UNITED NATIONS

EP

UNEP/MED WG. 482/21

UNEP

UNITED NATIONS
ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN

2 November 2020
Original: English

Integrated Meetings of the Ecosystem Approach Correspondence Groups on IMAP Implementation (CORMONs)

Videoconference, 1-3 December 2020

Agenda Item 5: Parallel CORMON Sessions (Pollution and Marine Litter, and Biodiversity and Fisheries)

Revised Guidance Fact Sheets for IMAP Common Indicators 6 and 19

UNEP/MAP
ATHENS 2020

Note by the Secretariat

In the framework of the Decision IG.22/7 on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP), adopted by COP 19 (Athens, Greece, February 2016), Common Indicator Guidance Factsheets have been developed to provide a common reference to support the implementation and improvement of national monitoring programmes of Contracting Parties.

The Meeting of the Correspondence Group on Monitoring (CORMON) on Pollution, held in Marseilles (France) on the 19-21 October 2017, the CORMON meeting on Marine Litter, held in Madrid (Spain) on 28 February – 2 March 2017 and the meeting of the MEDPOL Focal Points, held in Rome (Italy) on 29-31 May 2017, reviewed the factsheets of the Common Indicators of EO5 (Eutrophication), EO9 (Pollution) and EO10 (Marine Litter). Among these, the factsheet of the Common Indicator 19 "Occurrence, origin (where possible), and extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution" was also reviewed. Results of this revision are included in the document UNEP(DEPI)/MED WG.444/5 presented at the 6th Meeting of the Ecosystem Approach Coordination Group, Athens (Greece), 11th September 2017.

Similarly, the CORMON meeting on Biodiversity and Non-Indigenous Species, held in Madrid (Spain), 28 February- 1 March 2017 and meeting of the SPA RAC Focal Points, held in Alexandria (Egypt) on 9-12 May 2017, reviewed the factsheets of the Common Indicators of EO1 (Biodiversity), EO2 (Non-indigenous species) and EO3 (Harvest of commercially exploited fish and shellfish). Among these, the factsheet of the Common Indicator 6 "Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species (NIS)" was also reviewed. Results of this revision are included in the document UNEP(DEPI)/MED WG.444/6/Rev.1 presented at the 6th Meeting of the Ecosystem Approach Coordination Group, Athens (Greece), 11th September 2017.

The "Study on trends and outlook of marine pollution from ships and activities and of maritime traffic and offshore activities in the Mediterranean" (hereinafter referred to as "the Study") provides recent information which have been be used to revise some sections of CI19 and CI6 factsheets. The revision process also has been based on the conclusions of the Mediterranean 2017 Quality Status Report, and other documents of on-going processes (in particular on multi-scale approach for monitoring and assessment and the definition of "significant acute pollution" events under the Bonn Agreement) provided by REMPEC. It shall be noted that the Study and the other documents consulted provided information useful to review various sections of the factsheets, although not all of them. The revision focused on those elements directly or indirectly linked to the two drivers considered in the Study, i.e. maritime traffic, and offshore activities.

The revised Guidance Factsheet of CI19 and Guidance Factsheet of CI6 are provided in the present document for review by the meeting. In order to highlight the proposed changes and facilitate the review by the meeting, these are reported in highlighted text for added text and in strikethrough for deletion.

I. Introduction and objectives

1. The IMAP Common Indicator Guidance Factsheets share a common template, which is illustrated in Table 1 below. The information gathered in the frame of the "Study on trends and outlook of marine pollution from ships and activities and of maritime traffic and offshore activities in the Mediterranean", and the additional documents consulted, enabled to update the following sections of the factsheets:

- Rational: justification of the indicator selection (for CI19 and CI6)
- Rational: scientific reference (for CI19 and CI6)
- Policy context and targets: targets (for CI19)
- Indicator analysis and methods: general definitions (for CI6)
- Indicator analysis and methods: indicator units (for CI19)
- Methodology for monitoring, temporal and spatial scope: available data sources (for CI19)
- Methodology for monitoring, temporal and spatial scope: spatial scope guidance and selection of monitoring stations (for CI19 and CI6)
- Data analysis and assessment outputs: expected assessment outputs (for CI19 and CI6)
- Data analysis and assessment output: knowledge gaps and uncertainties in the Mediterranean (for CI19 and CI6).

Table 1. Template of IMAP Common Indicator Guidance Factsheets

Indicator Title			
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**	**IMAP Reference No and definition**
Rationale			**Scientific rationale and marine policy context (including relevant references)**
Justification for indicator selection			
Scientific References			
Policy Context and targets			
Policy context description			
Targets			
Policy documents			
Indicator analysis methods			**Agreed scientific methodologies in use, including detailed monitoring requirements**
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			**Data reporting, analysis and aggregation (outpout)**
Statistical analysis and basis for aggregation			
Expected assessments outputs			
Known gaps and uncertainties in the Mediterranean			
Contacts and version Date			**Document Registration**
Key contacts within UNEP for further information			
Version No	**Date**	**Author**	

2. The revised Guidance Factsheet of CI19 and Guidance Factsheet of CI6 are reproduced in the Sections II and III respectively in highlights and strikethrough.

