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National Assessments of the IMAP implementation

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**Analysis of the National Integrated Monitoring and Assessment
Programme (IMAP) of Lebanon**

April 2023

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Foreword

This document provides an analysis of the National Integrated Monitoring and Assessment Programme (IMAP) of Lebanon. It is a compilation of the information provided in the following documentation:

- The National Monitoring Programme developed by the team of the National Centre for Marine Sciences of the Lebanese CNRS for EO1 (Common Indicators 3, 4 and 5), EO2 (Common Indicator 6), EO5 (Common Indicators 13 and 14), EO9 (Common Indicators 17, 18, 20 and 21) and EO10 (Common Indicators 22 and 23).
- The analysis performed by four regional experts appointed by the IMAP-MPA Project to Support the implementation of the National IMAPs in Algeria, Egypt, Israel, Lebanon, Libya, Morocco and Tunisia by providing scientific and technical assistance to the national teams in charge of the development and implementation of IMAP at national level. In their respective reports, the regional experts evaluated the compliance of the National IMAPs with the IMAP monitoring requirements (proposed monitoring sites, techniques and methodologies), identified gaps and provided recommendations and proposals on the integration potential of IMAP EO1, EO2, EO5, EO9 and EO10.

The National IMAP of Lebanon was analysed to evaluate compliance with IMAP monitoring requirements (e.g. list of stations, maps, GIS layers, spatial-temporal scale/frequency, protocols, methodological/analytical techniques, monitoring protocols and reporting templates).

1. Introduction

Lebanon has approximately 220 km of coastline oriented north-south in the eastern part of the Levantine basin of the Mediterranean Sea. The coastal zone of Lebanon has a typical four-seasons Mediterranean climate with a cold and relatively winter and a long hot and dry summer season. It is essentially made up of three bays and a series of promontories and estuaries. About 20% of the coast has sandy or gravel beaches, but much of the sandy coast has been seriously degraded by illegal sand mining which has only been controlled since the nineties.

The Lebanese marine waters extend over approximately 19,516 km². They are relatively deep and characterized by the presence of several canyons and a narrow continental shelf. Along the Lebanese coast, marine currents are northeast oriented and they generate near the coast gyres rotating to the right (clockwise). The occurrence of many submarine fresh water springs along the Lebanese coasts was reported by several investigations.

The Lebanese coast is subject to significant anthropogenic pressures, linked in particular to urbanization. According to the Worldometer¹ elaboration of United Nations data, the country's population increased by about 52% during the ten last years (2013-2023) to reach 6.7 million in the first quarter of 2023. Beirut, the capital, is the largest city of the country with a population close to 2 million. The main sources of marine water pollution in Lebanon are generated by the dumping of solid waste on the seashore and the discharge of domestic and industrial wastewater. Oil pollution posed a serious threat in 2006-2007 with the spill of around 15,000 tonnes of oil spreading 100-120 km off the Lebanese coast and affecting tourist beaches, marinas, fishing wharves and seaports (UNDP, 2007). Currently this type of pollution is confined to sites hosting hydrocarbon storage areas, but other zones might be affected by the expected increase in the oil and gas sector in eastern Mediterranean.

In terms of marine biodiversity, the Lebanese coast is known to host natural habitats for endangered fauna and flora, including remarkable habitats and organogenic formations such as platforms with vermitids, considered as natural monuments in the Mediterranean. To protect the country's remarkable marine habitats, the Lebanese authorities, in collaboration with IUCN and SPA/RAC organised a series of field surveys to identify marine areas of conservation interest. The results of the surveys were used to elaborate the Lebanon's Marine Protected Areas Strategy adopted in 2012.

The fishing sector is not very developed in Lebanon. Annual landings from the fishery are estimated at around 2,500 tonnes. There are no studies on the state of exploited stocks in Lebanon, but studies published in 2006 indicated that it is essentially juveniles that are exploited by fishing, which is not in favour of the sustainability of this activity.

2. Legal and administrative provisions regarding environmental monitoring

The Environment Act (Law 444/2002) of 29/07/2002

The Environmental Act is the most important framework of environmental legislation in Lebanon. It defines the principles of environmental action and outlines the needed measures for the preservation of the various environments of the country. Concerning environmental monitoring:

¹ <https://www.worldometers.info/population/>

- It specifies that environmental monitoring should be abided with to prevent pollution (Article 4).
- It entrusts the Ministry of the Environment with defining environmental quality standards (Article 12).
- Its Chapter 3 is devoted to the environmental information system, the implementation of which is supervised by the Ministry of Environment.

For the application of this Act, several decrees have been issued. Those that are of relevance for environmental monitoring are the decrees relating to strategic environmental assessment and environmental impact assessment.

Decree 8213 of 24/05/2012 relating to the “Strategic Environmental Assessment for Proposed Policies and Plans and Programmes in the Public Sector”:

The relevance of this decree in terms of environmental monitoring stems in particular from its provisions relating to environmental management plans, which must include an environmental monitoring plan (Article 7).

Decree 8633 of 16/08/2012 relating to the “Fundamentals of Environmental Impact Assessment”.

This decree does not include in its main text any provisions explicitly related to environmental monitoring, but in its appendix 7, it requested that the environmental monitoring programme as well as the evaluation of its cost must appear in the impact assessment document of any project subject to this procedure.

Other texts are relevant for the implementation of IMAP, in particular the Ministerial Orders pertaining to standards for the quality of bathing waters (N° 216 of 8/4/1993) and to standards for reducing air, water and soil pollution (No. 1/52 of 12/09/1996).

The obligation of environmental monitoring is also covered by the management plans of protected areas, such as the management plans of the Palm Islands nature reserve and the Tyre Coast Nature Reserve.

3. National institutions having mandate or capacity in relation to monitoring marine environment²

In Lebanon several institutions have prerogatives in relation to the preservation of the marine environment, however only few of them have mandate or capacity to develop and implement monitoring programmes of the marine environment.

3.1 The Ministry of Environment

The Ministry of Environment of Lebanon was created in 1993 (Law 216/1993 of 02 April 1993). Its missions were modified in 2005 (Law 690/2005). Its Service of Planning and Programming is responsible for environmental monitoring through its Department of Environmental Monitoring and Statistics. According to Law 690/2005, this department has mandate to:

- Prepare strategies, plans and projects to introduce the concepts of environmental monitoring into the work of the General Directorate of the Environment
- Collect data relating to the environment at the local, regional and international level in collaboration with specialized centres.
- Calculate environmental and development indicators and monitor the state of natural resources and sources of pollution.

² This section is made of extracts from the study " National monitoring programme for pollution and marine litter in Lebanon (EO5, V9 and EO10)"

3.2 Ministry of Public Health (MoPH)

The Ministry of Public Health acts in the examination of water quality in public beaches and tourist resorts, conducts studies and suggests protocols aiming to protect the environment from threats to public health. It also has the authority of approving projects related to the construction of slaughterhouses and sewage networks.

3.3 National Centre for Marine Sciences (NCMS/CNRSL)

The National Centre for Marine Sciences-CNRSL was established in 1977. The decision to establish the centre (1975) was a national response to the 1972 Stockholm Conference. The centre is a recognized institute within the Mediterranean network of marine centres and is integrated in a number of regional and international activities.

Research activities at the centre focus on the following themes:

- Monitoring of the entire coastal zone in the framework of a national monthly monitoring programme.
- Biogeochemical measurements and time-series surveys in the context of the climate change and ocean acidification.
- Detection of the pollution sources on the coastline and assessment of the transfer and bioaccumulation of chemical compounds in the coastal and marine ecosystems.
- Evaluation of the marine species (from plankton to cetaceans) and their habitats, and assessment of the migratory species and their influences on local ecosystems.
- Ichthyological studies and fishery stock evaluation.

Within this framework, the actual skills cover the following aspects: Operational and physical oceanography, hydrological parameters, climate change and biogeochemistry, palaeontology, marine biology, primary and secondary production and biodiversity, marine water and sediment chemistry and bacteriological contamination.

3.4 National Center for Remote Sensing (NCRS/CNRSL)

The NCRS is another part of the Lebanese CNRS. It was established in 1995 and became fully operational in 1997. It is linked to various regional and international organizations for implementation of collaborative programmes. It has an important role in studies related to watershed and forestry management, urban settlements, archaeology and the environment, integrated coastal zone management, public participation, natural hazards, updated soil map of Lebanon. It is known to cooperate with several development projects necessary for environmental monitoring, data acquisition in various sectors, producing various thematic maps, training staff of various public agencies on requirements and applications of remote sensing and GIS, therefore, acting as a potential stakeholder for the monitoring of marine pollution and litter (IMAP).

3.5 National Center for Geophysical Research (NCGR/CNRSL)

The NCGR was established in 1975 and is the oldest center of the Lebanese CNRS. It is involved in monitoring the seismic activity in Lebanon and performing multi-beam bathymetric scans for map production of the Lebanese bathymetry using the CANA-CNRS vessel that is equipped with a multi-beam echo-sounder system.

3.6 Lebanese Atomic Energy Commission (LAEC)

The LAEC was established in 1996 with the full support and assistance of the International Atomic Energy Agency (IAEA). LAEC aims to encourage and develop the peaceful use of atomic energy in the country and spread the Safety and Security Culture for the use of

radiation sources. It also performs applied research using nuclear techniques and technologies and establish national infrastructure for radiation protection including the preparation of the necessary legislations for protecting the public, workers and environment against ionizing radiation.

3.7 Observatories for the environment and sustainable development

Observatoire Libano-Francais de l'Environnement (O-LiFE) / CNRSL was established in 2012. O-LiFE was conceived to establish a scientific collaborative system to tackle priority environmental issues affecting the Mediterranean Basin that takes into consideration the reality of limited timeframe and resources. O-LiFE is a shared environmental observatory between France and Lebanon to serve as a medium for scientific collaboration, resources and facilities sharing as well as for knowledge and expertise exchange. Based on concrete environmental data and information, the platform allows for effective management of current issues while predicting future trends, scenarios and challenges.

Lebanese Environment and Development Observatory (LEDO) hosted by the Ministry of Education. This observatory published a report in 2002 presenting the state of the Lebanese environment. LEDO ceased to function after the end of the project in 2002.

Tripoli Environment and Development Observatory (TEDO) was created in 2000 and has full-time staff and equipment for monitoring the main environmental factors in Tripoli, El Mina and Beddawi. TEDO is currently focused on monitoring air quality and solid waste.

3.8 Non-governmental organisations (NGOs)

There are several active environmental NGOs in Lebanon; however, few are involved in regular environmental monitoring actions. Some environmental NGOs in Lebanon include:

- Society for the Protection of Nature in Lebanon (SPNL)
- Bahr Loubnan
- Friends of Nature
- Operation Big Blue
- Diaries of the Ocean

4. Analysis of the National IMAP of Lebanon

4.1 Common Indicators

The National IMAP-based Monitoring Programme of Lebanon includes all Common Indicators for EO2 (CI 6), for EO5 (CIs 13 and 14), for EO9 (CIs 17, 18, 19, 20 and 21) and for EO10 (CIs 22 and 23). For EO1 only CIs 3, 4 and 5 are included, CIs 1 and 2 will be included in a next phase of the National IMAP if additional resources will be available.

4.2 Selection of monitoring areas

For **EO1** and **EO2** The pilot monitoring sites selected during the national kick-off meeting for the IMAP-MPA project are Palm Islands Nature Reserve (PINR) and Tyre Coast Nature Reserve (TCNR) (as Marine Protected Areas), as well as Beirut (as a site under human pressures).

For EO5 and EO9, Historical sampling stations were used as a basis for defining the areas and monitoring stations for IMAP. The network of monitoring stations was updated to include offshore locations within transects covering the entire Lebanese coast.

The monitoring stations and transects for the **EO5** have been chosen based on the pre-existing knowledge available from the national monitoring programme concerning 25 stations along the Lebanese coastline monitored since the early 1990s by the National Centre for Marine Sciences/CNRS-L. Additional ones have been determined to widen the stations network and strengthen the monitoring of eutrophication to fulfil the IMAP objectives.

In Lebanon, the 19 stations listed in the following table have been selected for the monitoring of eutrophication, representing different coast typology, as reference sites (Naqoura, Beirut offshore, Tripoli Palm Island) and pressure sites (Tyre, Saida, Beirut, Batroun, Triploi, Akkar). For 9 stations, there is a joint monitoring with EO9.

Proposed monitoring areas, transects, sampling locations and sampling depths for the monitoring of EO5

Measurement zone	Type	Station-Code	Longitude	Latitude	Max. depth	Samp. depth	Description	Type of substrate	Sampling frequency
Naqoura	Coastal	NAQ-2	35.14588	33.12845	_	0-0.5	Southern station (reference)	Rocky	Monthly
Tyre	Tr.2	Jamal 1	35.18488	33.27211	12	0	Off Tyre's protuberance in the sea	Rocky	Seasonally
	Tr. 2	Jamal 2	35.16049	33.27450	31	0, 20			Seasonally
	Tr. 2	Jamal 3	35.12537	33.27713	61	0, 20, 60			Seasonally
Saida	Coastal	AWL-2	35.38777	33.59460	_	0-0.5	Off Saida's playground-beach	Sandy	Monthly
Beirut	Tr. 6	MANARA-10	35.46853	33.90235	13	0	In front of Beirut's protuberance in the sea, facing many hotels and resorts	Rocky	Seasonally
	Tr. 6	MANARA-60	35.44826	33.89763	67	0, 60			Seasonally
	Tr. 6	MANARA-200	35.43917	33.89702	230	0, 100, 200			Seasonally
	Open-sea	A3	35.43296	33.98829	1500	0, 80, 150, 250, 400, 600	NCMS's main open-sea station-The furthest and the reference about the offshore status	Seasonally - Chl a; Monthly - T & S	
Batroun	Coastal	SEL-2	35.65715	34.26810	_	0-0.5	Close to Selaata industry (phosphogypsum factory; high radioactivity in the area)	Sandy	Monthly

Measurement zone	Type	Station-Code	Longitude	Latitude	Max. depth	Samp. depth	Description	Type of substrate	Sampling frequency
	Tr. 9	B1	35.65607	34.26000	8	0-0.5	Time-series station located few meters outside the port of Batroun	Rocky	Monthly
	Tr. 9	B2	35.60112	34.24760	500	0, 20, 40, 60, 80			Monthly
Tripoli	Tr. 10	TRI-10	35.84840	34.46530	10	0	This transect starts on the mouth of Abou Ali river and ends in the vicinity of the Palm Islands Nature Reserve (MPA)	Muddy	Seasonally
	Tr. 10	TRI-40	35.82570	34.48100	45	0, 20, 40			Seasonally
	Tr. 10	TRI-60	35.79260	34.49950	65	0, 20, 60			Seasonally
Akkar	Coastal	AKK-2	35.98782	34.59438	-	0-0.5	Close to the old Klayaat airport	Sandy	Monthly
	Tr. 11	AKK-10	35.97890	34.59250	10	0			Seasonally
	Tr. 11	AKK-40	35.96120	34.58870	45	0, 20, 40			Seasonally
	Tr. 11	AKK-60	35.92640	34.58090	65	0, 20, 60			Seasonally

Monitoring stations for **EO9** were selected considering spatial coverage and included offshore transects and coastal areas of concern which were identified based on existing information, such as areas in the vicinity of dumpsites, wastewater discharges, agricultural activities, industrial discharges and areas of known past/present release of chemical contaminants. The selection of stations has taken into consideration hotspots, risk areas, coastal locations and reference areas and also the feasibility of sample collection (i.e., type of substrate and sufficient number of the selected biota species).

The E09 monitoring stations are located in 9 areas (Naqoura, Tyre, Saida, Damour, Beirut, Jounieh, Byblos, Tripoli and Akkar governorate) and include long-term master stations distributed spatially, as well as coastal and offshore stations within transects. In each area there are point stations and/or transects (2 areas with point stations, 7 areas with transects; 4 point stations and 10 transects of 3 stations in total in all 9 areas). The EO9 stations cover both the different geomorphologic characteristics of the Lebanese coast from north to south, as well as the main anthropogenic pressures. Reference stations are included as well as a transect close to a Marine Protected Area, the Palm Island Nature Reserve.

For CI 17 monitoring, sediment and biota stations are located in transects in 7 areas (2 stations per transect for sediment sampling and 1 station per transect for biota sampling) and additional biota stations in 2 areas. The same biota sampling stations are proposed for CI 17, CI 18 and CI 20. For CI 21 monitoring, stations include the closest to the shore stations of the above transects, as well as an offshore station and an additional station in Beirut area.

The number of sampling stations and transects for the Monitoring for the Common Indicators of EO9 will be as follows:

- CI 17: 20 sediment sampling stations in 10 transects in 7 measurement areas plus 9 coastal sampling locations for biota in 9 measurement areas.
- CI 18: 9 coastal sampling locations for biota in 9 measurement areas.
- CI 19: according to national authorities in charge of oil spill contingency planning. Therefore, the dataflow and coordination should be further established.
- CI 20: to be additionally concreted according to the fisheries coastal and offshore sampling areas; the NCMS could not define more than overall directions for establishing monitoring based on IMAP CI 20 where joint sampling along the transects are proposed and additional coordination with the NCMS Department of Fish Biology and Stock Assessment is needed.
- CI 21: 30 locations contemplated in the existing national bathing water quality monitoring grid, plus the Manara transect offshore Beirut (3 sampling stations), the A3 offshore station, as well as the closest stations to coast in all 11 transects.

The areas selected to monitor litter washed ashore and/or deposited on coastlines (>2.5 cm) in relation to CI 22 (**OE 10**) are public beaches surrounded by multiple sources of pollution: Public Beach of Saida (South Lebanon), Public Beach of Ramlet El Bayda (South of Beirut City) and Public Beach of Byblos (Bahsa, North Lebanon).

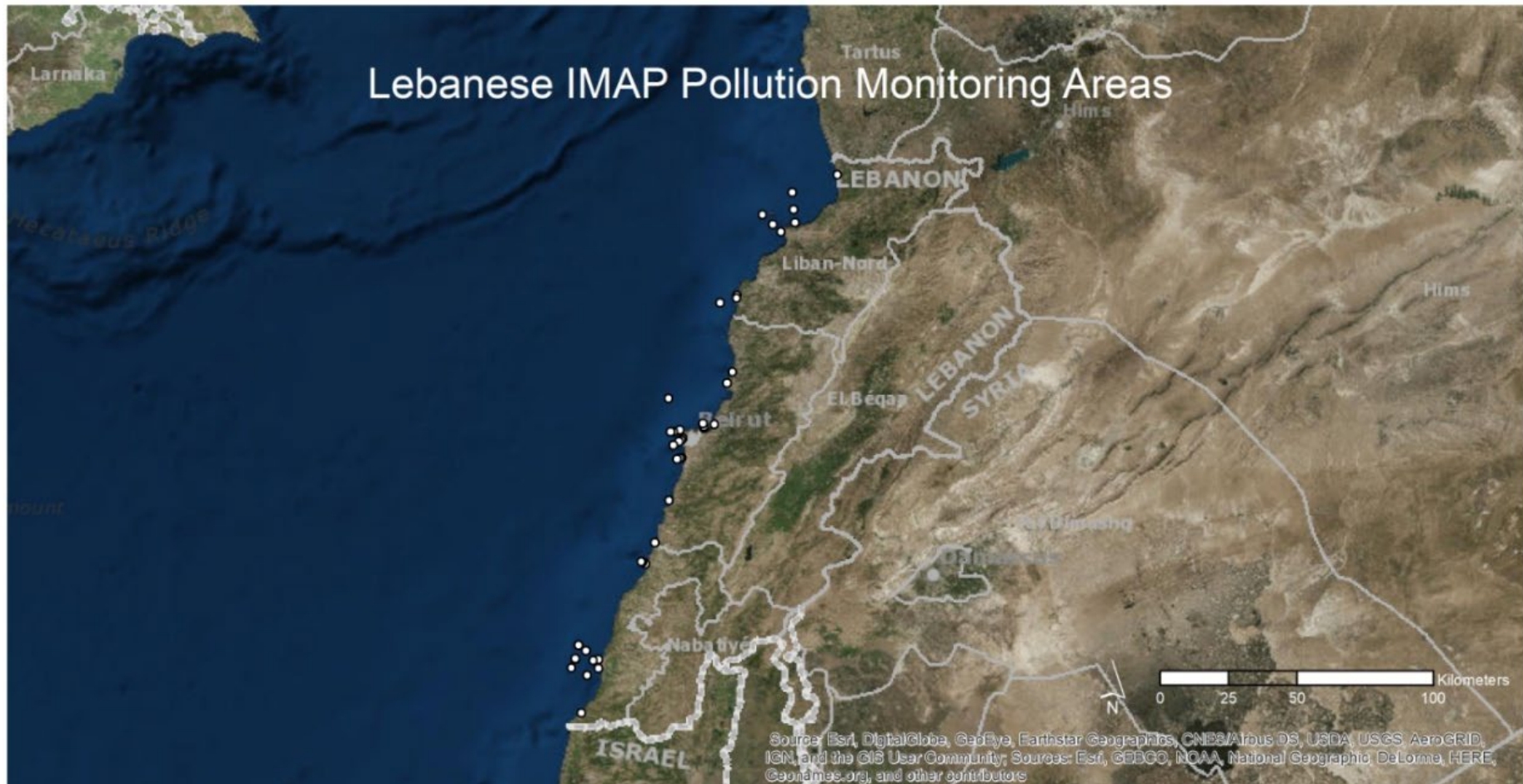
The Monitoring of floating marine litter for CI 23 (EO 10) will be (i) by continuous observation of marine litter > 2.5 cm along a transect between Beirut and Tyr (South Lebanon) for over a distance 80 Km and (ii) along four transects in Beirut marine area to collect microplastic in the sea and 3 transects in Tyr marine area.

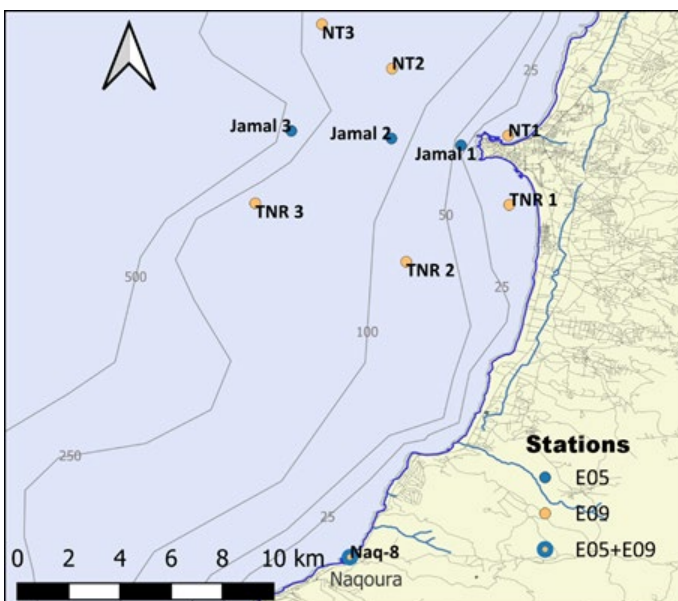
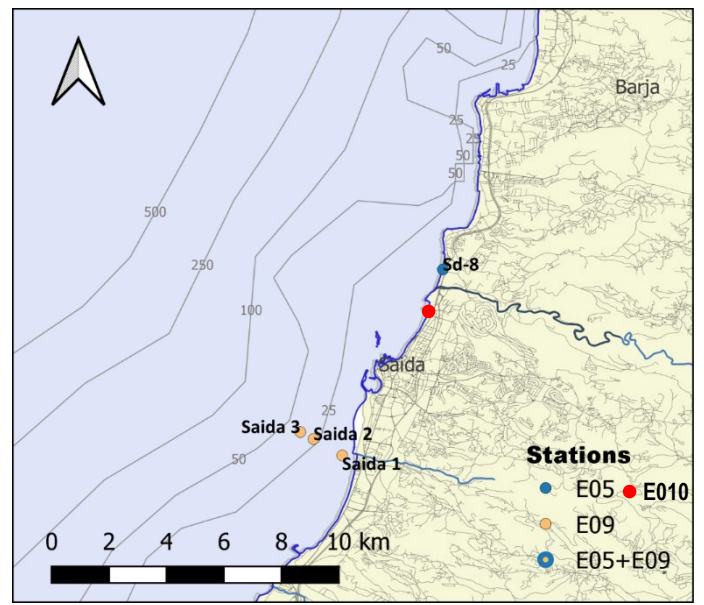
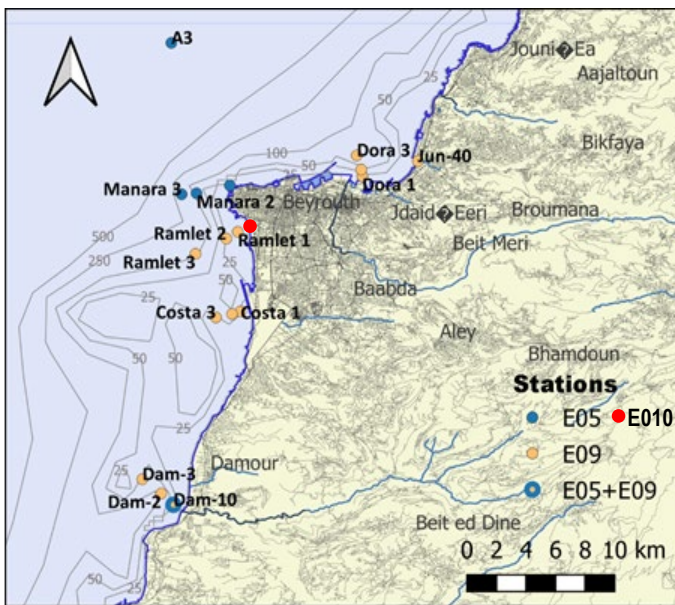
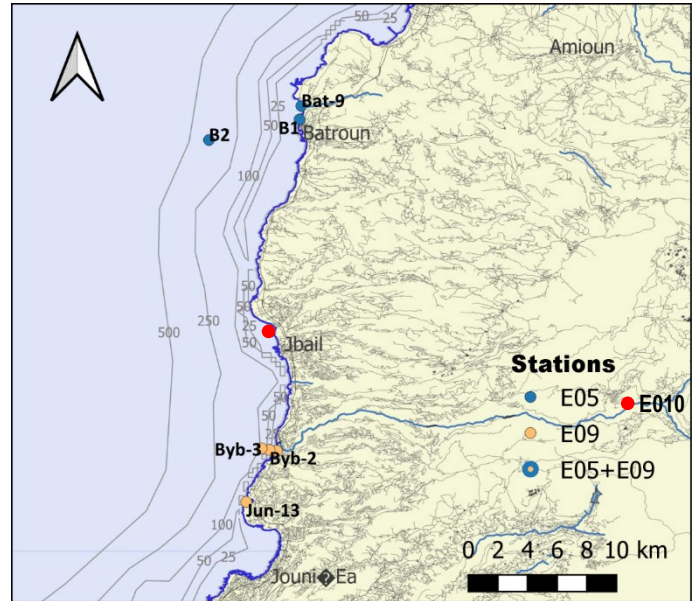
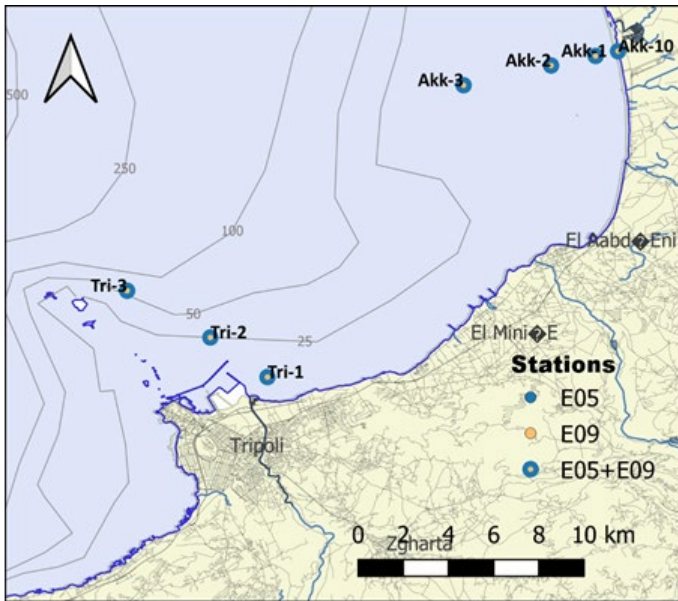
For seafloor marine litter (CI 23, EO 10), Sites should be selected to ensure that they comprise areas with uniform substrate (ideally sand / silt bottom), consider areas that might accumulate litter, avoid areas of risk (presence of munitions), sensitive or protected areas and finally do not exert impact on any endangered or protected species. Sampling sites should be stratified relative to sources (urban, rural, close to riverine inputs) and impacted offshore areas (major currents, shipping lanes, fisheries areas, etc.). The areas that are to going to monitored for their sea floor marine Litter are regions of potential accumulation of litter close to former or later coastal dumpsites or affected by water movements such as general or local currents carrying litter from different sources. The sea floor of some of the following areas Manara (Ras Beirut), Dora (Beirut), Antelias (Beirut), Saida (South) and Tyr (South) may be monitored by using an ROV for depth ranging between 10 and 100 m.

