



MED4EBM 



Kneïss Islands: Environmental characteristics and perspectives to Integrated Coastal Zone Management (ICZM)

Summary

This report is produced by the National Institute of Marine Science and Technology (**INSTM**), Tunis – Tunisia as part of “**Mediterranean Forum For Applied Ecosystem Based Management**” MED4EBM project.

MED4EBD project aims to enhance capacities of various stakeholders and institutional actors involved in the management of coastal and marine areas through the establishment of a cooperation and coordination platform. This platform includes a software application (the “EBM Decision Support System”, EBM-DSS) and a set of operational protocols and methodological tools. Data presented here will help to set up such innovative approach and come as a first step to implement ecosystem-based Integrated Coastal Zone Management (ICZM).

In this report we will present environmental characteristics of the archipelago of Kneïss islands. Environmental characteristics will include both physical aspect (morphological structure, hydrology, climate conditions) and biological specifications (fauna and flora). Information collected on the Kneïss Islands comes from several sources (scientific publication, governmental report, ...) in order to determine future prospects and development options for the islands.

The second part of this report will be focused on the socio-economic context. In this part we will raise current management issues and we will list the most relevant factors impacting the archipelagos ecosystem including both biotic and abiotic.

I. Introduction

1. Geographic position

The archipelagos of Kneiss Islands are located between latitudes 34°10'-34°30' N and longitudes 10°00'-10°30'E in the eastern Tunisian coast in the Gulf of Gabès not far from Mahrès coast in the south and in the northeast of Skhira city. The archipelago is administratively subordinate to Sfax governorate, Graïba delegation.

The archipelago includes 4 small islands (Figure.1):

- The main island (**El Bessila**) roughly circular in shape with a maximum diameter of 2.5 km (Gueddari & Oueslati, 2002)
- A succession of tiny islands (Islet) with very small surfaces, less than one hectare:

El Hjar islet in the north;

El Laboua islet in the center;

El Gharbia islets in the south (Cut in two part at high tide).

More details about the islands are summarized in table.1.

Table. 1: The islands of the Kneïss archipelago

Name	Shape	Surface (ha)	Distance to mainland (Meters)	Longitude / latitude
El Bessila	Island	36,24	3 128	N 34.36° E 10.31°
El Hjar	Islet	0,017	4 411	N 34.34° E 10.29°
El Laboua	Islet	0,227	5 885	N 34.32° E 10.28°
Gharbia North	Islet	0,191	6 510	N 34.32° E 10.27°
Gharbia South	Islet	0,53	6 690	N 34.31° E 10.27°

