ADAPTATION TO CLIMATE CHANGE IN THE NILE DELTA THROUGH INTEGRATED COASTAL ZONE MANAGEMENT PROJECT

INTEGRATED COASTAL ZONE MANAGEMENT IN THE NORTHERN COAST OF EGYPT
– A SCOPING STUDY –

ANNEX I:

ANNEX I: HAZARD CHARACTERIZATION AND CLIMATE CHANGE

DECEMBER 2016

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ANNEX I: HAZARD CHARACTERIZATION AND CLIMATE CHANGE

1. INTRODUCTION

This annex presents the detailed information concerning the climate data used in the project Integrated Coastal Zone Management in Egypt - A Scoping Study. One of the main efforts made in this work consisted in describing the hazard, herein characterized by historical information and future projections of climatic drivers. They include waves, storm surge, sea level, sea surface temperature, air temperature and precipitation. Its analysis allows the definition of climatic conditions at different time horizons and assessments: historical, present, near-term prediction or climatic projections throughout the 21st century.

The results of the climate drivers are given along the Egyptian Northern Coast in the different coastal points previously defined (every 10 km). The Egyptian northern coastline is indicated in each figure and is referenced by its longitude (x-axis) and latitude (y-axis).

2. HISTORICAL CHARACTERIZATION OF CLIMATIC DRIVERS

The historical characterization of the climatic drivers allows to assess how they have changed over the last decades and how they have contributed to coastal impacts.

2.1. Waves: GOW database (spatial resolution: 0.125°)

The GOW (Global Ocean Waves) database comprises hourly data of waves with a spatial resolution of 0.125° for the period 1979-2015 (Reguero et al., 2012). The following figures show the spatial variability of wave statistics along the Egyptian coast.

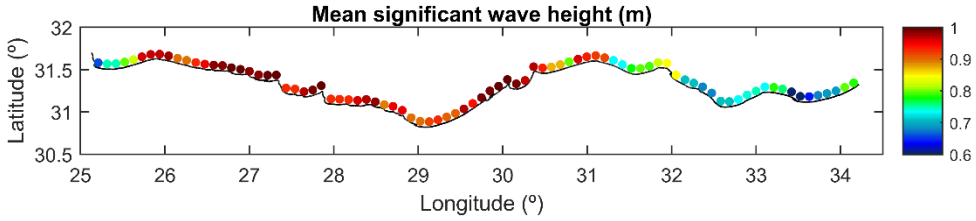


Fig. 1 Mean value of the hourly mean significant wave height (m) for the period 1979-2015

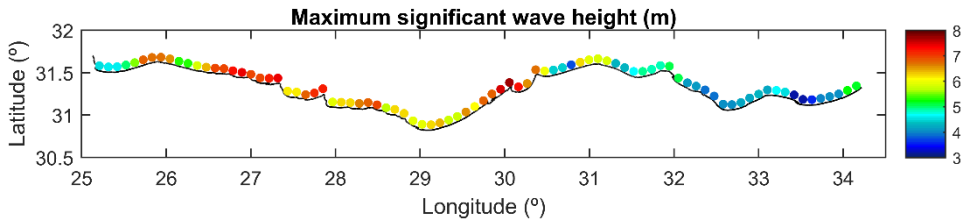


Fig. 2 Maximum value of the hourly mean significant wave height (m) for the period 1979-2015

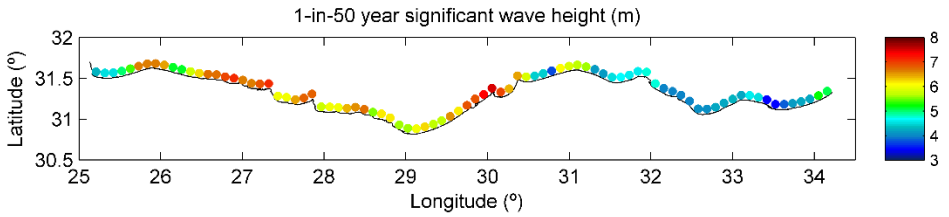


Fig. 3 1-in-50 year significant wave height (m) for the period 1979-2015

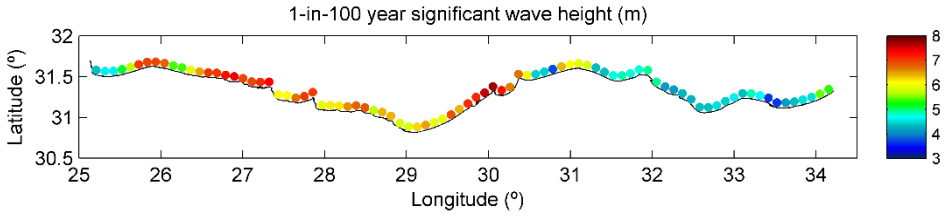


Fig. 4 1-in-100 year significant wave height (m) for the period 1979-2015

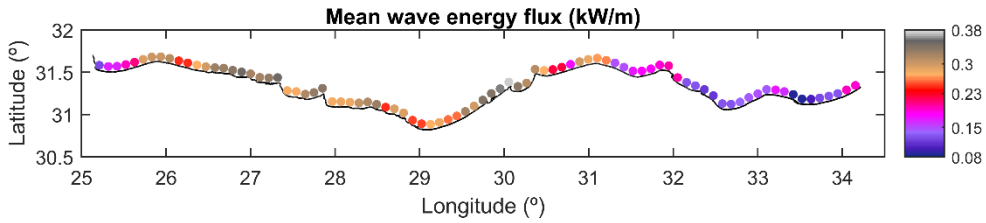


Fig. 5 Mean value of the wave energy flux (kW/m) for the period 1979-2015

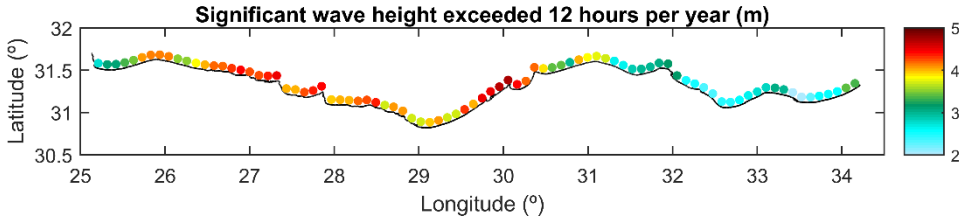


Fig. 6 Mean value of the significant wave height only exceeded 12 hours per year (m) for the period 1979-2015

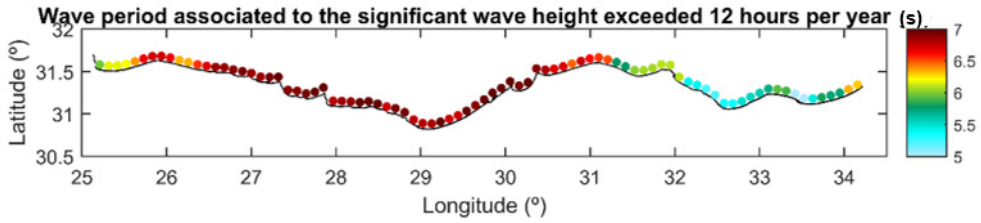


Fig. 7 Value of the wave period associated to the significant wave height exceeded 12 hours per year (s) for the period 1979-2015

2.2. Storm surge: GOS database (spatial resolution: 0.064° x 0.114°)

The GOS (Global Ocean Surges) database comprises hourly data of storm surge with a spatial resolution of 0.064° x 0.114° for the period 1979-2014 (Cid et al., 2014). The following figure show the spatial variability of the 99th percentile of storm surge along the Egyptian coast.

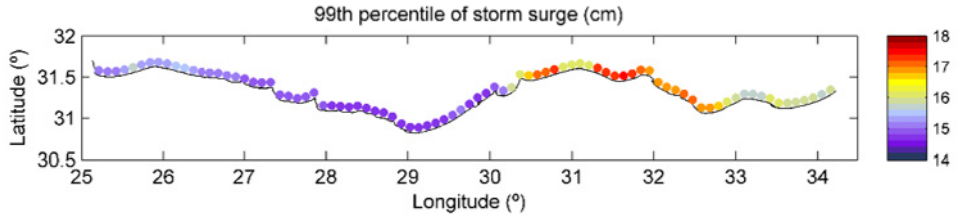


Fig. 8 Value of the 99 percentile of storm surge (cm) for the period 1975-2015

2.3. Sea surface temperature: GRHSST database (spatial resolution: 0.05°)

The GRHSST (Group for High Resolution Sea Surface Temperature) database comprises hourly data of sea surface temperature with a spatial resolution of 0.05° for the period 1985-2015 (Robert-Jones et al., 2012). The following figures show the spatial variability of the minimum, mean and maximum values of sea surface temperature along the Egyptian coast.

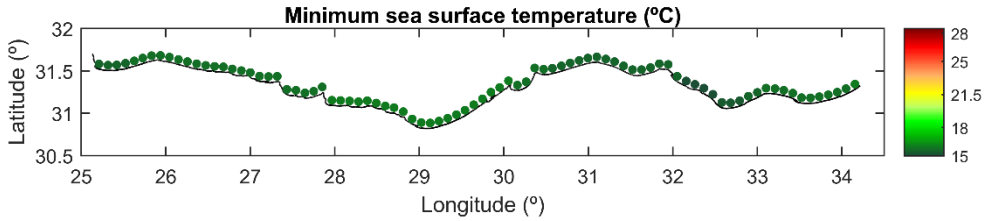


Fig. 9 Minimum value of the sea surface temperature (°C) for the period 1985-2015

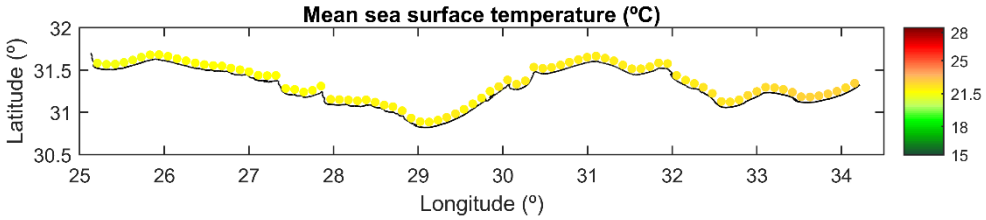


Fig. 9 Mean value of the sea surface temperature (°C) for the period 1985-2015

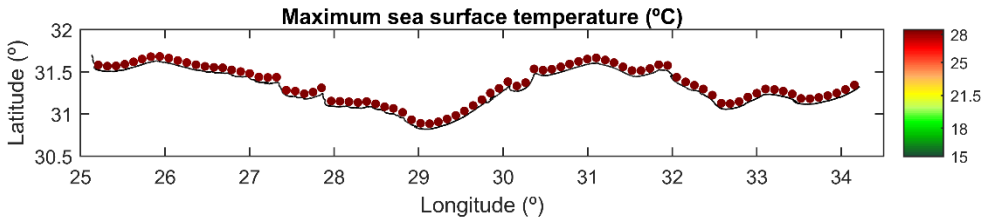


Fig. 10 Maximum value of the sea surface temperature (°C) for the period 1985-2015

2.4. Air temperature: Seawind II database (spatial resolution: 0.125°)

The Seawind II database comprises hourly data of air temperature with a spatial resolution of 0.125° for the period 1989-2015 (Donlon et al., 2012). The following figures show the spatial variability of the mean monthly values of the minimum, mean and maximum air temperature along the Egyptian coast. Please, note that air temperature data are obtained from the ocean model and consequently can be considered as a lower limit.

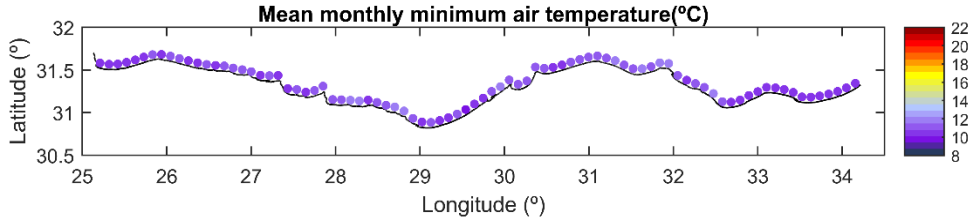


Fig. 11 Mean value of the monthly minimum air temperature (°C) for the period 1989-2015

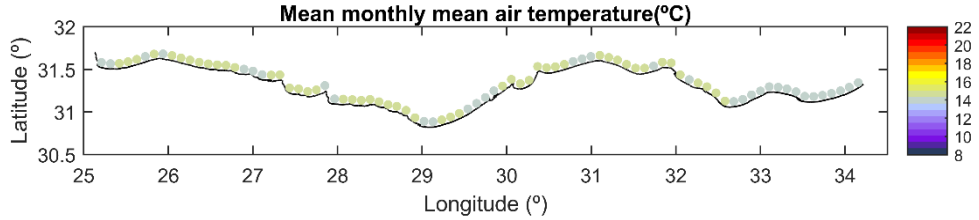


Fig. 12 Mean value of the monthly mean air temperature (°C) for the period 1989-2015

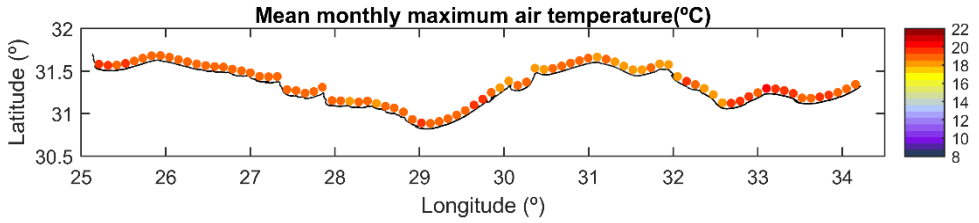


Fig. 13 Mean value of the monthly maximum air temperature (°C) for the period 1989-2015

2.5. Precipitation: Seawind II database (spatial resolution: 0.125°)

The Seawind II database comprises hourly data of precipitation with a spatial resolution of 0.125° for the period 1989-2015. The following figures show the spatial variability of the annual mean precipitation, the validation of the Seawind II dataset in Alexandria and Marsa Matrouh with GHCN (Global Historical Climatology Network - Daily) data to demonstrate its good performance along the Egyptian coast, and the monthly mean value of precipitation during wet and dry seasons (April to September and October to March, respectively).

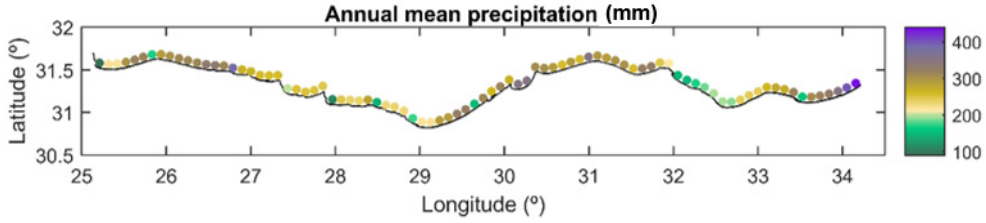


Fig. 14 Mean value of the annual precipitation (mm) for the period 1989-2015

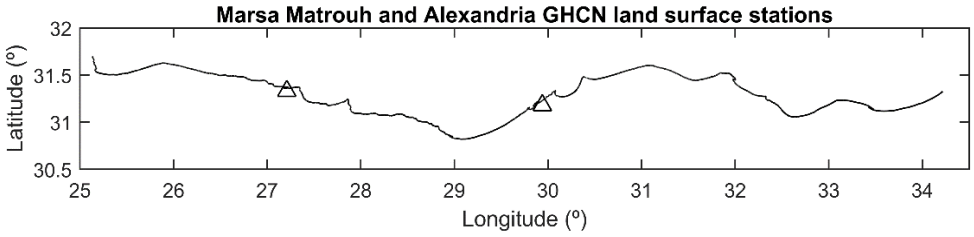


Fig. 15 Location of Marsa Matrough and Alexandria GHCN land surface stations

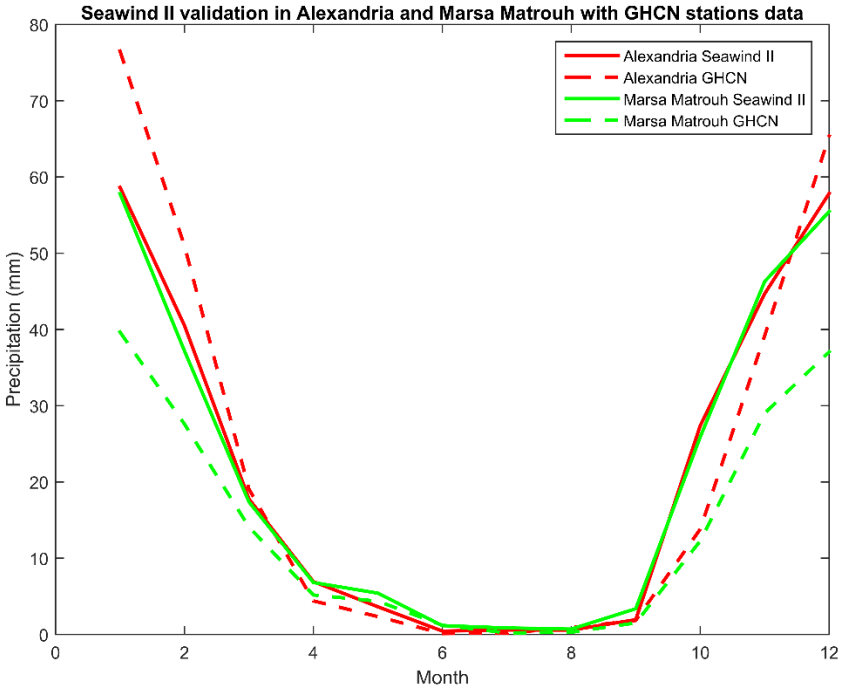


Fig. 16 Seawind II validation in Marsa Matrouh and Alexandra GHCN stations with GHCN data

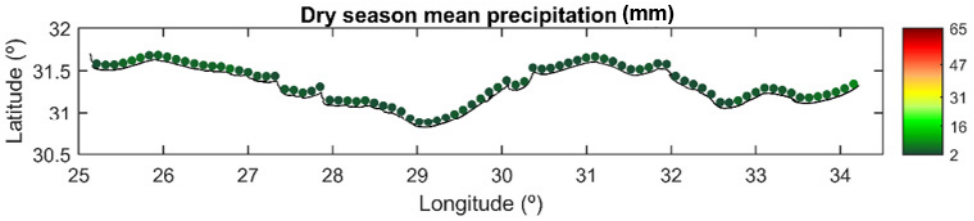


Fig. 17 Monthly mean value of precipitation (mm) during dry season (April to September) for the period 1989-2015

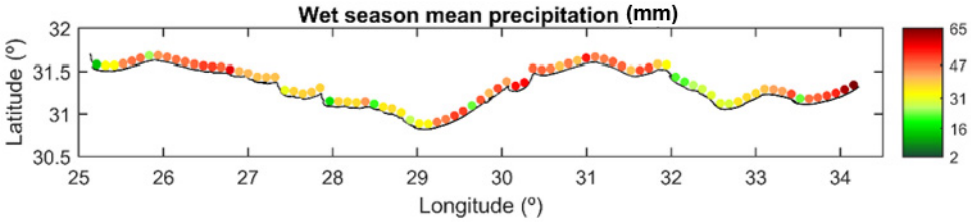


Fig. 19 Monthly mean value of precipitation (mm) during dry season (October to March) for the period 1989- 2015

3. NEAR- AND LONG-TERM PROJECTIONS OF CLIMATIC DRIVERS

The way the atmosphere will behave under different climate change scenarios is derived by global circulation models (GCM). GCMs are numerical models that represent physical processes in the atmosphere, ocean, cryosphere and land surface and are the most advanced tools currently available for simulating the response of the global climate system to increasing greenhouse gas concentrations (IPCC, 2013). Herein climate driver projections derived from GCMs are presented for the near- and long-term, and under two Representative Concentration Pathways (RCP) scenarios based on Greenhouse gas (GHG) emissions: RCP4.5, corresponding to a pathway with moderate GHG emissions; and RCP8.5, that accounts for the pathway with the highest GHG emissions.

3.1. Waves: GOW projections (spatial resolution: 0.125°)

Wave statistics projections have been developed at a spatial resolution of 0.125° (Perez et al., 2015) using 17 GCMs from the Coupled Model Intercomparison Project Phase 5 (CMIP5, Taylor et al., 2012). The following figures show the results for the RCP4.5 and RCP8.5 scenarios, and for the periods 2010-2039 and 2040-2069 with respect to the reference period 1975-2004.