Monitoring areas for the Common indicators of EO1, EO2, EO5, EO9 and EO10

Monitoring areas	EO1	EO2	EO5	EO9	EO10
Akkar					
Palm Island					
Tripoli					
Batroun					
Byblos					
Jounieh					
Beirut					
Beirut offshore					
Damour					
Saida					
Tyre					
Naqoura					

Monitoring stations and transects for EO5 and EO9 under The National IMAP of Lebanon





Monitoring stations and transects for EO5, EO9 and EO10 under The National IMAP of Lebanon:

A: Tripoli and Akkar area

B: North Beirut area

C: Damour and Beirut (Manara) area

D: Saida area

E: Naqoura and Tyre area

4.3 National entity responsible for the implementation of IMAP in Lebanon

The National Centre for Marine Sciences (NCMS) affiliated to the National Council for Scientific Research Lebanon (CNRSL) prepared the National IMAP for Lebanon and CNRS and it will continue with its regular implementation to act as the main national entity that is responsible for integrated monitoring and assessment of marine environment.

Over the past years, NCMS has built its capacity to become the leading marine sciences laboratory in Lebanon. It has two laboratories located in Jounieh and Batroun, and a research vessel (R/V CANA-CNRS) acquired as part of bilateral cooperation with Italy, as well as, a 7m twin-engine catamaran (CADMOS-CNRS). It has been performing a national monitoring programme of the Lebanese coast since 1972, where around 31 selected sites are visited monthly to collect samples (water, sediment and biota) to measure parameters such as: temperature, salinity, nutrients (nitrate, nitrite, phosphate), chlorophyll-a, Faecal coliforms, Faecal streptococci.

NCMS has four departments based on the research themes of focus:

- Department of Physical Oceanography involved in the study of currents, the water column and sediment parameters.
- Department of Hydrobiology and Environmental Chemistry involved in the monitoring of acidification and biogeochemistry and studying bacteriological and eutrophication parameters in the marine waters.
- Department of Primary and Secondary Production involved in the identification of phytoplankton and zooplankton in the water column, as well as, the determination of several harmful algae or planktonic fauna.
- Department of Fish Biology and Stock Assessment that participated in the preparation of the national IMAP Biodiversity related programme that is based on Ecological Objectives 1 and 3. It is involved in studying the biology and growth of several fish species along the Lebanese coast, as well as, performing the necessary analyses for fish stock assessment to provide recommendations in the General Fisheries Commission of the Mediterranean.

4.4 Analysis of the National IMAP of Lebanon for EO1

For EO1, Common Indicator 1 (Habitat distributional range) and Common Indicator 2 (Condition of the habitat's typical species and communities) are not included in the first phase of the National IMAP of Lebanon. They will be considered in the future if more resources will be available. The following Common Indicators are covered:

- Common Indicator 3: Species distributional range related to marine mammals, seabirds, marine reptiles);
- Common Indicator 4: Population abundance of selected species (related to marine mammals, seabirds, marine reptiles);
- Common indicator 5: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles)

The monitoring for marine mammals will be implemented according to pre-defined transects of the ACCOBAMS Survey Initiative (ASI 2018). During linear transects in the three monitoring areas, the following data will be collected:

- Time of observation,
- number of individuals for each species observed,
- Pod size,
- Exact GPS location of the observations
- Behaviour of the observed individuals (Normal swimming, Milling, Breaching, Feeding, Multispecies feeding aggregation, etc.),
- Number of calves (if any)
- Sighting conditions.

-
For marine turtles, the following data are expected to be collected:

- Data on the distribution ranges of sea turtles (nesting site distribution of loggerhead turtles, nesting site distribution of green turtles)
- Population abundance and trends
- Population demographics (growth, age at sexual maturity, survival, clutch size, hatching success, spatial and temporal monitoring of sex ratio)
- Monitoring of breeding areas (nesting female population and operational sex ratio)
- Samples and data to be collected from sea turtles (size measurement of individuals and tagging)
- Beach monitoring during nesting season and hatching season (hatched nest excavation)
- Calculation of hatching and incubation period, hatching success, number of nests
- Monitoring the effects of pressures on marine turtles (global warming, beach erosion, coastal development, etc.)
- Monitoring stranding
- Specific requested data related to seabirds:
- Data on the distribution ranges of seabirds and their habitats (species spatial distribution)
- Population abundance and trends (population abundance, population biomass when applicable)
- Population demographics (age distribution, sex distribution, fertility rate, survival, and mortality rate)
- Monitoring of the effects of certain pressures on seabirds (litter, contaminants, habitat destruction and disturbance to Wildlife, bycatch, etc.).

For seabirds the following specific data are expected to be collected:

- Data on the distribution ranges of seabirds and their habitats (species spatial distribution)
- Population abundance and trends (population abundance, population biomass when applicable)
- Population demographics (age distribution, sex distribution, fertility rate, survival, and mortality rate)
- Monitoring of the effects of certain pressures on seabirds (litter, contaminants, habitat destruction and disturbance to Wildlife, bycatch, etc.).

4.5 Analysis of the National IMAP of Lebanon for EO2

The biodiversity of the Levantine basin is heavily affected by non-indigenous species (NIS) invasion. The National IMAP of Lebanon should therefore include an important component for the monitoring and assessment in relation to EO2. The Common Indicator (CI) adopted by the Contracting Parties to the Barcelona Convention for EO2 is CI6 (Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas). In three monitoring areas selected for CI6 (Palm Island Nature Reserve, Beirut coast and Tyre coast Nature Reserve) A visual census conducted by scientific snorkelers and divers in predefined stations will be implemented for mobile species. Fish species will be identified and counted according to a 5 m visibility from all sides. Species and remarks will be recorded and photos will be taken. The habitat types will also be recorded, and the data will be supported by videos. Furthermore, a macro sample will be chosen to identify sessile species, their abundance, and coverage using a 50 x 50 cm quadrat at each predefined station. A photo and video of the quadrat will be taken for further validation. In addition, samples will also be scraped off the substrates for further analyses. Samples will be identified to the lowest possible taxonomic level according to several identification guides and by researchers from NCMS/CNRS-L. The World Register of Marine Species (WoRMS: www.marinespecies.org) will also be referred to for the updated confirmation of the species nomenclature.

The sampling will be done along transects of 100 m length covering several depths. A total of three quadrats in each transect will be sampled. Moreover, citizen science and local ecological knowledge, as well as information from small-scale fisheries will also be used for mobile species.

The monitoring methodology for CI6 in the National IMAP of Lebanon is in line with the recommendations of the Draft guidelines for the preparation of the country specific EcAp monitoring programme for biodiversity and NIS (UNEP(DEPI)/MED WG.444/Inf.14). It is based on direct observation and sampling in the water column and on the seabed.

In terms of monitoring areas, this component of the National IMAP of Lebanon is fully integrated with the monitoring for EO1, EO5 and EO9.

4.6 Analysis of the National IMAP of Lebanon for EO5

Although Eutrophication is not a common phenomenon along the Lebanese coastal waters, the terrestrial discharges (mainly sewage and industrial outlets) rich in phosphorus and nitrogen, would contribute largely to the acceleration of the occurrence of eutrophication mainly around the major coastal cities.

As part of the national monitoring programme of the Lebanese coast, since 1972 the NCMS has been monthly collecting samples (water, sediment and biota) in around 31 selected sites to measure parameters such as: temperature, salinity, nutrients (nitrate, nitrite, phosphate), chlorophyll-a, Faecal coliforms, Faecal streptococci. Also, Many sporadic studies were conducted in the Lebanese marine waters, mainly dedicated to the quantification of pollutants, some of them were related, directly or indirectly, to the EO5. Although only few of them tackled the long-term trends of environmental parameters on the coastal and marine areas, as required under IMAP, they could be used as reference for the implementation of IMAP in relation to EO5 along the Lebanese coast.

In order to monitor the eutrophication in the Lebanese coastal and offshore stations, the parameters listed in the following Table need to be measured in all the stations mentioned in the section 3.1. The NCMS is well equipped to run all the needed sampling and measurement procedures for the targeted parameters.

List of key parameters and sub-indicators according IMAP Common Indicator Guidance Facts Sheets (UNEP (DEPI)/MED WG.444/5)

Common indicator 13: Concentration of key nutrients in water column	
Key parameters:	Sub-Indicators:
Nitrate (NO ₃ -N)	Nutrient ratios (molar) of silica, nitrogen and phosphorus where appropriate: Si:N, N:P, Si:P
Nitrite (NO ₂ -N)	
Ammonium (NH ₄ -N)	
Total Nitrogen (TN)	
Orthophosphate (PO ₄ -P)	
Total Phosphorus (TP)	
Orthosilicate (SiO ₄ -Si)	
Common indicator 14: Chlorophyll <i>a</i> concentration in water column	

Key parameters:	Sub-Indicators:
Chlorophyll <i>a</i>	Water Transparency; Temperature; Salinity; Dissolved oxygen and Saturation; pH; Concentration of phytoplankton; Phytoplankton community composition

For a deeper understanding of the eutrophication process and its impacts in the studied areas, additional parameters (mentioned as sub-indicators in the above Table) are suggested to be included whenever possible in the monitoring programme. The key parameters in the Table are essential in the calculation of many multimeric indices such as turbidity index (TRBIX), general water quality index (GWQI), and trophic index (TRIX). These indices will simplify and make comparison between different spatial and temporal trophic situations of marine coastal waters more consistent.

With regard to the comparative analysis of the National IMAP of Lebanon against the UNEP/MAP IMAP Requirements, as a general observation it can be stated that most of the international standards relating to the various aspects of monitoring (sampling, storage and transport of samples, laboratory analyzes), summarized in the Factsheets for CI13 and CI14 (UNEP/MED W.G. 467/5), they were respected. Also, there is a good spatial coverage of the marine waters, both as regards coastal waters and offshore waters, in relation both to the length of the coastline and to its geomorphologic characteristics.

As regards the representativeness of the monitoring stations, there are transects which allow to evaluate the existence of a potential pressure gradient on the coast. In some cases, when there is a hotspot station located in the coast, it will be useful to monitor a transect starting from that station, in order to evaluate how long is the distance of influence from the coastline (e.g. the station in Batroun, close to Selaata industry because of the phosphogypsum factory with high radioactivity in the area).

Regarding the information on the stations, it is essential to associate, to each of them, the labels that are provided by the Data Dictionaries which are:

1. Closest Coast: Station distance from the coast in km
2. Area Typology: Typology of the monitored area enter one of the values in the list (R = Reference; C = Coastal; HS = Hot spot; O = Other)
3. Pressure Type: If the monitoring station id dedicated to monitor pressure, indicate the typology of pressure monitored, enter one of the values in the list (AP = Aquaculture plant; RP = River Plume; UWWTP = Urban Wastewater Treatment Plant; IP = Industrial Plant; O = Others)

Within the Pollution and Marine Litter Cluster, The National IMAP of Lebanon has a good coherence between monitoring stations for EO5 and monitoring stations for other EOs, in particular EO9 (contaminants), but also for EO10.

The sampling methodologies proposed for CI13 and for CI 14, comply with international standards and the information on sampling activities provided is clear and well defined.

4.7 Analysis of the National IMAP of Lebanon for EO9

Anthropogenic activities in the coastal zone of Lebanon have led to various levels of pollution in the marine environment which can have significant toxicological risk on seafood products, and consequently, on human health. In addition, the marine sediments and organisms, such as bivalves, tend to accumulate contaminants such as heavy metals and organochlorinated compounds, that could exceed the limits set by international standards, which are taken as the reference values for environmental assessments and included among others in the Decision of

the Contracting Parties to the Barcelona Convention with regards the IMAP assessment criteria (UNEP(DEPI)/MED WG.427/7). The increased urbanization pressures and population inhabiting coastal areas in Lebanon is causing a marked deterioration in water quality by pathogens, especially in the absence of adequate wastewater management plans in some areas. Therefore, all Common Indicators (i.e., CI 17, 18, 19, 20 and 21) for EO9 are relevant for the assessment of the status of the marine environment of Lebanon and are included in the National IMAP-based Monitoring Programme.

The NCMS/CNRS-L will implement the IMAP monitoring for EO9 based on the current efforts and built experience within the framework of MED POL. The NCMS/CNRS-L Departments of Hydrobiology and Environmental Chemistry and Fish Biology and Stock Assessment will be involved in EO9 monitoring. However, the IMAP parameters related to EO9 are not included in the current national monitoring programme and are identified as present gaps that need to be addressed to ensure full alignment of present national practices with IMAP. The parameters and complementary information proposed for the Lebanese revised monitoring programme for CI17, CI 18, 20 and 21 appear in the following Table.

Matrix	Contaminant group	Analytes	Additional parameters
Monitoring CI 17: Heavy metals, trace elements and organic chemicals			
Biota (bivalve <i>Brachidontes pharaonis</i> and fish <i>Mullus barbatus</i>)	Heavy metals	Cd, Pb, Hg, As, Fe, Li, Mn, Al, Cu, Zn, Cr, Ni and V	1. Biometric parameters for individual species 2. Dry/Wet ratio (lyophilization ratio) for normalization purposes
	Organic Contaminants	PCBs (28, 31, 52, 101, 105, 118, 138, 153, 156 and 180), HCBs, Lindane, DDXs, PAHs (16 congeners recommended by EPA)	
Sediments (fraction < 2 mm) for normalization purposes	Heavy metals	Cd, Pb, Hg, As, Fe, Li, Mn, Al, Cu, Zn, Cr, Ni and V	3. Total Organic Carbon 4. Dry/Wet ratio (lyophilization ratio) for normalization purposes
	Organic contaminants	PCBs (28, 31, 52, 101, 105, 118, 138, 153, 156 and 180), HCBs, Lindane, DDXs, PAHs (16 congeners recommended by EPA)	
Monitoring CI 18: Biomarkers and toxicology related methods			
Biota (bivalve <i>Brachidontes pharaonis</i> and fish <i>Mullus barbatus</i>)	Biomarkers	5. Lysosomal Membrane Stability 6. Acetylcholinesterase (AChE) 7. Micronucleus assay	
Monitoring CI 20: Seafood contaminants			
Fish: <i>Mullus barbatus</i> red mullet (benthic), <i>Diplodus sargus</i> white seabream (coastal, bentopelagic) <i>Euthynnus alletteratus</i> little tunny (pelagic)	Heavy metals	Cd, Pb and Hg (Regulated contaminants)	8. As, Fe, Li, Mn, Al, Cu, Zn, Cr, Ni and V 9. Biometric parameters for individual species and biological parameters 10. Dry/Wet ratio (lyophilization ratio) for normalization purposes
	Organic contaminants	PCBs (28, 31, 52, 101, 105, 118, 138, 153, 156 and 180), HCBs, Lindane, DDXs, PAHs (16 congeners recommended by EPA)	

Monitoring CI 21: Bathing water quality			
Sea Water	Faecal Bacteria	Intestinal enterococci	

4.8 Analysis of the National IMAP of Lebanon for EO10

The presence of marine litter is poorly studied in Lebanon. Only few studies were undertaken in the area. The most recent of them (published in 2019) evaluated the Marine Plastics pollution of the Lebanese coast as well as the most common polymers found. It studied the contamination of sediment, water and biota in 3 different sites. Different concentrations were found. Sidon water sample was highly contaminated in MPs (6.7 MPs/m³) while Tripoli had the highest MPs in sediments (4.68 MPs/g). In addition, the occurrence of MPs in the biota was also high (83.4% and 86.3% in anchovies and spiny oysters, respectively). The abundant MP was fragment with dominance of blue and red colours.

The National IMAP of Lebanon will cover Common Indicator 22 (Trends in the amount of litter washed ashore and/or deposited on coastlines) and Common Indicator 23 (Trends in the amount of litter in the water column including microplastics and on the seafloor).

4.9 Data quality assurance, reporting and assessment

The Quality Assurance (QA) processes proposed under IMAP will be followed in Lebanon, including an internal QA by National Laboratories for each monitoring process (i.e. sample collection, processing, analysis and reporting). Selected analytical methods and measurements are subject to internal Quality Assurance through National Laboratories QA/QC Protocols and Laboratory accreditations, as well as external Quality Assurance by performing regional interlaboratory QA/QC exercises organized by the UNEP/MAP MED POL/IAEA MESL.

A **data repository system** is being established at the NCMS and will be directly linked to a main database server located at the CNRS-L premises. Thematic databases will be organized at NCMS. CIs for EO9 fall within several of the themes, good coordination and exchange will be needed.

Assessment will be according to the IMAP indicator fact sheets. For CI 17, chemical contaminants trends analysis and distribution levels assessments will be on sub-regional and/or regional level, using Mediterranean BACs and EACs for chemical contaminants. For CI 18, trends analysis and distribution levels could be carried out on sub-regional level assessing biomarker responses using BACs. For the CI 19 and 20, the assessment is based on trends and annual statistics of datasets. For CI 21, the assessment of GES may be conducted at a sub-regional or local level, based on criteria and standards for bathing waters in the Mediterranean region (Annex II, Decision IG.20/9); distribution maps and temporal trend assessments (short periods) are also considered.

4.10 Coordination mechanisms

To ensure appropriate coordination of the National IMAP implementation, the NCMS/CNRS-L will create a **coordination unit** tasked with to coordinate between all main actors, to plan the sampling campaigns, to stay updated about the weather conditions, to prepare adequately all the logistics, to secure the samples analysis and to compile and gather the obtained results in the data repository. The following table indicates how the monitoring and assessment in relation to the IMAP Common Indicators could be integrated.

Proposal for an integrated monitoring and assessment for the IMAP-MPA Project for Lebanon

Lebanon						
	Ecological Objectives					
MPA	EO1	EO5	EO6	EO7	EO9	EO10

Palm Islands	CI13 CI14	CI13 CI14			CI17 CI18	CI22 CI23
Tyre Coast	CI13 CI14	CI13 CI14			CI17 CI18	CI22 CI23
High Pressure	EO1	EO5	EO6	E07	EO9	EO10
		-				
Beirut bay	CI1 CI2	CI13 CI14		CI15 (to evaluate)	CI17 CI18 CI19 CI21	CI22 CI23

4.11 Conclusions and recommendations

Overall, there is good coordination and implementation of monitoring activities according to EcAp MEDIII and IMAP-MPA Workplan for the Pollution Cluster in Lebanon. The CIs proposed for implementation with regards EO9 of the Pollution Cluster include CI 17- sediment and biota, CI 20 and CI 21. The proposed parameters to be determined in sediments and biota include the list of priority contaminants as reported in the IMAP for Lebanon in agreement with IMAP. There is good integration of EO5 and EO9 within the Pollution Cluster.

The analytical methodologies are broadly in line with IMAP recommendations. However, due to difficulties to perform the analyses internally in Lebanese laboratories, the analyses will be performed by an external laboratory. CI 18 will not be implemented due to lack of expertise.

The identifies **gaps and issues** in relation to the National IMAP of Lebanon are as follows:

- Additional chemical analysis should be conducted for EO9 (Hg analysis for CI 17 and CI 20, and biomarkers and toxicology measurements for CI 18).
- Intercalibration efforts need to be regularly implemented in order to always verify the precision and accuracy of our measurements.

The needs to address the above gaps are presented in the IMAP for Lebanon as follows:

- Recruitment of well-trained assistant researchers and technicians. Despite long expertise in the partner organization to satisfy IMAP, there is limited staff.
- Instruments that should be purchased:
 - AMA-254 for the direct analysis of Hg in sediments and biota.
 - Planetary ball mill grinder for the mixing and size reduction of sediments and biota
 - Microwave digestion system for the mineralization of sediments and biota before analysis for trace and heavy metals.
 - An automated extraction system for the sample preparation for the analysis of organic compounds (HAPs, PCBs and DDXs cited above).
- Trainings for the analysis of organic contaminants.
- Trainings and capacity building workshops for the time-series data processing of the different common indicators.

Additional issues identified by the analysis of the National IMAP of Lebanon:

- In accordance to the above gaps identified by the Lebanon National report and since the current national monitoring programme does not include some of the IMAP parameters related to EO9 while studies on chemical contaminants by NCMS are sporadic, increased effort is needed, including financial support, to increase capacities both in terms of human resources and equipment for all EO9 CIs.
- A better integration in EO5 and EO9 stations would be desirable i.e. increasing the number of common station and transects.

- Coordination with national authorities responsible of oil spill contingency planning is needed to ensure data flows for CI 19. Experts in charge of implementation of EO9 at NCMS are exploring the possibility to perform visual observation at the selected study sites that could be used for GES assessment within IMAP-MPA project.

**Analysis of the National Integrated Monitoring and Assessment Programme (IMAP) of
Libya**

April 2023

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Foreword

The aim of this document is to provide an analysis of the National Integrated Monitoring and Assessment Programme (IMAP) of Libya in relation to EO1 (Biodiversity), EO2 (Non-Indigenous Species), EO5 (Eutrophication), OE7 (Hydrography), OE8 (Coastal Ecosystems and Landscapes), EO9 (Pollution) and EO10 (Marine litter). The analysis evaluated the compliance of the National IMAP of Libya with the IMAP monitoring requirements (e.g. list of stations, maps, GIS layers, spatial-temporal scale/frequency, protocols, methodological/analytical techniques, monitoring protocols and reporting templates). It also assessed the possibilities and limits of integrating the monitoring and assessment in relation to the 19 Common Indicators in Libya.

The analysis is based on the compilation of the following sources of information:

- National Monitoring Programme for Pollution and Marine Litter in Libya (EO5, EO9 and EO10),
- National Monitoring Programme for Biodiversity in Libya (EO1 and EO2),
- National Integrated Monitoring and Assessment Programme (IMAP) for Coast and Hydrography Indicators for Libya,
- SPA/RAC Study to support the integration of the national monitoring programmes in Libya under the IMAP-MPA project
- The analysis performed by four regional experts appointed by the IMAP-MPA Project to Support the implementation of the National IMAPs in Algeria, Egypt, Israel, Lebanon, Libya, Morocco and Tunisia by providing scientific and technical assistance to the national teams in charge of the development and implementation of IMAP at national level. In their respective reports, the regional experts evaluated the compliance of the National IMAPs with the IMAP monitoring requirements (proposed monitoring sites, techniques and methodologies), identified gaps and provided recommendations and proposals on the integration potential of IMAP EO1, EO2, EO5, EO9 and EO10.
- Exchanges of Emails between IMAP Libyan team members and the IMAP regional experts.

1. Introduction

Libya has a coastline of about 1,970 Km representing about 4% of the total length of the Mediterranean Sea coastline. According to the Worldometer elaboration of United Nations data, the country's population increased by about 13% during the ten last years (2013-2023) to reach 7.1 million in the first quarter of 2023. About 80% of the population is urban, the largest cities are located on the coast. The most important are Tripoli, the capital, with a population of about 1.1 million and Benghazi with a population of 650 thousand.

The Libyan coast can be divided geomorphologically into seven sectors including (i) Ras Ajdir to Tripoli (180 km, concave coastline with some dunes, very few bays at wadi mouths, the port of Tripoli, some dunes and several sebkhas), (ii) Tripoli to Misrata (220 km, medium-elevated rocky formations with steep coastal slopes, small sea headlands and some narrow bays at wadi mouths), (iii) Misrata to El-Magroon (680 km, simple coastal structures, sandy shores), (iv) El-Magroon to Tolmitah (190 km, coastal slopes and caves at East, coastal lagoons /sebkhas with freshwater input), (v) Tolmitah to Ras Tin (250 km, elevated coastal formations, sandy or gravelly beaches and rocky boulders), (vi) Ras Tin to Elba (90 km, intense sandy formations and low topography, extensive presence of coastal lagoons and sebkhas), and (vii) Elba to Bir Ramla (160 km, short wadis in small to medium-sized gulfs. Limestone formations, low to medium elevated rocky shores to gravel coasts in the northern Aïn Ghazala Lagoon).

The hydrological conditions of the coastal region are dominated by three water mass layers. The surface layer, with low salinity is relatively poor in nutrient. It comes from the Atlantic, crosses Gibraltar and moves eastwards. The intermediate layer with a maximum salinity of 38.75‰ and a high nutrient level. It moves westward out of the Levantine Sea. The deep layer extends from below the intermediate layer (at a depth of >1000 m) to the bottom. The water of this layer is very homogeneous flowing from the nearby Adriatic. It is very cold and less saline than the intermediate water.

The main threats to the marine environment in Libya are linked to the uncontrolled coastal development, pollution, illegal fishing and hunting practices. However, although some of the Libyan coastal areas are facing significant anthropogenic pressure, the largest portion of the coast is still in good natural conditions with limited uses of the marine and coastal environment. Urbanisation is one of the most important sources of threats to the marine environment through uncontrolled construction and sewage discharging. The industry sector is not very developed in the Libyan coastal zone except in several sites that are mainly used by the oil industry, in particular export facilities.

Fishing is a growing sector in Libya but, compared to other Mediterranean countries, Libya has a low fishery production although the stock assessment surveys undertaken for the country's marine waters revealed the existence of considerable potential in terms of fish resources. Furthermore, some species known as declining in other Mediterranean countries are still in good conditions in Libya as showed by the quantities and large size specimens present in the landings of fishing boats in Libya.

Tourism in Libya was for many years a minor contributor to the national economy. But following the adoption in 2005 of the Law no 7 on tourism development, a national tourism plan was developed and included the identification of sites suitable for tourism development. Most of the identified sites are located along the Mediterranean coast. However, the current political situation in the country stopped the development of some economic sectors such as tourism.

The monitoring of marine environment and biodiversity parameters under IMAP is expected to provide data of particular relevance for the assessment of the Good Environmental Status (GES) in relation to most of the Ecological Objectives (EO) under the Ecosystem Approach (EcAp) of

the Barcelona Convention. Indeed, the data to be collected in zones that are still with high level of naturalness would provide reference data for the GES to achieve in the Mediterranean Sea.

2. Legal and administrative provisions regarding environmental monitoring

The legal framework governing the marine environment protection in Libya is mainly made of the following texts:

Law No.15/2003¹ on the protection and improvement of the environment. It includes a Chapter for the Protection of Sea and Marine wealth (Chapter III, Articles 18 – 38). The Chapter III covers (i) fishing gear, fishing practices including fishing seasons (arts. 18-20); (ii) dumping by ships into the Libyan marine waters of dust, stones, sand, dirt, residues of fuel or chemicals, throw oil or oil mixtures, wash tanks; (iii) dumping of wastes and toxic substances on beaches and into the territorial waters of Libya, (iv) ban of drainage of wastewater, waste disposal, toxic gases and radioactivity materials in the sea (iv) ban of constructions on the beaches likely to cause a change in the marine currents or cause the erosion or sedimentation without taking measures to protect subject to erosion.

Law No 14/1989 on Fishery resources. It regulates the exploitation of marine resources through a series of measures regarding (i) fishing licence procedures, (ii) requirements for fishing vessels, (iii) fishing practices including the of explosives, toxic substances and substances harmful to public health or the growth or reproduction of marine organisms. It is a framework text whose implementation is defined through Resolution No. 71 of 1990 (Implementing regulation) and Resolution No. 80 of 1991 issuing the Technical Guidelines of Law No. 14 of 1989. The later provides (i) technical specifications for the categories of fishing nets and the regulation of their use in Libyan waters, (ii) minimum size for fish and other marine organisms and measures to ensure the quality of fisheries products.

The provisions of these texts are oriented towards de management and the control of human activities with the view of mitigating their adverse impacts on the environment and the natural resources. There are no explicit provisions regarding monitoring in these texts.