Source : <https://www.researchgate.net/publication/316991625>

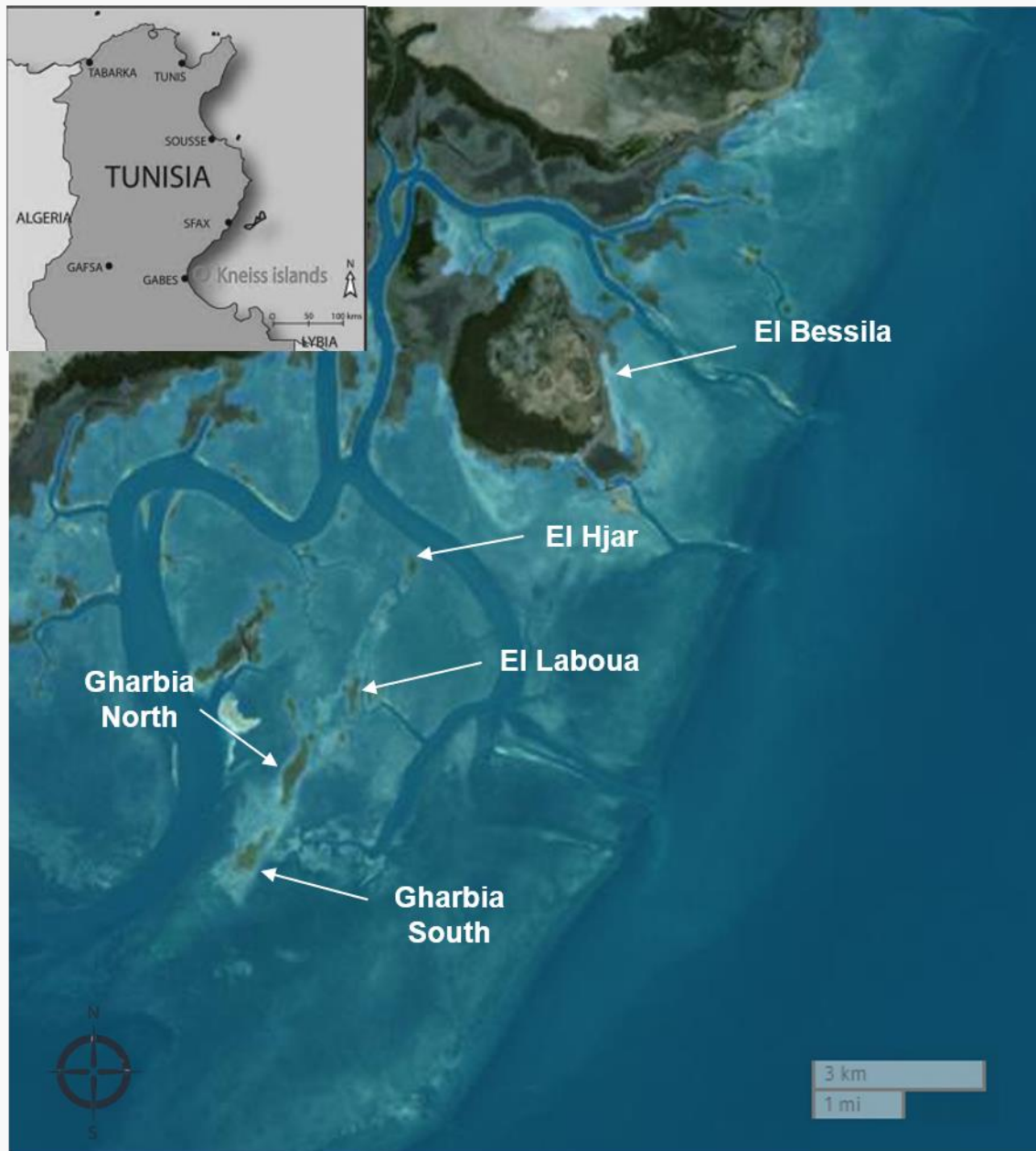


Figure.1: Localization of the archipelagos of Kneiss islands
(<https://umap.openstreetmap.fr/fr/>)

2. Current status:

Since December 1993, Kneiss Islands has been classified as a "Nature Reserve", in application of Chapter III of the Tunisian Forest Code, under the management of the Forestry General Directorate (DGF) at Ministry of Agriculture.

Internationally, the importance of the Kneïss has been recognized by several Mediterranean and International organizations:

- Since the twelfth Ordinary Meeting of the Contracting Parties of the Barcelona Convention in November 2001, as a **Specially Protected Areas of Mediterranean Importance (SPAMI)**.
- Since November 2007, as a Wetlands of International Importance under the **Ramsar** Convention.
- An **Important Bird and Biodiversity Area (IBA)** by BirdLife International.

The geographical position of the Kneïss Islands, its marine and continental geomorphology, the climatology and its inclusion to the Gulf of Gabès which is a weakened system, have dictated a particular environmental status to this area.

II. Environmental characteristics

1. Climate features

The Kneïss Islands is generally characterized by the presence two opposite climates: a dry and hot Saharan climate and a relatively humid and temperate Mediterranean climate.

Two situations are then observed:

- In summer, cool and humid air coming from the sea and pushed by winds from the SE sector, that can be limited by sirocco (dry and hot wind) coming from the Sahara.
- In winter, dry air coming from midland.

1.1 Pluviometry

Rains are rare and occur especially in autumn with marked drought between May and September. These rains generally fall in showers and thunderstorms forms which impact the hydrology and the sedimentology of the Kneïss Islands. The average annual rainfall is low with less than 200 mm/year ([APAL, 2018](#))

1.2 Temperature

Temperatures in this region are characterized by pre-saharian conditions and marked by an alternation of two distinct seasons (Boukhris, 2015):

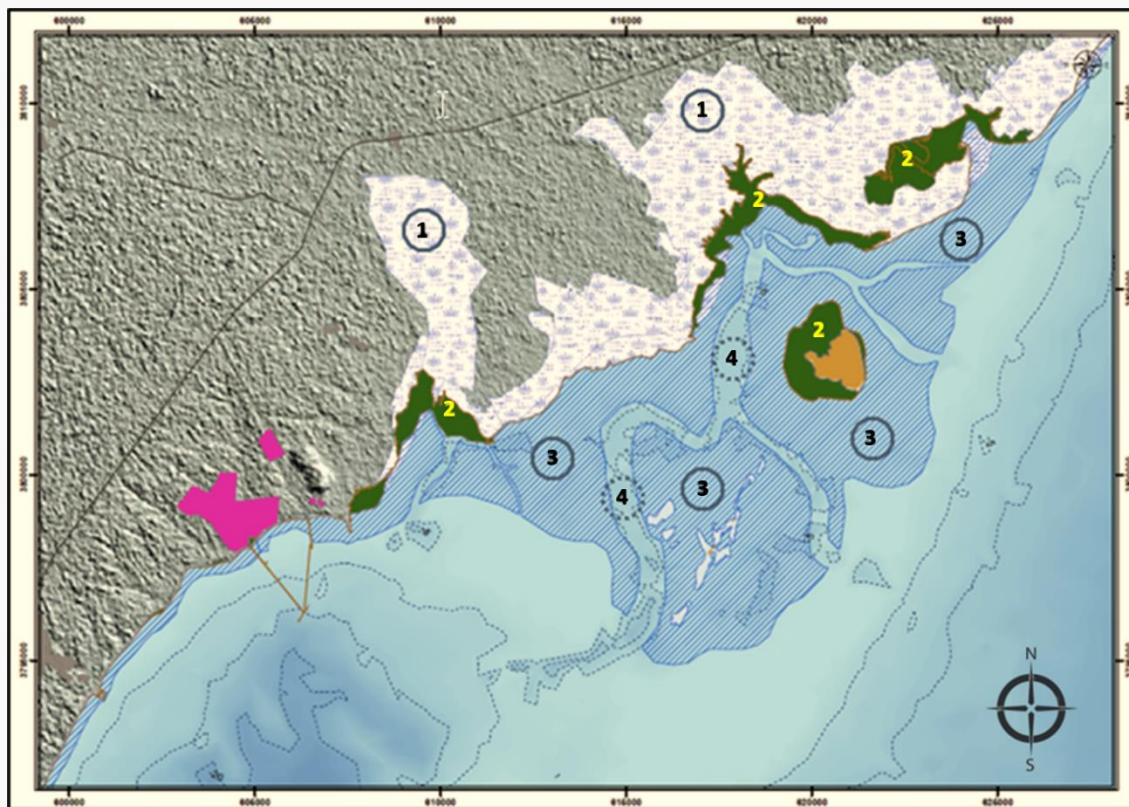
- Winter period, from December to April, where temperatures are in average of 12.3 °C, varying between 17 °C at daytime and 7.8 °C at night.
- Summer period, corresponding to hot weather which is moderated by sea proximity. Temperature in this period are generally on average of 27.95 °C and air warming becomes noticeable from May and reaches its maximum in August. Saharan advections can occur with values exceeding 40 °C due to the sirocco's winds (APAL, 2018).

