UN environment programme

Mediterranean Action Plan
Barcelona Convention

SPA/RAC

POST-2020 SAP BIO

TUNISIA
CONSERVATION OF MEDITERRANEAN MARINE AND COASTAL BIODIVERSITY BY 2030 AND BEYOND

Disclaimer
The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Specially Protected Areas Regional Activity Centre (SPA/RAC), United Nations Environment Programme/ Mediterranean Action Plan (UNEP/MAP) or the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Copyright
All property rights of texts and content of different types of this publication belong to SPA/RAC. Reproduction of these texts and contents, in whole or in part, and in any form, is prohibited without prior written permission from SPA/RAC, except for educational and other non-commercial purposes, provided that the source is fully acknowledged.

© 2021
United Nations Environment Programme
Mediterranean Action Plan
Specially Protected Areas Regional Activity Centre (SPA/RAC)
Boulevard du Leader Yasser Arafat
B.P.337 - 1080 Tunis Cedex - TUNISIA
car-asp@spa-rac.org

The original version of this document was prepared for the Specially Protected Areas Regional Activity Centre (SPA/RAC) in the framework of the Post-2020 SAPBIO elaboration by Mr Sami Ben Haj.

For bibliographic purposes, this document may be cited as
UNEP/MAP-SPA/RAC, 2021. Conservation of Mediterranean marine and coastal biodiversity by 2030 and beyond in Tunisia. By S. Ben Haj. Ed. SPA/RAC, Tunis: 89 pp.

Cover photo
© Citizen59

This publication has been prepared with the financial support of the MAVA foundation

For more information
www-spa-rac.org

TUNISIA
CONSERVATION OF MEDITERRANEAN MARINE AND COASTAL BIODIVERSITY BY 2030 AND BEYOND

Ecological Status, Pressures, Impacts, their Drivers and Priority Response Fields

POST-2020

SAP BIO

Strategic Action Programme
for the **Conservation** of **Biodiversity**
and **Sustainable Management**
of **Natural Resources**
in the **Mediterranean Region**

List of Acronyms

ACCOBAMS: Agreement for Conservation of Cetaceans of the Black Sea Mediterranean Sea and Contiguous Atlantic Area

AFD: French Development Agency

APAL: Coastal Protection and Development Agency

AT: Aichi Targets

CBD: Convention on Biological Diversity

CMS: Convention on the Conservation of Migratory Species of Wild Animals

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

CSO: Civil Society Organization

EIB: European Investment Bank

EcAp: Ecosystem Approach

EEG: Management Assessment Tool

EU: European Union

FAO: Food and Agriculture Organization of the United Nations

FFEM: French Facility for Global Environment

GEF: Global Environment Facility

GFCM: General Fisheries Commission for the Mediterranean

GIZ: German Agency for International Cooperation

Horizon 2020: EU Horizon 2020 program

ICZM Protocol: Integrated Coastal Zone Management Protocol

IPCC: Intergovernmental Panel on Climate Change

IBRD: International Bank for Reconstruction and Development

IUCN: International Union for Conservation of Nature

ICZM: Integrated Coastal Zone Management

INS: National Institute of Statistics

INSTM: National Institute of Marine Sciences and Technologies

KFW: Kreditanstalt für Wiederaufbau (Credit institution for reconstruction)

MSFD: Marine Strategy Framework Directive

MAP: Mediterranean Action Plan

NSAPB: National Strategy and Action Plan for Biodiversity

NM: nautical miles

NGO: Non Governmental Organization

SO: Strategic Objective

SAPBIO: Strategic Action Programme for the conservation of biodiversity in the Mediterranean

SPA/BD: Specially Protected Areas and Biological Diversity

SPA/RAC : Specially Protected Areas Regional Activity Center

UNDP: United Nations Development Programme

UNEP: United Nations Environment Programme

UFM: Union for the Mediterranean

UNFCCC: United Nations Framework Convention on Climate Change

© SPA/RAC, Ibrahim Ben Amer

List of Figures

List of Tables

Executive Summary

The Regional Activity Centre for Specially Protected Areas (SPA/RAC) has within the framework of its mandate the assistance to the Contracting Parties to the Barcelona Convention for the implementation of the SPA/BD Protocol adopted in 1995. In this context, following a request formulated by the Contracting Parties at their COP 21 in 2020, the Center launched the preparation of the "Post-2020 Strategic Action Program for the conservation of biodiversity and the sustainable management of natural resources in the Mediterranean region". (Post-2020 SAPBIO).

The development of the Post-2020 SAPBIO was decided by the Contracting Parties taking into account the significant changes that have occurred over the 15 years since the adoption of the SAPBIO in 2003 until its evaluation, submitted to the Contracting Parties in 2019, particularly with regard to the state of species and ecosystems as well as to the new challenges of conservation policies. The contracting parties also examined the conclusions and recommendations issued by the evaluation of the implementation of SAPBIO during the period 2004-2018.

The development of the Post-2020 SAPBIO will be done according to a participatory approach from the national level (national processes) and involving the competent authorities and other stakeholders. National processes will be followed by subregional consultations. The final step of the development process will use the results of national processes and sub-regional consultations and compile them to develop the draft Post-2020 SAPBIO which will be submitted to COP 21 for consideration in 2021.

The central objective of Post-2020 SAPBIO is to strengthen and rationalize the implementation of the plans and strategies already adopted at the national and international levels in the field of biodiversity, with a greater emphasis on subjects related to marine and coastal biodiversity. Particular attention should be paid to the integration of biodiversity conservation into all relevant environmental policies as well as policies relevant for the sustainable use of living marine resources, such as fishing, tourism and other uses of marine and coastal environment.

This present work was prepared by a national expert and assisted by the national SAPBIO correspondent and the national SAP/BD focal point: the latter contributed to the diagnosis of the state of marine and coastal biodiversity, as well as to the identification of conservation priorities at the national level.

Otherwise, this document was produced to represent a key reference base available to Tunisia for the development of the National Strategic Action Plan for Biodiversity (NSAPB) relating to marine and coastal issues.

The priority objectives and actions advocated by the Post-2020 SAPBIO to guarantee the conservation and sustainable use of marine and coastal biodiversity in the Mediterranean, will be the results of this new participatory and concerted process at national and sub-regional levels. This is an unprecedented experience unlike the old assessments of SAPBIO (2001/2002).

Reference documents and information consulted

© SPA/RAC, Yassine Ramzi Sghaier.

This work was developed on the basis of previous references and work:

- National reports on biodiversity ;
- SAP/RAC 2009 reports on the impacts of climate change on marine and coastal biodiversity in the Mediterranean ;
- Reports to CBD ;
- National reports and / or strategies to the Bern Convention ;
- Reports to the Bonn Convention (and subsidiary agreements ACCOBAMS, AEWA, etc.) ;
- Reports to the CGPM ;
- National action plans relating to marine and coastal biodiversity ;
- National action plans and ICZM strategies ;
- Reports on the implementation of the Barcelona Convention and the SAP / BD Protocol ;
- Other scientific reports and publications.

2.

Marine and coastal ecosystem status

© SPA/RAC, Mathieu FOULQUIE

Tunisia is located in the north of the African continent. It is limited to the west by Algeria, to the south by Libya and to the north and east by the Mediterranean Sea. Its coastline extends over 2,290 km, constituting a transition zone between the Eastern and Western Mediterranean basins (Fig. 1) (APAL, 2015). Between the Mediterranean and the Sahara, the Tunisian climate varies between humid and Saharan, offering Tunisia unique landscapes and remarkable biodiversity. According to the INS, the Tunisian population stands at around 12 million inhabitants for a total area of 164,000 km^2. This population is disproportionately distributed over 24 governorates where the coastline is the most populated.

Fig1.
Geographical situation géographique of Tunisia in the Mediterranean

2.1. Biological characteristics

2.1.1. Description of water column biological communities

Plankton

Plankton (plant or animal) is the first link in the trophic chain. It is directly subject to global changes which are more and more noticeable in recent decades. These changes are mainly reflected by a rise in temperature, an acidification of seas and oceans, thus, causing both a biological and ecological imbalance in the ecosystem.

In Tunisia, work relating to plankton is relatively limited, apart from studies carried out in lagoons, and within the framework of the monitoring network of bivalve mollusc production areas as well as sporadic surveys in lagoons and gulfs of Gabes, Tunis and Hammamet.

In Tunisia, 493 species of phytoplankton have been identified, spread over 11 groups represented mainly by *Dinophyceae (54%) and Diatoms (41%).* As for zooplankton, it is represented by 269 species spread over 23 groups dominated by *Tintinnids* (24%) and *Copepods* (24%) (UNEP / SAP/RAC - Tunis, 2010).

In the Gulf of Tunis, the dosages of chlorophyll (a) are related to seasonality. Indeed, the maximum levels of chlorophyll (a) are recorded in summer (1.3mg / m^3), while in autumn, these levels decrease to reach 0.5 mg / m^3 (Ramírez-Romero *et al.,* 2020). During the summer period, a proliferation of toxic algae can be detected, particularly by the dinoflagellate Cyanobacterium leptolyngbya (Aleya *et al.,* 2019). In the Gulf of Hammamet, the coastal zone is dominated by dinoflagellates (55%) represented mainly by the types *Protoperidinium, Gymnodinium* and the cryptic species *Scrippsiella trochoidea*. Diatoms are the most common offshore species (68%). The abundance of phytoplankton decreases from the coast to the open sea and from the surface to the bottom. On the other hand, the ciliates (zooplankton) are more abundant towards the open sea. In general, the coastal zone is more diversified at the specific level (Hannachi *et al.,* 2011).

In the Gulf of Gabès, we have been able to identify approximately 175 species of dinoflagellates, 47 species of diatoms, 7 species of cyanobacteria and 7 species of chlorophyceae, other classes such as euglenophyceae and dictyochophyceae are not very diversified. Among dinoflagellates, the genus Protoperidinium occupies the first place with 37 species. The type *Ceratium* is characterized by the presence of 24 species, 18 of which are offshore species. The type *Dinophysis* comprises several species known in the literature for their toxicity.

The inventory of proliferating phytoplankton species in the Gulf of Gabès includes 17 species, 9 of which belong to the Dinoflagellates class *(Prorocentrum minimum, P. rathymum, P. micans, Kareniaselliformis., Gymnodinium splendens, Protoceratium reticulatum, Protoperidinium quinquiquorne, Cooliamonotis and Gymnododine).* In the Diatom range, only one *Skletonema costatum* has been found.

In the Gulf of Gabès, the temperature exceeds 27 ° C in the summer season, establishing a stratification of the water column inducing an increase in salinity. For the whole year, zooplankton are represented mainly by copepods and their dominance gradually increases during summer periods and decreases when the water column is mixed.

During the summer season, the hydrodynamic characteristics of the environment are favorable to the proliferation of toxic microalgae such as *Karenia selliformis, Gymnodinium sp.* Off the Kerkennah Islands, the summer proliferation of a cyanobacterium of Trichodesmium is also frequent.

This phenomenon of proliferation of toxic microalgae in the Gulf of Gabès is recurrent and observable almost every year. These episodes are reflected by massive mortality of marine species (sparids, gobies, cuttlefish, etc.).

2.1.2. Information on invertebrate bottom fauna, macro-algae and angiosperms including species composition, biomass and annual/seasonal variability

Macroalgae and marine phanerogams

In Tunisia, nearly 414 plant species have been recorded along the coast. This number is underestimated, probably exceeding 600 species. The most represented taxonomic groups are respectively Rhodophyta (61%), Fucophycea (20%), Chlorophycea (17%) and Magnoliphyta (2%). Of the 21 species listed in Annex II of the Barcelona Convention,

there are 9 species reported in Tunisia, they are 2 Magnoliphyta *(Posidonia oceanica* and *Cymodocea nodosa),* and 6 Heterokontophyta *(Cystoseira genus (except of Cystoseira compressa), Laminaria rodriguezii, Sargassum acinarium, Sargassum flavifolium, Sargassum hornschuchii, Sargassum trichocarpum),* and one species Rhodophyta *(Lithophyllum byssoides).*

Magnoliophytes

The magnoliophytes (phanerogams) are represented by 4 marine species of which *Posidonia* is the most important from an ecological point of view and the halophile which is a newly introduced species; 4 brackish water species including the newly mentioned *Althenia filiformis.*

The magnoliophytes (phanerogams) present in Tunisia are divided into 3 groups:

Marine species: *Posidonia oceanica, Cymodocea nodosa, Halophila stipulacea.*

Brackish water species including: *Althenia filiformis, Potamogeton pectinatus, Ruppia cirrhosa, Ruppia maritima* and *Ruppia rostellata.*

For cymodocae, the work remains limited to signaling and evaluating coastal or lagoon distributions.

On the other hand, and until the present time, there is no complete cartography of the marine flora and the habitats associated with this flora on the entire Tunisian coast (with the exception of MCPAs; Galite, Zembra, Kuriat, Kerkennah, etc.). In what follows, we present the flora species that play a major role in maintaining the entire Tunisian marine ecosystem in a good state of conservation:

Posidonia oceanica

It is important to focus on Posidonia. This plant, endemic to the Mediterranean, constitutes a protected ecosystem in the Mediterranean because the *Posidonia* meadow plays a major ecological role. The Galite and Zembra meadow can be observed from a few meters deep, up to 35-40 meters. It occurs in the littoral fringe from the shore to the lower limits of the infralittoral. In Tunisia, this species is present all along the coast forming a herbarium, which can be of a specific shape like that of Kerkennah "tiger herbarium". This herbarium is closely linked to *Cymodocea nodosa* as well as green green algae such as *Caulerpa prolifera* and *Halimeda tuna* forming a particular biocenosis.

The Cymodocea

Cymodocea nodosa is sometimes associated with *Posidonia* but most of the time it is present as soon as the latter species disappears. The *Cymodocea* does not always form true herbaria but often forms large and dense spots.

Cystoseira

Very often, cystoseira (as well as sargassum) cover hard and rocky substrates forming dense mats (forests) of these brown algae. This type of environment formed by Cystoseira is quite widespread in the Mediterranean. It is particularly interesting to note that we find photophilic algae (*Padina pavonica* for example) associated with these expanses of

brown algae of Cystoseires, and up to depths of 30 meters and more. From a conservation point of view, 13 species of Cystoseira are listed as endangered or threatened in the Mediterranean:

Table 1.

List of species of Cystoseira present in Annex II of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean

	Annex II SPA/BD Protocol
Cystoseira stricta	X
Cystoseira amentacea	X
Cystoseira foeniculacea	X
Cystoseira sauvageana	X
Cystoseira sedoïdes	X
Cystoseira spinosa	X
Cystoseira zosteroides	X
Laminaria rodriguezii	X
Sargassum hornschuchii	X
Mesophylum lichenoides	X
Titanoderma byssoides	X
Cymodocea nodosa	X
Posidonia oceanica	X

Benthic invertebrates

Tunisian MCPAs represent the hotspot of choice in terms of the specific richness of marine biodiversity and in particular that of benthic invertebrates. The maximum specific richness of these taxas is observed in particular the new one of the northern facade of Tunisia; for example, at the level of the Galite MCPA, more than 188 species of marine invertebrates have been identified (Ramos-Espla *et al.* 1997, Ramos-Espla & Azzouna, 1999; Creocean, 2001; Andromède, 2010). Most of these invertebrates are found in most of the other Tunisian hotspot sites (in particular the Northern MCPAs). Among the different taxa of benthic invertebrates, 16 species would play an important role in terms of conservation in the Mediterranean:

Table 2.

List of species of benthic invertebrates present in the Annexes II and III of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean

Scientific name	French name	Annex II SPA/BD Protocol	Annex III SPA/BD Protocol
PORIFERA			
Axinella polypoides	*Axinelle commune*	*X*	
Sarcotragus muscarum	*Eponge fétide*	*X*	
Spongia agaracina	*Oreille d'éléphant*		
CNIDARIA			*X*
Cladocora caespitosa	*Cladocore*	*X*	
MOLLUSCA			
Charonia lampas	*Triton*	*X*	
Dendropoma petraeum	*Petit vermet colonial*	*X*	
Erosarias spurca	*Porcelaine souillée*	*X*	
Luria lurida	*Porcelaine fétide*	*X*	
Pinna nobilis	*Grande nacre*	*X*	
CRUSTACEA			
Maja squinado	*Grande araignée de Méditerranée*		
Palinurus elephas	*Langouste rouge*		*X*
Syllarides latus	*Grande cigale*		*X*
ECHINODERMATA			
Ophidiaster ophidianus	*Etoile de mer violette*	*X*	
Centrostephanus longispinus	*Oursin diadème de Méditerranée*		*X*
Paracentrotus lividus	*Oursin violet*		*X*

Finally, it is important to point out among these inventories, the presence of several invasive alien species, and those in coastal waters (including lakes and coastal lagoons) or further on in the different MCPAs (Galite, Zembra, Kuriates, Kneiss, etc ...).