3. National institutions having mandate or capacity in relation to monitoring marine environment

From May 2021, by Decision of the Head of the National Unity Government the properties and staff of the Environment General Authority (EGA) were transferred to the newly created Ministry of Environment (MoE). The later became therefore the main government department in charge of environment in Libya. Its functions and organisational structure were defined by Decision 300/2021 that entrust the MoE with the following prerogatives:

- Proposes plans and programs for the environment and follow up on approved ones, taking into account the environmental dimension in economic and social development plans.
- Supervising approved programs and plans for environmental sanitation, which are supervised by other competent agencies and municipalities.
- Keeping pace with scientific and technical development in the field of environmental protection and qualifying technical personnel in this field.
- Cooperating with international bodies to remove the causes of pollution in coordination with the relevant national bodies.
- Carrying out awareness campaigns by various means to introduce the environment and the rules and principles for protecting it from pollution and removing its causes.
- Registering all chemicals that may result in pollution of the environment, including fertilizers, agricultural pesticides, and pesticides used for public and veterinary health

¹ Repeals Law No. 7 of 1982 on the protection of the environment.

- purposes, by forming joint technical committees with the competent sectors and in accordance with the regulations approved by these sectors.
- Carrying out environmental inspections of service and production activities that result in pollution.
 - Monitoring water sources and protecting them from pollution.
 - Granting the necessary permissions to practice activities that may result in environmental pollution in accordance with the regulations and legislation in force.
 - Granting the necessary permissions for manufacturing, importing, selling, trading or releasing chemicals that may result in pollution to the environment through a joint committee between the ministry and the concerned sector, so that the provisions of the legislation in force are taken into account.
 - Evaluates the potential effects of using seeds, genetically improved strains, and genetically engineered treatments prior to entry or transit into Libya.
 - Proposes the establishment of protected areas and develop programs and plans aimed at protecting and preserving biodiversity in its various environments, in coordination with the relevant authorities.
 - Granting permission to practice the activities concerned with protecting the environment and following it up.
 - Determining the environmental requirements that must be taken into account when implementing any project after evaluating and reviewing the environmental impact study.
 - Coordinating and cooperating with national committees in all sectors concerned with international agreements and treaties related to the environment.
 - Follow up on international agreements and developments in the field of environment, and to benefit from them locally.
 - Preparing a national plan to confront emergency environmental situations and disasters in cooperation with the relevant authorities and presenting it for approval.
 - Encouraging and supporting civil institutions and associations accredited by the competent authorities whose activities fall within the field of environmental protection.
 - Proposing and reviewing legislation related to environmental protection or participating in its preparation.
 - Conducting studies and research related to environmental protection locally, in cooperation with relevant local and international research centres, bodies and institutions.

The Ministry of Environment of Libya has a central role in the implementation of the country's National IMAP. It coordinated the process undertaken for the elaboration of the National IMAP and is liaising with the members of the National Team to ensure the timely organisation of the field monitoring surveys. The MoE will be the centralized body for the systematic monitoring of the Libyan shorelines, collection of datasets and reporting to Barcelona Convention Secretariat under IMAP, as well as for national purposes.

The Marine Biology Research Centre (MBRC), established in 1981 (Act No. 1582/1981), is another important player in the implementation of the National IMAP of Libya. Its premises and laboratories are located on the coast of Tajura (15 km east of Tripoli) and has prerogatives to:

- conduct studies and field surveys of marine living and non-living habitats and resources,
- provide technical advice and consultation on marine wealth issues,
- publish the results of carried out studies and findings in various media types,
- cooperate with national, regional and international similar institutions and organizations through organization of joint research projects,
- organize symposia and conferences and exchange information.

Other institutions and organisations could contribute in terms of capabilities to the implementation of the National IMAP of Libya: University Departments (Universities of Tripoli, Tubruk and Omer Al-Moukhtar), Libyan Oil Institute, Ports & Maritime Transport Authority, local authority or municipality and NGOs.

4. Analysis of the National IMAP of Libya

4.1 Common Indicators

The National IMAP-based Monitoring Programme of Libya will include all Common Indicators for EO1 (CIs 1, 2, 3, 4 and 5), EO2 (CI 6), for EO5 (CIs 13 and 14), for EO9 (CIs 17, 18, 19, 20 and 21) and for EO10 (CIs 22 and 23). However, currently only capacity for monitoring in relation to CI 17 is available. Therefore, in a first phase, the monitoring for EO 9 will cover only CI 17.

4.2 Selection of monitoring areas

A total of 9 areas were identified as **monitoring areas for EO1 and EO2**. These are as follows (from West to East): Farwa Lagoon, Zwara, Tripoli coast, Gulf of Sirte, Raslanuf-Zuitina, Benghazi, Ain Al-Ghazaleh, Derna and Toubruk. The Common Indicators to be monitored for each of them are indicated in the following Table

Common Indicators to be monitored for each of the monitoring areas selected for EO1 and EO2

	EO1									EO2		
	CI1	CI2	CI3			CI4			CI5			CI6
			Turtles	Birds	M. Mammals	Turtles	Birds	M. Mammals	Turtles	Birds	M. Mammals	
Farwa Lagoon												
Zwara												
Tripoli coast												
Gulf of Sirte												
Raslanuf-Zuitina												
Benghazi												
Ain Al-Ghazaleh												
Derna												
Toubruk												

Farwa Lagoon: it is located near the border with Tunisia. Ecological data and information are available for this site thanks to a series of field survey undertaken in the area. It is a semi closed coastal lagoon of about 3500 hectares.

Zwara area: It is located at about 100 kilometres in the west of Tripoli. It includes sandy beaches

Tripoli Beach: This is a site under heavy anthropogenic pressures, mainly because of the vicinity of a big city and important maritime infrastructure.

Gulf of Sirte: This is a wide area in the central part of the Libyan coast, the sampling sites should be further defined since the area includes natural zones and some areas under anthropogenic pressures.

Zuwaytinah: the zone is located at about 120 kilometres in the west of the Benghazi city. The area hosts important oil exportation infrastructure including a port and oil storage equipment. The Gara Island located at about 20 Kilometres in the west of the oil terminal is particularly important as bird habitats.

Derna: The area is located at about 170 Kilometres in the East of Benghazi City.

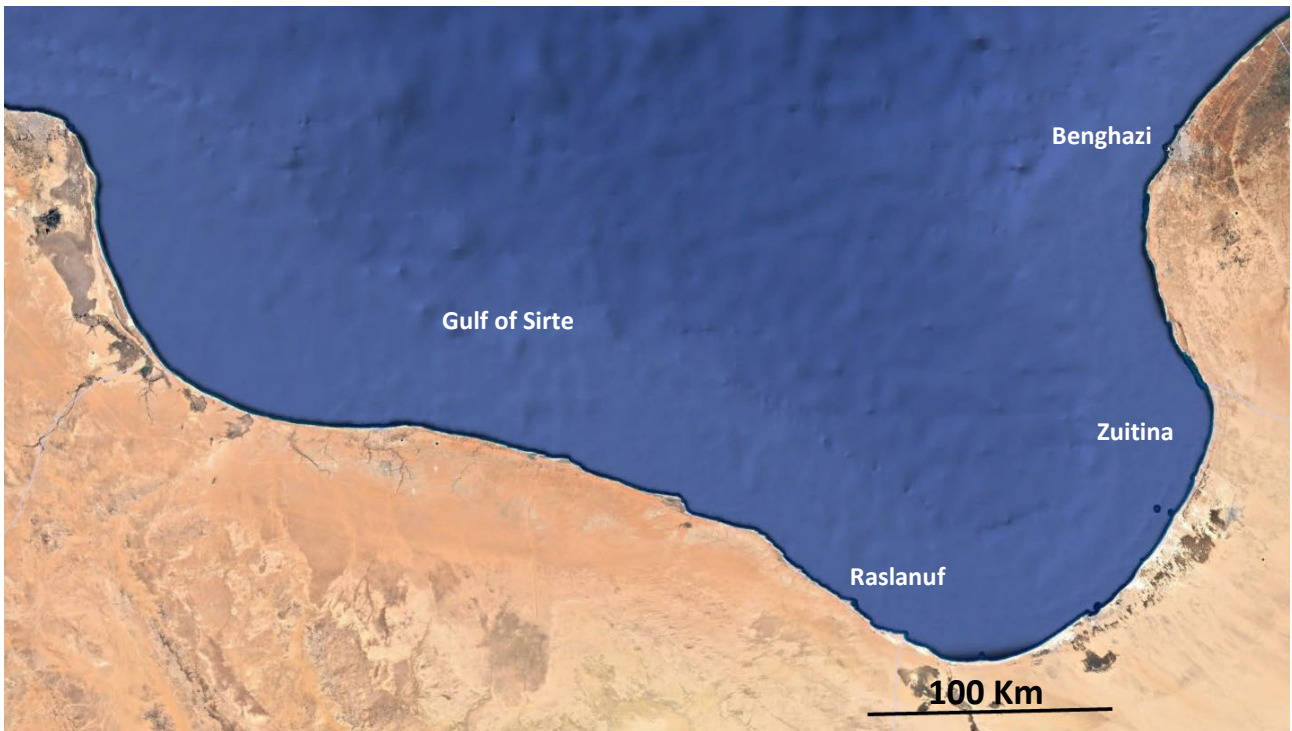
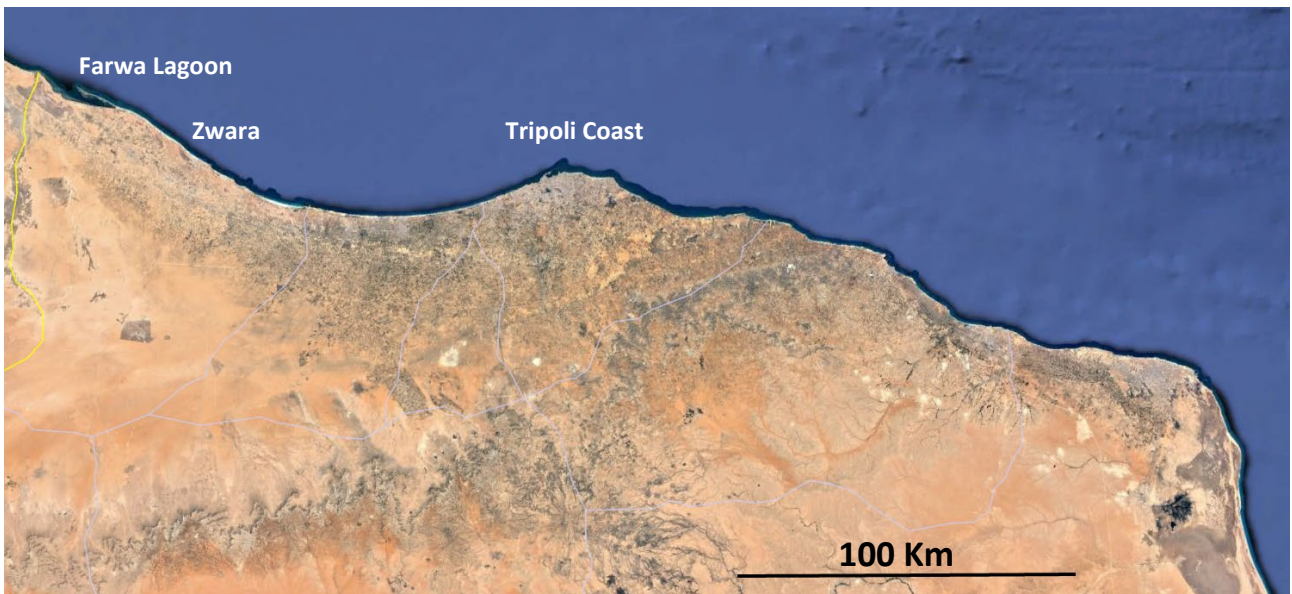
Ain El Ghazala: The site is located on the coast between Darnah and Tobruk. It is a coastal lagoon connected to the sea and reported as a well-preserved natural area hosting assemblages and natural monuments of conservation interest.

Tobruk: This portion of the Libyan coast is located at about 130 Kilometres from the Libyan borders with Egypt. Because of the presence of the City of Tobruk as well as an oil refinery and an oil terminal, the zone is considered as under heavy anthropogenic pressure.

All of the selected sites, including those under heavy anthropogenic pressure, host at least one habitat and species of interest for the IMAP CIs. This is reflected in the Annex III of the National Monitoring Programme for Biodiversity in Libya as follows²:

Selected monitoring zone	EcAp Common Indicators				
	Habitats present	Marine mammals	Sea turtles	Birds	Invasive species
Farwa Lagoon	1	1	1+1	3+9	3
Sabrata	1	1	1+1	11	3
Tripoli Beach	1	2	2	11	4
Gulf of Sirte	2	1	1+2	10	4
Zuwaytinah	0	1	1	1+4	3
Ain Zayana	0	0	0	5	3
Rass Teen to Derna	2	2	1	6	3
Ain El Ghazala	3	3	1+2	3+6	3
Gulf of Tobruk to El-Burdy	2	1	1	3	4

² Source: UN Environment/MAP- SPA/RAC, [2017], [National monitoring programme for Biodiversity in Libya]; by: [Esmail Shakman], [Contract n° 09_EcAp MED II SPA/RAC_2016], SPA/RAC, Tunis, [60] pp.



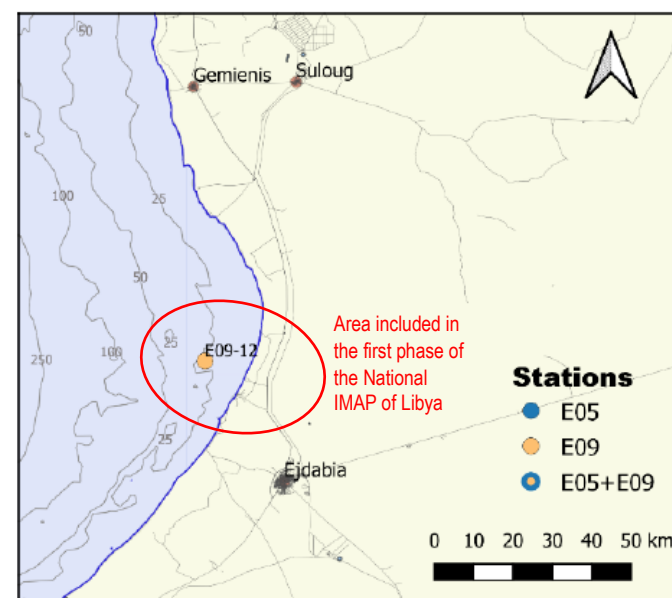
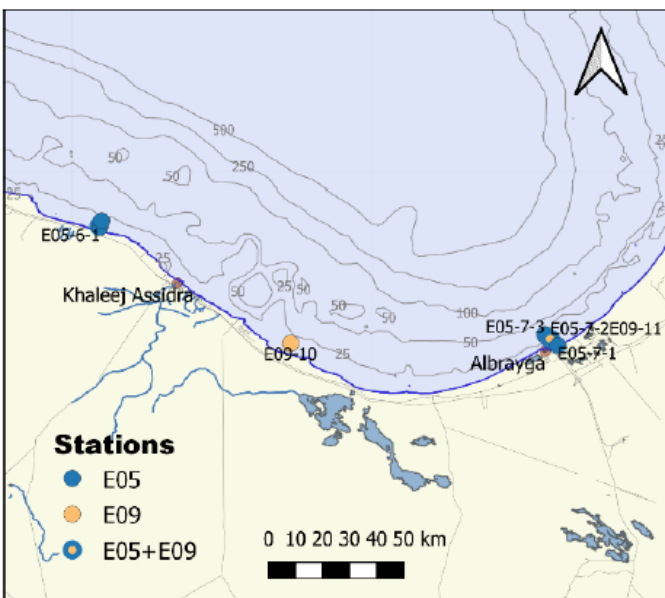
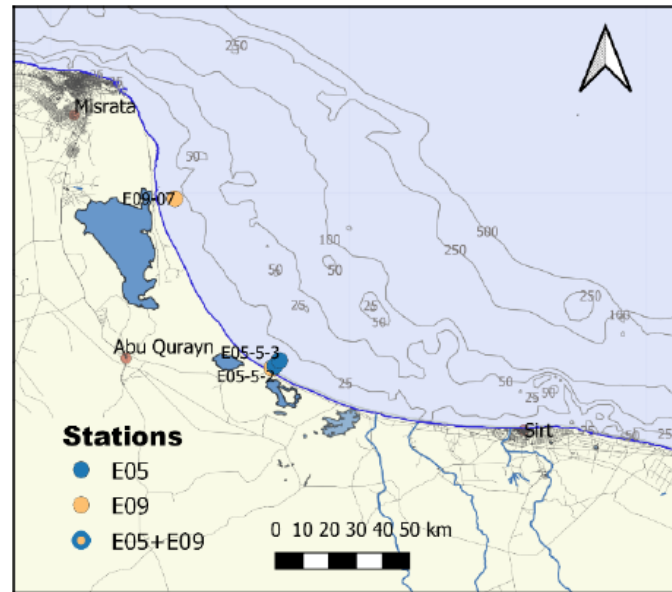
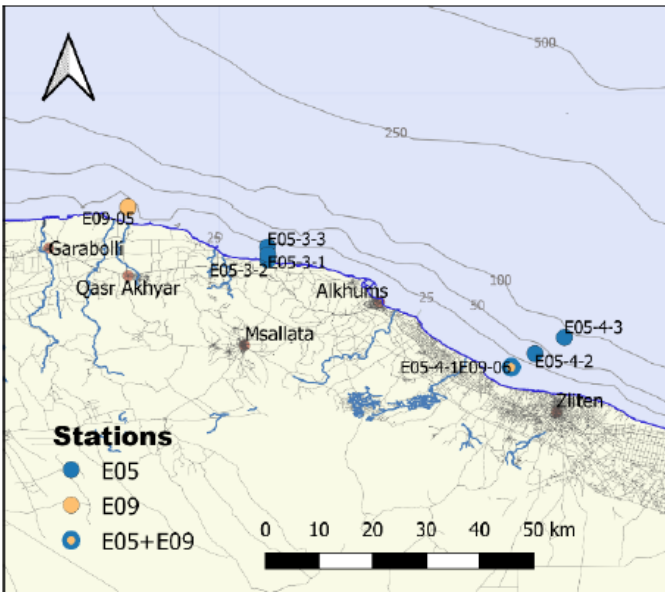
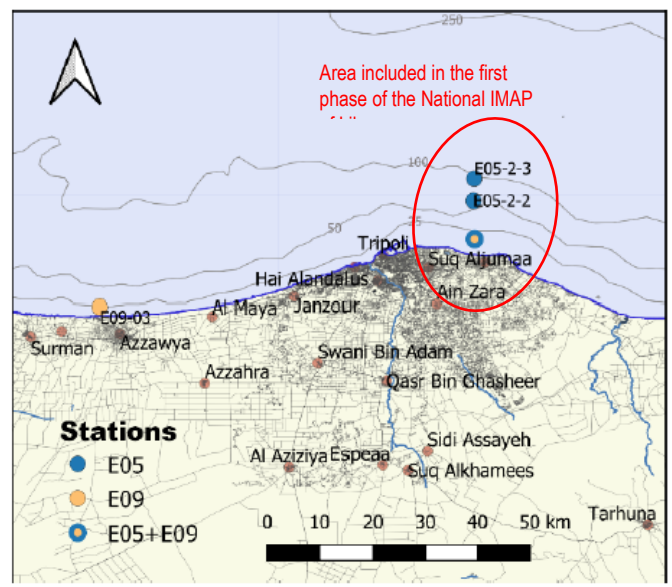
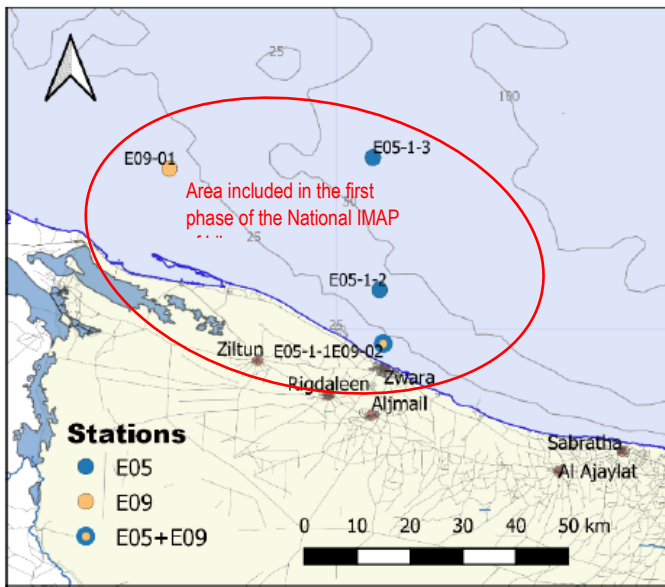
Location of the monitoring sites in relation to EO1 and contaminants EO2

The preliminary selection of **monitoring sites in relation to eutrophication (EO5) and contaminants (EO9)** has been based in a number of scientific and technical studies along the Libyan coast undertaken before 2011 with a special focus on the determination of pollution (particularly petroleum hydrocarbons) and its effects on the marine environment. It identified 18 monitoring areas: 8 for EO5, 2 for EO9 and 8 for both EO5+EO9). However, for the first phase of the National IMAP of Libya, only four monitoring sites were selected (Farwa Lagoon and the offshore zone of Abu Kamesh, Tripoli, Azzuaytina (Zuwaytinah) and Tobruk). These areas include heavy anthropogenic pressures (urban and maritime infrastructures (Tripoli and Zuwaytinah), oil refinery and oil terminal (Gulf of Tobruk to El-Burdy)) and the MPA of Farwa Lagoon.

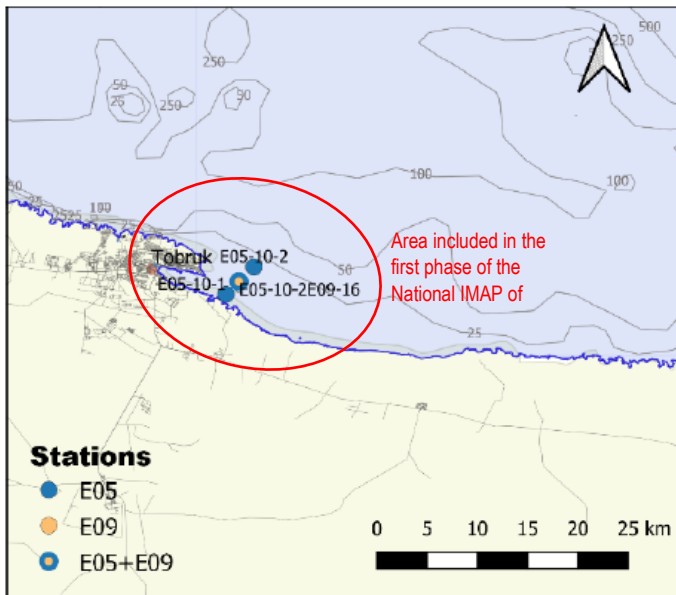
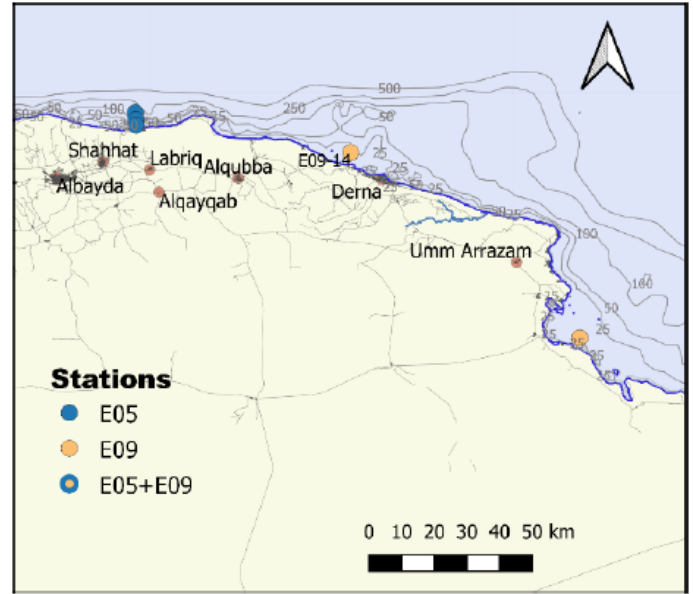
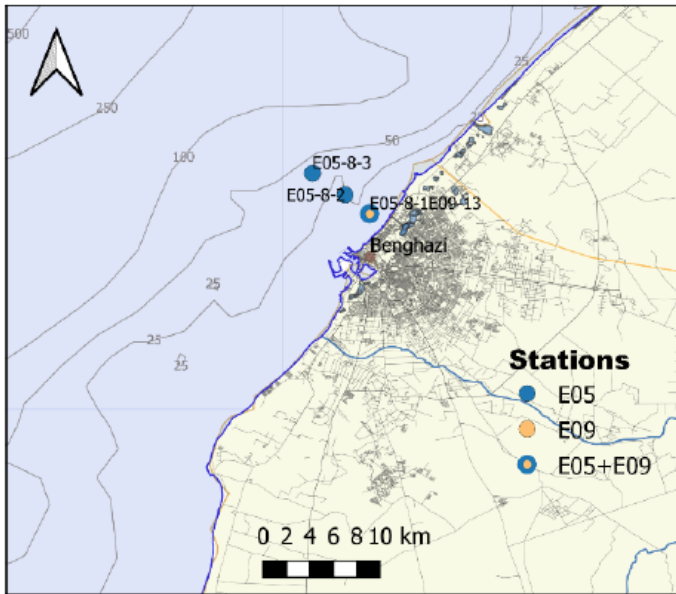
For EO5, the selected measurement areas and stations could be considered new monitoring areas and sampling sites, as it does not exist a routine sampling program in terms of marine pollution monitoring, despite scattered studies.

For the **Common Indicators in relation to EO7 and EO8**, the National IMAP in Libya will use a risk-based approach to select the monitoring sites. To this end:

- the most sensitive areas that are under higher pressures will be considered case by case.
- the monitoring efforts should be prioritised in the risk areas.
- the selected areas should be monitored more frequently in relation to those quality components at risk to achieve/maintain GES and associated relevant pressures than other areas that have maintained GES for a long period of time and are under less pressure.
- increased monitoring effort may be needed in areas that are close to the boundary of GES in order to increase confidence in assessments and, consequently, in the decision to take measures.



Location of the monitoring sites in relation to eutrophication (E05) and contaminants (E09)



Location of the monitoring sites in relation to eutrophication (E05) and contaminants (E09) (continued)

For Marine Litter (EO10), five beach sites (11 beaches) are selected, along the coast of Libya (3 beaches: ziwara, Tripoli 1 & 2), close to Kaam area (main input of freshwater, Gnim and Kaam beaches), close to the City of Sirte (sandy beaches of Buirat Alhason and Bin jawad), a site at the region of Benghazi (2 urban polluted beaches of Bregas and Benghazi), and the fifth close to the City of Tobruk (One rocky and one sandy beaches in Sosa and tobruk, urban and oil pollution).



Sampling Sites for the EO10 along the Libyan coastline

During the National Kick-off Meeting of the IMAP-MPA Project in Libya held online on 28 October 2020, the participants agreed that the potential sites for the implementation of the IMAP in Libya are the Farwa Lagoon (as a Marine Protected Area) and the coastal area of Tripoli (as a site under human pressures). They also agreed that the Gulf of Sirt may be considered among the monitoring sites under human pressures when further budget resources would be available.

4.3 Analysis of the National IMAP of Libya for EO1

The National IMAP of Libya will cover the following Common Indicators of EO1:

- Common Indicator 1: Habitat distributional range to also consider habitat extent as a relevant attribute,
- Common Indicator 2: Condition of the habitat's typical species and communities;
- Common Indicator 3: Species distributional range related to marine mammals, seabirds, marine reptiles);
- Common Indicator 4: Population abundance of selected species (related to marine mammals, seabirds, marine reptiles);
- Common indicator 5: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles)

4.3.1 Methodological/analytical techniques for CI1 and CI2

The monitoring of habitats in relation to CI1 and CI2 will be based on mapping of seagrass meadows by scuba diving. The lower limit of the meadows will be monitored by placing 11 markers according to the SPA/RAC Protocol for the setting up of Posidonia³.

4.3.2 Methodological/analytical techniques for turtles (CI3, CI4 and CI5)

The Monitoring will include nesting activity assessment from laying eggs till hatching assessment, in addition to stranding data. Data collecting will include the identified sites and other nearby sites to maximize the benefit of this project towards better understanding of the sea turtle data on Libyan coastline. Nesting Beaches will be monitored by Foot patrols. Recording of parameters for Nesting and Demography will include number of eggs per clutch, hatchling emergence success, etc.

For logistical reasons, each team will work on certain number of beaches in the vicinity of their residence (Sirte 4 beaches, Benghazi 3 beaches, Derna 4 beaches, Toubruk 2 beaches, Raslanuf-Zuitina 3 beaches, Zwara 2 beaches, Farwa 1 beach), to reduce travel time and cost and make local impact or awareness while preserving the nesting sites.

