 1 – 32.

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

- http://bd.eionet.europa.eu/activities/Reporting/Article_17/reference_portal

- ICES (2013). OSPAR Special Request on Review of the Technical Specification and Application of Common Indicators under D1, D2, D4, and D6. Copenhagen: International Council for the Exploration of the Sea.

- ICES. 2015. Report of the Working Group on Marine Mammal Ecology (WGMME), 9–12 February 2015, London, UK. ICES CM 2015/ACOM: 25. 114 pp.

- MARMONI (2015). The MARMONI approach to marine biodiversity indicators. Volume II: list of indicators f or assessing the state of marine biodiversity in the Baltic Sea developed by the life MARMONI project. Estonian Marine Institute Report Series No. 16. Available online at: http://marmoni.balticseaportal.net/wp/project-outcomes/

The "Range Tool"

- ETC/BD. 2012. User Manual for Range Tool for Article 12 (Birds Directive) & Article 17 (Habitats Directive). Prepared by Brian Mac Sharry (MNHN). http://bd.eionet.europa.eu/activities/Reporting_Tool/Documents

- ETC/BD. 2011. Assessment and reporting under Article 12 of the Birds Directive. Explanatory Notes & Guidelines for the period 2008-2012 (Final version). Compiled by Compiled by the N2K Group under contract to the European Commission. Avalaible online: https://circabc.europa.eu/sd/a/4fc954f6-61e3-4a0b-8450-ca54e5e4dd53/Art.12%20guidelines%20final%20Dec%2011.pdf

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

- Peifer, H. 2011. About the EEA reference grid. http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2/

Data Confidence and uncertainties

Quality 3 = Good. Complete survey or a statistically robust estimate
Quality 2 = Moderate. Estimate based on partial data with some extrapolation and/or modelling
Quality 1 = Poor. Estimate based on expert opinion with no or minimal sampling
0 = Uncertain (absent data, as in cases when newly arriving species has not yet established distribution).
A helpful rule for assessing the quality of the range calculation could consist in a judgement combining the *reliability* of the distribution at the time it was mapped, how *recently* it was mapped, and the *method* used to map it
The result would be 3 = reliable (accurate to within 10%); 2 = incomplete (accurate to within 50%) or 1 = poor (definitely not accurate to within 50%)

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Distribution of breeding/wintering/feeding areas including: location of breeding colonies on the coast
Breeding distribution map and range size: Map plotted on the selected ETRS grid showing occurrence (presence/absence)
Monitoring effort should be long term and should cover all seasons to ensure that the information obtained is as complete as possible.

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

The location of many bird colonies, as well as their wintering, feeding and developmental areas, may be achieved by checking existing bibliographic information (which can be of particular interest is assessing the basal stage), surveys conducted by different groups, observations (fishermen, citizen science), and regional expert knowledge.
For breeding / wintering areas:

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

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

Available data sources *Sources and url's*

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

Spatial scope guidance and selection of monitoring stations

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

Temporal Scope guidance

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

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

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

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

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.

A decreased range shouldn't be a major concern as far as other indicators, in particular the species indicator abundance, shows an acceptable trend.

But if the trends show a negative balance and a decrement on the occupied area, there are some techniques for change detection using grids (rasters). We suggest to explore the Map Comparison Kit (http://mck.riks.nl) a free software developed by the Netherlands Environmental Assessment Agency (MNP) which includes a range of algorithms for the comparison of raster maps similarities and dissimilarities and spatio-temporal analysis, and focus on 'categorical' or 'nominal' maps (H. Visser and T. de Nijs, 2006).

References (to be checked):

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

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

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

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

Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

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

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

Justification for indicator selection

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

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

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

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

The conservation status of marine mammals 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,
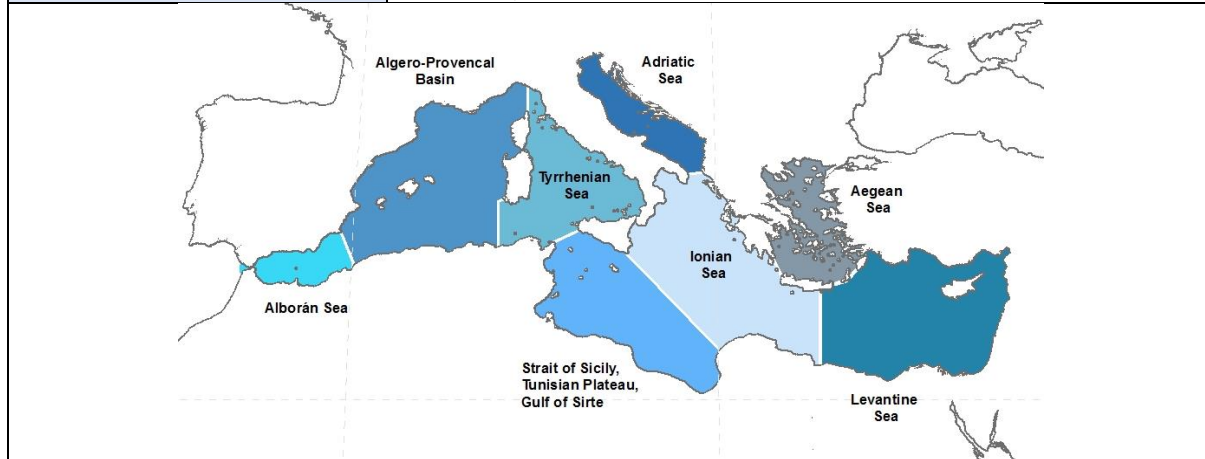
Indicator Title	*Common indicator 4: Species population abundance (marine mammals)*

habitat loss and degradation, chemical pollution, anthropogenic noise, direct killings and climate change.

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

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Policy Context and targets (other than IMAP)

Policy context description

Mediterranean fin whales and sperm whales are protected by the International Whaling Commission's moratorium on commercial whaling that entered into force in 1986.

The Mediterranean cetaceans' populations are also protected under the auspices of ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area), under the auspices of the UNEP Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS). The Corso-Ligurian-Provençal Basin and the Tyrrhenian Sea, where most cetacean species find suitable habitats, lie within the Pelagos Sanctuary established by France, Italy and Monaco, thus benefitting from its conservation regime.

All cetacean species in the Mediterranean Sea are protected under the Annex II of the SPA-BD Protocol under the Barcelona Convention; under the Appendix I of the Bern Convention; under the Annex II of the Washington Convention (CITES); under the Appendix II of the Bonn Convention (CMS).

The short-beaked common dolphin, the sperm whale and the Cuvier's beaked whale and the Mediterranean monk seal are also listed under the Appendix I of the Bonn Convention (CMS). The common bottlenose dolphin, the harbor porpoise and the Mediterranean monk seal are also listed under the Annex II and all marine mammals are in Annex IV of the EU Habitats Directive and considered strictly protected.

Indicator/Targets

Aichi Biodiversity Target 1, 3

EU Regulation 812/2004 concerning incidental catches of cetaceans in fisheries

EU MSFD Descriptor 1 and 4 - Marine Strategy Framework Directive requests regular reports on the population dynamics, range and status of cetacean species in Europe's waters.

EU Habitats Directive - The European Habitat Directive not only requires the monitoring of the Good Environmental Status (GES) of species and habitats of community interest, but also requires reporting on this status every 6 years.

The obligations under ACCOBAMS.

Policy documents

- Aichi Biodiversity Targets - https://www.cbd.int/sp/targets/
- EU Biodiversity Strategy - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN
- EU Regulation 1143/2014 - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN
- Marine Strategy Framework Directive - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN

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

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

Common Fisheries Policy (CFP) and its reform - http://ec.europa.eu/fisheries/cfp/index_en.htm and http://ec.europa.eu/fisheries/reform/ and http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:354:0022:0061:EN:PDF

Council Regulation (EC) No 812/2004 of 26.4.2004 laying down measures concerning incidental catches of cetaceans in fisheries and amending Regulation (EC) No 88/98 - http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32004R0812

Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning - http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.257.01.0135.01.ENG

Regulatory and Governance Gaps in the International Regime for the Conservation and Sustainable Use of Marine Biodiversity in Areas beyond National Jurisdiction - https://cmsdata.iucn.org/downloads/iucn_marine_paper_1_2.pdf

International Convention for the Prevention of Pollution from Ships (MARPOL) - http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx

United Nations Convention on the Law of the Sea - http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

UNEP Regional Seas Programme - http://www.unep.org/ecosystemmanagement/water/regionalseas40/
https://global.oup.com/academic/product/marine-mammal-conservation-and-the-law-of-the-sea-9780190493141?cc=us&lang=en&

Indicator analysis methods

Indicator Definition

This indicator is aimed at providing information about the abundance of marine mammal's population. It is intended to determine the abundance and density of cetaceans and seals species that are present in Mediterranean waters, with a special focus on the species selected by the Parties. The rationale behind the organisation of systematic surveys is that the knowledge of baseline information, such as abundance and density, is fundamental to address many questions of ecological importance and for the implementation of conservation measures. This is particularly true for the Mediterranean Sea, in light of the fact that most of the marine mammals populations

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

occurring in the area are threatened by human activities and their conservation status requires effective protection actions.

Methodology for indicator calculation

Line transect surveys (both aerial and ship-based) have proved to be particularly effective in estimating the abundance and density of many marine mammal species, and to provide robust data with low CVs and narrow CIs. Distance Sampling comprises a family of methods to estimate natural populations' parameters, the use of which is widespread and applied to various animal and plant taxa. The principle of this method is to search for objects (individuals or groups) along pre-defined fixed routes (transects). The result is a density value for the objects, calculated by the ratio between the area surveyed and the number of observations made. Data are elaborated through dedicated software (Distance 6.x).

The use of Geographical Information Systems (GIS) is required for the compilation of the monitoring data collected and the elaboration of the predictions of species density and abundance. Information on density and abundance of cetaceans may be obtained through dedicated ship and aerial surveys, acoustic surveys, platform of opportunities (e.g., whale watching operators, ferries, cruise ships, military ships), as well as mark-recapture methodologies.

As for the Mediterranean monk seal, information on density and abundance may be obtained through coastal cave surveys, counting of animals and pups, mark/recapture using photoid when possible. For pinnipedes, the better methodology to obtain the information about density and abundance is to perceed when they reach the coast (haul out / resting/ nursing sites) rather than out at sea.

In the case of monk seal, any information from fishermen/tourists... i.e. citizen science considered valuable to determine potential presence individual ID thus counting.

To ensure a comprehensive coverage of the ecosystem, the indicator species should be selected taking into account their functional role. In this context the Contracting Parties agreed to monitor the following indicator species (Decision IG.22/7):

Marine mammals:

Pinnipeds: *Monachus monachus*
Baleen whales: *Balaenoptera physalus*
Toothed whales:
- deep diving species: *Physeter macrocephalus*
                                        Ziphius cavirostris
- epipelagic species: *Delphinus delphis*
                                        Tursiops truncatus
                                        Stenella coeruleoalba
                                        Globicephala melas
                                        Grampus griseus

Methods for estimating density and abundance are generally species-specific and ecological characteristics of a target species should be considered carefully when planning a research campaign. For example, visual surveys may be particularly appropriate for large whales, but may be inappropriate for deep diving species such as sperm whales. In this latter case, passive acoustic monitoring is by far the most robust data collection methodology.

When a global approach such as that currently proposed by ACCOBAMS is unfeasible or too ambitious, small scale monitoring programmes should be established, adapting to MSFD macro-regions or UNEP-MAP-RAC/SPA (2010) marine eco-regions (Fig. 1), according to specific needs. In any case, once dealing with a subregional implementation approach for cetacean surveying campaigns, this should be carried out in line with agreed common, regional methodologies, using existing and shared Protocols, with the facilitation, as appropriate, of ACCOBAMS.

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

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

Indicator units

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

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

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

List of Guidance documents and protocols available

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

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

Data Confidence and uncertainties

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

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

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Several protocols are available using different monitoring platforms and approaches such as:
- dedicated ships or aerial surveys,
- tagging, artificial tags & photo-identification to facilitate capture-mark-recapture analysis.
- passive acoustic data collection,
- automatic infrared cameras to allow mark-racapture analysis.
- Coastal cave surveys

Available data sources

Indicator Title	*Common indicator 4: Species population abundance (marine mammals)*
OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, is a spatially referenced online database, aggregating marine mammal, seabird, sea turtle and ray & shark observation data from across the globe. http://seamap.env.duke.edu/	

Spatial scope guidance and selection of monitoring stations
Current spatial distributional range of marine mammals in the Mediterranean Sea is largely affected by available data, due to the uneven distribution of research effort during the last decades. In particular, the south-eastern portion of the basin, the coasts of North Africa and the central offshore waters are amongst the areas with the most limited knowledge on cetacean presence, occurrence and distribution. Priority should be given to the less known areas, using online data sources, such as Obis SeaMap and published data and reports as sources of information. Most of the species selected as indicator species in relation to this common indicator are migratory species, whose range extends over wide areas in the Mediterranean. It is therefore recommended to consider monitoring these species at regional or sub-regional scales for the assessment of their population abundance. ACCOBAMS is currently planning to undertake a regional synoptic survey covering most of the Mediterranean waters to estimate cetacean species density and abundance. This initiative – known as the ACCOBAMS Survey Initiative (ASI) - is expected to start in 2017 and to provide useful, robust and reliable data concerning population abundance of cetaceans in the Mediterranean area. Data on all the cetacean species present in the Mediterranean will be collected.

Temporal Scope guidance
Estimates of density of abundance relate to a specific time and area, and may vary on annual, or seasonal basis. Ideally, seasonal monitoring programmes should be conducted, although winter and summer campaigns should provide enough information. As for monk seals, campaigns during the fall (breeding periode) should be considered. Temporal scale is largely affected by the conservation questions and expected outputs. International regulation suggests a six-year interval between large scale monitoring programmes, but smaller intervals are recommended. Long-term projects provide robust indications on trends over time and space in selected areas and are important project for photo-identification programmes.

Data analysis and assessment outputs
Statistical analysis and basis for aggregation
Values of density and abundance of cetaceans and other large marine vertebrates can be estimated using design-based and model-based methodologies. Both methods present very similar and comparable results. Power analysis for detecting trends in density or abundance should be also applied.

Expected assessments outputs
I.e. trend analysis (monthly, seasonally, yearly), density maps, statistical frameworks applied.

Known gaps and uncertainties in the Mediterranean
Data in the Mediterranean Sea are characterized by their uneven distribution, both geographical and spatial. The summer months are the most representative ones and very few information have been provided for the winter months, when conditions to conduct off-shore research campaigns are particularly hard due to meteorological adversity. Ongoing effort by ACCOBAMS will provide estimates of density and abundance for the entire Mediterranean Sea. ACCOBAMS is currently planning to undertake a regional synoptic survey covering most of the Mediterranean waters to estimate cetacean species density and abundance. This initiative – known as the ACCOBAMS Survey Initiative (ASI) - is expected to be implemented during summer 2018. This will provide useful, robust and reliable data concerning population abundance of cetaceans in the Mediterranean area. Data on all the cetacean species present in the Mediterranean will be collected and will provide important baseline data to liaise with national and international requirements, such as those by the Ecosystem Approach and the MSFD.