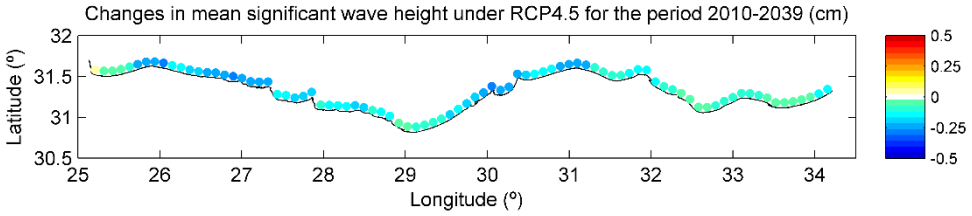


Fig. 18 Changes in the mean value of the significant wave height (cm) under RCP4.5 for the period 2010-2039 with respect to the reference period 1975-2004

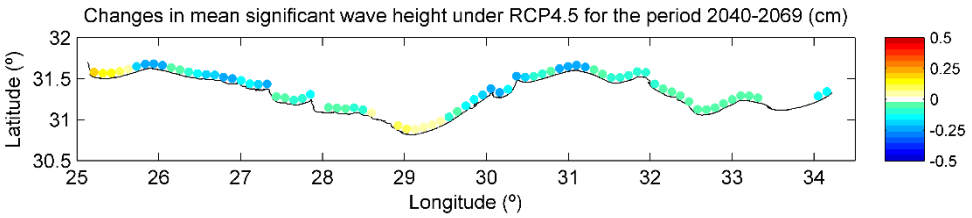


Fig. 19 Changes in the mean value of the significant wave height (cm) under RCP4.5 for the period 2040-2069 with respect to the reference period 1975-2004

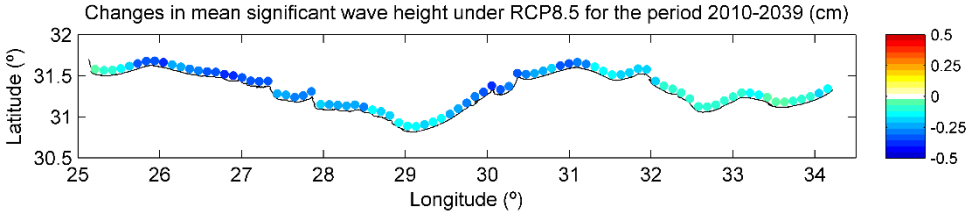


Fig. 20 Changes in the mean value of the significant wave height in (cm) under RCP8.5 for the period 2010-2039 with respect to the reference period 1975-2004

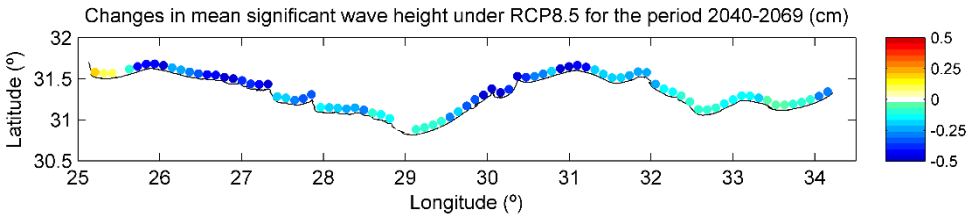


Fig. 21 Changes in the mean value of the significant wave height in (cm) under RCP8.5 for the period 2040-2069 with respect to the reference period 1975-2004

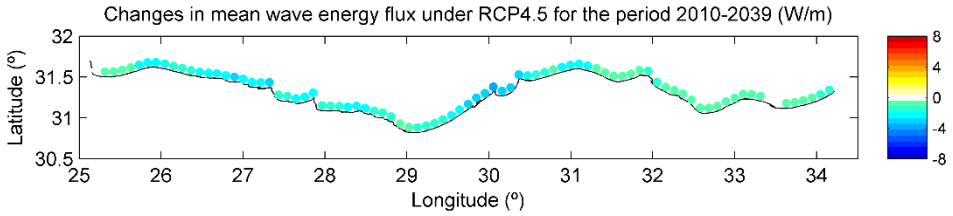


Fig. 22 Changes in the mean value of the wave energy flux (W/m) under RCP4.5 for the period 2010-2039 with respect to the reference period 1975-2004

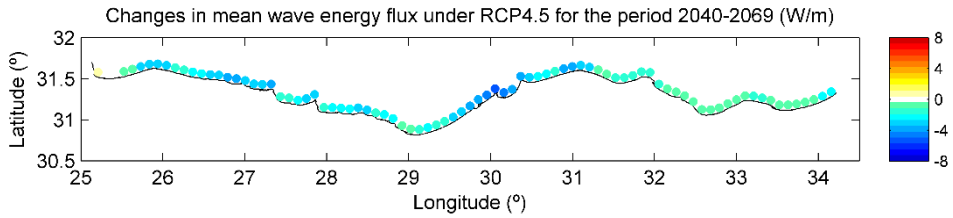


Fig. 23 Changes in the mean value of the wave energy flux (W/m) under RCP4.5 for the period 2040-2069 with respect to the reference period 1975-2004

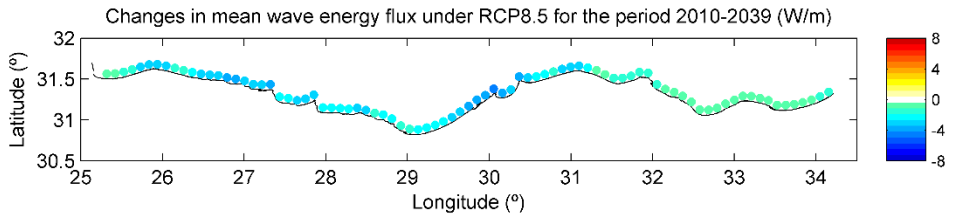


Fig. 24 Changes in the mean value of the wave energy flux (W/m) under RCP8.5 for the period 2010-2039 with respect to the reference period 1975-2004

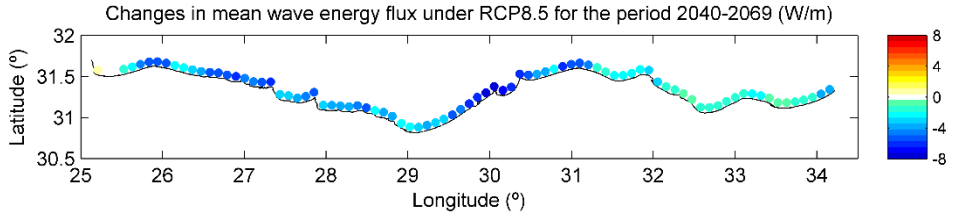


Fig. 25 Changes in the mean value of the wave energy flux (W/m) under RCP4.5 for the period 2040-2069 with respect to the reference period 1975-2004

3.2. Storm surge: GOS projections (spatial resolution: 0.064° x 0.114°)

The storm surge projections have been developed at a spatial resolution of 0.064° x 0.114° using 6 GCMs from the CMIP5 (Taylor et al., 2012). The following figures show the 99th percentile of storm surge projected for the RCP4.5 and RCP8.5 emission scenarios, and for the period 2070-2099 with respect to the reference period 1975-2004. Results for the near term are not available.

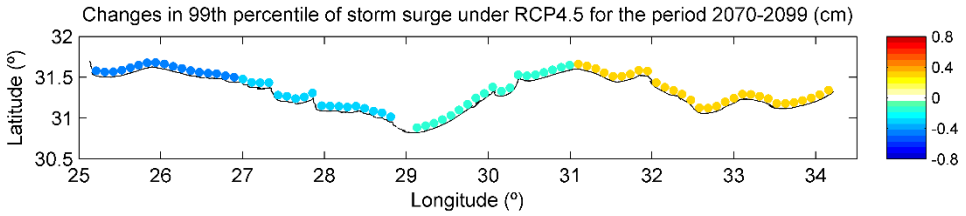


Fig. 26 Changes in the 99th percentile of storm surge (m) under RCP4.5 for the period 2070-2099 with respect to the reference period 1975-2004

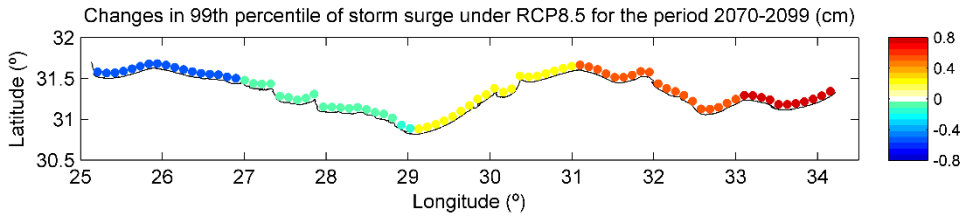


Fig. 29 Changes in the 99th percentile of storm surge (m) under RCP8.5 for the period 2070-2099 with respect to the reference period 1975-2004

3.3. Sea level rise: Slangen et al. (2014) (spatial resolution: 1°)

Slangen et al. (2014) developed the regionalized global sea-level projections in all the basins around the world at a spatial resolution of 1°. They have been developed under the RCP4.5 and RCP8.5 scenarios and for the period 2081-2100 with respect to the reference period 1985-2005. Using the global mean values of sea level rise provided by the IPCC (Church et al., 2013) over the 21st century and assuming the same spatial distribution patterns of the regionalized global sea-level projections for the end of the century, regional sea level rise for the periods 2016-2035 and 2040-2069 have been herein derived. The following figures show sea-level rise projections for the RCP4.5 and RCP8.5 emission scenarios, and for the periods 2016-2035, 2046-2065 and 2081-2100, with respect to the reference period 1985-2005.

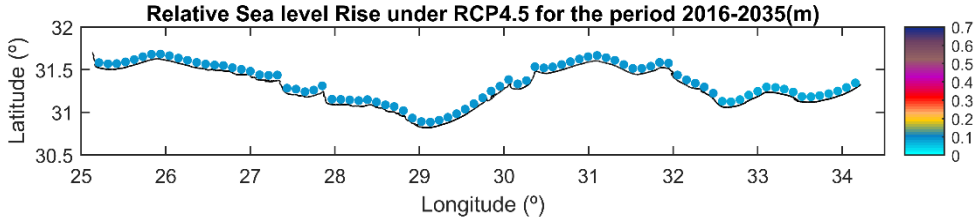


Fig. 27 Relative sea level rise (m) under RCP4.5 for the period 2016-2035 with respect to to the reference period 1986-2005

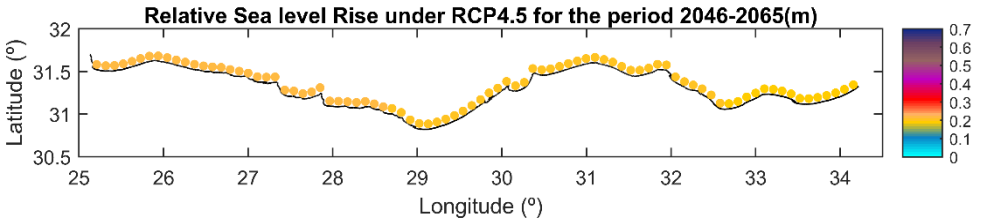


Fig. 28 Relative sea level rise (m) under RCP4.5 for the period 2046-2065 with respect to to the reference period 1986-2005

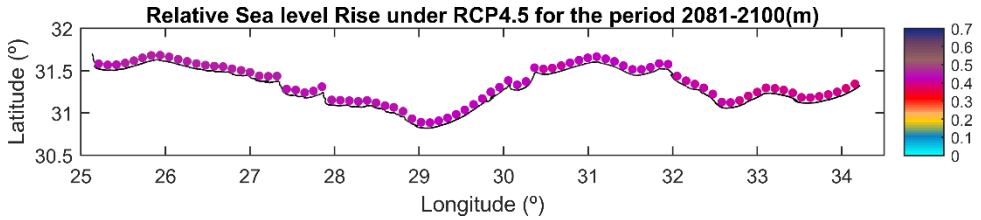


Fig. 29 Relative sea level rise (m) under RCP4.5 for the period 2081-2100 with respect to to the reference period 1986-2005

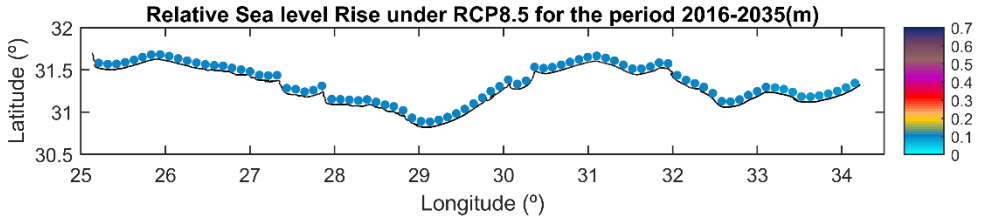


Fig. 30 Relative sea level rise (m) under RCP8.5 for the period 2016-2035 with respect to to the reference period 1986-2005

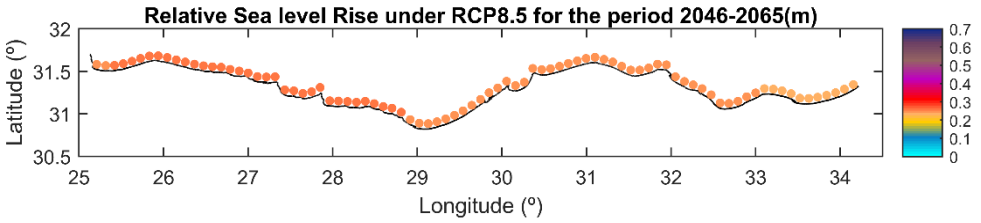


Fig. 31 Relative sea level rise (m) under RCP8.5 for the period 2046-2065 with respect to to the reference period 1986-2005

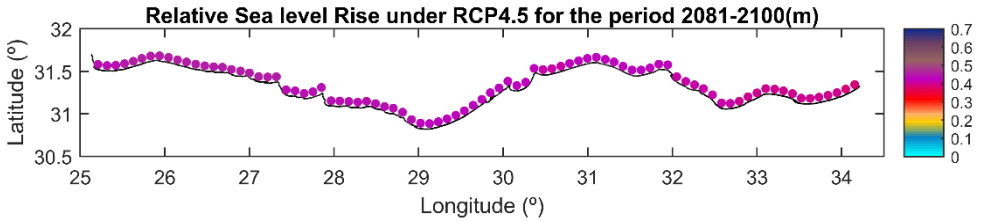


Fig. 32 Relative sea level rise (m) under RCP8.5 for the period 2081-2100with respect to to the reference period 1986-2005

3.4. Sea surface temperature: CMIP5 (spatial resolution: 1°)

Sea surface temperature projections have been assembled using the results given by the CMIP5 models at al spatial resolution of 1° (Taylor et al., 2012). The following figures show changes in the minimum, mean and maximum values of sea surface temperature for the RCP4.5 and RCP8.5 emission scenarios, and for the periods 2030-2040 (near-term) and 2050-2070 (long-term) with respect to the period 1986-2005.

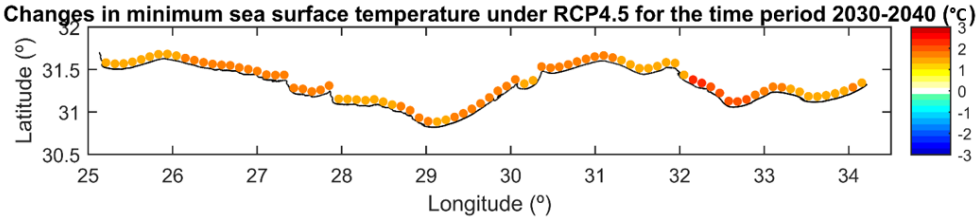


Fig. 33 Changes in the minimum sea surface temperature (°C) under RCP4.5 for the period 2030-2040 with respect to to the reference period 1986-2005

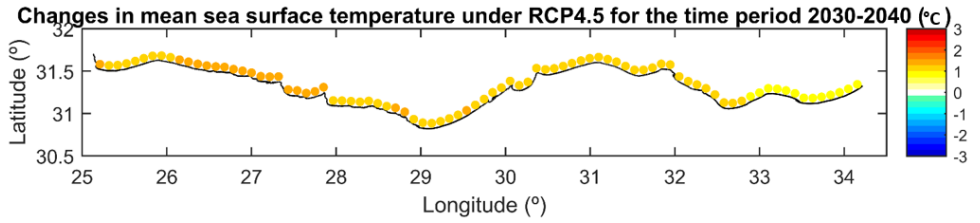


Fig. 34 Changes in the mean sea surface temperature (°C) under RCP4.5 for the period 2030-2040 with respect to to the reference period 1986-2005

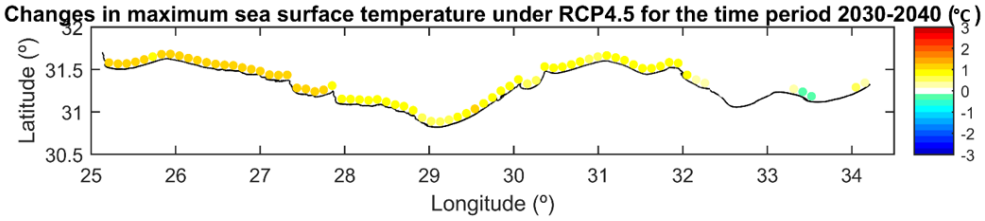


Fig. 35 Changes in the maximum sea surface temperature (°C) under RCP4.5 for the period 2030-2040 with respect to the reference period 1986-2005

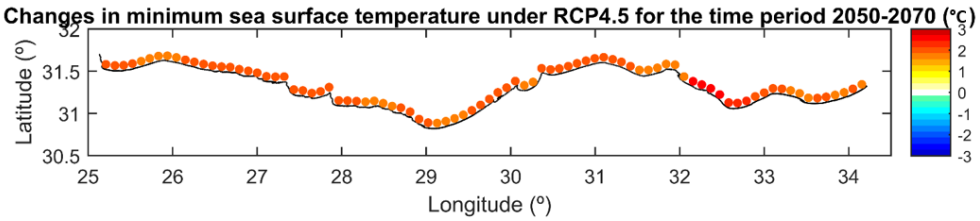


Fig. 39 Changes in the minimum sea surface temperature (°C) under RCP4.5 for the period 2050-2070 with respect to to the reference period 1986-2005

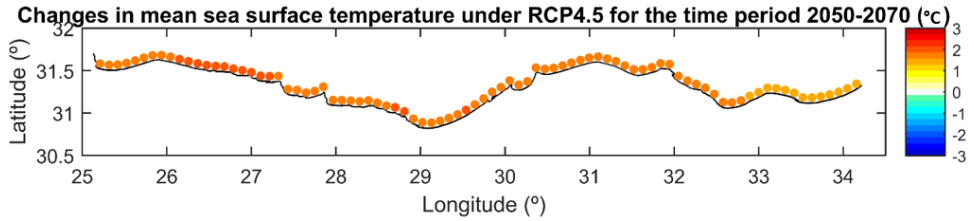


Fig. 36 Changes in the mean sea surface temperature (°C) under RCP4.5 for the period 2050-2070 with respect to to the reference period 1986-2005

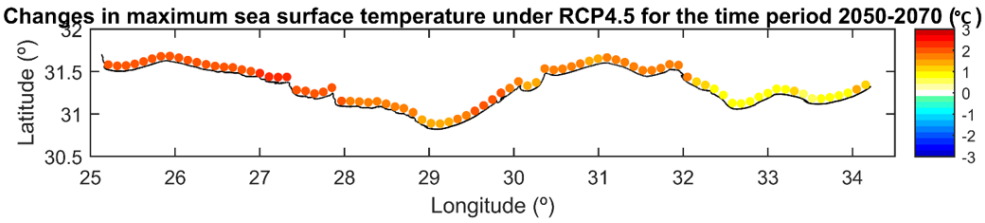


Fig. 37 Changes in the maximum sea surface temperature (°C) under RCP4.5 for the period 2050-2070 with respect to the reference period 1986-2005

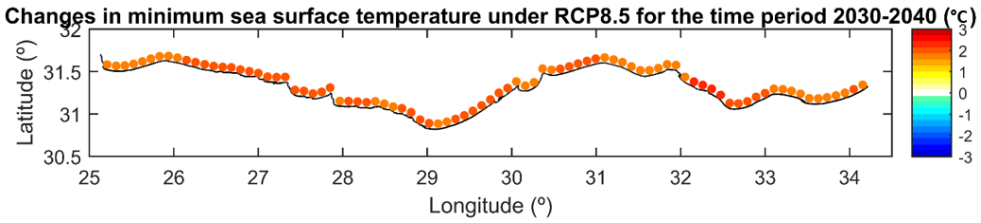


Fig. 38 Changes in the minimum sea surface temperature (°C) under RCP8.5 for the period 2030-2040 with respect to the reference period 1986-2005

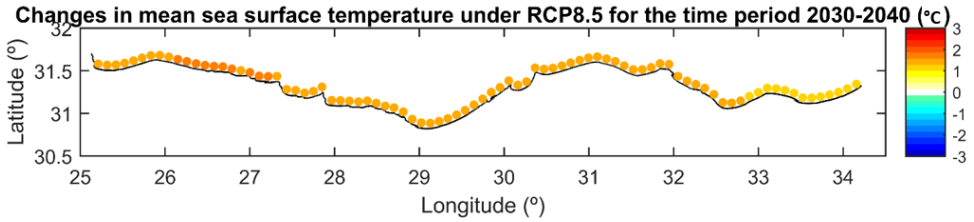


Fig. 39 Changes in the mean sea surface temperature (°C) under RCP8.5 for the period 2030-2040 with respect to the reference period 1986-2005

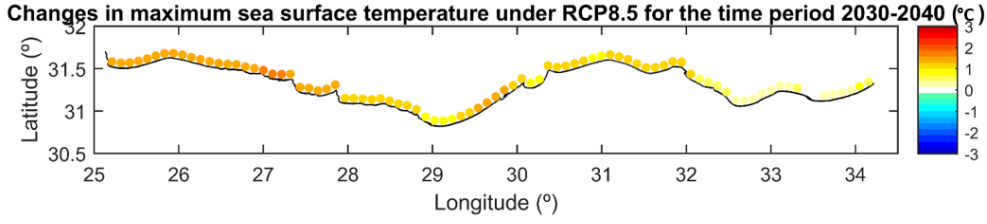


Fig. 40 Changes in the maximum sea surface temperature (°C) under RCP8.5 for the period 2030-2040 with respect to the reference period 1986-2005