2.1.3. Information on vertebrates other than fish

Reptiles

Marine turtles recorded in Tunisia are *Caretta caretta* (loggerhead turtle: Common species in Tunisia), *Chelonia mydas* (green turtle: rather rare species) and *Dermochelys coriacea* (Leatherback turtle: regularly observed). These 3 species are considered endangered or threatened (Appendix II, Barcelona Convention, 1995; Appendix II, Bern Convention, 1996, Appendix IV, European Union; IUCN Red List; Appendix I, CITES). Tunisia represents a wintering and feeding area for several species including *C. caretta* which is the only nesting species in the Tunisian coasts. This nesting was discovered for the first time in 1988 on the beach located between Ras Dimas and Mahdia and on the large Kuriat island off Monastir (Laurent *et al.*, 1990). Several recent observations and testimonies evoke the nesting of the marine turtle on other beaches such as Nabeul, Kerkennah, Zarzis and especially Chebba where the nesting was well documented (Jribi, 2017). More recently,

the presence of *C. caretta* nests has been reported in the northern part of Tunisia at Chatt el Zouaraa (Béja governorate). Which makes Tunisia the upper limit of the eastern basin for the nesting of this species in the Mediterranean. The main threats are those related to the deterioration of habitats, including nesting, feeding and wintering areas and key migratory corridors; the direct impacts on turtle populations are caused mainly by the ingestion of plastics, bycatches in trawl and longline fisheries, consumption (risk of intoxication) and collisions with boats and finally pollution that can have an impact on habitats. In Tunisia, loggerhead turtle nesting monitoring began in 1997 by INSTM in collaboration with APAL and SPA/RAC. To this institutional collaboration has been added the very active mobilization of civil society and numerous resource people. To this end, we will cite the exemplary work carried out by the Notre Grand Bleu association mainly on the Kuriat islands and in the bay of Monastir. In 2004, a centre for the protection and care of marine turtles at INSTM / Monastir in collaboration with the APAL was launched. In 2014, we saw the establishment of a national monitoring network for stranding cetaceans and marine turtles. From a legislative point of view, fishing and collecting sea turtle eggs were prohibited by a decree of the Ministry of Agriculture published in 2014.

Marine mammals

In Tunisia, seven species of marine mammals have been reported, at sea and in stranding, namely the fin whale (***Balaenoptera physalus***), the striped dolphin (***Stenella coeruleoalba***), the common dolphin (***Delphinus delphis***), the bottlenose dolphin (***Tursiops truncatus***), Risso's Dolphin (***Grampus griseus***), Pilot Whale (***Globicephala melas***) and Sperm Whale (***Physeter macrocephalus***).

In Tunisia, there is little work on marine mammals, limited to reports and observations of strandings. The study of the spatial distribution of these species concerned the north and South-East of Tunisia. Bottlenose dolphins (***Tursiops truncatus***) form groups which vary in size depending on the season and mainly live in the coastal zone. On the other hand, the common dolphin (***Delphinus delphis***) is present in open sea (> 12 NM).

Marine mammals are threatened mainly by interaction with fishing (nets, longlines) and aquaculture, collision with navigational devices, reduction of prey and degradation of their habitat.

Table 3

Status of marine mammals reported in Tunisia

Marine mammals in Tunisia	Red list of threatened species of IUCN (category in the Mediterranean)	Protocol SPA/BD	CITES	CMS	GFCM
Fin whale *(Balaenoptera physalus)*	Vulnerable (VU)	Annex II	Appendix I	Appendix I	GFCM/36/2012/2
Striped dolphin *(Stenella coeruleoalba)*	Vulnerable (VU)	Annex II	Appendix II	Appendix II	GFCM/36/2012/2
Common dolphin *(Delphinus delphis)*	Endangered (EN)	Annex II	Appendix II	Appendix II	GFCM/36/2012/2

Marine mammals in Tunisia	Red list of threatened species of IUCN (category in the Mediterranean)	Protocol SPA/BD	CITES	CMS	GFCM
Bottlenose dolphin *(Tursiops truncatus)*	Vulnerable (VU)	Annex II	Appendix II	Appendix II	GFCM/36/2012/2
Risso's Dolphin *(Grampus griseus),*	Data Deficient (DD)	Annex II	Appendix II	Appendice II	GFCM/36/2012/2
Long-finned pilot whale *(Globicephala melas)*	Data Deficient (DD)	Annex II	Appendix II	Unclassified	GFCM/36/2012/2
The great sperm whale *(Physeter macrocephalus)*	Endangered (EN)	Annex II	Appendix I	Appendice I	GFCM/36/2012/2

Other very rare sightings in the Mediterranean have been reported in Tunisia, in the Gulf of Gabes, such as the Minke Whale, *Balaenoptera acutorostrata* and the humpback whale *Megaptera novaeangliae.* A sign of *Pseudorca crassidens* is to be recorded in Bizerte.

Aquatic avifauna

Tunisia is an important wintering site for western Palaearctic waterfowl and an important stopover point for trans-Saharo-Palaearctic migration. Apart from the counting campaigns carried out by the association of friends of birds (AAO / BirdLife), the studies carried out on aquatic avian biodiversity in Tunisia are limited, based on the study by Hamdi and Charfi 2011, for the census period between 2001/2002 and 2006/2007. They were able to identify 106 species of aquatic birds spread over 23 families. The most represented are: *Scolopacidae* (22.6%), *Anatidae* (17%), *Laridae* (9.4%), *Sternidae* (9.4%), *Ardeidae* (6.6%), *Charadriidae* (6.6%), *Podicipedidae* (6.6%).

It is reported that the largest population of Scopoli's Shearwater *(Calonectris diomedea)*, which is a vulnerable species (Annex II of the Barcelona Convention), is concentrated in Zembra National Park with approximately 142,000 pairs.

In Tunisia, to safeguard the avifauna in general, the state regulated the hunting of several species with a total ban on others, the safeguarding of their habitats through the creation of marine and coastal reserves, as well as the classification of several wetlands as Ramsar sites.

Among the threatened or endangered species in Tunisia, we find the Eleonora's Falcon *(Falco eleonorae)* which is listed in Appendix II of the Bern, Bonn, Barcelona and Washington Conventions, and in Appendix A of the EEC / CITES regulations. The Crested Cormorant *(Phalacocorax aristolelis)* which is in the IUCN Red List of Threatened Species (LC), and Appendix III of the Bern Convention.

Table 4

Status of vulnerable seabirds in Tunisia

Aquatic avifauna	Red list of threatened species of IUCN (category in the Mediterranean)	Protocol SPA/BD	CITES	CMS	GFCM
Little tern *(Sterna albifrons)*	Least Concern (LC)	Annex II	NA	Appendix II	GFCM/35/2011/3
Audouin's Gull *(Larus audouinii)*		Annex II	NA	Appendix I and Appendix II	GFCM/35/2011/3
Mediterranean shearwater (*Puffinus yelkouan)*	Least Concern (LC)	Annex II	NA	unclassified	GFCM/35/2011/3
Scopoli's Shearwater *(Calonectris diomedea)*		Annex II	NA	unclassified	GFCM/35/2011/3

2.1.4 Inventory of the temporal occurrence, abundance and spatial distribution of non-indigenous, including invasive, species

Tunisia is a pivotal area between the eastern and western basin of the Mediterranean. It is particularly concerned by the phenomenon of bioinvasion, given that we are currently witnessing a phenomenon of subtropicalization of the Mediterranean. Thus, encouraging the arrival of Indo-Pacific species and Atlantic species with a warm affinity, this phenomenon has been observed for a long time, it is embodied by the rapid succession of reports of exotic species. In Tunisia, 181 non-native animal species have been recorded in Tunisian waters. 60 species have been reported from the north and west coasts and 76 species have been reported from the east and south coasts of the country. More than half of these sightings were reported in the Gulf of Gabès. Crustaceans, fish, molluscs and annelids are probably the most represented because their identification is easy: ascidians, aplysia, corals, sponges should be the subject of an intensification of prospecting and research efforts and strengthening the skills of taxonomists specializing in these groups, in particular the list of exotic marine macrophytes introduced in Tunisia has been updated in the light of available data and new observations. A total of 27 exotic marine macrophytes have been recorded to date in Tunisia: 18 Rhodophyta, 3 Ochrophyta, 5 Chlorophyta and 1 Magnoliophyta.

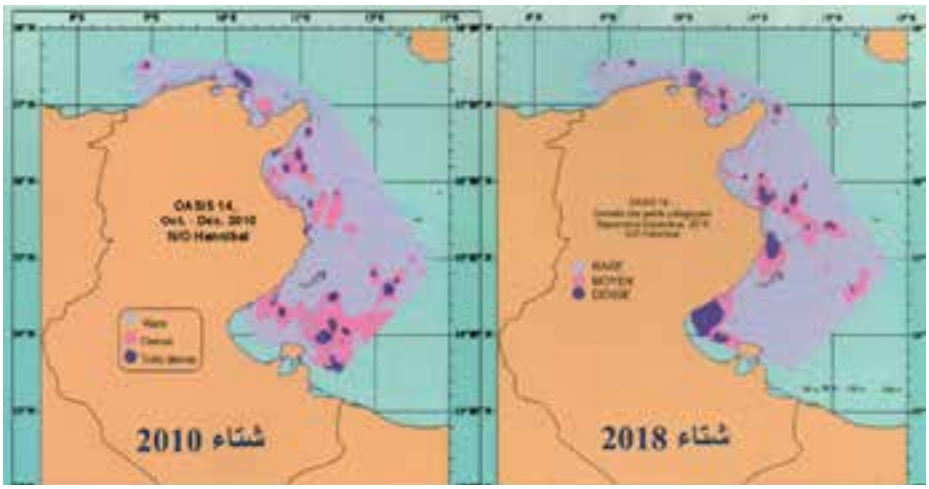
The distribution and status (occasional, cryptogenic, established or questionable) of species in Tunisia were assessed and, where appropriate, discussed. Among them, *Hypnea cornuta* is reported for the first time in Tunisia. Fourteen of the alien marine macrophytes are established, while seven cryptogenic and two occasional species require further investigation. Eleven species are considered as invasive or potentially invasive in the Mediterranean Sea: *Acrothamnion preissii, Asparagopsis armata, A. taxiformis Indo-Pacific lineage, Hypnea cornuta, Lophocladia lallemandii, Womersleyella setacea, Caulerpa chemnitzia, C. cylindracea, C. taxifolia, Codium fragile subsp. fragile* and *Halophila stipulacea.*

2.1.5 Information on species of commercial interest for fishing (fish, mollusk and shellfish)

The fishing sector occupies an important place in the national economy. Together with agriculture they contribute by 12.1% of the GDP. Outputs from fishing in Tunisia reached 133,972 tons in 2018 against 100,451 tons in 2009, i.e., an increase of 25%, mainly provided by pelagic species which contribute by 36% of catches. The active fleet in 2018 is composed of 13,541 units, mainly represented by inshore fishing units, which represent 93% of the fleet. From a social point of view, the fishing sector provides employment for 100,000 employees (direct and indirect), including 50,201 fishermen reference.

Several actions and research programmes were carried out in Tunisia by the National Institute of Marine Science and Technology (INSTM) for the assessment of stocks between 1996 and 2005. An update of the assessment of fishery resources was carried out between 2016 and 2019.

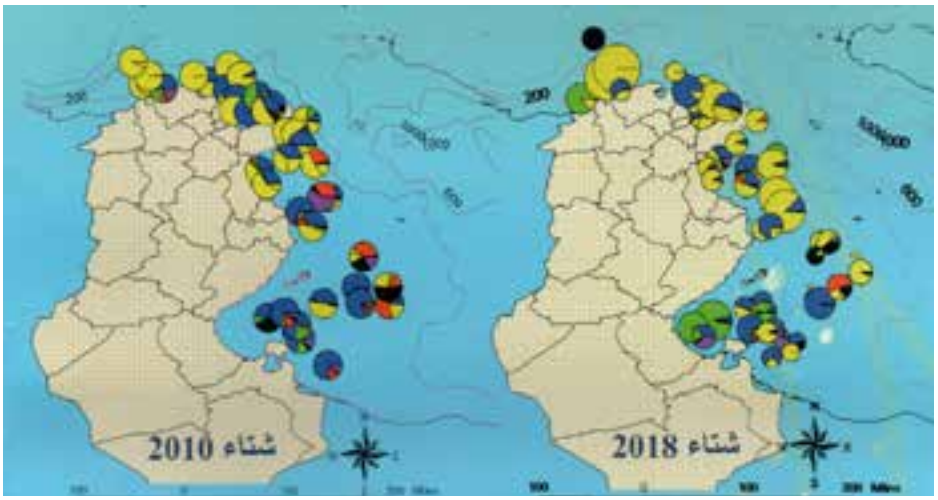
At the national level, the results of the assessment of small pelagic stocks on the Tunisian coasts showed that the exploitable potential fell by 53% in 2018 compared to 2010, with a decrease of 72% in the Gulf of Gabès, 69% in the Sahel region, 35% in the Gulf of Hammamet and 10% in the northern region which is the least affected by this decrease. On the other hand, an increase in the exploitable potential was recorded in the Gulf of Tunis by 20%, mainly represented by mackerel, sardine and allache.



(Winter 2010) **(Winter 2018)**

Fig 2

Spatial distribution of the density of small pelagic species over the Tunisian coast between 2010 and 2018.



(Winter 2010) (Winter 2018)

Fig 3

Specific composition of small pelagic species during experimental fishing campaigns on the Tunisian coasts between 2010 and 2018 (blue: Sardine (*Sardina pilchardus*), green: anchovy (*Engraulis encrasicolus*), mackerel (*Scomber spp*), round sardinella (*Sardinella aurita*), yellow: Atlantic horse-mackerel (*Trachurus spp*).

In Tunisia, most of the benthic species exploited are in a state of overexploitation or are in optimum exploitation, in particular the coral *(Corallium rubrum)* and the red lobster *(Palinurus elephas)* which are both emblematic of the northern region, listed in Annex III of the Barcelona Convention. Following the latest results of the stock assessment carried out in Tunisiaev seral species were considered to be underexploited, they have become overexploited for all fishing areas in Tunisia such as the deep-water rose shrimp *(Parapenaeus longirostris).*

Exploitation status of common fisheries species (FAO, 2018)

Species	Status of exploitation	GSA
Merluccius merluccius	Overexploited	12-13-14
Parapenaeus longirostris	Overexploited	12-13-14
Mullus barbatus	Overexploited	13-14

Coastal / traditional fishing, which employs about two-thirds of the maritime population, participates on average with 27% of catches and 40% of the value of national production and provides between 40% to 50% of the value of exports of seafood products fishing and according to the stock assessment made by INSTM (2006-2010), the main species targeted by coastal/traditional fishing are in a situation of optimal exploitation to overexploited.

zones	Underexploited	Optimal exploitation	Overexploited
South	Sand steenbras Annular seabream White shrimp	Salemma Sole Red mullet Cuttlefish Octopus	Common pandora Little pagre Toothed R. white Sea bream European hake Saurel T. Serra

zones	Underexploited	Optimal exploitation	Overexploited
East	Sand steenbras Gilthead seabream Cuttlefish	Common pandora Red mullet Bug	European hake White Mullet Saurel T.
North	Toothed Sand steenbars Red mullet Octopus Cuttlefish Small prawns	White mullet Common pandora Annular seabream Senegalese Sole	European hake Salemma Saurel T. Saurel M.

The fish fauna recorded in Tunisia reveals the presence of 333 species out of 657 recorded in the Mediterranean. These species are distributed in 30 orders, 114 families and 221 genera, with 1 Petromyzonidae, 1 Holocephalus, 62 Elasmobranchs, 1 Chondrostean and 267 Teleosts.

Among these fish species, several of them are listed as protected or proposed for their protection according to the various conventions.

Fish	Convention of Barcelona (1995)	Convention of Bern (1997, 1998)	Convention of Washington (CITES)	Red List IUCN
Sharks				
Cetorhinus maximus (Gunnerus, 1765)	II	II	II	X
Carcharodon carcharias (Linnaeus, 1758)	II	II	II	X
Isurus oxyrinchus (Rafinesque, 1810)	III	III	-	-
Mobula mobular (Bonnaterre, 1788)	II	II	-	X
Raja alba (Lacepède, 1803)	III	III	-	-
Rhinobatos cemiculus (E. Geoffroy Saint-Hilaire, 1817)	-	-	-	X
Squatina squatina (Linnaeus, 1758)	III	III	-	X
Teleosteens				
Alosa fallax (Lacepède, 1803)	III	III	-	-
Anguilla anguilla (Linnaeus, 1758)	III	-	II	-
Aphanius fasciatus (Nardo, 1827)	II	II, III	-	X
Dicentrarchus punctatus (Bloch, 1792)	-	-	-	-
Epinephelus aeneus (Geoffroy Saint-Hilaire, 1817)	-	-	-	-
Epinephelus caninus (Valenciennes, 1843)	-	-	-	-
Epinephelus costae (Sand steenbras, 1878)	-	-	-	-

Fish	Convention of Barcelona (1995)	Convention of Bern (1997, 1998)	Convention of Washington (CITES)	Red List IUCN
Epinephelus marginatus (Linnaeus, 1758)	III	III	-	-
Hippocampus hippocampus (Linnaeus, 1758)	II	II	II	X
Hippocampus ramulosus (Leach, 1814)	II	II	II	X
Mycteroperca rubra (Bloch, 1793)	-	-	-	-
Pomatoschistus microps (Krøyer, 1838)	-	III	-	-
Pomatoschistus tortonesei (Miller, 1968)	II	II	-	-
Sciaena umbra (Linnaeus, 1758)	III	III	-	-
Scorpaena porcus (Linnaeus, 1758)	-	-	-	-
Syngnathus abaster (Risso, 1826)	-	III	-	-
Thunnus thynnus (Linnaeus, 1758)	III	-	-	-
Umbrina cirrosa (Linnaeus, 1758)	III	III	-	-
Xiphias gladius (Linnaeus, 1758)	III	-	-	-
Zosterisessor ophiocephalus (Pallas, 1811)	-	III	-	-

2.1.6. Abundance of commercial species in Tunisia

According to the results of assessments of stocks of commercial species in Tunisia which are developed in the form of abundance index maps expressed in hourly yields for the global resource. The spatial distribution mapping of commercial fish, crustaceans and cephalopods over the entire Tunisian coastline reveals both areas of low and high concentrations (see figure below).