1.3 Air humidity

Humidity is quite high but monthly varied, fluctuating between 71% in October and 59% in July. Day-night variations are much more sensitive with maximum values between 80% and 82% during the second half of the night and only 40% around at maximal temperatures times (APAL, 2018).

2. Oceanographic and Hydrographic characteristics

The archipelagos of Kneiss Islands coast are characterized by the presence of diverse wetlands especially shoals and marshes (**Figure.2**). The islands are surrounded by supratidal mudflat (Sebkha), tidal marsh, intertidal zones (estran) and tidal channels (oueds). The transition zones of the terrestrial and aquatic environment are characterized by the presence of water, on the surface or in the soil.



1. **Figure.2:** Distribution of Kneiss Island wetland. 1: Supratidal mudflat (Sebkha), 2: tidal marsh, 3: intertidal zones (estran) 4: tidal channels (oueds). Source: APAL, 2018.

2.1 Marine hydrodynamics

2.1.1 Tides

The gulf of Gabès is characterized by the highest tidal range in the western Mediterranean Sea; the tide is semi-diurnal with an amplitude varying from 0.8 to 2.3 m (Sammari et al., 2006). At the Kneïss Islands, the average values at spring tides are 1.7 m at high tide and 0.3 m at low tide. While in neap tides, the high tide reaches 1.1 m and 0.8 m for the low tide (APAL, 2018).

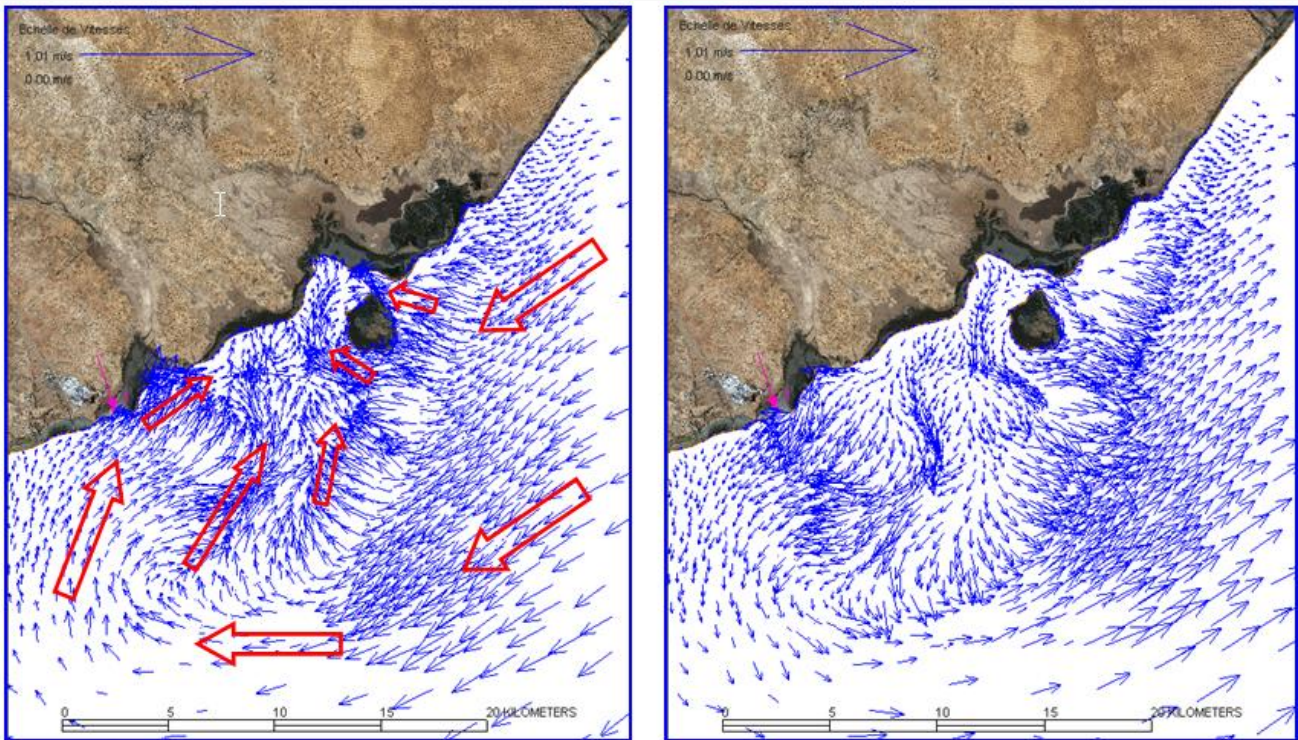
2.1.2 Swells

Swells induced by the winds in this area are generally unstable and induced currents are 2 to 5 times stronger than tidal currents. These swells are dampened due to small shoal depths, low slope bottoms and especially to the presence of seagrass beds. The tidal channels which characterize the Kneïss banks, give more efficiency to tidal currents (Oueslati, 1993). These currents are essentially of NNE – SSW direction for all swells from the north to east sector and their speed can reach 2 m/s (Guillaumont, 1992).

2.1.3 Marine currents

The morphologic complexity of seabed and the structure of water circulation in the area, are at the origin of various types of circulation. The presence of tidal channels are the main actors of these currents. The circulation is always oscillatory in phase with the tide, but the speeds are more intense near the coasts and at the level of the tidal channels.