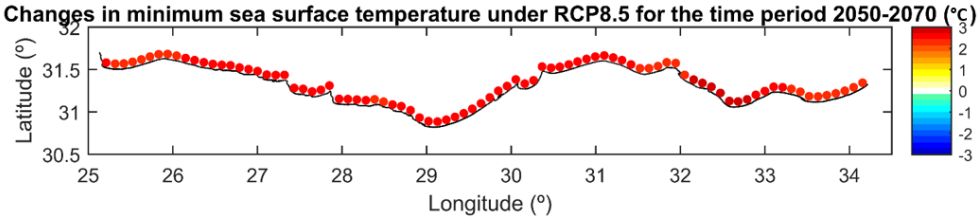


Fig. 41 Changes in the minimum sea surface temperature (°C) under RCP8.5 for the period 2050-2070 with respect to the reference period 1986-2005

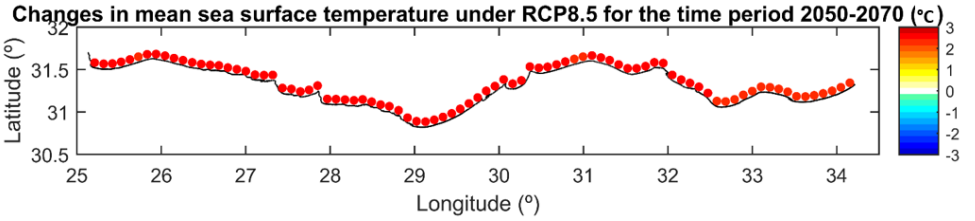


Fig. 42 Changes in the mean sea surface temperature (°C) under RCP8.5 for the period 2050-2070 with respect to the reference period 1986-2005

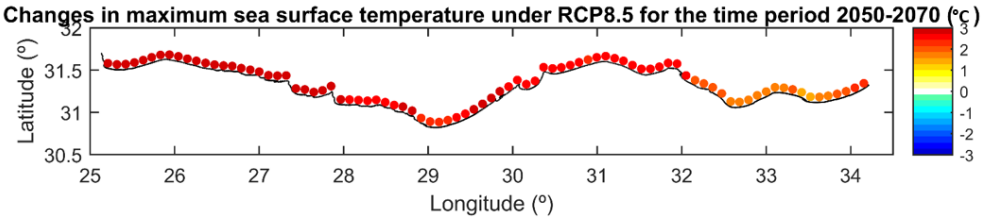


Fig. 43 Changes in the maximum sea surface temperature (°C) under RCP8.5 for the period 2050-2070 with respect to the reference period 1986-2005

3.5. Air temperature: CMIP5 (spatial resolution: 1°)

Air temperature projections have been assembled using the results given by the CMIP5 models at al spatial resolution of 1° (Taylor et al., 2012). The following figures show changes in the mean value of the monthly minimum, mean and maximum air temperatures for the RCP4.5 and RCP8.5 emission scenarios, and for the periods 2030-2040 and 2050-2070 with respect to the reference period 1986-2005. Please, note that air temperature projections are obtained from the ocean model and consequently can be considered as a lower limit of the projections.

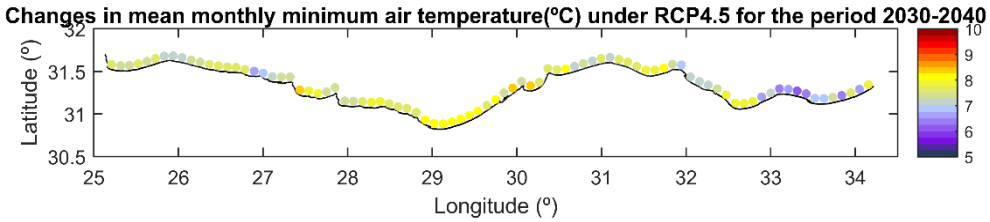


Fig. 44 Changes in the mean value of the monthly minimum air temperature (°C) under RCP4.5 for the period 2030-2040 with respect to the reference period 1986-2005

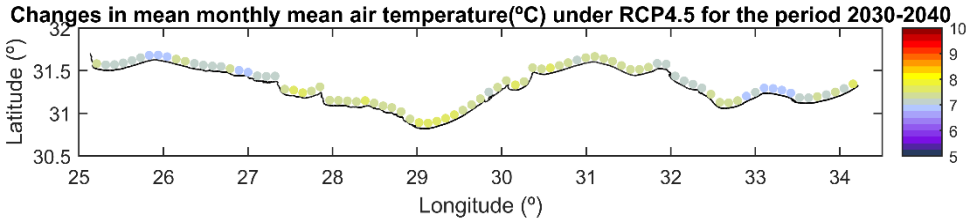


Fig. 49 Changes in the mean value of the monthly mean air temperature (°C) under RCP4.5 for the period 2030-2040 with respect to the reference period 1986-2005

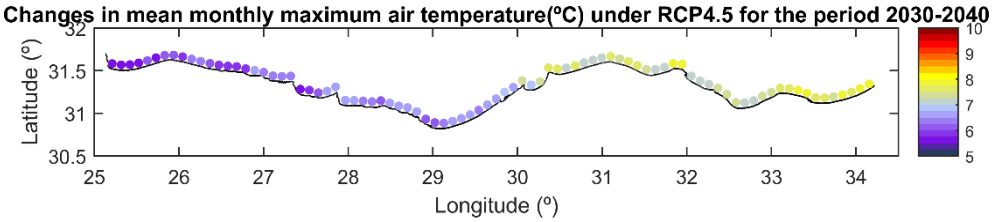


Fig. 45 Changes in the mean value of the monthly maximum air temperature (°C) under RCP4.5 for the period 2030-2040 with respect to the reference period 1986-2005

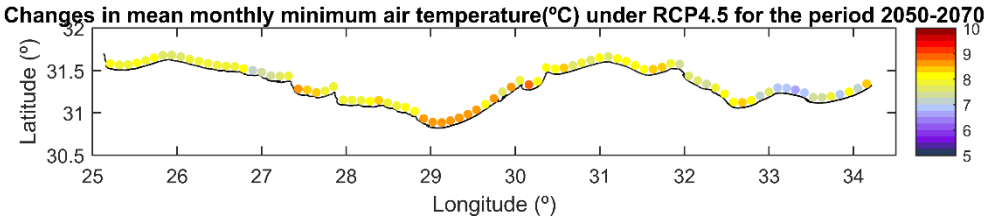


Fig. 46 Changes in the mean value of the monthly minimum air temperature (°C) under RCP4.5 for the period 2050-2070 with respect to the reference period 1986-2005

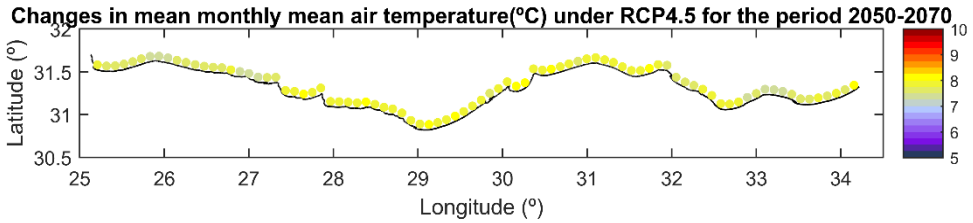


Fig. 47 Changes in the mean value of the monthly mean air temperature (°C) under RCP4.5 for the period 2050-2070 with respect to the reference period 1986-2005

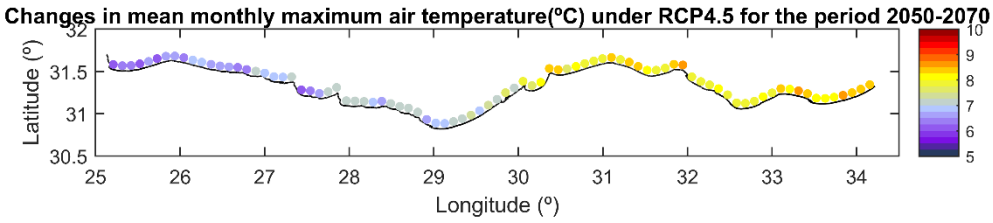


Fig. 48 Changes in the mean value of the monthly maximum air temperature (°C) under RCP4.5 for the period 2050-2070 with respect to the reference period 1986-2005

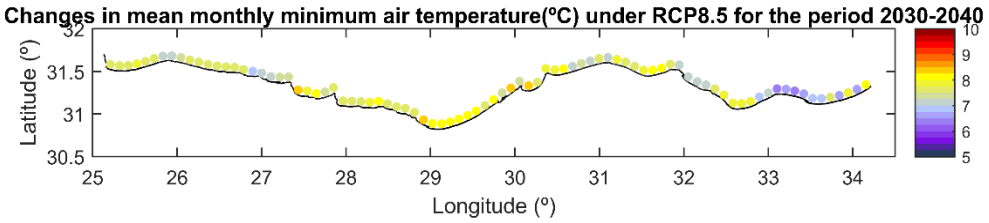


Fig. 49 Changes in the mean value of the monthly minimum air temperature (°C) under RCP8.5 for the period 2030-2040 with respect to the reference period 1986-2005

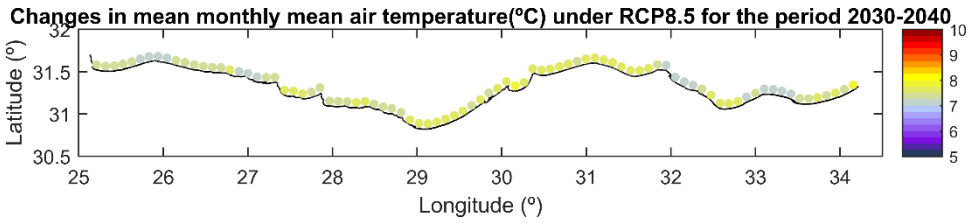


Fig. 50 Changes in the mean value of the monthly mean air temperature (°C) under RCP8.5 for the period 2030-2040 with respect to the reference period 1986-2005

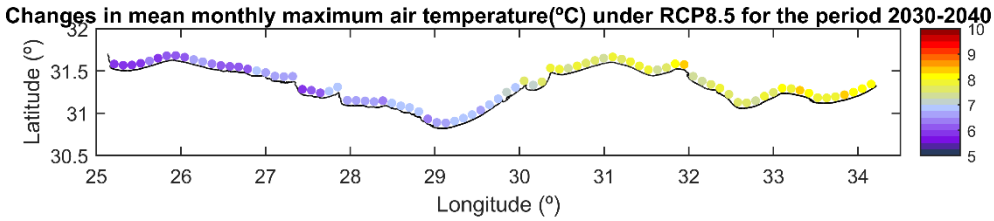


Fig. 51 Changes in the mean value of the monthly maximum air temperature (°C) under RCP8.5 for the period 2030-2040 with respect to the reference period 1986-2005

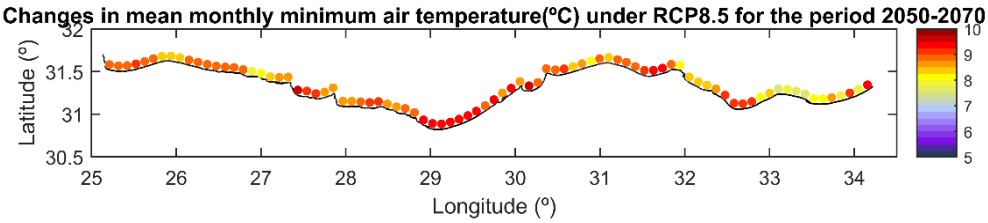


Fig. 52 Changes in the mean value of the monthly minimum air temperature (°C) under RCP8.5 for the period 2050-2070 with respect to the reference period 1986-2005

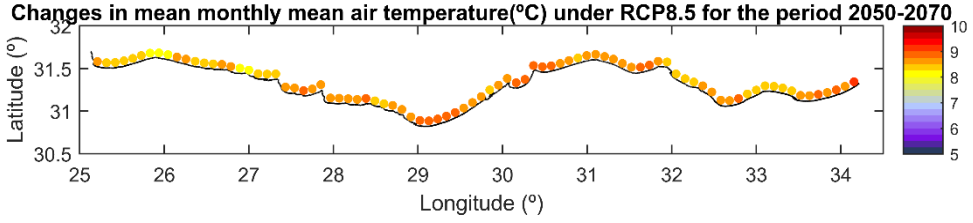


Fig. 53 Changes in the mean value of the monthly mean air temperature (°C) under RCP8.5 for the period 2050-2070 with respect to the reference period 1986-2005

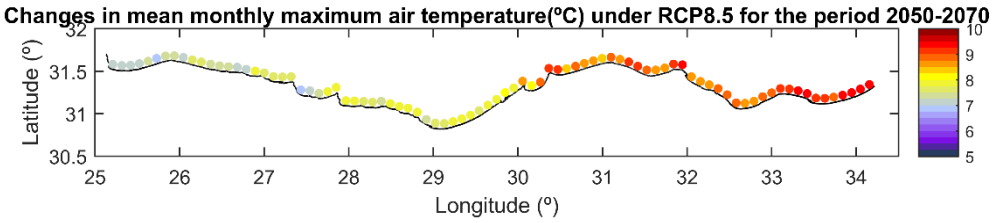


Fig. 59 Changes in the mean value of the monthly maximum air temperature (°C) under RCP8.5 for the period 2050-2070 with respect to the reference period 1986-2005

3.6. Precipitation: CMIP5 (spatial resolution: 1°)

Precipitation projections have been assembled using the results given by the CMIP5 models at al spatial resolution of 1° (Taylor et al., 2012). The following figures show changes in the monthly mean value of precipitation during the dry and the wet season (April to September and October to Marc, respectively) for the RCP4.5 and RCP8.5 emission scenarios, and for the periods 2030-2040 and 2050-2070 with respect to the reference period 1986-2005.

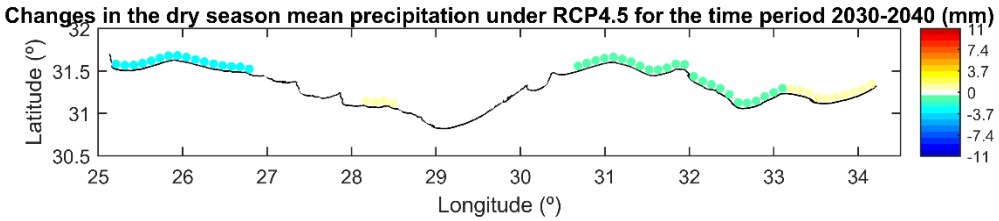
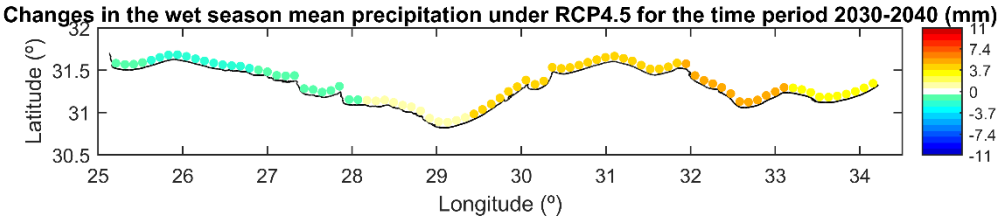


Fig. 54 Changes in the monthly mean value of precipitation (mm) during the dry season (April to September) under RCP4.5 for the period 2030-2040 with respect to the reference period 1986-2005



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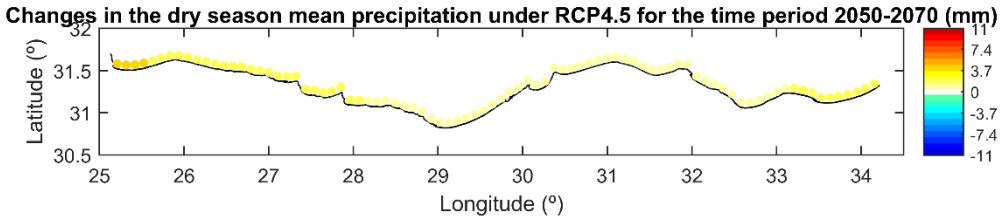


Fig. 56 Changes in the monthly mean value of precipitation (mm) during the dry season (April to September) under RCP4.5 for the period 2050-2070 with respect to the reference period 1986-2005

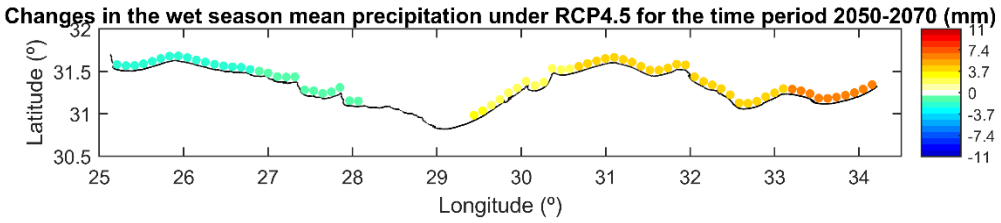


Fig. 57 Changes in the monthly mean value of precipitation (mm) during the wet season (October to March) under RCP4.5 for the period 2030-2040 with respect to the reference period 1986-2005

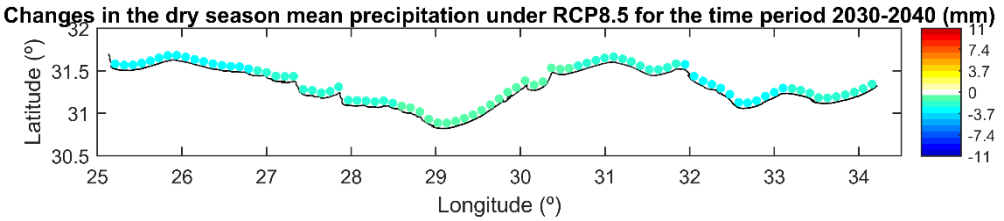


Fig. 58 Changes in the monthly mean value of precipitation (mm) during the dry season (April to September) under RCP8.5 for the period 2030-2040 with respect to the reference period 1986-2005

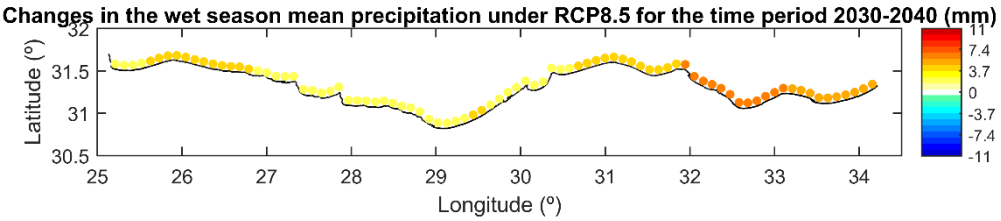
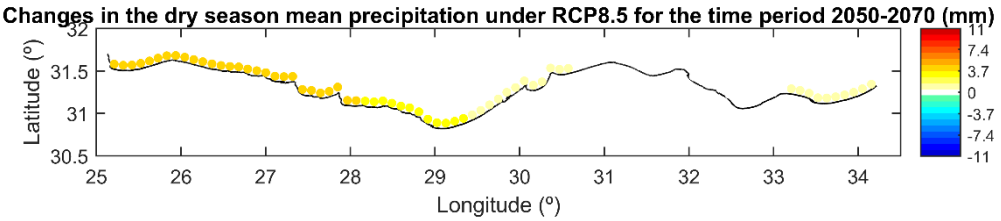


Fig. 59 Changes in the monthly mean value of precipitation (mm) during the wet season (October to March) under RCP8.5 for the period 2030-2040 with respect to the reference period 1986-2005



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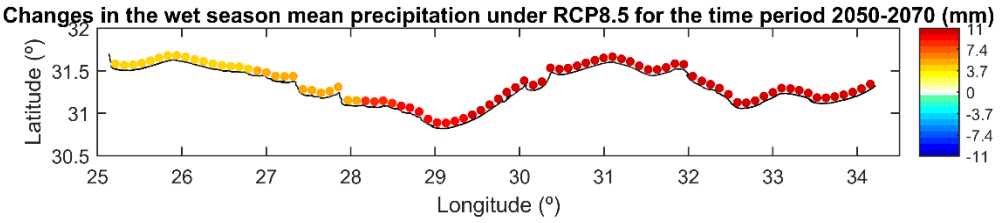

Fig. 61 Changes in the monthly mean value of precipitation (mm) during the wet season (October to March) under RCP8.5 for the period 2050-2070 with respect to the reference period 1986-2005

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ADAPTATION TO CLIMATE CHANGE IN THE NILE DELTA THROUGH INTEGRATED COASTAL ZONE MANAGEMENT PROJECT

INTEGRATED COASTAL ZONE MANAGEMENT IN THE NORTHERN COAST OF EGYPT
– A SCOPING STUDY –

ANNEX II:

ANNEX II: COASTAL IMPACTS AND INDICATORS

DECEMBER 2016

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1. INTRODUCTION

This annex is part of Activity 1.3 (Assessment of each coastal unit) and Activity 1.4 (Assessment of long-term scenarios) of the project Integrated Coastal Zone Management in Egypt - A Scoping Study.