4.3.3 Methodological/analytical techniques for birds (CI3, CI4 and CI5)

The survey will be divided into two main phases and will adapt Module BB1, Module BB2, Module BB3 and Module BB4. The first phase (counting the total number of individuals) will be from January to the end of February, the team will participant in Libyan wintering bird census team, when the presence of bird species at its peak. The team will also focus on the nesting of Shag. because of the bird's sensitivity to disturbances in the nesting sites, the team will use a drone to track the nesting season.

The second phase (medium Colony census) will be from the beginning of March to the end of May, which is breeding season, and according to the previous information, the focus will be on the Lesser Crested Tern, in order to update the previous data, also tracking the possibility of nesting some other species in the specified locations. Some cruises will be with the marine mammal team to count pelagic birds that use Libyan waters for feeding during the breeding season in neighbouring countries such as Tunisia and Malta. The targeted species are presented in the following Table.

List of target bird species for CI3, CI4 and CI5

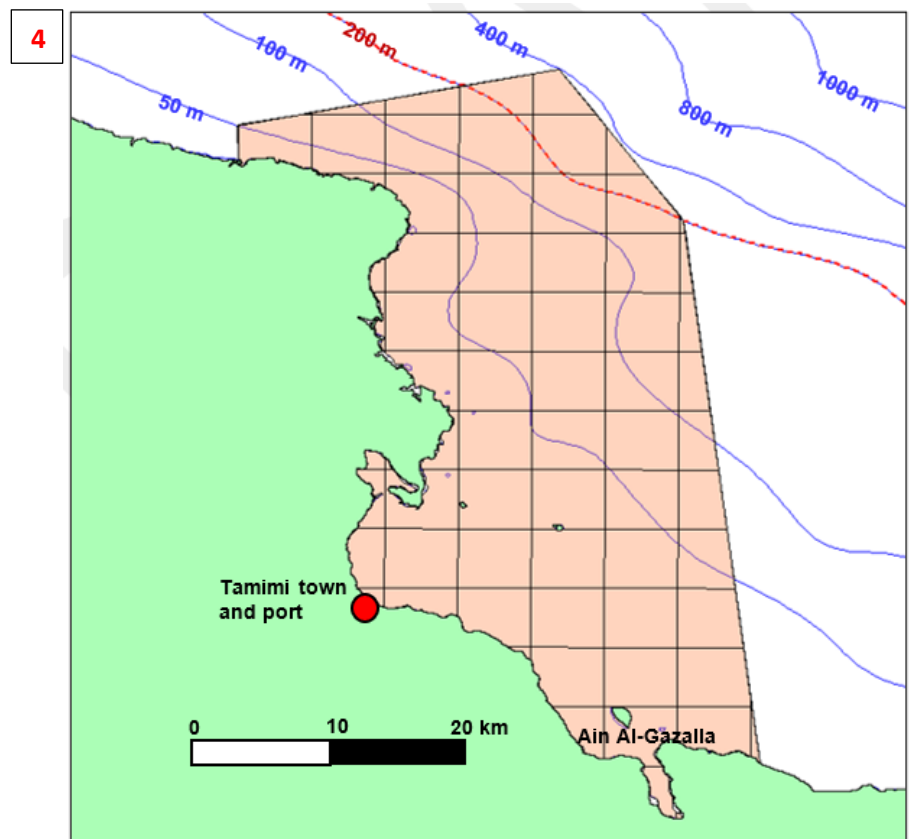
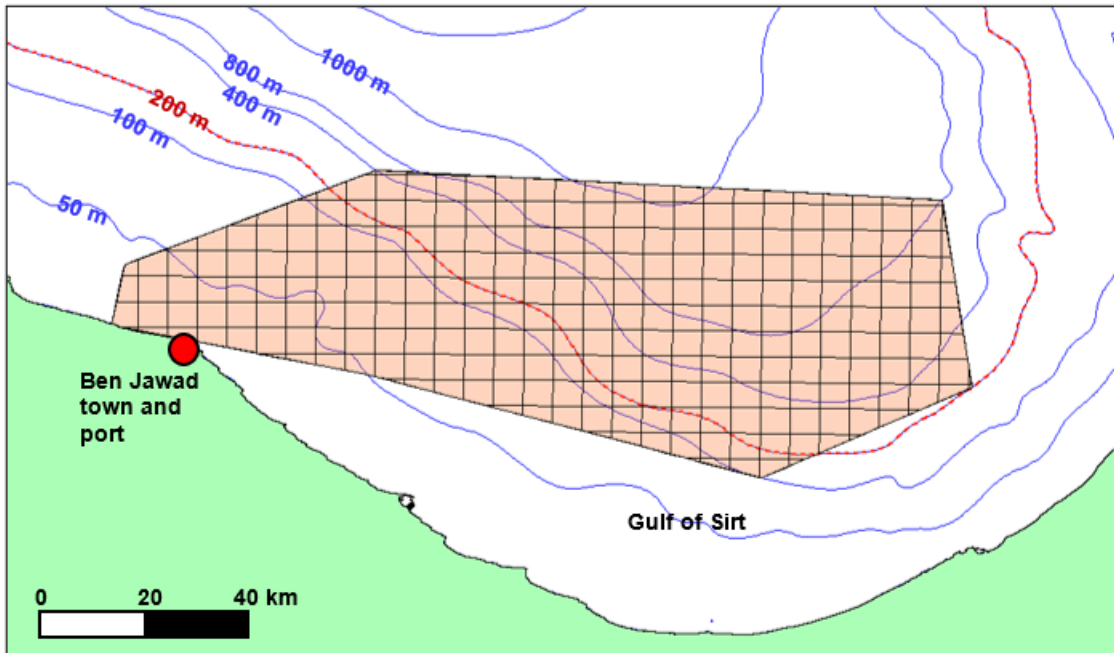
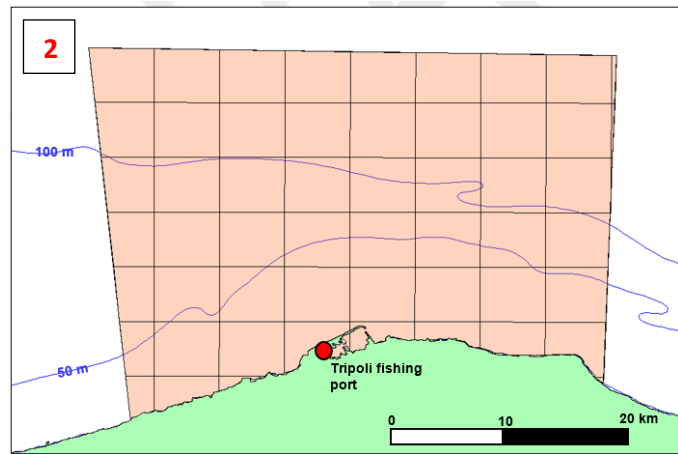
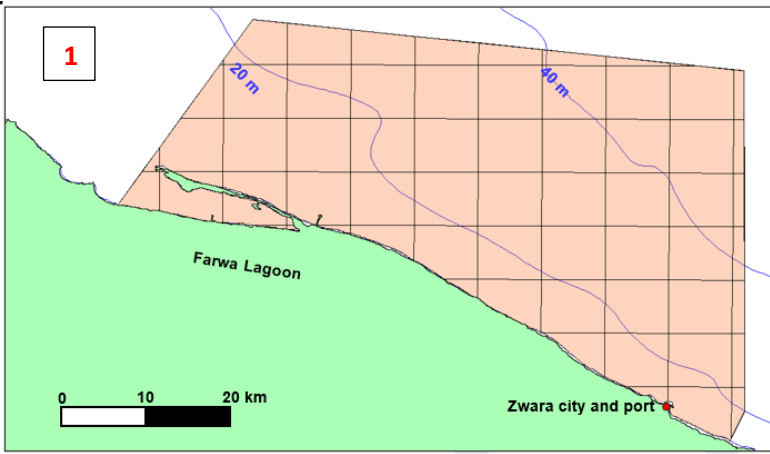
FUNCTIONAL GROUP	SPECIES	
	Scientific name	Common name

³ 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.

Coastal top predators	<i>Pandion haliaetus</i>	Osprey
Inshore benthic feeders	<i>Phalacrocorax aristotelis ssp. desmarestii</i>	(Mediterranean) Shag
Offshore surface-feeders	<i>Larus audouinii</i>	Audouin's gull
Inshore surface feeders	<i>Larus genei</i>	Slender-billed Gull
	<i>Thalasseus (= Sterna) bengalensis</i>	Lesser Crested Tern
	<i>Thalasseus (= Sterna) sandvicensis</i>	Sandwich Tern
Offshore (surface or pelagic) feeders	<i>Hydrobates pelagicus</i>	Mediterranean Storm-petrel
	<i>Calonectris diomedea</i>	Scopoli's Shearwater
	<i>Puffinus yelkouan</i>	Yelkouan Shearwater
	<i>Puffinus mauretanicus</i>	Balearic Shearwater

4.3.4 Methodological/analytical techniques for cetaceans (CI3, CI4 and CI5)

Four Sub-Areas in Libya will be surveyed for cetaceans in accordance with the recommendations of the national kick-off meeting of the projects (October 2020) and the ministry of the Environment in Libya with the decision of the previous CORMON meetings. These are (not in geographic order); Ain Al-Gazallah MPA (32.258°N, 23.252°E) and Farwa Lagoon (33.092°N, 11.731°E) as sites less impacted by human activities; the Gulf of Sirt (30.586°N, 19.423°E) and Tripoli coast (32.915°N, 13.208°E) as areas with substantial impacts. For each sub-area, a designated port/city has been selected as a base for the team and a departing point for the survey vessel. For Ain Al-Gazallah (Sub-Area 4), the small town of Tamimi and its artisanal marina (32.347°N, 23.085°E), for Farwa Lagoon (Sub-Area 1), the nearby Zwara port (32.922°N, 12.119°E), for Tripoli (Sub-Area 2), the main fishing port, and finally, since the gulf of Sirt (Sub-Area 3) is such a vast area to cover, the team will be based in Ben Jawad town and will use its small fishing marina (30.810°N, 18.071°E) as a departing point to sail eastward to survey the gulf. These Sub-Areas will be divided into 5x5km grids which will be equally surveyed to have a homogeneous distribution of effort within the study area. For more details about the Sub-Areas, please refer to Figure 1 and table 1. The gridded maps can be found in the appendix of this document.



The Sub-areas for cetacean monitoring with their targeted area of the survey divided in grids:

- 1 Farwa Lagoon
- 2 Tripoli
- 3 Gulf of Sirt
- 4 Ain Al-Gazalla MPA

4.4 Analysis of the National IMAP of Libya for EO2

4.4.1 Methodological/analytical techniques for CI6

For the monitoring in relation to Common Indicator 6 (Trends in abundance, temporal occurrence, and spatial distribution of nonindigenous species, particularly invasive, non-indigenous species, notably in risk areas) two protected areas (Farwa Lagoon in the western coast of Libya and Ain EL Ghazala in the eastern coast of Libya) and the two following hotspot sites

- Tripoli Gulf (A rocky area including the main harbour in Tripoli and three landing sites, it has a lot of human activities)
- Garah Island (A small Island located near the oil export terminal of Zwaytinah)

The monitoring will be conducted during two seasons: winter and summer. Samples will be collected from different locations in the sites according to the habitats (rocks, sand and seaweeds) and depths in the coastal area, the number of locations will be decided in the first trip. These sites will be monitored twice during the study period, in order to survey the non-indigenous species (NIS) focusing on Macrophytes and Macrofauna (Mollusca, crustaceans and fishes), the surveys of sessile communities on docks, permanently installed pontoons, floats, ropes, and any other available hard substratum. Transects for different stations in the different areas will be done.

The monitoring of NIS **Macrophytes** in each different habitat will record the coverage of NIS algae by using 25 cm x 25 cm quadrats, each subdivided into 25 sub quadrats of 5 cm x 5 cm. In each habitat type, the divers position 20 quadrats (covering a total area of 1.25 m²) randomly over the substrate and record the number of sub quadrats in which the specific invasive alga occurs.

Bathymetric transects will be performed to monitoring NIS of **invertebrates** in different habitats at each sampling station to identify the depth at which other NIS are most abundant. At each depth, two transects (50 m x 1 m) located randomly should be monitored by a scuba-diving team. In those cases, where NIS may be of a considerable size (e.g. the invasive coral *Oculina patagonica*), only colonies or individuals with at least 50% of their surface area lying within the belt transect should be considered and counted to avoid bias in the sampling.

At each sampling station, the abundance and size of any **invasive fish** will be recorded along transects. An observer should dive at an approximately constant speed along three 25 m x 5 m transects at each sampling station and at a fixed depth (where invasive fishes are most abundant). Along each transect the observer will identify the species, count the number of individuals observed and estimate the approximate size of all individuals (in 2 cm increments of total length, TL). Fish biomass (g wet weight m⁻²) can be estimated from size data using length-weight relationships from the available literature and databases.

4.5 Analysis of the National IMAP of Libya for EO5

For EO5, the National IMAP of Libya covers the CI 13 (Concentration of key nutrients in water column) and CI 14 (Chlorophyll-a concentration in water column). For both of them, the monitoring will be ensured by the Marine Biology Research Centre (MBRC) of Tajura.

4.5.1 Methodological/analytical techniques for CI6

The analytical methods proposed is coherent with the UNEP/MED WG. 467/5 (IMAP Guidance Factsheets: Update for Common Indicators 13, 14, 17, 18, 20 and 21; New proposal for Candidate Indicators 26 and 27) and document and guidelines and protocols cited therein.

The covered parameters and the related analytical techniques are listed in the following Table.

Analytical and sampling techniques (C13 and C14) envisaged for the National IMAP of Libya

C13	Nutrient analysed	NO3-N, NO2-N, NH4-N, TN PO4-P, TP SiO4-Si	Frequency	Seasonal
	Methods*	spectro	Sampling methods	Niskin bottle
	Unit	µmol/L	Sample depth (m.)*	0, -5, -10
	Guidance and protocols	<ul style="list-style-type: none"> Strickland & Parsons, 1972 UNEP / MEDPOL.N. 163 	Number of samples for station	3
	Quality assessment	EN ISO/IEC/ 17025	Protocols for sampling and samples storage	<ul style="list-style-type: none"> ISO 5667-9 ISO 5667-14 ISO 5667-3 UNEP/ MEDPOL N.163
C14	Methods*	<ul style="list-style-type: none"> Chl a: spectro or fluorimetry WT: Secchi disk DO: Winkler O-sat: saturation table Phyto: Uthermöl 	Frequency ^s	Seasonal,
	Unit	<ul style="list-style-type: none"> Chl a: µg/L WT: m DO: µmol/L O-sat: % Phyto: cell/L 	Sampling methods	Niskin bottle, Secchi disk, CTD probe,
	Guidance and protocols	<ul style="list-style-type: none"> Strickland & Parsons, 1968 UNEP / MEDPOL.N. 163 UNESCO 1994 ISO 10260-92 ISO 7027-99 Magaletti et al., 2001 	Sample depth (m.)	0, -5, -10, water column profile with CTD
	Quality assessment	<ul style="list-style-type: none"> ISO/IEC/17025 UNI 14996-06 	Number of samples	3
			Protocols for sampling and samples storage	<ul style="list-style-type: none"> ISO 5667-14 ISO 5667-3 UNEP / MEDPOL.N. 163 ISO/WD 7027-2 HELCOM- Combine 2017

4.6 Analysis of the National IMAP of Libya for EO9

The National IMAP-based Monitoring Programme of Libya for EO9 will include all relevant IMAP Common Indicators *i.e.*, CI 17, 18, 19, 20 and 21. However, since current capacity for implementation of CI 18, CI 20 and CI 21 is not sufficient, they have not yet been integrated into the current National IMAP-based Monitoring Programme, while CI 19 monitoring is also not yet addressed. Throughout the country's report, it is pointed out that capacity does not currently exist to ensure a continuous regular monitoring programme in Libya.

There has been no regular and coordinated marine pollution monitoring program in Libya until now; the National IMAP-based Monitoring Programme will be the first to be implemented in the country. Thus, the areas and sampling stations were newly selected based on IMAP requirements, considering existing studies along the Libyan coast as well as a risk-based approach considering the urban locations, industrial inputs, power plants, and refineries among other criteria.

From national IMAP prepared in 2019 the grid of ten monitoring stations proposed for the IMAP includes the whole Libyan coast from the Western to the Eastern part, thus cover the entire Libyan coast, adjusted to the continental platform characteristics for the selection of offshore areas at 10 and 20 km.

There are 16 EO9 stations for sediment and biota sampling, including coastal and offshore stations, which are proposed for CI 17, CI 18 and CI 20 monitoring. The EO9 stations are located in hot spots and reference areas and there are 2 reference stations close to MPAs. Eight EO9 stations coincide with stations at EO5 monitoring transects.

The rationale for the selection of monitoring stations under EO9 in Libya is in accordance with IMAP requirements. The National IMAP document for EO9 provides the geographical coordinates and bathymetry for the selected monitoring stations and indicates that the sampling will be on a yearly basis.

4.6.1 Methodological/analytical techniques

Currently, only CI 17 is included in the National IMAP-based Monitoring Programme. Water sampling, although not mandatory for CI 17, maybe considered as complementary temporary effort, if equipment for sediment and biota sampling is lacking, since present monitoring efforts are mainly related to water sampling.

Detailed proposals on monitoring of CI 19, CI 20, CI 21 will be submitted not later than in a period of first three years of the initial phase of IMAP implementation. CI 18 is also not included and will be further investigated for implementation in the future.

Methodology for CI 17 in the 2019 IMAP proposal for Libya is overall in accordance with IMAP (UNEP/MED WG.467/5) as shown in Table 6. Species to be used are not selected yet, but caged mussels or other bivalves species as suggested by UNEP/MAP (UNEP(DEPI)/MED WG.427/7) are considered in IMAP National plan, the species to be selected will be identified by MBRC.

Methodologies are described according to IMAP indicator fact sheets. Current capacities on analytical methods for CI 17 parameters (heavy metals and organic compounds in biota and sediment) are listed. However, it is pointed out that although capacity in terms of equipment is adequate, personnel training and financial resources maybe limited.

Methodology for each Common Indicator (CI) and analytical techniques of the National IMAP of Libya for EO9 and accordance with IMAP (Y: yes; N: no; P: partially).

CI	Matrix	Substance, biomarker or Parameter	Analytical method	Accompanying parameters	IMAP
17	Biota principally bivalves (whole soft tissue or dissected parts according sampling and	Heavy metals / Traces (TM): Total mercury (HgT),	Solid Hg analyser, GF-	Lipid content, fresh/dry weight ratio	Y

	sample preparation protocols)	Cadmium (Cd) and Lead (Pb)	AAS, ICP-OES, ICP-MS		
17	Biota principally bivalves (whole soft tissue or dissected parts according sampling and sample preparation protocols)	Polycyclic aromatic hydrocarbons (US EPA 16 PAH compounds)	HPLC-UV-Flu, GC-MS	Lipid content, fresh/dry weight ratio	Y
17	Biota principally bivalves (whole soft tissue or dissected parts according sampling and sample preparation protocols)	Organochlorine compounds (PCBs, hexachlorobenzene, lindane and Σ DDTs)	GC-ECD, GC-MS, GC-NCI-MS	Lipid content, fresh/dry weight ratio	Y
17	Marine sediments (particle size fraction <2 mm)	Trace / Heavy Metals (TM): Total Mercury (HgT), Cadmium (Cd) and Lead (Pb)	Solid Hg analyser, GF-AAS, ICP-OES, ICP-MS	Al in the < 2mm particle size fraction, Freeze-drying ratio (dry/wet sediment ratio), < 63 μ m fraction as complementary,	Y
17	Marine sediments (particle size fraction <2 mm)	Organochlorine compounds (PCBs, hexachlorobenzene, lindane and Σ DDTs)	HPLC-UV-Flu, GC-MS	Total Organic Carbon TOC in the particle size fraction <2mm. < Freeze-drying ratio (dry/wet sediment ratio)	Y
17	Marine sediments (particle size fraction <2 mm)	Polycyclic aromatic hydrocarbons (US EPA 16 PAHs)	GC-ECD, GC-MS, GC-NCI-MS	Total Organic Carbon (TOC) in the < 2mm particle size fraction /Freeze-drying ratio (dry/wet sediment ratio)	Y

4.7 [Analysis of the National IMAP of Libya for EO10](#)

The monitoring and assessment of marine litter will cover, during a first phase of two years, beach meso- and macro-litter, floating marine litter, field observations made from ship or aerial based platforms, collection of floating litter via manta net, and also address Benthic litter surveys, with observations made experimentally by divers, submersibles or camera tows, or via benthic trawls.

The beach sites for CI22 fulfil certain criteria (vicinity of ports; river mouths; coastal urban areas; tourists' destinations; reference sites) where there are no regular clean-up activities. In addition, the selected beaches should have a minimum length of 100 m; low slope, clear access to sea, accessible to survey teams and posing no threat to endangered or protected species (sea turtles, birds, and sensitive beach vegetation) .

4.7.1 Methodological/analytical techniques

4 seasonal surveys are proposed for each year using the UNEP MAP guidelines and survey forms (filled once a year), with digital photographs to document the situation. Litter items with a lower limit of 0.5 cm in the longest dimension will be monitored. All litter items should be removed from the beach during the survey. Results will be expressed as counts of litter items /100 m and the main categories (plastic, etc.) weighed, coupled with the total weight (kg). Most beach marine litter surveys are organized by NGOs with a focus on cleaning.

For IMAP Common Indicator 22 (Beach Macro Litter), GES (Decreasing trend in the number of/amount of marine litter (items) deposited on the coast) will be monitored using the UNEP/IMAP baseline value 450 –1,400 items/ 100 m and a reduction target of 20% by 2024 (UNEP MAP proposed target).

4.8 Data quality assurance, reporting and assessment

Currently there is no data management system operational to support data reporting into the IMAP Information System. The lack of integration of available sporadic data on marine pollution collected by different groups is pointed out, and also the need to establish an information system for monitoring and measuring marine pollution. It is acknowledged that further efforts are needed to ensure interoperability of national reporting and IMAP Info System with the assistance of INFO RAC as the administrator of this system.

The importance of quality assurance is pointed out and will follow IMAP proposed processes, including an internal QA by National Laboratories for each monitoring process (i.e. sample collection, processing, analysis and reporting).

The first phase of the National IMAP of Libya is focusing on monitoring and data collection with the view of providing the required sets of data and upload them to the IMAP Info System. The GES assessment phase will require special arrangements and coordination with the relevant subregional and regional assessment processes as well as capacity building for national teams.

4.9 Coordination mechanisms

As this is the first time a regular marine pollution monitoring program will be implemented in Libya, coordination mechanisms for IMAP are not currently in place.

The Ministry of Environment (MoE) will be the national authority responsible for the coordination of the national IMAP. It will be the centralized body for the systematic monitoring of the Libyan shorelines, collection of datasets and reporting to Barcelona Convention Secretariat under IMAP, as well as for national purposes. To this end it will ensure permanent liaison with the teams, institutions and organisations contributing to the implementation of the National IMAP as indicated in the following Table.

Affiliation of the team members contributing to the implementation of IMAP monitoring in Libya in relation to the Common Indicators for EO1, EO2, EO5, EO9 and EO10

Common Indicator		Team member affiliation
CI1		Ministry of Environment (central and local branches), with other team members from University of Tripoli, University of Omar AL Mokhtar (local contact for Ain Alghazala) and Besida Association (local contact for Farwa)
CI2		
CI3, CI4, CI5	Turtles	Ministry of Environment (central and local branches) with other team members from University of Tripoli (team leader) and other organisations.
CI3, CI4, CI5	Birds	Ministry of Environment, Libyan society of bird (LSB), Bado Association, Bseda Association

CI3, CI4, CI5	M. Mammals	Ministry of Environment (central and local branches), with other team members from the Universities of Omar Mukhtar and Tobruk, the National Council for Civil Liberties, the Alhaya Society and Bado Society.
CI6		Head of the team from Tripoli University and other team members from Universities (Tripoli, Omar AL Mokhtar and Tubruk) and the Marine Biology Research Centre.
CI13		Marine Biology Research Centre
CI14		
CI 17		MoE in collaboration with the Libyan Petroleum Institute (LPI)
CI 18		The Marine Biology Research Centre (MBRC). It will initially develop in collaboration with the MoE pilot projects for CI 18.
CI 19		The Ports and Maritime Transport Authority (PMTA) will collaborate with the MoE
CI 20		The MoE in collaboration with LPI, MBRC and Academia
CI 21		The MoE and the Ministry of Local Governments will collaborate to establish monitoring involving laboratories of the municipalities performing microbiological analyses.
CI 22		Pollution cluster team with team members from the Marine Biology Centre, University, other research centres and volunteers from NGOs.
CI 23		

4.10 Identified gaps and recommendations

Although the selected monitoring areas are likely to allow a good spatial integration, at least during the first phase of the implementation of the Libya's National IMAP, there is a need to ensure harmonisation of sampling frequency and periods, in particular between the surveying campaigns for EO5/EO9 and those for EO1/EO2. In this context, it is highly recommended to establish a national coordination IMAP committee composed of the representatives of the involved scientific institutions and government authorities and chaired by the Ministry of Environment. Its role will be to streamline the planning of the monitoring campaigns and to ensure the timely delivery of datasets.

The main issues identified concerning the implementation of the National IMAP of Libya, apart from the political instability and the related security circumstances are as follows:

- The limitations in government resources may negatively impact the financial sustainability for the implementation of the monitoring campaigns according to the IMAP schedule. External technical and financial support would be essential.
- Difficulty of offshore sampling (> 12 nm) due to difficulty of finding a suitably equipped vessel and also due to the current security situation regarding illegal emigration.
- Difficulty of sample collection, transportation and storage due to the long coastline.
- Need for step-by-step implementation of pilot programmes for EO5 and EO9 in a similar manner as for EO10, as Libya has not developed a coastal MED POL monitoring network. Establishing collaboration between the national institutions and regional organizations, as well as researchers in the Mediterranean basin is highly recommended.

- According to information exchange with the national IMAP team up to January 2023, the appropriate equipment is available to complete sampling and sample handling for CI 17-sediments. Analysis of the target priority substances (metals and PAHs) will be performed at accredited national laboratories (to be confirmed: the type of agreement (long-term or single mandate) and the QA/QC protocol in accordance with IMAP implementation).
- Need to develop a national data base/information system fully interoperable with the IMAP Information System.
- Need for capacity building (e.g. QA/QC, sampling and analysis protocols).

Analysis of the National Integrated Monitoring and Assessment Programme of Morocco

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Foreword

The aim of this document is to provide an analysis of the National Integrated Monitoring and Assessment Programme (IMAP) of Morocco in relation to EO1 (Biodiversity), EO2 (Non-Indigenous Species), EO5 (Eutrophication), OE7 (Hydrography), OE8 (Coastal Ecosystems and Landscapes), EO9 (Pollution) and EO10 (Marine litter). The analysis evaluated the compliance of the National IMAP of Morocco with the IMAP monitoring requirements (e.g. list of stations, maps, GIS layers, spatial-temporal scale/frequency, protocols, methodological/analytical techniques, monitoring protocols and reporting templates).

The analysis is based on the compilation of the following sources of information:

- Programme national global de surveillance intégrée (IMAP-AMP) relatif aux objectifs écologiques concernant la biodiversité-espèces non indigènes, la pollution-déchets marins et la cote-hydrographie (Chaoui M., Menioui M. & Zine NE, juillet 2022)
- Actualisation du plan de surveillance de la composante « biodiversité et espèces non-indigènes » - Projet IMAP-MPA (Maroc)
- Programme national de surveillance intégrée (IMAP) pour les indicateurs relatifs à la côte et à l'hydrographie (OE & OE). Ministère de la Transition Énergétique et du Développement Durable - Département du Développement Durable, juillet 2022
- Programme de surveillance national de la pollution et des déchets marins au Maroc (OE5, OE 9 et OE10). Etude dans le cadre de: Projet EcAP Med II, Contract: n° 05/LNESP-MEDPOL/2018, SSFA-Maroc: n° UNEP/SSFA/2016/DEPI/FMEB-MAP/126. Rapport élaboré par Mohammed CHAOUI, Mohammed EL BOUCH, M. Samir BENBRAHIM et MM. OUAHIDI et ABID.
- Rapport élaboré pour valider la structure du plan d'exécution de l'IMAP National du Maroc par la coordination nationale et par les experts régionaux dans la mesure où la structure ci-après proposée est relativement différente de celle suggérée par la coordination régionale
- The analysis performed by four regional experts appointed by the IMAP-MPA Project to Support the implementation of the National IMAPs in Algeria, Egypt, Israel, Lebanon, Libya, Morocco and Tunisia by providing scientific and technical assistance to the national teams in charge of the development and implementation of IMAP at national level. In their respective reports, the regional experts evaluated the compliance of the National IMAPs with the IMAP monitoring requirements (proposed monitoring sites, techniques and methodologies), identified gaps and provided recommendations and proposals on the integration potential of IMAP EO1, EO2, EO5, EO9 and EO10.