At spring tide, the currents coming from the North-East bypass the shoals to enter the bay from the south and thus move towards to the North-East near coasts. At of the Kneïss shore platform, the current is then opposed by North-East flow to be stopped near the islands. At neap tide, the currents are reversed and the waters return to the offshore crossing the tidal channels. Currents then are deviated to the northeast offshore (**Figure.3**). Currents speeds in this area increases with the amplitude of the tide. The current reaches 0.30 m / s with the maximum speeds observed at the level of the tidal channels (APAL, 2018).



A : Currents at spring tide

B : Currents at neap tide

Figure.3: Currents speeds at the coasts of Kneiss islands (APAL, 2018)

2.2 Hydrography

Hydrographic network of the Kneïss area is complex composed by three main watercourse (wadi) (APAL, 2018):

- **Wadrane Wadi;** the largest one taking for origin El Leben wadi at Sidi Bouzid governorate. Its flows into the sea at the level of the Kneïss marsh creating Wadrane Sebkhah. This wadi seems to be the most active and its flow is seasonal dependent on rainfall however we recorded several floods that shaped the Kneïss mudflat.
- **Smara wadi;** Smaller than the first one and discharges at the north shore of Wadrane Sebkhah.
- **El Kalba wadi;** with same geographical and physical characteristics of Wadrane wadi but less important. Located on south of the Kneïss marsh and influence the southern part of the mudflat. This wadi discharges on a coastal sebkhah named Sebkhah El Kalb.

3. Geological and geomorphological characteristics

The Gulf of Gabès coastline is generally characterized by sandy and muddy coasts with only a few rock formations, composed of marine sandstone of Eutyrrhenian age, as the central parts of El Bessila, El Hajar, El Laboua and El Gharbia islets. The coasts are marshy with sediment rich in alluvium and surrounded by a muddy sandbank covered with high-density vegetation (Gueddari & Oueslati, 2002). For the Kneïss Islands, we do not notice any complex structure:

- The Bessila island is mainly formed by low and salty lands, traversed by tidal channels surrounded by a sandstone core of 7 m above sea level which dates from about 125,000 years (Eutyrrhenian geological time) (**Figure.4A**). The island is surrounded by muddy and sandy shoals which make it difficult to access at low tide (Médail et al., 2016).
- El Hajar islet is the first rocky formation with asymmetric shape. It consists of sandstone (Eutyrrhenian geological time) and not exceeding 2 m of height (**Figure.4B**).
- El Laboua islet, not exceeding 3 or 4 m above the sea level. It is made up of rocky bench (scopulus) of limestone sandstone of marine origin with remains of the Monastery of St Fulgence at the top (**Figure.4C**). The rock is also covered with tufts of *Salicornia* (Médail et al., 2016).
- El Gharbia islet is formed by a fine oolitic sandstone topped by red silt. The island is a small cliff of 2 to 3 m high (**Figure.4D**). It is preceded by a rocky platform which emerges at low tide (Médail et al., 2016).

3.1 Pedology

The pedological environment of Kneïss Island is marked from the surface, to the depth, by the presence of salt and marl. There are three soil formations:

- A hydro-halomorphic marl soil, at the periphery of the islands and commonly submerged. This soil is generally covered by a large layer of organic matter from herbarium debris such as *Posidonia oceanica* leaves.
- A marl soil covered with a light deposit of sand and salt, unsuitable for vegetation cover.

- A loamy soil, weakly halomorphic and non-submersible, due to its location in high places on the islands. This soil is occupied by an important vegetation diversity.