Indicator Title	*Common indicator 4: Species population abundance (marine mammals)*
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.	
Contacts and version Date	
Key contacts within UNEP for further information	

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

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

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

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes GES definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD includes Descriptor 1: Biodiversity: "The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions." Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them.

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

Indicator/Targets

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

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

Source: [Evaluation of] National Reports on Article 12 Technical Assessment of the MSFD 2012 obligations

http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/pdf/national_reports.zip

GREECE (*page 15)*

Environmental targets:

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

Associated indicators:

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

ITALY (*page 18)*

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

[…]

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

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

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

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

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

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

- Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling nest through structural modifications to the gear (i.e. circle hooks, TEDs etc.) and application of best practices for the reduction of mortality following capture (percentage). Note: in

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

order to allow an immediate reduction of the pressure it is advised that best practices be applied in the geographic areas where preliminary knowledge already defines the presence of an aggregation area, before defining the incidence of total capture in the specific gear.

- Reduction of fishing pressure (percentage)

SPAIN (*Page 25*)

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

[...]

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

[...]

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

[...]

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

SLOVENIA - No information on Targets

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

In the accompanying text to the GES definition, Slovenia provides a list of the species that are covered by the GES definition. This includes the bottlenose dolphin (*Tursiops truncatus*), the loggerhead sea turtle (*Caretta caretta*).

(II. Initial assessment, 2.2 Biological features)

Slovenia indicates that *[...]* turtles are covered under the reporting obligations of the Habitats Directive *[...]*. Each of these groups is briefly described and their state in relation to natural conditions is reported.

CYPRUS - No information on Targets

page 11: (II. Initial assessment, 2.2 Biological features)

 [...] Chelonia mydas and *Monachus monachus* are considered stable but the situation of *Caretta caretta* is actually improving.

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

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

Indicator analysis methods

Indicator Definition

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

Population Size:

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

Population density:

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

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

Index of population abundance:

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

Methodology for indicator calculation

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

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

Indicator units

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

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

- for population size at breeding colonies, number of females, number of nests or number of tracks, with appropriate modelling to extrapolate population numbers depending on the method used
- for total number of nesting sites, number of sites (n)
- for average nesting site size, size of the nesting area versus number of females, number of nests or number of tracks, with appropriate modelling to extrapolate population numbers depending on the method used (i.e. to obtain density/km) (n)
- for non-breeding animals at wintering/foraging/developmental sites, number of individuals (n) with appropriate modelling to extrapolate population numbers taking into account individuals that are not observed due to low surfacing frequency in the marine environment.
- For all size/age classes that are being injured/killed, the number of individuals (n) will be documented via the stranding network/bycatch data

Marine area surveys

Numbers of individuals based on the number of individuals, separated where possible according to:
1. Size class categories (as the sex of juveniles can only be determined by laparoscopy)
2. Sex of adult individuals: males can generally be distinguished from females by a longer tail

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

List of Guidance documents and protocols available

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

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

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

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

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

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

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

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

Data Confidence and uncertainties

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

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

In-water surveys

It is not possible to count all individuals in a given habitat/population. Transects must be corrected for the likelihood of observing surfacing animals, according to species. For instance, sea turtles are much smaller (particularly juveniles) and spend less time at the surface than sea birds or mammals. Furthermore, animals are more likely to be sighted in shallow waters (<10 m depth) versus deeper waters. All of these issues need to be incorporated into the survey techniques and subsequent extrapolation/analyses.

Male numbers can only be inferred from in-water surveys.

Aerial surveys

These techniques may be used for sea turtles; however, due to their small size (particularly for juvenile stages) and brief surfacing time, the appropriate statistical analyses would be required to assess the collected data objectively. These techniques are best applied in shallow areas where sea turtles are known to aggregate and where they could be detected underwater too.

Beach-based surveys

It is not possible to count all females that nest in a nesting area, as some may emerge before the onset of monitoring or may emerge on beaches that are not monitored. Thus, it is important to document tracks too.

On beaches where remote techniques are used to count tracks/nests, there is a risk of double counting the same tracks if monitoring is infrequent; frequent monitoring could use the proximity of the track to the sea to guide track freshness. This issue needs careful consideration.

Extrapolating female numbers from track/nest counts must be treated with caution, as the number of nests laid by females varies with the sea temperature (i.e. fewer nests are laid by the same females at <25 °C versus >25 °C). Various models exist to extrapolate this information. However, ultimately track/nest counts should be used to infer female numbers and inter-annual changes in female numbers with extreme caution.

Male numbers cannot be obtained from beach surveys, as they do not emerge on beaches.

Methodology for monitoring, temporal and spatial scope

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

Available Methodologies for Monitoring and Monitoring Protocols

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

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

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

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

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

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

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

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

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

may be used for sea turtles; however, due to their small size (particularly for juvenile stages) and brief surfacing time, the appropriate statistical analyses would be required to assess the collected data objectively. These techniques are best applied in shallow areas where sea turtles are known to aggregate and where they could be detected underwater too.

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

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

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

Beached and stranded specimens monitoring

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

Beach-based surveys

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

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

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

Existing techniques include:

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

Available data sources

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

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

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

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

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

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

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

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

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

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

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

Governmental Ministries

IUCN specialists (MTSG)

Spatial scope guidance and selection of monitoring stations

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

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

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

Temporal Scope guidance

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

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

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

Every year – comprehensive breeding surveys at index beaches (included all beaches that are monitored annually through various programs) to estimate the no. of breeding individuals, number of breeding sites and average size. Monitoring every 5 years[1] of the entire coastline of all countries

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

to detect changes in sporadic beach use or the use of new sites driven by climate change or changes to the habitat at existing sites (e.g. erosion or development)

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

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

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

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

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

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

Expected assessments outputs

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

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

Indicator Title	*Common Indicator 4: Population abundance (Reptiles)*

Known gaps and uncertainties in the Mediterranean
- Number of males and females frequenting all breeding/nesting sites each year (operational sex ratio), and the total number of individuals in the breeding populations.
- Number of adults and juveniles frequenting wintering, feeding, developmental sites, along with how numbers vary across the season as individuals enter and leave different sites.
- Vulnerability/resilience of these populations/sub-populations in relation to physical pressures;
- Analysis of pressure/impact relationships for populations/sub-populations and definition of qualitative GES;
- Identification of extent (area) baselines for each population/subpopulation and the habitats they encompass;
- Criteria for the risk based approach to monitoring and develop harmonized sampling instructions where appropriate;
- Common computing methodologies and data collection instructions, specifying the accuracy (spatial resolution or grid) of the determination of extent (area) a priori;
- Appropriate assessment scales;
- Standardized data flows for spatial pressure data;
- GES baselines for sites that cannot be inferred from contemporary records of pressure or construction;
- Harmonised sampling, cartographic, data collation and GIS protocols
- Generate or update databases and maps of known nesting, feeding, wintering habitats in each Contracting Party
- Identify possible baselines and index sites.
- Identify monitoring capacities and gaps in each Contracting Party
- Develop a guidance manual to support the monitoring programme, which will provide more detailed information, tools, and advice on survey design, monitoring methodology and techniques that are most 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
V.1	20/7/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

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

Indicator Title	*Common indicator 4: Species population abundance (Seabirds)*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Population size of selected species (of seabirds) is maintained. The species population has abundance levels allowing to qualify to Least Concern Category of IUCN (less than 30% variation over a time period equivalent to 3 generation lengths)	Breeding population size of selected species is maintained or, where depleted, it recovers to natural levels	No human-induced decrease in breeding population size or density. Breeding populations recover towards natural levels where depleted. The total number of individuals is sparse enough in different spots. Local declines are balanced out by increases elsewhere, so that overall numbers of breeding birds are maintained at the appropriate scale

Rational
Justification for indicator selector Abundance is a parameter of population demographics, and is critical for determining the growth or decline of a population. The number of individuals within a population (population size) is defined as the number of individuals present in an animal aggregation (permanent or transient) in a subjectively designated geographical range. Population density is the size of a population in relation to the amount of space that it occupies, and represents a complementary description of population size. Density is usually expressed as the number of individuals per unit area. The index of population abundance is a single species indicator that reflects the temporal variation in the breeding or the non-breeding (wintering) population of selected species compared to a base year (or reference level). This indicator can be added into multi-species indices to reflect the variation over time of functional groups of species. The objective of this indicator is to determine the population status of selected species by medium-long term monitoring to obtain population trends for these species. This objective requires a census to be conducted in breeding, migratory, wintering, developmental and feeding areas.
Scientific References *Parsons, M., Mitchell, I., Butler, A., Ratcliffe, N., Frederiksen, M., Foster, S., & Reid, J. B. (2008). Seabirds as indicators of the marine environment. ICES Journal of Marine Science: Journal du Conseil, 65(8), 1520-1526.*
Policy Context and targets
Policy context description EU MSFD; UE Nature Directives; Red List, AEWA

Indicator Title		*Common indicator 4: Species population abundance (Seabirds)*
EU Marine Strategy Framework Directive	In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned".	<u>Descriptor 1: Biodiversity</u> The population abundance of key marine species is stable and their population dynamics are indicative of long-term viability <u>Parameters and trends:</u>
UE Nature Directives (Birds and Habitats Directives)	The conservation status of a species "will be taken as 'favourable' when: 1. population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats […]. Every six years, all EU Member States are required to report on the implementation of the directives. There is a methodology for the assessment of conservation status and has been widely used for the compulsory reporting by EU member states for Habitats Directive (HD). This approach has been extended also to Birds Directive (BD) reporting (N2K Group 2011).	<u>Parameters and trends:</u> Distribution (range)
UICN Red List		

Targets

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

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

  IUCN: The overall target must be to prevent any significant decline in the population abundance of any of the selected species. For species in a Least Concern (LC) IUCN status, the specific target

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

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.

Policy documents

List and url's

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

Indicator analysis methods

Indicator Definition

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

Methodology for indicator calculation

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

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

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

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

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

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

Indicator units

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

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

- for population size at nesting colonies, <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)
- for total number of birds estimated on migration, <u>number of individuals</u> (n)

Priority species

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

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

List of Guidance documents and protocols available

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

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

Framework Directive. Management Group Report. EUR, 24336, 57. http://www.ices.dk/news-and-events/Documents/Themes/MSFD/Management%20Group%20Report_Final_vII.pdf

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

Data Confidence and uncertainties

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

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

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

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

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

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

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

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

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

Available data sources

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

Spatial scope guidance and selection of monitoring stations

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

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

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

Temporal Scope guidance

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

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

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

- Strong increase - increase significantly more than 5% per year (5% would mean a doubling in abundance within 15 years). Criterion: lower limit of confidence interval > 1.05.

- Moderate increase - significant increase, but not significantly more than 5% per year. Criterion: 1.00 < lower limit of confidence interval < 1.05.

- Stable - no significant increase or decline, and most probable trends are less than 5% per year. Criterion: confidence interval encloses 1.00 but lower limit > 0.95 and upper limit < 1.05.

- Uncertain - no significant increase or decline, and unlikely trends are less than 5% per year. Criterion: confidence interval encloses 1.00 but lower limit < 0.95 or upper limit > 1.05.

- Moderate decline - significant decline, but not significantly more than 5% per year. Criterion: 0.95 < upper limit of confidence interval < 1.00.

- Steep decline - decline significantly more than 5% per year (5% would mean a halving in abundance within 15 years). Criterion: upper limit of confidence interval < 0.95.

Expected assessments outputs

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

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

Known gaps and uncertainties in the Mediterranean

Neither bird populations nor monitoring capacity are distributed equally across the Mediterranean and, for this reason, it may be advisable to plan a phased development of pan-Mediterranean indices of population abundance for seabirds. The best approach is to build on the existing national biodiversity monitoring units, and to homogenise methodologies as initial steps. The extension of equivalent programmes across the whole of the Mediterranean region may be achieved in a second phase.In terms of methodology, surveying colonies of nocturnal species situated in areas of difficult access may prove challenging. In these cases, it may be advisable to select certain areas or subsections of the total colony in order to obtain data on their abundance.

Contacts and version Date

Indicator Title	*Common indicator 4: Species population abundance (Seabirds)*		
Key contacts within UNEP for further information			
Version No	Date	Author	
V.1	07/2016	SPA/RAC	
V.2	14/04/2017	SPA/RAC	

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

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

Justification for indicator selection

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

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

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

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

Indicator Title	*Common Indicator 5: Population demographic characteristics*

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

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Policy Context and targets (other than IMAP)

Policy context description

Mediterranean fin whales and sperm whales are protected by the International Whaling Commission's moratorium on commercial whaling that entered into force in 1986.

The Mediterranean cetaceans' populations are also protected under the auspices of ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area), under the auspices of the Convention on the Conservation of Migratory Species of

Indicator Title	*Common Indicator 5: Population demographic characteristics*
Wild Animals (UNEP/CMS). The Corso-Ligurian-Provençal Basin and the Tyrrhenian Sea, where most cetacean species find suitable habitats, lie within the Pelagos Sanctuary established by France, Italy and Monaco, thus benefitting from its conservation regime. All cetacean species in the Mediterranean Sea are protected under the Annex II of the SPA-BD Protocol under the Barcelona Convention; under the Appendix I of the Bern Convention; under the Annex II of the Washington Convention (CITES); under the Appendix II of the Bonn Convention (CMS). The short-beaked common dolphin, the sperm whale and the Cuvier's beaked whale and the Mediterranean monk seal are also listed under the Appendix I of the Bonn Convention (CMS). The common bottlenose dolphin, the harbor porpoise and the Mediterranean monk seal are also listed under the Annex II and all marine mammals are in Annex IV of the EU Habitats Directive and considered strictly protected..	

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

Policy documents
- Aichi Biodiversity Targets - https://www.cbd.int/sp/targets/   - EU Biodiversity Strategy - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN   - EU Regulation 1143/2014 - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN   - Marine Strategy Framework Directive - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN   - Commission Decision on criteria and methodological standards on good environmental status of marine waters - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010D0477(01)&from=EN   - Pan-European 2020 Strategy for Biodiversity - https://www.google.no/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiP1J-v_P7NAhWHjSwKHZfoBRIQFggtMAE&url=https%3A%2F%2Fcapacity4dev.ec.europa.eu%2Fsystem%2Ffiles%2Ffile%2F08%2F10%2F2012_-_1535%2Fpan-european_2020_strategy_for_biodiversity.pdf&usg=AFQjCNGa4NkkljA4x3l9WDO49uwrdYafMg   - Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the Mediterranean Region - http://sapbio.rac-spa.org/   - Draft Updated Action Plan for the conservation of Cetaceans in the Mediterranean Sea - http://rac-spa.org/nfp12/documents/working/wg.408_08_eng.pdf   - National Biodiversity Strategies and Action Plans (NBSAPs) - https://www.cbd.int/nbsap/   - ACCOBAMS –Agreement Text - http://www.accobams.org/images/stories/Accord/anglais_text%20of%20the%20agreement%20english.pdf   - ACCOBAMS STRATEGY (PERIOD 2014 – 2025) - https://accobams.org/images/stories/MOP/MOP5/Documents/Resolutions/mop5.res5.1_accobams%20strategy.pdf

Indicator analysis methods
Indicator Definition This indicator is aimed at providing information about the population demographic characteristics of marine mammals in the Mediterranean Sea. Monitoring effort should be directed to collect long-

Indicator Title	*Common Indicator 5: Population demographic characteristics*

term data series covering the various life stages of the selected species. This would involve the participation of several teams using standard methodologies and covering sites of particular importance for the key life stages of the target species.