1. Introduction

The Mediterranean coast of Morocco extends over approximately 512 km and is characterized by an often-rugged relief dominated by cliffs with valleys, some bays and beach areas. Located at the entrance to the Mediterranean. The eastern part of the Mediterranean coast of Morocco is however flatter and is characterized by the presence of a large coastal lagoon (Lagune de Nador) and the mouth of a major river (La Moulyya). The Mediterranean coast of Morocco is subject to the influence of Atlantic waters which condition the movements of water masses and have a clear influence on the composition of fauna and flora.

Anthropogenic pressure on the Mediterranean coast of Morocco is concentrated on certain coastal areas with 3 major urban agglomerations (Tangier, Tétouan and Nador), two major industrial centres (Tangier and Nador), and 3 major port infrastructures located near Tangier, Al Hoceima and Nador. The opening up of this area, which occurred following major investments in road and rail infrastructure over the last decades, is likely to increase anthropogenic pressure on the Mediterranean coast of Morocco. In addition, the area is subject to the impact of heavy maritime traffic crossing the Strait of Gibraltar. Another source of anthropogenic pressure is the tourism activity that has developed in the Mediterranean coastal area of Morocco thanks to the attractiveness of the area for both local and international tourism. In addition to hotel units and second homes, marinas (Saidia, Marina Smir and Kabila) have developed taking advantage of the natural attractiveness of the area and the saturation of marinas on the northern shore of the Mediterranean.

The fishing activity in the Mediterranean zone of Morocco is essentially coastal and artisanal. It showed during the period 2018-2020 the highest increase in the Mediterranean reaching an annual landing of 24,900 tonnes. In 2020, it generated jobs for 15,110 fishermen working on board 3,238 vessels and craft operating mainly from 8 fishing ports (Ras Kebdana, El Jebha, M'diq, Cala Iris, Sidi Hssaine, Chmaala, Fnideq, Ksar Sghir) and several.

The knowledge about the marine biodiversity of the Mediterranean coasts of Morocco increased significantly during the two last decades. Indeed, since the establishment in 2004 of the National Strategy for the Conservation and Sustainable Use of Biodiversity and the related action plan, field studies have been carried out to better understand the habitats, fauna and the flora of this marine area. Thus, several sites of interest have been identified: Moulouya mouth, Nador lagoon, Cap des Trois Fourches, Cirque de Jebha, Côte des Rhomara, Koudiat Taifour, Smir lagoon and Jbel Moussa. Detailed data is currently available for some of these sites to define the habitats and species whose monitoring will provide a clear idea of the evolution of the ecological status of the marine environment in this area.

2. Legal and administrative obligations regarding environmental monitoring

Environmental monitoring is instituted in Morocco by a several legal texts. The main provisions of relevance for monitoring in relation to at least one of the IMAP Common Indicators are presented below.

Framework Law No. 99-12, on the national charter for the environment and sustainable development (Dahir n° 1-14-09 du 4 jomada I 1435 (6 March 2014))

This Law establishes the fundamental objectives of the State action in terms of environmental protection and sustainable development. In relation to environmental monitoring, it clearly stipulates that in the context of environmental governance, the government is called upon to put in place the structures, institutions, mechanisms and procedures necessary for the continuous monitoring of the quality of the environment and the collection of data and information relating to the state of the environment and the use of this data and information and their dissemination (Article 24).

Law No. 11-03 relating to the protection and enhancement of the environment (Dahir n° 1-03-59 du 10 rabii I 1424 (12 May 2003))

This Law defines the basic rules and the general principles of the national policy in the field of the protection and development of the environment in Morocco. It devotes its Section V to marine spaces and resources, including the coastline and defines marine pollution as any spillage or introduction into the sea, directly or indirectly, of a product likely to damage living beings and plants to constitute a danger to human health, to hinder marine activities such as fishing and other lawful uses of the sea or to harm the nature and quality of sea water.

In terms of environmental monitoring, it stipulates that the administration should set up a national environmental observatory and regional networks for the observation, control and continuous monitoring of the quality of the environment. These networks periodically monitor, each in its field, the components and the pollutants of the environment, provide the data to the competent authorities and may request the assistance of research centres, scientific and university institutes and the competent authorities (Article 57). This same Law indicates that the norms and standards essential to maintaining the quality of the environment must be defined by legislative and regulatory provisions.

Law n° 49-17 relating to environmental assessment (Dahir n° 1-20-78 du 18 hija 1441 (8 August 2020)

According to this Law, the environmental impact assessment must include a monitoring and follow-up program for the project as well as the required measures in accordance with the technical prescriptions and environmental requirements adopted by the study (Article 7, paragraph 8).

Law No. 22-07 relating to protected areas (Dahir n° 1-10-123 du 3 chaabane 1431 (16 July 2010)

This Law regulates the classification of protected areas into several categories as well as the methods of their management. It stipulates that the monitoring and control mechanisms, as well as the environmental impact indicators are part of the elements that must contain any plan for the development and management of protected areas in Morocco. It therefore establishes environmental monitoring obligations in protected areas.

Law n° 81-12 of July 16, 2015 relating to the coast (Dahir n° 1-15-87 du 29 ramadan 1436 (16 July 2015)).

This Law establishes the basic principles and rules concerning the integrated and sustainable management of the coast with a view to its protection, rehabilitation and conservation. It aims to preserve the balance of coastal ecosystems, biological diversity as well as natural and cultural heritage.

In its article 28, this Law stipulates that the administration must inventory the beaches and dune ridges that may be subject to erosion with a view to protecting and rehabilitating them. The provisions of this article therefore have a direct link with IMAP CIs 15 and 16 relating to EOs 7 and 8.

Decree No. 2-95-717 of November 22, 1996 relating to the preparation and response to accidental marine pollution.

This decree stipulates that the national emergency plan includes provisions aimed at ensuring the establishment of an appropriate detection and alert system in the event of massive marine pollution. For interventions at sea, this decree requires the keeping of a register of actions undertaken. This register could be of great use for Common Indicator 19 (Occurrence, origin (where possible), extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances), and their impact on biota affected by this pollution).

Standard 03-7-199 (2014) relating to the management of bathing water

This standard was approved as a Moroccan standard by decision of March 12, 2014 by the Director of the Moroccan Institute for Standardization. It introduces a modification of an older standard and defines the parameters to be monitored and the procedures for assessing and classifying the quality of bathing water. Intestinal enterococci are one of the parameters imposed by this standard, monitoring

this parameter is particularly relevant for IMAP CI21 (Percentage of intestinal enterococci concentration measurements within established standards).

3. National institutions having mandate or capacity in relation to monitoring marine environment

The institutional framework governing the environment sector in Morocco includes several institutions. Those involved in or having mandates in relation to the marine and coastal environments are public bodies belonging in particular to the Department of Sustainable Development and the Department of Fisheries.

3.1 Laboratoire National des Etudes et de Surveillance de la Pollution (LNEBP)

The LNEBP was inaugurated at the beginning of 2015 as an autonomous body of the Ministry in charge of the Environment with a view to monitoring and characterizing pollution and environmental nuisances. In terms of environmental monitoring, its main missions are:

- To monitor and characterize pollution and nuisances in the environment and contribute to the establishment of thematic monitoring networks
- To control pollution to support the implementation of environmental management and protection programs;
- To contribute to compliance with international and regional commitments in terms of monitoring and controlling pollution;
- To participate in the coordination of the network of laboratories operating in the field of the environment and contribute to the implementation of discharge standards and ensure their respect.

The LNEBP is equipped with modern technical means for the analysis of pollutants in various media as well as systems for the storage and analysis of environmental data.

Equipment available at the LNEBP

Designation	Constructor	Model
Atomic absorption spectrophotometer	Thermo scientific	3500
Microwave Plasma Atomic Emission Spectrometer (MP-AES)	Agilent	4200
Microwave	MILESTONE	Ethos One
Gas chromatograph (GC) with ECD detector (electron capture detector)	Thermo scientific	GC 2130
Gas chromatograph (GC) with FID detector (flame ionization detector)	Thermo scientific	GC 2130
GC with MS detector (mass spectrometry detector) - in progress	Agilent	
UV-VIS spectrophotometer	SECOMAM	Anthelieandvenced 2
UV-VIS spectrophotometer	WTW	Flex 6600 Spectrum
UV-VIS spectrophotometer	Merck	Pharo 300 spectroquant
Computer aided spectrophotometer	PerkinElmer	Lambda 35
Ion chromatograph (IC) for cation analysis		

Ion chromatograph (IC) for anion analysis	Dionex	ICS 2000
Small laboratory equipment		
Sampling equipment		

3.2 Institut National de la Recherche Halieutique (INRH)

The INRH is a public institution of a scientific and technical nature. Endowed with legal personality and financial autonomy, it operates under the supervision of the Department of Maritime Fisheries. Its main missions are:

- Study of the functioning of marine and coastal ecosystems
- Monitoring of the quality and health of the marine environment
- Assessment of fishery resources and monitoring of their exploitation
- Trials of fishing techniques
- Assessment of aquaculture potential and contribution to the development of aquaculture
- Promotion of seafood products

On the Mediterranean coast, the INRH has two regional research centers (Tangier and Nador), a center specializing in aquaculture in M'diq and a fish pathology laboratory in Tangier. This Institute also has means of intervention at sea for sampling and monitoring the marine environment, including two research vessels:

- The Al AMir Moulay Abdellah Research Vessel: Commissioned in 2001, this 38.5 m boat is dedicated to prospecting campaigns for small pelagics and oceanographic campaigns. It has an autonomy of 21 days at sea and can embark 14 crew members and 7 scientists.
- The Charf AL Idrissi Research Vessel: This 41 m vessel is dedicated to monitoring the state of demersal resources stocks. Its autonomy at sea is 30 days and it can embark 25 people including 5 officers and 9 scientists.

Equipment available at the INRH

Designation	Mark	Place
Atomic absorption spectrophotometer (AAS)	Shimatzu	Casablanca
ICP-MS spectrometer	Thermo	Casablanca
Microwave	Milestone	Casablanca, Tangier
GC gas chromatography (ECD and FID)	Agilent	Casablanca
GC Gas Chromatography (FID)	Shimatzu	Tangier
UV-VIS spectrophotometer	WTW	Oualidia
DMA spectrophotometer for direct mercury analysis	Milestone	Casablanca
Electronic micro-scales	-	Network of laboratories
Chemical hoods	-	Casablanca, Tangier
Sampling equipment	-	Network of laboratories

3.3 Institut National d'Hygiène du Maroc,

This is one of establishments of the Ministry of Health. It provides services and expertise in the field of medical biology and Health Environment. For the marine environment, it carries out regular monitoring in relation to microbiological pollution.

4. Analysis of the National IMAP of Morocco

4.1 Common Indicators

The National IMAP-based Monitoring Programme of Morocco includes all Common Indicators for EO1 (CIs 1, 2, 3, 4 and 5), for EO2 (CI 6), for EO5 (CIs 13 and 14) and for EO10 (CIs 22 and 23).

For EO9, only CI 17 will be covered and CIs 18, 19, 20 and 21 will not be implemented during the phase covered by the IMAP-MPA Project. For CI 18, the biomarkers have never been monitored before in Morocco and may pose a problem in terms of experience, inter-calibration and also means (missing equipment and consumables). For CI 19, although there is a legal framework in place there is no information about data flow for IMAP.

4.2 Selection of monitoring areas

The National IMAP of Morocco will be implemented in 3 pilot along the Mediterranean coast of Morocco from Gibraltar strait area to the eastern sector of the Moroccan coastal zone: Jbel Moussa, Al Hoceima and Nador Lagoon (Mar Chica).

Location of the three pilot sites selected for the implementation of the National IMAP of Morocco



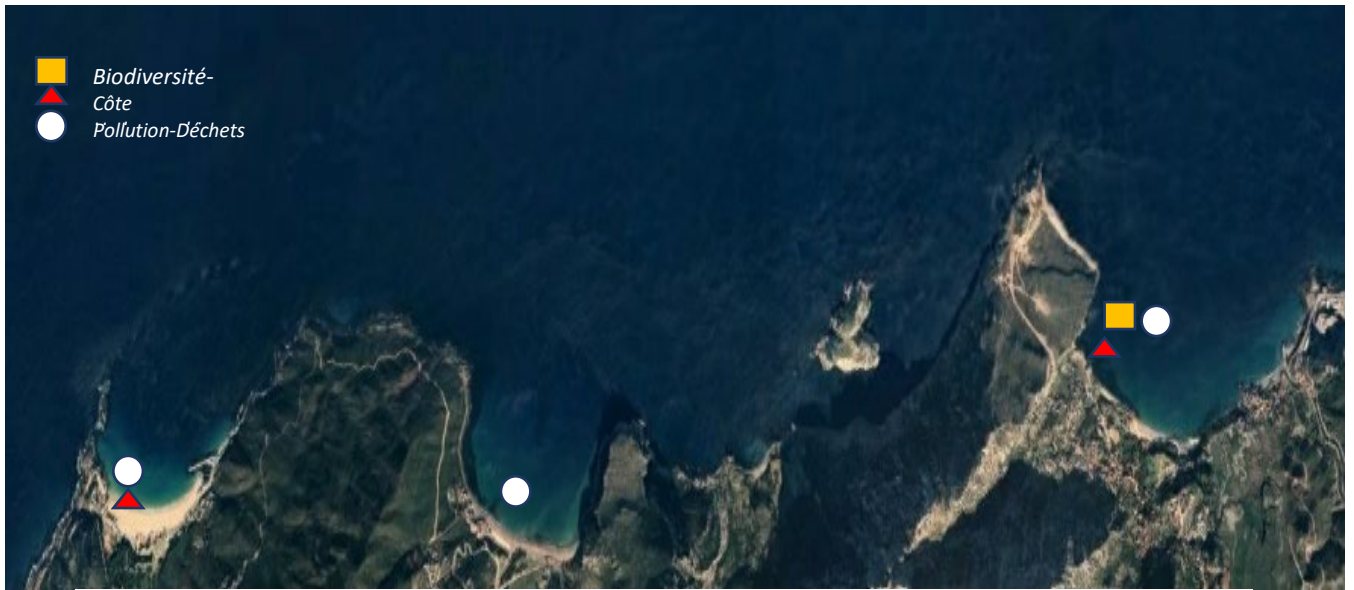
The three selected pilot sites are:

- Reference sites: Al Hoceima National Park (PNAH) and Jbel Moussa (as a site of Biological and ecological interest, SIBE). These two sites were selected according to the following criteria:
 - Availability of information, among others through the habitats project of the MAVA-funded project (MedKey Habitats II) and the MTF SPA/RAC budget (biennium 2016-2017).
 - The existence of actors trained to carry out monitoring activities and of divers
 - Site accessibility
 - The existence of management plans.
 - Development plan adapted for the PNAH by the MAVA-funded project (in July 2020)

The Jbel Moussa is located on the southern coast of the Strait of Gibraltar. It is among the priority sites of the Master Plan for Protected Areas of Morocco. Its ecological value has been documented by a series of field surveys that revealed a marine and terrestrial natural heritage of great value and of great interest for conservation, including dense forest, vultures, falcons, red coral, seagrass beds, etc. A management plan is being developed for the site by the Agence Nationale des Forêt with support from SPA/RAC.

The National Park of Al Hoceima is listed as SPAMI¹ from 2009. It is the largest protected area on the Mediterranean coast of Morocco (48,000 ha), with a marine part of about 19,600

¹ Specially Protected Areas of Mediterranean Importance



Sampling station in the area of Jbel Moussa



Sampling station in the Al Hoceima National Park



Sampling station in Mar Chica/Nador Lagoon

4.3 Analysis of the National IMAP of Morocco for E01

The National IMAP of Morocco will cover the following Common Indicators of EO1:

- Common Indicator 1: Habitat distributional range to also consider habitat extent as a relevant attribute,
- Common Indicator 2: Condition of the habitat's typical species and communities;
- Common Indicator 3: Species distributional range related to marine mammals, seabirds, marine reptiles);
- Common Indicator 4: Population abundance of selected species (related to marine mammals, seabirds, marine reptiles);
- Common indicator 5: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles)

4.3.1 Methodological/analytical techniques for CI1 and CI2

The monitoring of habitats in relation to CI1 will cover the following habitat types to have accurate estimates of the habitat extent, using snorkelling, scuba diving, ROV or acoustic devices:

Hard substrate:

- Mediolittoral rock
- Lithophyllum rims
- Assemblages with *Cystoseira spp.*
- Kelp forests
- Coralligenous
- Underwater caves.

Soft substrate:

- Meadows of *Zostera marina*
- Meadows of *Cymodocea nodosa*
- Maerl beds

For CI2, the species to be considered are those characterizing the habitats selected for the evaluation and monitoring of Common Indicator 1. However, for feasibility reasons and considering existing

data, only the following species associated to coralligenous formation and seagrass meadows will be considered:

Hard substrate: *Corallium rubrum*

Monitoring parameters:

- Coverage rate of typical species
- Bleaching phenomenon
- Biometric measurements (red coral: height and thickness of the base; branching pattern; presence of juveniles)

Monitoring methods:

- Scuba diving
- Taking pictures at fixed and constant points over time.
- Permanent Quadrats

Frequency: 1/year

Soft substrate:

Meadows of *Zostera marina* (*Zostera marina* species)

Meadows of *Cymodocea nodosa* (the *Cymodocea nodosa* species)

Monitoring parameters: Abundance, biomass and biometric characteristics

Monitoring methods:

- Scuba diving
- Taking pictures at fixed and constant points over time.
- Permanent Quadrats

Frequency: 1/year

4.3.2 Methodological/analytical techniques for turtles (CI3, CI4 and CI5)

Three species of sea turtles are reported in the Mediterranean zone of Morocco: the loggerhead *Caretta caretta* and to a lesser extent the leatherback turtle *Dermochelys coriacea* and the green turtle *Chelonia mydas*. There are no records of turtle nesting in the Mediterranean coast of Morocco. The available data about turtles in the Mediterranean waters of Morocco is occasional and come mainly from sporadic observations at sea and strandings documented by the Stranding Monitoring Network (RSE) of the INRH.

The collection of data about turtles under the National IMAP of Morocco will be by regular monitoring of strandings throughout the year and where possible taking the opportunity offered by the INRH's oceanographic campaigns or by organizing specific campaigns dedicated to seabirds, marine mammals and sea turtles. The next rounds of the ACCOBAMS Survey Initiative is another option that can be envisaged for the evaluation of Common Indicator 2 (CI2) in relation to Sea Turtles.

4.3.3 Methodological/analytical techniques for birds (CI3, CI4 and CI5)

The monitoring of seabird species in relation to CI3, CI4 and CI5 will focus on threatened breeders, including Osprey (*Pandion haliaetus*) and Audouin's Gull (*Larus audouinii*). Other species may be considered: *Sterna albifrons*, *Charadrius alexandrinus*, *Thalasseus sandvicensis*, *Thalasseus bengalensis* and *Phoenicopterus roseus*.

Several monitoring protocols using different monitoring platforms and approaches could be used:

- Aerial observation campaigns of the entire Mediterranean zone of Morocco;
- Observation campaigns at sea from ships;
- Observers, placed on strategic fixed points on the coast using binocular or telescopes.

Given the current context, the recommended protocol is coastal monitoring by direct observations using telescopes and binoculars from fixed points. However, observations at sea can be envisaged in the near future by capitalizing on the oceanographic campaigns of the INRH.

The recommended frequency of monitoring is one or two surveys per year to report on the presence and distribution of target species. However, for species of special interest such as osprey, populations should be monitored continuously.

4.3.4 Methodological/analytical techniques for marine mammals (CI3, CI4 and CI5)

Many cetacean species are present in the Mediterranean waters of Morocco. However, there is no specific marine monitoring program for these species. The available data are occasional and mainly come from records of strandings or sporadic observations at sea.

The main parameters to monitor for cetaceans within the framework of the National IMAP of Morocco are presence and geographical distribution of the different species. The monitoring methods to be implemented are observation from ships during campaigns at sea and the regular monitoring of strandings.

The ACCOBAMS Survey Initiative is a good opportunity to collect the required cetacean data in relation to Common Indicator 2 (CI2). The "Delphis" program implemented in Morocco by AGIR could also provide data.

4.4 Analysis of the National IMAP of Morocco for EO2

4.4.1 Methodological/analytical techniques for CI6

In Morocco, the monitoring in relation to Common Indicator 6 (Trends in abundance, temporal occurrence, and spatial distribution of nonindigenous species, particularly invasive, non-indigenous species, notably in risk areas) will cover the following species:

- *Caulerpa cylindracea*: relatively abundant and easily identifiable algae species
- *Callinectes sapidus*: crab species that could be found in fishermen's nets;
- *Bursatella leachii*: mollusc species that could found in the shallow waters of Nador and in fishermen's nets.

Monitoring parameters and methos for the selected species in relation to CI6 in Morocco

Species	Parameters	Monitoring site	Technique & protocol (Orteo et al.,2013)	Frequency
<i>Caulerpa cylindracea</i>	-Recovery rate	- Jbel Moussa	- visual surveys / Diving - QPBS (Permanent Quadrates of Sessile Bioindicators) for algae	1/ year
<i>Callinectes sapidus</i>	- Abundance	- Nador Lagoon - Al Hoceima National Park	- diving in critical habitats (meadows); - transects (50 m. x 1 m.) - Surveys of fishers	1/ year
<i>Bursatella leachii</i>	- Abundance -	Nador Lagoon	- diving in critical habitats	1/ year

			(herbarium);	
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4.5 Analysis of the National IMAP of Morocco for EO5

The monitoring sites for the Morocco's National IMAP on Eutrophication, are selected from historical monitoring station. The choice of sites was made in order to cover the entire coastal area of the Moroccan Mediterranean, taking into consideration the access to the sites, the implementation of sampling equipment and the representativeness of the region. One site (Mar Chica) is selected as representative of area exposed to eutrophication (hot spots) sources and two sites (Jbel Moussa and Al Hoceima) are chosen as reference sites.

Summary of sampling protocols for CI13 and CI14 in the National IMAP of Morocco

C13	Frequency ^s	seasonal,
	Sampling methods	Niskin bottle
	Sample depth (m.)*	0, -5, -10
	Number of samples for station	3
	Protocols for sampling and samples storage	<ul style="list-style-type: none"> • ISO 5667-3 • ISO 5667-14 • ISO 5667 - 3:2003 • UNEP/ MEDPOL N.163
C14	Frequency ^s	seasonal
	Sampling methods	Niskin bottle, Secchi disk, CTD probe
	Sample depth (m.)*^	0, -5, -10, water column profile with CTD
	Number of samples	3
	Protocols for sampling and samples storage	<ul style="list-style-type: none"> • ISO 5667-3 • ISO 5667-14 • UNEP / MEDPOL.N. 163 • ISO/WD/7027-2

Summary of analytical techniques for CI13 and CI14 in the National IMAP of Morocco

	Information	Morocco
CI13	Nutrient analyzed	NO3-N NO2-N NH4-N PO4-P SiO4-Si
	Methods*	spectro
	Unit	µmol/L
	Guidance and protocols	<ul style="list-style-type: none"> • Aminot and Chaussepied, 1983 • UNEP / MEDPOL.N. 163 • ISO/WD/7027-2
	Quality assessment	EN ISO/IEC/ 17025
CI14	Methods*	<ul style="list-style-type: none"> • Chl a: spectro • WT: Secchi disk • DO: Winkler • O-sat: saturation table
	Unit	<ul style="list-style-type: none"> • Chl a: µg/L • WT: m • DO: µmol/L • O-sat: %
	Guidance and protocols	<ul style="list-style-type: none"> • Strickland & Parsons, 1968 • UNEP / MEDPOL.N. 163 • UNESCO 1994 • ISO 10260-92

	Quality assessment	<ul style="list-style-type: none"> • ISO/IEC/ 17025 • WOCE, 1994
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4.6 Analysis of the National IMAP of Morocco for EO7 and EO8

The National IMAP of Morocco covers the Common Indicators 15 (Location and extent of the habitats impacted directly by hydrographic alterations) of EO7 and 16 (Length of coastline subject to physical disturbance due to the influence of man-made structures) of EO8.

The relevance of the monitoring in relation to these two CIs for each of the three pilot sites of the National IMAP of Morocco is as follows:

Jbel Moussa MPA site (MPA)

Monitoring in relation to CI15 is relevant for the area of Jbel Moussa since Housing and infrastructure considered necessary for the development of the area have been put in place with or without assessment of their possible impacts on the area of less than 100 meters from the shoreline and its coastal habitats.

For CI16, the monitoring will allow to evaluate the perturbation degree generated by the artificialization of some portions of the coastline.

National Park of Al Hoceima (MPA)

Although any construction and artificialization activities of the coast of the National Park are regulated, the monitoring in relation to CI15 is envisaged by the National IMAP concerning old infrastructures for which the impact has not been clearly established.

The monitoring in relation to CI 16 will target the possible perturbation generated by the man-made structures that are still functional.

Mar Chica (Site under anthropogenic pressure)

The area is a very artificialized environment by many tourism and urban development projects. The monitoring in relation to CI15 is expected to provide data about the impacts generated on the habitats of the area.

The monitoring in relation to CI16 in the area around the Mar Chica is needed to document the variation in the length of coastline subject to disturbance due to the influence of man-made structures and other numerous tourism, urban and socio-economic projects in the area.

Given the complexity of the parameters involved in the monitoring in relation to CI15 and CI16, many institutions shall collaborate with the Laboratoire National des Etudes et de Surveillance de la Pollution (LNESP) to provide the needed data. The Centre Royale de Télédétection Spatial (CRTS) will play a central role since it is the official distributor in Morocco of satellite images (SPOT, Landsat, ERS, NOAA and other). It has its own image archives and direct access to the archives of SPOT IMAGE (France) and EURIMAGE (Italy).

4.7 Analysis of the National IMAP of Morocco for EO9

As for the other EOs, the pilot sites for the implementation of monitoring in relation to EO9 in Morocco are 2 MPAs (Jbel Moussa and Parc d'Al Hoceima) and one site under pressure (Mar Chica/Nador Lagoon).

In the first phase of the implementation of the National IMAP of Morocco, only CI17 and CI21 will be covered. CI 18, 19 and 20 would be covered in a later stage. For CI18, the biomarkers have never been monitored before in Morocco and may pose a problem in terms of experience, inter-calibration and also means (missing equipment and consumables). For CI19, there is a legal framework in place but there is no information on the data flow for IMAP.

For CI17 (both biota and sediments) and CI 21, the parameters that will be targeted include the metals Cd, Pb and Hg, the 5 PAHs currently monitored in Morocco (benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, chrysene) and the PCBs (28, 52, 101, 138, 153 and 180).

For CI17, a total of 5 sites and 12 stations are monitored including at different depths. The stations are common for EO5 and EO9, ensuring integration and synergies for monitoring activities.

For CI21, 12 beaches are monitored with 1 to 3 stations each. The beaches selected for monitoring IC22 (EO10) are common, ensuring further integration.

4.7.1 Methodological/analytical techniques

The methodology and analytical techniques envisaged for the CIs of EO9 are in accordance with IMAP (UNEP/MED WG.467/5). However, as noted in the national the report, current capacities on analytical methods of the two institutes (LNESP and INRH laboratories) that will carry out the analyses, are partially fulfilling IMAP requirements. Specifically, these include part of the PAHs (Benzo(a)pyrène, Benz(a)anthracène, Benz(b)fluoranthène, Chrysène) and PCBs (PCB 28, PCB52, PCB101, PCB153, PCB138, PCB180) required by IMAP for CI 17, and part of the biomarkers (lysosomal stability) required by IMAP for CI 18.

It is also noted that although sampling in the water column is not mandatory, it may be considered in some stations as a temporary complementary effort, especially if monitoring efforts confirm the lack of equipment available for sediment and biota sampling, as current monitoring efforts are mainly related to sampling in the water column.

As regards CI 21, monitoring of intestinal enterococci according to established standards is already part of the national bathing water quality monitoring program.