II. Revision of the Guidance Factsheet of CI19

Indicator title	Common Indicator 19. Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution (EO9)	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**
Occurrence of acute pollution events is reduced to the minimum	Acute pollution events are prevented, and their impacts are minimized.	1. Decreasing trend in the occurrences of acute pollution events.

Rational

Justification for indicator selection

Oil and Hazardous and Noxious Substances (HNS) products released at sea may impact an environment as follows:

- physical smothering with an impact on physiological functions;
- chemical toxicity giving rise to lethal or sub-lethal effects or causing impairment of cellular functions;
- ecological changes, primarily the loss of key organisms from a community and the takeover of habitats by opportunistic species; and
- indirect effects, such as the loss of habitat or shelter and the consequent elimination of ecologically important species.

In addition, pollution by oil and HNS ~~has~~ can also determine socio-economic impact (e.g. on recreational activities; fisheries, mariculture, as well as other activities such as power plants, shipping, salt production or seawater desalination). Occurrence of acute pollution events involving oil or HNS needs to be measured and possible impacts monitored.

The nature and duration of the effects of an oil spill depend on a wide range of factors. These include: the quantity and the type of spill; its chemical characteristic and its behaviour in the marine environment; the location of spill in terms of ambient conditions, physical and ecological characteristics; the season and the prevalent weather conditions.

In order to build a comprehensive assessment of impact from shipping, monitoring and assessment under this Indicator should be linked to monitoring of NIS invasion and underwater noise.

Scientific References

ITOPF. “Effect of oil pollution on the marine environment”. ITOPF, Technical Information Paper 13.

ITOPF Effect of oil pollution on fisheries and mariculture. Technical Information Paper 11.ITOPF Effect of oil pollution on social and economic activities. Technical Information Paper 12.

GESAMP. Report n° 75: “Estimates of Oil Entering the Marine Environment from Sea-Based Activities”, IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (2007).

Zeina G. Kassaify, Rana H. El Hajj, Shady K. Hamadeh, Rami Zurayk and Elie K. Barbour. “Impact of Oil Spill in the Mediterranean Sea on Biodiversified Bacteria in Oysters”, Journal of Coastal Research, Vol. 25, No. 2 (2009), pp. 469-473. Published by: Coastal Education & Research Foundation, Inc.
Peterson CH, Rice SD, Short JW, Esler D, Bodkin JL, Ballachey BE, Irons DB. “Longterm ecosystem response to the Exxon Valdez oil spill”. Science 302:2082–2086(2003).

REMPEC (2019). Study of the short- and medium-term environmental consequences of the sinking of the Agia Zoni II tanker in the marine ecosystem of the Saronikos Gulf. REMPEC/WG.45/INF.7

REMPEC (2020). Study on trends and outlook of marine pollution from ships and activities and of maritime traffic and offshore activities in the Mediterranean".

Policy context and targets

Policy context description

Acute pollution from oil and other hazardous substances, resulting either from maritime casualties or from ships' routine operations, is addressed in a number of international conventions under the aegis of the International Maritime Organization (IMO), the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships, some of which provide for stricter regimes in the Mediterranean Sea, including discharges of oil and oily mixtures. At the regional level, the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean ("the Barcelona Convention") and the Protocol concerning Cooperation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea ("the 2002 Prevention and Emergency Protocol") thereto are crucial instruments enabling cooperation and joint action to support all Mediterranean coastal States implementing and enforcing IMO Conventions on pollution prevention and preparedness and response to oil and HNS spills.

The Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), administered by the IMO in cooperation with the Mediterranean Action Plan (MAP) of the United Nations Environment Programme (UN Environment), also referred to as UN Environment/MAP, is responsible for the implementation of the 2002 Prevention and Emergency Protocol. The Centre has maintained a database on alerts and accidents causing or likely to cause pollution of the sea by oil (since 1977) and by other harmful substances (since 1989) in the Mediterranean Sea. Furthermore, following the adoption by the Contracting Parties to the Barcelona Convention of the Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil ("the Offshore Protocol"), Contracting Parties thereto should endeavour to ratify the said Protocol as well as develop and adopt monitoring procedures and programmes for offshore activities, which is envisaged to take place building on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP) of the Ecosystem Approach (EcAp).

Targets

To measure the trend of occurrence of oil and HNS accidental pollution events, the following indicator can be used: number of pollution events of ~~(~~50~~)~~ cubic metres or more per year in the marine waters of each Contracting Party to the Barcelona Convention. A target could be a maximum of 1 occurrence per year per Contracting Party to the Barcelona Convention. As further detailed in the section "Indicator analysis methods: Indicators units", the definition of a threshold for spilled volume is surely useful from an operational perspective. However, the detailed evaluation of significant pollution events requires the assessment of other aspects and therefore the adoption of a multifunctional approach.

Regarding illicit discharges of oil and oily waters (Annex I to the International Convention for the Prevention of Pollution from Ships (MARPOL)), minimum tolerance (near to 0 events) could be considered.