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

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

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

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

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

Methodology for indicator calculation

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

- Age structure
- Sex ratio
- Fecundity
- Mortality

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

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

Indicator units

The main demographic parameters are defined in the following units:

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

List of Guidance documents and protocols available

- A document on 'MONITORING GUIDELINES TO ASSESS CETACEANS' DISTRIBUTIONAL RANGE, POPULATION ABUNDANCE AND POPULATION DEMOGRAPHIC CHARACTERISTICS' has been produced by ACCOBAMS and should be considered as guidance when establishing monitoring programmes.
- Guidelines for monitoring threatened population of marine and coastal bird species in the Mediterranean[6].

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

Indicator Title	*Common Indicator 5: Population demographic characteristics*

- RAC/SPA-ACCOBAMS Guidelines for the Development of National Networks of Cetacean Strandings Monitoring[7].

Data Confidence and uncertainties

Sex and length at death may come from stranded animals. This information may be uneven, since in many cases sex and exact size measurements may be unprecise due animal decomposition.

Dealing with stranded data implies several assumptions; the main one being that stranding data represent a faithful description of the real mortality by different life stages. This assumption, however, is true only if the probability of stranding is equal in all life stages.

Estimating age and length from free-ranging individuals may be rather difficult and increase the uncertainties in the models. Long-term data sets on known individuals through photo-identification may overcome some of the biases.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

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

- Direct observation
- Stranded animal monitoring
- Dedicated ships surveys
- By-catch data
- Photo-identification (mark-recapture models)
- Automatic infrared camera
- Direct killings

Available data sources

- OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, is a spatially referenced online database, aggregating marine mammal, seabird, sea turtle and ray & shark observation data from across the globe. http://seamap.env.duke.edu/
- When existing, the databases from the National Stranding Networks, such as in Italy the CSC (Cetacean Study Centre) database, available online at http://www-3.unipv.it/cibra/spiaggiamenti.html or in France, the Pelagis Observatory database (http://www.observatoire-pelagis.cnrs.fr/les-donnees/).
- The Mediterranean Database of Cetacean Strandings (MEDACES), has been set-up to co-ordinate all national and regional efforts for riparian countries. Cetacean stranding data are organized into a spatially referenced database of public access.
- International Whaling Commission List of Stranding Networks (as at 13 April 2011) https://iwc.int/private/downloads/fECe-nYMEKa7G5C8RRCqKg/WHALE%20STRANDING%20NETWORKS%20LIST_2011.pdf

Spatial scope guidance and selection of monitoring stations

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

Temporal Scope guidance

Demographic studies on marine mammals, which are long-living species, require long-term projects, to allow robust indications on trends in population size and demographic parameters over time.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

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

Indicator Title	*Common Indicator 5: Population demographic characteristics*
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 stationary (i.e. the population is assumed to be constant in number and age structure over time) can be used.	

Expected assessments outputs
Demographic studies can supply useful tools to the management and the conservation of threatened and overexploited species. Population models, based on life-history tables and transition matrices, allow to assess population performance, to project population trends overtime and thus to foster the conservation of the studied populations, suggesting specific measures for their protection.

Known gaps and uncertainties in the Mediterranean
Data in the Mediterranean Sea are characterized by their uneven distribution, both geographical and spatial. The summer months are the most representative ones and very few information have been provided for the winter months, when conditions to conduct off-shore research campaigns are particularly hard due to meteorological adversity. Ongoing effort is targeting the identification of Cetacean Critical Habitats (CCHs) and Important Marine Mammal Areas (IMMAs) in the entire Mediterranean Sea. A gap analysis is also ongoing at regional scale in order to provide an inventory of available data and to select areas where more information should be collected.

Contacts and version Date		
Key contacts within UNEP for further information		
Version No	Date	Author
V.1	20/07/2016	SPA/RAC
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10. Common indicator 5: Population demographic characteristics (Reptiles) (EO1)

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

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

Similar to the Ecosystem Approach, the EU adopted the European Union Marine Strategy Framework Directive (MSFD) on 17 June 2008, which includes GES definitions, Descriptors, Criteria, Indicators and Targets. In the Mediterranean region, the MSFD applies to EU member states. The aim of the MSFD is to protect more effectively the marine environment across Europe. In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD includes Descriptor 1: Biodiversity: "The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions." Assessment is required at several ecological levels: ecosystems, habitats and species. Among selected species are marine turtles and within this framework, each Member State that is within a marine turtle range, has submitted GES criteria, indicators, targets and a program to monitor them.

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

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

At a country scale, Descriptor 1 criteria have been applied:
Greece
*page 15: (Section 3. D1, D4 and D6 (Biodiversity), III. Environmental targets, 1. Descriptor 1*Environmental targets:
*[...]*2) Census of marine turtle *Caretta caretta* reproducing in the Greek coasts and conservation of spawning areas.
Associated indicators:
*[...]*2) Breeding area of the Mediterranean monk seal *Monachus monachus* and the sea turtle *Caretta caretta*

Italy
page 18: (Section 3.D1, D4 and D6 (Biodiversity), III. Environmental targets, 3.1 Descriptor 1
Italy has provided six targets and associated indicators *[...]* The second target focuses on the loggerhead turtle, and has the aim of decreasing accidental mortalities by regulating fishing practices. The target has several components which aim to acquire increased knowledge and to implement regulatory practices (it is not clear whether these practices are already in place). No targets or threshold values are otherwise given. The target is stated as being based on the completion of indicator 1.1.2 (which is not addressed for GES but is included in the initial assessment).
[...]
T2: By-catch reduction in the areas of aggregation of *Caretta caretta*
It is proposed that the operative target for the mitigation of *Caretta caretta* by-catch be articulated as follows:
1) Spatial identification of the areas with highest use of pelagic long line (southern Tyrrhenian and southern Ionian sea) and trawling (northern Adriatic)
2) Completion of the spatial definition of *Caretta caretta* aggregation areas based on an approach capable of assessing temporal and seasonal distribution differences for each aggregation area (based on indicator 1.1.2 completion) so as to provide a final definition of the operative target

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

3) Monitoring of accidental captures in the areas subjected to operational target
4) Application of by-catch reduction measures in areas listed in point 3), through one or more of the following activities:

- Application of methods for the mitigation of accidental capture in pelagic surface longlines and trawling nest through structural modifications to the gear (i.e. circle hooks, TEDs etc.) and application of best practices for the reduction of mortality following capture (percentage). Note: in order to allow an immediate reduction of the pressure it is advised that best practices be applied in the geographic areas where preliminary knowledge already defines the presence of an aggregation area, before defining the incidence of total capture in the specific gear.
- Reduction of fishing pressure (percentage)
Spain
Page 25: Section 3. D1, D4 and D6 (Biodiversity), III. Environmental targets
A.1.4: Reduce the main causes of mortality and of reduction of the populations of groups of species at the top of the trophic web (marine mammals, reptiles, sea birds, pelagic and demersal elasmobranchs), such as accidental capture, collisions with vessels, intaking of litter at sea, introduced terrestrial predators, pollution, habitat destruction, overfishing.
[...]
A.1.7: Establish a national coordination system of the accidental catch monitoring programmes of birds, reptiles, marine mammals, and mammal and reptile stranding and bird tracking.
[...]
A.3.4: Maintain positive or stable trends for the populations of key species or apex predators (marine mammals, reptiles, seabirds and fish) and maintain commercially exploited species within safe biological limits.
[...]
C.1.2: Promote international cooperation on studies and monitoring of populations of groups with broad geographic distribution (e.g. cetaceans and reptiles)

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

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

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

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

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*
http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm http://ec.europa.eu/environment/marine/pdf/1-Task-group-1-Report-on-Biological-Diversity.pdf http://ec.europa.eu/environment/marine/pdf/9-Task-Group-10.pdf	

Indicator analysis methods
Indicator Definition Demography is the study of various population parameters. Demography provides a mathematical description of how such parameters change over time. Demographics may include any statistical factors that influence population growth or decline, but several parameters are particularly important: population size, density, age structure, fecundity (birth rates), mortality (death rates), and sex ratio.
Methodology for indicator calculation The same methods should be used as those described in "*Common Indicator 4: Population abundance (Reptiles)*"; however, additional data are required to assess demography, such as age at sexual maturity, growth rate and age structure, fecundity (clutch size and numbers of hatchlings that emerge from nests and then reach the sea), mortality (death rates) for each stage/age class, sex ratios (in turtles: hatchling, juveniles, and adults), number of offspring (e.g. eggs and hatchlings). The choice of the most appropriate methodology to calculate the different types of demographic information will depend on the temporal pattern of the available data. The methods to obtain the data used in the calculations are described in the monitoring methods below. For data available on an annual basis, site and year specific data of each species can be related to site and year effects (factors) and missing values can be imputed from the data of all surveyed sites.
Indicator units A variety of population demography values will be compiled for different components of the populations of the two species. Analyses should be based on at least a decade of information as the base level (following International Union for Conservation of Nature Red List minimal criteria for sea turtles). Number of individuals in relation to population estimates per population range or management unit, per year, per age and per sex - Mortality rate from by-catch, stranding - Breeding success/failure of marine turtles (Number of eggs that fail to hatch at marine turtle nesting sites per year. Number of emergences versus successful nests) - Annual survival probability of adults and juveniles (i.e. different age/size classes) at different sites (breeding, feeding, wintering, developmental) - Sex ratio of turtles of all age/size classes from hatchings to juveniles to breeding and non breeding adults at wintering, breeding, foraging and developmental sites. Sex ratios within different components of a population Physical health indicators Genetic health indicators Numbers of individuals entering and leaving different components of populations through dispersal/migration or birth/mortality. Numbers of individuals killed through causes that are not natural in parallel to information on the age/size class of individuals and sex to determine sex/age/size specific mortality.
List of Guidance documents and protocols available Bevan E, Wibbels T, Rosas M, Najera BMZ, Sarti L, Montano J, Pena LJ, Burchfield P. Herpetological Review, 2016, 47(1), 27–32.

Indicator Title	*Common indicator 5: Population demographic characteristics (Reptiles)*
Eckert, K. L., Bjorndal, K. A., Abreu-Grobois, F. A. and Donnelly, M. (Eds.) 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4. Washington, DC: 235 pp. https://mtsg.files.wordpress.com/2010/11/techniques-manual-full-en.pdf Gerosa, G. (1996). Manual on Marine Turtle Tagging in the Mediterranean. –Mediterranean Action Plan - UNEP, RAC/SPA, Tunis, 48 pp. Gerosa, G. and M. Aureggi. 2001. Sea Turtle Handling Guidebook for Fishermen. UNEP Mediterranean Action Plan, Regional Activity Centre for Specially Protected Areas. Tunis. http://www.rac-spa.org McClellan DB. 1996. Aerial surveys for sea turtles, marine mammals and vessel activity along the south east Florida coast 1992-1996. NOAA Technical Memorandum NMFS-SEFSC-390 42pp Phelan, Shana M. and Karen L. Eckert. 2006. Marine Turtle Trauma Response Procedures: A Field Guide. Wider Caribbean Sea Turtle Conservation Network (WIDECAST) Technical Report No. 4. Beaufort, North Carolina.71 pp Schofield, G., K.A. Katselidis, P. Dimopoulos, J.D. Pantis. 2008. Investigating the viability of photo-identification as an objective tool to study endangered sea turtle populations. Journal of Experimental Marine Biology & Ecology 360:103-108 SWOT Scientific Advisory Board. 2011. The State of the World's Sea Turtles (SWOT) Minimum Data Standards for Nesting Beach Monitoring, version 1.0. Handbook, 28 pp	
Data Confidence and uncertainties	
Life history studies and demographic analyses need extensive and, often, long-term data accumulation from either carcass collection or capture-mark-recapture (tagging or photo-id) histories, or a combination of several different techniques. In general, these studies may be implemented by different research teams that use different sampling and analysing processes. However, demographic parameters must be collected in a standard way among different research groups.	
Methodology for monitoring, temporal and spatial scope	
Available Methodologies for Monitoring and Monitoring Protocols - Shipboard, aerial (including drone), or diver-based/video/acoustic (potential). Aerial or boat line transects surveys under specific circumstances, with the appropriate modelling techniques to account for missed animals (i.e. due to low surfacing time and low frequency of time spent at the surface) - Artificial external flipper tagging (metal and plastic on flippers), - Photo-identification - Genetic sampling identification within the metapopulation - PIT tagging of flippers, Telemetry (satellite, GPS/GSM, radio telemetry) and loggers, capture-mark-recapture studies - Swimming/snorkeling surveys with photo-id and GPS in densely populated areas (e.g. certain breeding sites) - CPUE (bycatch), Direct mortality rate Post-release mortality rate - Nest counts, Photo-id of individuals, Time-Depth-Recorder tags - Stranding on beaches Aerial or boat surveys (line transects) under specific circumstances, with the appropriate modelling techniques to account for missed animals (i.e. due to low surfacing time and low frequency of time spent at the surface) Artificial external flipper tagging (metal and plastic on flippers), Photo-identification PIT tagging of flippers, Telemetry (satellite, GPS/GSM, radio telemetry) and loggers, capture-mark-recapture studies Shipboard, aerial (including drone), or diver-based/video/acoustic (potential) Swimming/snorkelling surveys with photo-id and GPS in densely populated areas (e.g. certain breeding sites)	

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

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

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

Age structure:
Individuals could be sorted into age-specific categories called cohorts or age/stage classes (such as "juveniles" or "sub-adults"). Then, a profile of the abundance and different age classes can be created. The demographic structure may provide an estimate of the annual survival probability and/or reproductive potential of that population, which is critical information along with other parameters, from which current and future growth may be estimated.
-   Age class identification in censuses and transects (based on size class estimates).
-   Aging of stranded specimens (skeletochronology and/or age-size correlation sea turtles).
-   Aging of beached specimens (skeletochronology and/or age-size correlation sea turtles).
-   Aging of tagged (capture and recapture) specimens: size correlation for sea turtles.

Sex ratio:
The sex ratio is the ratio between the number of males and females within a population and across all age (size) classes, and may help researchers predict population growth or decline. Much like population size, sex ratio is a simple concept with major implications for population dynamics.
-   Sex identification of adults in census and transects (juveniles and sub-adults require other techniques such as laparoscopy, blood analysis, genetic analysis).
-   Sexing of stranded specimens (size, blood or genetic analysis, laparoscopy).
-   Sexing of tagged (capture and recapture) (size, blood or genetic analysis, laparoscopy).
-   Sexing of offspring before leaving the nest, and at different growth stages until maturity (blood or genetic analysis)

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

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

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

Mortality (death rates):

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

Available data sources

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

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

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

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

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

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

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

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

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

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

IUCN specialists (MTSG)

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

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

Spatial scope guidance and selection of monitoring stations

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

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

diversity (i.e. the greatest accumulation of different breeding populations), as well as those that support single breeding populations, which may be of equal importance.