Methodology for each Common Indicator (CI) and analytical techniques of the National IMAP of Morocco for EO9 and accordance with IMAP (Y: yes; N: no; P: partially; NR: nor required by IMAP for the particular CI).

CI	Matrix	Substance, biomarker or parameter	Analytical method	Accompanying parameters	IMAP
17	Marine biota: Bivalves (mussels <i>Mytilus galloprovincialis</i> and at area where mussels are not available clams <i>Callista chione</i> and <i>Chamelea gallina</i>)/caged bivalves/fish	Trace Metals: Cd, Hg, Pb	GF-AAS, ICP-OES, ICP-MS	Biometric parameters	Y
17	Marine biota: Bivalves (mussels <i>Mytilus galloprovincialis</i> and at area where mussels are not available clams <i>Callista chione</i> and <i>Chamelea gallina</i>)/caged bivalves/fish	16 EPA PAH congeners	HPLC-UV-Flu, GC-MS	Biometric parameters	P
17	Marine biota: Bivalves (mussels <i>Mytilus galloprovincialis</i> and at area where mussels are not available clams <i>Callista chione</i> and	PCBs (28, 31, 52, 101, 105, 118, 138, 153, 156 and 180) HCB Lindane	GC-ECD, GC-MS, GC-NCI-MS	Biometric parameters	P

	<i>Chamelea gallina</i>)/caged bivalves/fish	ΣDDTs			
17	Marine sediments	Trace/Heavy Metals (TM): Cd, HgT, Pb	GF-AAS, ICP-OES, ICP-MS	AI in the < 2mm particle size fraction, < 63µm fraction as complementary, Freeze-drying ratio (dry/wet sediment ratio)	Y
17	Marine sediments	Polycyclic aromatic hydrocarbons (US EPA 16 PAHs)	HPLC-UV-Flu, GC-MS)	Total Organic Carbon (TOC) in the < 2mm particle size fraction /Freeze-drying ratio (dry/wet sediment ratio)	P
17	Marine sediments	PCBs (28, 31, 52, 101, 105, 118, 138, 153, 156 and 180) HCB Lindane ΣDDTs	GC-ECD, GC-MS, GC-NCI-MS	Total organic carbon (TOC) and liophilisation dry/wet ratio	P
17	Water	Complementary			NR
21	Seawater	Analysis of intestinal enterococci	According to Directive 2006/7 / EC and UNEP (DEPI) / MED IG 20/8 Decision IG 20/9		Y

Sampling frequency is overall in accordance with IMAP requirements i.e., annually for CI 17-biota, once every two years for CI 17-sediment for the initial phase and thereafter every three years depending on the evaluation of the initial phase results. For C21, bimonthly during the bathing season from May to September with a reference sampling in March.

4.8 Analysis of the National IMAP of Morocco for EO10

In Morocco, marine litter has been monitored since 2018. The marine litter monitoring programme is part of a national programme for monitoring bathing water and sand quality covering in the Mediterranean coast of Morocco 21 beaches. Also, as part of the pilot project "Adopt a beach", 4 beaches were selected to carry out awareness and communication activities and to characterize waste on beaches. For the implementation of the National IMAP of Morocco, six beaches covered by the national marine litter monitoring programme will be monitored in relation to CI22 (Trends in the amount of litter washed ashore and/or deposited on coastlines (including analysis of its composition, spatial distribution and, where possible, source)

Selected beaches from the Marine Litter Monitoring programme to be monitored in relation de CI22

Beach	Type	Localization
Saidia Med	Tourist/Marina/Presence of mouth	City of Saidia
Miami Nador	Port/Lagoon	Province of Nador
Sabadilla	Rural	Al Hoceima Province
Amsa	Rural/Mouth of a small wadi	Prefecture Tetouan
Martil	Mouth Oued Martil	City of Martil
Municipal Tangier	Urban	City of Tangier

The monitoring parameters in relation to IC22 will be the quantities and classification of wastes over 2.5 cm (macro-litter) recovered from the coastline according to the IMAP sheets. The methodology for waste characterization is as follows:

- Choose and delimit the sampling area by defining:
 - Location: the most frequented area / which is at the door of the beach by specifying its GPS coordinates
 - Length: 100 m
 - Width: from the seaside (at a possible and safe location) or from the shoreline to the bottom of the beach.
- Observe the scope of the investigation and record:
 - Weather conditions (wind/rain/sandstorm/fog or exceptional high tide
 - If there are stranded or dead animals or objects of marine pollution
- Collect waste of any type found between designated boundaries in a plastic bag
- Sort waste by category (Plastic/polystyrene – Rubber – Fabric – Paper/Cardboard – Processed/worked wood – Metal – Glass – Ceramics – Sanitary waste – Medical waste – Faeces – Paraffin wax / Crumbs or pieces of wax) and subcategory according to the MED POL Beach Waste Survey Form
- Count waste and record the results in number and weight using the form.

For CI23 (Trends in the amount of litter in the water column including microplastics and on the seafloor), the litter will be characterized during the monitoring campaigns at the sites selected for the indicators CI13, CI14 and CI17 Monitoring methods for marine litter (seabed and floating) will be in accordance with the relevant expectations and recommendations of the UN Environment/MAP MED POL Programme.

For floating litter, sampling will be carried out using a Manta net, towed by a boat for a fixed period of time (approximately 15 to 20 min) and at a fixed speed.

For litter on the seabed of shallow coastal waters (0-20m), sampling will be carried out by bottom dredging, using a shell dredge to collect waste larger than 2.5 cm. Concerning litter on the seabed (20-800m), and given the complexity of sampling and the heavy means it involves, the characterization will be carried out by trawl during offshore trawling campaigns.

Required actions to an efficient implementation of monitoring in relation to CI22 and CI23 harmonized monitoring

Beach Litter	Floating Litter	Microplastics	Seafloor litter	Data management	Quality assurance
Operational, long term	coordination/capacity	Capacity building,	coordination/capacity	ML Database to be	To be formalized

optimization & funding	building, pilot monitoring	funding	building/	optimized , links with INFO/RAC	(Q/A documents, data check, etc.)
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4.9 Data quality assurance, reporting and assessment

Quality assurance (QA)/Quality Control (QC) of the analytical methods will be based on method blank, reference materials, and interlaboratory studies. Laboratories are accredited ensuring QA/QC protocols and participate in inter-calibration exercises. International standards will be followed.

Currently, there is no specific database and information system for the data that will be produced on the IMAP indicators. An information system will be set up that will be able to interact with the database of the pilot information system INFO / RAC IMAP by the National and Regional Observatoires de l'Environnement et de Développement Durable and by the INRH.

Assessment of GES will be carried out according to the IMAP indicator fact sheets in the first place at the country level and thereafter at a sub-regional and / or regional level. For CI 17 assessment will be based on OSPAR and Mediterranean BACs and EACs.

4.10 Coordination mechanisms

A national IMAP committee is now in place, coordinating all institutions involved in the implementation of the IMAP, with thematic groups involving the different institutions per cluster. A cooperation agreement among the two main institutions involved in the sampling and analysis has been signed for promoting coordination and synergies. A call for expressions of interest for national experts to support capacity building of local actors, managers and institutions involved in the monitoring of each of the three clusters.

The institutions involved in the implementation of the National IMAP of Morocco are as follows:

Biodiversity and NIS: MTE-DD, focal point of the Convention on Biological Diversity, the Department of Water and Forests, as focal point of the SPA/BD protocol and the Department of Maritime Fisheries institutionally responsible, through the Institut National de Recherche Halieutique (INRH), for the surveillance and monitoring of marine living resources in Morocco.

Pollution and marine litter: Laboratoire National des Études et de la Surveillance de la Pollution (LNEP) who is in charge of monitoring pollution at national level and INRH who has among its main functions the monitoring of the quality and healthiness of the marine environment.

Cost and Hydrography: the monitoring in relation to EO7 and EO8 needs multidisciplinary data whose availability requires the involvement of the following institutions:

- The MTE-DD, being the Focal Point for the Barcelona Convention, is the key institution that could ensure the coordination at national level the coordination of the monitoring in relation to EO7 and EO8;
- Centre Royale de Télédétection Spatiale (CRTS), main holder in Morocco of satellite images and aerial photos (SPOT, Landsat, ERS, NOAA, and others), that essential for the interpretation of monitoring information for EO7 and EO8;
- INRH, the scientific research body of the Department of Fisheries could contribute, through its human and material resources, in monitoring activities, in terms of physicochemical and environmental analyzes in the marine and coastal environment;
- The "Service hydrographique de la Marine Royale" has the experience, the human resources and the logistics necessary to contribute to the monitoring of the marine and coastal environment, in particular the bathymetric and hydrographic components;

- The "Département de l'équipement" as the manager of public maritime domain (DPM);
- The "Ministère de l'Aménagement du territoire national, de l'Urbanisme, de l'Habitat et de la Politique de la ville" whose role is essential in planning and regulating the artificialization of urban areas;
- University department which also have programmes of relevance to EO7 and EO8 (sedimentology, hydrology, fauna, coastlines, geomorphology, etc.).

4.11 Conclusions and recommendations

There is a good spatial integration for the monitoring in relation to the Common Indicators covered by the National IMAP of Morocco. Further integration in terms of timing of the sampling campaigns could be ensured through the National IMAP committee.

The selected monitoring areas include one site under anthropogenic pressure (Mar Chica/Nador Lagoon, where impacts of human activities on the marine and coastal environment are recorded) and two reference sites (the MPA of Jbel Moussa and the National Park of Al Hoceima where baseline information is available since a series of surveys were carried out, in particular for the characterisation of marine habitats and species).

All the Common Indicators of EO1, EO2, EO5, EO7, EO8 and EO10 are covered by the National IMAP of Morocco. For EO9, only CI17 and CI21 will be covered in the first phase of the National IMAP implementation, while CI 18, CI19 and CI20 are expected to be covered in a later stage when capacity in terms of experience, inter-calibration and also means (missing equipment and consumables) will be available at national level.

For the proper implementation and future development of the National IMAP of Morocco, it is recommended to:

- Reinforce the capacities in terms of material resources (laboratories, research vessels and scientific instruments) for sampling and analyses in relation to the CIs.
- Considering the difficulties to cover all sites on the Mediterranean coast and to sample in offshore waters, harmonization of sampling operations at sea, in terms of coordination and material resources, including research vessels, should be given special consideration. The National IMAP committee could play a central role in this respect.
- Support should be given in relation to certain parameters that are not currently analyzed by the laboratories involved in IMAP (certain PAHs, organochlorines and biomarkers required for CI 17 and CI 18), as well as coordination of the different institutes involved in sampling, analysis and reporting for CI 20.
- Special attention should be paid to data quality control for all Eos. The participation in inter-laboratory exercises and continuing education should be promoted.
- Consider the development of the National IMAP of Morocco to cover as soon as possible CI 18, 19 and 20. To this end, support in terms training, inter-calibration and also means (missing equipment and consumables).

Analysis of the National Integrated Monitoring and Assessment Programme of Tunisia

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Foreword

The aim of this document is to provide an analysis of the National Integrated Monitoring and Assessment Programme (IMAP) of Tunisia in relation to EO1 (Biodiversity), EO2 (Non-Indigenous Species), EO5 (Eutrophication), EO9 (Pollution) and EO10 (Marine litter). The analysis evaluated the compliance of the National IMAP of Tunisia with the IMAP monitoring requirements (e.g. list of stations, maps, GIS layers, spatial-temporal scale/frequency, protocols, methodological/analytical techniques, monitoring protocols and reporting templates).

The analysis is based on the compilation of the following sources of information:

- Mise en œuvre de la première phase de l'IMAP : pollution et déchets marins – EcAp-MEDII. Mise en œuvre des activités IMPA et Marine Litter MED. Par Ben Haj S.& Shaiek M., Ed. APAL 2019 – Projet EcApMEDII ((Rapport APAL-IMAP, 2019)
- Etude d'appui à l'intégration et la mise en œuvre en Tunisie de l'IMAP au niveau national dans le cadre du projet IMAP-MPA (SPA/RAC, 2021)
- The analysis performed by four regional experts appointed by the IMAP-MPA Project to Support the implementation of the National IMAPs in Algeria, Egypt, Israel, Lebanon, Libya, Tunisia and Tunisia by providing scientific and technical assistance to the national teams in charge of the development and implementation of IMAP at national level. In their respective reports, the regional experts evaluated the compliance of the National IMAPs with the IMAP monitoring requirements (proposed monitoring sites, techniques and methodologies), identified gaps and provided recommendations and proposals on the integration potential of IMAP EO1, EO2, EO5, EO9 and EO10.

1. Introduction

Tunisia is located in the North of Africa with a coast extending over about 1300 km opening to the East on the eastern basin of the Mediterranean Sea and to the North on the western basin of this sea.

The northern coast of the country is mainly rocky and characterized by many capes and a narrow continental shelf. The seabed morphology is an extension of the mountainous coast with canyons and submarine cliffs and soft bottoms. In the Eastern coast, rocky shores are rare, while large portions of the coast are made of sandy beaches.

The southern coast of the country is essentially constituted by the Gulf of Gabès which extends towards the Tunisian-Libyan border and is characterized by sandy and sandy-muddy bottoms. The continental shelf is large with a light slope. The important tide movements characterizing the Gulf of Gabès coupled with the light slope of its continental shelf creates large foreshore zones in this area.

Overall, on all the northern rocky coasts, biological diversity is subject to low disturbances (low pollution, difficult access for trawling and sport fishing, etc.). The eastern part of Cap-Bon, the Gulf of Hammamet and the Sousse-Monastir region, although little prospected, can be considered as regions where biodiversity is in good condition except in certain areas that are currently considered pollution hotspots, particularly with regard to eutrophication. Biodiversity in the Gulf of Gabès has been under significant anthropogenic pressure due to industrial pollution and intense trawling. Along its coasts, the country has many islands, most of which are ecological oases.

The main anthropogenic pressures on the marine environment in Tunisia are related to the excessive development of urban planning and tourism. Industry is another source of nuisance, but its impact remains confined to isolated areas except in the Gulf of Gabes where pollution of industrial origin has contributed to the severe degradation of marine habitats over a large part of the area.

Fishing is a very important sector in Tunisia economically and socially. The environmental consequences of fishing activity are numerous, particularly on the most fragile habitats, such as Posidonia meadows, and on fishing stocks. Signs of overexploitation are visible for several species.

2. Legal and administrative obligations regarding environmental monitoring

Environmental monitoring in Tunisia is governed by the texts relating to the management of natural resources and those relating to the preservation of the environment. The texts presented below are particularly relevant for environmental monitoring in the marine and coastal environment related to at least one of the IMAF indicators.

The **Water Code** promulgated in 1975 by **Law No. 75-16** of 31 March 1975 and amended several times imposes a series of measures to monitor water quality, including the monitoring of discharges into the water environment. The Ministry of Agriculture is responsible for implementing the provisions of this Code, but the health aspects are the responsibility of the Ministry of Public Health. On the basis of the Water Code, the latter carries out regular sampling throughout the country, including beaches, to monitor the quality of bathing water.

The regulations relating to **discharges into the receiving environment** are governed by the Decree No. **85-56** of 2 January 1985 and **Decree No. 94-1885** of 12 September 1994. The first stipulates in its Article 14 that periodic inspections shall be carried out at the level of installations subject to permits and that the data of these monitoring shall be recorded in a register kept for this purpose. The second Decree lays down the conditions for the discharge of waste water, other than domestic wastewater, into sewerage networks.

The **conservation of species and natural habitats** in Tunisia is governed in particular by the **Forest Code** which was promulgated in 1966 and amended by **Law 88-20** of 13/04/1988. Its Chapter III is devoted to the protection of nature, flora and fauna. This Chapters instructs the Directorate General of Forests to monitor endangered species in Tunisia. It is obvious that this text concerns in particular the terrestrial environment, but it partially covers the marine environment through the monitoring of certain bird species covered by indicators 3, 4 and 5 of IMAP.

Issues relating to coastal **protection and land-use control** in the coastal zone are governed in Tunisia by the **Code of Spatial Planning and Town Planning** promulgated by **Law 94-122** of 28 November 1994. This Code lays down the rules to be followed for the optimal organization and use of space, planning, creation and development of urban settlements. It promotes harmonization between economic development, social development, and ecological balances, with a view to guaranteeing sustainable development and the citizen's right to a healthy environment. Its provisions concern (i) the living environment, (ii) the sustainable exploitation of resources, (iii) the protection of natural and cultural sites, (iv) public safety and health and (v) a balanced distribution between urban and rural areas.¹

The management of the **Public Maritime Domain (DPM)** is governed in Tunisia by **Law No. 95-73** of 24 July 1995, as amended by **Law No. 2005-33** of 4 April 2005. This text defines the categories of the DPM and sets the conditions of its occupation. **Law No. 95-72** of 24 July 1995 establishing an agency for the protection and development of the coastline entrusts the latter with the monitoring the coastline and its occupation/use.

The **Agricultural Land Protection Act** (Act No. 83-87 of 11 November 1983) established protection for agricultural land and established the necessary conditions for changing its use. This law is particularly important for the implementation of IMAP in Tunisia regarding the indicator 25 on land-use change in relation to Ecological Objective 8.

The Tunisian legislation on **Environmental impact Assessment** is constituted in particular by the **Law 88-91** of 2 August 1988 establishing the National Agency for Environmental Protection (ANPE) and amended by **Law No. 92-115** of 30 November 1992. Since 1991, the law establishing the ANPE introduced the obligation in Tunisia to carry out an environmental impact assessment (EIA) before the establishment of any industrial, agricultural or commercial unit whose activity presents risks of pollution or degradation of the environment. More regulatory details were then introduced by the **Decree 91-362** of 13 March 1991 on EIA. The elaboration and implementation of a monitoring plan are among the provisions of this Decree.

3. National institutions having mandate or capacity in relation to monitoring marine environment

The institutional framework governing the environment sector in Tunisia is essentially constituted by the Ministry in charge of the environment and the institutions under its supervision. At the central level of the Ministry, it is the Directorate General for the Environment and Quality of Life that is most concerned with environmental monitoring issues.

3.1 The National Environmental Protection Agency (ANPE)

The ANPE was created by **Law No. 88-91** of August 2, 1988 and amended by **Law No. 92-115** of November 30, 1992. It is placed under the supervision of the Ministry of the Environment. Its main missions concern the fight against pollution and the protection of the environment. To this end, it carries out actions to control discharges and monitors the quality of the environment: air, water and soil. It also has a mission of environmental education and awareness. The ANPE is the main state body in charge of Environmental Impact Assessments.

¹ The Code of Spatial Planning and Town Planning was amended in 2003 (**Law 2003-78** of 29/12/2003), in 2005 (**Law 2005-71** of 01/08/2005) and in 2009 (**Law 2009-9** of 16/02/2009).

The ANPE hosts the Tunisian Observation of Environment and Sustainable Development (OTEDD) that ensures the development and monitoring of indicators in several sectors of activity such as fishing, tourism, etc. It is also responsible for the preparation of annual reports on the state of the environment in Tunisia.

3.2 The Coastal Protection and Development Agency (APAL)

APAL is responsible for implementing the State policy in the field of coastal protection and development. It therefore seeks to protect the maritime public domain against encroachments and illegal occupations. Its approval is required for any development and equipment project on the coast before its execution. Its main missions concern:

- The management of the maritime public domain.
- The clearance of the land situation of existing buildings and constructions its creation, in accordance with the legislation in force.
- The management of coastal areas through the realization, monitoring and control of development and protection operations.
- The development of expert studies and research relating to coastal protection and the conservation of natural areas and sensitive areas.
- The establishment of an observatory of coastal ecosystems.
- Rehabilitation and management of natural coastal areas and sensitive areas (wetlands, coastal forests, islands, etc.).

3.3 The National Institute of Science and Technology of the Sea (INSTM)

INSTM is a Public Research Institution operating under the supervision of the Ministry in charge of fisheries, its missions are to:

- Conduct research programmes in fields directly or indirectly related to the sea and its resources: Fisheries, Aquaculture, Marine Environment, Marine Technology, Oceanography, etc.
- Participate in the various national, regional and international networks related to the sea.
- Contribute to solving problems related to the development of urban and economic activities on the coast and in territorial waters.
- Transfer its know-how and research results to decision-makers and marine professionals and scientists.
- To serve as a decision-making tool for the sustainable management of the sea and its resources.
- Contribute to the dissemination of marine culture and public awareness of the protection and preservation of the sea and its biodiversity.

The INSTM contributes to university training by supervising doctoral students in master's degree and end-of-study projects. This institute is the main actor in Tunisia in terms of monitoring the marine environment. INSTM has laboratories equipped to monitor parameters relating to marine pollution, biodiversity and fisheries resources, and thanks its long collaboration with MEDPOL as well as its skilled staff, INSTM is a key player in the implementation of the National IMAP of Tunisia.

3.4 The International Centre for Environmental Technologies of Tunis (CITET)

CITET was created in 1996 to support environmental research and to assist Tunisian companies in promoting clean production. It derives its international vocation from its extensive program of collaboration with international organizations and national institutions of several Mediterranean, Arab and African countries. Its missions are:

- Strengthening the human and institutional capacities of Tunisia and the countries of the region in the field of environmental protection,
- The acquisition, adaptation and transfer of environmentally sound technologies and the promotion of clean technologies,
- Technical assistance to industrial companies to help them better integrate environmental management into their overall management,
- Collection and dissemination of information on environmental protection.

As part of its missions, CITET carries out activities such as:

- Continuing education and skills development in the field of environmental management.
- Research & Development and transfer of eco-technologies and promotion of clean technologies.
- Analysis laboratory services.
- Technical assistance to industry
- Information, documentation and publication.

CITET has laboratories equipped to undertake analysis of parameters relating to pollution in water, atmospheric and soil environments. It has the capacity to efficiently contribute in the analysis of the parameters relating to EO5 and EO9.

3.5 The National Agency for Waste Management (ANGed)

ANGed was created in 2005 by Decree No. 2005-2317 of 22 August 2005, it is placed under the supervision of the Ministry in charge of the environment. Its missions are:

- Participate in the development of national waste management programmes;
- Manage public waste management systems;
- Manage industrial and special waste infrastructure;
- Promote waste collection, recycling and recovery systems and programs;
- Assist and assist municipalities and industrialists in the field of sustainable waste management;
- Promote partnership between all stakeholders, particularly between local authorities, industry and the private sector;
- Contribute to the consolidation of national expertise in the field of waste management;
- Prepare and implement waste management awareness programs;
- Participate in the development of laws and regulations relating to waste management;
- Participate in international cooperation in the search for the necessary funding for the implementation of waste management programmes and projects.

Considering its missions in terms of waste management, the ANGed is one of the State bodies best placed to contribute to the monitoring of marine debris. However, it is not involved in the monitoring and assessment in relation to E010.

3.6 The National Institute of Standardization and Industrial Property (INNORPI)

INNORPI was created in 1982 and is placed under the supervision of the Ministry of Industry, Energy and Mines. Its missions concern standardization, the quality of products and services and the protection of industrial property. Its relevant missions for the field of environmental monitoring are:

- The preparation, in collaboration with the organizations concerned, of the general programme for the development of standards, establishes the technical standardization commissions, organizes their work within them and provides the secretariat for them. INNORPI is the national enquiry point on standards;
- Certification of conformity to standards of products, services and management systems and manages national marks of conformity to standards.

In the area of environmental monitoring, INNORPI has promulgated a series of standards for discharge into the environment, including the marine environment.

3.7 The National Institute of Statistics (INS)

The INS is the central executive body of the National Statistics System in Tunisia. Its activities concern all areas of collection and processing of statistical data. In the environmental field, the INS collects and disseminates statistical data on water, air, soil, forests, waste and biodiversity.

3.8 The Directorate of Environmental Health and Protection (DHMPE)

The DHMPE is an organ of the Ministry of Public Health. In terms of control in the field of the environment, the DHMPE monitors air pollution, noise pollution, chemical pollution, non-ionizing waves, ionizing waves, solid waste, etc. This directorate regularly monitors the quality of bathing water. Such data are particularly relevant for IMAP indicators (Indicator 21 on intestinal enterococci concentration, EO9).

3.9 The Directorate General of Veterinary Services (DGSV)

The DGSV of the Ministry of Agriculture intervenes in animal health and the quality of animal products control. Some of its missions, as set by Decree 2001-420 on the organization of the Ministry of Agriculture, are relevant to IMAP, particularly with regard to Common Indicator 20 (Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood) of OE9. Indeed, the DGSV is called upon as part of its missions to:

- delineate, design and define strategies, programmes and guidelines relating to the quality of animal products, monitor their implementation and evaluate them.
- monitor and control the quality at the level of production, distribution and use of veterinary products.
- ensure health and quality control of animals and products of animal origin for import and export,

In 1995, the DGSV developed the "National Network for Monitoring the Production and Marketing Conditions of Bivalve Molluscs". Through this network, it coordinates the intervention of several specialized institutions to monitor, in the production areas of bivalve molluscs, several parameters (phytoplankton, biotoxins, harmful chemical contaminants, bacteriology, etc.).

4. Analysis of the National IMAP of Tunisia

4.1 Common Indicators

The National IMAP-based Monitoring Programme of Tunisia includes all Common Indicators for E01 (CIs 1, 2, 3, 4 and 5), for EO2 (CI 6), for EO5 (CIs 13 and 14), and for EO10 (CIs 23 and 23). for EO9 CIs 17 and 21 are covered.

4.2 Selection of monitoring areas

Three zones were selected for the implementation of the National IMAP of Tunisia:

- Zone under anthropogenic pressure: The Gulf of Gabès
- Reference sites: Kuriat Archipelago and Kerkennah Archipelago

The Gulf of Gabès:

The Gulf of Gabès is located in the southern coast of Tunisia. It has experienced during the past four decades significant population growth and increase of the industrial activity with 1,895 industrial units concentrated on the coast of city of Gabès and its surrounding areas.

The coastal strip of the marine environment in the area is subject to various pressures and nuisances of anthropogenic and natural origin. Indeed, the various urban and industrial discharges have led to serious degradation of the seabed and coastal biocenoses in certain areas, with in particular a worrying decline of the *Posidonia oceanica* meadow. Field surveys whose results were published in 2004 that phosphogypsum pollution was spread in the Gulf of Gabès over an area of around 60 km². The various anthropogenic pressures (discharges of industrial, agricultural, domestic effluents, etc.) lead to eutrophication in several places of the area, with excessive development of algae and microalgae. In addition to their impact on the environment, such phenomena affected the safety of seafood products.

Excessive trawling in shallow depths and overexploitation of natural resources have contributed to the degradation observed in the marine environment of the Gulf of Gabès.

The archipelago of Kuriat



Location of the monitoring areas covered by the National IMAP of Tunisia

4.3 Analysis of the National IMAP of Tunisia for E01

The National IMAP of Tunisia will cover the following Common Indicators of E01:

- Common Indicator 1: Habitat distributional range to also consider habitat extent as a relevant attribute,
- Common Indicator 2: Condition of the habitat's typical species and communities;
- Common Indicator 3: Species distributional range related to marine mammals, seabirds, marine reptiles);
- Common Indicator 4: Population abundance of selected species (related to marine mammals, seabirds, marine reptiles);
- Common indicator 5: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles)

4.3.1 Methodological/analytical techniques for CI1 and CI2

The key habitats to be considered for CI1 and CI2 under the National IMAP of Tunisia will be those presenting particular importance for:

Marine vegetation

- *Posidonia oceanica* meadows

- *Cymodocea nodosa* meadows
- *Lithophyllum* rims
- Assemblages with *Cystoseira* spp.

Coralligenous and bioconstructions

- Maerl beds
- Vedrmitid terraces

Dark habitats

- Underwater caves (if present in the pilot monitoring areas).

The biological parameters to be monitored for these habitats are:

- In relation to CI1: location, extension (surface area) and level of fragmentation.
- In relation to CI2: density and demographic parameters

These parameters will be monitored by snorkelling and scuba diving.

4.3.2 Methodological/analytical techniques for turtles (CI3, CI4 and CI5)

The main turtle species observed in Tunisia is the loggerhead *Caretta caretta*. Its observation is more difficult at sea than on land, especially during the breeding period (nesting). The sandy beaches with low human presence are the most suitable sites for the nesting monitoring of the species. The Kuriat archipelago (one of the pilot monitoring sites of the National IMAP) is the most important nesting sites of *Caretta caretta* in Tunisia. However, nesting is also observed in other sites in the country, but there is no documented information about its occurrence. The two other pilot monitoring sites (Kerkennak archipelago and Gulf of Gabès) are among the areas cited in the grey literature as possible nesting sites of the species.