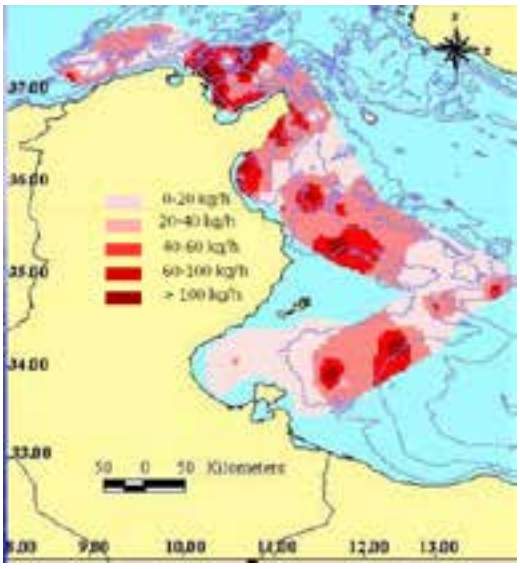


Figure 4

Spatial distribution of the abundance of exploitable benthic fishery resources in Tunisia (INSTM) year.

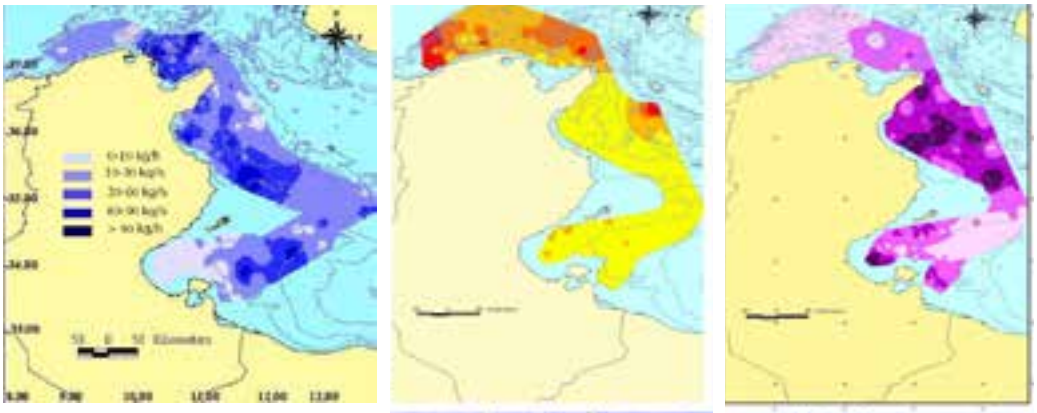


Figure 5

Spatial distribution of the abundance of species exploited in Tunisia (A: commercial yield of fish, B: yield of crustaceans, C: yield of cephalopods) (INSTM)

2.2. Main habitat types

The northern region of Tunisia presents an often reduced continental shelf, strongly rugged and extended by a steeply sloping embankment with a very troubled submarine morphology. While, the eastern and southern regions of the country are characterized by a relatively extensive shelf with a very gentle slope, with sandy and sandy-muddy bottoms.

For the description of habitats in Tunisia, the sectors to be adopted in the "National report for the identification of the major properties of ecosystems and the assessment of the ecological state and pressures on marine and coastal biodiversity: Tunisia UNEP / SAP/ RAC - Tunis, 2010. "will be the same used for this description of habitats.

Sector1

Tabarka / Cap Sidi Ali El Mekki: This sector is characterized by the predominance of rocky coasts marked by the individualization of numerous capes, in particular Cap Negro, Cap Serrat, Cap Blanc, Cap Zebib. The continental shelf is quite narrow and forms a steep slope with vast channels formed of loose sediments characterized by high depths (Canal de la Galite, Canal des Esquerquis). This sector is characterized by shallows, such as the banks of Sorelles, Mazarilles, Esquerquis, Lakhwet (Fratelli) and the presence of numerous islands and islets (La Galite, Fratelli, the Canis Islands, Pilau...). The coasts are characterized by an alternation of rocky bottoms and soft bottoms favoring a rich biodiversity. This has been shown by the study carried out by the SPA/RAC to map the key marine habitats in the future MCPA cap-Negro cap Serrat developed in 2015, where exceptional richness was observed. The main habitats described are: *Posidonia oceanica* herbarium; the Coralligenous biocenosis (facies with *Eunicella singularis* and *Flabellia petiolata*; Facies with *Eunicella cavolinii*) and the Coralligenous platforms (facies with *Eunicella singularis* and facies with *Leptogorgias armentosa*). In this region, we find

fishing for red coral (*Corallium rubrum*) and red lobster (*Palinurus elephas*), which are considered emblematic species of the region where their landings keep falling from year to year. We note that Posidonia and Caulerpa meadows are present up to 30 m depth. Within the loose substrates and close to these meadows, exist the lamellibranchs *Pinna nobilis* and *Pinna rudis.* The frequent presence of the sea urchin *Paracentrotus lividus* on these coasts, as well as the seahorse *Hippocampus sp.*

The beaches, limited in number and reduced in size (Berkoukech. Zouaraa) are most often located at the mouths of wadis and alluvial plains. Their presence is associated in places with that of very developed dune fields (Zouaraâ and Errimel).

The essentially rocky nature of the substrates favors the development of a high biodiversity characterized by the presence of many rare or endangered species including the vermetidae sidewalks *(Dendropoma petraeum* and *Lithophyllum bissoides).* The bioconcretionary mediolittoral stage is clearly apparent in Sidi Mechreg, Lakhouet islets (Fratelli) and the Cani islands. These habitats are more conserved and more diversified in island environments, which was shown by the study carried out by Andromède on the Galite archipelago in 2010. In this archipelago which has exceptional biodiversity, there are 4 main marine habitats:

- Well calibrated fine sand banks,
- Posidonia herbarium on sand or rock;
- The reefs, there are rocks and rocky scree with photophilic algae as well as the coralligenous.
- The coastal detrital there is a maërl facies and a fucal facies

Sector 2

Sidi Ali EL Mekki / Cap Bon. This sector is distinguished by:

Caulerpa meadows and Posidonia meadows in good condition that extend to a depth of 25 m. In the south-eastern part of the bay of Tunis, we note the presence of a very important barrier reef of Posidonia *Posidonia oceanica*. It is reported that a mapping of marine habitats and biodiversity was carried out on the island of Zembra in 2010 and highlighted the presence of four marine biocenoses:

- Fine sand banks well calibrated and coarse with the presence of cymodocea
- Posidonia herbarium with the presence of a dead mat.
- Hard substrates with the presence of rock with photophilic algae and coralligenous.
- Coastal detrital, silted up, sometimes the presence of maërl, with an association with fucales.

Sector 3

El Haouaria / Chebba, this sector is marked by the extension of sandy beaches interspersed with a few rocky points and presenting shoals. The Gulf of Hammamet is a wide coastal indentation, beginning in the north with a narrow continental shelf, gradually widening towards the south. The underwater relief is characterized by the presence of banks: the El Haouaria bank in the North, the Korba and Maamoura banks in the center and the Hergla

bank in the South and the islands of: Pantelleria and Kuriat. The seabed is predominantly sandy and muddy. Posidonia meadows are in good condition and quite frequent, especially in the Monastir - Chebba area. Studies concerning the marine mapping of habitats have mainly affected only future MCPAs as is the case of the Kuriat Islands. This study highlights the presence of barrier reefs with Posidonia oceanica in four zones in the vicinity of the Kuriat Islands and the maërl and Rhodolith beds.

Sector 4

The Gulf of Gabès is characterized by a very extensive continental shelf with a very low slope. The Gulf of Gabes is subject to the phenomenon of the semi-diurnal tide. Its amplitude is maximum at the bottom of the gulf and decreases on its periphery. The Gulf of Gabès is bordered on its periphery by a fringe of Posidonia meadows, particularly well developed near the island of Kneiss in the NW, and especially around the island of Jerba in the SE. In the axis of the Gulf and in particular in front of Gabès, this herbarium is much narrower. The dense herbarium is only found in shallow depths to the south of the Gulf of Gabès, all the other herbaria are evenly distributed between dense herbaria and sparse herbaria. According to Hattour el 2013, 54% of seagrass beds are of abnormal density with an average rate of cover. Seagrass beds at normal density represent only 24.3%. This desertification is mainly due to industrial waste and fishing for dragging arts. The Gulf of Gabès has always represented Tunisia's largest fish reserve.

2.3 Singular habitats in the country

In Tunisia, remarkable ecosystems are reported from north to south of the country, in its island environments and in its banks on site:

- The sidewalks with vermetidae (gastropods), reported in particular on the entire coastal fringe (in particular on the rocky coasts in beaten mode) of northern Tunisia from Tabarka to Cap Bon, with hotspots of this habitat (Galite, Zembra, Ras Engelas, Cap Blanc, Fratelli islets, Cap Zebib, Cani Islands, Haouaria)
- The Reefs at *Neogoniolithon,* 30 km long north of the El Bibane lagoon; expansion due to the particular conditions of the environment (high temperature and salinity), which limit interspecific competitions.
- The *Posidonia oceanica* herbarium; whose distribution, vitality and state of degradation differ from region to region.
- The coralligenous biocenosis, generally in excellent condition (Gulf of Tunis, Galite, Zembra, Fratelli, Cani islands, shoals or banks of Mazarilles, Speiss, Hallouf, Korba, etc.), except in the facies with soft bottom or the Trawler action is sometimes visible.

These unique habitats will be found later in the section dedicated to "Vulnerable habitats"; Indeed, these biocenoses, although they constitute entities recognized at the Mediterranean scale, heritage and very important for the Tunisian underwater biodiversity, represent at the same time very vulnerable habitats and subject to several threats and

degradations at the level of several regions of Tunisia; destruction of these habitats for illegal fishing methods such as benthic trawling and kiss (mini-trawl), particularly in the Gulf of Gabès, destruction by industrial pollution (discharge of phosphogypsum and acid water), discharges from domestic used waters (ONAS deficient sanitation plants), discharge of brines (desalination plants), pollution by hydrocarbons (open sea (degassing of commercial vessels), ports, marinas, oil terminals, etc.).

2.4 Transboundary issues

The growing awareness of the benefits of common management of shared natural resources is a good sign. In this regard, the creation and management of Mediterranean MPAs sometimes calls on the skills at sea of several border countries (i.e. the Pelagos Sanctuary). More generally, the Mediterranean area has seen several joint initiatives and good examples of bilateral collaboration for the conservation of cross-border areas (rivers, wetlands, sensitive marine areas, Sebkhet, lakes, lagoons, estuaries, etc.). In fact, the conservation of biodiversity and the management of natural resources (in particular fishery resources with regard to shared stocks). In this regard, transboundary management plans have been drawn up going beyond national boundaries for holistic and ecosystem management, and those for large-scale coastal areas (i.e., Transboundary Management Plan for the Lower Neretva Valley and Malostonski Bay, Croatia).

For the case of Tunisia, and until today, the question of developing cross-border MCPAs / MPAs is not on the agenda although the question of the management of shared marine resources is subject for several years to several measures (i.e., the management of bluefin tuna fishing in the Mediterranean undertaken by ICCAT, or the question of swordfish (whose fishing will soon be regulated by the quota mode). Shared living resources such as small pelagics are the subject today of several debates at the level of FAO / GFCM with a view to rationalizing their fishing on a Mediterranean scale.

Otherwise, other resources in relation to water and the sea, give rise to cross-border management (cross-border park and forests between Tunisia and Algeria; or cross-border Sebkhet (i.e. Sebkhet Adhibate (salt exploitation), i.e., Sebkhet Tadet, Mellahet el Brega (salt exploitation) between Tunisia and Libya.

Cross-border and regional initiatives specifically target the conservation and protection of vulnerable protected species (i.e., the Caretta caretta turtle, the monk seal, cetaceans, seabirds, several taxa and marine species (see Strategic Programs, Endangered Species and Habitats Programs), transversal programmes, and projects of SPA/RAC: http://rac-spa.org/fr/).

Thus, international collaboration, which is in great demand in this field, makes it possible to increase efficiency and greater public awareness of the interests of creating MCPAs and their management. Today, this administration of MCPAs is done more with the participatory, integrated and ecosystem model. The concept of co-management of MCPAs more present at the level of the north shore and the western basin of the Mediterranean, is more and more adopted at the level of MCPAs of the south shore and the eastern basin (i.e. Tunisia).

2.5. Identification of the country's marine and coastal biodiversity gaps needed for scientifically sound based conservation

Despite this intense bibliographic research effort on all aspects, the degree of precision remains variable, several gaps may be raised regarding the characterization of the ecological state and the pressure on marine and coastal biodiversity in the countries of the Southern and Eastern Mediterranean. Identifying these gaps is more than necessary to establish well-founded and effective marine and coastal biodiversity conservation.

It should be noted that these gaps are more likely to be seen on the southern shore of the Mediterranean (Libya, Syria). This is due to:

- Prospects and investigations remain limited and punctual to the rather coastal area and to areas classified as future MCPAs (ie Kuriat, Zembra, Galite, Kneiss in Tunisia), the offshore areas and especially the deep areas remain little known.
- The precise delimitation of vulnerable areas and biodiversity hot spots is still missing.
- The impact of urbanization and coastal development are little or poorly monitored and quantified, knowing that Mediterranean coastal areas are home to most of the infrastructure and urban and industrial poles (i.e. for countries like Tunisia, Morocco or Lebanon the coastal zone is home to more than 80% of the country's ports and maritime structures, including ports (trade, fishing, leisure), dikes, groynes, channels, etc.).
- The effects and impacts of fishing (professional and recreational) on biodiversity and habitats also remain poorly documented in terms of the qualitative and quantitative composition of trawling discharges in the northern region on the one hand and in terms of areas degraded by towing gear: traditional bottom trawls, as well as prohibited gear.
- And bycatches: turtles, cetaceans, sea birds.

Finally, with the recent development of offshore aquaculture and the rapid increase in the number of fattening farms (Atlantic blue-fin tuna *Thunnus thynnus*) or farms (mainly the European seabass *Dicentrarchus labrax* and sea bream Sparus aurata), especially in the eastern region. of the country, special attention deserves to be undertaken in order to monitor the interactions between aquaculture and the marine environment and the impact on habitats and biodiversity.

In general, the northern shore remains better explored and covered by the various initiatives and projects of SAPBIO than the southern one: At the level of the latter, the countries of the western basin (North Africa) are more covered by the countries of the eastern basin (Libya, Egypt, Syria).

On the other hand, at the level of the country alone, it often happens that there are quite marked differences in the scientific monitoring of biodiversity, and the prospecting effort; for example, in the case of Tunisia, the northern areas are occasionally surveyed (MCPAs of Galite, Zembra, Cap Serrat-Cap Négro) compared to other areas of Tunisia. This is mainly due to the difficulty of access to its areas and to the meteorological conditions and those of the sea in these areas of heavy seas.

2.5.1. Project for the preparation of a Strategic Action Plan for the Conservation of Biodiversity in the Mediterranean Region (PAS BIO):

Within the framework of the implementation of a SAP for the Conservation of Biodiversity in the Mediterranean Region (SAPBIO), several initiatives have been led by SPA/RAC since 2003. Among these initiatives we quote in particular:

- Project for the preparation of a Strategic Action Plan for the Conservation of Biodiversity in the Mediterranean Region (SAPBIO)
- Strategic action programme for the conservation of biodiversity in the Mediterranean region (2003)
- Strategic action plan for the conservation of marine and coastal biodiversity in the Mediterranean (2003).

In this same context, and for more targeted Mediterranean biodiversity conservation actions, several specific programmes linked to the preservation of this biodiversity have been developed and some of which are being implemented with projects and actions in the field. Among these dedicated programmes we cite:

- the conservation program for the communities of white coral, and the fauna of canyons and seamounts in deep Mediterranean environments (2003): This involves characterizing and describing the distribution, biological richness and interest of the "white coral" community, and the fauna of the canyons and seamounts of the deep Mediterranean
- the Mediterranean Coralligenous conservation program (2003): This program aims to define the coralligenous habitats in the Mediterranean, its main builders, its richness and its key role in benthic ecology as well as its threats)
- the evaluation program of the effects of fishing practices in the Mediterranean: aiming at the evaluation of the impacts on habitats and sensitive marine species, technical solutions and recommendations (2003)
- the program dedicated to the legal analysis of the measures adopted following the study of Mediterranean coastal statistics aimed at minimizing the impact of fishing activities on marine ecosystems and non-target species (2003)
- the study and evaluation program of the Impact of tourism on Mediterranean marine and coastal biodiversity (2003)
- the study program of the Biodiversity of Mediterranean coastal wetlands (2003)

Note that these themes are treated only and in a generalized manner at the Mediterranean level; they are not dealt with at sub-regional scales (South and East Mediterranean) and even less at the national level of the target countries (with the exception of a few specific projects (i.e. Deep-Sea Lebanon Project).

Finally, the MedMPA programme or the EcAp-Med Projects which encourage the development of managements plans for MCPAs represent real opportunities for the development of the first assessments and the monitoring of marine and coastal biodiversity at the hotspot sites of the Mediterranean countries and in particular Tunisia

(Kuriat, Kerkennah, Kneiss, etc.). These programmes also represent an opportunity to assess the needs necessary for the implementation of the management of the MCPAs in question and the identification of participatory management / co-management processes, the stakeholders involved and the actions to be implemented.