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

Temporal Scope guidance

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

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

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

Data analysis and assessment outputs

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

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

Known gaps and uncertainties in the Mediterranean
- Knowledge on the sex ratios within different components (breeding, foraging, wintering, developmental habitats), age classes and overall within and across populations.
- Knowledge about the physical and genetic health status of these groups.
- Vulnerability/resilience of these populations/sub-populations in relation to physical pressures;
- Analysis of pressure/impact relationships for populations/sub-populations and definition of qualitative GES;
- Identification of extent (area) baselines for each population/subpopulation and the habitats they encompass;
- Criteria for the risk based approach to monitoring and develop harmonized sampling instructions where appropriate;

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- 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
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V.2	14/04/2017	SPA/RAC

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

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

Justification for indicator selector

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

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

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

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

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

Scientific References

List and url's

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

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. J Appl Ecol, 53: 1158–1168. doi:10.1111/1365-2664.12622

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

Sanz-Aguilar, A., Igual, J. M., Oro, D., Genovart, M., & Tavecchia, G. (2016). Estimating recruitment and survival in partially monitored populations. *Journal of Applied Ecology*, 53(1), 73-82.

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

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

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

Policy Context and targets

Policy context description

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

Indicator Title		*Common indicator 5: Population demographic characteristics (Seabirds)*
EU Marine Strategy Framework Directive	In order to achieve GES by 2020, each EU Member State is required to develop a strategy for its marine waters (or Marine Strategy). In addition, because the Directive follows an adaptive management approach, the Marine Strategies must be kept up-to-date and reviewed every 6 years. The MSFD will be complementary to, and provide the overarching framework for, a number of other key Directives and legislation at the European level. Also it calls to regional cooperation meaning "cooperation and coordination of activities between Member States and, whenever possible, third countries sharing the same marine region or subregion, for the purpose of developing and implementing marine strategies" […] "thereby facilitating achievement of good environmental status in the marine region or subregion concerned".	Descriptor 1: Biodiversity The population abundance of key marine species is stable and their population dynamics are indicative of long-term viability Criteria: population condition Parameters and trends: Population demographic characteristics (e. g. body size or age class structure, sex ration, fecundity rate, survival and mortality rates) Population genetic structure, where appropriate

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

UE Nature Directives (Birds and Habitats Directives)	The conservation status of a species "will be taken as 'favourable' when: Article 1(i)). Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats […]. […] to take measures to maintain the population of wild bird species at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements or to adapt the population of these species to that level. Birds Directive, Art.2. Every six years, all EU Member States are required to report on the implementation of the directives. There is a methodology for the assessment of conservation status and has been widely used for the compulsory reporting by EU member states for Habitats Directive (HD). This approach has been extended also to Birds Directive (BD) reporting (N2K Group 2011).	Parameters and trends: Favourable: Population of the species above 'favourable reference population' AND reproduction, mortality and age structure not deviating from normal (if data available) Unfavourable – Inadequate: Any combination other than those described under 'Green' or 'Red'. Unfavourable – Bad: Large decline in population (equivalent to a loss of more than 1% per year within the period specified by MS; other thresholds can be used but must be explained on Annex B) AND below 'favourable reference population OR population more than 25% below 'favourable reference population' OR reproduction, mortality and age structure strongly deviating from normal (if data available) Unknown: No or insufficient reliable information available.

Targets

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

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

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

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

Policy documents

List and url's

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

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

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

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

18. McConville, A.J. & Tucker, G.M. 2015. Review of Favourable Conservation Status and Birds Directive Article 2 interpretation within the European Union. Natural England Commissioned Reports, Number 176.

19. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities.

20. Links between the Marine Strategy Framework Directive (MSFD 2008 /56/EC) and the Nature Directives (Birds Directive 2009/ 147 /EEC (BD) and Habitats Directive 92/43/EEC (HD).

21. Cochrane, S.K.J., Connor, D.W., Nilsson, P., Mitchell, I., Reker, J., Franco, J., Valavanis, V., Moncheva, S., Ekebom, J., Nygaard, K., Santos, R.S., Naberhaus, I., Packeiser, T., Bund, W. Van De & A.C. Cardoso. 2010. Marine Strategy Framework Directive. Guidance on the interpretation and application of Descriptor 1: Biological diversity. Report by Task Group 1 on Biological diversity for the European Commission's Joint Research Centre. Ispra, Italy,

22. BirdLife International (2015) European Red List of Birds. Luxembourg: Office for Official Publications of the European Communities

Indicator analysis methods

Indicator Definition

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

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

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

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

Population growth λ results from the combined effects of reproduction (which adds individuals to the population), survival (which determines how many individuals remain in the population from one year to the next) and mortality (which subtracts individuals from the population). Survival and

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mortality are mutually inverse, so if we can estimate survival, mortality can be calculated by subtraction.

Methodology for indicator calculation

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

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

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

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

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

Computer software is critical, as few of the models available have parameter estimators that are in closed form. The most widely used software program is MARK (available for download at http://warnercnr.colostate.edu/~gwhite/mark/mark.htm), which provides parameter estimates from marked animals when they are re-encountered at a later time. Re-encounters can be from dead recoveries (e.g., the animal is harvested), live recaptures (e.g., the animal is re-trapped or re-sighted), radio tracking, or from some combination of these sources of re-encounters. The basic input to program MARK is the encounter history for each animal.

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

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

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

Indicator units

The main demographic parameters are defined in the following units:

- adult survival probability: range between 0 and 1

- juvenile survival probability: range between 0 and 1

- fecundity, or breeding productivity: average no. of young produced per breeding pair per year

- age class distribution: percentage of each age class

- sex ratio: percentage

Priority species

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

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

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

List of Guidance documents and protocols available

- http://www.phidot.org/, especially the online discussion forum *Analysis of Data from Marked Individuals* found at: http://www.phidot.org/forum/index.php

- http://warnercnr.colostate.edu/~gwhite/mark/mark.htm

- http://www.capturerecapture.co.uk/

Data Confidence and uncertainties

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

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

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

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

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

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

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

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

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

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

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

Spatial scope guidance and selection of monitoring stations

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

Temporal Scope guidance

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

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

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

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

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

Projection matrix models make it possible to assess the influence that the vital rates of particular classes have on the growth of the population as a whole. They also allow predicting future

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

population trends for long-lived species that have undergone either recent changes in one or more vital rates (e.g. due to a novel human impact, or a recently-imposed management plan) or a perturbation in the population structure (i.e. the distribution of individuals among classes). They are particularly well suited to evaluating management alternatives, provided demographic data from contrasting situations exist.

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

1. Determine what feature of individuals (age, size, or life stage) best predicts differences in vital rates. Then divide the population into classes based upon the feature chosen.

2. Use demographic data on known individuals to estimate the vital rates for each class, and use them to construct a population matrix.

3. Construct a population vector by specifying the initial number of individuals in each class in the population. A population vector is a list of the number of individuals in each class; the sum of the elements in the vector equals the total population size.

4. Use the matrix and the population vector to project the population forward in time, thus predicting the future size of the population, the long-term population growth rate, λ, and the risk of future extinction. This step involves simple rules of linear algebra.

Expected assessments outputs

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

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

Known gaps and uncertainties in the Mediterranean

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

Contacts and version Date
Key contacts within UNEP for further information

Indicator Title	Common indicator 5: Population demographic characteristics (Seabirds)	
Version No	Date	Author
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

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

Indicator Title	*Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Decreasing abundance of introduced NIS in risk areas	Invasive NIS introductions are minimized	Abundance of NIS introduced by human activities reduced to levels giving no detectable impact
Rationale		
Justification for indicator selection Marine invasive alien species are regarded as one of the main causes of biodiversity loss in the Mediterranean, potentially modifying all aspects of marine and other aquatic ecosystems. They represent a growing problem due to the unprecedented rate of their introduction and the unexpected and harmful impacts that they have on the environment, economy and human health. According to the latest regional reviews, more than 6% of the marine species in the Mediterranean are now considered non-native species as around 1000 alien marine species have been identified , while their number is increasing at a rate of one new record every 2 weeks (Zenetos et al., 2012). Of these species, 13.5% are classified as being invasive in nature, with macrophytes (macroalgae and seagrasses) as the dominant group in the western Mediterranean and Adriatic Sea, and polychaetes, crustaceans, molluscs and fishes in the eastern and central Mediterranean (; Zenetos et al., 2010, 2012). Although the highest alien species richness occurs in the eastern Mediterranean, ecological impact shows strong spatial heterogeneity with hotspots in all Mediterranean sub-basins (Katsanevakis et al. 2016). To mitigate the impacts of NIS on biodiversity, human health, ecosystem services and human activities there is an increasing need to take action to control biological invasions. With limited funding, it is necessary to prioritise actions for the prevention of new invasions and for the development of mitigation measures. This requires a good knowledge of the impact of invasive species on ecosystem services and biodiversity, their current distributions, the pathways of their introduction, and the contribution of each pathway to new introductions. Common indicator 6 is an indicator that summarizes data related to biological invasions in the Mediterranean into simple, standardized and communicable figures and is able to give an indication of the degree of threat or change in the marine and coastal ecosystem. Furthermore, it can be a useful indicator to assess on the long-run the effectiveness of management measures implemented for each pathway but also, indirectly, the effectiveness of the different existing policies targeting alien species in the Mediterranean Sea.		
Scientific References Katsanevakis, S., Tempera, F., Teixeira, H., 2016. Mapping the impact of alien species on marine ecosystems: the Mediterranean Sea case study. Diversity and Distributions 22, 694–707. Zenetos A., Gofas, S., Verlaque, M., Cinar, M. E., García Raso, E., et al., 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. Mediterranean Marine Science, 11, 2, 381-493. Zenetos A., Gofas, S., Morri, C., Rosso, A., Violanti, D., et al., 2012. Alien species in the Mediterranean Sea by 2012. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part 2. Introduction trends and pathways. Mediterranean Marine Science, 13/2, 328-352.		
Policy Context and targets (other than IMAP)		
Policy context description The Convention on Biological Biodiversity (CBD) recognised the need for the "compilation and dissemination of information on alien species that threaten ecosystems, habitats, or species to be		

Indicator Title	*Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)*

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

The Marine Strategy Framework Directive (MSFD), which is the environmental pillar of EU Integrated Maritime Policy, sets as an overall objective to reach or maintain "Good Environmental Status" (GES) in European marine waters by 2020. It specifically recognizes the introduction of marine alien species as a major threat to European biodiversity and ecosystem health, requiring Member States to include alien species in the definition of GES and to set environmental targets to reach it. Hence, one of the 11 qualitative descriptors of GES defined in the MSFD is that "non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem" (Descriptor 2). Among the indicators adopted to assess this descriptor are "trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species". Ecological Objective 2 and the Common Indicator 6 are in agreement with the MSFD objectives and targets.

Indicator/Targets
Aichi Biodiversity Target 9
EU Biodiversity Strategy Target 5
EU Regulation 1143/2014 targets
MSFD Descriptor 2 and related criteria and indicators

Policy documents
Aichi Biodiversity Targets - https://www.cbd.int/sp/targets/
EU Biodiversity Strategy -
http://eurlex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN
EU Regulation 1143/2014 - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN
Marine Strategy Framework Directive - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN
Commission Decision on criteria and methodological standards on good environmental status of marine waters - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010D0477(01)&from=EN

Indicator analysis methods

General definitions (according to UNEP(DEPI)/MED WG.420/4)
'Non-indigenous species' (NIS; synonyms: alien, exotic, non-native, allochthonous) are species, subspecies or lower taxa introduced outside of their natural range (past or present) and outside of their natural dispersal potential. This includes any part, gamete or propagule of such species that might survive and subsequently reproduce. Their presence in the given region is due to intentional or unintentional introduction resulting from human activities. Natural shifts in distribution ranges (e.g. due to climate change or dispersal by ocean currents) do not qualify a species as a NIS. However, secondary introductions of NIS from the area(s) of their first arrival could occur without human involvement due to spread by natural means.
'Invasive alien species' (IAS) are a subset of established NIS which have spread, are spreading or have demonstrated their potential to spread elsewhere, and have an effect on biological diversity and ecosystem functioning (by competing with and on some occasions replacing native species),

Indicator Title	*Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)*

socioeconomic values and/or human health in invaded regions. Species of unknown origin which cannot be ascribed as being native or alien are termed cryptogenic species. They also may demonstrate invasive characteristics and should be included in IAS assessments.

Indicator Definition

For the needs of Common Indicator 6, the following definitions apply:

'Trend in abundance' is defined as the interannual change in the estimated total number of individuals of a non-indigenous species population in a specific marine area.

'Trend in temporal occurrence' is defined as the interannual change in the estimated number of new introductions and the total number of non-indigenous species in a specific country or preferably the national part of each subdivision, preferably disaggregated by pathway of introduction.

'Trend in spatial distribution' is defined as the interannual change of the total marine 'area' occupied by a non-indigenous species.

Methodology for indicator calculation

To estimate Common Indicator 6, a trend analysis (time series analysis) of the available monitoring data needs to be performed, aiming to extract the underlying pattern, which may be hidden by noise. A formal regression analysis is the recommended approach to estimate such trends. This can be done by a simple linear regression analysis or by more complicated modelling tools (when rich datasets are available), such as generalized linear or additive models.

To monitor trends in temporal occurrence, two parameters [A] and [B] should be calculated on a yearly basis. Parameter [A] provides an indication of the introductions of "new" species (in comparison with the prior year), and parameter [B] gives an indication of the increase or decrease of the total number of non-indigenous species:

[A]: The number of non-indigenous species at T_n that was not present at T_{n-1}. To calculate this parameter the non-indigenous species lists of both years are compared to check which species were recorded in year *n*, but were not recorded in year *n-1* regardless of whether or not these species was present in earlier years. To calculate this parameter the total number of non-indigenous species is used in the comparison.

[B]: The total number of known non-indigenous species at T_n minus the corresponding number of non-indigenous species at T_{n-1}. Hereby T_n stands for the year of reporting.

Indicator units

'Trends in abundance': % change per year

'Trends in temporal occurrence': % change in new introductions or % change in the total number of alien species per year or per decade

'Trends in spatial distribution': % change in the total marine surface area occupied or % change in the length of the occupied coastline (in the case of shallow-water species that are present only in the coastal zone)

List of Guidance documents and protocols available

There are no established standard protocols for the monitoring of NIS. However, sampling methods are used by monitoring activities implemented in many Mediterranean countries, in particular in relation to the Ballast Water Convention, the EU Water Framework Directive, and the Marine Strategy Framework Directive. These methods may be useful for the estimation of Common Indicator 6.