In Kuriat archipelago the monitoring will be conducted each year during the nesting season by a dedicated campaign during which a permanent presence of the monitoring team will be ensured to identify on a daily basis the new nests and protect them. In kerkennah and the Gulf of Gabès, nesting beaches will be monitored by Foot patrols.

Recording of parameters for Nesting and Demography will include number of eggs per clutch, hatchling emergence success, etc.

4.3.3 Methodological/analytical techniques for birds (CI3, CI4 and CI5)

The monitoring of seabird species in relation to CI3, CI4 and CI5 will focus on the following species:

<i>Phalacrocorax aristotelis</i>	(Mediterranean) Shag
<i>Larus audouinii</i>	Audouin's gull
<i>Larus genei</i>	Slender-billed Gull
<i>Thalasseus (= Sterna) bengalensis</i>	Lesser Crested Tern
<i>Thalasseus (= Sterna) sandvicensis</i>	Sandwich Tern
<i>Calonectris diomedea</i>	Scopoli's Shearwater
<i>Puffinus yelkouan</i>	Yelkouan Shearwater
<i>Puffinus mauretanicus</i>	Balearic Shearwater

The monitoring parameters for bird species will be as follows:

Presence and distribution of breeders: these parameters inform about the presence of the species within each area and allow the determination of the geographical distribution of the colonies by species and its temporal evolution.

Abundance of breeders: this parameter informs the number of breeding pairs per species.

Young production: average number of young fledged by breeding pair.

Breeding success: percentage of couples who have raised young successfully. It informs performance of reproduction and any inter-annual variations or between geographical sectors.

4.3.4 Methodological/analytical techniques for marine mammals (CI3, CI4 and CI5)

Many cetacean species are present in the waters of Tunisia. However, mainly the Bottlenose Dolphin *Tursiops truncatus* is regularly observed. Under the National IMAP of Tunisia, the monitoring of cetaceans will be focusing on this species. The following parameters may be monitored:

- Presence and distribution at sea;
- Displacement of populations (photo-identification)
- Spatial (and seasonal) distribution
- Abundance (number of resident groups);
- Population structure / demographic parameters including the number of births;
- Health status and condition of individuals.

However, if adequate monitoring resources are not available, the main parameters to monitor for cetaceans within the framework of the National IMAP of Tunisia could be presence and geographical distribution of the species. The monitoring methods to be implemented are observation from ships during campaigns at sea and the regular monitoring of strandings.

4.4 Analysis of the National IMAP of Tunisia for EO2

4.4.1 Methodological/analytical techniques for CI6

In Tunisia, the monitoring in relation to Common Indicator 6 (Trends in abundance, temporal occurrence, and spatial distribution of nonindigenous species, particularly invasive, non-indigenous species, notably in risk areas) will cover a risk area (the Gulf of Gabès, because of the presence of the oil terminal with the & associated risks from ballast water discharging) and the candidate MPAs (Kuriat and Kerkennah archipelagos).

The monitoring method is not yet defined, it will be decided following a scoping visit to the sites.

4.5 Analysis of the National IMAP of Tunisia for EO5

In Tunisia, since 2001, in the framework of the MEDPOL, several monitoring activities related to the EO5, have been carried out along the coastal waters, performed by the ANPE (National Agency for the Environmental Protection), by the INSTM (National Institute of Science and Technologies of the Sea). The monitored parameters were nutrients and Chlorophyll-a.

For the monitoring in relation to CI13 and CI14, five transects have been identified, each with 3 stations. The stations are located at a distance of 1 nm (nautical mile), 3 nm and 12 nm, except for the transect 1 and transect 3 that have the furthest station respectively at 6,7 nm and 7 n.m. In addition, the transect R2 has been extended until it reaches the AMP of Zembra; therefore, transect R2 is the only one with 4 stations. The 5 transects belong to 4 Regions, Bizerte-Cap Blanc (transect 1), Golfe de Tunis (transect 2), Golfe de Hammamet (transect 3), Golfe de Gabès- Sfax (transects 4 and 5).

N. of stations	16
Transects	5 transects
Coordinates	yes
Maps	yes
Area/region	5 areas/4 regions
Shape file	no
Historical monitoring sites	yes
Distance from the coast	1nm – 3nm-. 12 (6.7/7) nm. Zembra station (MPA) 29 nm.
Type of station (hotspot, reference, etc.)	Information on type of pressure and reference (MPA)
Cross with other EO proposed from CPs	All 16 sts. are both for EO5 and EO9

<i>Summary of monitoring protocols for CI13 and CI14 from National IMAP of Tunisia</i>		
CI	Information	Tunisia
13	Operator	INSTM
	Frequency [§]	seasonal,
	Sampling methods	Niskin bottle
	Sample depth (m.)*	0, -5, -10, 2m from bottom
	Number of samples for station	4
	Protocols for sampling and samples storage	<ul style="list-style-type: none"> • ISO 5667-9 • ISO 5667-14 • ISO 5667-3 • ISO 5813-83 • OSPAR 2004-2 • OSPAR 2005-4 • ICES – JAMP -2009 • Daniel A., 2009
14	Operator	INSTM
	Frequency [§]	seasonal,
	Sampling methods	Niskin bottle, Secchi disk, CTD probe,
	Sample depth (m.)*^	0, -5, -10, 2 m from bottom, water column profile with CTD
	Number of samples	4
	Protocols for sampling and samples storage	<ul style="list-style-type: none"> • ISO 10260- 1992 • ISO 7027:1999 • See CI 13
* the depth 0 indicates a subsurface sample		
^ for CTD probe measures		

<i>Summary of analytical techniques for C13 and C14 from National IMAP of Tunisia</i>	
C13 – INDICATOR: <i>Inorganic Nutrient Concentration (NO₃-N; NO₂-N; NH₄-N; TN; PO₄-P; TP; SiO₄-Si)</i>	
C13 – SUB-INDICATOR: <i>Nutrient ratios (Si:N; N:P; Si:P)</i>	
Operator	INSTM
Nutrient analyzed	NO3-N NO2-N NH4-N TN PO4-P TP SiO4-Si
Methods*	spectro
Unit	µmol/L
Guidance and protocols	<ul style="list-style-type: none"> • Aminot & K�rouel, 2004, 2007 • OSPAR: JAMP; HARP-NUT (Ref. 2004-2) • ICES, 2009 • Daniel, 2009 • Daniel, Kerouel, Aminot, 2010
Quality assessment	NA
C14 – INDICATOR: Chlorophyll a concentration in water column	
C14 – SUB-INDICATOR: <i>Water transparency (WT) and Dissolved oxygen (DO)</i>	
Operator	INSTM
Methods*	<ul style="list-style-type: none"> • Chl a: spectro or fluorimetry • WT: Secchi disk • DO: CTD probe • O-sat: CTD probe • Phyto: Utherm�l
Unit	• Chl a: µg/L

	<ul style="list-style-type: none"> • WT: m • DO: µmol/L O-sat: % Phyto: cell/L
Guidance and protocols	<ul style="list-style-type: none"> • ISO 7027-99 • ISO 10260-92 • Lorenzen Protocol • SOMLIT, 2015 • Uthermöhl, 1981 • Brock, 1978 • Holm-Hansen, 1993
Quality assessment	NA
NA: Not available *: spectr = spectrophotometry; O-sat = Oxygen saturation ^: except Total phosphorus and Ammonium	

4.6 Analysis of the National IMAP of Tunisia for EO9

Monitoring transects were selected near the stations of the MED POL program in Tunisia with a modification in coordinates and addition of one reference station in an MPA at 29 nautical miles (NM) from the coast. Five transects with 3 or 4 stations at increasing distance from the coast (1 NM; 3 NM; 6.7, 7 or 12 NM; one station at 29 NM), satisfying the IMAP requirements for coverage beyond coastal areas. Out of the total 16 stations, 11 stations are described as master stations, 4 stations as hot spots and 1 station as reference. Rationale for station selection is in accordance with IMAP requirements. In accordance with the IMAP requirements, list of stations with coordinates, maps with bathymetry are provided, and the stations are the same for EO5.

Sampling areas cover the three Tunisian marine sub-regions (North, East and South) with two transects in the North, one in the East and two transects in the South.

CI methodology and analytical techniques are overall in accordance with IMAP (UNEP/MED WG.467/5). Organochlorinated compounds, which are required substances for CI 17 by IMAP are not included in substances to be measured in sediments, and it is not clear which institution will be responsible for these analyses in biota. A clarification on the individual substances to be measured by type of priority compounds (PAHs and PCBs) is also pending. For CI 17-biota, in addition to the species shown in the following table, fish, cephalopods, crustaceans and marine mammals are mentioned but with no further specifications.

Monitoring protocols recommended by IMAP will be adopted.

<i>Methodology for each Common Indicator (CI) and analytical techniques of the National IMAP of Tunisia for EO9 and accordance with IMAP (Y: yes; N: no; P: partially; NR: nor required by IMAP for the particular CI).</i>					
CI	Matrix	Substance, biomarker or parameter	Analytical method	Accompanying parameters	IMAP
17	Marine biota: bivalves (clams, mussels), fish (<i>Mullus barbatus</i> , <i>Sardina pilchardus</i> flesh and liver)	Trace/Heavy Metals (TM): Cd, Hg, Pb	AAS (ICP-OES optional)	Not mentioned	Y
17	Marine biota: bivalves (clams, mussels), fish (<i>Mullus barbatus</i> , <i>Sardina pilchardus</i> flesh and liver)	Polycyclic Aromatic Hydrocarbons (PAHs), US EPA 16 PAHs, Total PAHs, benzo(a)pyrene	GC-MS, (HPLC optional)	Not mentioned	Y

17	Marine biota: bivalves (clams, mussels), fish (<i>Mullus barbatus</i> , <i>Sardina pilchardus</i> flesh and liver)	PCBs (28, 31, 52, 101, 105, 118, 138, 153, 156 and 180) Hexachlorobenzene, Lindane, Σ DDTs ⁺	GC-ECD	Not mentioned	Y
17	Marine sediments	Trace/Heavy Metals (TM): Cd, HgT, Pb	AAS (ICP-OES optional)	Al in the < 2mm particle size fraction, < 63 μ m fraction as complementary, Freeze-drying ratio (dry/wet sediment ratio)	Y
17	Marine sediments	Polycyclic aromatic hydrocarbons (US EPA 16 PAHs)	GC-MS, (HPLC optional)	Total Organic Carbon (TOC) in the < 2mm particle size fraction /Freeze-drying ratio (dry/wet sediment ratio)	Y
21	Seawater	Percentage of measurements of the concentration of intestinal enterococci within established standards. Concentration of intestinal enterococci in the sample (normalized to 100 ml) and calculation of the 95th and 90th percentiles of the LogNormal probability distribution	Microbiological and biochemical methods		Y
21		Flows (daily, monthly, annual), concentrations of contaminants (NR)			NR

Sampling frequency is in accordance with IMAP requirements i.e., twice a year for CI 17-biota (although not clearly specified), once every two years for CI 17-sediment. For CI 21, sampling frequency will be in accordance with the EU Directive 2006/7/EC and IMAP; it is also stated that a minimum of 12 samplings per year (monthly) is required for bathing areas and a minimum of 4 samplings per year in other cases (seasonal) with sampling dates distributed throughout the bathing season, with the interval between sampling dates never exceeding one month.

4.7 Analysis of the National IMAP of Tunisia for EO10

For IMAP Common Indicator 22 (Beach Macro Litter), The implementation of IC22 will cover the following parameters:

- Abundance of litter scattered over each survey unit: elements per 100m of transect;
- Composition of litter by survey unit (master list of marine litter)

For each selected beach, a fixed section (transect) of 100 linear meters with a width of 100 m or more where possible will be fixed. It is recommended to keep at least one (1) section of 100 m on the same beach and at most two (2) sections for the purposes of monitoring slightly to moderately polluted beaches.

The frequency of monitoring of the IC 22 will be 4 surveys per year (spring, summer, autumn and winter). The exact date of the surveys will be defined when the program is implemented, while trying as far as possible to keep the same monitoring date each year.

For IMAP Common Indicator 23 (Marine litter in the water column), the monitored parameters will be density of floating marine litter and type of litter. The monitoring will be carried out by observation from ships. The same parameters will be monitored for the CI23 (Marine Litter on the sea floor), ic trawlers.

4.8 Data quality assurance, reporting and assessment

There is no information system at the national level. The data are shared with the MED POL secretariat and is expected to be included in the InfoRAC system. There is no mention of data quality assurance processes, apart from participation in exercises, trainings, seminars and workshops.

4.9 Coordination mechanisms

There is no coordination mechanism for the implementation of IMAP in Tunisia. APAL is in charge of the implementation of IMAP for EO1 and EO2 and ANPE is in charge of the IMAP in relation to EO5, EO9 and EO10.

The sampling operations and analysis in relation to EO5 and EO9 are to be carried out by INSTM. The National IMAP-based Monitoring Programme for EO9 is moderately covered by the already existing monitoring programs in particular those of INSTM and ANPE. However, existing monitoring programs need to be extended to offshore stations, and for some indicators such as CI 19, CI 20 and CI 21, adaptations to IMAP protocols are needed.

The existing monitoring program includes 5 sub programs:

Program 1: Chemical contaminants in the environment and marine organisms. Monitoring is already in place since 2003 for water, sediment, and biota (metals and PAHs). Modifications for including additional species may be made (fish, cephalopods, crustaceans).

Program 2: Effects of chemical contaminants on marine organisms. Monitoring is in place in coastal environments (monitoring network of bivalve production areas and the national pollution monitoring program), adaptations will be needed.

Program 3: Effects of contaminants on marine organisms and in fishery products (current consumption by humans). The system is already in place (bivalve monitoring, national pollution and contaminant monitoring network), adaptations will be needed (biological effects measurements, additional species).

Program 4: Continental inflows and bathing water monitoring. Relevant mechanisms are in place, in particular the national and institutional monitoring networks such as those of the ANPE (National Continental Water Quality Monitoring Network) or DHMPE (Ministry of Health, Bathing Water Quality Control Network). The Bathing Water Quality Control Program is already in place, which will constitute the main basis for the implementation of the "bathing water monitoring" program relating to IC 21 and in particular the monitoring of microbial contamination (concentration of intestinal enterococci).

Program 5: Critical events and acute pollution episodes. Tunisia has a well-structured emergency plan for oil spills and HNS involving different stakeholders and ministries, and is also a member of the REMPEC activities in the Mediterranean.

For EO7 and EO8, APAL, through its "Observatoire du Littoral" could perform the monitoring in relation to CI15 and CI16. However, for the time being, there is no dedicated programme covering these two Common Indicators.

4.10 Conclusions and recommendations

Although most of the methodologies planned for the National IMAP of Tunisia are in line with the requirements of IMAP, a special effort is recommended to ensure further integration between the Ecological

Objectives. It is highly recommended to focus the monitoring activities on the selected three pilot area: Kuriat archipelago, Kerkennah archipelago and Gul of Gabès. It is also recommended to ensure that a first sampling campaign be conducted before the end of June 2023 with the participation of the National IMAP team members in charge of the covered Common Indicators.

For the future development of the National IMAP of Tunisia, here are the main recommendations:

- Establish a national IMAP Committee to ensure (i) further development of the monitoring and GES assessment, (ii) better integration in terms of monitored sites and time planning of the monitoring/sampling operations (iii) wide consultation for the GES assessment at national level.
- Clearly define the role of the National IMAP actors concerning EO2, EO5, EO7, EO8, EO9 and EO10.
- For CI1, the use of ROVs or acoustic devices is recommended if the related resources are available, and the required authorisation are timely obtained.
- The target substances for CI 17 should be further clarified. Organochlorinated compounds are not included in the substances to be measured in sediments while the number of compounds to be targeted for other priority groups are not mentioned (e.g. PCBs and individual PAHs).
- Include in the National IMAP the CIs not yet covered: CI15, CI16, CI18, CI19 and CI20.
- For CI23, the use of dedicated boats for the sampling campaigns should be envisaged.

Analysis of the National Integrated Monitoring and Assessment Programme of Algeria

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Foreword

The aim of this document is to provide an analysis of the National Integrated Monitoring and Assessment Programme (IMAP) of Algeria in relation to EO5 (Eutrophication), EO9 (Pollution) and EO10 (Marine litter). The analysis evaluated the compliance of the National IMAP of Algeria with the IMAP monitoring requirements (e.g. list of stations, maps, GIS layers, spatial-temporal scale/frequency, protocols, methodological/analytical techniques, monitoring protocols and reporting templates).

The analysis is based on the compilation of the following sources of information:

- Programme National de surveillance de la Pollution et des Déchets Marins – Algérie, 2019. Étude réalisée par Samir Grimes (Consultant) pour l'Observatoire National de l'Environnement et du Développement Durable (ONEDD) et financée par le Plan d'Action pour la Méditerranée dans le cadre du Projet EcAP Med II.
- The analysis performed by four regional experts appointed by the IMAP-MPA Project to Support the implementation of the National IMAPs in Algeria, Egypt, Israel, Lebanon, Libya, Algeria and Algeria by providing scientific and technical assistance to the national teams in charge of the development and implementation of IMAP at national level. In their respective reports, the regional experts evaluated the compliance of the National IMAPs with the IMAP monitoring requirements (proposed monitoring sites, techniques and methodologies), identified gaps and provided recommendations and proposals on the integration potential of IMAP EO1, EO2, EO5, EO9 and EO10.

1. Introduction

Algeria has a coastline of about 1280 km characterized by a great geomorphological diversity and where the marine waters are under the influence of the Algerian current" which comes from the Atlantic and moves along the Algerian coasts creating a set of gyres and upwellings with a marked instability that characterizes the hydrographic conditions in the area. Continental freshwater inputs are in some zones, and according to the seasons, very important and influence the characteristics of marine water masses, especially in areas where the geomorphology of the coast is not favourable to water circulation.

With the presence of large coastal cities such as the capital (Algiers) located in the centre, Oran in the west and Annaba in the east, the Algerian coast is subject to strong pressures of anthropogenic origin. In response to such pressures, a Coastal Protection Law was promulgated in 2002 as well as a series of regulations relating to the control of discharges into the natural environment.

Urban development and industry are the most important human activities influencing the coastal and marine environment, but other activities are present, including agriculture in the coastal zone, tourism and fishing. The latter consists mainly of coastal fishing with a fleet composed of small boats that operate in a limited spatial range. Intensive marine aquaculture is developing with the cage culture farms increasingly important in production capacity.

Tourism is essentially seaside and predominantly national with concentrations in hot spots of bathing tourism. Tourist accommodations are diversified, but without the emergence of large hotel areas. It is therefore a diffuse tourism on large portions of the coast, even if increasingly high concentrations are recorded on certain points of the coast, with negative impacts and difficulties difficulty in terms of environmental management.

Marine pollution, although it has reached levels that are increasingly difficult to manage, particularly with regard to eutrophication caused by organic discharges, it is still confined to certain hotspot areas, and the rest of the coast has good environmental qualities.

2. Legal and administrative obligations regarding environmental monitoring

The legal framework relating to the environment in Algeria has been expanded by a series of laws and other regulatory texts. Some of them include provisions of relevance for environmental monitoring. The texts considered particularly relevant for the implementation of IMAP in Algeria are described below.

Law No. 03-10 of 19 July 2003 on the protection of the environment in the context of sustainable development

This law defines the rules for environmental protection in the context of sustainable development. With regard to environmental monitoring and surveillance, it considers that the organization of environmental information and the definition of environmental standards are among the instruments of environmental management (Article 5). In addition, Article 10 of this Law indicates that the State monitors the various components of the environment and that it must define limit values, alert thresholds, and quality objectives, particularly for air, water, soil and subsoil.

Law No. 01-19 of 12 December 2001 on waste management, control and disposal

This law covers waste management in Algeria and aims to determine waste management, control and treatment procedures on the basis of general principles such as the prevention and reduction of waste generation and what it involves in term threats to environment. It also aims to promote new techniques for sorting, collecting, transporting and treating waste.

Law No. 02-02 of 5 February 2002 (Coastal Law). It relates to the protection and development of the coastal zone. It is intended to implement the national strategy for coastal protection and the development of its resources. It has strengthened the national legislative framework for better spatial management. Its provisions concern the management of conflicts of use between the various stakeholders. It is based on the principles of sustainable development and promotes the conservation of natural sites through their valorisation.

Law No. 01-11 of 3 July 2001 on fisheries and aquaculture. It constitutes the Fisheries Code of Algeria and determines the conditions for the exercise of this activity and lays down the general rules on fishing gear and practices relating to fishing and aquaculture. This Act provides for measures for the monitoring of resources and imposes an obligation on the administration to carry out this function. Through one of its implementing decrees, it regulates the procedures for setting up fisheries and the types of use of living marine resources.

Executive Decree No. 06-141 of 19 April 2006 defining the limit values for industrial liquid effluent discharges.

This decree is promulgated pursuant to Law No. 03-10 of 19 July 2003 mentioned above. It includes a section for the control of industrial liquid effluent discharges (Section 3). This section establishes self-control and self-monitoring by operators of installations generating discharges of industrial liquid effluents, as well as periodic and/or unannounced inspections carried out by the competent services to verify that the physical, chemical and biological characteristics of industrial liquid effluent discharges comply with the limit values set by the decree. These are specified in Annex I of the Decree. Annex II of the Decree sets the tolerance for certain limit values for industrial liquid effluent discharge parameters according to the categories of installations.

Executive Decree No. 14-264 of 22 September 2014 on the organization of the fight against marine pollution and institution of emergency plans

This Executive Decree was promulgated pursuant to the provisions of Law No. 02-02 of 5 February 2002 on the protection and enhancement of the coastline (Article 33) and Law No. 03-10 of 19 July 2003 on the protection of the environment in the context of sustainable development (Article 56). It is part of the implementation of several international conventions and protocols ratified by Algeria. It is also part of the implementation of the Sub-Regional Agreement for Preparedness to Combat and Combat Accidental Marine Pollution in the South-West Mediterranean Area. This sub-regional agreement was initiated under the impetus of REMPEC to establish a sub-regional emergency plan between Algeria, Morocco and Tunisia. It was signed in Algiers by the representative of the Governments of the three States on 20 June 2005. For Algeria, it was approved by Presidential Decree No. 06-302 of 2 September 2006. The calculation and evaluation of IMAP indicator Common Indicator 19 (Occurrence, origin (where possible), extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances), and their impact on biota affected by this pollution (EO9)) could benefit from the information and data available in the reports of the Tel Bahr committees established by this Executive Decree.

Executive Decree No. 07-206 of 30 June 2007 on spatial planning. This decree establishes the procedures for the construction and use of land on the coastal strip, the occupation of natural areas adjacent to beaches and the extension of the *non-aedificandi* zone. This text concerns land used for (i) authorized economic activities on a three-kilometre coastal strip and (ii) safeguarding natural areas adjacent to sand dunes and beaches in order to preserve sedimentary balance (dunes, sandbanks, etc.). This decree also applies to the *non-aedificandi* zone of three hundred meters. This decree requires monitoring by the authorities concerned as to the uses and movements of the coastline. The enforcement of this executive decree may generate useful data for the IMAP Candidate Indicator 25 (Land use change (EO8)).

3. National institutions having mandate or capacity in relation to monitoring marine environment

The institutional framework governing the environment sector in Algeria is essentially constituted by the Ministry in charge of the environment and the institutions under its supervision. The Ministry (Ministère de l'environnement et des énergies renouvelables) has among its prerogatives the permanent assessment of the state of the environment. It is also called upon to elaborate, propose, and ensure the operation of observation and monitoring systems and networks, including laboratories for the analysis and control of the environment.

In addition, many institutions have prerogatives or missions related to the monitoring of the marine environment in Algeria. These prerogatives and tasks are often clearly defined by legislation. Those that can play a role in IMAP monitoring are presented below:

Observatoire national de l'environnement et du développement durable (ONEDD)

The ONEDD was created in 2002 as a public body placed under the supervision of the Ministry in charge of the Environment and has its own legal personality and financial autonomy. The role of ONEDD is to collect, process, produce and disseminate scientific, technical and statistical environmental information. Since its creation, ONEDD has developed its structures which include, in addition to the headquarters located in Algiers, 20 regional laboratories, stations and monitoring networks. As part of its missions, the observatory is responsible for:

- the setting up and management of networks for observing and measuring pollution and monitoring natural environments;
- the collection from national institutions and specialized bodies, data and information related to the environment and sustainable development;
- the compilation of environmental data and information in order to develop information tools;
- initiating, carrying out or contributing to the realization of studies to improve the environmental knowledge as well as better understanding the pressures exerted on the environment;
- publishing and disseminating environmental information.

Most ministries and the National Statistics Office are represented on the ONEDD Board of Directors.

Centre National de Recherche et de Développement de la pêche et de l'aquaculture

The CNRDPA has operated under several names and under the supervision of several ministries. In it was restructured as public establishment of a scientific and technological nature (Executive Decree No. 08-128 of 30 April 2008) of the Ministry in charge of fisheries. The CNRDPA is responsible for contributing to the preparation and implementation of national scientific research and technological development programmes in the field of fisheries and aquaculture. It also has many missions related to the development of fisheries and aquaculture in Algeria (assessment of fish stocks, economic and social studies, development of fishing techniques, etc.).

In the field of monitoring the marine environment, the CNRDPA conducts annual survey campaigns and contributes to monitoring networks and joint projects with national and foreign partners. It has a fleet composed of small boats and a 40-m research vessel, the Belkacem GRINE, with surveying technologies including equipment for the assessment of pelagic and benthic stocks and a multibeam sonar for mapping the seabed and habitats. This research boat has a great autonomy allowing it to intervene on all Algerian waters.

The mission of the CNRDPA as set by its founding decree is to:

- Evaluate fisheries resources and monitor their exploitation.
- Undertake pilot actions related to the development of aquaculture.
- Identify areas suitable for aquaculture.
- Study and function of aquatic ecosystems.
- Valuing aquatic resources.
- Carry out economic and social studies related to fisheries and aquaculture.

- Initiate and carry out extension programmes, in liaison with relevant structures and institutions, with a view to contributing to the development of the fisheries sector.
- Define the most suitable fishing techniques and experiment fishing gear.

École Nationale Supérieure des Sciences de la Mer et de l'Aménagement du Littoral (ENSSMAL)

ENSSMAL was created by the Executive Decree No. 08-221 of 14 July 2008. It is a former institution that has changed its vocation and name several times from a university marine station to a research and training institution. Currently ENSSMAL is a training and research school in the fields of oceanography, coastal development and management. Its main missions are academic training and scientific and technical research. It provides multidisciplinary training courses at the graduation level (Engineering) and post-graduation (Magister and Doctorate). To this end, ENSSMAL provides:

- High level training for the management of marine resources and the development of coastal zones.
- Training for the benefit of user sectors.
- Participation in socio-economic development through the production of marine scientific data allowing an assessment and adequate exploitation of marine resources and rational management of the coastline.
- Contribution to the dynamism of oceanographic research by strengthening and consolidating cooperation with national, regional and international institutions.
- The valorization of the results of scientific research and the dissemination of scientific and technical information.

ENSSMAL has a fleet of boats composed of a multidisciplinary oceanographic research vessel (M.S. BENYAHIA) and 3 other smaller vessels operating in coastal environments. The M.S. BENYAHIA is a 25-metre vessel that caters for 10 researchers in addition to its crew and having an autonomy at sea of 10 days. This vessel is equipped with satellite positioning equipment and oceanographic measurement and sampling equipment in the water column and sediment.

Centre National de Développement des Ressources Biologiques (CNDRB)

The CNDRB is placed under the supervision of the Minister in charge of the Environment. It is responsible for activities related to the knowledge, conservation and enhancement of biological diversity. Its mission, as defined in its founding Decree (Executive Decree No. 2-371 of 11 November 2002, amended and supplemented by Executive Decree No. 4-198 of 19 July 2004), is to:

- centralize all inventories of fauna, flora, habitats and ecosystems;
- contribute, in consultation with the sectors concerned, to the development of plans for the development of biological resources in the context of sustainable development
- propose, in consultation with the sectors concerned, the conservation of national biological resources according to the modalities laid down by the regulations in force;
- promote the implementation of public awareness programmes on the conservation and sustainable use of biological diversity.

Laboratoire National de Contrôle et de l'Analyse des Produits de la Pêche et de l'Aquaculture et de la Salubrité des Milieux (LNCAPPASM)

This Laboratory was created by Executive Decree No. 12-215 of 15 May 2012 as a public institution of an administrative nature, endowed with legal personality and financial autonomy. It is placed under the supervision of the Ministry in charge of Fisheries and has a steering committee in which all the relevant ministries are represented. The main missions of this laboratory are:

- carrying out various types of biochemical, bacteriological, physico-chemical parasitologists and toxicological analyses of fishery and aquaculture products,
- the analysis of the health of the environment and the control of the quality of marine and aquaculture waters,
- the compilation of all documentation or information relating to the quality of fishery and aquaculture products,
- contributing to raising awareness in the field of control of fishery and aquaculture products and their environments.