Policy documents

General Policy documents

i. 19th COP to the Barcelona Convention, Athens, Greece, 2016. Decision IG.22/7 – Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28)

ii. 19th COP to the Barcelona Convention, Athens, Greece, 2016. Integrated Monitoring and Assessment Guidance (UNEP(DEPI)/MED IG.22/Inf.7)

iii. 18th COP to the Barcelona Convention, Istanbul, Turkey, 2013. Decision IG.21/3 – Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9)

Related Policy documents

iv. 18th COP to the Barcelona Convention, Istanbul, Turkey, 2013. Decision IG.21/9 - Establishment of a Mediterranean Network of Law Enforcement Officials relating to MARPOL within the framework of the Barcelona Convention (UNEP(DEPI)/MED IG.21/9)

v. 2002 Prevention and Emergency Protocol

vi. Offshore Protocol

vii. MARPOL, specifically its Annex I (Regulations for the prevention of pollution by oil), Annex II (Regulations for the control of pollution by noxious liquid substances in bulk) and Annex III (Regulations for the prevention of pollution by harmful substances carried by sea in packaged form)

viii. International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention) and Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol).

Indicator analysis methods

Indicator Definition

In the case of oil and HNS acute pollution events, the indicator will be obtained from the information of oil and HNS pollution events recorded and submitted in the Mediterranean Sea each year.

Methodology for indicator calculation

Under the 2002 Prevention and Emergency Protocol, Contracting Parties thereto established a reporting procedure (Article 9) whereby the following information (see the format below) should be reported by masters or other persons having charge of ships flying their flags and to the pilots of aircraft registered in their territories:

(1) all incidents which result or may result in a discharge of oil or hazardous and noxious substances; and

(2) the presence, characteristics and extent of spillages of oil or hazardous and noxious substances, including hazardous and noxious substances in packaged form, observed at sea which pose or are likely to pose a threat to the marine environment or to the coast or related interests of one or more of the Contracting Parties.

Moreover, in accordance with Article 10 (Operational Measures) of the said Protocol, any Contracting Party thereto faced with a pollution incident shall, amongst others:

(1) immediately inform all Contracting Parties thereto likely to be affected by the pollution incident of their assessments and of any action which it has taken or intends to take, and simultaneously provide the same information to REMPEC, which shall communicate it to all other Contracting Parties thereto; and

(2) continue to observe the situation for as long as possible and report thereon in accordance with Article 9.

The standard pollution accidents reporting format (POLREP) composed of three parts POLWARN, POLINF and POLFAC:

The standard pollution accidents reporting format (POLREP) composed of three parts POLWARN, POLINF and POLFAC:

POLWARN: Gives the first information or warning of the pollution or the threat:

(1) Date and time

(2) Position

(3) Incident

(4) Outflow

(5) Acknowledge

POLINF: Gives a detailed supplementary report, as well as situation reports

(40) Date and time

(41) Position

(42) Characteristics of pollution

(43) Source and cause of pollution

(44) Wind direction and speed

(45) Current or tide

(46) Sea state and visibility

(47) Drift of pollution

(48) Forecast

(49) Identity of observer and ships on the scene

(50) Actions taken

(51) Photographs or samples

(52) Names of other States informed

(53-59) Spare

(60) Acknowledge

POLFAC: Requests assistance from other Contracting Parties, and for defining operational matters related to the assistance

(80) Date and time

(81) Request for assistance

(82) Cost

(83) Pre-arrangements for the delivery

(84) Assistance to where and how

(85) Other States requested

(86) Change of command

(87-98) Exchange of information

(99) Spare

BCRS (Barcelona Convention Reporting System) format:

(a) accident location (latitude and longitude or closest shore location and country);

(b) accident type* (*blow-out, cargo transfer failure, contact, collision, engine or machine breakdown, fire/explosion, grounding, foundering, hull structural failure, ~~weather, machinery breakdown~~ installation structural failure, oil and gas leak, other);

(c) date

(d) vessel IMO number or vessel name;

(e) vessel flag;

(f) whether any product has been released or not. If yes~~, type of product released (Oil.Hazardous and Noxious Substances) should be specified~~ the type of pollution (MARPOL Annex I, MARPOL Annex II or MARPOL Annex III); and

(g) whether any actions have been taken or not. If yes, the actions taken should be specified.

The 2017 revised BCRS allows now Contracting Parties to report and directly upload data on acute pollutions events onto the Mediterranean Integrated Geographical Information System on Marine Pollution Risk Assessment and Response (MEDGIS-MAR), to facilitate compliance with their biannual reporting obligation and avoid duplication.