The annex aims at providing the detailed methodology and results concerning the coastal physical diagnosis (sectoral diagnosis), regarding, specifically, the characterization of the most relevant coastal impacts along the Egyptian coastline for present and future situations.

2. METHODOLOGY

The main objective of the physical diagnosis is to perform an assessment of the most relevant climatic and climate-related drivers triggering impacts on key environmental and socioeconomic coastal sectors. In order to inform the decision making process in coastal planning, impacts will be assessed at three different timeframes, namely present, near-term (2030-2040) and long-term (2050-2070) situations, and two Representative Concentration Pathways (RCP scenarios) will be studied. The RCP scenarios are based on Greenhouse gas (GHG) emissions: RCP4.5, corresponding to a pathway with moderate GHG emissions; and RCP8.5, that accounts for the pathway with the highest GHG emissions (see Annex 1: Hazard characterization and climate change).

A preliminary step consisted of selecting and identifying the most relevant impacts that can affect the northern Egyptian coastline. This has been done in close concertation with the key stakeholders and agreed during the Inception Workshop. A brief description of the analysed impacts is given as follows:

- **Erosion.** Coastal erosion is especially high in vulnerable exposed sandy beaches with high potential of shoreline retreat, located in an area of strong sediment transport. Cliffy areas with rocky beaches are however less affected at present, but the situation can change in the future if artificial beaches are created.
- **Flooding.** The level (degree) of flooding in a coastal stretch is closely related to the mean sea level observed during stormy conditions and to the topographic characteristics of the area. The highest flooding will be registered in the low lying areas (e.g. Nile Delta areas or sabkhas) when high energetic waves and storm surge coincide leading to extreme values of sea levels.
- **Saltwater intrusion.** Sea level rise and saltwater intrusion are closely linked since the former is expected to further exacerbate the latter, significantly affecting groundwater supplies for the region.
- **Abiotic stress.** Abiotic stress has been characterized based on the rate at which Posidonia oceanica meadows can decline due to climate change.
- **Drought.** The historical and future level of drought can be directly estimated based on the precipitation data. Particularly, we focus on the number of consecutive day with low precipitation (dry days) and on the intensity of the precipitation during the rainy days.
- **Heat waves.** Heat wave levels is linked to the air temperature, and, precisely, the degree at which frequency and duration of heats waves impacts on human health can be evaluated.
- **Port downtime.** Port downtime is expressed based on the water agitation inside the port and on the overtopping over the port structures. Large values of agitation and overtopping prevent the port operability.
- **Siltation.** Siltation due to sediment deposition is a recurrent problem in the northern Egyptian coast in harbors and navigation channels, and in drainage channels. The strongest problems occur in area with strong longshore sediment transport.

To accurately quantify the different climatic impacts along the Egyptian Northern Coast and to get a spatial characterization of the impacts within each coastal unit, analysis subunits have been defined with a fixed length of 10 km along the eastern direction. At each subunit corresponds a so-called Coastal Point, where the physical impacts will be computed. This uniform division will allow us to perform an homogenous assessment of the physical impacts and to link the obtained results to the other sectorial diagnoses. Finally, the key issues derived from the integrated diagnosis will be obtained in these coastal points.

The coastal points along the Egyptian Northern Coast are presented in the following figure.

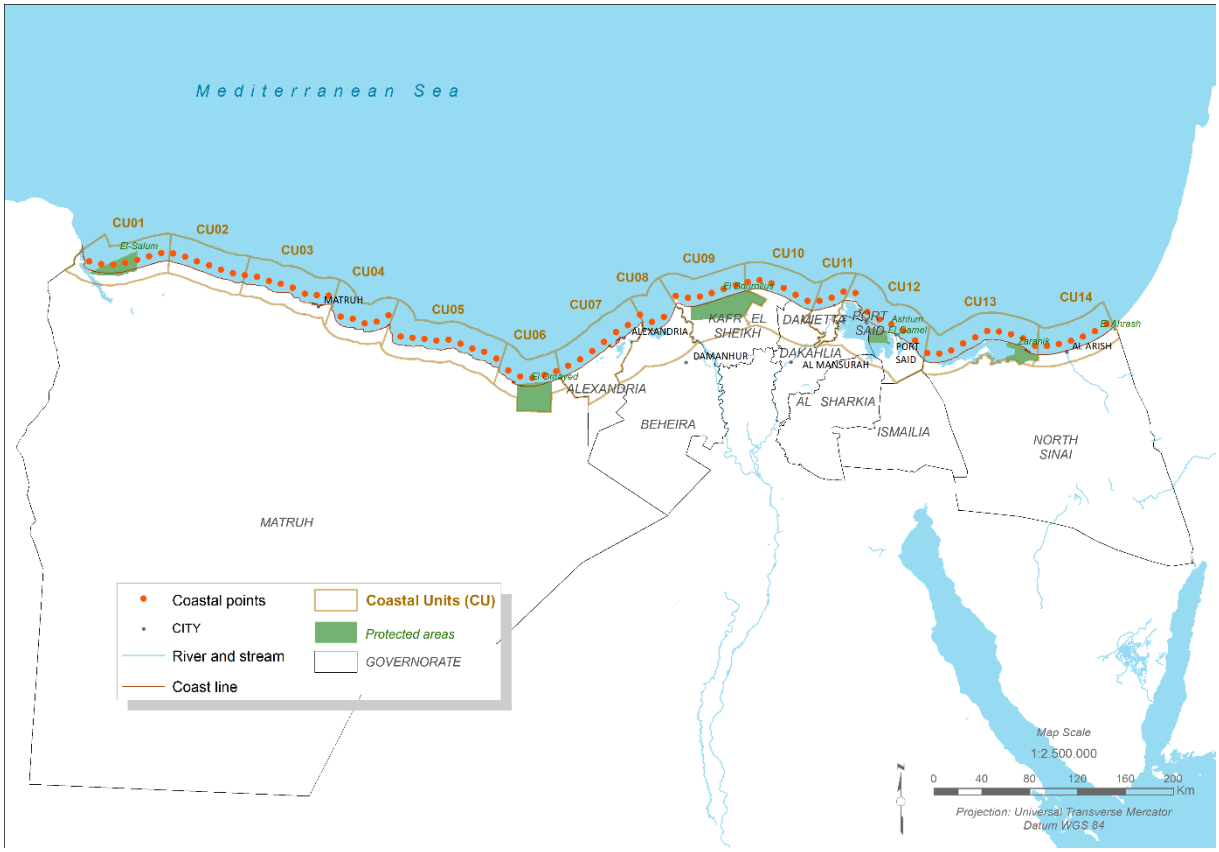


Figure 1. Coastal points (red dots) and coastal units (brown lines).

To quantify the selected physical impacts for the present and future situations, the methodology consists of 5 steps. They are presented in the following flow chart and a brief description is given next.

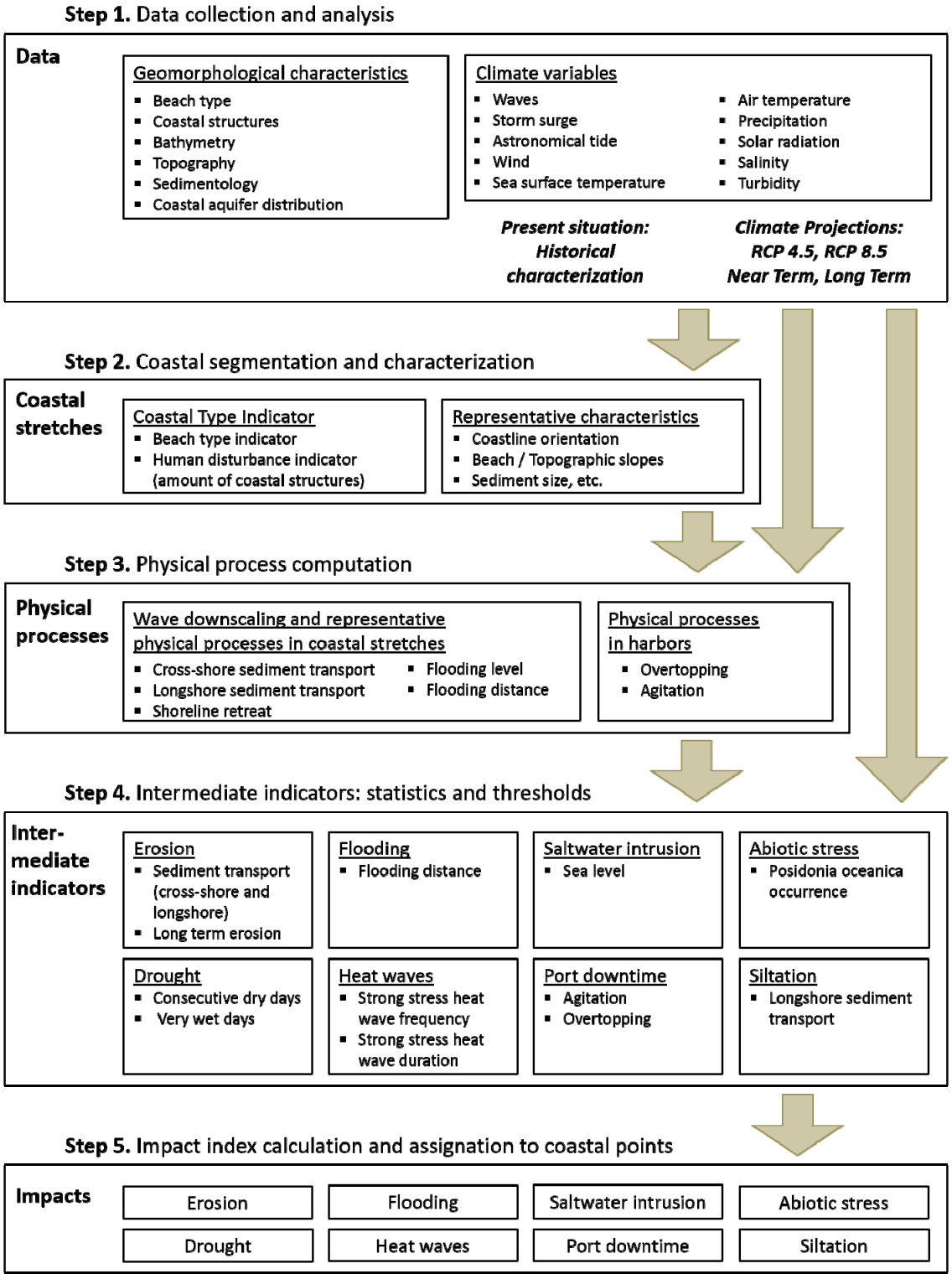


Figure 2. Flow chart of the methodology to evaluate the different impacts (physical diagnosis).

– **Step 1.** Data collection and analysis

Two types of data have been used to perform the physical assessment: (1) climate data of the past (historical) climate and of future projections along the Egyptian Northern Coast and (2) physical data of the relevant information relative to the physical characteristics and to the geomorphology of the coast. Information concerning the data used in the study have been described in the Atlas and details concerning the climate data are given in Annex 1: Hazard characterization and climate change.

– **Step 2.** Coastal segmentation and characterization

The coastline is divided into coastal stretches with length of the order of 5-15 km. This is based, essentially, on the geomorphology (e.g. changes in orientation of the coastline), on the type of beaches and on the degree of anthropization (presence of coastal structures). The results of the coastline characterization are given in Section 3.

– **Step 3.** Coastal process computation

The physical impact assessment through indicators required the computation of the main coastal processes related to erosion, flooding and channel siltation. The results of the coastal process computations are given in Section 4.

– **Step 4.** Intermediate indicators: statistics and thresholds

Here we define a series of specific indicators that will be applied to characterize the different impacts previously defined. The general method of computation and the list of the different indicators are presented in the figure next page. The detailed method and results are given in Section 5.

– **Step 5.** Calculation of impact indexes and assignation to coastal points

The last step of the impact characterization consists of determining the final indexes in a 1-3 scale (1: low, 2: medium and 3: high), in the different coastal points. These indexes will be used to determine the key issues related to our different impacts. For some impacts, intermediate indicators in a 1-5 scale (1: very low, 2: low, 3: medium, 4: high and 5: very high) have been computed. The correspondence between the 1-3 scale and 1-5 scale is given in the following table.

Index	1		2	3	
Index (1-3 scale)	low		medium	high	
Indicator	very low	low	medium	high	very high
Indicator (1-5 scale)	1	2	3	4	5

Table 1. Correspondence between the 1-5 indicator scale and the 1-3 final index scale.

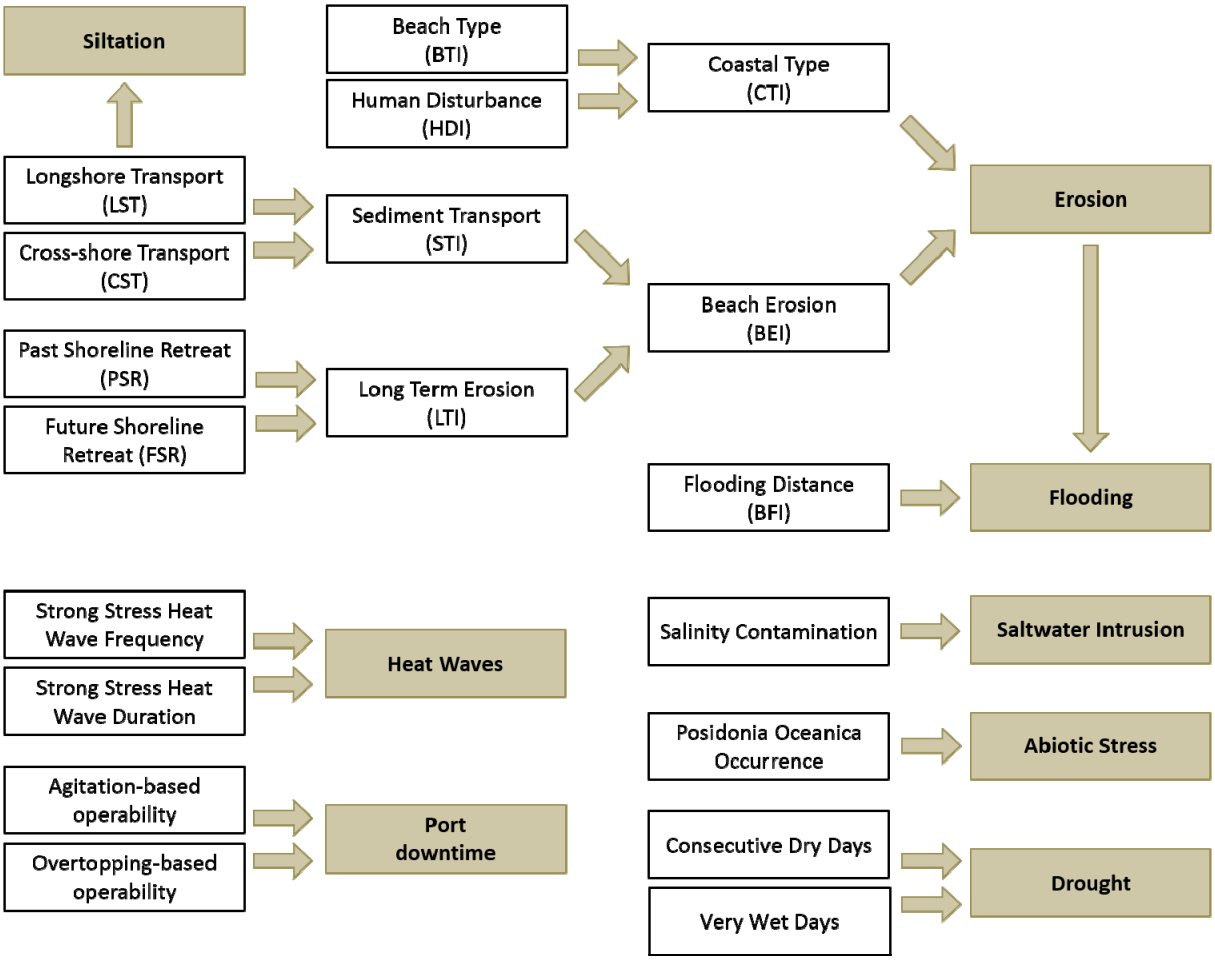


Figure 3. Flow chart of the impact calculation method based on a series of indicators.

3. COASTLINE CHARACTERIZATION

For those specific impacts related to sediment transport, erosion or flooding, which strongly depend on the morphological characteristics of the coastline, on the types of beaches and on the presence of coastal structures, a specific segmentation of the coastline is necessary. To this end, the coastline is divided into irregular coastal stretches with length of the order of 5-15 km. A smaller scale analysis is out of scope of the present study as it would require a local scale study of both marine dynamics and morphological characteristics.

The division is based, essentially, on the geomorphology (e.g. changes in orientation of the coastline), on the type of beaches (rocky, sandy) and on the degree of anthropization (presence, absence of coastal structures). The associated coastal processes (Step 3) and indicators of erosion, flooding and siltation (Step 4) will be evaluated in these segments, then, the final impacts will be assigned to the coastal points (Step 5). Notice that the other impacts have been directly evaluated at the coastal points (then, Step 2 does not proceed).

Furthermore, the analysis of these coastal segments allows us to provide the following information that will be used during the next steps:

- Representative characteristics of the coastal stretches used for the coastal process modelling (Step 3): coastal orientation, beach slope, topographic slope and sediment characteristics (medium grain size).
- An indicator of the type of coastline (the Coastal Type Indicator, CTI), that will be used in Step 4 to compute indicators of flooding and erosion. The CTI depends on the beach type (Beach Type Indicator, BTI) and on the degree of anthropization of the coastline (Human Disturbance Indicator, HDI) that are defined bellow.

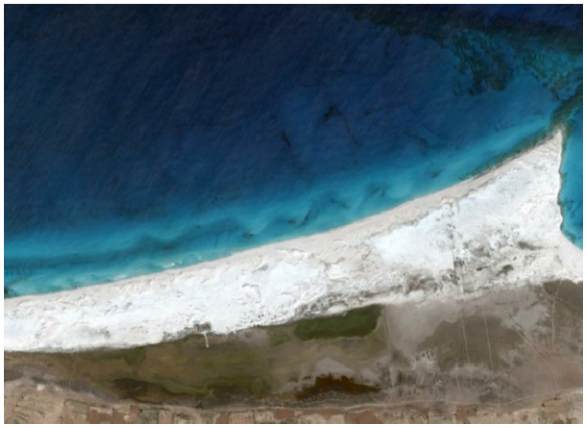
3.1. Beach Type Indicator (BTI)

This indicator has been designed specifically for the Egyptian Northern Coast based on the indicator of Gornitz et al., 1994 and later studies. Here we focus on the kinds of beaches and on the presence/lack of sandy beaches in the analysed segment. Five types of beaches have been identified, and ranked from 1 to 5. In the next part of the analysis, when the 1-5 scale is used, the value of (1) will be assigned to the least vulnerable coast to erosion and flooding, where beaches cannot be eroded, and (5) to the most vulnerable coast as, for a given marine climate, erosion will be maximum in these segments.

No beach.
W of Ceaser bay, Dabah.

Isolated beaches.
Agiba pocket beach, Marsa Matruh.

Rocks & beach.
East of Marsa Matruh.



Beach & rocks.
Maaten El Negela, Neguila.

Beach.
El Burullus sand barrier.

Figure 4. Beach type characterization. Google Earth images.

Beach Type Indicator (BTI)	
BTI	Description
1	No beach. Coastline with high cliffs, medium cliffs, low cliffs, with insignificant patches of sandy beaches, or coastline stretch consisting of major coastal structures, where harbours or seawalls impede the presence of beaches.
2	Isolated beaches. Cliffy coastline with patches of pocket sandy beaches.
3	Rocks & beach. Coastline with low cliffs and many patches of sandy beaches, rocks are still dominant.
4	Beach & rocks. Coastline with low cliffs or no cliffs (e.g. sand dunes) and long sandy beaches with the presence of rocks.
5	Beach. Coastline consisting in long sandy beaches with no rocks (e.g. delta, salt marshes, mud flats)

Table 2. Beach type characterization and Beach Type Indicator (BTI).

The coastline segmentation and the beach type characterization results for the entire Egyptian Northern Coast are shown in the next figure.

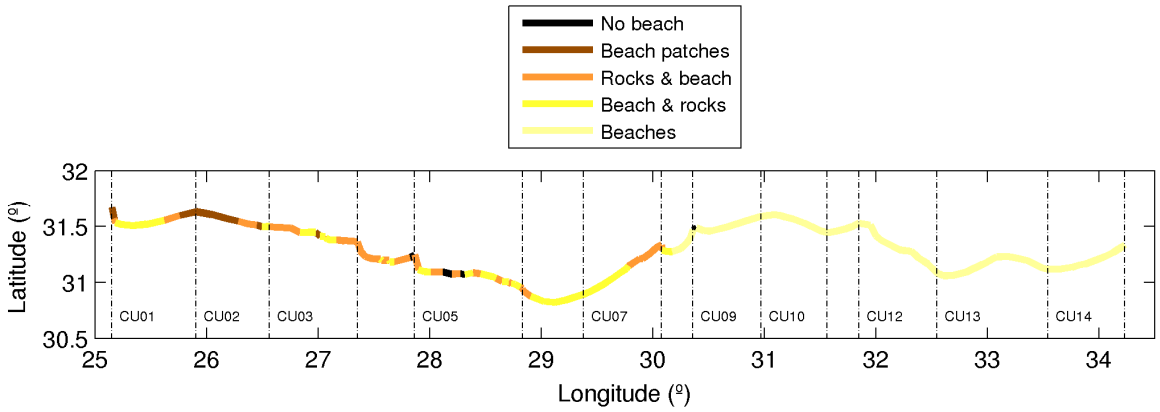


Figure 5. Beach type characterization along the Egyptian Northern Coast.