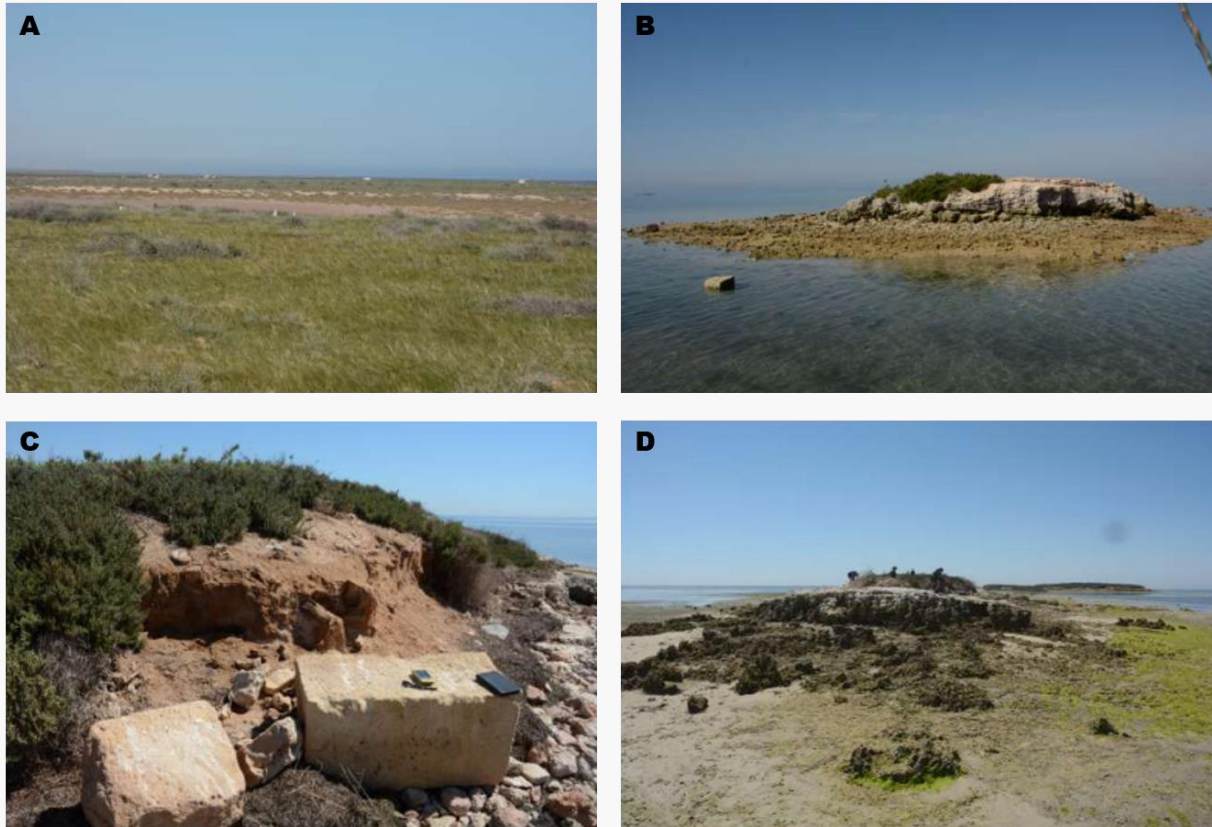


Figure.4: Soil Photographs of the kneiss islands soils (Médail et al., 2016). **A:** sandy soils of the island of El Bessila, **B:** rocky formation of El Hajar islet, **C:** remains of the Monastery of St Fulgence in El Laboua islet, **D:** fine oolitic sandstone of El Gharbia islet. (11.04.2015 L. Charrier Photography).

III. Biodiversity characteristics: flora and fauna

1. Vegetation composition and richness

1.1 Terrestrial flora

According to the various surveys carried out on the Kneiss archipelago, we can note the presence of 124 species or subspecies.

There is also a variable quota of ten annual species, with appearance is occasional and linked to annual rainfall episodes (Médail et al., 2016). flora richness disparity is significant, between El Bessila, the main island with 74 taxa, and the other islets of Kneïss which contain only 12 taxa in total.

The vegetation is usually very small (not more than 1 m) and is in the form of halophilic meadows divided into three main groups (APAL, 2018):

- Hydro-halomorphic group relative to saline environment, occasionally submerged with *Salicornia arabica* and *Arthrocnemum indicum*: this group is present in the center and the periphery of El Bessila island. It is characterized by an important plant cover close to 100%. Among the species we find: *Salicornia arabica*, *Halocnemum strobilaceum*, *Suaeda fruticosa*, *Zygophyllum album*, *Halumione portulacoides*, *Limoniastrum monopetalum* and *Salsola tetrandra*;
- Pseudo-halophilic group; based on *Salsola villosa* and *Suaeda fruticosa*, and particularly occupies the domes structure.
- Halophilic group; mainly formed by a cover of *Halocnemum strobilaceum*.

Another feature the kneïss islands is the presence of several protected, threatened and rare species, as well as of a scientific or symbolic interest. We can quote: *Ammosperma cinereum*, *Linaria laxiflora*, *Limonium tunetanum*, *Parapholis marginata* and *Spergula fallax* (Figure.6).



*Ammosperma
cinereum*



Linaria laxiflora



*Ammosperma
cinereum*

Figure.6: Protected species observed in Kneïss archipelagos.

In **Table. 2** we summarize the Main terrestrial species identified on the Kneïss archipelagos:

Present species	El Bessila	El Hajar	El Laboua	El Gharbia
<i>Suaeda maritima</i>	x			
Mediterranean halophilic species: - A thicket of <i>Sarcocornia fruticosa, Suaeda vermiculata, Arthrocnemum fruticosum or Halimione portulacoides</i> - A thicket of <i>Halocnemum strobilaceum</i> - A thicket of <i>Limbarda crithmoides</i>	x x x	x	x	x
Pioneer species with Salicornia and muddy-sandy areas species: - A thicket of <i>Salicornia europaea</i> agg - Grassland of <i>Frankenia pulverulenta</i> and <i>Sphenopus divaricatus</i>	x x			
Halo-nitrophilic species: - A thicket of <i>Salsola oppositifolia, Caroxylon vermiculatum</i> and <i>Caroxylon tetrandrum</i>	x			
Drought adapted vegetation (xeric species) and sub-nitrophilic grasses: - Grassland of <i>Stipa capensis</i> and <i>Rhodalsine geniculata</i> - Grassland of <i>Carrichtera annua</i>	x x			
Nitrophilic and ruderal species: - <i>Mesembryanthemum nodiflorum, Malva parviflora</i> and <i>Chenopodium murale</i>	x	x	x	x

1.2 Marine flora

The benthic macroflora is mainly represented by 9 species: four Magnoliophyta species: *Cymodocea nodosa*, *Posidonia oceanica*, *Zostera noltii* and *Halophila stipulacea*, three Chlorophyta species: *Ulva rigida*, *Flabellia petiolata* and *Halimeda tuna* and two Rhodophyta species: *Phymatolithon calcareum* and *Alsidium corallinum*. *Posidonia* remain the most important specie in the archipelagos, present between 2 and 10 m, at the upper part of the infralittoral level.

2. Fauna characteristics

The Kneis islands are considered as an area of international importance for avifauna and the ornithology is well documented. However, we mention a reptile diversity especially in El Bessila. According to the various surveys we can draw up a list of 5 reptiles' species ([Riviere and Lo Cascio, 2014](#)):

- *Stenodactylus sthenodactylus*, found in sandy areas with sparse bushes.
- *Chalcides ocellatus* a Mediterranean skink using a wide variety of habitats, observed in the southern islets in rocky habitats.
- *Trachylepis vittata*, a Saharan skink, whose distribution seems to be limited to coastal regions in the eastern Mediterranean basin. It has been observed bushy habitats in the eastern part of El Bessila island.
- *Acanthodactylus boskianus*, observed in sandy habitats with sparse vegetation.
- *Malpolon insignitus*, the only snake observed on the islets.