2.5.2. National Strategies and Action Plans dedicated to the conservation of Biodiversity (NBSAP) in Tunisia

In Tunisia, the national strategies and action plans dedicated to the conservation of biodiversity (SPANB) have made it possible to achieve a great deal of progress in terms of conservation and sustainable use of biodiversity: in this regard, we particularly mention the two national strategies and action plans of 1998 and 2009. However, difficulties still hamper their implementation, and these NBSAPs remain inherent in:

- insufficient knowledge on the components of biodiversity, the erosion that threatens it as well as on ecosystem functions (specific diversity, ecosystem values, invasive alien species, etc.);
- the difficulty of planning, coordinating and prioritizing actions for biodiversity;
- low institutional and individual involvement in the management and conservation of biodiversity;
- weak sectoral and intersectoral integration of biodiversity;
- lack of national and international financial means;

Today the updating of the NBSAPs targets, for a long-term vision by 2030, advocates for a national biodiversity resilient to climate change, away from threats, conserved and managed in such a way as to contribute sustainably to socio-economic development of the country. The objectives of the strategy take into account the national context and are considered as instruments to be integrated into planning and socio-economic development policies. They aim among others:

- reducing the rate of depletion of the components of biodiversity with its three hierarchical levels (ecosystems, species and genetic diversity);
- sustainable use of biodiversity;
- reduction of the main pressures on biodiversity, exerted by anthropogenic pressures, invasive alien species, climate change, pollution;
- preservation of ecosystems and the services provided by their biodiversity;
- the protection of traditional knowledge, innovations and practices and the fair and equitable sharing of the benefits arising from the use of genetic resources;
- the mobilization of financial resources for biodiversity as well as capacity building in the area of biodiversity.

To achieve these objectives, the NBSAPs have been developed around 5 national priorities, broken down into 15 Strategic Objectives (SO), 40 Target Objectives (TO) and 48 actions to be implemented by 2030.

Among these priorities we can specifically mention Priority 3 aimed at the "need to develop knowledge and promote traditional know-how" (broken down into 2 SOs). Indeed, the need for the improvement and integration of knowledge on the evolution of the state of biodiversity respond to the needs felt by the majority of the target countries. At the same time, these go through the strengthening and federation of research on biodiversity and their orientation towards the valorization of acquired knowledge.

It should be noted that the achievement of the various objectives (SO and TO) is assessed through Operational Indicators (OI) developed in areas consistent with those retained by the CBD. These IOs include among others:

- **I** the state and evolution of the components of biodiversity,
- **II** the sustainable use of biodiversity,
- **III** threats to biodiversity,
- **IV** the integrity of ecosystems and the goods and services they provide,
- **V** the state of traditional knowledge, innovations and practices,
- **VI** the status of access and benefit sharing,
- **VII** the state of resource transfers.

Pressures and impacts

© SPA/RAC, University of Sevilla

The nature and extent of threats to Mediterranean marine and coastal biodiversity vary from one part of the Mediterranean to another, sometimes from one country to another. Many of these pressures and threats are linked to pollution and the exploitation of the region's natural resources, particularly the overexploitation of fishery resources. Beyond these Threats, discussed in detail below, Mediterranean biodiversity is more and more subject to the effects of global phenomena, such as the effects of global warming, the impacts of which could be felt at the level of species and the balance of ecosystems. Indeed, according to the latest IPCC reports (5th and 6th report), the Mediterranean region is one of the regions most affected by the impacts of climate warming and in particular the scarcity of water resources, marine erosion and the sea level rise (ENM), bioinvasion and disruption of biodiversity, and acidification of marine waters.

In some cases, such global phenomena could exacerbate the impact of other local or regional threats. In Tunisia, several anthropogenic threats already weigh considerably on the coast and the marine environment with an amplitude with an evolutionary tendency. These threats generate several deteriorations on life and biodiversity with effects as diverse as they are complex. Among these threats and impacts, we specifically mention:

Pollution

Pollution of marine and coastal areas is a frequently cited problem threatening biodiversity. Most of the effects of pollution on Mediterranean biodiversity are addressed in the "Strategic Action Plan to Address Pollution from Land-based Activities" (SAPMED) ("Strategic Action Plan to Address Pollution from Land-based Activities" (SAPMED)), implemented by UNEP MAP / MED POL.

Pollution of the coastal zone and its wetlands by solid and liquid by-products, domestic and industrial, is reported as a major problem by many Mediterranean countries: this perpetual problem is aggravated by the lack of appropriate treatment facilities. For Tunisia, the discharges of domestic waste water (wastewater treatment plants) concentrated on the entire coastline represent a major problem which constantly affects the marine environment and the quality of its water.

On the other hand, and like most Mediterranean countries, in Tunisia, the chemical and petrochemical industries concentrated around the large coastal cities (Bizerte, Tunis, Gabès, Skhira and Sfax) represent the major source of pollution.

Added to this, there is now agricultural pollution from runoff containing high concentrations of fertilizers, pesticides and other agrochemicals. In addition to significant eutrophication, their combined impact on the health of habitats and on particular species is often quite high. It should be noted, however, that this is not always an irreversible effect, and that after removing the sources of pollution, biodiversity can be restored to a large extent.

The main general consequences of these pollution-related threats for the marine environment and marine biodiversity are numerous, including:

- Occurrence of eutrophication events, producing hypoxia / anoxia of water and sediments, proliferation of algae and red tides;
- Decrease in the species richness of benthic blendings; due to the selection of some opportunistic species;

- Reduced density and biomass of benthic species, with the exception of nitrophilic algae;
- Alteration (or even destruction) of seagrass beds, by direct and indirect effects ;
- Accumulation of persistent substances (heavy metals, organic pollutants) in marine organisms, producing deformations in larval, juvenile and adult individuals of marine species, and causing an increase in mortality, in particular due to disturbances and destabilization of the network trophic.

Overexploitation of natural resources (fishery) and illegal fishing: trends and impacts

Negative impacts of inappropriate fishing activities on marine biodiversity are recorded in most Mediterranean countries, although countries have approached this issue differently. The important socio-economic implications of fishing activity make resolving this issue particularly delicate. The problem of fishing affecting marine biodiversity is likely to increase due to recent improvements in fishing and navigation technologies. This situation entails the risk that the fishing effort will be maintained despite the possible reduction in the fishing fleet.

The impacts of fishing activity on benthic and pelagic species are:

- Direct overexploitation of commercial species;
- Indirect effects of fishing on the ecosystem;
- Direct effects of overfishing on target species;

A characteristic of Mediterranean fisheries is their high level of exploitation, which often places resources in a state of overexploitation, and in the best case in an optimal exploitation, in particular in the three European countries which total 60% of the fishery production (Spain, France and Italy). The pressure on resources is exacerbated by the ever-increasing demand for seafood, with the Mediterranean supplying barely a third of the demand of borderline countries.

a) Indirect effects of fishing on ecosystems

Among the effects are those affecting populations of target and non-commercial species, such as:

- Disturbance or destruction of habitats (in particular *Posidonia* meadows and maërl beds);
- Effect on populations (commercial or not), due to bycatches, discharges, ghost fishing, etc.;
- Effect on other non-commercial (often threatened) species (chondrichthyans; sea turtles, sea birds, marine mammals, etc.), accidentally caught in fishing engines;
- Increased targeted fishing, less valuable resources at lower trophic levels, due to decreasing abundance of valuable species high up the food chain;

b) Uncontrolled recreational fishing activities

The increase in coastal tourism in the Mediterranean region is accompanied by a considerable increase in recreational sport fishing, associated with devices such as angling, handline, harpoon, longline, rod and the reel, etc. The main problem with recreational fishing is the total absence of rigorous controls on the composition, size and abundance of catches. In addition, there is a real conflict of use with commercial fishermen, since sport fishermen have started to illegally sell their catches.

Impact on the natural resources of wetlands

Wetland resources are useful to people living around them for food, fiber and biomass. In some cases, however, overuse of these resources leads to their collapse. The main problems can be listed as follows:

- Fishing in coastal lakes and lagoons, where the use of finer nets and other methods can lead to a dramatic decrease in catches;
- Excessive hunting of birds in wetlands and coastal areas;
- Overgrazing of coastal areas;
- Uncontrolled and excessive extraction of sand from beaches and river beds;
- Filling of wetlands to obtain construction or farm areas;

Urbanization in uncontrolled expansion and construction of infrastructure

Large parts of the coastal area are now rapidly being converted from a natural state to an urbanized state, through urban expansion, construction of economic / recreational and other facilities, and technical infrastructure, such as ports, airports and road networks. The result is the total destruction or, at best, the fragmentation of valuable habitats.

Bioinvasions and invasive species

Some 400 exotic species are recorded in the Mediterranean. These are species introduced directly by humans (accidentally or on purpose in the case of aquaculture, for example), or whose arrival in the Mediterranean has been made possible by human action. Some of these species are invasive, their effects are as follows:

- Competition / predation by invasive species and replacement of native species ;
- Hybridization with native species ;
- Introduction of pathogens ;
- Habitat loss ;

Trade in endangered species.

Several endangered or threatened populations are in decline because they are captured for commercial purposes (sponges, sharks, turtles, seahorses, shells (sea dates, Noble penshell) etc.). Although many Mediterranean countries have joined CITES, international trade in endangered species is widespread in several Mediterranean countries such as

turtles and seahorses, used as "souvenirs" in many countries, even in occasional cases sent to the Far East and Asian countries because of their claimed beneficial properties in certain traditional medicines (i.e., shark fins, turtle oil). The recent wild exploitation of sea cucumbers is also to be noted contributing to the depletion of these organisms, other formerly abundant species such as the Mediterranean crab are overfished (bait), this species is already in decline because of the extension and the proliferation of invasive decapod species that have invaded its habitats. The list of endangered species in Tunisia would benefit from being updated: many commercial species are declining under the effect of overfishing, such as the clam, which is the subject of intense fishing on the southern coasts of the country. Other marine species are also illegally overfished (selachians, groupers, etc.).

Fishing for juveniles or young individuals (placed on the market) using prohibited gear risks increasing the depletion of many other species.

Uncontrolled recreational activities

About 200 million tourists visit the Mediterranean region every year. They create a significant development of recreational activities (sport fishing, thalassotherapy center, seaside activities, etc.) mainly in coastal areas and in shallow water (especially during summer).

Scarcity and rarefaction of freshwater resources and impact on biodiversity

Population growth leads to an increasing demand for fresh water. This is exacerbated by tourist consumption, which is generally much higher than the corresponding levels for local inhabitants. Fresh water is necessary for biodiversity, particularly for habitats and species associated with wetlands, coastal lagoons and marine environments. The problem is exacerbated by pollution of freshwater sources by sewage and agricultural runoff to the sea. This scarcity of freshwater is likely to increase in some areas due to global changes.

Inappropriate aquaculture practices

In Tunisia, as everywhere in the Mediterranean, aquaculture production has experienced a drastic increase in recent years. The impacts of inappropriate aquaculture can come from several sources:

- Food waste not consumed by fish (estimated at 10-30% of the total, depending on the feeding method);
- Products of fish metabolism (faeces, pseudo-faeces and excretions);
- Chemical treatments used to prevent the accumulation of messy organisms on the nets;
- Chemicals to treat diseases and parasites of fish;

The effects of fish farming at sea can be multiple:

- Nutrient enrichment of the water column surrounding the aquaculture facility, causing the increase in primary production, as well as the attraction of pelagic and shoal fish species under and near fish farms ;

- Degradation of the bottom surrounding the farms, and above all an increase in the proportion of fine fractions of sediment, profoundly altering the communities of soft bottoms and grass beds ;
- Chemical pollution and bio-accumulation of antifouling and pharmacological products ;
- Genetic pollution of wild populations with individuals of high species escaping from cages (although no studies have been carried out on this particular subject) ;
- Visual degradation of coastal landscapes ;
- In some cases, the socio-economic effects derived ;
- lack of management studies, weakness of environmental impact studies, lack of control of aquaculture concessions (during production) ;
- Invasion of natural areas by exotic species.

The example of the establishment of numerous fish cages in the bay of Monastir, which is shallow and with low hydrodynamics, contributes to the organic pollution of the bay and occasionally to the destruction of all forms of life under the cages due to the sedimentation of faeces and pseudofeces very rich in organic matter.

3.1. Biological disturbances

Among the main problems affecting marine and coastal biodiversity and generating significant biological disturbances are:

- Simplification of the coastal and marine community ;
- Decrease in the population of susceptible species ;
- Decline of endangered species ;
- Decrease in the population of target species of fishing ;
- Destruction, fragmentation, erosion or disturbance of habitat ;
- Distortion of the natural dynamics of biodiversity ;

These disturbances are issues of primary importance and generalized to all Mediterranean marine biodiversity. In addition, other more general problems with indirect impacts have been identified, among them, the following are mentioned in particular:

- knowledge gaps (scientific, technical, management) ;
- insufficient level of awareness among the public and the authorities ;
- inadequacy of several existing systems for the governance of biodiversity conservation, in particular:

- weak institutional and human capacities for implementation, monitoring, evaluation and updating ;
- insufficient participation, involvement of the general public and stakeholders ;
- lack of incentives ;
- gaps and conflicts in legislative texts

3.2. Vulnerable marine ecosystems

These ecosystems are formed by fairly specific and particular biocenoses: they are heritage habitats in the Mediterranean whose presence indicates the value of a site, the richness of its biodiversity and potentially the reasons for its management and conservation (ie PMAs / MCPAs).

In this regard, the depths of the Tunisian coast, in particular those of its northern facade (Galite, Zembra, Kerkennah, kneiss, Kuriat) present a large number of biocenoses, underwater landscapes and species of biological interest dependent on these habitats. Today, MCPAs are sites where these habitats are best preserved. Thus at these sites, the seabed testifies to good water quality, and the low turbidities allow species such as *Posidonia oceanica, Cymodocea nodosa, Caulerpa prolifera, Cystoseira spp. (C.compressa* and *C.elegans) or Padina pavonica,* to grow at significant depths.

These biocenoses mark the Tunisian coast in particular at the level of MCPAs (Galite, Zembra, Kuriat, Kerkennah, Kneiss, and...) ; these are habitats as varied as they are diverse, and often richly populated by the biocenosis, including heritage and protected species. Thus, the Andromeda missions of 2010, dedicated to the mapping of underwater habitats at the level of the MCPAs of the Galite and Zembra archipelagos, made it possible to identify 4 biocenotic entities broken down into 14 habitats. Among these biocenoses and habitats, we distinguish in particular:

Sandbanks

These sandbanks can be differentiated into:

- Fine sands well calibrated;
- Coarse sand and fine gravels under the influence of bottom currents;
- Coarse black sands;

Posidonia herbarium

These Posidonia herbarium facies can be differentiated into:

- Herbarium with Posidonia on rock;
- Herbarium with Posidonia on sand;
- Dead mat of Posidonia;
- Herbarium at Cymodocées

Reefs

These reefs can be differentiated into:

- Infralittoral rock with photophilic algae;
- Rock scree with photophilic algae;
- Coralligenous

Coastal detritic

These coastal detritic facies can be differentiated into:

- Coastal detritic;
- Silted coastal detritic;
- Coastal detritic of maërl;
- Coastal detritic association with fucales

On the Tunisian coast, these habitats follow one another depending on the depth and the current, and the size of their surface varies considerably depending on the site. The majority of these biocenoses (4 biocenoses) and habitats (14 habitats) are observed, most often at the level of MCPAs, in particular those of the northern facade of the country (Galite, Zembra), but also in Cap Negro / Cap Serrat area.