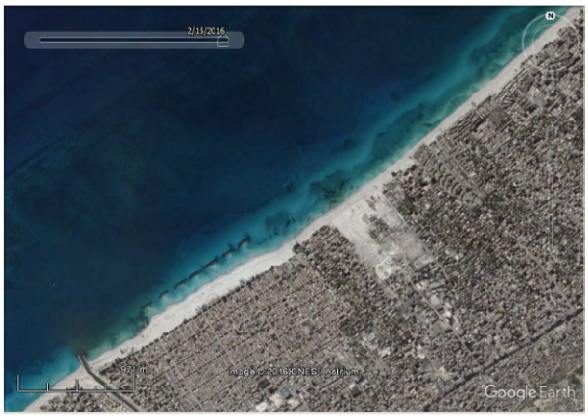
3.2. Human Disturbance Indicator (HDI)

The degree of anthropization of the coastline is determined from the percentage of the coastal segment length affected by coastal structures. The affection length has been determined by analysing the most recent Google Earth images, and different criteria have been used depending on the kinds of coastal structures. It depends essentially on the alongshore extent of the structures but also to its cross extent and position. Precisely, the affection length of the sea wall is defined as its alongshore length, but the affection length of a shore perpendicular sea groin is its cross-shore span. In this way, for a detached break water system, we defined the affection length has the alongshore extent of the entire breakwater system plus the cross-shore position of the last and first breakwater. Based on these criteria, we propose a five group classification of the coastline.

The Human Disturbance Indicator represent the degree of anthropized coastline. Value of (1) corresponds to the least vulnerable coastlines that are the stretches of coastline with no coastal structure, value of (5) corresponds to the most vulnerable coastline that are the coastline highly anthropized. Noticed that coastal stretched composed entirely by sea wall will give a maximum vulnerability. This is because, although sea walls protect the coastline from erosion and flooding impacts, they may have adverse effects on the adjacent coastal stretches.

No coastal structures (0% of the coastline length).
Burullus sand barrier.

0% - 10% of the coastline length.
West of Gamasa drain.



10% - 25% of the coastline length.
El Agami, Alexandria.

25% - 50% of the coastline length.
New Damietta.

> 50% of the coastline length.
East Rosetta sea groins.

Figure 6. Classification of the coastline anthropization. Google Earth images.

Human Disturbance Indicator (HDI)	
HDI	Description
1	0%. Coastal stretches without coastal structures
2	0-10%. Coastal stretches with coastal structures, the affection length is less than 10% of the coastal stretch length.
3	10-25%. The affection length of the coastal structures is between 10% and 25% of the coastal stretch length.
4	25-50%. The affection length of the coastal structures is between 10% and 25% of the coastal stretch length.
5	>50%. The affection length of the coastal structures is larger than half the coastal stretch length.

Table 3. Percentage of coastal stretch affected by coastal structures: the Human Disturbance Indicator (HDI).

The characterization of the coastal structures along entire Egyptian Northern Coast by using the coastal segmentation previously presented is shown in the next figure.

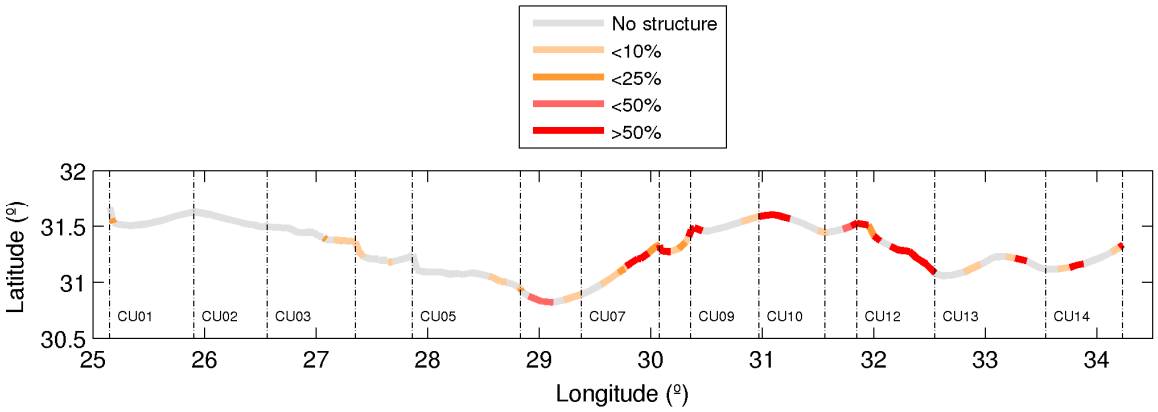


Figure 7. Coastal protection map. Percentage of coastal stretch affected by coastal structures.

3.3. Coastal Type Indicator (CTI)

The Coastal Type Indicator (CTI) will be used for the computation of erosion and flooding indicators, it depends on the beach type (Beach Type Indicator, BTI) and on the degree of anthropization of the coastline (Human Disturbance Indicator, HDI) from the following relation: CTI = (BTI + HDI) / 2.

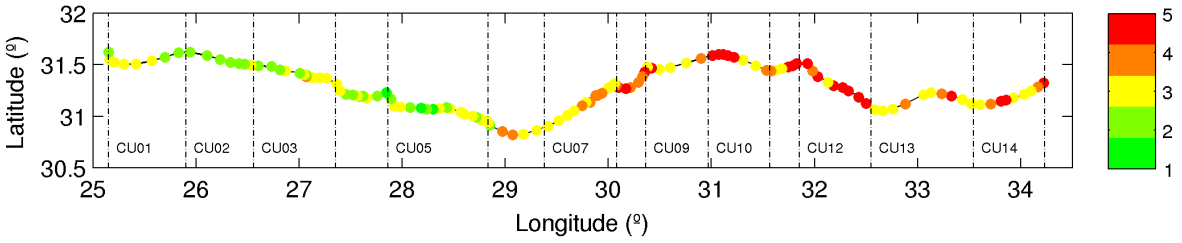


Figure 8. Coastal Type Indicator along the Egyptian Northern Coast.

4. COASTAL PROCESSES

The physical impact assessment through indicators required the computation of the main coastal processes related to erosion, flooding, channel siltation and harbour hydrodynamics.

4.1. Downscaling wave climate

To obtain the local wave climate from intermediate depths (GOW database), the formula of Larson et al., 2009 has been used. It allows us to compute incipient breaking wave properties based on a simplified solution of the wave energy flux conservation equation combined with Snell's law from the hourly sea states of the historical database (36 years) in the different coastal stretches. This is a relatively simplified technique that assumes parallel depth contour from the intermediate depths to the breaking zone, thus, the refraction effects due to the complex bathymetry and the diffraction processes over the headlands and coastal structures are disregarded. This method is valid to give an approximation of the representative mean wave climate in the surf zone along the entire northern Egyptian coast. For a more accurate downscaling, i.e., for local studies, a more sophisticated wave propagation model is needed as well as a high resolution bathymetry.

To downscale the future (projected) wave climates, a similar method has been used, and has been applied to a projected database that includes the changes in significant wave height and mean wave period obtained in the four different scenarios (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

4.2. Sediment transport

Both alongshore and cross-shore sediment transport have been computed for the different coastal stretches.

Concerning the alongshore sediment transport, different formulations have been tested (CERC formula, Coastal Engineering Manual, 2002; Kamphuis, 1991; Van Rijn, 2002; Van Rijn, 2014). The Van Rijn (2002) formula has been used as it gave the best agreement with the local studies performed by Coastal Research Institute (2012). It depends essentially on the significant wave height (at breaker line), on the wave incidence angle at the breaker line, on the sediment size and on the beach slope. Hourly time series of longshore sediment transport for the 36-year historical database as well as for the four projected scenarios have been obtained in the different coastal stretches. From these data both yearly net alongshore sediment transport (in m3/year, positive values mean eastward and negative values mean westward) and gross (positive) alongshore sediment transport (in m3/year) have been computed.

To compute the cross-shore sediment transport, the formula introduced by Bailard (1982) has been used. It depends on the significant wave height, on the fall velocity of the sediment, on the beach slope, and on other parameters that have been set as constant in this study. Positive values indicate onshore directed transport (obtained during calm conditions) and negative values indicate offshore directed transport (during storms). In this study, we compute the net yearly cross-shore transport in m3/m/year from the cross-shore transport computed from our hourly historical database.

Historical characterization

The historical characterization of the net and gross longshore sediment transport (in m3/year) and of the net cross-shore sediment transport (in m3/m/year) along the Egyptian Northern coast, based on the wave climate data of the period 1979-2015, is given as follows.

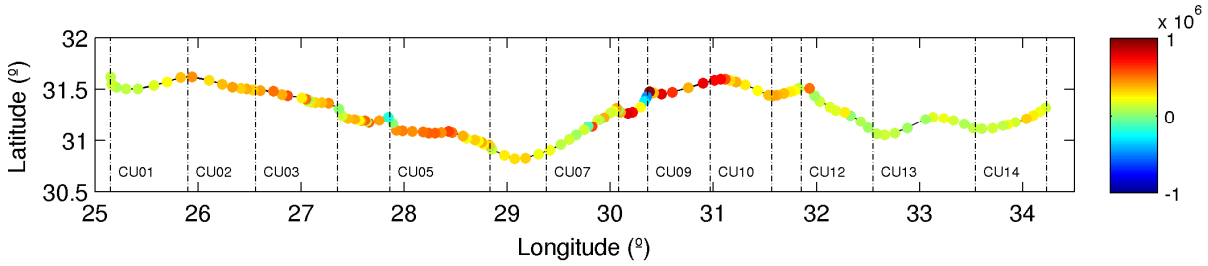


Figure 9. Net longshore sediment transport (m3/year)

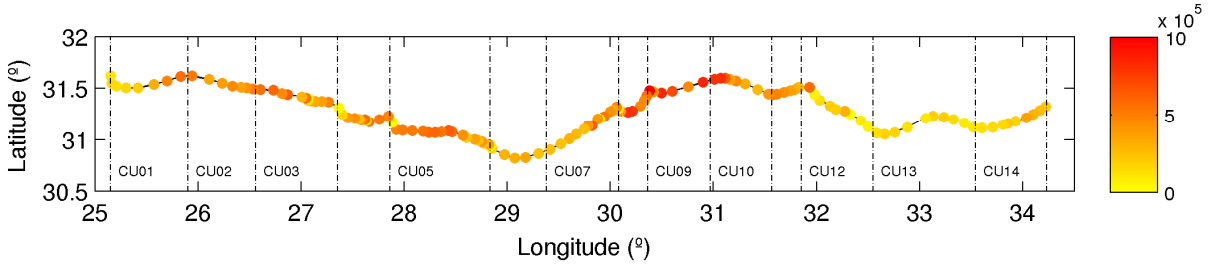


Figure 10. Gross longshore sediment transport (m3/year)

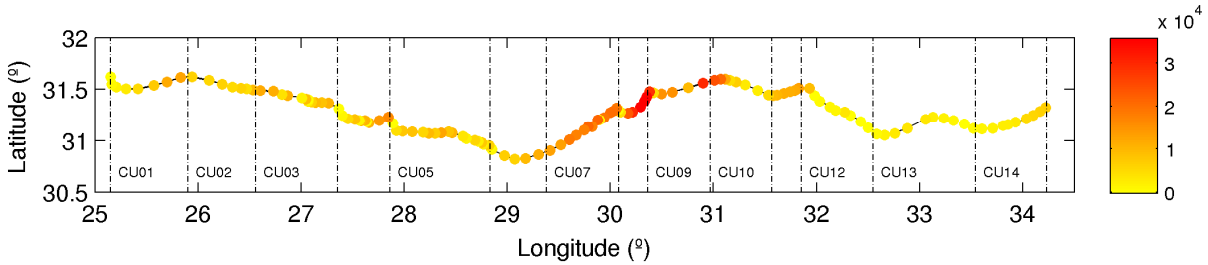


Figure 11. Net cross-shore sediment transport (m3/m/year)

Projections

The future characterization of the sediment transport is performed for four different scenarios (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term). The variations (in percentage) of the gross longshore sediment transport and of the net cross-shore sediment transport are given.

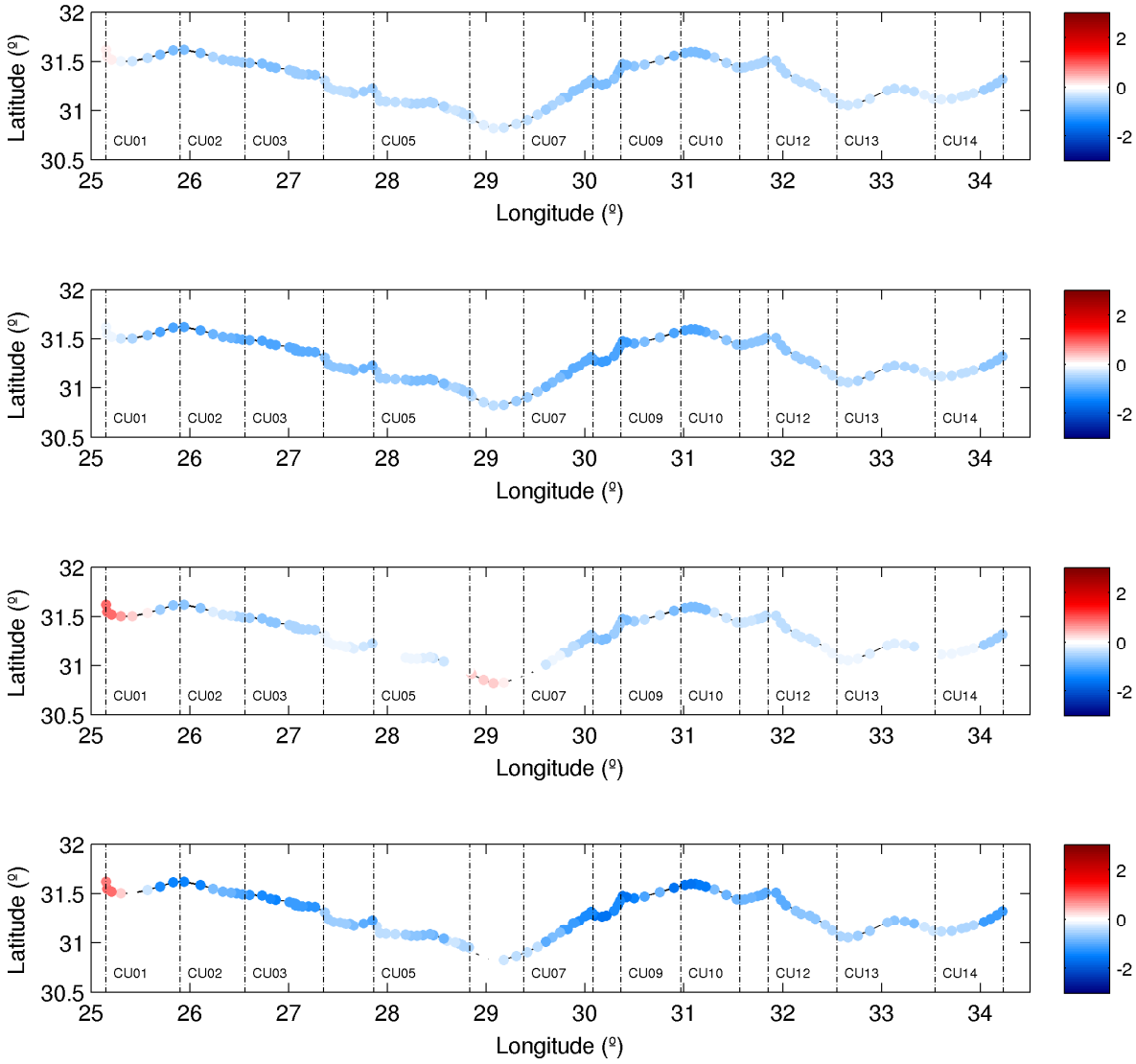


Figure 12. Gross longshore sediment transport variation (in %) for different scenarios with respect to the period 1975-2004. From top to bottom: 2010-2039 (RCP4.5), 2010-2039 (RCP8.5), 2040-2069 (RCP4.5), 2040-2069 (RCP8.5).

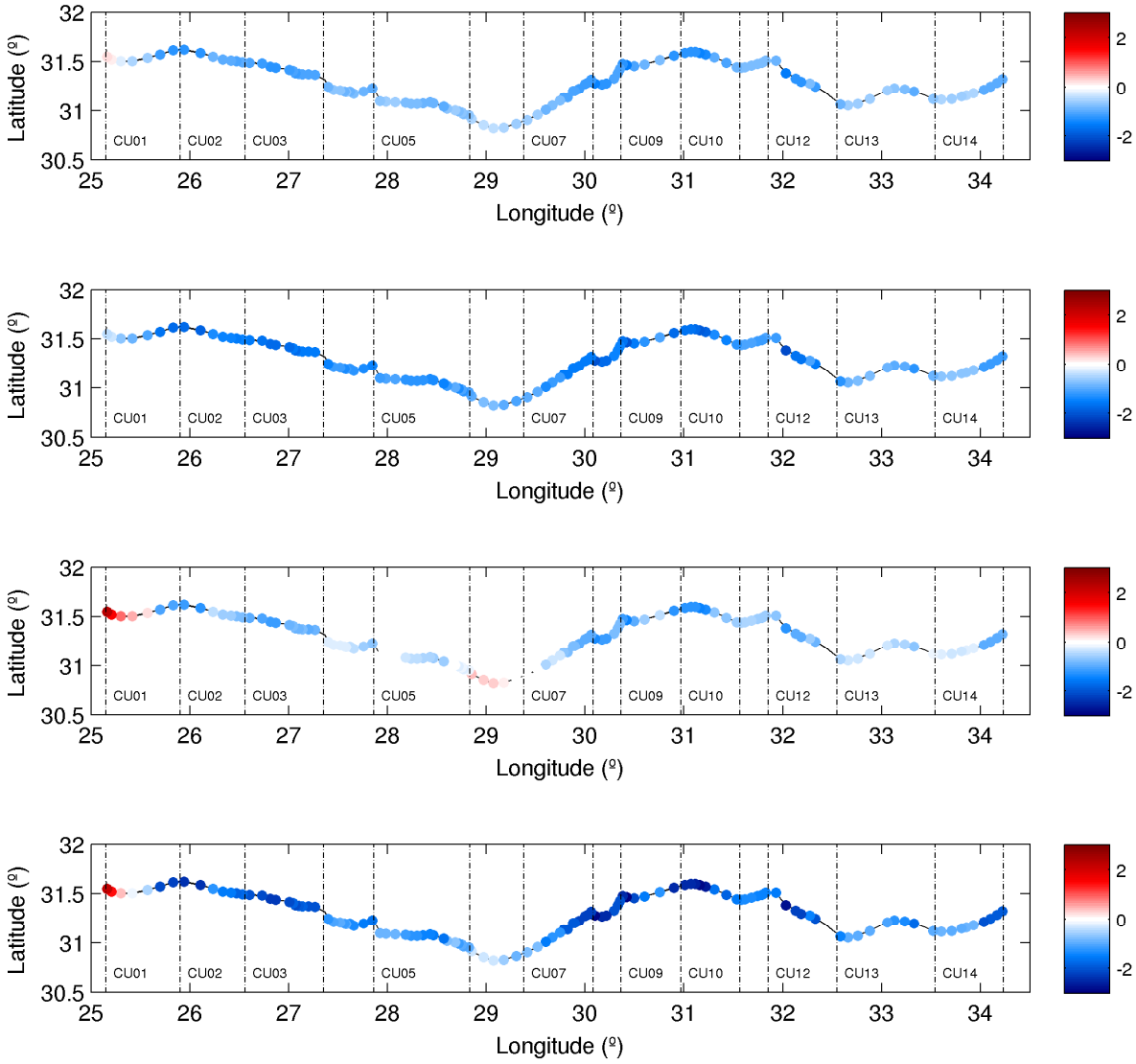


Figure 13. Net cross-shore sediment transport variation (in %) for different scenarios with respect to the period 1975-2004. From top to bottom: 2010-2039 (RCP4.5), 2010-2039 (RCP8.5), 2040-2069 (RCP4.5), 2040-2069 (RCP8.5).

4.3. Flooding

The coastal flooding in the different coastal stretches has been obtained by considering the flooding due to the astronomical tide, the meteorological tide (storm surges) and the effect of waves (wave setup). Historical data of astronomical and meteorological tides have been obtained from the GOST database. Wave setup at the shoreline has been computed by using the Dean and Dalrymple (2002) formulation from the downscaled wave climate.

Concerning the historical characterization, the representative flooding level for each coastal stretch has been defined as the 99th percentile of the hourly total flooding time series obtained from the summation of the astronomical/meteorological tidal level and wave setup at the shoreline.

To compute the projected flooding level in the different scenarios (near-term / long-term, RCP 4.5 / RCP 8.5), the astronomical tide has been obtained from the historical characterization, storm surge projections have been performed, and the wave setup projections have been obtained from wave climate projections. Furthermore, the projected sea level rise has been included.

Finally, the representative flooding distance has been obtained by considering a representative topographic slope for each coastal stretch.

Historical characterization

The historical characterization of the sea levels and flooding distances is given based on sea level data of the period 1979-2014.