Figure.7: *Stenodactylus sthenodactylus* observed in El Bessila Island.

Regarding other animals' species we note the presence of frogs and the rodents such as the gray mouse (*Jerboas*), and *Ctenodactylus gundi*. Some arthropods were also observed including the scorpion, *Androctonus australis*. Insects are mainly represented by species from Diptera order. ([APAL, 2018](#)).

2.1 Avifauna

The Kneïss islands can be described as the main wintering area for waders birds in the Mediterranean. BirdLife International estimated that up to 330,000 birds can be present in winter, reflecting remarkable avifauna abundance for waterbirds in the Mediterranean. The most abundant specie in winter, observed in the Kneïss, is the Dunlin (*Calidris alpina*) up to 125,000 according to BirdLife International. The Kneïss islands constitute most important Eurafrikan region for this specie.

The Kneïss are characterized to be a refuge for various species that have a particular status in term of vulnerability and extinction danger ([Ouni, 2016](#)):

- Two vulnerable species in the Mediterranean region; the Great Egret (*Egretta alba*) and greater flamingo (*Phoenicopterus*)
- Two endangered species at European and Mediterranean level: the Eurasian Spoonbill (*Platalea leucorodia*) and the Slender-billed gull (*Larus genei*).
- 6 vulnerable species at national level: The little egret (*Egretta garzetta*), the grey heron (*Ardea cinerea*), the western marsh harrier (*Circus aeruginosus*), the little ringed plover (*Charadrius dubius*), the gull-billed tern (*Gelochelidon nilotica*) and the common tern (*Sterna hirundo*).

Other species can be also observed in Kneïss islands offering an aera for migration, nidification. According to [APAL 2018](#) report we can identify:

- 130,000 to 160,000 migratory birds.
- up to 50,000 wintering birds.
- 3000 to 3500 pairs of nesting birds.

3.1 Marine fauna

The Kneïss area is characterized by high biodiversity macrobenthic species. A total of 102 macrobenthos taxa were identified, with a dominance of Amphipods (37%), Polychete Annelids (27%) and Molluscs (23%). The AMBI biotic index has shown that the region is in good ecological condition ([Mosbahi et al., 2015](#)).

From the observed fauna groups we can note (APAL, 2018) :

- Bivalvia: *Acanthocardia tuberculata*, *Arca noae*, *Corbula gibba*, *Dosinia exolata*, *Glans trapezia*, *Loripes lucinalis*, *Modiolus barbatus*, *Ruditapes decussatus* and *Solen marginatus*.
- Gastropoda: *Bitium reticulatum*, *Gibbula ardens*, *Jujubius exasperatus*, *Nassarius sp*, *Neverita josephinea*, *Tricolia sp*, *Tricolia speciosa*, *Vermetus triqueter* and *Vermetus sp*
- Scaphopods: *Dentalium dentale*
- Amphipoda: *Corophium aculatum*, *Elasmopys sp*, and *Gammarus sp*.
- Isopoda: *Sphaeroma sp*
- Decapoda : *Hippolite longirostris*, *Pachygrapsus marmoratus*, *Paguristes syrtensis*.
- Porifera : *Porifera sp*.
- Cnidaria : *Caryophyllia sp*.
- Ascidiacea : *Didemnum sp*.
- Annelid : *Eunice vittata*, *Perinereis cultrifera*, *Platynereis dumerilii*.
- Bryozoa : *Seretella sp*.

Several fish species were also observed in Kneïss marine area, particularly in the seagrass beds. Kneïss marine area seems to be attractive for fish as spawning and feeding area, particularly in the presence of seagrass. There are 18 fish species with varied diets are commonly identified in the area ([APAL, 2018](#)).

IV. Socio-economic context

1. Population

Population to the Kneiss area comes from four coastal Imadas (Imada is the smallest administrative division of Tunisia):

- The Imadas of **El Manar** and **Hchichina Sud** administratively subordinate to Ghraïba delegation.
- The Imada of **Smara**, administratively subordinate to Mahres delegation.
- The Imada of **El Hmada** administratively subordinate to Skhira delegation.

The archipelago is administratively subordinate to Sfax governorate, Graïba delegation. The distribution of Tunisian population is generally characterized by a high density in coastal governorates, however Sfax governorate remain in different situation. Five sectors are attached to the Ghraiba delegation (El Ghraiba, El Manar, Hchichina south, Hchichina north, Echaal). According to the last census in 2014, the population of Ghraiba delegation is 15,776 citizens spread over five sectors. The population density is around 36 inhabitants / km². The Ghraiba delegation is dominated by rural population (79.40%) while 20.60% of this population lives in urban areas (APAL, 2018).

Table.3

Sector	House/Habitation	Population		
		Male	Female	Total
EL Ghraiba	832	1 883	1 832	3 715
El Manar	1 494	2 727	2 687	5 414
El Hchichina Sud	847	1 959	1 887	3 846
Hchichina Nord	563	942	929	1 871
El Châal	292	452	478	930
Total by delegation	4 028	7 963	7 813	15 776

Source: [National Institute of statistics \(NIS\), 2014](#)

2. Socio-economic activities

2.1 Agriculture

Agriculture is an important part of the local economy of the Kneiss area despite environmental constraints such as aridity, erosion and soil salinization. This agriculture is dominated by arboriculture (mainly olive, almond and apple trees), and sheep husbandry (APAL, 2018).