Some guidance on the monitoring of biodiversity (including non-indigenous species) for the needs of the MSFD is provided in: *Zampoukas et al. (2014) Technical guidance on monitoring for the Marine Stategy Framework Directive. JRC Scientific and Policy Reports (EUR collection), Publications Office of the European Union, EUR 25009 EN – Joint Research Centre, doi: 10.2788/70344, ISBN: 978-92-79-35426-7, 166p.*

The EU Project BALMAS has provided guidelines for the monitoring of NIS in ballast water (https://www.balmas.eu/).

Data Confidence and uncertainties

Indicator Title	*Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)*

The trend analysis should be accompanied by an evaluation of confidence and uncertainties. Standard regression methods (simple linear regression, generalized linear or additive models, etc) provide estimates of uncertainty (standard errors and confidence intervals of estimated trends). Such uncertainty estimates should accompany all reported trends.

Furthermore, the issue of imperfect detectability should be properly addressed, as it may cause an underestimation of the relevant state variables (abundance, occupancy, geographical range, species richness). There are many available methods that properly tackle the issue of imperfect detection when monitoring biodiversity, by jointly estimating detectability (see Katsanevakis et al. 2012 for a review).

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

It is recommended to use standard monitoring methods traditionally being used for marine biological surveys, including, but not limited to plankton, benthic and fouling studies described in relevant guidelines and manuals. However, specific approaches may be required to ensure that alien species are likely to be found, e.g. in rocky shores, port areas and marinas, offshore areas and aquaculture areas.

As a complimentary measure and in the absence of an overall NIS targeted monitoring programme, rapid assessment studies may be undertaken, usually but not exclusively at marinas, jetties, and fish farms

(e.g. Pederson et al. 2003).

The compilation of citizen scientists input, validated by taxonomic experts, can be useful to assess the geographical ranges of established species or to early record new species.

For the estimation of Common Indicator 6, it is important that the same sites are surveyed each monitoring period, otherwise the estimation of the trend might be biased by differences among sites.

Standard methods for monitoring marine populations include plot sampling, distance sampling, mark-recapture, removal methods, and repetitive surveys for occupancy estimation (see Katsanevakis et al. 2012 for a review specifically for the marine environment).

Katsanevakis S, et al., 2012. Monitoring marine populations and communities: review of methods and tools dealing with imperfect detectability. Aquatic Biology 16: 31–52.

Pederson J, et al., 2003 Marine invaders in the northeast: Rapid assessment survey of non-native and native marine species of floating dock communities, August 2003 (available in https://dspace.mit.edu/bitstream/handle/1721.1/97032/MITSG_05-3.pdf?sequence=1*)*

Available data sources

Marine Mediterranean Invasive Alien Species database (MAMIAS) - http://www.mamias.org/
European Alien Species Information Network (EASIN) - http://easin.jrc.ec.europa.eu/
CIESM Atlas of Exotic Species in the Mediterranean - http://www.ciesm.org/online/atlas/
World Register of Introduced Marine Species (WRIMS) - http://www.marinespecies.org/introduced/

Spatial scope guidance and selection of monitoring stations

The monitoring of NIS generally should start on a localised scale, such as "hot-spots" and "stepping stone areas" for alien species introductions. Such areas include ports and their surrounding areas, docks, marinas, aquaculture installations, heated power plant effluents sites, offshore structures. Areas of special interest such as marine protected areas, lagoons etc. may be selected on a case by case basis, depending on the proximity to alien species introduction "hot spots". The selection of the monitoring sites should therefore be based on a previous analysis of the most likely "entry" points of introductions and "hot spots" expected to contain elevated numbers of alien species.

It is important to establish a network of monitoring sites at regional level in which common protocols are applied so that Common Indicator 6 can be assessed at both national and regional level.

Indicator Title	*Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)*

The use of Habitat Suitability Models and Ecological Niche Modelling (ENM) may be considered at a later stage of IMAP to identify priority monitoring sites and to predict the spread of NIS.

Temporal Scope guidance

Monitoring at "hot-spots" and "stepping stone areas" for alien species introductions would typically involve more intense monitoring effort, e.g. sampling at least once a year at ports and their wider area and once every two years in smaller harbours, marinas, and aquaculture sites.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

Standard statistics for regression analysis should be applied to estimate trends and their related uncertainties.

Expected assessments outputs
- Graphs of the time series of the calculated metrics (abundance, occurrence, etc), including confidence intervals
- Distribution maps of the selected species, depicting temporal changes in their spatial distribution
- National inventories (and also by the national part of each marine subdivision, if relevant) of non-indigenous species by year

Known gaps and uncertainties in the Mediterranean

NIS identification is of crucial importance, and the lack of taxonomical expertise has already resulted in several NIS having been overlooked for certain time periods. The use of molecular approaches including bar-coding are sometimes needed to confirm traditional species identification. Sampling effort currently greatly varies among Mediterranean countries and thus on a regional basis current assessments and comparisons may be biased.

Contacts and version Date

Key contacts within UNEP for further information

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

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

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

Justification for indicator selection
In 2012, following several recommendations made on the management of different fisheries in the Mediterranean and Black Sea (e.g. Recommendations GFCM/27/2002/1, GFCM/30/2006/1 and Resolution GFCM 33/2009/1 on the management of certain fisheries exploiting demersal and small pelagic), and on the basis of Scientific Advisory Committee on Fishery (SAC) advice on the need to develop multiannual management plans based on agreed reference points, the GFCM has formulated the "*Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area*". In the GFCM guidelines are included clear indications on suitable objectives and procedures to implement a management plan, and is reported a clear definition of the requirements to provide scientific advice useful for management. The framework is based on the definition of reference points related to key indicators of the status of stocks, such as stock biomass and fishing mortality. Indeed these guidelines, in relation to reference points and stock status, define suitable indicators for biomass either *Total Biomass or Spawning Stock* Biomass, while suitable indicators for exploitation can be either *Fishing mortality or Exploitation rate* (ratio between fishing mortality and total mortality). In all cases, reference points should be defined in relation to the indicator used. Following the recommendations from the SAC, the advice should be based, if possible, on both indicators of biomass and exploitation, and for each indicator ideally target, threshold and limit (e.g. B_{tgt}, B_{thr}, B_{lim}) reference points should be defined. When only one indicator is available, there should be a clear advice to explore the possibility of having indicators for both biomass and exploitation.
In general terms, a suggested target reference point for biomass and exploitation is that value of the indicator at which maximum sustainable yield (MSY) is obtained from the fishery, in accordance with the 1995 UN Fish Stocks Agreement (UNFSA), while limit and threshold reference points should be established based on precautionary principles.

Spawning Stock Biomass
Biomass reference points are nearly always based on SSB, which is one of the most important stock status indicators and the primary indicator for the reproductive capacity of the stock. Achieving or maintaining good environmental status requires that SSB values are equal to or above SSB_{MSY} (the level capable of producing Maximum Sustainable Yield-MSY).
B_{thr} (Biomass threshold) is defined as a point at which the probability to be below B_{lim} (Biomass limit) is lower than 5%. In absence of precise estimates of the distribution of the biomass estimate, a lognormal distribution of B_{lim} should be assumed, with a coefficient of variation of 40%. This approximately results in $B_{thr} = 2*B_{lim}$.
Fishing mortality (F) is directly related to the way a stock is being fished. Yield will increase as more fishing capacity is applied (more vessels or fishing effort) until it reaches a maximum level (MSY). If fishing mortality is increased further than this MSY, yield will decrease because smaller size fish (which are too young to reproduce) are being caught, leading to a continuous decline of the SSB (total weight of mature fish). Even if a stock is fished at a constant level of fishing mortality, the SSB can fluctuate due to natural factors. Thus, a stock fished constantly at F_{MSY} (the value of F expected to produce the long-term maximum sustainable yield) should result in the SSB

Indicator Title	*Common Indicator 7: Spawning Stock Biomass*

fluctuating around SSB_{MSY} (the spawning-stock biomass expected to produce the long-term maximum sustainable yield).

Scientific References

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

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

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

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

-GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area.

-ICES, 2008. Report of the Workshop on Methods to Evaluate and Estimate the Accuracy of Fisheries Data used for Assessment (WKACCU). Bergen, Norway, 27–30 October 2008. ICES CM 2008\ACOM: 32. 41 pp.

-ICES, 2010e. Report of the Workshop on methods to evaluate and estimate the precision of fisheries data used for assessment (WKPRECISE). Copenhagen, Denmark, 8-11 September 2009. ICES CM 2009/ACOM: 40. 43 pp.

-Sparre, P.; Venema, S.C. Introduction to tropical fish stock assessment. Part 1. Manual. *FAO Fisheries Technical Paper.*No. 306.1, Rev. 2. Rome, FAO. 1998. 407p.

-Sparre P.J., 2000. Manual on sample-based data collection for fisheries assessment. Examples from Vietnam. FAO Fisheries Technical Paper. No. 398. Rome, FAO. 2000. 171 pp.

-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995

Policy Context and targets (other than IMAP)

Policy context description

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

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

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

Indicator/Targets

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

Policy documents

Indicator Title	*Common Indicator 7: Spawning Stock Biomass*

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

Indicator analysis methods

Indicator Definition

Description: The Spawning Stock Biomass, usually referred to as SSB, is the total weight of the spawning stock. The SSB is available through stock assessment so not all species will have this information. Note that B_{MSY} is currently not considered as a threshold for stock management in European waters and values are not available. When both biomass indices and exploitation indicators are available (only for few species) the most precautionary will be adopted. Only available if the stock has been assessed. This indicator is linked with sustainable fishing.

The spawning stock biomass (SSB) is the combined weight of all individuals in a fish stock that are capable of reproducing. To calculate the spawning stock biomass, it is necessary to have estimates of the number of fish by length/age group, estimates of the average weight of the fish in each length/age group and an estimate of the amount of fish in each length/age group that are mature. SSB and SSB_{MSY} need to be estimated from appropriate quantitative assessments based on the analysis of catch at-age or/and at length (to be taken as all removals from the stock including discards). Where possible, reference points relative to SSB should be established for each stock.

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

Methodology for indicator calculation

Indicator Title	*Common Indicator 7: Spawning Stock Biomass*

The status of stocks is ideally based on a validated stock assessment model, from which indicators of stock status (e.g. biomass, fishing mortality, recruitment) are obtained, and reference points are agreed for the chosen indicators. When possible, analytical stock assessment models that incorporate both fishery-dependent (e.g. catches) and independent information (e.g. surveys) are used, although direct surveys are used for some stocks. Different stock assessment models are used in the GFCM area of application, including variations of virtual population models (from pseudo-cohort based models, such as VIT, to tuned versions, such as extended survivor analysis – XSA), statistical catch at age analysis (e.g. state-space assessment model – SAM or stock synthesis – SS3) and biomass models (BioDyn, two-stage biomass models, etc.). Some stock assessment methods are only based on information from scientific surveys at sea (e.g. survey-based assessment – SURBA, or acoustic estimates of biomass).

When no analytical assessment model or reference points are validated by the Scientific Advisory Committee on Fishery (SAC), advice can still be provided on a precautionary basis, in cases where there is evidence that the stock may be threatened (high fishing pressure, low biomass, habitat loss, etc.). When possible, advice on stock status should be based both on biomass and on fishing pressure, using indicators and reference points for both quantities.

Indicator units (*under development*)
- Number of stocks for which status with respect to SSB_{MSY} is known
- The number (and proportion) of stocks above or below SSB_{MSY}
- Trends in SSB

List of Guidance documents and protocols available
- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp.
- GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp.
- GFCM 2016. GFCM-DCRF, Data Collection Reference Framework. GFCM Secretariat. 116 pp.
-Stock Assessment Form version 1.0 (January 2014 - http://www.fao.org/gfcm/data-reporting/data-reporting-stock-assessment/en/)

Data Confidence and uncertainties

Methodology for monitoring, temporal and spatial scope

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

Available data sources
-Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016
http://www.fao.org/gfcm/reports/statutory-meetings/en/
-Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp.
http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/
-Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp.
http://www.fao.org/gfcm/reports/technical-meetings/en/

Indicator Title	*Common Indicator 7: Spawning Stock Biomass*
-[Report of the Working Group on Stock Assessment of Demersal Species (WGSAD)](#), 2015 (23 November-28 November) GFCM HQ. 60pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -[Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP)](#), 2015 (23 November-28 November) GFCM HQ. 82pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1 https://stecf.jrc.ec.europa.eu/meetings/2015 -Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2 https://stecf.jrc.ec.europa.eu/meetings/2015	
Spatial scope guidance and selection of monitoring stations Stock assessment in the GFCM area of application is often conducted by management units, based on GSAs (Resolution GFCM/33/2009/2). This method does not ensure that the whole stock is assessed, since stocks may cover several different management units. In some cases, when there is scientific evidence of a stock spreading through different GSAs existing information is combined across GSAs. Although the concept of their delimitation still needs further consideration, the GSAs, appear as the most appropriate subdivisions for stock assessments for management purposes in the Mediterranean Sea.	
Temporal Scope guidance (*under development*)	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation (*under development*)	
Expected assessments outputs • Monitoring trend of SSB • Monitoring the stock(s) performance • Project the stock(s) trend over time • Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources. The information gathered should be sufficient and reliable enough to review the status of the different resources, to assess the economic and social dimensions of the fleets and to provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.	
Known gaps and uncertainties in the Mediterranean Even if stock assessments and advice are now available for several stocks in the Mediterranean and Black Sea, and the number of stocks for which estimates of MSY-based indicators are available has also increased, still different stocks lack information on spawning stock biomass (SSB) and/or proxies are not available; thus, it is not possible to establish reproductive potential levels relative to MSY. Furthermore, the exploitation of several stocks may be shared, and the available scientific inputs have not been sufficient or have not been organised cohesively at the appropriate scale in view of supporting a regional based decision making process. Some countries have not been kept an acceptable level of accuracy due to different causes including the fragmented nature of smaller size stocks exploited by artisanal multiple-gears fisheries, small fishing fleets dispersed over quite long coastlines and islands, and/or no data collection in place.	
Contacts and version Date	
GFCM Secretariat (gfcm-secretariat@fao.org)	

Version No	Date	Author

Indicator Title	*Common Indicator 7: Spawning Stock Biomass*	
V.1	15-12-2016	GFCM Secretariat

Indicator Title	*Common Indicator 7: Spawning Stock Biomass*	
V.1	15-12-2016	GFCM Secretariat

14. Common Indicator 8: Total landing (EO3)

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

Justification for indicator selection

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

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

Total landing

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

- determine the level at which fisheries resources can be exploited without exhausting them;
- determine the Maximum Sustainable Yield (MSY).

| Indicator Title | *Common Indicator 8: Total landing* |

- measuring the level of exploitation or total fishing pressure on an ecosystem (including IUU catch and discards).