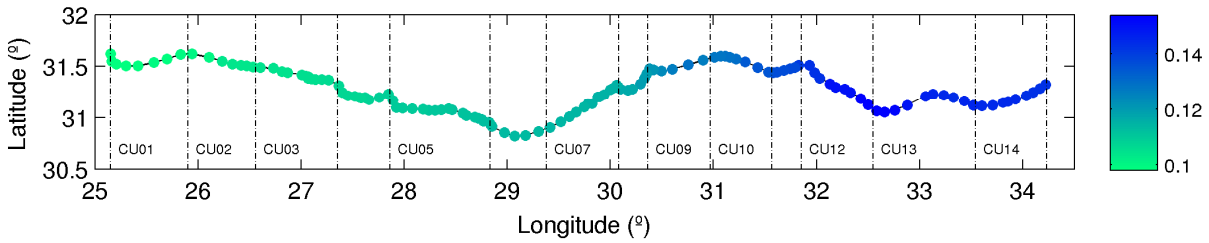


Figure 14. Mean spring tide tidal range (m).

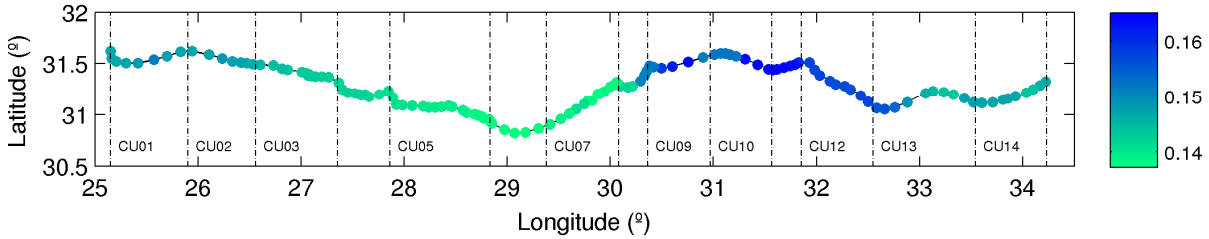


Figure 15. 99th percentile of storm surge for the period 1979-2015 (m).

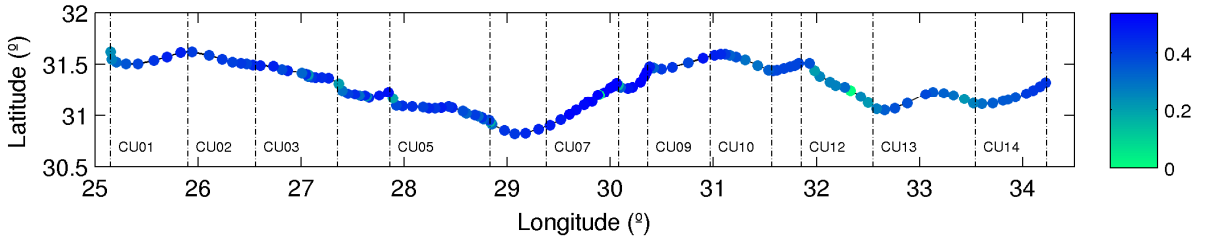


Figure 16. 99th percentile of wave setup for the period 1979-2015 (m).

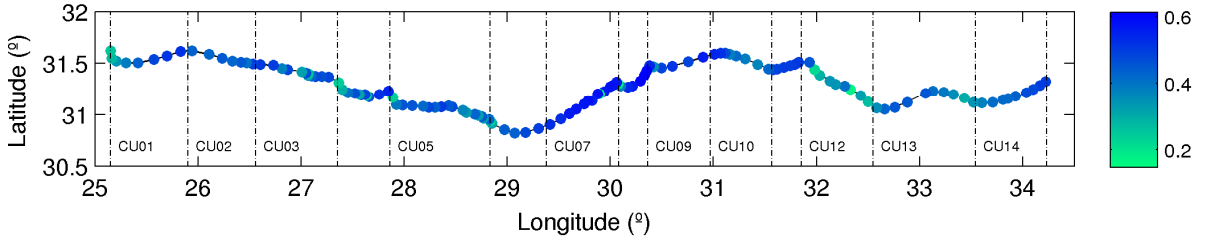


Figure 17. 99th percentile of the total flooding level for the period 1979-2015 (m).

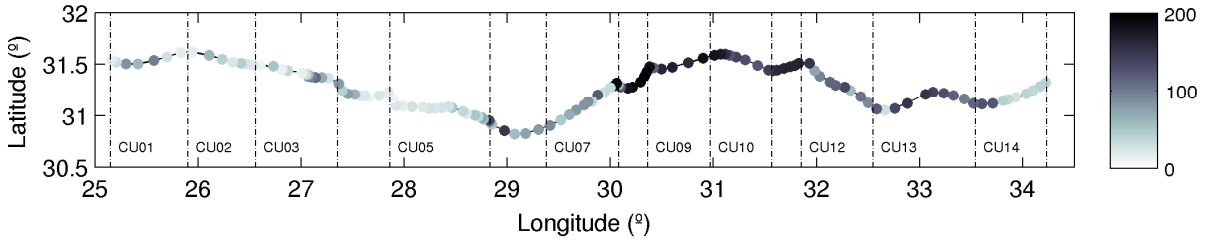


Figure 18. 99th percentile of the total flooding distance for the period 1979-2015 (m). For the computation, a minimum slope of 3:2000 has been set.

Projections

The future characterization of the flooding distance is performed for four different scenarios (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

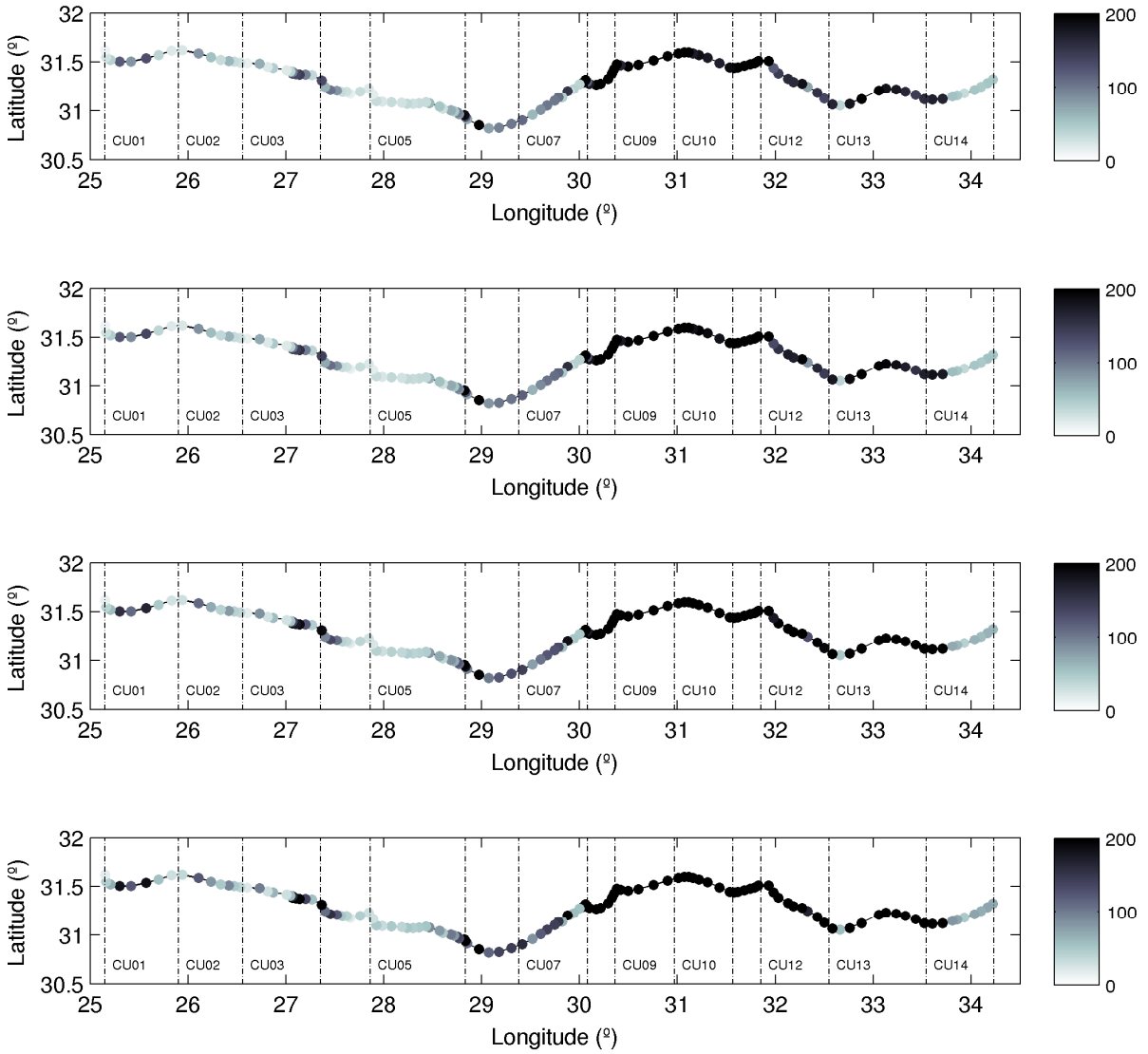


Figure 19. Projected flooding distance (for representative slopes) corresponding to the 99 percentile of the total flooding level for different scenarios (m). Minimum slope set to 3:2000, black values represent distance larger than 200 m. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

4.4. Shoreline retreat

The shoreline retreat of sandy beaches associated to sea level rise induced by climate change has been obtained following the concepts of Bruun (1954) and Dean (1977). The water depth along the beach profile will be increased as a result of sea level rise. In this new situation, the beach will adjust to maintain its equilibrium profile relative to the new water level. This is achieved by moving the profile landwards and upwards. This movement should occur at the expense of existing sand in the profile, assuming two-dimensional beach. Therefore, the shoreline retreat will occur in order to cover the shortfall sand generated on the beach. The significant wave height only exceeded 12 hours a year determinates the closure depth of the beach profile (the depth where the profile is still active). A possible increase of the incident significant wave height in the future will generate an increase in the closure depth, and therefore, a general retreat in the beach whenever the beach is oversupplied of sand.

Based on projected values of sea level rise and projected changes in wave heights, a representative shoreline retreat has been obtained in each coastal stretch for the four scenarios studied (near-term / long-term, RCP 4.5 / RCP 8.5).

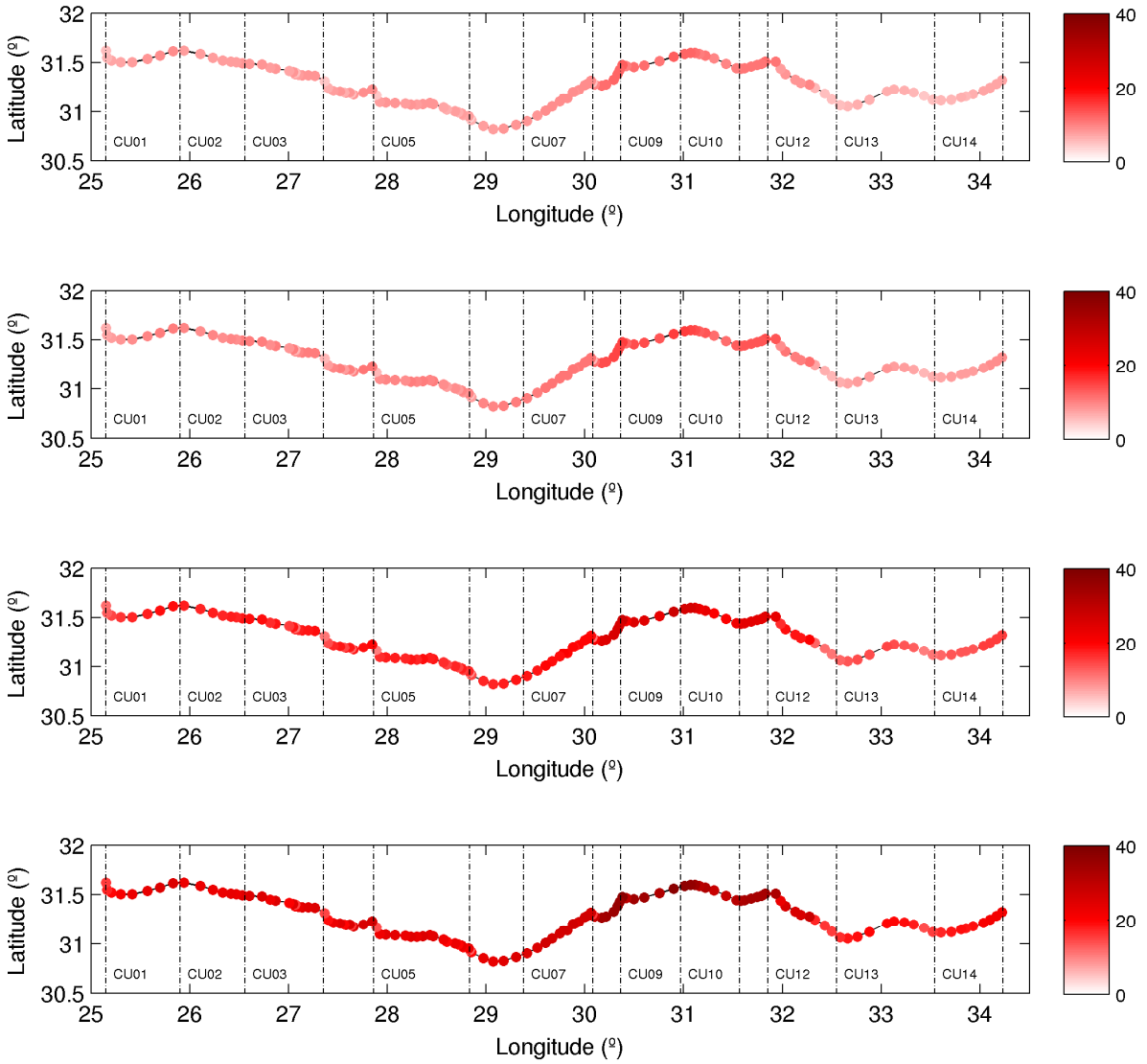


Figure 20. Expected shoreline retreat for different scenarios (m) with respect to the period 1986-2005. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

5. COASTAL IMPACTS

5.1. Erosion

An indicator to evaluate erosion impacts in the Egyptian coastline has been obtained from the **Coastal Type Indicator (CTI)** defined in step 2 and the **Beach Erosion Indicator (BEI)** which allows us to evaluate erosion of sandy beaches only. The Beach Erosion Indicator is based on the Beach Vulnerability Indicator of Alexandris an Poulos (2014), developed for sandy beaches only. The objective of such indicator definition is to evaluate the potential drivers (sediment transport) and the potential erosion for different transect of the Egyptian coast for the existing sandy beaches, but also for future potential beaches. Here we relate this potential beach erosion to the sediment transport magnitude in each coastal stretch (**Sediment Transport Indicator, STI**), and to the longer term erosion (**Long Term erosion Indicator, LTI**) related to the observed mean shoreline retreat occurred in the past and, for future scenarios, related to shoreline retreat due to sea level rise.

5.1.1. Sediment Transport Indicator (STI)

The Sediment Transport Indicator (STI), is based on the following indicators:

- **Gross longshore sediment transport (LST)**
- **Cross-shore sediment transport (CST)**

STI=(LST+CST)/2

To compute the Sediment Transport Indicator, the values of the gross longshore sediment transport and of the cross-shore sediment transport have grouped in 5 categories corresponding to (1) very low, (2) low, (3) medium, (4) strong and (5) very strong. To this end the thresholds between the different levels have to be defined. They have been defined specifically for the Egyptian coastline, such as the mean values along the Egyptian Northern Coast (weighted taken into account the coastal stretch length) belongs to the medium level (3).

Gross longshore sediment transport range (m3/year)	0 150 000	150 000 300 000	300 000 500 000	500 000 750 000	750 000 1 000 000
LST	1	2	3	4	5

Table 4. Gross Longshore Sediment Transport indicator (LST) definition.

Cross-shore sediment transport range (m3/m/year)	-3 500 500	-6 500 -3 500	-15 000 -6 500	-27 500 -15 000	-36 000 -27 500
CST	1	2	3	4	5

Table 5. Cross-shore Sediment Transport indicator (CST) definition.

Historical characterization

The indicators derived from the sediment transport calculations are presented for the historical characterization.

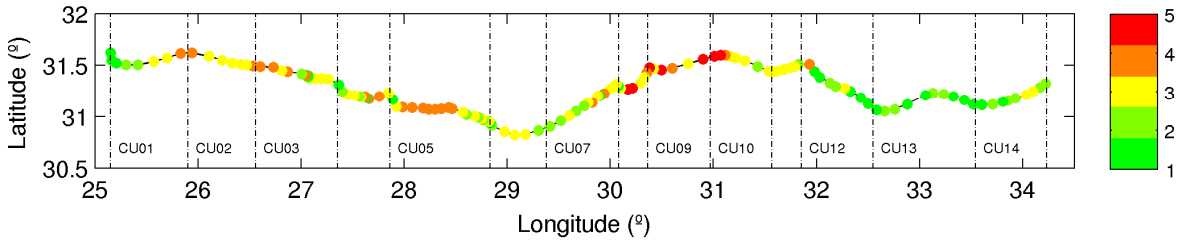


Figure 21. Gross Longshore Sediment Transport indicator (LST) along the Egyptian Northern Coast. Historical characterization.

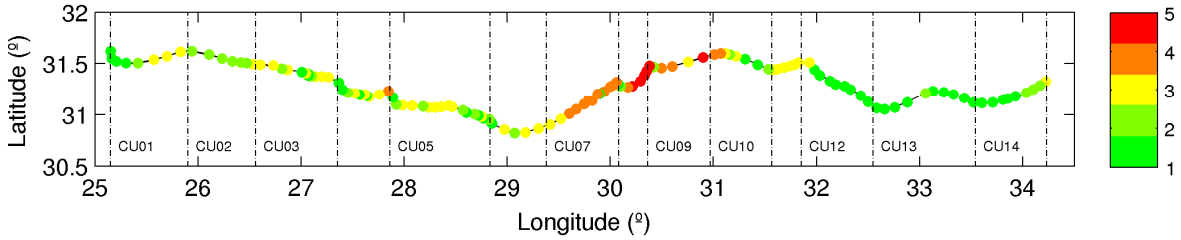


Figure 22. Cross-shore Sediment Transport indicator (CST) along the Egyptian Northern Coast. Historical characterization.

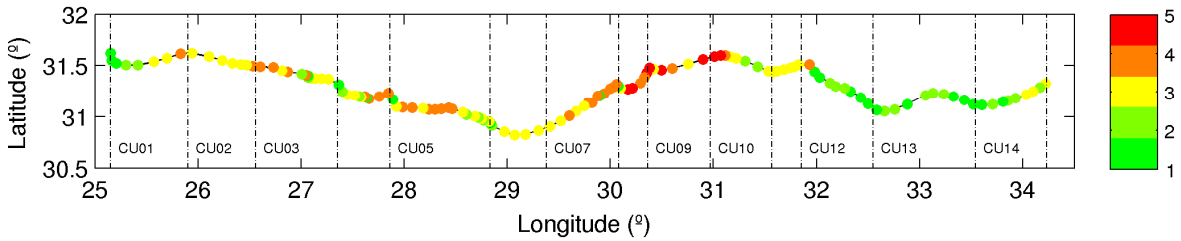


Figure 23. Sediment Transport Indicator (STI) along the Egyptian Northern Coast. Historical characterization.

Projections

No changes are expected under the four different scenarios studied (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

5.1.2. Long Term erosion Indicator (LTI)

The Long Term erosion Indicator (LTI), is based on the following indicators:

- Past observations of mean shoreline retreat (**Past Shoreline Retreat, PSR**) based on the results of Hereher (2014).
- Future erosion due to sea level rise and differences in climate dynamics (futures scenarios only): **Future Shoreline Retreat (FSR)**.

LTI=(PSR+FSR)/2

To compute the Future Shoreline Retreat indicator, the threshold values have been obtained based on the largest values for all the projected scenarios.

Projected shoreline retreat (m)	0 10	10 20	20 30	30 40	40 50
FSR	1	2	3	4	5

Table 6. Future Shoreline Retreat (FSR) indicator definition.

Historical characterization

The indicators derived from the sediment transport calculations are presented for the historical characterization.

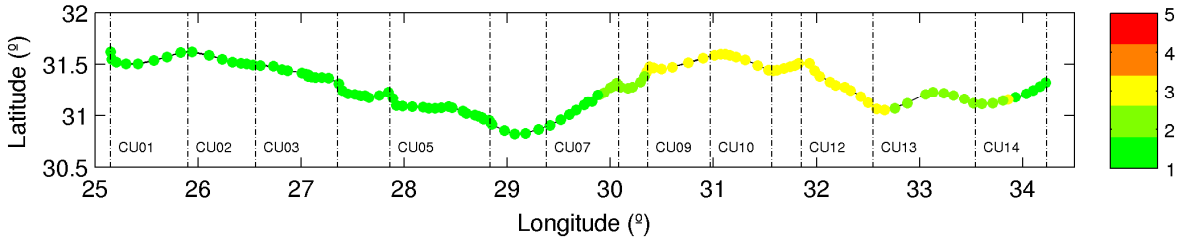


Figure 24. Long-Term erosion Indicator (LTI) along the Egyptian Northern Coast. Historical characterization.