MEDGIS-MAR Reporting format for accidental pollution:

(a) date

(b) accident location (latitude and longitude or closest shore location and country);

(c) accident type* (*blow-out, cargo transfer failure, contact, collision, engine or machine breakdown, fire/explosion, grounding, foundering, hull structural failure, installation structural failure, oil and gas leak, , other);

(d) whether any product has been released or not. If yes, pollution range (0, <7 tonnes, 7<x<700, >700 tonnes), the type of pollution (non-hazardous substance, non-volatile oil, other hazardous substance, volatile oil, unknown);

(e) vessel IMO number, MMSI, or vessel name;

(f) vessel flag and other vessel information;

(g) Fix object name, ID Number and category

(h) Oil handling facility name, ID Number and category

EU systems and services for monitoring and reporting marine pollution includes the Emergency Communication and Information System for marine pollution incidents (CECIS Marine), the Union Maritime Information and Exchange System (SafeSeaNet) and CleanSeaNet. While CECIS Marine is open to third countries sharing a regional sea basin with the Union[1], there is currently no access to SafeSeaNet for third Countries. However, one-way reporting access to SafeSeaNet, which is linked to CECIS may be granted, upon request, to 3rd Countries for POLREP, the format of which is described below (pollution warning and information request and response):

POLWARN

- Date/Time Received
- Date/Time
- Incident Outflow
- Acknowledge
- Geo Coordinates
- Geographical Area
- Bearing Distance

POLINF

- Date/Time Received
- Date/Time
- Pollution Position
- Pollution Chars
- Pollution Source
- Wind (Speed and direction)
- Tide (Speed and direction)
- Sea State (Wave Height and visibility)
- Pollution Drift (Drift course and speed)
- Pollution Effect Forecast
- Observer Identity (Name, Home Port, Flag, call sign)
- Action Taken
- Photographs

[1] Albania, Algeria, Bosnia Herzegovina, Egypt, Georgia, Israel, Lebanon, Libya, Monaco, Montenegro, Morocco, Palestine, Russian Federation, Syria, Tunisia, Turkey and Ukraine.

- Informed State Org (Name)
- Other Information
- Acknowledge

Furthermore, Parties to MARPOL (all Mediterranean coastal States except Bosnia and Herzegovina) are requested to submit their annual reports to the Secretariat of the International Maritime Organization (IMO) using the reporting format set out in MEPC/Circ.318. Mandatory reports for a particular year have to be submitted by Parties to MARPOL by 31 December of the next calendar year, as specified in MEPC.1/Circ.874/Rev.1, including:

i) For discharges of 50 tons or more (Discharge of less than 50 tons to be reported at the discretion of Parties), the summary of discharges not permitted under the provisions of MARPOL 73/78 and pollution due to casualties to ships:

(a) Date of incident
(b) Name and IMO No. of the ship
(c) Flag State
(d) Name of port or location of incident (Lat-Long)
(e) Type of substance spilled
(f) Quantity spilled
(g) Full report on file at IMO (Yes/No) Reference
(h) Remarks and action taken
(i) Consequences for marine environment

ii) For alleged discharge violations, the report by the coastal State to IMO of alleged violations of the discharge provisions or incidents involving harmful substances referred to flag States taking into account the flag States' responses:

(a) Date of incident
(b) Name and IMO No. of the ship
(c) Flag State to whom alleged violation was referred and date
(d) Name of Port or Location of Incident (Lat-Long)
(e) Type of substance spilled and estimated quantity
(f) Summary of alleged offence, evidence. Other action taken by coastal State.
(g) Party responding to alleged discharge violation and date
(h) Action taken by flag State including official proceedings
(i) Concluding comments by the coastal State including those on official proceedings (if applicable)

At regional level Parties can report illicit discharges from ships by uploading data on the MEDGIS-MAR, as follows:

(a) date

(b) location (latitude and longitude or alternative geographical information)

(c) Location of infringement (Internal waters, Territorial sea, Contiguous zone, Exclusive economic zone, High seas, Continental shelf)

(d) Country where the infringement is located

(e) Country that detected the infringement

(f) vessel IMO number, MMSI, or vessel name;

(g) vessel flag and other vessel information;

(h) Type of discharge (MARPOL Annex I, MARPOL Annex II, MARPOL Annex III, MARPOL Annex IV, MARPOL Annex V, MARPOL Annex VI, BWM Convention)

(i) Discharge quantity

(j) Convicted, type of sanction finally imposed, entity imposing the sanction, amount of fine

In addition to monitoring pollution events occurrences against the target (incidents involving oil or hazardous substances that are < or = 1 event per year in the waters of each Contracting Party to the Barcelona Convention), it is recommended to carry out a trend analysis in order to measure performance against the target. Data on actual pollution events from ships would be collected every year and compared to the data for the previous year, to calculate a % increase or a % decrease in occurrences yearly frequency.

Indicator units

The Guidelines for Co-operation in Combating Marine Oil Pollution in the Mediterranean (UNEP/IG.74/5, UNEP/MAP, 1987) recommended Contracting Parties to the Barcelona Convention to report to REMPEC all spillages or discharges of oil in excess of 100 cubic metres. To align with the revised reporting formats for a mandatory reporting system under MARPOL ("one-line" entry format) adopted by IMO in 1996 (see MEPC/Circ.318), the Joint Session of MED POL and REMPEC Focal Points Meetings, which was held in Attard, Malta on 17 June 2015, discussed the appropriate threshold and concluded that spills of 50 cubic metres should be reported, whereas countries could also opt to report on spillages of lower amounts.