2.2 Industry

In the Kneiss area Industry complex were localized at the level of the continental zone in the south in Skhira. This economic zone extends to an area of 1,937 hectares. It includes four industrial units related to the petroleum and chemical activities. The four activities are detailed in Table. 4 (APAL, 2018).

Table.4: Industrial units present in the Skhira economic area

Name of unity	Intervention area	Activity field
TRAPSA (Petroleum Industry)	250 ha	-Transport of Crude oil by pipeline -Storage of Crude oil - Operation of the port of Skhira (piloting, towing, mooring)
GCT (Chemical industry)	580 ha	- Manufacture of sulfuric and phosphoric acid
TANKMED	32 ha	-Storage of petroleum refining products -Transport of petroleum refining products by sea
SEPT	12 ha	-Construction and operation of storage tanks -Storage of petroleum refining products

In figure.8 we present the geographical extents of the different economic activities.

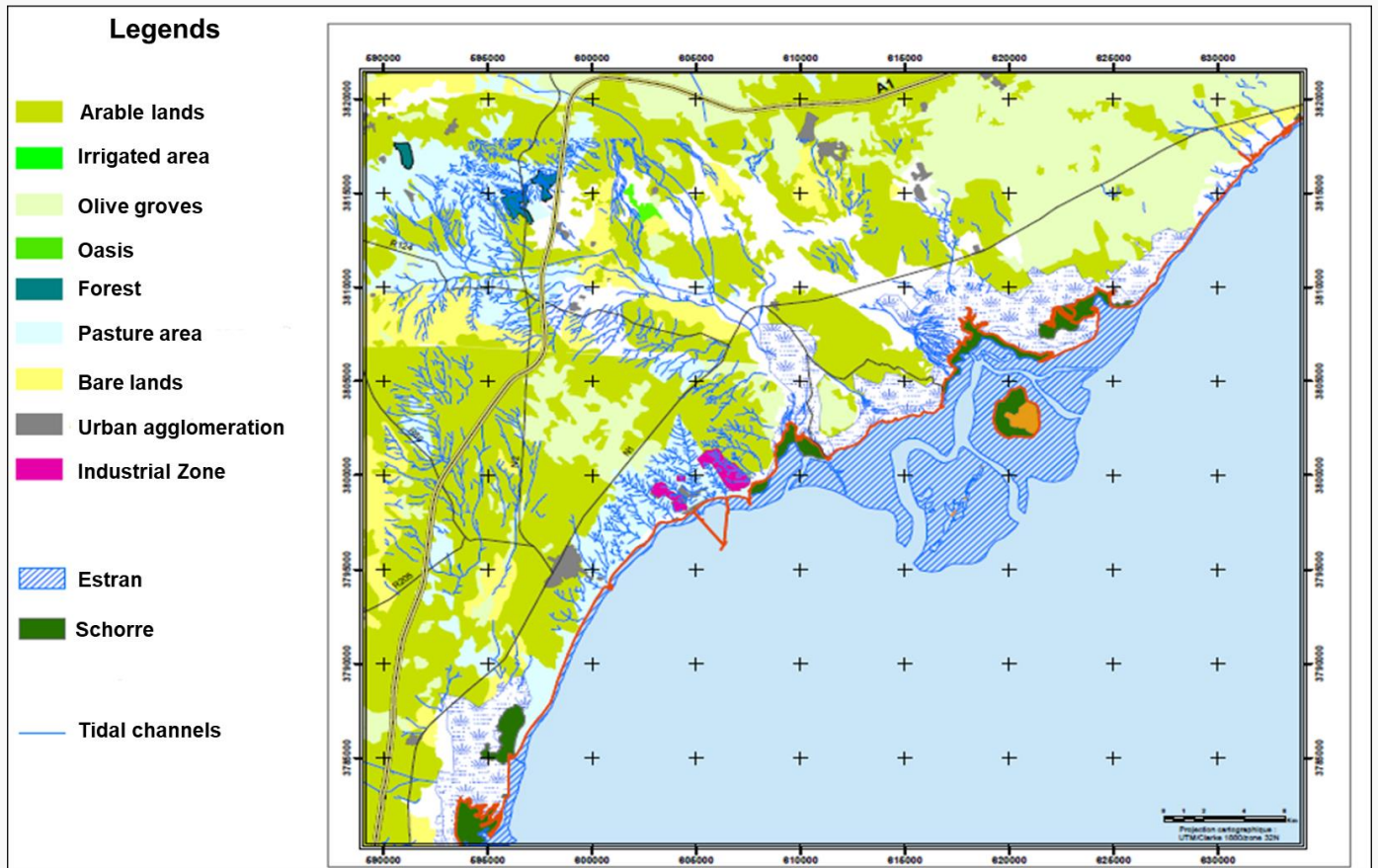


Figure.8: Geographical extents of different economic activities in Kneiss area.

2.3 Fishing activities

Fishing can be considered as the main economic activity in the Kneïss area. Fishing activity is dominated by small pelagic fisheries, coastal fishing and clam harvesting mainly targeted on the species *Ruditapes* spp (Mosbahi et al., 2016). We can also note the collection of polychaete bait collection (Abdennadher et al., 2011). Employees of the fishing sector in the Kneïss area is divided into two groups: official fishermen (178, DGPA 2017) attached to Zboussa port and shore fishermen on average of 400 collectors (DGPA 2017) (most of them are women) attached to the coastal line of the Ghraïba delegation (Figure. 9). In table. 4 we present recent statistics of fishing production from Zaboussa in 2018.