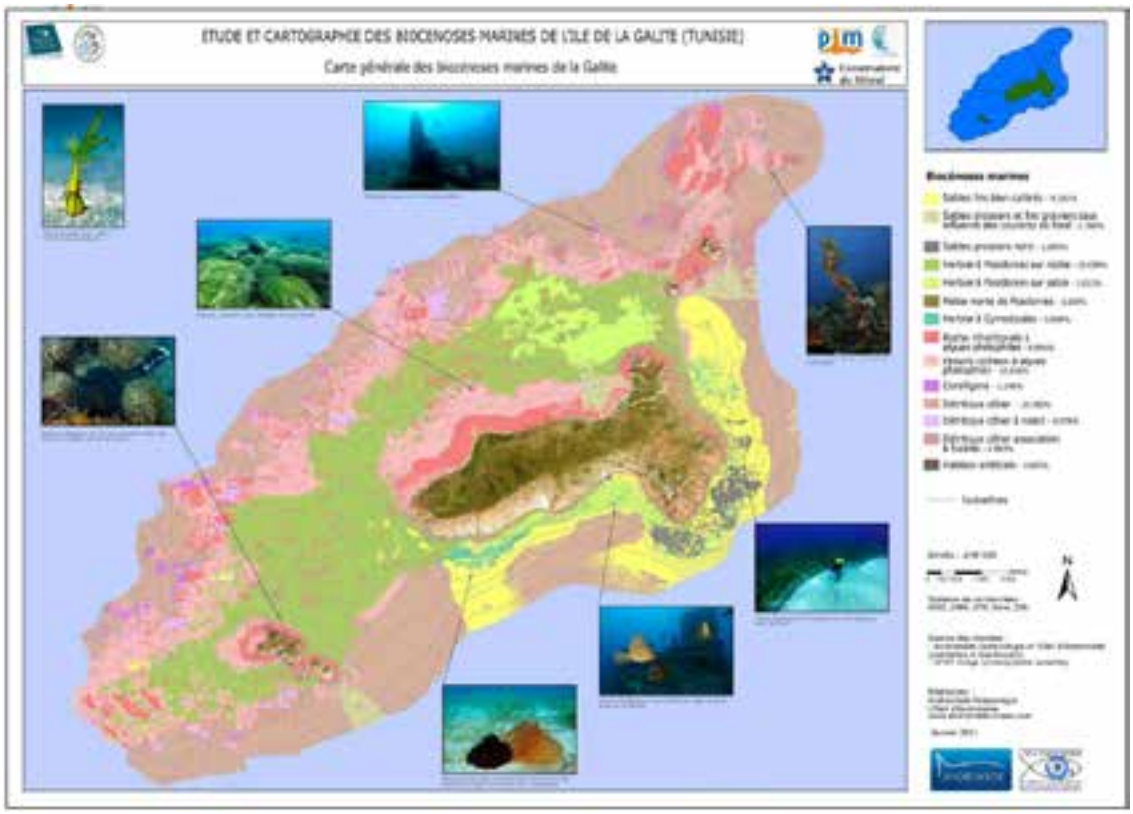


Figure 6

Mapping of marine biocenoses and habitats of MCPAs of la Galite (according to Andromeda, 2010a)

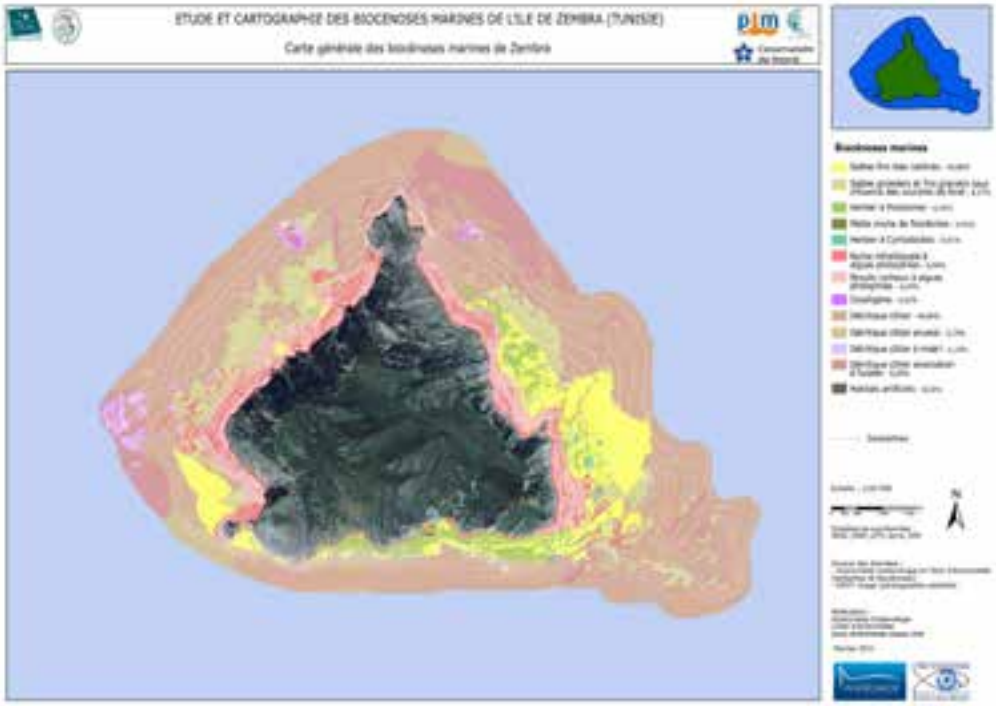


Figure 7

Mapping of marine biocenoses and habitats of the Island of Zembra (according to Andromède, 2010b)

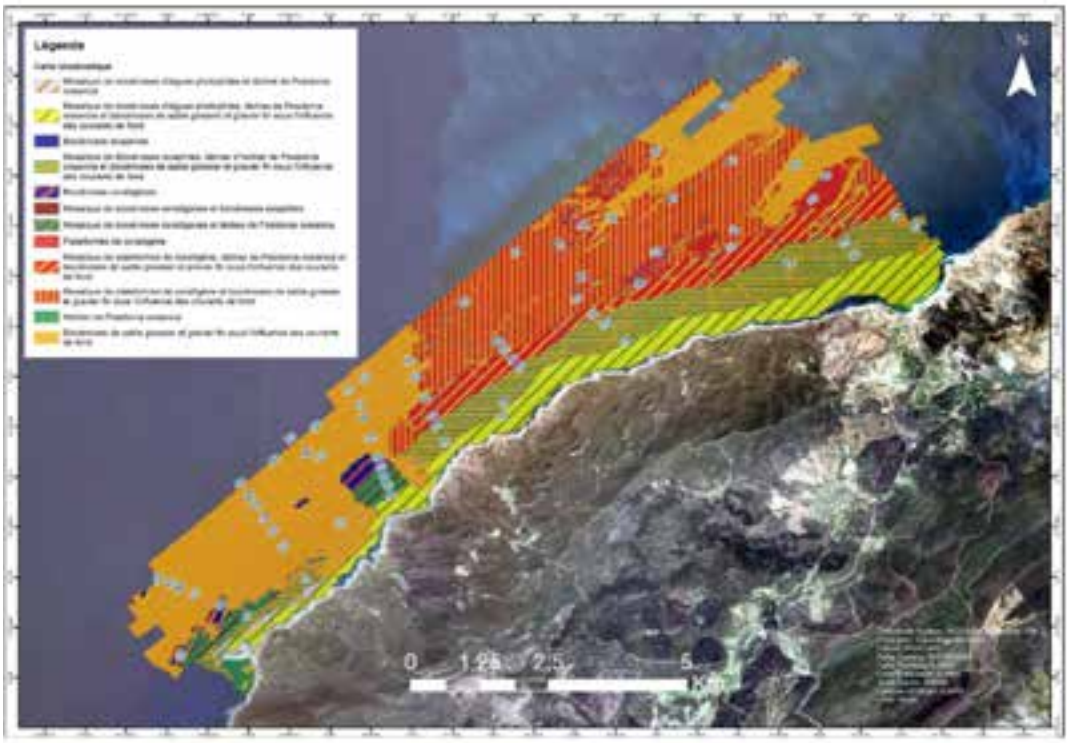


Figure 8

Map of the biocenoses of the area of Cap Negro Cap Serrat (according to UNEP/MAP RAC/SPA 2016)

But apart from these biocenoses and nomenclature habitats at the level of the Tunisian coasts (MCPAs) and more generally the Mediterranean coasts, we can quote other more specific and less extensive habitats, but with high value in terms of biodiversity; Among these ecosystems we quote the:

- Coralligenous (including coralligenous assemblages and communities of white coral, false corals and gorgonians);
- Maërl bottoms;
- Sponges and photophilic algae (including their associations with rocky and detritic bottoms);
- Colonies and associations of corals, false corals (i.e., *Astroides calycularis*), encrusting sponges (*Spirastrella cunctatrix, Crambe crambe*), calcareous algae (*Lithothamnion sp., Mesophyllum sp., Peyssonnelia sp.*) And green algae calcified (*Halimeda sp., Flabellia sp.*) ;
- Vermet sidewalks (*Dendropoma spp; Mesophyllum spp., Neogoniolithon spp., Vermetus sp. Thylacodes spp., Serpulorbis spp., etc.*);
- Rhodolithic coastal detritic grounds;
- Dark and deep habitats (including canyons and seamounts);
- Coastal and oceanic herbarium associations such as the associations with Posidonia-cymodocés, Posidonia-caulerpes (*C. olivieri* and *C. prolifera*) and Posidonia-eelgrass (shallow coastal waters such as deltas, lagoons and estuaries) , as well as associations with caulerps (*C.ollivieri* and *C.prolifera*). These latter very present on the Tunisian coasts, are at the base of associations with padina (*Padina pavonica*), eelgrass (Zostera marina) and cymodocea (Cymodocea nodosa).
- Rock habitats: underwater caves (agglomerate, pebbles, clusters of rocky boulders (*parallelepipeds, monoliths*, etc.), and rocky walls, etc.
- Underwater rocky habitats (rocks, boulders, faults, caves and cliffs and underwater canyons).

Finally, we note that the majority of these habitats and biocenoses today benefit, within the framework of the "Strategic Action Plan for the Conservation of Biodiversity in the Mediterranean Region (SAPBIO)" from a specific program for their conservation and which is more generally linked to the conservation of Mediterranean biodiversity.

3.3 Emerging issues such as climatic change effects and open sea including deep-sea ecosystem concerns (including high seas and deep sea ecosystem concerns)

Climate change affects all regions of the world. The polar ice caps are melting and the sea level is rising. For some regions, notably the Mediterranean region, extreme weather events and precipitation are increasingly frequent, while others are facing increasingly extreme heat waves and droughts. Today, at the level of the Mediterranean basin, These effects are felt year by year, and are expected to intensify over the upcoming decades. Thus, threats to biodiversity result from an interaction of factors, particularly anthropogenic, accentuated directly or indirectly by Climate Change. The main factors are:

- The destruction and weakening of marine habitats and ecosystems;
- Water pollution from the continent (wastewater, industrial water and fresh water);
- Overexploitation of natural marine resources;
- The intrusion of invasive alien species;

With regard to bioinvasion, and even if we can consider that the effort of prospecting and identifying biological disturbances (in particular those linked to biodiversity and invasive non-native species), we can point out that the ecological eve has improved significantly over time and since the last PAS BIO National Report was produced. Indeed, for non-native and invasive species, this factor is important, the surveys carried out until then by scientific and more widely public institutions have been strengthened by contributions from resource persons and associations.

The current trends of first reports and new occurrences are significantly increasing. (*Percnon gibbesii, Portunus segnis, Callinectes sapidus,* etc.).

Melting ice and rising sea levels

The warming of water causes it to expand. At the same time, global warming is causing glaciers and polar ice caps to melt.

The combination of these changes causes ocean levels to rise, leading to flooding and erosion of coastal areas and other low lying areas.

Extreme weather conditions and changes in precipitation

Heavy precipitation and other extreme weather events are increasingly common. They can cause flooding and adversely affect water quality, but also reduce the availability of water resources in some areas.

Consequences for the Mediterranean basin

The Mediterranean basin is becoming increasingly drier, making it even more vulnerable to droughts and fires. The northern shores as well as the southern shores are facing an upsurge in heat waves, forest fires and episodes of drought. Coastal cities, urban areas and the entire coastline are exposed to heat waves, floods and sea level rise, while they

are generally poorly prepared to adapt to climate change (cities, urban areas and tourist areas too close to the coastline, absence of the concept of strategic retreat from ENM).

Consequences for developing countries

Many developing countries in the southern Mediterranean are among the most affected. Often, people who live there depend heavily upon their natural environment, especially the coastal zone, even though they have the least resources to cope with climate change.

Risks to human health

Climate change is already having an impact on health: Thus, the number of heat-related deaths has increased with the frequency of summer heatwaves more and more sustained; We are already seeing an evolution in the number and distribution of certain water-borne diseases (so some are of tropical origin) and certain disease vectors (i.e., tiger mosquito).

Costs for community and economy

Damage to property and infrastructure and the effects on human health entail considerable costs to society and the economy. Thus, losses caused by extreme events such as floods can affect large populations, and cause direct economic losses often amounting to tens of billions of euros.

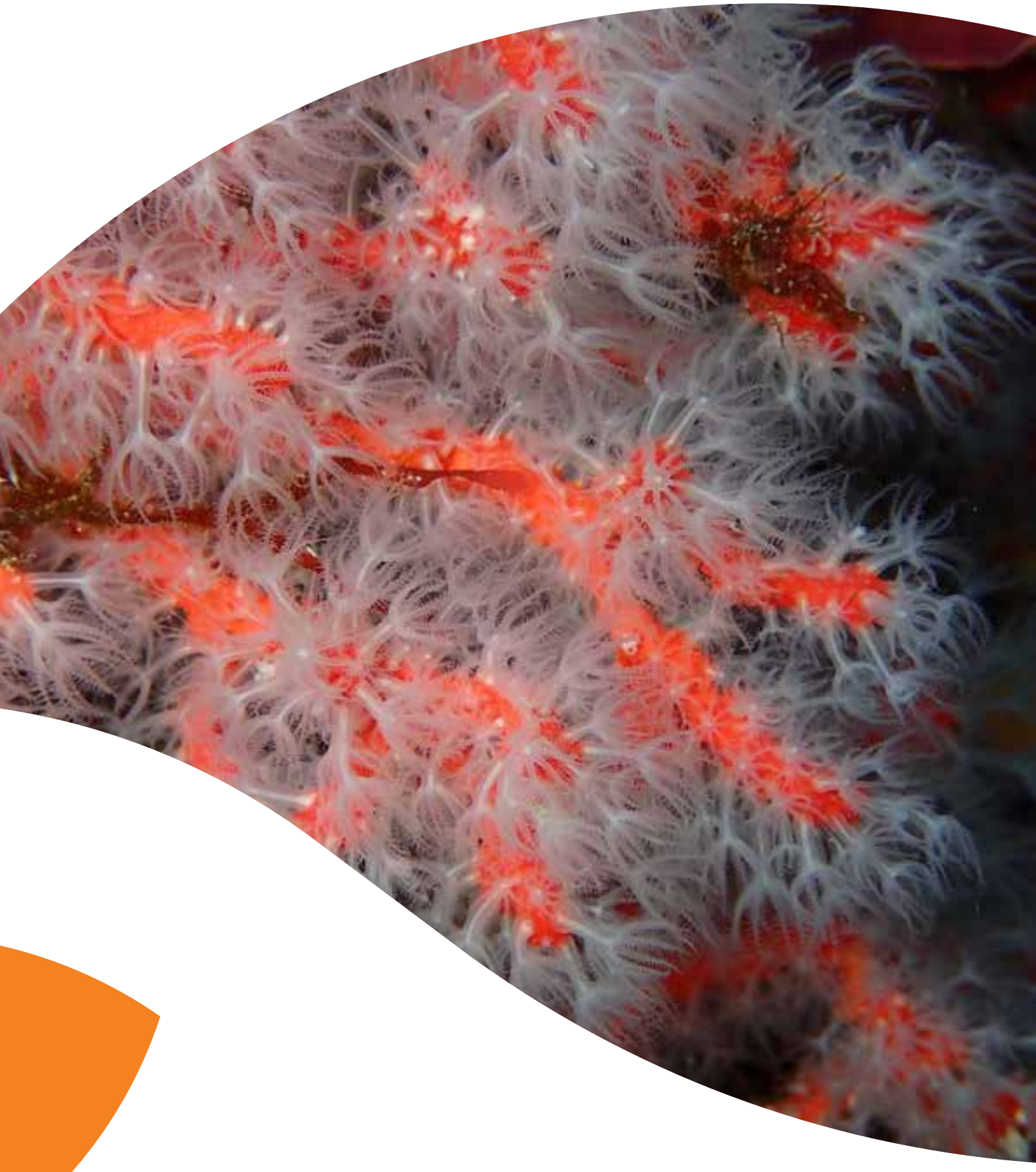
At the level of the Mediterranean basin, and in particular in the case of Tunisia, the sectors which depend heavily on temperature and rainfall, such as agriculture, forestry, energy and tourism are particularly affected.

Consequences for marine biodiversity

The direct and indirect impacts of climate change will have significant consequences on biodiversity (i.e. invasive species; evolution and disruption of ecosystems in the face of CC) and deep-sea ecosystems, in particular on coralligenous reefs, the biodiversity of dark habitats, canyons. , and all the other forms of biodiversity directly linked to hydro-oceanic and physicochemical phenomena such as water acidification, currents (especially bottom currents), movements of water masses, salinity, temperature, as well as phytoplankton and zooplankton production. Many marine species are resigned to moving to new territories, at the risk of disappearing in ecosystems disturbed by the effects of CC. At present, some Mediterranean species are seriously threatened with extinction if the average water temperature continues to increase uncontrollably.

4.

Current response measures



© SPA/RAC, University of Sevilla

4.1. Marine protected areas and other area-based conservation measures

Island ecosystems, represented by islands and islets are considered to be among the richest marine ecosystems in terms of biodiversity, habitats and fishery productivity. The monitoring of their fauna and flora and the prospects for their management and conservation are the subject of a national strategy specifically dedicated to MCPAs and implemented by APAL in collaboration with international organizations including SAP/RAC.

The establishment of the classification process of 4 protected areas began with a public survey related to the following sites: Archipelagoes of La Galite, Zembra and Zembretta, Kuriat and the Kneiss. Subsequently, after this survey, laws to create these protected areas will be promulgated and formalize their existence. Beyond this first wave, a dozen marine and coastal protected areas will be created.

The La Galite archipelago was home to a now extinct population of monk seals, but has significant terrestrial and marine flora and fauna of heritage interest. The Zembra archipelago is particularly distinguished by the presence of the largest colony of gray shearwaters and is the only reservoir of giant limpets in Tunisia. The Kuriat's emblem is the loggerhead. The Kneiss, located in a mesotidal zone sheltering swarms of wintering birds and also constituting an appreciable stock of clams generating interesting income for women collectors.

The Galite archipelago is located north of the Tunisian coast, the area of this future protected area is estimated at 2,715 ha (the current area not displayed in the management plan). The archipelago was classified SPAMI in 2001.