It shall be noted that the definition of "acute pollution events" is a highly debated issue, by other Regional Seas Programme, in particular, the Bonn agreement as well as under the Marine Strategy Framework Directive (see e.g. the report from the 22nd meeting of the Working Group on Good Environmental Status (WG GES), 19-20/09/2019). Spilled volume is one of the factors that can be relevant for defining significant acute pollution event; however other important factors should be taken in consideration, including: the nature and the behaviour of the spilled product(s), the proximity and the sensitivity of threatened areas and/or human activities, the environmental conditions at the time of spillage and shortly after, and the need for and effectiveness of response operations. The definition of a spilled volume threshold is surely useful from an operational perspective and can provide a rough indication of the significance of the event. However, the full evaluation of a polluting spill should be

multifactorial and approached on a case-by-case basis, and a minimum should flag if the spill threatens a particular vulnerable area.

In the process of identification of thresholds, coordination with other initiatives (Marine Strategy Framework Directive, OSPAR, HELCOM) is crucial. Any threshold becoming available under other processes should be considered for harmonization. The Bonn Agreement is leading the discussion on this matter and the identification of a minimum value for spills, expressed as spatial extent [km²] and amount [tonnes] to trigger the assessment of the impact on biota affected by "acute pollution events" is expected to be defined in that context and to be adopted also for the Mediterranean,

List of guidance documents and protocols available

i. ITOPF. "Aerial Observation of Marine Oil Spills", Technical Information Paper 1.

ii. ITOPF. "Recognition of Oil on Shorelines", Technical Information Paper 6.

iii. ITOPF. "Fate of Marine Oil Spills", Technical Information Paper 2.

iv. ITOPF. "Response to Marine Chemical Incidents", Technical Information Paper 17.

v. Bonn Agreement. "Bonn Agreement Oil Appearance Code".

vi. IPIECA/IMO/IOGP/CEDRE. "Aerial Observation of Oil Spills at Sea: Good practice guidelines for incident management and emergency response personnel" (February 2015).

vii. CEDRE. "Surveying Sites Polluted by Oil: An Operational Guide for Conducting an Assessment of Coastal Pollution" (March 2006).

viii. REMPEC. "Mediterranean Guidelines on Oiled Shoreline Assessment" (September 2009).

ix. GESAMP. "Revised GESAMP Hazard Evaluation Procedure for Chemical Substances Carried by Ships" (2014).

x. IMO Codes:

- For packaged goods: International Maritime Dangerous Goods (IMDG) Code.
- For Bulk liquids: International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code).
- For Gases: International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).
- For solids in bulk: International Maritime Solid Bulk Cargoes (IMSBC Code).

Data confidence and uncertainties

Although characterisation of impact of oil and oily products at sea and on shore is well documented and response strategies well defined, there has been much less investment in research for HNS spills. Chemical spills occur at a much lower frequency than spills of oil and involve a very large variety of products with different physical and toxicity properties. Therefore, the characterisation of impacts from HNS pollution due to maritime casualties is more complex and response strategies and indicators will vary according to the specific chemical product involved.

Methodology for monitoring, temporal and spatial scope

Available methodologies for monitoring and monitoring protocols

As oil and HNS accidental spills and discharges from ships take the form of acute pollution events, there are no specific pollution methodologies for systematic oil and HNS pollution surveillance in IMO Conventions and guidance documents, where monitoring is essentially addressed from the perspective of ships' compliance monitoring (flag State surveys; coastal State and port State controls) or in the context of pollution response operations. In this latter case, a monitoring protocol was developed to detect and survey pollution events.

Pollution events are monitored using the following methods/protocols:

- **Oil:**

- Expert human eye observation;
- Aerial observation (human eye observation and/or remote sensing equipment);
- Satellite imagery analysis; and
- Sampling and analysis.

Monitoring at sea will provide the following information:

- Volume of oil: use ITOPF guidance based on oil type and appearance to assess thickness (mm) and volume of oil (m^3/km^2) at sea, or the guidance of the Bonn Agreement Oil Appearance Code (BAOAC) identifying the following relations between oil appearances and oil volume:

1. sheen, 0.15-0.3 m^3/km^2;
2. rainbow, 0.3-5 m^3/km^2;
3. metallic, 5-50 m^3/km^2;
4. discontinuous true color, 50-200 m^3/km^2; and
5. continuous true color, > 200 m^3/km^2.

- Location and coverage of slick at sea (latitude and longitude - GPS);
- Oil characteristics (persistent vs. non persistent / viscosity); and
- Origin of slick (if visible, ship name and IMO number, offshore installations ID number).

On-shore monitoring will be used to assess the extent of impacted shorelines, type and degree of contamination as well as impact on habitats and wildlife casualties.

- **HNS:**

Detection of HNS pollution events and assessment of impacts are primarily achieved on site by expert human eye observation, complemented with real time monitoring, sampling and analysis, as well as the

use of modelling tools. Conclusions of any risk assessment for HNS will be based on a number of information including identification of incident circumstances and location; identification of the involved chemical, its properties/toxicity, and its form (packaged/bulk) as well as identification of sensitive neighbouring areas and environment conditions.