In addition to these missions, the laboratory is authorized to provide analysis and/or expertise services and may enter into contracts and agreements for this purpose.

Commissariat National du Littoral (CNL)

The CNL is a public administrative institution under the supervision of the Ministry in charge of the Environment. It was created by Article 24 of Law No. 02-02 of 5 February 2002 on the protection and enhancement of the coastline.

In accordance with the provisions of Article 4 of Decree No. 04-113 defining its organization, functioning and missions, the CNL has the following missions:

- Preserve and enhance the coastline, coastal areas and their ecosystems.
- Implement coastal and coastal protection measures.
- Provide local communities with all assistance related to its areas of intervention.
- Maintain, restore and rehabilitate land and marine spaces that are remarkable or necessary to maintain natural balances with a view to their conservation.
- Promote public awareness and information programmes on the conservation and sustainable use of coastal areas and their biological diversity.

Institut National de Cartographie et de Télédétection (INCT)

The INCT is a public industrial and commercial establishment (EPIC) under the economic sector of the Ministry of National Defence. Created in 1967, the main missions of the INCT are the production, collection, conservation and dissemination of geographic information. It provides assistance to various administrations, communities and public and private organizations. Its main missions are:

- The realization and maintenance on the national territory of a basic canvas in Geodesy, levelling and gravimetry;
- The coverage of the territory in aerial photography;
- The preparation and updating of the 1/50000 and 1/200000 base topographic maps and those derived from them;
- The collection and conservation of satellite data;
- The realization of geographical databases;
- The realization of research work in the fields of geographic information;
- The conservation of archives.

Possible contribution of each of the organizations presented above to the implementation of the National IMAP of Algeria:

	Possible contribution to the implementation of the National IMAP of Algeria
Observatoire national de l'environnement et du développement durable (ONEDD)	Common Indicators of EO5, EO9 General coordination and compilation of data
Centre National de Recherche et de Développement de la pêche et de l'aquaculture (CNRDPA)	Common Indicators of EO1, EO2 and EO3
Nationale École Nationale Supérieure des Sciences de la Mer et de l'Aménagement du Littoral (ENSSMAL)	Common Indicators of EO1, EO2 and EO3, EO5, EO9 and EO10
Centre National de Développement des Ressources Biologiques (CNRDB)	Common Indicators 3, 4 and 5 of EO1 (in particular for Birds) and Common Indicator 6 of EO2
Laboratoire National de Contrôle et de l'Analyse des Produits de la Pêche et de l'Aquaculture et de la Salubrité des Milieux (LNCAPPASM)	Common Indicators 17 (in biota matrix), 20 and 21
Commissariat National du Littoral (CNL)	Common Indicators of EO7 and EO8

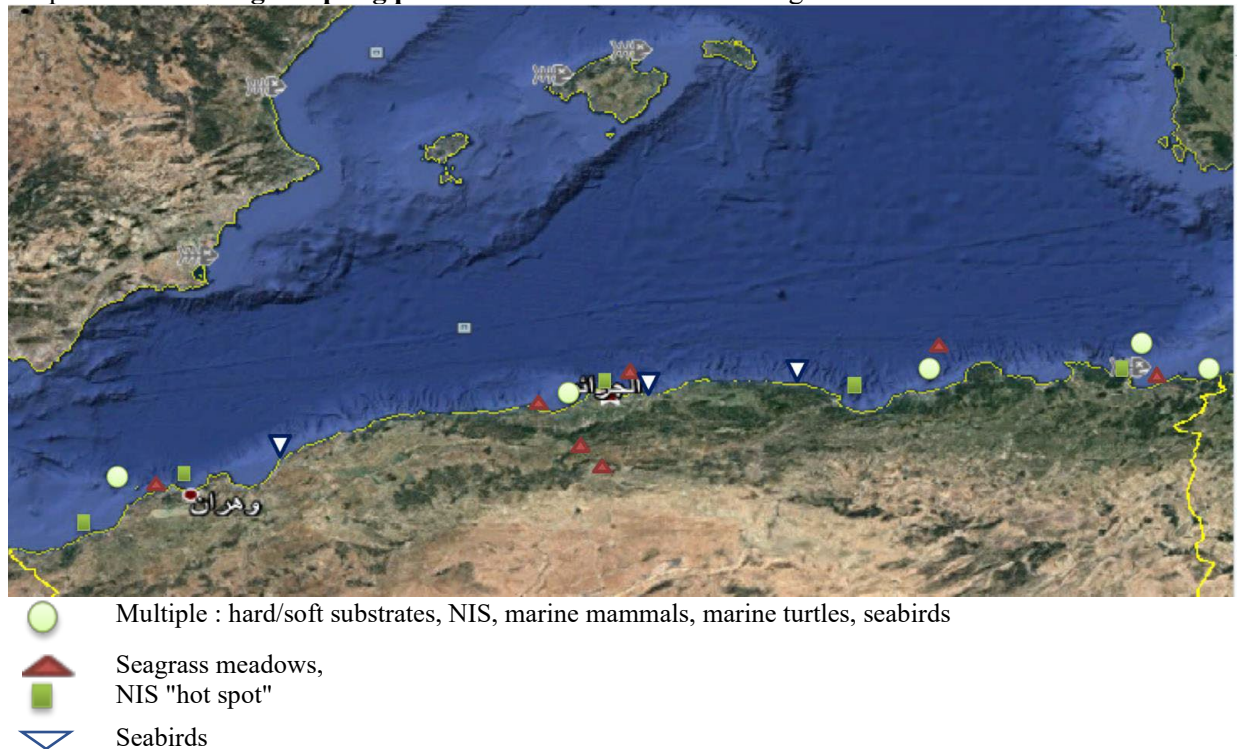
4. Analysis of the National IMAP of Algeria

4.1 Common Indicators

The National IMAP-based Monitoring Programme of Algeria includes the Common Indicators for EO1 (CIs 1, 2, 3, 4 and 5), for EO2 (CI 6), for EO5 (CIs 13 and 14), for EO9 (CIs 17, 18, 19, 20 and 21).

4.2 Selection of monitoring areas

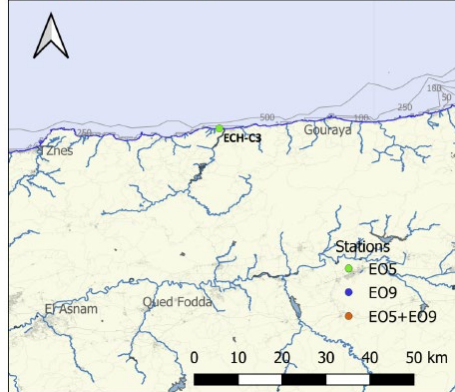
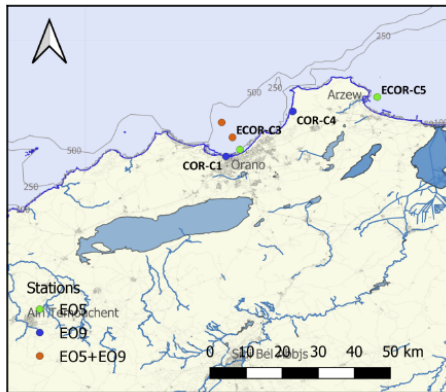
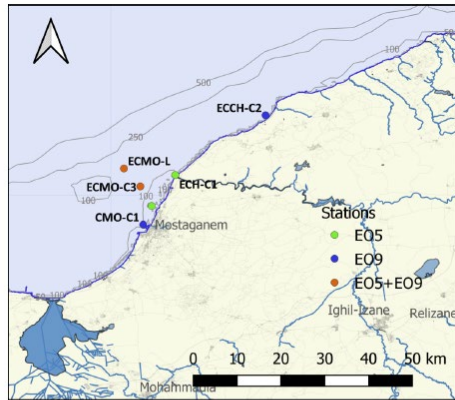
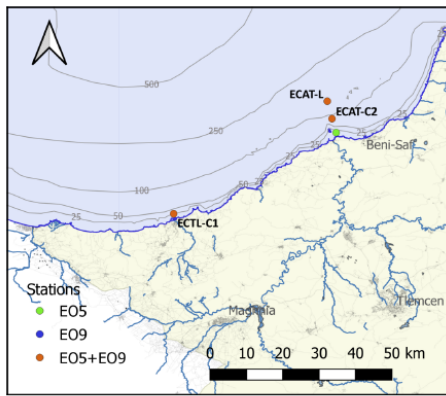
Proposed monitoring sampling plan for EO 01 and EO 02 in Algeria



For EO9, as for EO5 and EO10, monitoring stations were selected considering pollution sources, anthropogenic pressures, integration with other IMAP EOs and knowledge on hot spots monitored in the MED POL I and II programme in Algeria. The following criteria were applied for the selection of EO9 stations: large coastal population, occurrence of industrial pollution sources, ports and wastewater treatment plants, involvement in the IMAP-Biodiversity, IMAP-Hydrography program and MED POL I and II.

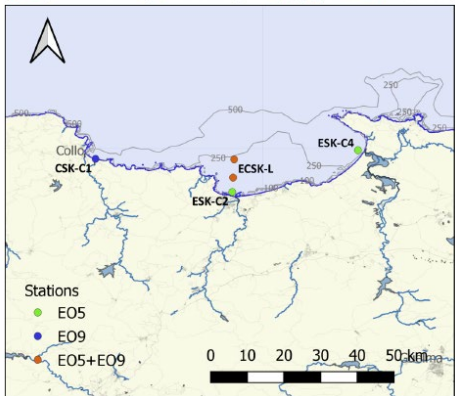
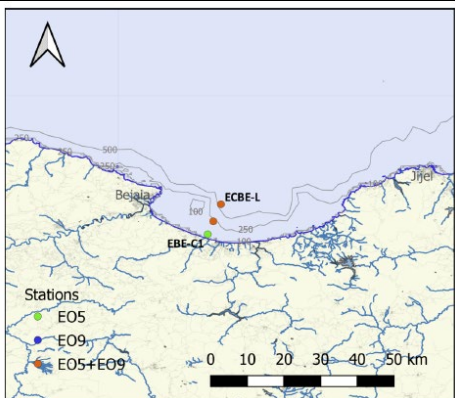
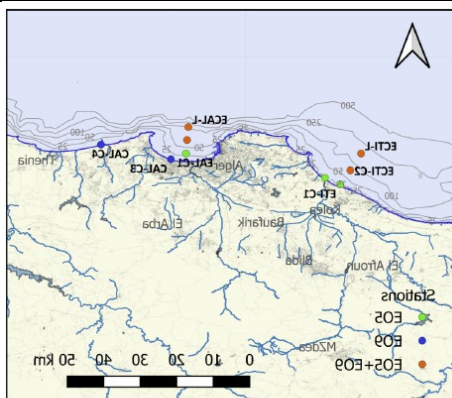
As shown in the national IMAP report of 2019 on the monitoring programme for pollution and marine litter, the EO9 stations are located in 12 out of the 14 coastal regions of Algeria covering the Algerian coastline, with 1 to 5 stations per area and a total of 33 stations. However, the exact number and location of monitoring stations need further consideration. Stations include hot spots and reference areas with two reference stations near National Parks. In 10 out of the 12 areas there are transects of 3 stations including offshore stations and 1 to 2 nearby (coastal) stations. In 2 of the areas, there is one station per area. Two stations in each transect coincide with EO5 stations, while in one transect, 3 stations coincide with EO5 stations. The stations located close by the transects do not coincide with EO5 stations. In accordance with the IMAP requirements, list of stations with coordinates, maps with bathymetry are provided. Further refinement is however needed as for the number of stations and their codes.

Rationale for station selection for CI 17 is in accordance with IMAP requirements. New stations were added to complement the existing network under the MED POL program and cover sensitive areas, as well as, few offshore stations for sampling of sediments. For biological effects monitoring (CI 18), the same stations where mussels will be sampled for CI 17 will be used, for co-ordination with chemical monitoring. For CI 19, monitoring will prioritize all areas near the oil ports (Skikda, Arzew, Béjaia) and then other ports, as well as the two main petrochemical complexes of the Algeria (Skikda and Arzew) and their bordering areas and also consider offshore exploration and/or exploitation areas. For CI 20, monitoring will primarily include fishing or coastal aquaculture areas in line with CI 17, as well as sampling from fish markets, fishing fleets and as part of regular controls by national authorities, in accordance with IMAP. For CI 21, monitoring stations will be representative of recreational bathing areas.



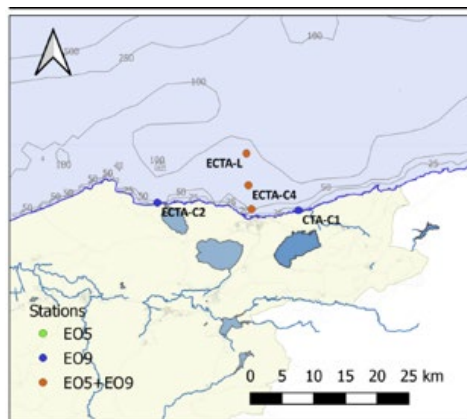
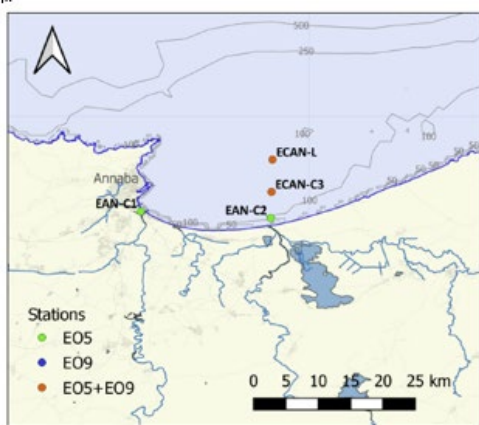
Proposed monitoring stations for OE5 (Eutrophication): Ain Temouchent (Top) and Oran (Down).

Proposed monitoring stations for OE5 (Eutrophication): Mostaganem (Top) and Chlef (Down).

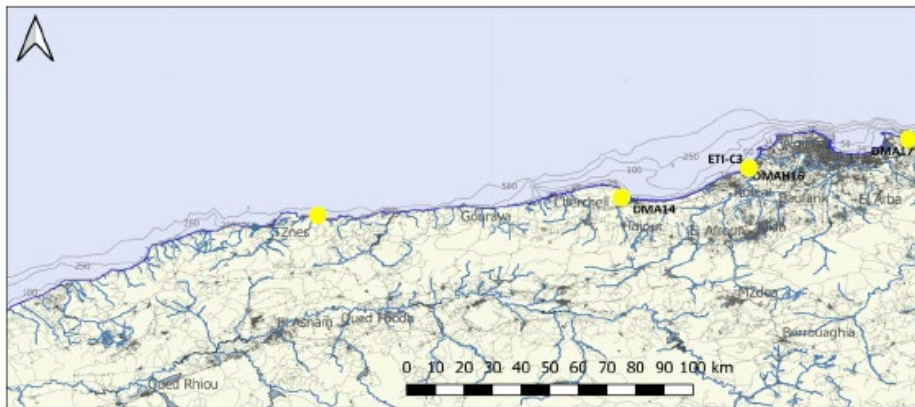
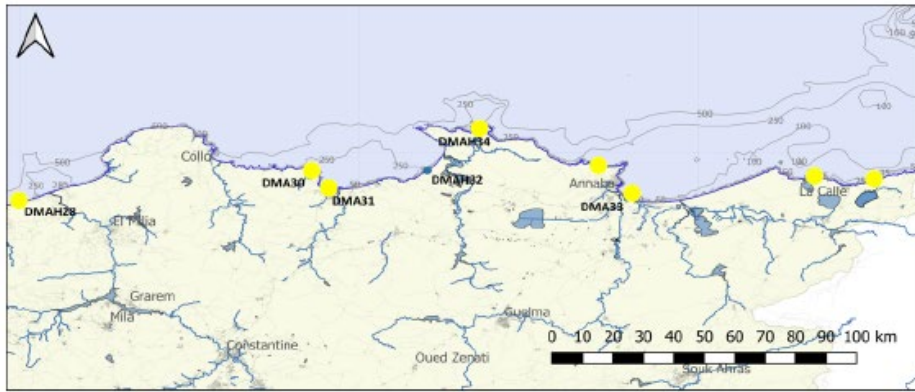


Proposed monitoring stations for OE5 (Eutrophication): Tipaza-Alger (Top) and Tizi Ouzou (Down).

Proposed monitoring stations for OE5 (Eutrophication): Bejaia (Top) and Skikda (Down).



Proposed monitoring stations for OE5 (Eutrophication): Annaba (Left) and El Tarf (Right).



Proposed beaches for the monitoring under EO10 (Marine litter):
 From top to down:
 sectors of El Tarf-Skikda, Jijle-Alger, Tipasa – Chlef and Mostaganem-Tlemcen

To ensure an appropriate integration level of monitoring and assessment for the IMAP in Algeria, the following combination of Common indicators is proposed for three sites (1 MPA as reference site and 2 high pressure sites)

Algeria						
	Ecological Objectives					
MPA	EO1	EO5	EO6	EO7	EO9	EO10
Rachgoun	CI13 CI14	CI13 CI14			CI17 CI18	CI22 CI23
High Pressure	EO1	EO5	EO6	EO7	EO9	EO10
Bou Ismail* Port du Ghazaouet*		-				
Oran§	CI1 CI2	CI13 CI14			CI17 CI18 CI19 CI21	CI22 CI23
*= potentially not suitable for EO5 High-Pressure site §= potentially suitable as candidate for EO5 High-Pressure site						

4.3 Analysis of the National IMAP of Algeria for EO5

For CI 13 and CI 14, the following monitoring parameters were selected:

- Physico-chemical parameters (*Temperature, salinity and pH*)
- Transparency and turbidity
- Inhibitory parameters (phytoplankton)
- Biological material (*chlorophyll*)
- Nutrient (*Ammonium, Nitrogen, Nitric nitrogen, Total nitrogen, Orthophosphates, total phosphate and silicate*)

Information provided in the proposed IMAP report of Algeria about the main characteristics of the sampling stations

N. of stations	36
Transects	9 transects, plus 8 coastal sts. and 1 offshore st.
Coordinates	yes
Maps	yes
Area/region	12 areas (<i>localité</i>)
Shape file	no
Historical monitoring sites	yes
Distance from the coast	Only <i>Coastal</i> or <i>offshore</i> definition, no linear distance
Type of station (hotspot, reference, etc.)	information on type of area for pressure, 2 MPAs
Cross with other EO proposed from CPs	23 sts., 18 of them are. organized in transects, 4 coastal sts. and 1 offshore st.

Summary of monitoring protocols for CI13 and CI14 from the National IMAP of Algeria

CI	Information	Algeria
13	Operator	ENSSMAL/CRAPC
	Frequency [§]	seasonal,
	Sampling methods	Niskin bottle
	Sample depth (m.)*	0, -5, -10, 2m from bottom

CI	Information	Algeria
	Number of samples for station	4
	Protocols for sampling and samples storage	<ul style="list-style-type: none"> • ISO 5667-3 • ISO 5667-14 • ISO 5667 – 9 • UNEP/ MEDPOL N.163
14	Operator	ENSSMAL/CRAPC
	Frequency ^s	seasonal,
	Sampling methods	Niskin bottle, Secchi disk, CTD probe, turbidimeter
	Sample depth (m.) ^{*^}	0, -5, -10, 2 m from bottom, water column profile with CTD
	Number of samples	4
	Protocols for sampling and samples storage	<ul style="list-style-type: none"> • ISO 7027-19 • ISO 5667-14 • ISO 5667-3 • UNEP / MEDPOL.N. 163 • ISO/WD/7027-2

4.4 Analysis of the National IMAP of Algeria for EO9

CI methodology and analytical techniques for Algeria are overall in accordance with IMAP (UNEP/MED WG.467/5). CI 17 parameters have been used since 2001 for MED POL while parameters of CI 18 have not been systematically implemented and will be implemented for IMAP. For CI 20, the matrix (i.e. fish and/or other edible species) and the contaminants to be analysed are not specified. Methodologies are described according to IMAP indicator fact sheets. Some disagreement between section 4.3 and 4.5 are observed in terms of analytical techniques to be implemented. Reporting formats will be according to the IMAP Pilot Information System Data Standards and Data Dictionaries.

Methodology for each Common Indicator (CI) and analytical techniques of the National IMAP of Algeria for EO9 and accordance with IMAP (Y: yes; N: no; P: partially).

CI	Matrix	Substance, biomarker or parameter	Analytical method*	Accompanying parameters	IMAP
17	Marine biota (bivalves and/or fish: all the soft tissues or parts according to the sampling and sample preparation protocols)	Heavy metals / Traces (TM): Total mercury (HgT), Cadmium (Cd) and Lead (Pb)	F-AAS (ICP-OES optional); FIMS for Hg.	Fat content, ratio of fresh to dry weight	Y
17	Marine biota (bivalves and/or fish: all the soft tissues or parts according to the sampling and sample preparation protocols)	Polycyclic aromatic hydrocarbons (US EPA 16 PAH compounds)	GC-MS, (HPLC optional)	Fat content, ratio of fresh to dry weight	Y
17	Marine biota (bivalves and/or fish: all the soft tissues or parts according to the	Organochlorine compounds (PCBs, hexachlorobenzene, lindane and Σ DDTs)	GC-MS, (HPLC optional)	Fat content, ratio of fresh to dry weight	Y

	sampling and sample preparation protocols)				
17	Marine sediments (particle size fraction <2 mm)	Trace / Heavy Metals (TM): Total Mercury (HgT), Cadmium (Cd) and Lead (Pb)	F-AAS (ICP-OES optional); FIMS for Hg.	Al in the < 2mm particle size fraction, < 63µm fraction as complementary, Freeze-drying ratio (dry/wet sediment ratio)	Y
17	Marine sediments (particle size fraction <2 mm)	Organochlorine compounds (PCBs, hexachlorobenzene, lindane and ΣDDTs)	GC-MS, (HPLC optional)	Total Organic Carbon TOC in the particle size fraction <2mm. < Freeze-drying ration (dry/wet sediment ratio)	Y
17	Marine sediments (particle size fraction <2 mm)	Polycyclic aromatic hydrocarbons (US EPA 16 PAHs)	GC-MS, (HPLC optional)	Total Organic Carbon (TOC) in the < 2mm particle size fraction /Freeze-drying ratio (dry/wet sediment ratio)	Y
18	Marine biota: marine bivalves (such as <i>Mytilus galloprovincialis</i>) and / or fish (such as <i>Mullus barbatus</i>)	Lysosomal membrane stability, Acetylcholinesterase activity, Micronucleus frequency Complementary biomarkers to be investigated	Biochemical methods	Not mentioned	P
19	Spills of more than 50 cubic meters	Parameters to be reported according to BCRS a) location of the accident b) type of accident c) IMO ship number or ship name; d) flag of the vessel; e) whether a product has been released or not, if so, the type of product specified f) whether or not action has been taken, if so, the measures taken specified	Visual observation		Y
20	Marine biota	Contaminants in seafood	F-AAS (ICP-OES optional) GC-MS, (HPLC optional)		P

21	Seawater	Bathing water quality (fecal coliforms, total coliforms, fecal streptococci, Salmonella and Vibrio)	Micro-biological methods		Y
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* Analytical techniques differed in section 4.3 and 4.5. Those included by the former regional expert are retained here, to be confirmed.

4.5 Analysis of the National IMAP of Algeria for EO10

In relation to EO10, the National IMAP of Algeria will focus mainly on the common indicator IMAP 22: Trends in the amount of waste discharged to shoreline and/or deposited on shores (including the analysis of their composition, spatial distribution and, where possible, source).

The other two indicators will be also addressed where possible:

- Common Indicator 23: Trends in the amount of litter in the water column including microplastics and on the seafloor.
- Candidate Indicator 24: Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds, and marine turtles

Beach litter monitoring will be conducted in accordance with the guidelines outlined in the "Guidance on Monitoring of Marine Litter in European Seas" (Galgani et al., 2013) and the "IMAP Monitoring and Assessment Methodological Guidance on EO10" (UN Environment/MAP, 2016).

4.6 Data quality assurance, reporting and assessment

A national IMAP database (BDD-IMAP DZ) will be set up for data and information management of all datasets relating to EO5, EO9 and EO10. Quality controls (QC) and a quality assurance process (QA) are foreseen in compliance with the IMAP Pilot Information System. A national information system relating to environmental protection is currently required by Algerian legislation and information systems or thematic databases relating to various elements have either been set up or are in the process of implementation. ONEDD (Observatoire National de l'environnement et du développement durable) is in the process of structuring the National Environmental Information System (SIE) with support from the European Union. ONEDD implemented the assessment for the MED POL program initiated in 2005, and relaunched in 2011 in coordination with the Ministry responsible for the environment.

Monitoring data assessment will be according to the IMAP indicator fact sheets based on OSPAR and Mediterranean BACs and EACs for CI 17 and CI 18, trend analysis and annual statistics for CI 19, and the 95th and 90th percentile rating for CI 20.

It is clearly pointed out in the National IMAP report of Algeria, that all participating laboratories should use the IMAP methods, protocols and standardized tools and should carry out inter-calibration exercises at the regional (MED POL I) or international (e.g. IAEA and WHO) level. Data validation, and verification mechanisms will be set up at the national IMAP virtual platform planned to be created (PF-DZ-IMAP).

4.7 Coordination mechanisms

Although Algeria has implemented the MED POL programme as well as various operations and projects in order to monitor the quality of marine and coastal waters, coordination mechanisms for IMAP are not currently in place. Thus, a governance structure is proposed for the implementation of IMAP monitoring of EO5, EO9 and EO10 within the framework of the national IMAP integrating other Eos. This structure includes two systems (integrated monitoring system and integrated information system) integrating

laboratories and institutions of different tasks, accompanied by mechanisms of validation, integrated assessment and revision.

A network of laboratories (ResLab-DZ-IMAP) will be formed for EO5, EO9 and EO10 as new Algerian legislation sets up the conditions and modalities for the creation of thematic research networks. A national IMAP technical group will be also formed, as part of a larger group covering all EOs, which will include a national group and thematic sub-groups. Mobilization and training of human resources will be needed; thus, a continuous training program should be established and implemented with the support of UNEP/MAP, both on analytical methods and information systems.

4.8 Conclusions and recommendations

There is a good spatial integration for EO5, EO9 and EO10. In nine of the transects, two EO9 stations coincide with EO5 stations and in one transect, 3 EO9 stations coincide with EO5 stations. Only the EO9 stations located out of the transects do not coincide with EO5 stations. EO10 stations are in accordance with EO5 and/or EO9 stations and there are more EO10 stations at all sampling areas.

The integration with the monitoring and assessment with EO1 and EO2 could be achieved for two of the proposed pilot sites: Rachgoun and Oran. For the third pilot sites, Bousmail, integration is possible only for EO1, EO2, EO9, and EO10 since the area is not a potentially suitable for EO5 High-as Pressure site.

Gaps on EO5, EO9 and EO10 as of end of 2019 were clearly identified by the IMAP report of Algeria and summarized as follows:

- Sea sampling constraints due to lack or unsuitability of research vessels for on board sampling and analysis, especially offshore.
- Lack of sampling equipment, analytical reagents including reference standards, and analytical equipment spare parts.
- Lack of accreditation and certification of university scientific research laboratories, lack of quality assurance and standardization of methods, very limited participation in intercalibration exercises.
- Difficulties in maintenance of analysis equipment, and customs difficulties in receiving intercalibration samples.

The needs to address the above gaps are very well presented in the report. These include:

- Establishment of agreements between institutions with means for sea sampling e.g., pilot boats of the ports, and make fully operational current research vessels.
- Acquisition of equipment and consumables.
- MED POL support for the accreditation of three pilot laboratories, quality assurance development, improvement of the standardization of analytical methods, regular participation in IAEA intercalibration exercises, MED POL support for the establishment of national intercalibration exercises.
- Better equipment maintenance, the recruitment of technicians, training current personnel on equipment maintenance, facilitate customs procedures for equipment, reagents and samples through ministries.

Additional issues identified by the current analysis as regards EO9:

- Inconsistency in the description of stations for EO9 in terms of number of stations per area and station codes- revision is needed.
- Clear attribution of tasks to laboratory/laboratories for the different Cis.

- The necessity for intercalibration among laboratories (also pointed out in the country's report) performing the same analysis at different stations to ensure comparability of results.