Figure. 9: Clam harvesting activity in the Kneiss Islands



Figure.10: Zaboussa port

Table .4 Fishing production in Zaboussa Port in Kg. [Sources DGPA 2018](#)

Fesheris Type	January	February	March	April	May	June	July	August	September	October	November	December
Coastal Fishing	56 828	39 611	57 841	49 175	40 285	27 221	23 572	12 027	12 865	22 351	25 574	22 890
Small pelagic fisheries	11 312	43 518	59 327	47 885	369	0	0	0	0	0	0	17 690
Clam harvesting	68 140	83 129	117 168	97 060	40 654	27 221	23 572	12 027	12 865	22 351	25 574	40 580

V. Biotic and abiotic impact levels and management issues

Despite its classification as a Nature Reserve since 1993, the Kneïss Islands archipelago is impacted by several factors which can have negative consequences on the structure and the biodiversity of the ecosystem.

1. Sea level rising

The significant rise in the sea level observed in the global ocean serious threats to the island biodiversity, especially for islands surrounded by low coasts and formed by sandy sediments or friable rocks (Medail et al., 2016). In the Mediterranean basin, the Gulf of Gabès islands can be considered as one of most affected areas by this phenomenon. Sea level rise was estimated at 5.7 mm per year (Pirazzoli, 1986), much faster rise than the global average (1.7 ± 0.2 mm / year during the period from 1901 to 2010) (Church & White, 2011).

In fact, these small Tunisian islands have impacted by Sea level rising since two thousand years (Etienne et al., 2012; Médail et al., 2015b) including: physiographic modification, significant shrinkage of emerged land, increased vulnerability to erosion, extension of the sebkha to the detriment of lands and lands salinization. The physiographic modifications are clearly perceptible on the Kneiss archipelago (Trousset, 2008; Oueslati, 2002). In fact, the four islets present today, formed a single elongated island in the Middle Ages. The sea level rising impacted also the vegetation biodiversity. One of the most notable results is the salinization of terrestrial biotopes, thus promoting the progression of halophilic species. Marine erosion also alters the sandstone formation in the central of these islets, which will lead to the very disappearance of halo-nitrophilic species.

2. Biological invasions

With the growth of international trade in recent decades and especially maritime transport, Tunisia faces ecological issues linked to the spread of invasive exotic species. The introduction of these species has negative effects on environment and local economy since they have no natural predators.

For the marine ecosystem we can notice risks related to ballast water in the Gulf of Gabès and more particularly in the Kneiss area that is responsible for the introduction of invasive species such as the Blue crab (*Portunus segnis*).

In the other hand introduction of Exotic plants, can lead to the modification of the specific composition and structure especially on small islands in the Mediterranean Sea ([Pretto et al., 2012](#)). In Kneiss island two exotic species (*Atriplex lindleyi* subsp. *inflata* and *Solanum linnaeanum*) have been noted ([Chaieb, 2003](#))

3. Macro-waste and pollution

The Gulf of Gabès is recognized as an area impacted by industrial air or marine pollution ([Boukhris, 2015](#)). The Kneiss Islands sector is particularly subject to this pollution because of its proximity to the industrial area of Skhira, one of the most important oil terminals in Tunisia, with a storage depot for petroleum products.

The coastal sectors of the Gulf of Gabès are also subject to a strong accumulation of macro-waste ([Price et al., 2014](#)), and this phenomenon particularly affects the islands ([Médail et al., 2015b](#)). These macro-wastes come mainly from waste management issues along the coast and maritime navigation. Locally, wastes are also generated by visitors and clam collectors. Among this waste we find bottles and various plastic objects, accompanied by a multitude of metallic waste, pneumatic, or fishing net residue. The accumulation of such waste can have an impact on the regeneration and dispersion of the fauna and flora in the islands. Moreover, their degradation in the ecosystem which releases a cocktail of chemical compounds could have devastating consequences.

4. Impact of Fisheries activities

Fishing is the main economic activity in the Kneiss region. Fisheries activities are dominated by coastal fishing and clam collection. The latter activity is considered as the main activity of women in the Kneiss region.

Clam Harvesting does not appear to have a direct effect on halophilic plant communities located at proximity. However, the increase in the number of unauthorized collectors may have an impact on the disturbance of nesting avifauna and the collection of eggs during their reproduction period on the islands. Significant decreases in macrofauna were also observed after the harvesting activity was initiated ([Mosbahi et al., 2016](#)). For coastal fishing the main issues are related to the overexploitation, Illegal fishing and use of destructive gear. Impact were also observed on marine plant cover (*Posidonia*, *Zostera*) leading to their limit's regression and structures destruction.

5.Overgrazing and vegetation burning:

Despite the status of Nature reserve Sheep grazing on the Kneiss Islands is practiced illegally on El Bessila Island. This unregulated grazing plays a primordial role in the regression of the herbaceous vegetation cover and in the modification of its floristic composition. Such overgrazing was at the origin of the disappearance of the pastoral species ([Chaieb 2003](#)) and indicate that pastoral pressures are too high for such space. Combined with consequences of overgrazing, the repeated cutting and **vegetation burning** by local population will lead to the disappearance of key species from the steppe ecosystem of southern Tunisia.

VI. Conclusion

The Kneïss Islands are one of the wonders of the Mediterranean. However, despite the natural potential and the diversity of ecosystems, the rich heritage of the Kneïss archipelago is very strongly threatened today.

Considering identified management issues in this report, their intersection and the complexity of management approach. An ecosystem-based management system involving all of the stakeholders remains fundamental.

Combined with national efforts in this context, MED4EBM project remains a real opportunity for the various stakeholders and decisions makers to be involved in this new approach to a better management of the Kneïss Islands area.



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