Furthermore, Article 18 (Mutual Assistance in cases of Emergency) of the Offshore Protocol states that in cases of emergency, a Contracting Party thereto, which is also a Contracting Party to the Protocol Concerning Co-operation in Combating Pollution of the Mediterranean Sea by Oil and other Harmful Substances in Cases of Emergency ("the 1976 Emergency Protocol"), shall apply the pertinent provisions of the said Protocol.

Available data sources

Because pollution events originating from ships must lead to response operations and investigations, there are a number of reporting obligations and reporting protocols that are useful for the purpose of determining the frequency of occurrences and assess trends:

(1) Contents and forms of reports that ships must send following maritime casualties involving oil and other hazardous substances are detailed in MARPOL Annex I. In addition, IMO developed the "General Principles for Ship Reporting Systems and Ship Reporting Requirements, including Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances and/or Marine Pollutants", containing recommendations on reporting requirements (when to report, information required, whom to report to). MEPC/Circ.318 described above set out the format of the mandatory submission to the Secretariat of IMO.

(2) At regional level, the standard pollution accidents reporting format (POLREP) and related procedures provided under MARPOL detailed above are used between Contracting Parties to the 2002 Prevention and Emergency Protocol and between these Contracting Parties and REMPEC for exchanging information when pollution of the sea has occurred or when a threat of such is present. Contracting Parties can use MEDGIS-MAR and/or BCRS described above to comply with their biannual reporting obligation on spill incidents.

(3) With respect to illegal discharges of oil from ships, REMPEC organised pilot projects on surveillance and monitoring of oil discharges at sea in the past. These initiatives led to the establishment of the Mediterranean Network of Law Enforcement Officials relating to MARPOL within the framework of the Barcelona Convention (MENELAS). This network works as a forum where information is exchanged and it is expected that data on pollution incidents (as well as on investigation and prosecution as the case may be) will be collected. REMPEC acts as the MENELAS Secretariat and the possible development of a MENELAS database on illicit ship pollution discharges in the Mediterranean and related reporting format are being looked into. Contracting Parties to the Barcelona Convention can use MEDGIS-MAR to report illegal discharges from ships and those parties to MARPOL have the obligation to submit an annual report to the Secretariat of IMO, the format of which is set out in MEPC/Circ.318, as described above.

Databases available:

- Global Integrated Shipping Information System (GISIS) (http://gisis.imo.org) maintained by IMO, with a module on marine casualties and incidents.

- Mediterranean Integrated Geographical Information System on Marine Pollution Risk Assessment and Response (MEDGIS-MAR) ~~2012~~ 1977-2018 ~~5~~

(http://medgismar.rempec.org/) provides data (private access) on offshore, marine incidents, oil handling facilities, and response equipment.

- Emergency Communication and Information System for marine pollution incidents (CECIS Marine), the Union Maritime Information and Exchange System (SafeSeaNet) and CleanSeaNet

- Lloyd's list intelligence database (https://www.lloydslistintelligence.com/incidents/), including a section on incidents with detailed reports for each event.

Spatial scope guidance and selection of monitoring stations

REMPEC will continue to be the central organisation coordinating and maintaining data on oil and HNS acute events and pollution surveillance in the Mediterranean Sea. REMPEC has implemented pilot projects involving aerial surveillance exercises and satellite imagery analysis jointly with Mediterranean coastal States and this effort should be strengthened.

Despite the fact the spatial scope for acute events recording is the entire Mediterranean Sea, aerial surveillance and satellite image analysis can be concentrated in specific areas. Maritime traffic routes should be considered because they can be indicated as sea-based sources of marine pollution in relation to some of the Common Indicators, and particularly for CI 19. In addition, available evidences show that most of the incidents occur near the coasts and in particular close to major ports and anchoring areas which are also areas where to concentrate monitoring effort.

When revising and agreeing on the nested areas (bottom-up approach), proposing the list of monitoring and reporting units in the Mediterranean Sea, the distribution of offshore O&G platforms and pipelines should also be taken into consideration.

Temporal Scope guidance

As oil and HNS pollution incidents from ships occurs unexpectedly (as a consequence of maritime casualties) or are not systematic (MARPOL illicit discharges), it is expected that pollution monitoring will continue to essentially take place "in real time" when pollution incidents actually happen or are detected.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

Frequencies and quantitative statistical analysis. The basis for aggregation would be a "nested approach" over a geographical scale. Trend analysis to calculate the percentage of occurrences for oil and HNS incidents over a period of time (yearly) in the Mediterranean Sea.

Expected assessments outputs

Temporal trends analysis and distribution maps. If possible, this trend should be related to the maritime traffic crossing the Mediterranean Sea. Mapped events can be classified by different attributes, including the volume of the spill, the spilled substance and the year of occurrence. As for trends, maps should be related to maritime traffic, for example by overlapping main shipping routes and most busy areas (see REMPEC, 2020 for reference).

Known gaps and uncertainties in the Mediterranean

While Contracting Parties to the Barcelona Convention and to the 2002 Prevention and Emergency Protocol have a pollution monitoring and reporting obligation, data submitted to REMPEC are still scarce. Thus, the main aim during the initial phase of the IMAP will be to strengthen monitoring efforts towards this already existing obligation.