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

Current status

In the Mediterranean and Black Sea around 85% of EU fish stocks are overfished. This overfishing, leads to uncertain catches and makes the fishing industry vulnerable. Within the GFCM mandate a series of stocks are assessed on an annual basis, and for some fish stocks, no estimates of MSY are currently available. In order to have reliable information to assess the stocks and to determine MSY there is the need to have reliable fishing data. In the GFCM areas, data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Recently, the GFCM has also developed a new specific data requirement in force for data collection and submission: the Data Collection Reference Framework (GFCM-DCRF, 2016). This new framework has been adopted during the GFCM annual Session 2015. The DCRF is the first GFCM comprehensive framework for the collection and submission of the fisheries-related data that are requested as per existing GFCM Recommendations and are necessary for relevant GFCM subsidiary bodies to formulate advice in accordance with their mandate. It encompasses all the necessary indications for the collection of fisheries data (i.e. global figure of national fisheries, catch; incidental catch of vulnerable species; fleet; effort; socio-economics; biological information) by GFCM members in a standardized way, in order to provide the GFCM with the minimum set of data needed to support fisheries management decision-making processes.

Scientific References
- FAO, 1999. *Guidelines for the routine collection of capture fishery data*. Prepared at the FAO/DANIDA Expert Consultation. Bangkok, Thailand (18–30 May), 1998. FAO, Fish. Tech. Pap. 382. Rome, FAO. 113 pp.
- FAO, 2016. *The State of Mediterranean and Black Sea Fisheries*. General Fisheries Commission for the Mediterranean. Rome, Italy.
-GFCM, 2002. Recommendation GFCM/27/2002/1: Management of selected demersal and small pelagic species.
-GFCM, 2006. Recommendation. GFCM/30/2006/1: Management of certain fisheries exploiting demersal and small pelagic.
-GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area.
- Joint research agreement 2013. A Mediterranean Cooperation for the Sustainable Use of the Marine Biological Resources. A supportive tool for the synergic implementation of the MSFD and the ECAP initiative. Joint Project Agreement between the Ministry of the Environment, Territory and Sea of Italy and the GFCM.
- GFCM 2012. Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area. 2012.
- GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis.
- GFCM 2014a. Reference points and advice in the SAC ad in other relevant organizations. WKREF-WGSA. Bar, Montenegro, 28th January-1st February 2014.
- GFCM, 2014b. Report of the First MedSuit Regional Workshop on indicators and targets to ensure GES of commercially exploited marine populations in the GFCM area. FAO HQ, Rome, Italy (6–7 November 2014). 14 pp.
- GFCM, 2014c. Report of the Workshop on the implementation of the DCRF in the Mediterranean and the Black Sea. Madrid, Spain (15-16 December) 2014. 22 pp.
- GFCM 2016. GFCM-DCRF, Data Collection Reference Framework. GFCM Secretariat. 116 pp.

Indicator Title	*Common Indicator 8: Total landing*

- Patterson, K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. Reviews in Fish Biology and Fisheries, 2, pp. 321–338.
- UNEP-MAP, 2012. Support to the Barcelona Convention for the implementation of the ecosystem approach. Including the establishment of MPAs in open seas areas, including deep sea. Contribution Agreement N°21.0401/2008/519114/SUB/D2. Final Report, April 2012. 50pp.
- UNEP-MAP & GFCM 2013. Background document on cooperation needs between UNEP-MAP and GFCM. Internal document. 14pp.
-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995

Policy Context and targets (other than IMAP)

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

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

Policy documents
 - EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF
- GFCM, 2012a. Report of the Transversal Workshop on Spatial Based Approach to Fisheries Management, Rome, Italy, 6–8 February 2012. 2 March 2016].
https://gfcmsitestorage.blob.core.windows.net/documents/Reports/2012/GFCM-Report-2012-SAC-SCs-Spatial-Approach.pdf
-GFCM, 2012b. Resolution OTH-GFCM/36/2012/ Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area
- GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis. http://www.fao.org/3/a-ax847e.pdf
- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's, Malta, 17–20 March 2014. 261pp. http://www.fao.org/3/a-i4381b.pdf

Indicator Title	*Common Indicator 8: Total landing*

- GFCM 2014b. Proposal on the definition of Good Environmental Status and associated indicators and targets for commercially exploited fish and shellfish populations. Scientific Advisory Committee (SAC). St Julian's, Malta, 17-20 March 2014. 18 pp.

-GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries.

- Recommendation GFCM/33/2009/3, 2009. On the implementation of the GFCM task 1 statistical matrix and repealing resolution GFCM/31/2007/1. www.fao.org/gfcm/decisions

- Regulation (EU) No 1380/2013 of the European parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC

- UNEP-MAP 2012. EcAp-MED Project Document. Implementation of the Ecosystem Approach (EcAp) in the Mediterranean by the Contracting parties in the context of the Barcelona Convention for the Protection of the Marine Environment and the Coastal region of the Mediterranean and its Protocols. 34pp.

Indicator analysis methods

Indicator Definition

The total catch is the quantity of fish that is retained by the fishing gear during fishing operations. This should ideally include landings by commercial fleet, national landings in foreign ports, and foreign landings in domestic ports, recreational fishing, bycatch and IUU estimates.

The Maximum Sustainable Yield (MSY) is the theoretical maximum catch that can be extracted from a stock. Due to difficulties to calculate MSY, this should be a limit. This indicator is linked with sustainable fishing and conservation of biodiversity.

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

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

Methodology for indicator calculation

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

Several analytical methods, based on population dynamics of different stocks of demersal and small pelagic species, have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. In the GFCM area, data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain information on

Indicator Title	*Common Indicator 8: Total landing*

reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Within the GFCM mandate a series of stocks are already assessed on an annual basis. On a yearly basis, Scientific and Advisory Committee (SAC) and the Working for the Black Sea (WGBS) will identify those species/stocks that should be assessed and for which stock assessment form should be provided.

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

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

Data Confidence and uncertainties

Methodology for monitoring, temporal and spatial scope

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

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

Indicator Title	*Common Indicator 8: Total landing*

-Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp.
http://www.fao.org/gfcm/reports/technical-meetings/en/
-Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1
https://stecf.jrc.ec.europa.eu/meetings/2015
-Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2
https://stecf.jrc.ec.europa.eu/meetings/2015

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

Temporal Scope guidance (*under development*)

Data analysis and assessment outputs

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

Expected assessments outputs
- Monitoring of total annual biomass landed.
- Monitoring trends of the catch (by fleet segment, country and area).
- Monitoring the stock(s) performance
- Project the stock(s) trend over time
- Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.

Known gaps and uncertainties in the Mediterranean
The limited monitoring of fisheries catch/landing makes it difficult to evaluate the relative contribution of the sector to the exploitation of stocks assessed by the GFCM. There are, several important gaps of knowledge concerning landing data: information are not complete (in terms of species identification, quantities etc.) for several fishing gears; countries or/and subregions and most of the existing studies cover relatively short temporal and small spatial scales; there are significant discrepancies between sub-regions in terms of availability, quality and relevance of data that could be useful for conducting GES assessments in relation to EO 3. The rationale behind the new GFCM-DCRF is to reduce data requirements and encompass them into a single, simple and easy-to-understand manual, providing Members with the necessary indications for the collection and transmission of data related to fisheries to the GFCM Secretariat. Moreover, the information gathered should be sufficient and reliable enough to review the status of the different resources, to assess the economic and social dimensions of the fleets and to provide scientific advice on the status of the resources, as well as to allow Members to prepare recommendations to manage those resources.

Contacts and version Date

GFCM Secretariat (gfcm-secretariat@fao.org)

Version No	Date	Author

Indicator Title	*Common Indicator 8: Total landing*	
V.1	15-12-2016	GFCM Secretariat

Indicator Title	*Common Indicator 8: Total landing*	
V.1	15-12-2016	GFCM Secretariat

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

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

Justification for indicator selection

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

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

Fishing mortality

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

Current status

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

Indicator Title	*Common Indicator 9: Fishing mortality*

(sardine, anchovy or sprat), while only a few stocks of demersal species, such as whiting, some shrimp species, picarel and red mullet, are estimated to be fished at or below the reference point for fishing mortality.

To ensure the highest quality stock assessments, the data used must be accurate and timely evaluated. The Mediterranean fisheries are characterised by fragmented fleets, usually composed by relatively small vessels, use of a large number of landing sites, with multi-species catches. These factors make it difficult and expensive to get extensive and reliable data time series and to get biological samples. In the GFCM areas, data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Further, the GFCM has recently developed a new specific data requirement in force for data collection and submission: the Data Collection Reference Framework (GFCM-DCRF, 2016). This new framework has been adopted during the GFCM annual Session 2015. The DCRF is the first GFCM comprehensive framework for the collection and submission of the fisheries-related data that are requested as per existing GFCM Recommendations and are necessary for relevant GFCM subsidiary bodies to formulate advice in accordance with their mandate. It encompasses all the necessary indications for the collection of fisheries data (i.e. global figure of national fisheries, catch; incidental catch of vulnerable species; fleet; effort; socio-economics; biological information) by GFCM members in a standardized way, in order to provide the GFCM with the minimum set of data needed to support fisheries management decision-making processes.

Scientific References

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

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

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

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

-GFCM, 2009. Resolution GFCM/33/2009/1 on the Management of demersal Fisheries in the GFCM area.

-ICES, 2008. Report of the Workshop on Methods to Evaluate and Estimate the Accuracy of Fisheries Data used for Assessment (WKACCU). Bergen, Norway, 27–30 October 2008. ICES CM 2008\ACOM: 32. 41 pp.

-ICES, 2010e. Report of the Workshop on methods to evaluate and estimate the precision of fisheries data used for assessment (WKPRECISE). Copenhagen, Denmark, 8-11 September 2009. ICES CM 2009/ACOM: 40. 43 pp.

-Sparre, P.; Venema, S.C. Introduction to tropical fish stock assessment. Part 1. Manual. *FAO Fisheries Technical Paper.*No. 306.1, Rev. 2. Rome, FAO. 1998. 407p.

-Sparre P.J., 2000. Manual on sample-based data collection for fisheries assessment. Examples from Vietnam. FAO Fisheries Technical Paper. No. 398. Rome, FAO. 2000. 171 pp.

-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995

Policy Context and targets (other than IMAP)

Policy context description

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

This means maintain the sustainability of fisheries, in order to prevent overfishing of demersal and small pelagic fish stocks, maintain their stocks at levels that can produce the maximum sustainable

Indicator Title	*Common Indicator 9: Fishing mortality*

yield (MSY) and to facilitate the restoration of stocks to historical levels. GFCM also aims to guarantee a low risk of stocks falling outside safe biological limits and to ensure protection of biodiversity to avoid undermining ecosystems structure and functioning (GFCM, 2013). Fishing mortality must be kept below safe levels to ensure long-term high yields, while limiting the risk of stock collapse and guaranteeing stable and viable fisheries (GFCM, 2012).

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

Indicator/Targets

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

Policy documents

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

Indicator analysis methods

Indicator Definition

Indicator Title	*Common Indicator 9: Fishing mortality*
Description: The Maximum Sustainable Yield is, theoretically, the maximum yield that can be obtained from a species, and it is associated with a maximum fishing mortality (F_{MSY}). When F is higher than F_{MSY} the yield decreases. F_{MSY} is considered as a limit due to the consequences of overestimating F. Only available if the stock has been assessed. Fishing mortality (F) reflects all deaths in the stock that are due to fishing per year (not only what is actually landed). It is usually expressed as a rate ranging from 0 (for no fishing) to high values (1.0 or more). It is common practice to refer F as a scalar value but it would be more appropriate to refer to it as a vector. This indicator is linked with sustainable fishing. The catch should correspond to a fishing mortality (F) that maximises the yield from the stock. This is defined as the MSY, and the fishing mortality rate that generates this is F_{MSY}. F_{MSY} is the F value that will maximise the long-term yield, taking into account natural mortality, growth and the dependence of the abundance of incoming year-classes on the abundance of the spawning stock size. Given the variability and uncertainty inherent in the estimation of fishing mortality reference levels and the difficulty of simultaneously maintaining all stocks in a mixed fishery at their optimum exploitation rate, a range within which the exploitation rate is maintained may be considered appropriate rather than using the exact reference levels as limit or target values. Priority species (Group 1, 2 and 3) as reported in Appendix A of the GFCM-Data Collection Reference Framework (GFCM-DCRF, 2016), will be the species considered for the evaluation for this indicator (see attached Appendix A reporting the list of priority species).	
Methodology for indicator calculation The status of stocks is ideally based on a validated stock assessment model, from which indicators of stock status (e.g. biomass, fishing mortality, recruitment) are obtained, and reference points are agreed for the chosen indicators. When possible, analytical stock assessment models that incorporate both fishery-dependent (e.g. catches) and independent information (e.g. surveys) are used, although direct surveys are used for some stocks. Different stock assessment models are used in the GFCM area of application, including variations of virtual population models (from pseudo-cohort based models, such as VIT, to tuned versions, such as extended survivor analysis – XSA), statistical catch at age analysis (e.g. state-space assessment model – SAM or stock synthesis – SS3) and biomass models (BioDyn, two-stage biomass models, etc.). Some stock assessment methods are only based on information from scientific surveys at sea (e.g. survey-based assessment – SURBA, or acoustic estimates of biomass). When no analytical assessment model or reference points are validated by the Scientific Advisory Committee on Fishery (SAC), advice can still be provided on a precautionary basis, in cases where there is evidence that the stock may be threatened (high fishing pressure, low biomass, habitat loss, etc.). When possible, advice on stock status should be based both on biomass and on fishing pressure, using indicators and reference points for both quantities.	