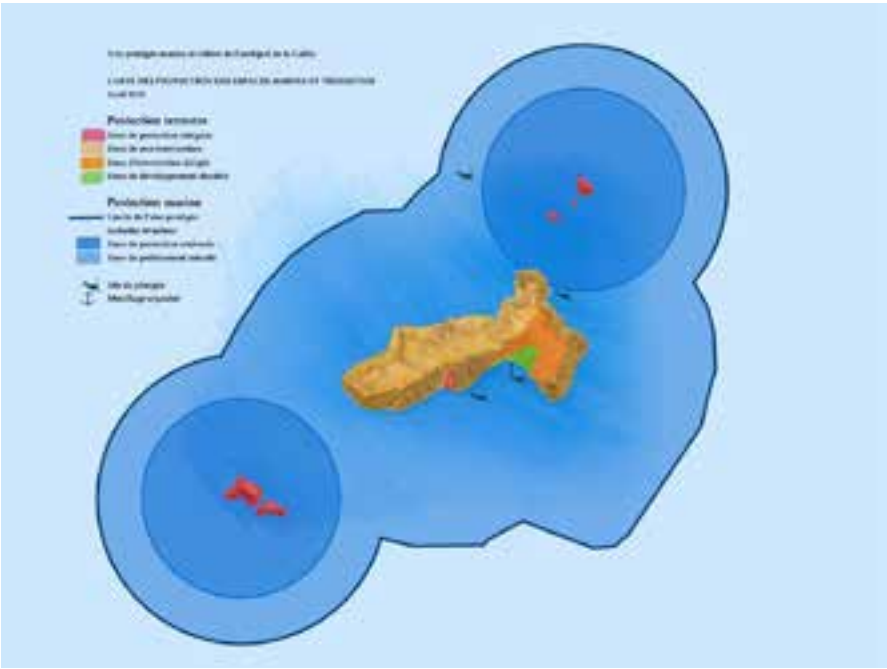


Figure 9

The Zembra archipelago and Jebel el Haouaria: Biosphere Reserve and SPAMI, National Park since 1975, The total area of the protected area is 73,402 ha (land environment 2,139 ha and marine environments 71,263 ha). The last management plan extended to Jbel el Haouaria to better justify the anthropogenic issues to argue for the extension here of the Biosphere Reserve, too.

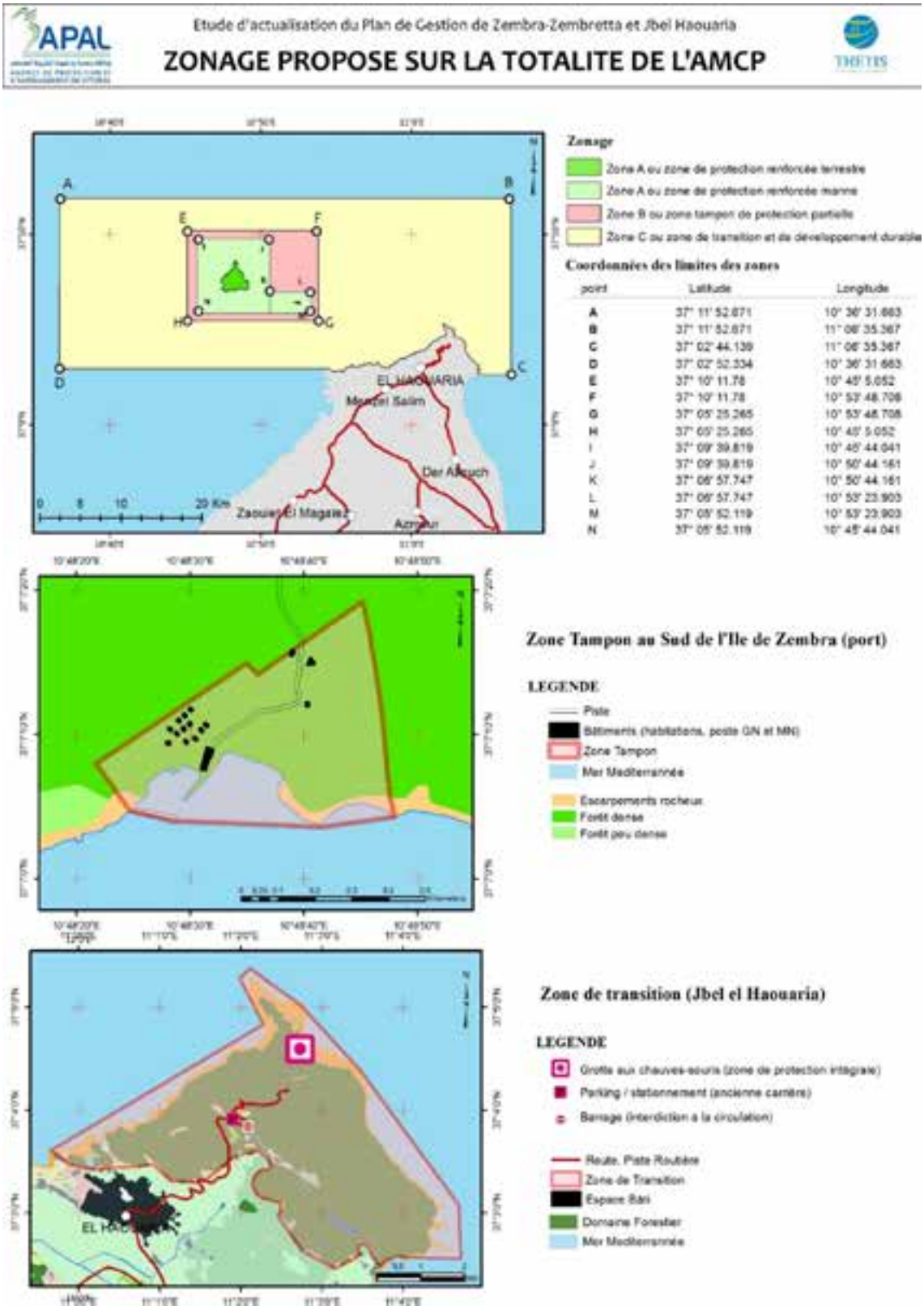


Figure 10

The Kuriat Islands: The total area of the protected area is 84,403 ha (terrestrial areas 340 ha and marine areas 84,063 ha).

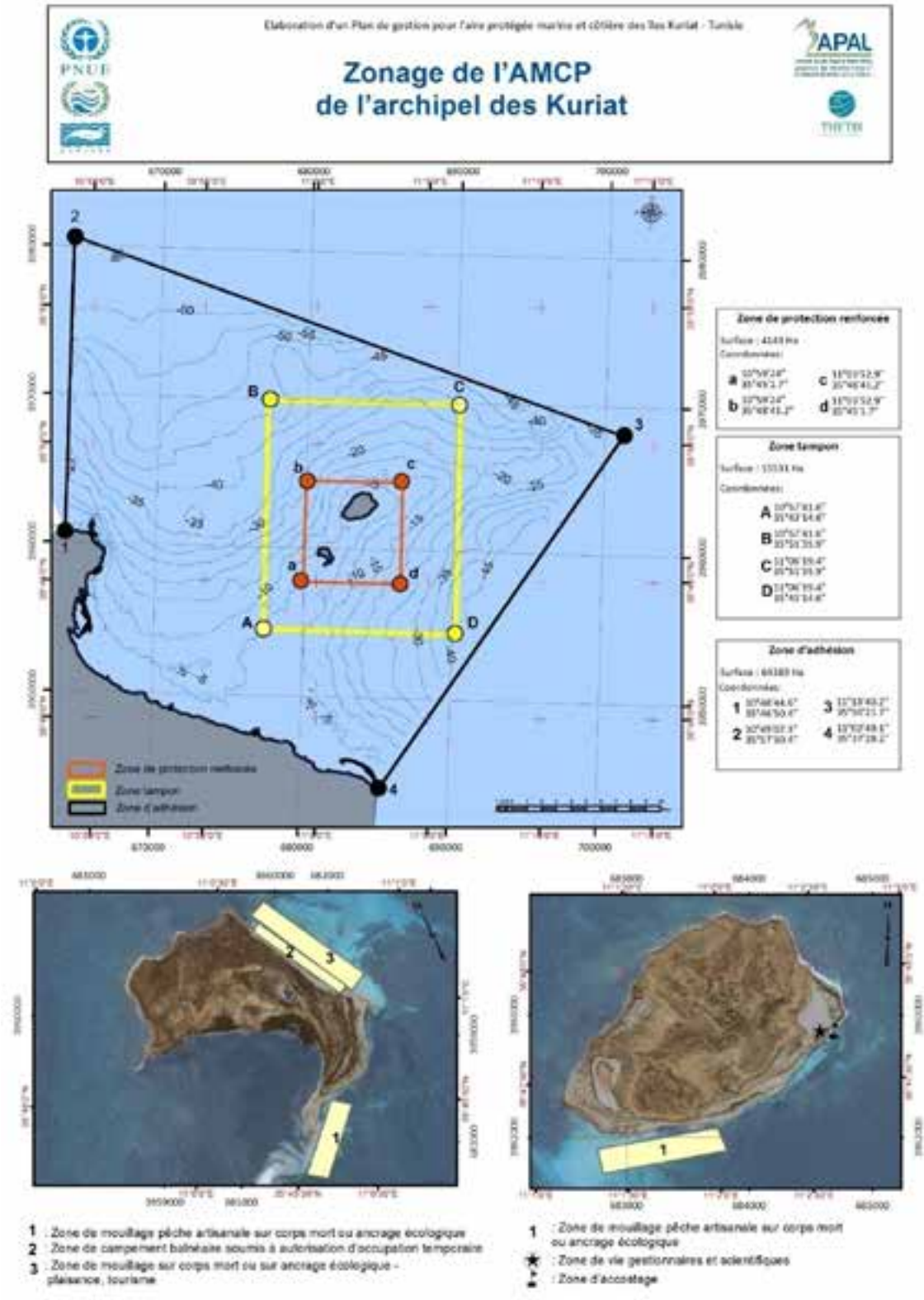
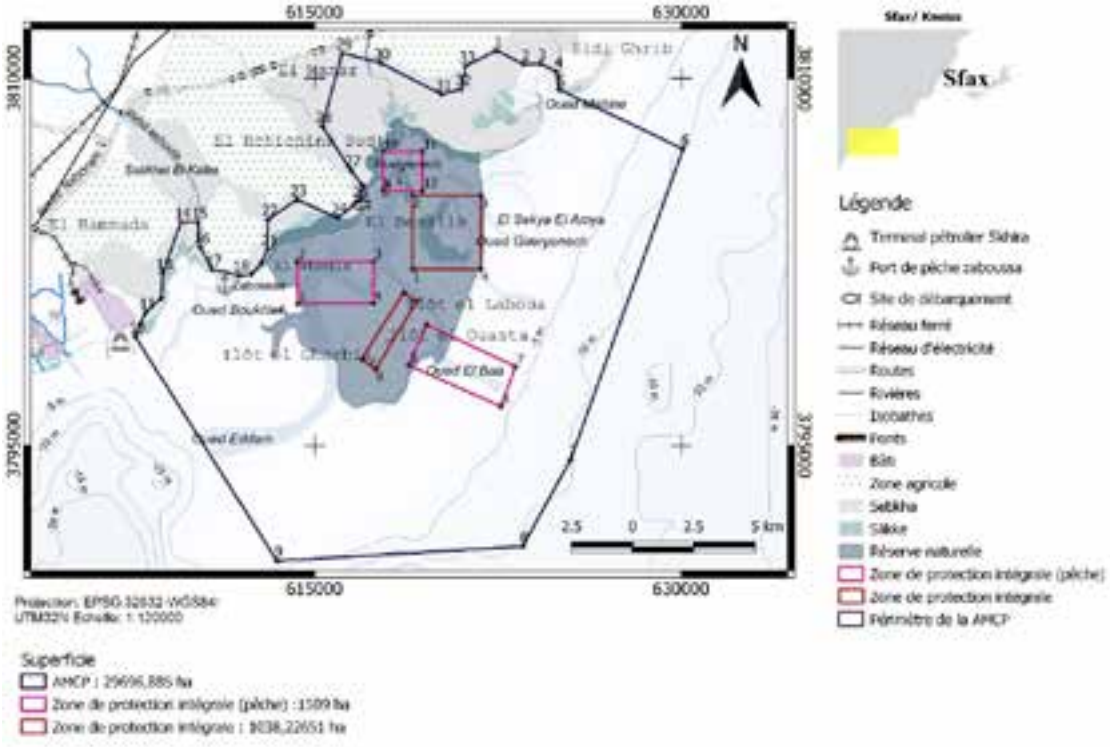


Figure 11

The Kneiss: The total area of the protected area is 29,696.885 ha, including islands but also a foreshore. Coastal wetlands are not included in this area even though they are part of the Ramsar site. The Kneiss are a natural reserve currently managed by the Directorate General of Forests and Specially Protected Area of Mediterranean Importance.



4.2. Legal and institutional frameworks governing the conservation and sustainable use of marine and coastal biodiversity

Institutional actors in relation to marine and coastal biodiversity

The various conventions signed and ratified by Tunisia relating to the conservation of biodiversity and the development of the Tunisian coastline mobilize several administrative and research bodies to monitor and ensure the implementation of these protocols and legislative texts. Thus, within the Ministry of the Environment, and the Ministry of Agriculture, Fisheries and Water Resources, several departments are responsible for the conservation of biodiversity. These include the Directorate General for the Environment and Quality of Life (DGEQV), the Directorate General for Forests (DGF), the National Environmental Protection Agency (ANPE) and the International Center for Technology. 'Environment of Tunis (CITET); as well as the Coastal Protection and Planning Agency

(APAL) but also the National Bank of Genes which contributes to the identification of species, some of which are rare and / or threatened. Tunisia is also home to the Specially Protected Areas Regional Activity Centre.

Other research institutions (INSTM, INAT, Faculties of Science) provide support and contribute in collaboration with the departments of the Ministry to the conservation of biodiversity. In this sense, many research works, several seminars and workshops have been carried out on the state of biodiversity in wetlands, marine and terrestrial areas. Several other bodies are created: the Environment and Sustainable Development Observatory (OTEDD), the Coastal Observatory based at APAL whose main task is the creation of a database on sensitive, wet and coastal areas, and the Observatory of the sea based at INSTM , which works in collaboration with INAT and other academic institutions.

Likewise, there are several Non-Governmental Organizations (environmental NGOs and scientific NGOs) which are very interested in biodiversity, the rehabilitation of wetlands and the inventory of avifauna, not to mention competent resource people who contribute both to improving knowledge, as whistleblowers and in certain environmental engineering actions.

On the other hand, Tunisia has led efforts and carried out several works aimed at the conservation of marine and coastal biodiversity.

Relevant legislation for marine and coastal biodiversity (conservation, management of uses (fishing, tourism, etc.)

At the national level and always in relation to the environmental concern and as for the management and the promotion of the environment in general and of the coastal domain in particular, as well as the conservation of the natural and cultural heritage, several texts are to be considered as fundamental as they express the very favorable development of public authorities in this area. We particularly quote:

- Law 88-91 as of 2 August 1988 establishing the National Agency for the Protection of the Environment (ANPE);
- Decree 93-2061 as of 11 October 1993 establishing the National Commission for Sustainable Development (CNDD);
- Decree 94-1223 as of November 28, 1994 promulgating the code of land use planning and urban planning;
- Law 94-13 as of January 31, 1994 relating to fishing and decrees of the Ministry of Agriculture;
- Law 95-73 as of July 24, 1995 relating to the Public Maritime Domain;
- Law 96-29 as of April 3, 1996, establishing the national emergency response plan for the fight against marine pollution;
- Law establishing the Coastal Protection and Development Agency (72-95 of July 24, 1995);

to these laws and decrees, we can also add other texts, in particular:

- the Forest Code set up by law 88-20 as of April 13, 1988 (which repealed law n ° 66-60 as of July 4, 1966, revised on August 9, 1974). This code was amended in 2010;
- the Code of Archaeological, Historical and Traditional Artistic Heritage, implemented by Law 94-35 as of February 24, 1994 (implementing decrees not yet published);
- the Code of Regional Planning and Urban Planning (decree 94-1223 as of November 28, 1994);
- the Water Code (1975);

In order to preserve fish stocks from any wild exploitation and consequently ensuring the biological balance of the marine environment and the sustainability of fishing activity, Tunisian legislation has a wide range of texts on fishing; laws, decrees and orders). Among the texts governing fishing activity, we particularly mention:

- the Ministerial Decree as of September 28, 1995 relating to fishing.
- The Ministerial Decree as of September 20, 1994, relating to diving and underwater recreational fishing.
- Law n ° 2009-17 as of March 16, 2009 relating to the regime of biological rest in the fishing sector and its financing. The application of this law on biological rest is related to the only area of the Gulf of Gabès and covers the activity of trawl fishing only.
- Law n ° 2009-49 as of July 20, 2009 relating to marine and coastal protected areas which establishes a specific legal framework for the preservation of nature and biodiversity in marine and coastal environments and the use of their natural resources, for the sake of sustainable development and the maintenance of sustainable biodiversity, through the creation of MCPAs. Law No. 2009-49 (in its article 27) specifies the regulatory provisions (prohibitions, restrictions, authorizations) accompanying the exercise of fishing in MCPAs.