Maintaining the Mediterranean Alerts and Accidents Database is a prerequisite and the condition for being able to measure Common Indicator CI19.

Little information is available on the impact of pollution events caused by shipping on biota and habitat. This is due to the fact that ship generated pollution impact is usually considered from a response perspective (protection of sensitive areas and facilities) and there is no obligation for countries to carry out environmental surveys of sea and shorelines affected by a spill. Following the sinking of the product tanker Agia Zoni II, which was loaded with 2,194 metric tons of heavy fuel oil and 370 metric tons of marine gas oil, on 10 September 2017, a Study of the short- and medium-term environmental consequences of the sinking of the AGIA ZONI II tanker on the marine ecosystem of the Saronikos Gulf (REMPEC/WG.45/INF.7) was carried out, addressing a gap identified by the MED QSR 2017. The set-up of database gathering assessment of the impact on biota affected by acute pollution events should be considered in future updated of MEDGIS-MAR.

Additional efforts should be undertaken towards the definition of sub-indicators under CI19, to assess the impact of oil spill on biota. Approaches are available (based e.g. on ecotoxicological, bioaccumulation and biomarkers data), under the EU Marine Strategy Framework Directive (Descriptor 9, Criterion 4), and could be capitalized and adapted to the Mediterranean context. (Source: Adverse effects of significant pollution events on species and habitats dataset in support of the Marine Strategy Framework Directive (MSFD) Descriptor 8 (D08C04, 2018 Reporting).

The focus of IMO conventions and guidelines relating to prevention of marine pollution is on ships' compliance monitoring rather than on monitoring or measuring the state of the marine and coastal environment. The same can be noted with respect to reporting obligations. Reporting is required in the case of an accident causing pollution or in case of an illegal pollution is discovered (operational discharges). This perspective is reflected in the 2002 Prevention and Emergency Protocol. Therefore, the information collected is related to specific pollution events and not always useful or compatible with the information needed to assess the status of the marine environment.

Very little data is available regarding illicit discharges from ships. As these are illegal operations by nature (when not within the limits set by MARPOL), it is extremely difficult to get information on occurrences and extent of spills. Marine surveillance requires aerial means and equipment (planes, airborne radars and sampling sets) or special technology such as the use of satellite images.

Despite the effort of the Secretariat to facilitate reporting obligation, the majority of 22 Contracting Parties with few exceptions of four (4) are still in non-compliance with their reporting obligation under Article 9 of the 2002 Prevention Protocol. A similar observation can be made with regard to the reporting obligation defined by IMO Circular MEPC/Circ.318. This has an impact on the monitoring of the CI19 and on the assessment of the progress made regarding EO9. To address the lack of reporting, the Compliance Committee under the Barcelona Convention and its Protocols, recommended through Decision IG.24/1:

(1) To foster the collection of data on pollution incidents a user friendly and simple online system for reporting should be in place.

(2) To encourage Contracting Parties to report pollution incidents under the online Barcelona Convention Reporting System (BCRS).

(3) To support the Secretariat in carrying out (at international and regional level) a comparative exercise between already existing reporting procedures and formats.
Contacts and version Date
http://www.rempec.org

Version No	Date	Author
V.3 ~~2~~	21.08.2020 ~~31.05.2018~~	MED POL/REMPEC

III. Revision of the Guidance Factsheet of CI6

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.
Rational		

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 ~~while their number is increasing at a rate of one new record every 2 week (Zenetos et al. 2012)~~ NIS introductions still occur, the rate of NIS introductions decreases in the time period 2006-2017. The decreasing trend can be assigned to polices effectiveness as well as to other reasons, such as decreasing pool of potential NIS species, variations in sampling effort or available expertise (Galil et al., 2018). However, only around 12% of all of NIS in the Mediterranean are today considered as invasive, or potentially invasive (Rotter et al., 2020)[2]. Macrophytes (macroalgae and seagrasses) are the dominant NIS 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.

However, the overall ecological impact of NIS on the Mediterranean Sea remains relatively difficult to quantify, and it evaluation is mainly qualitative; nevertheless, there have been some good attempts at quantification (Katsanevakis et al., 2014, 2016; Gallardo et al., 2016). In particular, the analyses of Katsanevakis et al. (2014) have led to the conclusion that the majority of the recognized invasive species in the European seas (72%) have both positive and negative impacts on the native biota. Few have only positive effects (8%), while more (~20%) have only negative effects on the host environment.

[2] Invasive Alien Species (IAS) means an alien species whose introduction and/or spread threaten biological diversity (rif. CBD Guiding Principles (CBD Decision VI/23) and the European Strategy on IAS).

To take effective actions against biological invasion, knowledge about the vector of NIS is crucial. Corridors represent the main vector for NIS in the Mediterranean, followed by vessels, though the relative importance of vectors varies among individual countries.

In order to build a comprehensive assessment of impact from shipping, monitoring and assessment under this Indicator should be linked to monitoring of acute pollution events and underwater noise.