Indicator units
   • 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}	

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

Indicator Title	*Common Indicator 9: Fishing mortality*
Methodology for monitoring, temporal and spatial scope	
Available Methodologies for Monitoring and Monitoring Protocols Several analytical methods, based on population dynamics of different stocks of demersal and small pelagic species, have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. In the GFCM area, data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Within the GFCM mandate a series of stocks are assessed on an annual basis. On a yearly basis, Scientific and Advisory Committee (SAC) and the Working for the Black Sea (WGBS) will identify those species/stocks that should be assessed and for which stock assessment form should be provided.	
Available data sources -Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016 http://www.fao.org/gfcm/reports/statutory-meetings/en/ -Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp. http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/ -Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Demersal Species (WGSAD), 2015 (23 November-28 November) GFCM HQ. 60pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1 https://stecf.jrc.ec.europa.eu/meetings/2015 -Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2 https://stecf.jrc.ec.europa.eu/meetings/2015	
Spatial scope guidance and selection of monitoring stations Stock assessment in the GFCM area of application is often conducted by management units, based on GSAs (Resolution GFCM/33/2009/2 and Appendix L of the GFCM-DCRF, 2016 - see attached Appendix). This method does not ensure that the whole stock is assessed, since stocks may cover several different management units. In some cases, when there is scientific evidence of a stock spreading through different GSAs existing information is combined across GSAs. Although the concept of their delimitation still needs further consideration, the GSAs, appear as the most appropriate subdivisions for stock assessments for management purposes in the Mediterranean Sea.	
Temporal Scope guidance (*under development*)	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation (*under development*)	
Expected assessments outputs • Monitoring trend of fishing mortality • Monitoring the stock(s) performance • Project the stock(s) trend over time	

Indicator Title	*Common Indicator 9: Fishing mortality*
- Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources. - The information gathered should be sufficient and reliable enough to review the status of the different resources, to assess the economic and social dimensions of the fleets and to provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.	
Known gaps and uncertainties in the Mediterranean Even if stock assessments and advice are now available for several stocks in the Mediterranean and Black Sea, and the number of stocks for which estimates of MSY-based indicators are available has also increased, still different stocks lack information on F reference points and/or proxies are not available; thus, it is not possible to establish current fishing mortality levels relative to MSY. Furthermore, the exploitation of several stocks may be shared, and the available scientific inputs have not been sufficient or have not been organised cohesively at the appropriate scale in view of supporting a regional based decision making process. Some countries have not been kept an acceptable level of accuracy due to different causes including the fragmented nature of smaller size stocks exploited by artisanal multiple-gears fisheries, small fishing fleets dispersed over quite long coastlines and islands and/or no data collection in place.	
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Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

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.	(*under development*)
Rationale		
Justification for indicator selection In 2012, following several recommendations made on the management of different fisheries in the Mediterranean and Black Sea (e.g. Recommendations GFCM/27/2002/1, GFCM/30/2006/1 and Resolution GFCM 33/2009/1 on the management of certain fisheries exploiting demersal and small pelagic), and on the basis of Scientific Advisory Committee on Fishery (SAC) advice, the GFCM has formulated the "*Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area*". In the GFCM guidelines are included clear indications on suitable objectives and procedures to implement a management plan, and is reported a clear definition of the requirements to provide scientific advice useful for management. The framework is based on the definition of reference points related to key indicators of the status of stocks, such as stock biomass and fishing mortality. Indeed these guidelines, in relation to reference points and stock status, define suitable indicators for biomass either *Total Biomass or Spawning Stock Biomass*, while suitable indicators for exploitation can be either *Fishing mortality,Exploitation rate* (ratio between fishing mortality and total mortality) and *Fishing effort*. In all cases, reference points should be defined in relation to the indicator used. Following the recommendations from the SAC, the advice should be based, if possible, on both indicators of biomass and exploitation, and for each indicator ideally target, threshold and limit (e.g. F_{tgt}, F_{thr}, F_{lim}) reference points should be defined. When only one indicator is available, there should be a clear advice to explore the possibility of having indicators for both biomass and exploitation. In general terms, a suggested target reference point for biomass and exploitation is that value of the indicator at which maximum sustainable yield (MSY) is obtained from the fishery, in accordance with the 1995 UN Fish Stocks Agreement (UNFSA), while limit and threshold reference points should be established based on precautionary principles. *Fishing effort* "*The amount of fishing gear of a specific type used on the fishing grounds over a given unit of time for example hours trawled per day, number of hooks set per day or number of hauls of a beach seine per day. When two or more kinds of gear are used, the respective efforts must be adjusted to some standard type before being added* (FAO, 1997)." Fishing effort it is usually approximated by a metric of capacity, such as gross tonnage or engine power, with a measure of activity (e.g. days-at-sea or hours fished), and is therefore an aggregated measure of fishing behaviour (e.g. in which area, in which period etc.). It is an essential parameter in the assessment of fish stocks and their effective management. Effort information are needed to interpret changes in the amount of catch, and to regulate fishing efficiency to maximize profit and minimize overfishing. Especially in Mediterranean and Black Sea, fishing effort is a measure to manage fleet capacity and the amount of time that can be spent at sea by that fleet. It is linked to fishing mortality, through the catchability at length/age of a stock, a term that generally means the extent to which the stock is susceptible to fishing and that would be captured by one unit of effort. All these information (i.e. fishing effort, catchability, fishing mortality), are needed to analyse changes in the amount of catch and are crucial for developing multiannual management plans.		
Scientific References - FAO. 1997. Fisheries management. FAO Technical Guidelines for Responsible Fisheries No. 4. Rome, FAO. 82p.		

Indicator Title	*Common Indicator 10: Fishing effort*

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-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 2013a. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis.
- GFCM 2013b. Recommendation GFCM/37/2013/1 on a multiannual management plan for fisheries on small pelagic stocks in the GFCM-GSA 17 (Northern Adriatic Sea) and on transitional conservation measures for fisheries on small pelagic stocks in GSA 18 (Southern Adriatic Sea). 10pp.
- GFCM 2014a. Reference points and advice in the SAC ad in other relevant organizations. WKREF-WGSA. Bar, Montenegro, 28th January-1st February 2014.
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-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995

Policy Context and targets (other than IMAP)

Policy context description
The overall operational objectives of GFCM is to ensure the conservation and sustainable use, at the biological, social, economic and environmental level, of living marine resources in the area of application.
This means maintain the sustainability of fisheries, in order to prevent overfishing of demersal and small pelagic fish stocks, maintain their stocks at levels that can produce the maximum sustainable yield (MSY) and to facilitate the restoration of stocks to historical levels. GFCM also aims to guarantee a low risk of stocks falling outside safe biological limits and to ensure protection of biodiversity to avoid undermining ecosystems structure and functioning (GFCM, 2013). Fishing mortality must be kept below safe levels to ensure long-term high yields, while limiting the risk of stock collapse and guaranteeing stable and viable fisheries (GFCM, 2012).

Indicator Title	*Common Indicator 10: Fishing effort*
To follow these issues and to advance towards its goal of sustainability of fisheries, the GFCM has established a temporal framework and intermediate global objectives through the implementation of both the mid-term strategy (GFCM, 2016b) and the different recommendations as in the Compendium of GFCM decisions. In the Mediterranean and Black Sea, fishing effort restrictions have been introduced in a number of situations: under multiannual plans for the management of a specific stock or group of stocks, and more generally area-based. Examples of fishing effort restrictions can be found in, for instance, the plan for management of small pelagic stocks in the GFCM-GSA 17 (Northern Adriatic Sea) and on transitional conservation measures for fisheries on small pelagic stocks in GSA 18 (Southern Adriatic Sea) (Recommendation GFCM/37/2013/1).	

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

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

Indicator analysis methods
Indicator Definition

Indicator Title	*Common Indicator 10: Fishing effort*
Fishing effort is the amount of time and/or fishing capacity (e.g. GT) used to harvest fish. Effort measurements therefore allow an estimation of the pressure placed by fishing activities on fish stocks. Effort indicators are used to measure the impact of the fishery sector on natural resources. Data on the spatial and temporal distribution of fishing effort are crucial requisites for calculating pressure indicators describing the impact of fishing on the seafloor (Piet *et al*., 2007). Effort indicators coupled with catch data, forms the main contribution that the monitoring of commercial fisheries can provide to the assessment of the state of stocks. These indicators are necessary, although certainly not sufficient, to assess the state of the resources in a given geographical area. This indicator will be assessed according both to the Mediterranean and Black Sea sub-areas (GSA) and GFCM sub-regions (see attached Appendix L; GFCM-DCRF, 2016,) in order to reflect spatial changes).	

Methodology for indicator calculation
The need to accurately quantify fishing effort has increased in recent years and quantification methods vary greatly among fisheries. To date there has not been a comprehensive review of these methods. In general, quantification methods that are based on information on gear use and spatial distribution offer the best approaches to representing fishing effort on a broad scale.   Fishing effort can be calculated through a combination of inputs related to capacity, gear and time: for example multiplying the fishing capacity deployed (i.e. total GT, total kW, number of hooks, etc.) by the period of time (number of hours or days spent fishing). Those inputs, fundamental to estimate effort measurements, can be obtained through various sources (e.g. logbooks, by sampling, by census, port surveys, interviews with fishermen etc.), and can be expressed in a different way on the basis of the fleet segments concerned (see GFCM-DCRF, 2016). Generally, fishing effort measurements are reported as unit of activity (i.e. the number of fishing days at sea) per unit of capacity (i.e. GT) (see attached Appendixes F.1 "*Effort measurement by fleet segment*" and F.2 "*Effort measurement by fishing gear*" from the DCRF-GFCM, 2016).

Indicator units
• Total effort (e.g. GT*fishing days)   • Effort by fleet segments and per area   • Trends of nominal effort

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

Data Confidence and uncertainties

Methodology for monitoring, temporal and spatial scope
Available Methodologies for Monitoring and Monitoring Protocols   Effort information regarding both the units of capacity (e.g. net length, number of lines, GT, number of pots etc.) and the units of activity (e.g. fishing days, number of fishing sets etc.), can be obtained from different sources and are usually derived from a combination of catch reports, logbooks, observers, market and/or landing survey or landing statistics from port authorities. Effort data can be further collected and classified by species, area, fishing gear used, and other factors.   Several methods to calculate effort measurements have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. These information, in

Indicator Title	*Common Indicator 10: Fishing effort*

the GFCM area, are collected through the Data Collection Reference Framework (GFCM-DCRF, 2016) and the stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.).

Available data sources
-GFCM-DCRF, 2016. Data Collection Reference Framework on line platform (under development)
-FAO, 2016. Fisheries and Aquaculture Department FAO Fishery Commodities Global Production and Trade [Database]. [Cited 2 March 2016].
http://www.fao.org/fishery/statistics/global-commoditiesproduction/query/en
-Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016
http://www.fao.org/gfcm/reports/statutory-meetings/en/
-Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp.
http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/
-Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp.
http://www.fao.org/gfcm/reports/technical-meetings/en/
-Report of the Working Group on Stock Assessment of Demersal Species (WGSAD), 2015 (23 November-28 November) GFCM HQ. 60pp.
http://www.fao.org/gfcm/reports/technical-meetings/en/
-Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp.
http://www.fao.org/gfcm/reports/technical-meetings/en/
-Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1
https://stecf.jrc.ec.europa.eu/meetings/2015
-Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2
https://stecf.jrc.ec.europa.eu/meetings/2015

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

Temporal Scope guidance (*under development*)

Data analysis and assessment outputs

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

Expected assessments outputs
- Monitoring of total effort.
- Monitoring trends of the effort (by fleet segment, country and area).
- Monitoring the stock(s) performance
- Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.

Known gaps and uncertainties in the Mediterranean

Indicator Title	*Common Indicator 10: Fishing effort*
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.	

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

Indicator Title	*Common Indicator 11:* Catch per unit effort (CPUE)	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Catch per unit effort (CPUE) is an indirect measure of the abundance of target species. Changes in the catch per unit effort are inferred to signify changes to the target species' abundance.	Stable or positive trend in CPUE Declines in CPUE may mean that the fish population cannot support the level of harvesting. Increases in CPUE may mean that a fish stock is recovering and more fishing effort can be applied.	(*under development*)

Rationale
Justification for indicator selection In 2012, following several recommendations made on the management of different fisheries in the Mediterranean and Black Sea (e.g. Recommendations GFCM/27/2002/1, GFCM/30/2006/1 and Resolution GFCM 33/2009/1 on the management of certain fisheries exploiting demersal and small pelagic), and on the basis of Scientific Advisory Committee on Fishery (SAC) advice, the GFCM has formulated the "*Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area*". In the GFCM guidelines are included clear indications on suitable objectives and procedures to implement a management plan, and is reported a clear definition of the requirements to provide scientific advice useful for management. The framework is based on the definition of reference points related to key indicators of the status of stocks, such as stock biomass and fishing mortality. Indeed these guidelines, in relation to reference points and stock status, define suitable indicators for biomass either *Total Biomass or Spawning Stock Biomass*, while suitable indicators for exploitation can be either *Fishing mortality, Exploitation rate* (ratio between fishing mortality and total mortality) or *Fishing effort*. In all cases, reference points should be defined in relation to the indicator used. Following the recommendations from the SAC, the advice should be based, if possible, on both indicators of biomass and exploitation, and for each indicator ideally target, threshold and limit (e.g. F_{tgt}, F_{thr}, F_{lim}) reference points should be defined. When only one indicator is available, there should be a clear advice to explore the possibility of having indicators for both biomass and exploitation. In general terms, a suggested target reference point for biomass and exploitation is that value of the indicator at which maximum sustainable yield (MSY) is obtained from the fishery, in accordance with the 1995 UN Fish Stocks Agreement (UNFSA), while limit and threshold reference points should be established based on precautionary principles. CPUE The most commonly reported measure of fisheries production is the amount of catch. Catch data provides important information on the number of individuals harvested, but it does not provide information on the expended effort. Effort information is needed to interpret changes in the amount of catch, and to regulate fishing efficiency to maximize profit and minimize overfishing. When effort is combined with catch one of the most widely used effort indicators is obtained: the catch per unit of effort (CPUE), expressed as the biomass captured for each unit of effort applied to harvest the stock. CPUE is extensively used by biologists to determine variations in biomass and by economists as a measure of the efficiency of the fleet. Accurate estimates of CPUE and fishing effort are essential for accurate stock assessment, tracking of market trends, estimating profitability of a fishery, designation of marine protected areas and estimation of total catch (including discards and incidental catch of vulnerable species), all critical components of promoting sustainable fisheries. Trends in CPUE have been an important means of estimating trends in stock abundance when independent abundance data are not available. As CPUE decreases, it may reflect a decrease in

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

stock abundance. Despite being one of the most common pieces of information used in assessing the status of fish stocks, relative abundance indices based on catch per unit effort data are notoriously problematic. Raw CPUE is seldom proportional to abundance over a whole exploitation history and an entire geographic range, because numerous factors affect catch rates. CPUE values are therefore typically standardized to control for environmental, seasonal, habitat and other factors. Although caution needs to be used when interpreting CPUE as an indicator of stock trends, it is still a useful index of abundance for stock trends.

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-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.

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-United Nations, 1995. Conference on straddling fish stocks and highly migratory fish stocks. Sixth session New York, 24 July-4August 1995

Policy Context and targets (other than IMAP)
Policy context description

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

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

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

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

Indicator/Targets

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

Policy documents

- EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF
- GFCM, 2012a. Report of the Transversal Workshop on Spatial Based Approach to Fisheries Management, Rome, Italy, 6–8 February 2012. 2 March 2016]. https://gfcmsitestorage.blob.core.windows.net/documents/Reports/2012/GFCM-Report-2012-SAC-SCs-Spatial-Approach.pdf
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- 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
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Indicator Title	*Common Indicator 11:* Catch per unit effort (CPUE)
Indicator analysis methods	

Indicator Definition

The catch per unit of fishing effort (CPUE) is a relative measure of fish stock abundance and can be used to estimate relative abundance indices; it could be an indicator of fishing efficiency, both in terms of abundance and economic value. In its basic form, the CPUE could be expressed as the captured biomass for each unit of effort applied to species/stock (e.g. total catch of a species divided by the total fishing effort: kg/number of fish per long line hook days). Declining trends of this estimator could indicate overexploitation, while unchanging value could indicate sustainable fishing.

Because the effects of a fishery are determined in large part by both the intensity of fishing effort and the habitat where the effort occurs, quantifying and monitoring changes in fishing effort is fundamental for effective fisheries management. In many situations, fishery catch and effort data is often the only information available which may provide an indication of the impact of fishing. Trends in a pressure indicator such as CPUE, when considered in relation to trends in other indices such as changes in mean species size or mean species length may provide insight into fishing impacts at an ecosystem level.