Tunisia has adopted numerous legislative and regulatory texts which govern coastal sectors and island sites (see appendices). Directly related to the environmental concern, three texts are to be considered as fundamental as they express the very positive evolution of the public authorities in the matter:

- relating to the Public Maritime Domain (1995)
- relating to the Creation of APAL (1995)
- relating to MCPAs (2009)

The last two texts, which can be considered as complementary, establish a perfectly adequate framework for the conservation and sustainable management of sensitive and ecologically remarkable coastal and marine sites. With the law on GPAs as of 2009, we have achieved a very DECISIVE achievement for Tunisia, which gives the latter a remarkable legislative tool that many other Mediterranean countries should seek to acquire.

Other regulations

The improvement of the legal framework for marine and coastal protected areas has been greatly boosted in recent years. In this context, the national legislative framework was enriched by the creation of the National Council of Marine and Coastal Protected Areas (meeting for the first time in June 2017), and by the approval of decrees and regulatory texts N° 2014 - (1844 to 1848) as of May 19, 2014, relating to law N° 2009-49 as of July 20, 2009 (relating to MCPAs and CNAMCPs).

With the establishment of the CNAMCPs and the regulatory texts relating to the MCPAs (ministerial decrees as of May 2014), as well as the law N° 49-2009 relating to MCPAs, this legal arsenal now allows Tunisia to access a quite decisive legislative asset which many other Mediterranean countries should seek to acquire.

International conventions and agreements

The improvement of the national environmental legislation has been strengthened following its commitments under international conventions and protocols, including:

- The African Convention for the conservation of nature and natural resources (1968 - Algiers), accession in 1977;
- The Convention on Wetlands of International Importance (Ramsar 1971), ratification 1981;
- The Convention on World Cultural and Natural Heritage, Paris - 1972) ratification in 1975;
- The Convention on International Trade in Wild Species of Fauna and Flora (CITES, Washington, 1973), ratified in 1975;
- The Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona - 1976), ratification in 1977. This convention was amended in 1995 and ratified in 1998;
- The Protocol relating to specially protected areas in the Mediterranean (the Barcelona Convention, Geneva, 1982), ratification in 1983;
- The Convention on Migratory Species (Bonn, 1979), ratified in 1986;
- The Convention on Climate Change (New York - 1994), signed in 1993;
- The Convention on Biodiversity (Rio - 1992), ratification in 1993.
- The Integrated Coastal Zone Management Protocol (Madrid -2008) - signed in 2008 not yet ratified.
- Acceptance of the Agreement establishing the General Fisheries Commission for the Mediterranean (2003)
- International conventions in the maritime field (mainly IMO conventions) which it has ratified but which has not yet been transposed into its legislative and regulatory framework. Among these, and by way of example, we find the MARPOL conventions (Prevention of marine pollution from ships), SOLAS (protection of human life at sea), MLC 2006 (maritime labor convention), OPRC (preparation response and cooperation in the event of oil pollution), etc.
- International Convention for the Control and Management of Ballast Water and Ship Sediments (BWM Convention), Adoption: February 13, 2004; Entry into force: September 8, 2017, this convention has not yet been signed by Tunisia.

4.3. Transboundary issues and existing, planned or needed coordination / harmonisation at subregional or regional level

An analysis at the national and regional levels of the policies and methods applied to the management of Mediterranean biodiversity reveals certain gaps which require the implementation of management strategies adapted to this heritage.

Today, the broad lines of Mediterranean strategies for marine and coastal biological conservation are based on protected areas (MPAs / MCPAs) and the management of commercial fishing.

However, cross-border actions remain below expectations; in fact, these initiatives aiming at the conservation and management of biodiversity on cross-border geographical scales remain quite rare and are only related to a few areas of the Mediterranean on the north shore (i.e. Pelagos sanctuary; RAMOGE Agreement (France, Monaco and Italy). The large difference between inter-country conservation and management policies, strategies, plans and measures is among the major shortcomings of this type of initiatives.

The analysis of this section dedicated to the assessment of the level of coordination / harmonization of actions for the conservation of marine and coastal biodiversity, brings out the following conclusions:

- There is an urgent need for the Mediterranean region to apply an integrated management of the coastal zone;
- There is a growing evidence that there is a need for a much deeper understanding of the socio-economic aspects of bio-conservation, but so far, little has been done in this regard. Only sporadic attempts are or have been made to identify and apply economic instruments to support biodiversity conservation;
- Unclear competences and overlapping responsibilities between public services are often recognized as a serious obstacle to the sustainable management of biodiversity;
- In all Mediterranean States, the role of non-governmental organizations (NGOs), which represent civil society, is being well-developed. They are becoming a notable and worthy stakeholder in biodiversity issues and must be taken seriously both at the practical and strategic level;
- Mediterranean States have a high degree of participation in conventions relating to biodiversity. All of them participate in the Barcelona Convention and the Convention on Wetlands, and many of them are members of the Convention on Biodiversity, as well as the Bern and Bonn Conventions and CITES.

However, their degree of substantial involvement in the work of these conventions is uneven.

- The richest countries in the north of the Mediterranean basin maintain cooperation agreements with those in the south and east. Such agreements often include financial and technical assistance for biodiversity conservation. They provide very valuable (albeit limited) resources. It is, however, necessary to have these resources increased considerably in the years to come, so that they become according to the needs and target them on the capacity building of developing countries in the region. It is necessary that the recipient countries request financing of projects linked to biodiversity, in addition to and in support of development aid;

- Although, recently, many Mediterranean States have developed conservation policies and rational management of coastal zones and wetlands, in many Mediterranean countries, legislation relating to coastal biodiversity and wetlands is often weak or obsolete and requires modernization and harmonisation. Often, however, the problem is not the lack of appropriate legislation, but its low level of implementation and enforcement. This is very evident in the increase in construction along the Mediterranean coasts, despite legislation which strictly prohibits it. The ICZM protocol is proving to be a tool promoting a virtuous occupation of the coastline dedicated to the prevention and mitigation of the negative impacts of human uses and development and the impacts related to the effects of climate change, in particular the rise in the level of the sea.

Assessment of marine and coastal status and pressures and impacts on the marine and coastal biodiversity

© Artescienza

5.1. Marine and coastal status and pressures relevant for national marine and coastal areas NBSAP

The Mediterranean region is undergoing the pressures and anthropogenic impacts on its coastal zone and its marine environment. It is also one of the most affected regions by the effects of climate change in the world.

These pressures and impacts concern in particular marine pollution from the continent (industrial pollution, sanitation and wastewater, pollution by hydrocarbons (offshore oil / gas exploitation and maritime traffic) and biological pollution (bioinvasion due to maritime traffic and aquaculture), pressure on the coastal zone, coastal erosion, submersion and salinization of coastal water tables, etc..

The impacts also concern overexploitation, illegal fishing, habitat destruction, and the erosion of biodiversity in the Mediterranean.

However, the analysis of the ecological situation on the impact of anthropogenic pressures on the marine environment and its biodiversity as well as the coastline and the coastal zone suggests rather a fairly critical assessment, particularly with regard to the implementation of conservation policies of biodiversity at national levels. It is indeed, the case of Tunisia with marine and coastal areas relevant to national marine and coastal areas

The results of the implementation of its CBD policy (since 1998) remain largely below expectations and in the absence of objectives and measurable results, it is not possible to conclude as to the achievement of the targeted objectives. Achievements remain limited both in terms of volume and in terms of the effectiveness of activities dedicated to biodiversity as such. Nevertheless, these activities have laid the foundation for a process of planning and managing biodiversity. This process must be structured, consolidated and extended to all the concerned sectors, in order to remedy the shortcomings observed in the implementation of previous NBSAPs, in particular :

- Insufficient knowledge on the components of biodiversity, genetic erosion and ecosystem functions;
- The lack of adequate and systematic planning of activities, which reflects the absence of a national body for coordinating and monitoring the implementation of the NBSAP. In fact, the planning of actions is unclear, does not always include measurable objectives, and does not systematically take into account the conservation priorities according to the levels of threat to biodiversity, nor their institutional and regulatory environment, which affects their effectiveness and the sustainability of their impacts;
- The low involvement of institutional and non-institutional stakeholders in the management and conservation of biodiversity, which reflects a lack of information, motivation and resources, as well as limited capacities;
- Sectoral and intersectoral integration of biodiversity remains barely perceptible.

Such a situation calls for the need to:

- Adjust the texts governing the sovereign powers of the relevant institutions to include the responsibility for harmonisation with all provisions emanating from international conventions ratified by Tunisia, in particular the CBD, as well as providing for the means and recurrent costs to do so;
- Take institutional and regulatory measures to coordinate and monitor the implementation of these measures through the establishment of a higher body for the coordination and monitoring of biodiversity;
- Inform, sensitize and communicate well with all categories of stakeholders in order to strengthen their capacities and knowledge in terms of biodiversity and raise their interest and commitment.
- Integrate biodiversity into national sectoral planning and therefore into national budgeting in addition to efforts to mobilize international financial resources in order to guarantee the implementation of the various actions for biodiversity.

5.2. Critical impacts and effects on marine and coastal biodiversity

In coastal areas, on the continent as well as on the islands, the fast- increasing coastlisation is at the origin of the destruction of habitats and of the fauna and flora biodiversity.

We will also point out the salinization of the water tables due to the intrusion of salted wedges significantly disrupting irrigated agricultural practices.

Coastal wetlands are also subject to the artificialization of their banks, by coastal development but also because of their gradual backfilling and wild garbage deposits. Sometimes, they constitute a receptacle for raw or partially treated wastewater contributing to the eutrophication of these vulnerable areas and to upheavals in the composition of the original species and the functioning of these ecosystems. In addition, the graus communicating wetlands to the sea are sometimes shifting mainly due to the effects of climate change and tend either to migrate or to widen, predisposing to the marinization of the sebkhas and lagoons.

At sea, threats, disruptions and risks are also high.

First of all because of the effects of climate change, in particular the rise in sea level, which disturbs and will further disturb the habitats of the coast, which are mainly soft. Increases in seawater temperature are already impacting the distribution of habitats and species. They promote the establishment and especially the proliferation of non-native species, especially thermophiles. They also promote the establishment and blooms of certain species of sometimes toxic plankton, causing mortalities of several marine species. The installation of protozoa, bacteria and exotic viruses are also the cause of massive mortalities (i.e., the noble penshell *Pinna nobilis*). Rising temperatures are also the cause of the bleaching of cnidarians. These same phenomena, combined with organic pollution emanating from the continent, generate eutrophication or even dystrophies, disrupting

habitats and biodiversity and sometimes leading to massive mortalities.

Among other disturbances, we can point out the impacts of excessive fishing:

- legal or illegal dragging arts destroying benthic habitats, in particular seagrass beds. These devices are also the source of non-selective fishing and the destruction of non-commercial biodiversity.
- the use of plastic devices whose degradation leads to the proliferation of microplastics ;
- passive catches of ghost nets ;
- the use of small mesh nets fishing juveniles ;
- bycatch ;
- and of course, the fishing effort has become very important, undermining stocks and their renewal and the production of fishery resources

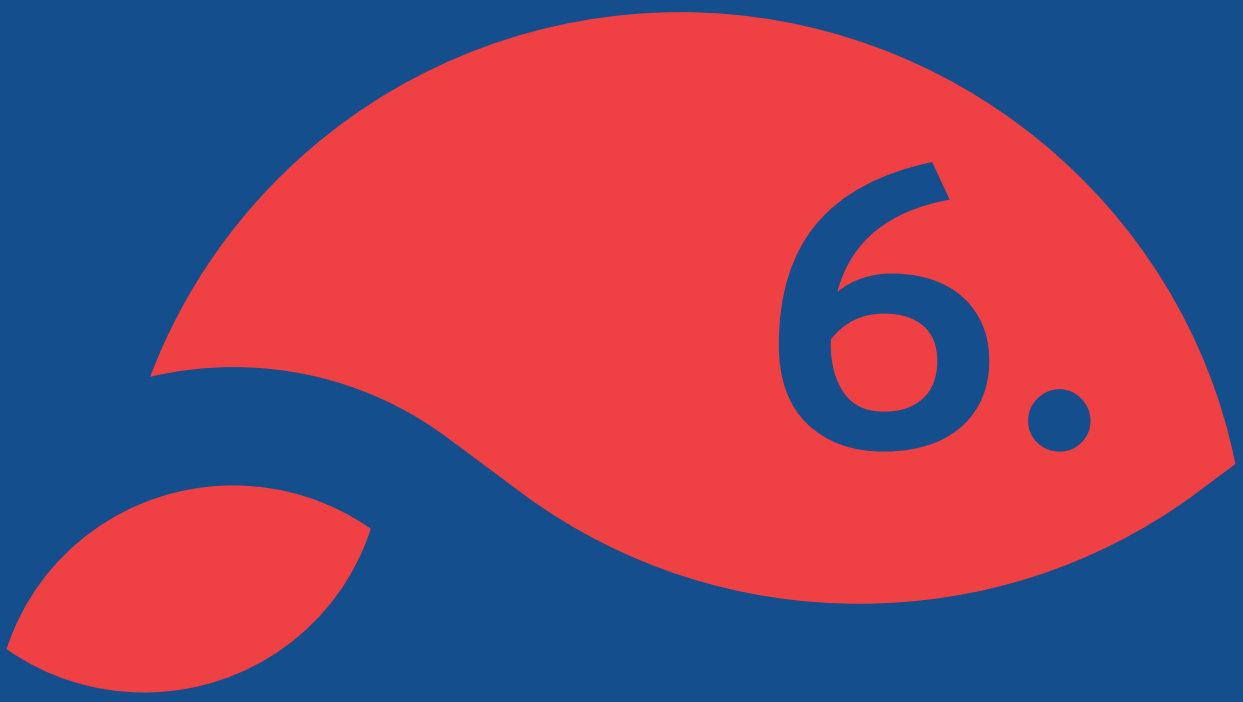
Recreational activities also have high impacts:

- recreational fishing is to date little controlled and accentuates the impact on stocks ;
- the fairground mooring of yachts, recreational fishing boats such as coastal fishing boats causes degradation of phanerogam meadows and algal cover.
- contribution to pollution by used oils and fuel.

Other issues include pollution:

- direct organic pollution or emanating from defective sewage treatment plants, also the source of bacterial pollution affecting biodiversity and fishery resources such as mussels and oysters in the Bizerte lagoon or clam beds in the intertidal areas of the Gulf of Gabès making these resources unfit for consumption.
- organic and antibiotic pollution from fish farming activities, especially intensive and established in areas with poor hydrodynamics (i.e. Bay of Monastir) ;
- chemical pollution emanating from industrial zones not equipped with pre-treatment stations ;
- agricultural pollution by fertilizers and pesticides, sometimes leading to eutrophication of the environment or even dystrophies ;
- pollution by hydrocarbons (degassing and leaks in off-shore wells as recently on the Kerkennah islands), refineries, wrecks polluting the marine environment in general and more noticeably the supra and the mediolittoral ;
- biological pollution (biofouling and deballasting water) at the origin of the introduction of non-native species ;

Finally, the intentional or accidental stranding of boats on the Tunisian coast should also be highlighted, distorting the landscapes and contaminating the marine environment (chemical and oil pollution).



Assessment of national priority needs and response actions

© SPA/RAC, Artescienza

6.1. Needs

As mentioned previously, the conservation of marine and coastal biodiversity in Tunisia mainly involves the management, conservation and good governance of the coastal zone (in particular ICZM) and of island and continental MCPAs. With regard to the management of Tunisian MCPAs, the co-management mode of management is an essential step which was adopted by APAL with the co-management of the MCPA of the Kuriat Islands (APAL / NGB). However, the implementation of this co-management in other MCPAs (Galite, Zembra and Kneiss) requires adaptive approaches. Thus, this adaptive co-management must imperatively take into account the specific needs of each site ("co-management applied on a case-by-case basis"). Indeed, the financial, human and logistical needs differ considerably for the implementation of management from one MCPA to another. The area, access (distance between the island and the meteorological and maritime conditions), human, logistical and financial needs. This co-management also remains dependent on the level of the local NGO involved with APAL in the management of the relevant site.

Among other needs is the need for capacity building in the field (management of MCPAs, financial and administrative management, fundraising, setting up projects relating to the management of MCPAs, engineering-ecology techniques, new communication / awareness techniques, etc.).

Interaction between fishing (North, East and South), the conservation of biodiversity in coastal waters, and the management of national MCPAs.

National management assessment (use of EEG management assessment tools) of MCPAs in Tunisia (Kuriat, Galite, Zembra and Kneiss: achievements, shortcomings, needs and prospects (correcting the course for the management effort and its implementation.)

Involve scientists (selection of scientists working on projects related to management in MCPAs, monitoring and conservation of biodiversity) and better sensitize them and guide their work towards co-management and its implementation (through actions and programmes related to the co-management of MCPAs).

6.2. Urgent actions proposed

The priority actions presented below are based upon the inventory of needs at the national level, in particular through the analysis of the situation during the preparation of national action plans. These actions were identified according to the following criteria:

1) They are necessary, relevant, meaningful and / or relevant ;

2) They are achievable in a rational way, being realistic from a financial point of view ;

3) The equity and sustainability of the measures adopted are ensured ;

4) The legal implications do not conflict with existing international (regional and international conventions and protocols) and / or national legislation ;

5) They include a sufficient level of flexibility in their implementation ;

6) They receive a sufficient level of acceptability at regional and national levels ;

7) The biological and socio-economic consequences of their implementation are reasonably foreseeable (taking into account the precautionary principle).