Scientific References

Galil BS, Marchini A, Occhipinti-Ambrogi A, Minchin D, Narščius A, Ojaveer H, Olenin S. (2014). International arrivals: widespread bioinvasions in European Seas. Ethol Ecol Evol. 26(2–3):152–171. doi:10.1080/03949370.2014.897651.

Galil BS., Agnese Marchini and Anna Occhipinti-Ambrogi (2018). Mare Nostrum, Mare Quod Invaditur—The History of Bioinvasions in the Mediterranean Sea. In: Queiroz Ana Isabel & Simon Pooley Eds. Editors. Histories of Bioinvasions in the Mediterranean. Springer.

Gallardo, B., Clavero, M., Sánchez, M. I., and Vilà, M. (2016). Global ecological impacts of invasive species in aquatic ecosystems. Glob. Chang. Biol. 22, 151–163. doi: 10.1111/gcb.13004

Katsanevakis, S., Wallentinus, I., Zenetos, A., Leppäkoski, E., Çinar, M. E., Oztürk, B., et al. (2014). Impacts of marine invasive alien species on ecosystem services and biodiversity: a pan-European review. Aquat. Invas. 9, 391–423. doi: 10.3391/ai.2014.9.4.01

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.

REMPEC (2020). Study on trends and outlook of marine pollution from ships and activities and of maritime traffic and offshore activities in the Mediterranean".

Rotter Ana, Klun Katja, Francé Janja, Mozetič Patricija, Orlando-Bonaca Martina (2020). Non-indigenous Species in the Mediterranean Sea: Turning from Pest to Source by Developing the 8Rs Model, a New Paradigm in Pollution Mitigation. Frontiers in Marine Science 7: 178. 10.3389/fmars.2020.00178

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

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

Policy Context and targets (other than IMAP)

Policy context description

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

can have. The Regulation foresees three types of interventions; prevention, early detection and rapid eradication, and management.

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

In order to provide basis for development of relevant policies to combat NIS, assessment of vectors of introduction is needed.

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 Tn that was not present at Tn-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 Tn minus the corresponding number of non-indigenous species at Tn-1. Hereby Tn stands for the year of reporting.

Indicator units

'Trends in abundance': % change per year

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

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

List of guidance documents and protocols available

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

Some guidance on the monitoring of biodiversity (including non-indigenous species) for the needs of the MSFD is provided in: Zampoukas et al. (2014) Technical guidance on monitoring for the Marine Stategy Framework Directive. JRC Scientific and Policy Reports (EUR collection), Publications Office

of the European Union, EUR 25009 EN – Joint Research Centre, doi: 10.2788/70344, ISBN: 978-92-79-35426-7, 166p.

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

Data confidence and uncertainties

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

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

Methodology for monitoring, temporal and spatial scope

Available methodologies for monitoring and monitoring protocols

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

As a complimentary measure and in the absence of an overall NIS targeted monitoring programme, rapid assessment studies may be undertaken, usually but not exclusively at marinas, jetties, and fish farms (e.g. Pederson et al. 2003).

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

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

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

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

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

Available data sources

Marine Mediterranean Invasive Alien Species database (MAMIAS) - http://www.mamias.org/

European Alien Species Information Network (EASIN) - http://easin.jrc.ec.europa.eu/

CIESM Atlas of Exotic Species in the Mediterranean - http://www.ciesm.org/online/atlas/

World Register of Introduced Marine Species (WRIMS) - http://www.marinespecies.org/introduced

Spatial scope guidance and selection of monitoring stations

The monitoring of NIS generally should start on a localised scale, such as "hot-spots" and "stepping stone areas" for alien species introductions. Such areas include ports and their surrounding areas, docks, marinas, aquaculture installations, heated power plant effluents sites, offshore structures. Areas of

special interest such as marine protected areas, lagoons etc. may be selected on a case by case basis, depending on the proximity to alien species introduction "hot spots". The selection of the monitoring sites should therefore be based on a previous analysis of the most likely "entry" points of introductions and "hot spots" expected to contain elevated numbers of alien species.

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

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

A revision and agreement on the nested areas (bottom-up approach) is needed that includes integration of monitoring scales based on nested approach, proposing the list of monitoring and reporting units in the Mediterranean Sea. The geographical distribution of NIS, showing a higher presence in the Aegean and Levantine basin, should be taken into consideration when defining monitoring stations. The nested approach has to consider the differences in NIS occurrence in the different sub-basins.

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
- National inventories clustering NIS according to main vectors of introduction (e.g. seaways, shipping, mariculture, etc.).

Known gaps and uncertainties in the Mediterranean

The lack of dedicated and coordinated monitoring at national and regional scale implies a low confidence in the assessment of NIS, even if the continuous and regular occurring of new introductions are demonstrated. This lack of standardized monitoring and data currently compromises representability and comparability between assessment cycles, and thus complicate assessment of effects of management measures on these trends.

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.

Evidence for most of the reported impacts of alien species is weak, mostly based on expert judgement; a need for stronger inference is needed based on experiments or ecological modelling. The assessment of trends in abundance and spatial distribution is largely lacking.
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
V.3	30.09/2020	SPA/RAC-REMPEC