Projections

The Long-Term erosion Indicator has been calculated for the four different scenarios studied (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

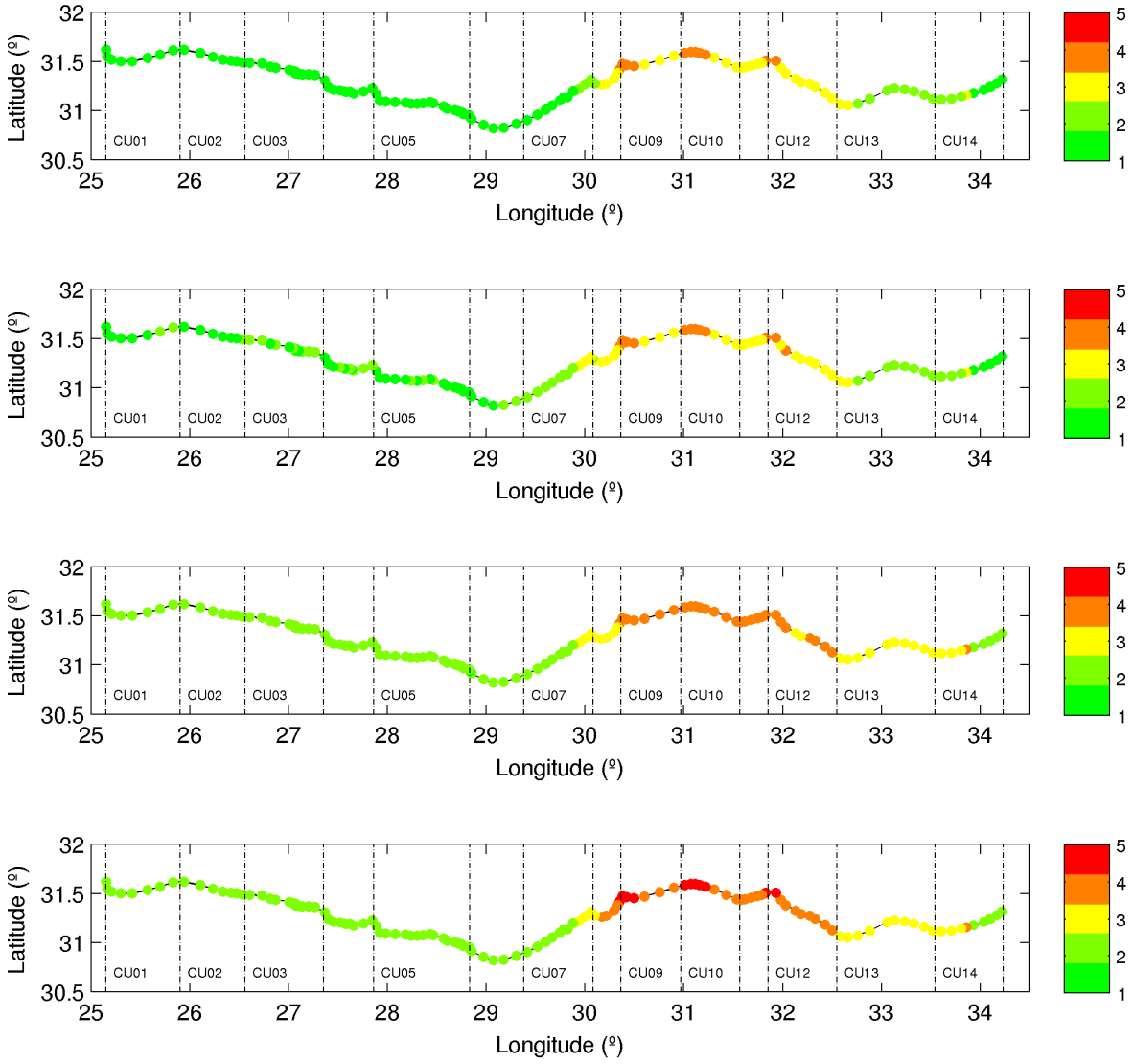


Figure 25. Long-Term erosion Indicator (LTI) along the Egyptian Northern Coast for different projected scenarios. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

5.1.3. Beach Erosion Indicator (BEI)

The Beach Erosion Indicator (BEI) is derived from the Sediment Transport Indicator (STI) and the Long Term erosion Indicator (LTI) from the following relationship:

$$BEI=(STI+LTI)/2$$

This indicator is based on the Beach Vulnerability Indicator of Alexandris an Poulos (2014), developed for sandy beaches only.

Historical characterization

The Beach Erosion Indicator has been obtained from the historical climate dynamics based on the results previously described.

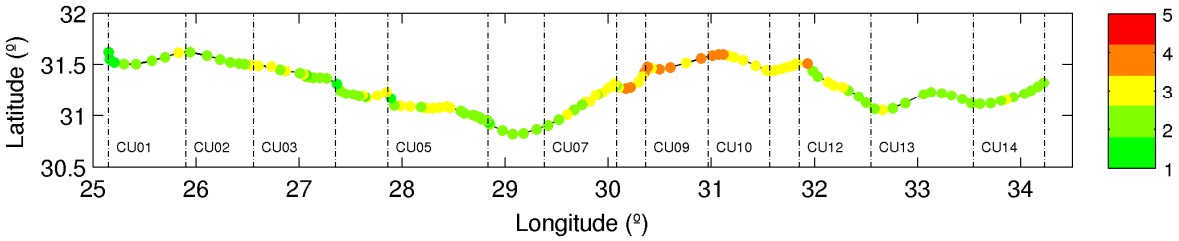


Figure 26. Beach Erosion Indicator (BEI) along the Egyptian Northern Coast. Historical characterization.

Projections

The Beach Erosion Indicator has been calculated for the four different scenarios studied (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

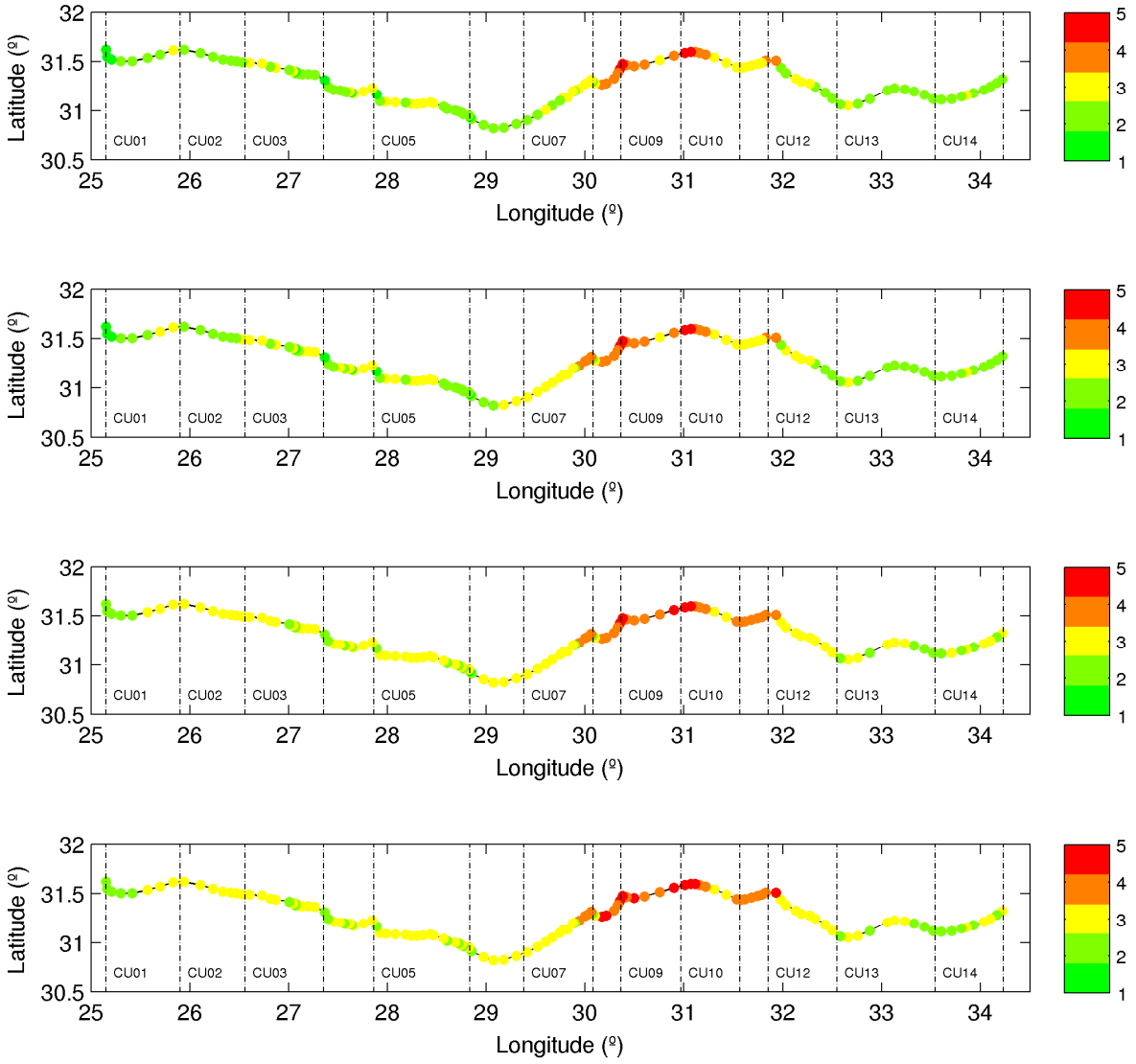


Figure 27. Beach Erosion Indicator (BEI) along the Egyptian Northern Coast for different projected scenarios. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

5.1.4. Coastal Erosion Indicator (CEI)

The Beach Erosion Indicator does not consider the type of coastline and can therefore give high erosion in a stable coastline stretch that is composed by rocks. However, this serves as indicator of potential erosion and can be useful for the future development of artificial beaches in rocky environments. For the key issue identification, the Coastal Erosion Indicator (CEI) will be preferred. It is defined in order to take into account the coastal types to evaluate the erosion in the following way:

$$CEI=(CTI+BEI)/2$$

Historical characterization

The Coastal Erosion Indicator has been obtained from the historical climate dynamics based on the results previously described.

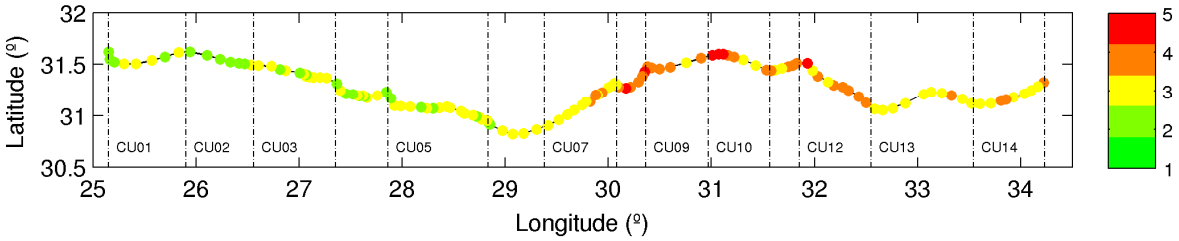


Figure 28. Coastal Erosion Indicator (CEI) along the Egyptian Northern Coast. Historical characterization.

Projections

The Coastal Erosion Indicator has been calculated for the four different scenarios studied (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

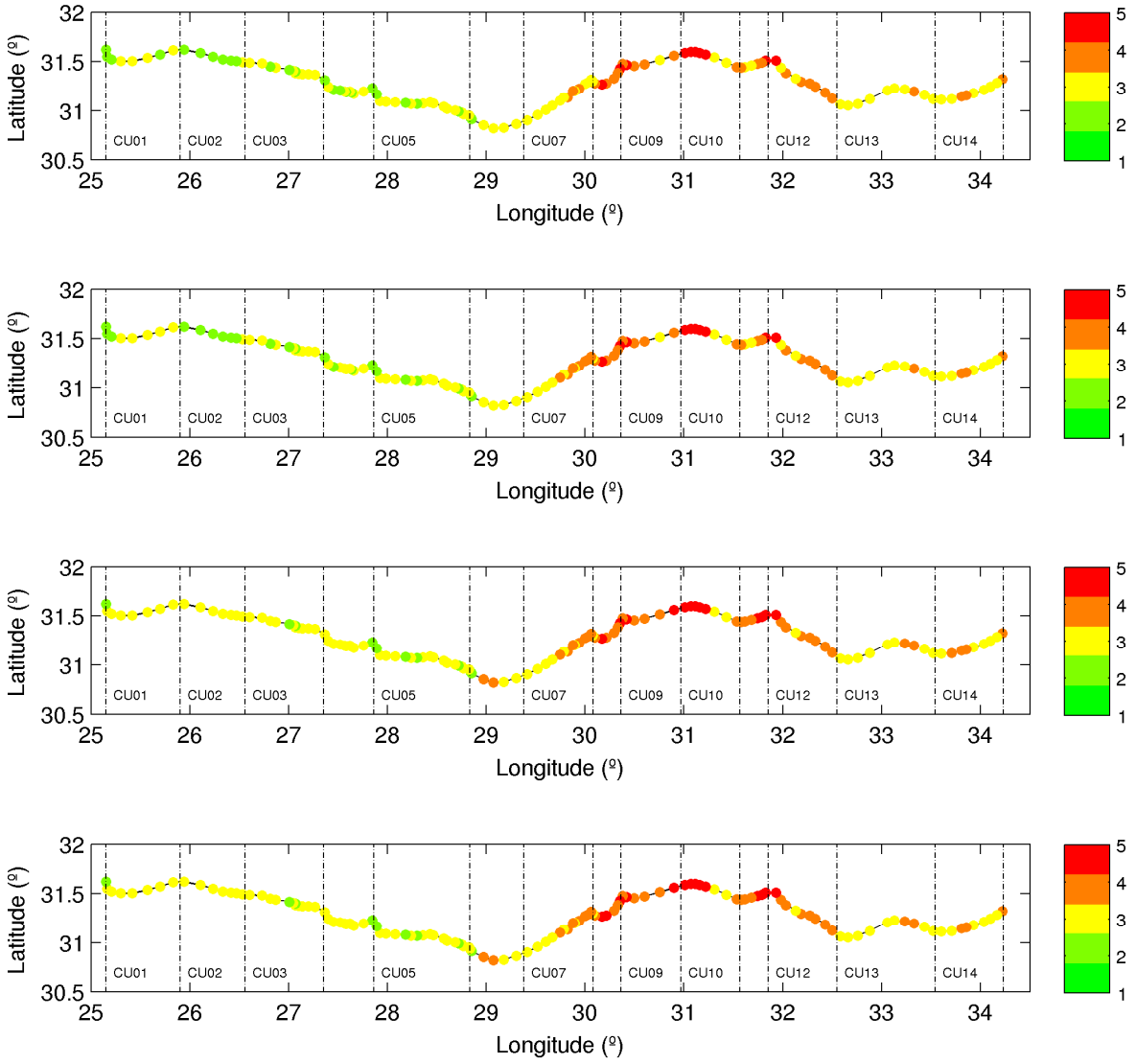


Figure 29. Coastal Erosion Indicator (CEI) along the Egyptian Northern Coast for different projected scenarios. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

5.1.5. Assignation to coastal points, the erosion index

The final erosion index is then obtained for the historical and future characterizations following the criteria previously introduced.

Historical characterization

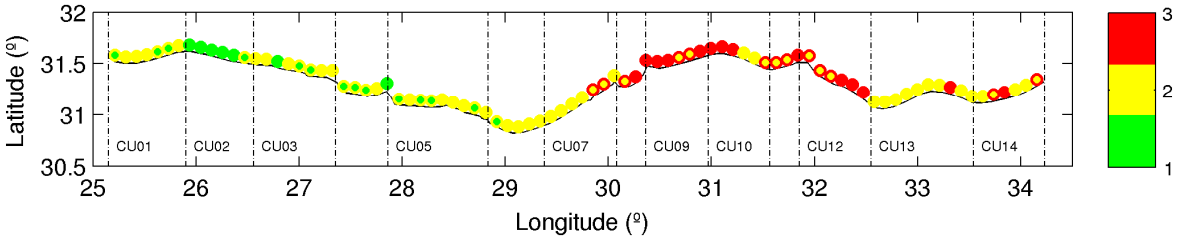


Figure 30. Erosion index along the Egyptian Northern coast. Historical characterization. When a coastal point is assigned to multiple coastal stretches, the minimum and maximum values of the indicators are given.

Projections

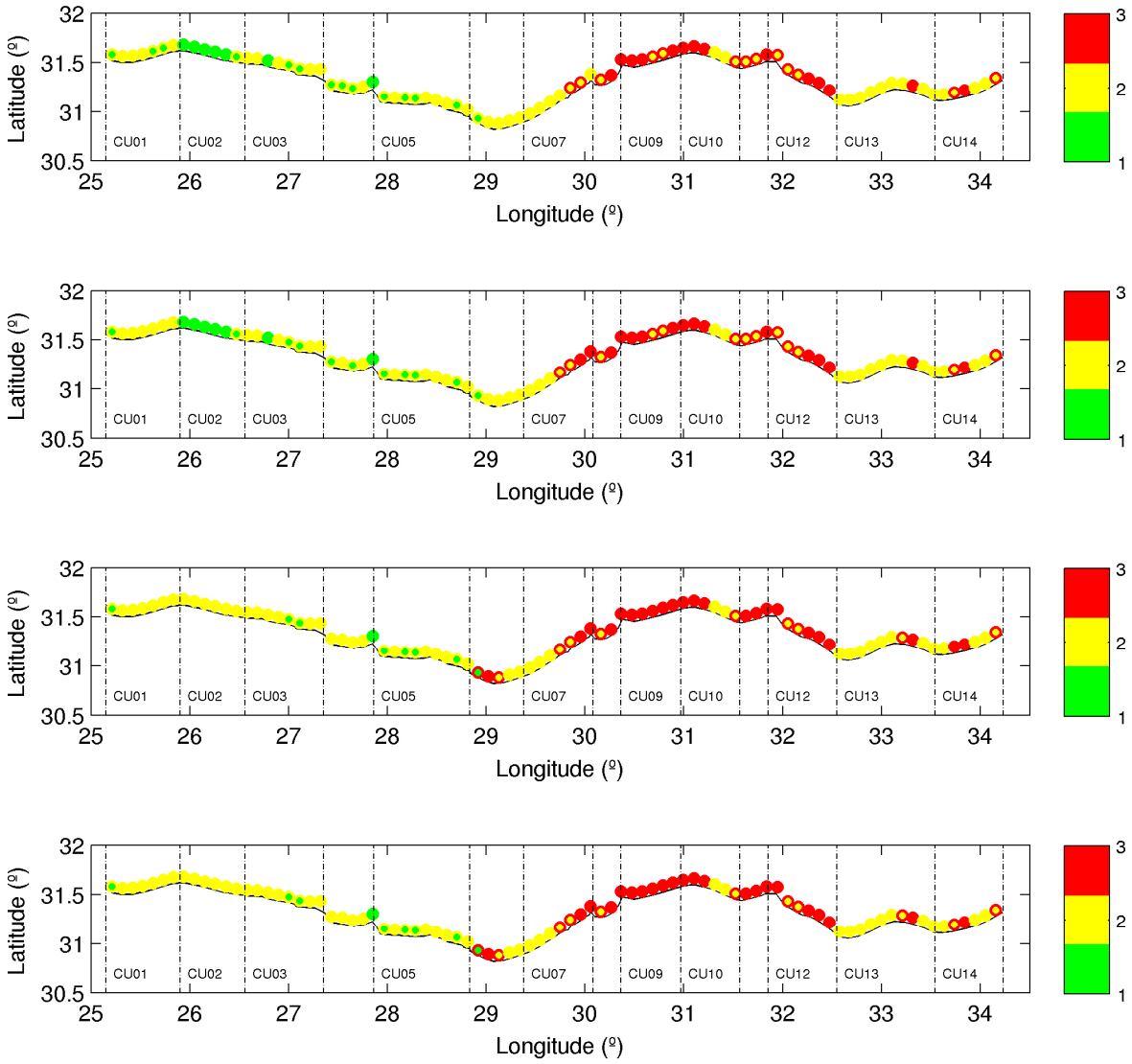


Figure 31. Erosion index along the Egyptian Northern coast for different projected scenarios. When a coastal point is assigned to multiple coastal stretches, the minimum and maximum values of the indicators are given. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

5.2. Flooding

An indicator to evaluate coastal flooding has been designed based on the representative flooding distance over the different coastal stretches (through the **Beach Flooding Indicator, BFI**) but also, by considering in some way the possible interaction between the erosion and flooding processes. For instance, a coastal stretch strongly affected by erosion, or that expects a strong shoreline retreat in the future will be more severely concerned by flooding problems.

5.2.1. Beach Flooding Indicator (BFI)

To compute the Beach Flooding Indicator, the values of the flooding distance have been grouped in 5 categories corresponding to (1) very low, (2) low, (3) medium, (4) strong and (5) very strong flooding distance. Similarly to the sediment transport classification, the thresholds between the different levels have been defined such as the mean flooding value along the Egyptian Northern Coast (weighted taken into account the coastal stretch length) belongs to the medium level (3). These values have been obtained based on the historical data, this means that for the projected scenarios, the sea level rise will increase the indicator values and that the projected mean value will not necessarily belong to the medium level.