Among the priority actions needed, and recommended to be deployed, we specifically mention:

1_ Increase in the number of managers in the field, mainly at the level of MCPAs, which are numerous and require a demanding staff, and much larger than the current staff) ;

2_ Ensure the presence of managers on the site to ensure the monitoring, control and policing of the environment ;

3_ Inventory, map and monitor national and transboundary coastal and marine biodiversity (transboundary MCAP projects, for example sub-regional or regional), at least as recommended by the monitoring programme for biodiversity and non-native species (IMAP) and covering all groups of marine plants and animal organisms (from plankton to marine mammals, as well as mainly invasive non-native species ;

4_ Store all the information related to habitats and marine and coastal biodiversity within an observatory. Develop cartographic and data time series when possible ;

5_ Better manage, control and conserve sensitive / protected habitats, species and sites ;

6_ Assess and mitigate the impact of threats on biodiversity ;

7_ Develop research to supplement knowledge and fill gaps in biodiversity ;

8_ Establishment of synergies and capacity building to ensure coordination and technical and scientific support ;

9_ Information and participation ;

10_ Awareness.

These priority actions come to respond to the Priorities and SOs set out by the update of the national strategy for the Conservation of Biodiversity (2019) and the Aichi Targets (as well as the SDGs) and in particular such as:

- Development of knowledge and promotion of traditional know-how: by improving and integrating knowledge on the evolution of the state of biodiversity ;
- Reducing pressures and threats to biodiversity ;
- Promotion of the sustainable use of biodiversity and natural resources generated by marine ecosystems: with the reduction of the causes of loss of biodiversity, reduction of anthropogenic pressures on the marine environment (coastal and offshore), mitigation and prevention of environmental threats to ecosystems, and access to genetic resources and the sharing of benefits arising from their use.

Otherwise, actions to conserve biodiversity and manage these hot spots must be implemented both nationally and regionally. These will support and add synergy to the priority actions selected at national level.

7.

Funding problems and opportunities

© SPA/RAC, Simone Modugno

One of the major problems is linked to the unsustainability of funding for actions linked to conservation and / or conservation and development at the level of biodiversity hot spots such as MPAs and coastal wetlands for example. Indeed, these actions are funded on an ad hoc basis or on short terms via international, bilateral, subregional, regional (Mediterranean) projects, however the first results of conservation efforts (management of MPAs, biological rests, habitat restoration, management / control IAS, etc.) does not generally manifest itself, and cannot be quantified (monitoring / evaluation of conservation and management actions), as well as the financial monitoring of projects only in the medium or even long term.

However, funding opportunities are not lacking, especially at the Mediterranean level and several frameworks today offer regular funding possibilities for (national) strategies, (national) programmes, projects and actions for the conservation of biodiversity and sustainable management. natural resources and / or sustainable development.

In recent years and following a deep diagnosis and evaluation of conservation and management efforts of MPAs in the Mediterranean, several recommendations have been issued encouraging the diversification of funding sources and mechanisms (ie trust funds) and those in the aim to set up medium- and long-term projects, and / or to ensure regular and sustainable funding for projects and actions aimed at biodiversity conservation, MPA management and pollution control. Among these initiatives, we, particularly, mention the MedFund, the CEPF or the Horizon 2020 programme (EU). Other historic donors are now joining forces on this new approach to long-term projects and sustainable financing such as the French Development Agency (AFD) and the French Global Environment Fund (FFEM).

Other funding opportunities can be explored and exploited with other donors such as the KFW (Kreditanstalt für Wiederaufbau or the Credit Institution for Reconstruction), the German Agency for International Cooperation GIZ, the UfM, and The European Investment Bank (EIB) (through the EU's Horizon 2020 programme), and many other international cooperation agencies and donors.

Considerations to be taken to increase (maximize) funding opportunities: example of the Funding of NBSAPs and their update

The financing of the NBSAPs at the dawn of 2030 and / or their updating requires the search for funding which is often not insignificant, even important: taking the example of Tunisia, the updating of the NBSAP 2018-2030 was estimated at around 1,151 MTND (€ 358 million).

Thus, and in order to achieve predisposition of the necessary financing to cover the funding of the implementation of the NBSAP, several solutions should be mobilized through:

- The integration of the NBSAP into sectoral strategies and programmes aimed at the conservation and sustainable use of biodiversity. We will quote as examples: scientific research strategies, various other strategies, programmes and projects planned and having direct links with SPANB (i.e., for Tunisia, we cite the National Strategy for the Development and Management of Forests and 2015-2024 route), as well as various programmes (agricultural development, development and mobilization of water resources, etc.);

- The implementation of the plan to mobilize financial resources for biodiversity developed within the framework of this strategy.

On the other hand, efforts to integrate updated SPANBs (i.e., SPANB 2018-2030, Tunisia) into national development priorities will often ensure the mobilization of the necessary funding, whether at the national or international level. This integration will involve the implementation of the communication strategy around the SPANB.

Thus, through this integration, this SPANB will reach all relevant actors at the national, regional and local levels, from decision-makers to civil society and local communities. The communication component will have a key role to play in the implementation of the NBSAP and the achievement of its objectives by 2030.

8.

Conclusion and recommendations

© The Tunisian Dolphin Project

The monitoring and evaluation of coastal and marine biodiversity in Tunisia is a complex process which requires a vision as clear as it is enlightened and which must be inspired by international standards, especially regional Mediterranean standards. This monitoring aims in the long term for the conservation of biodiversity, in particular that of MPAs / MCAs and other coastal and marine biodiversity hotspots. These conservation efforts will only find their full meaning with the consideration and remediation of more obstacles and problems blocking the entire process of monitoring and conservation of marine biodiversity in Tunisia. Particular attention must be paid to the monitoring and assessment of eutrophication, the effects of plastic pollution, human activities on the alteration of coastal ecosystems (chemical and oil pollution) and in particular ecosystems in the high seas. This attention must be concretized by programmes and concrete actions in the field, carried out through visions, concepts and protocols validated technically and scientifically.

Among the most important issues hampering these monitoring, assessments and therefore the conservation of marine biodiversity, the sustainable exploitation of natural marine resources, we note in particular:

- An insufficient legal system, lack of adequate legislation ;
- Overlapping of powers or fragmentation of responsibilities (leading to problems in the implementation of existing laws);
- The weakness of human resources (problem of recruitment and financing of dedicated positions) dedicated to the monitoring and conservation of biodiversity, in particular the field staff on MPAs / AMCPs;
- Weak participation of all stakeholders in the decision-making process;
- Lack of sustainable and effective scientific monitoring;
- Lack of sustainable financial resources (with the exception of regional and international projects often implementing short-term, occasional and sporadic actions) promoting sustainable management of MCPAs and more generally of marine and coastal biodiversity;
- Need for integrated planning and management of coastal areas (IPMCA) and, participatory / concerted, real, concrete and effective maritime spatial planning (MSP);

Among other recommendations that can be made, we include:

In terms of mobilizing NGOs and resource persons to improve knowledge

- The need to insist on collaboration with scientific associations, in particular for actions of ecological monitoring and prospection of marine biodiversity and strengthening of their administrative, financial, scientific and technical capacities, mainly with regard to management and preservation of coastal and marine environments
- The promotion of citizen or participatory science (ecological watch and improvement of knowledge.

In terms of improving knowledge and scientific monitoring

- Set short-term objectives (3 years) in particular for the monitoring / follow up of endangered species (Pinna nobilis) or the installation of Networks (IUCN network for the monitoring of P.nobilis in the Mediterranean), prioritization health suite or on longer scales (monitoring in relation to specific species / Mediterranean; initiate the implementation of the national monitoring programme for biodiversity and non-native species;

In terms of management of natural spaces

- Strengthening management teams in terms of co-management (in particular the co-management of MCPAs);
- Strengthen human capacities and put APAL at the core of the process of multiple networks and resource persons, imperatively promoting synergies with other stakeholders;
- Needs for strengthening governance capacities and strengthening knowledge accumulation (in particular for the management staff of APAL and NGOs involved in the co-management of MCPAs); organize resource persons (students, former students mainly taxonomists and enlightened self-taught people for participation in prospecting efforts and the management of marine and coastal natural spaces;

In terms of awareness

- Awareness of the general public (prosecution);
- Sensitization and advocacy (institutional organizations and associations) on the value of vulnerable species;
- Pursue the participatory, integrated and concerted approach for ICZM and the management of MCPAs with the involvement of ministries, regional authorities (i.e. during the development of public surveys (in progress) relating to the creation of 4 MCPAs (Galite , Zembra, Kuriat, Kneiss); and the CLAGs during the management of these MCPAs).

References List

- **Visited websites**

http://www.fao.org/fi/oldsite/FCP/fr/TUN/profile.htm

http://www.ins.tn/fr/themes/population?page=12&Code_inducteur=0201070

https://www.populationdata.net/cartes/tunisie-densite-2014/

https://www.algaebase.org

- **Reports and articles**

Coastal protection and development agency (APAL). Tunisian coastline key figures. Tunis, December 2015.

Aissaoui, A., Dhib, A., Reguera, B., Hassine, OKB, Turki, S., & Aleya, L. 2014. First evidence of cell deformation occurrence during a Dinophysis bloom along the shores of the Gulf of Tunis (SW Mediterranean Sea). Harmful Algae, 39, 191-201.

Aïssi, M 2010. Cetacean distribution in the northern Tunisian coasts. Contract SAP/RAC N ° 97/2009, 16p.

Aleya, L., Béjaoui, B., Dhib, A., Ziadi, B., Fertouna-Bellekhal, M., Helali, M. A., ... & Zaaboub, N. 2019. Tunisia. In World Seas: an Environmental Evaluation (pp. 261-282). Academic Press.

Azzouz A., 1973. Bull of the National Scientific and Technical Institute of Oceanography and Fishing Vol 2, N ° 4. Trawlable bottoms in the northern region of Tunisia.1. Physical setting and benthic biocenoses.

Ben Mustapha, K., & Afli, A. 2007. Some features of Tunisia's marine biodiversity: Proposal for conservation and management areas. Report of the MedSudMed Expert Consultation on Marine Protected Areas and Fisheries Management. MedSudMed Technical Documents. Rome (Italy), 32-55.

Ben Naceur L., Gannier A., Bradai M. N., Drouot V., Bourreau S., Laran S., Khalfallah N., Mrabet R. & M. Bdioui, 2004. Census of the bottlenose dolphin Tursiops truncatus in Tunisian waters. Bull. Inst. Nat. Sci. Tech. Salammbô Sea, Vol. 31, 2004: 75-81

Ben Ltaief, T., Drira, Z., Devenon, JL, Hamza, A., Ayadi, H., & Pagano, M. 2017. How could thermal stratification affect horizontal distribution of depth-integrated metazooplankton communities in the Gulf of Gabes (Tunisia) ?. Marine BiologyResearch, 13 (3), 269-287.

Bradai, M.N. and Karaa, S. 2015. Turtles, Dolphins and Whales of Tunisia: Biodiversity and Conservation Efforts. 56 pp.

Bradai, M.N. and Karaa, S. 2017. First mention of the nesting of the loggerhead turtle Carettacaretta on the beach zouaraa (North of Tunisia). Bull. Inst. Natn. Scien. Tech. Salammbô Sea, vol. 44.

Benmassoud R 2017. Overlap of bottlenose dolphins (Tursiopstruncatus) and common

dolphins (Delphinusdelphis) habitats in northeastern Tunisia. Conference: Fourth Biennial Conference on the Conservation of Cetaceans in the Southern Mediterranean Countries

SAP/RAC - UNEP / MAP, 2011. Marine habitats and main species of the Kuriat Islands (Tunisia) - Complementary study: Natural formations of interest for conservation. By Langar H., Bouafif C., Charfeddine A., El Asmi S., Limam A., Ouerghi A., Sghaier Y.R. Ed. SAP/RAC - MedMPAnet Project, Tunis: 36 pages + annexes.

Du Rau, Pierre Defos, Bourgeois, Karen, Thévenet, Mathieu, et al. 2015. Reassessment of the size of the Scopoli's Shearwater population at its main breeding site resulted in a tenfold increase: implications for the species conservation. Journal of Ornithology, vol. 156, no.4, p. 877-892.

Ellouz G., 1996. Contribution to the study of the reproduction of the loggerhead turtle CarettacarettaLinnaeus, 1758. DEA University of Tunis II: 111p.

FAO. 2018. General Fisheries Commission for the Mediterranean. Report of the twentieth session of the Scientific Advisory Committee onFisheries, Tangiers, Morocco, 26-29 June 2018 / Report of the twentieth session of the Comitéscientifiqueconsultatif des pêches, Tangier, Morocco, 26-29 June 2018. [FAO Fisheries and Aquaculture Report / FAO Fisheries and Aquaculture Report No. R1245.] Rome, Italy / Italy.225 pp. License: CC BY-NC-SA 3.0 IGO.

HAMDI, N., & CHARFI-CHEIKHROUHA, F. (2011). Estimation of the total number of waterfowl wintering in Tunisia: period 2001/2002 to 2006/2007. Ecology review.

Hannachi, I., Drira, Z., Hassen, MB, Hamza, A., Ayadi, H., & Aleya, L. 2011. Species composition and spatial distribution of abundances and biomass of phytoplankton and ciliates during summer stratification in the Gulf of Hammamet (Tunisia). Journal of the Marine Biological Association of the United Kingdom, 91 (7), 1429-1442.

Hattour, A., Ben Mustapha, K., 2013-The marine vegetation cover of the Gulf of Gabès: Mapping and monitoring network of the Posidonia herbarium. Publication of the Inst. Natn. Sci. Tech. Sea, 151 pages.

Jribi I. & M.N. Bradai, 2017. Monitoring of the nesting of the Carettacaretta sea turtle on the Kuriat Islands (Campaign 2017). ANPE - SPA / RAC - INSTM (2017): 20 pp.

Laurent L., Nouira S., Jeudy De Grissac A. & M.N. Bradai, 1990. Marine turtles in Tunisia: First data. Bull. Soc. Herp. Fr. 53: 1-17.

Mannocci L., Roberts JJ, Halpin PN, Authier A., Boisseau O., Bradai MN, Cañadas A., Chicote C., David L., Di-Méglio N., Fortuna C., Frantzis A., Gazo M. , Genov T., Hammond PS, Holcer D., Kaschner K., Kerem D., Lauriano G., Lewis T., Notarbartolo di Sciara G., Panigada S., Raga JA, Scheinin A., RidouxV., Vella V . & J. Vella, 2018. Assessing cetacean surveys throughout the Mediterranean Sea: a gap analysis in environmental space. SCIENTIFIC ReporTS | (2018) 8: 3126

Ounifi- Ben Amor, K., Rifi, M., Ghanem, R., Draeif, I., Zaouali, J., & Ben Souissi, J. 2015. Update Of Alien Fauna And New Records From Tunisian Marine Waters. Mediterranean Marine Science, 17 (1), 124-143. Doi: Https: //Doi.org/10.12681/Mms.1371.

UNEP/MAP-SPA/RAC - Tunis, 2010 "National Report For The Identification Of Major Properties Of Ecosystems And The Evaluation Of The Ecological State And Pressures On Marine And Coastal Biodiversity: Tunisia: North Zone"

UNEP/MAP-SPA/RAC - Tunis, 2010 "National Report For The Identification Of Major Properties Of Ecosystems And The Evaluation Of The Ecological State And Pressures On Marine And Coastal Biodiversity: Tunisia: East And South Zone.

Ramírez-Romero, E., Molinero, J. C., Sommer, U., Salhi, N., Yahia, O. K. D., & Yahia, M. N. D. 2020. Phytoplankton Size Changes And Diversity Loss In The Southwestern Mediterranean Sea In Relation To Long-Term Hydrographic Variability. Estuarine, Coastal And Shelf Science, 235, 106574.

Shaiek, M., 2012, Tunisia And The International Convention For The Control And Management Of Ballast Water And Sediment From Ships (Bwm Convention 2004), Professional Master In Maritime Affairs; 119 Pp.

SPA/RAC WORKING AREAS

*SPA/ RAC, the UNEP/ MAP **Specially Protected Areas Regional Activity Centre**, was created in 1985 to assist the Contracting Parties to the Barcelona Convention (21 Mediterranean contries and the European Union) in implementing the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol).*

POST-2020
SAPBIO
Strategic Action Programme for the **Conservation** of **Biodiversity** and **Sustainable Management** of **Natural Resources** in the **Mediterranean Region**

Marine turtles

Cetaceans

Mediterranean Monk Seal

Cartilaginous fishes
(Chondrichtyans)

Marine and coastal bird species
Listed in Annex II of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean

SPAMI

Specially Protected Areas of Mediterranean Importance

Specially Protected Areas

Monitoring

Coralligenous and other calcareous bio-concretions

Marine vegetation

Dark Habitats

Habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemo-synthetic phenomena

Species introduction and invasive species

POST-2020

SAP BIO

Strategic Action Programme
for the **Conservation** of **Biodiversity**
and **Sustainable Management**
of **Natural Resources**
in the **Mediterranean Region**

UN environment programme

Mediterranean Action Plan
Barcelona Convention

SPA/RAC
The Mediterranean Biodiversity Centre

Specially Protected Areas Regional Activity Centre (SPA/RAC)
Boulevard du Leader Yasser Arafet
B.P. 337 - 1080 - Tunis Cedex - Tunisia
+216 71 206 649 / +216 71 206 485
car-asp@spa-rac.org
www.spa-rac.org

MAVA FONDATION POUR LA NATURE

This publication has been prepared
with the financial support of the MAVA foundation