For the purpose of this ecological objective, the CPUE should be reported for the priority species belonging to Group 1 and Group 2 (Appendixes A.1 and A.2 – Priority species as reported in the GFCM-Data Collection Reference Framework GFCM-DCRF, 2016). Further, this indicator will be assessed according both to the Mediterranean and Black Sea sub-areas (GSA) and GFCM sub-regions (Appendix L; GFCM-DCRF, 2016) in order to reflect spatial changes (see attached Appendixes A and L).

Methodology for indicator calculation

The catch per unit effort may be considered the most likely indicator to contain information of relative abundance over time. However, should be underlined that there are many factors other than abundance that can influence CPUE, these factors are mainly biotic (e.g. species/stock behaviour, fishing area, etc.) and abiotic (e.g. type fishing gear, fishing power). Despite these recognized limitations CPUE is routinely used in stock assessments as index of relative abundance and trends in CPUE are considered to reflect trends in the relative abundance of fish populations. A range of models of varying complexity may be used to estimate population abundance, and reference points (e.g. harvest rate at maximum sustainable yield, biomass relative to carrying capacity, etc.).

The calculation of CPUE, requires both catch or landings data and some metric of nominal effort, such as net length, number of lines, number of hooks etc. CPUE by fleet segments and gear categories, often combined with data on fish size at capture, permit a large number of analyses relating to gear selectivity, indices of exploitation and monitoring of economic efficiency.

Indicator units
- Total effort (e.g. GT*fishing days)
- CPUE by fishing gear and species
- Trends of CPUE

List of Guidance documents and protocols available

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

Data Confidence and uncertainties

Methodology for monitoring, temporal and spatial scope

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

Available Methodologies for Monitoring and Monitoring Protocols
Several methods to calculate CPUE and different effort measurements have been applied within the GFCM-WGSAs (Working Groups on Stock Assessment) and are also available in literature. These information, in the GFCM area, are collected through the Data Collection Reference Framework (GFCM-DCRF, 2016) and the stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Effort information, necessary for calculating the CPUE, regarding both the units of capacity (e.g. net length, number of lines, GT, number of pots etc.) and the units of activity (e.g. fishing days, number of fishing sets etc.), can be obtained from different sources and are usually derived from a combination of catch reports, logbooks, observers, market and/or landing survey or landing statistics from port authorities (see attached Appendix F.1 of the GFCM-DCRF "*Effort measurement by fleet segment*"). Effort data can be further collected and classified by species, area, fishing gear used, and other factors (see attached Appendix F.2 of the GFCM-DCRF "*Effort measurement by fishing gear*").

Available data sources
-GFCM-DCRF, 2016. Data Collection Reference Framework on line platform (under development) -FAO, 2016. Fisheries and Aquaculture Department FAO Fishery Commodities Global Production and Trade [Database]. [Cited 2 March 2016]. http://www.fao.org/fishery/statistics/global-commoditiesproduction/query/en -Report of the eighteenth session of the Scientific Advisory Committee (SAC) on fisheries Nicosia, Cyprus, 21–23 March 2016 http://www.fao.org/gfcm/reports/statutory-meetings/en/ -Report of the seventeenth session of the Scientific Advisory Committee FAO headquarters, 24-27 March 2015, 310pp. http://www.fao.org/documents/card/en/c/adea41df-6092-460d-982b-32a977b90be6/ -Report of the fifth meeting of the Working Group on the Black Sea (WGBS) 2016 (05 April-07 April) Kiev, Ukraine. 95pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Demersal Species (WGSAD), 2015 (23 November-28 November) GFCM HQ. 60pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Report of the Working Group on Stock Assessment of Small Pelagic species (WGSASP), 2015 (23 November-28 November) GFCM HQ. 82pp. http://www.fao.org/gfcm/reports/technical-meetings/en/ -Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 1 (STECF-15-18). 2015. Publications Office of the European Union, Luxembourg, EUR 27638 EN, JRC 98676, 410 pp. EWG 15-16: Mediterranean assessments - Part 1 https://stecf.jrc.ec.europa.eu/meetings/2015 -Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) – Mediterranean assessments part 2 (STECF-16-08). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, 483 pp. EWG 15-16: Mediterranean assessments - Part 2 https://stecf.jrc.ec.europa.eu/meetings/2015

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

Temporal Scope guidance (*under development*)

Data analysis and assessment outputs

Indicator Title	*Common Indicator 11:* Catch per unit effort (CPUE)
Statistical analysis and basis for aggregation (*under development*)	
Expected assessments outputs - Monitoring trends of CPUE (by fishing gear, species, country and area). - Monitoring the stock(s) performance - Provide scientific advice on the status of the resources, as well as to allow countries to prepare recommendations to manage those resources.	
Known gaps and uncertainties in the Mediterranean Concerning CPUE and the related information on fishing effort needed to calculate it, there are significant discrepancies between areas (GSA) and sub-regions in terms of availability, time series, quality and relevance of data, which are fundamental for conducting a robust assessment in relation to this ecological indicator. Information regarding total catch, and the effort units of capacity (e.g. net length, number of lines, GT, number of pots etc.)/activity (e.g. fishing days, number of fishing sets etc.), are not complete for several fleet segments and fishing gears.	
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Version No	Date	Author
V.1	15-12-2016	GFCM Secretariat

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

Indicator Title	*Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)*	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
The abundance/trends of populations of seabirds, marine mammals, sea turtles and sharks key species (selected according to their actual and total dependence on the marine environment, and to their ecological representativeness) is stable or not reducing in a statistically significant way taking into account the natural variability compared to the current situation.	Incidental catch of vulnerable species (i.e. sharks, marine mammals, seabirds and turtles) are minimized	Work in progress within GFCM

Rationale
Justification for indicator selection

Bycatch is the part of the catch that is unintentionally captured during a fishing operation in addition to target species. It may refer to the catch of other commercial species that are landed, commercial species that cannot be landed (e.g. undersized, damage individuals), non-commercial species that are discarded, as well as to incidental catch of endangered or rare species. Incidental catch of vulnerable species is defined here as a subset of bycatch, which includes species that for some reason are considered vulnerable (i.e. long-lived vertebrates with low reproductive rates such as marine mammals, but also sea turtles, seabirds and elasmobranchs).

Bycatch is considered one of the most important threats to the profitability and sustainability of fisheries, and as such has been recently attracting the attention of most regional fisheries management organizations (RFMOs) and other fisheries management bodies. Bycatch costs fishermen time and money, cause problems to endangered and threatened species, affects marine and coastal ecosystems, and makes it more difficult to measure the effect of fishing on the stock's population, and to set sustainable levels for fishing. Preventing and reducing bycatch is an important part of ensuring sustainable living marine resources and coastal communities. However, estimates of bycatch (both discards and incidental catch if vulnerable species) are still lacking and with a not homogenous coverage in all Mediterranean and Black Sea regions.

Following this issue, this indicator will focus on the incidental catch of vulnerable species, with a special emphasis on the interaction/impact with fishing activities, monitoring also the spatial and temporal distribution of the catches.

Scientific References

-Casale, P. and Margaritoulis, D. (Eds.) .2010. Sea turtle in the Mediterranean: Distribution, threats and conservation priorities. Gland, Switzerland: UICN. 294 pp.
-Coll, M. et al. 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. - PLoS ONE 5: e11842.
-FAO, 2003. The ecosystem approach to fisheries. FAO Technical guidelines for responsible fisheries. Rome.
112 pp.
-FAO, 2009. Guidelines to reduce sea turtle mortality in fishing operations. Fisheries Department, Food and
Agriculture Organization of the United Nations. Rome. 128 pp.
-FAO, 2011. Fisheries management. Marine protected areas and fisheries. FAO Technical Guidelines for
Responsible Fisheries. No. 4, Suppl. 4. Rome. 198 pp.

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

-FAO, 2016. The State of Mediterranean and Black Sea Fisheries. General Fisheries Commission for the Mediterranean. Rome, Italy.
-Franzosini C., Genov, T., Tempesta, M., 2013. Cetacean Manual for MPA managers. ACCOBAMS, MedPAN and UNEP/MAP-RAC/SPA. Ed. RAC/SPA, Tunis. 77 pp.
Reeves R., Notarbartolo di Sciara G. (compilers and editors). 2006. The status and distribution of cetaceans in the Black Sea and Mediterranean Sea. IUCN Centre for Mediterranean Cooperation, Malaga, Spain. 137 pp.
-IUCN, 2012. Marine mammals and sea turtles of the Mediterranean and Black Seas.
-UNEP/MAP-RAC/SPA, 2003. – Action Plan for the conservation of bird species listed in annex II of the Protocol concerning specially protected areas and biological diversity in the Mediterranean. http://rac-spa.org/
-UNEP/MAP- Blue Plan, 2009. State of the environment and development in the Mediterranean. UNEP/MAP-Blue Plan, Athens.
-UNEP, 2013. SAP BIO implementation: The first decade and way forward. UNEP(DEPI)/MED WG.382/5. UNEP RAC/SPA, Tunis.
-UNEP/MAP RAC/SPA, 2007. Action Plan for the conservation of Mediterranean marine turtles. Ed. RAC/SPA, Tunis, 40pp. http://rac-spa.org/
-UNEP/MAP-RAC/SPA, 2013. Action Plan for the Conservation of Cetaceans in the Mediterranean Sea
http://rac-spa.org/

Policy Context and targets (other than IMAP)

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

Indicator/Targets
-EU Regulation 812/2004 "*Concerning incidental catches of cetaceans in fisheries*"
-EU MSFD Descriptors 1 "*The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions*" and 4 "*All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity*"
-EU Habitats Directive
-GFCM Recommendations: GFCM/35/2011/3, GFCM/35/2011/4, GFCM/35/2011/5, GFCM/36/2012/2, GFCM/36/2012/3

Policy documents
-Barcelona Convention (Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean).
-EC Directive of the European parliament and of the Council 2008/56/of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF

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

-EU Biodiversity Strategy
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN
-EU Régulation 1143/2014
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1143&from=EN
- GFCM 2013. Report on the Sub-Regional Technical Workshop on Fisheries Multiannual
Management Plans for the Western, Central and Eastern Mediterranean. 7-10 October 2013, Tunis.
http://www.fao.org/3/a-ax847e.pdf
- GFCM, 2014a. Report of the sixteenth session of the Scientific Advisory Committee. St. Julian's,
Malta, 17–20 March 2014. 261pp. http://www.fao.org/3/a-i4381b.pdf
- GFCM-Data Collection Reference Framework (GFCM-DCRF, 2016)
-GFCM, 2016b. Resolution GFCM/40/2016/2 for a mid-term strategy (2017–2020) towards the
sustainability of Mediterranean and Black Sea fisheries.
-Marine Strategy Framework Directive
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN
-Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the
Mediterranean Region http://sapbio.rac-spa.org/
-Draft Updated Action Plan for the conservation of Cetaceans in the Mediterranean Sea
http://rac-spa.org/nfp12/documents/working/wg.408_08_eng.pdf
-Recommendation GFCM/35/2011/3, 2011. On reducing incidental bycatch of seabirds in fisheries
in the GFCM Competence Area. www.fao.org/gfcm/decisions
-Recommendation GFCM/35/2011/4, 2011. On the incidental bycatch of sea turtles in fisheries in
the GFCM Competence Area. www.fao.org/gfcm/decisions
-Recommendation GFCM/35/2011/5, 2011. On fisheries measures for the conservation of the
Mediterranean monk seal (*Monachus monachus*) in the GFCM Competence Area.
www.fao.org/gfcm/decisions
-Recommendation GFCM/36/2012/2, 2012. On mitigation of incidental catches of cetaceans in the
GFCM area. www.fao.org/gfcm/decisions
-Recommendation GFCM/36/2012/3, 2013. On fisheries management measures for conservation of
sharks and rays in the GFCM area. www.fao.org/gfcm/decisions
-Strategic Action Programme for the conservation of Biological Diversity (SAP BIO) in the
Mediterranean Region - http://sapbio.rac-spa.org/

Indicator analysis methods

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

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

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

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

Incidental catch of vulnerable species can be sampled through:

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

1) Direct observation
- a) at-sea monitoring of commercial catches (*by observers on board*);
- b) dedicated survey
- c) fishers (*by self-sampling*) can sample their own bycatch in order that surveys could be made more representative of the whole fleet segment without having to have too many observers.
2) Conducting direct dialogues with fishers (*by questionnaires*), collecting also perspectives on the bycatch issue, which is meant to complement the on board observations data analyses, and to provide an integrated approach toward management.
3) Stranded animal monitoring

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

Indicator units
- Incidental catch (weight and number) of vulnerable species by main fleet segments and areas
- Trends in abundance
- Trends in spatial distribution
- Trends in temporal occurrence
- Identification of risky areas
- Record strandings of vulnerable species due to incidental catch

List of Guidance documents and protocols available
- Several protocols, guidelines and technical documents are available, and can be used, to monitor the different abundance/trends in the incidental catches of populations of seabirds, marine mammals, sea turtles and sharks key species.
- GFCM-Data Collection Reference Framework (GFCM-DCRF, 2016)

Data Confidence and uncertainties

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols
Several protocols are available using different monitoring platforms and approaches such as:
- Direct observation
- Stranded animal monitoring
- Landing/market survey
- Dedicated surveys
- Photo-identification

Available data sources
- Data Collection Reference Framework (GFCM-DCRF, 2016) online platform
- ICCAT database https://www.iccat.int/en/
- OBIS-SEAMAP, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, is a spatially referenced online database, aggregating marine mammal, seabird, sea turtle and ray & shark observation data from across the globe. *http://seamap.env.duke.edu/*
- The Mediterranean Database of Cetacean Strandings (MEDACES), has been set-up to co-ordinate all national and regional efforts for riparian countries. Cetacean stranding data are organized into a spatially referenced database of public access.

Spatial scope guidance and selection of monitoring stations
This indicator will take into account the spatial (GSA) and temporal (quarterly) variability in order to monitor both the impact of different fishing activities on vulnerable species by area, and to detect seasonal differences in incidental catch.

Indicator Title	*Common Indicator 12: Bycatch of vulnerable and non-target species (EO1 and EO3)*
Temporal Scope guidance (*under development*)	

Data analysis and assessment outputs
Statistical analysis and basis for aggregation (*under development*)
Expected assessments outputs -Identification of the incidental catch (e.g. vulnerable species composition, quantities, period of the year, etc.) of the main fleet segments (per GFCM sub-region, countries and GSA, see attached Appendix L); -Describe the typology of the current fishing practices pertaining to these fisheries that lead to bycatch (e.g. fishing area, seasonality, fishing gears); -Find out the most important factors that could determine the incidental catch amounts (including ecological and technical factors). -Trend analysis (by quarter and year)
Known gaps and uncertainties in the Mediterranean As highlighted in the report on the "The state of Mediterranean and Black Sea fisheries" (FAO, 2016), studies on bycatch cover only a small portion of the total fishing activity in the Mediterranean and Black Seas. There are several important gaps of knowledge: bycatch studies are absent for many fishing gears, countries or/and subregions and most of the existing studies cover relatively short temporal and small spatial scales. This gap of knowledge highlights the need to expand bycatch surveys and standardize practices in order to compare among fisheries, and test potential methods and, eventually, tools aiming to their mitigation.

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