Flooding distance (m)	0 40	40 70	70 100	100 150	> 150
BFI	1	2	3	4	5

Table 7. Beach Flooding Indictor (BFI) definition.

Historical characterization

The Beach Flooding Indicator has been obtained from the historical climate dynamics based on the results previously described.

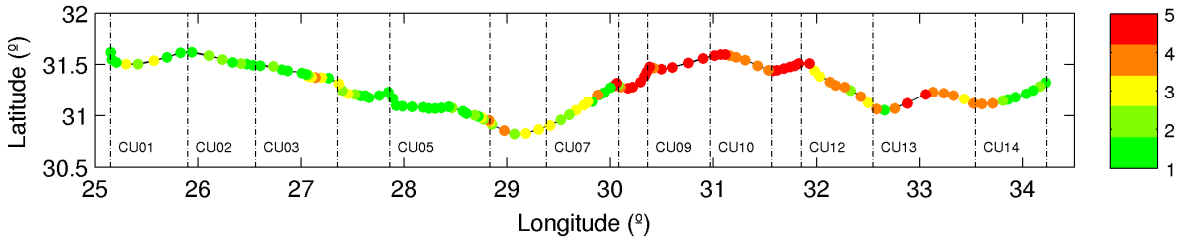


Figure 32. Beach Erosion Indicator (BEI) along the Egyptian Northern Coast. Historical characterization.

Projections

The Beach Erosion Indicator has been calculated for the four different scenarios studied (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

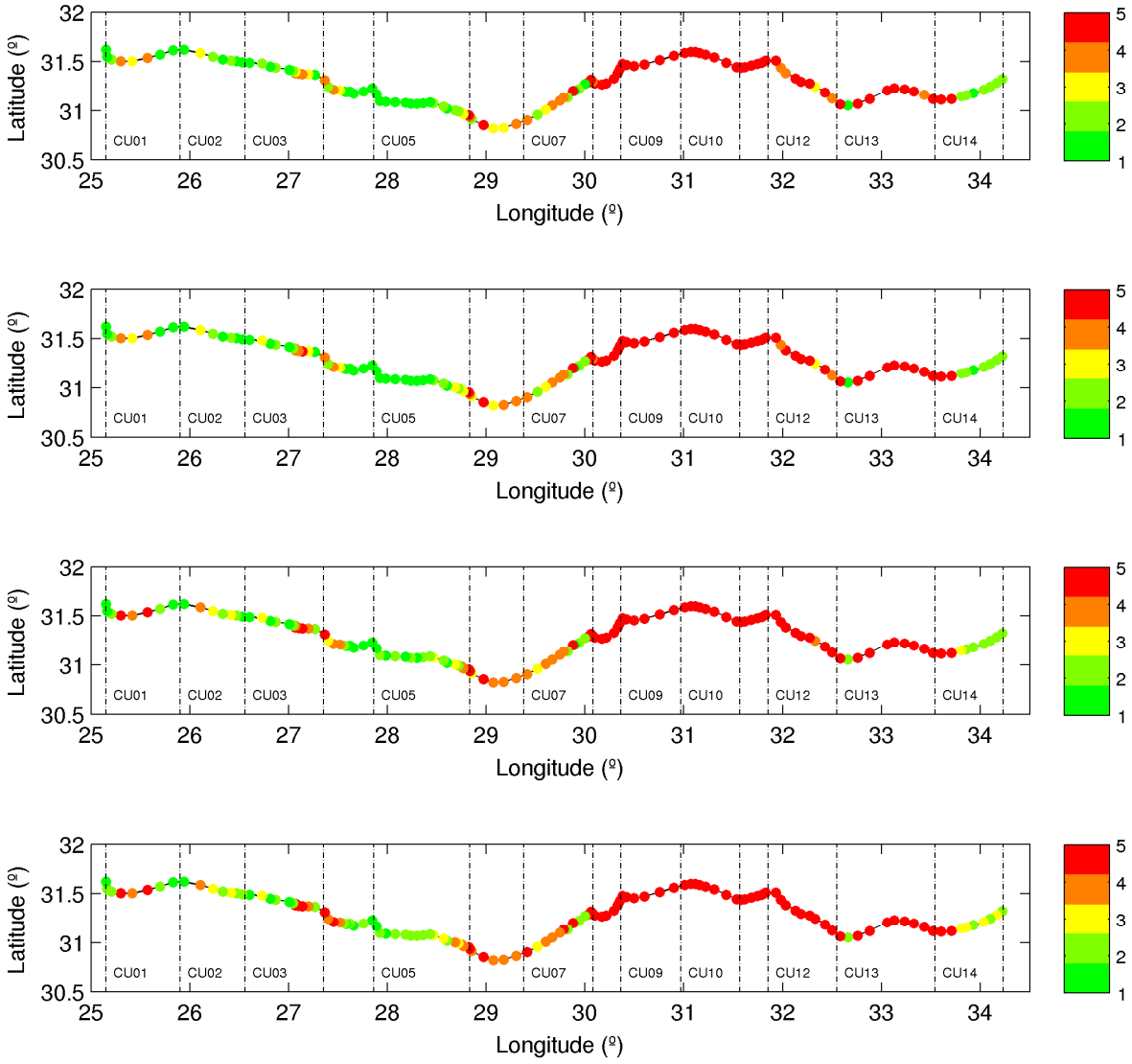


Figure 33. Beach Flooding Indicator (BEI) along the Egyptian Northern Coast for different projected scenarios. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

5.2.2. Coastal Flooding Indicator (CFI)

The Coastal Flooding Indicator has been designed in order to consider the interaction between flooding and erosion (and, implicitly to take into account the beach type and the degree of anthropization of the coastline). It is defined as follows:

CFI = (CEI + BFI) / 2

Historical characterization

The Coastal Flooding Indicator has been obtained from the historical climate dynamics based on the results previously described.

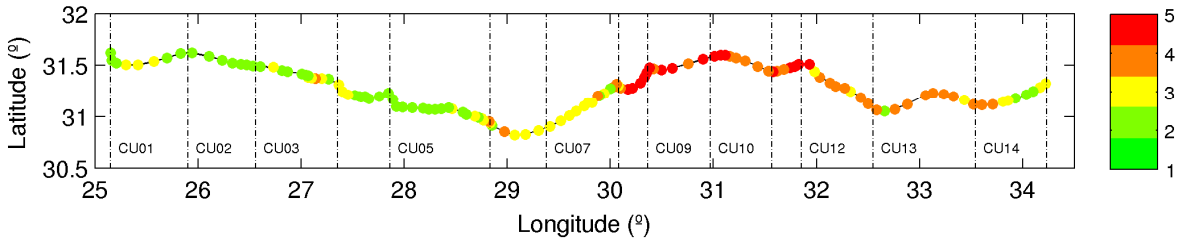


Figure 34. Coastal Flooding Indicator (CFI) along the Egyptian Northern Coast. Historical characterization.

Projections

The Coastal Erosion Indicator has been calculated for the four different scenarios studied (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

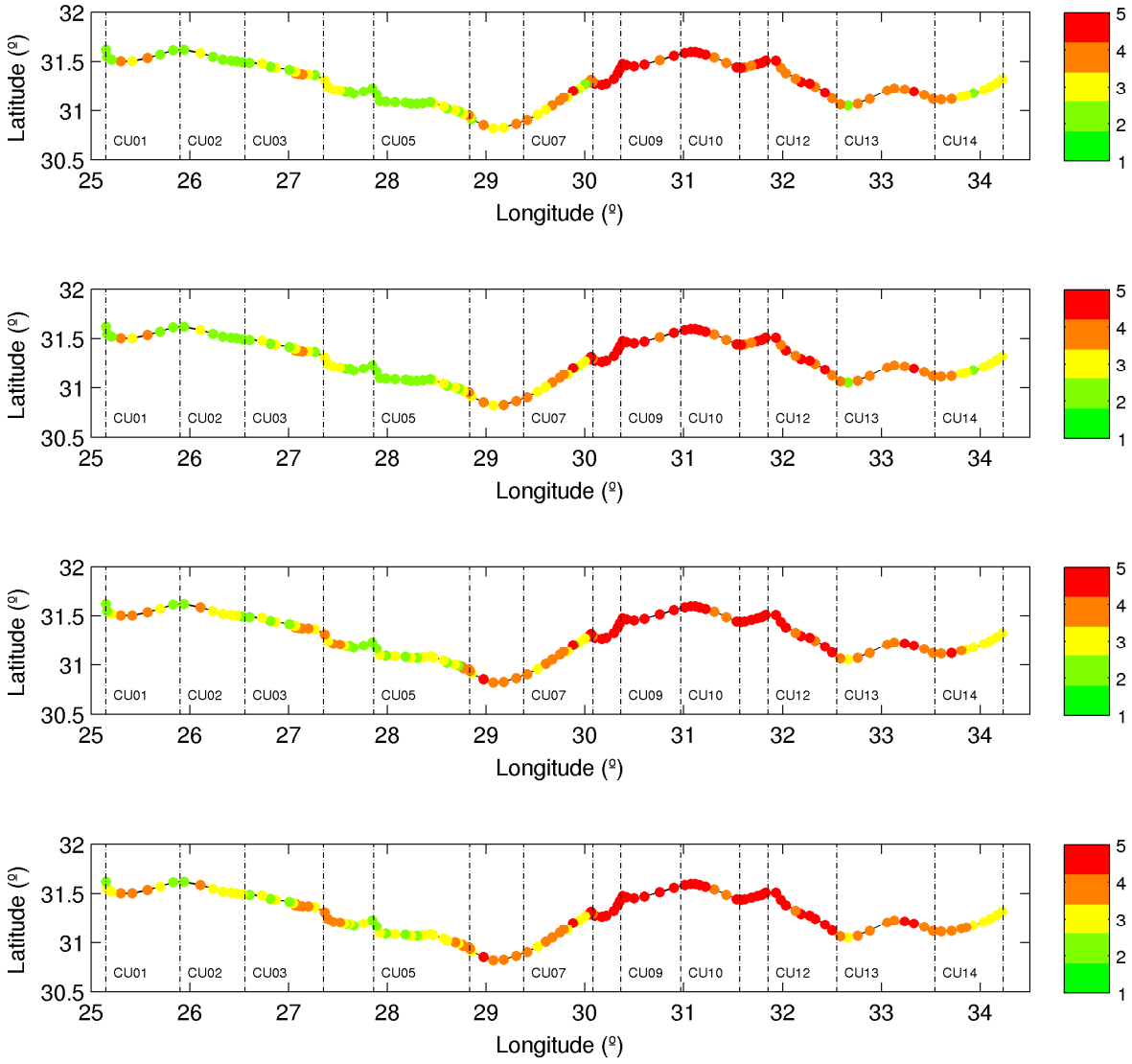


Figure 35. Coastal Flooding Indicator (CFI) along the Egyptian Northern Coast for different projected scenarios. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

5.2.3. Assignation to coastal points, the flooding index

The final flooding index is then obtained for the historical and future characterizations following the criteria previously introduced.

Historical characterization

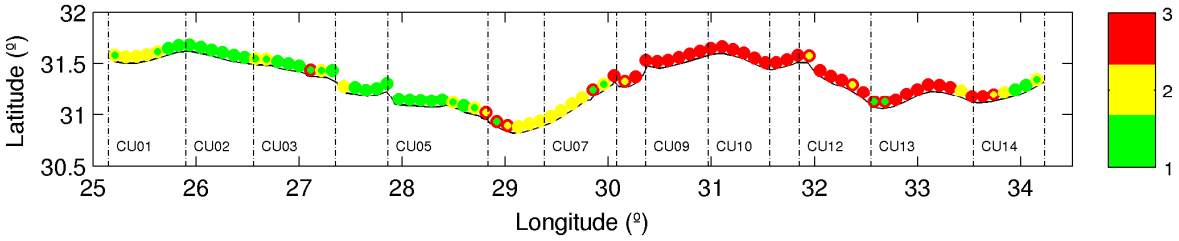


Figure 36. Flooding index along the Egyptian Northern coast. Historical characterization. When a coastal point is assigned to multiple coastal stretches, the minimum and maximum values of the indicators are given.

Projections

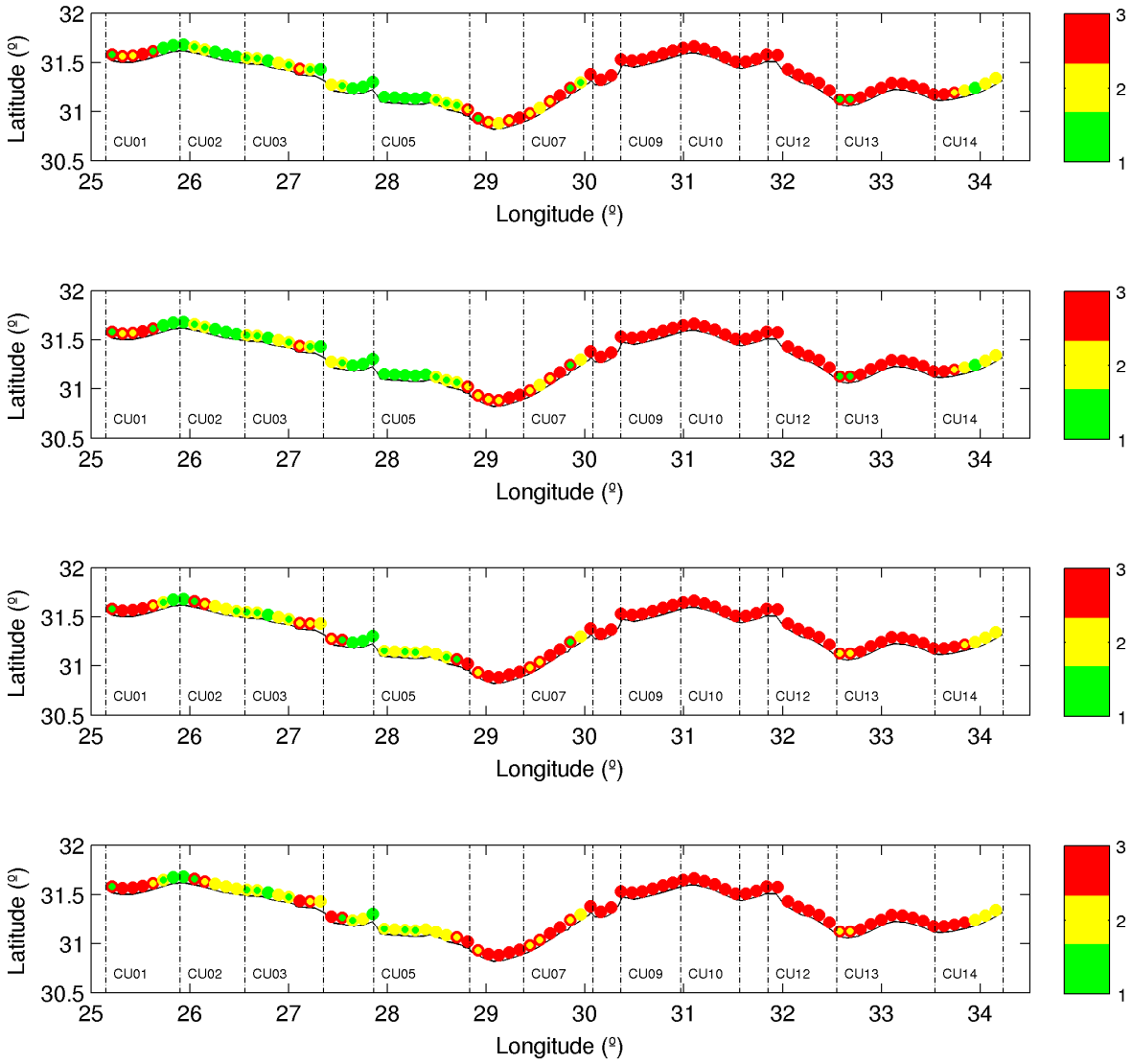


Figure 37. Flooding index along the Egyptian Northern coast for different projected scenarios. When a coastal point is assigned to multiple coastal stretches, the minimum and maximum values of the indicators are given. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

5.3. Saltwater intrusion

5.3.1. Coastal aquifers and sea level rise

Sea level rise and saltwater intrusion are closely linked since the former is expected to further exacerbate the latter, significantly affecting groundwater supplies for the region. The following figures show the location of the coastal aquifer in Egypt and sea level rise for the periods 2016-2035 and 2046-2065 under RCP4.5 and RCP8.5. The coastal aquifer extends all over the coastal stretch and has been digitalized according to existing literature on the topic (Elbeih, 2015; Masouh, 2014). Certain variability in sea level rise can be observed along the Egyptian Northern Coast, with the highest values projected for the western coast.

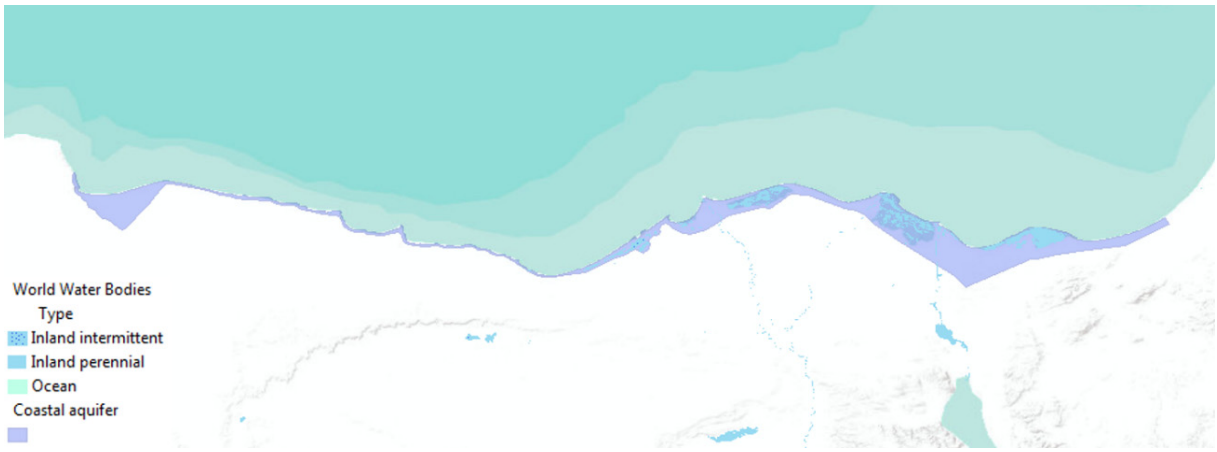


Figure 38. Coastal aquifer and water bodies.

Figure 39. Coastal aquifer and water bodies (colour shapes) and relative sea level rise under RCP4.5 for the period 2016-2035 (colour dots).

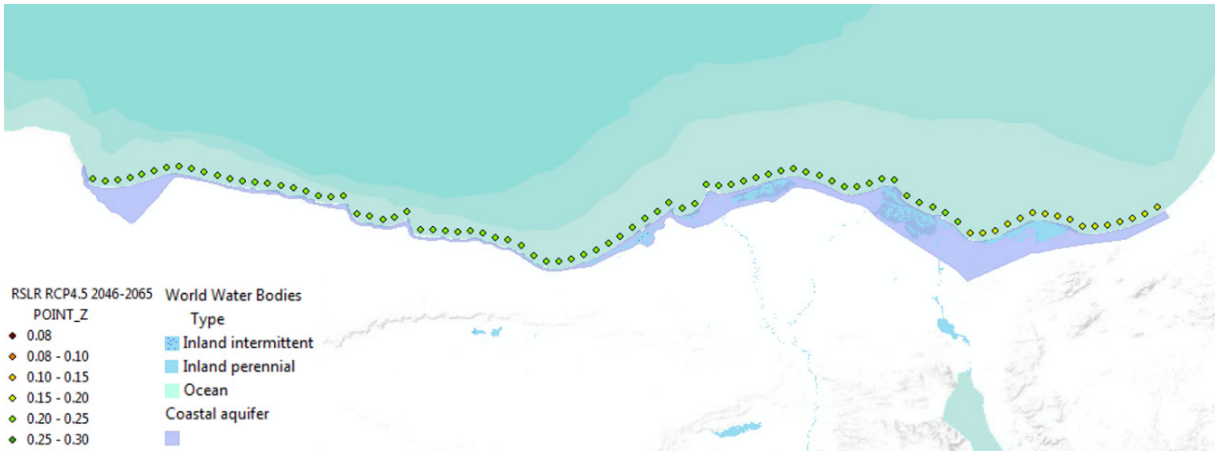


Figure 40. Coastal aquifer, water bodies (colour shapes) and relative sea level rise under RCP4.5 for the period 2046-2065 (colour dots).

Figure 41. Coastal aquifer, water bodies (colour shapes) and relative sea level rise under RCP8.5 for the period 2016-2035 (colour dots).

Figure 42. Coastal aquifer, water bodies (colour shapes) and relative sea level rise under RCP8.5 for the period 2046-2065 (colour dots).

5.3.2. Saltwater intrusion index

According to such close relation between sea level rise and salt water intrusion a saltwater intrusion index has been herein developed based on expert judgement to indicate the degree at which salinity contaminates the coastal aquifer (low, medium or high) and how it varies for different horizons. For the definition of the index over the historical period 3 factors have been taken into account: 1) information from stakeholders, 2) the coastal aquifer and 3) water bodies along the coastal stretch. For the evolution of saltwater intrusion across future scenarios, thresholds between low-medium and medium-high have been established as 10 cm and 20 cm of sea level rise, respectively.

Historical characterization

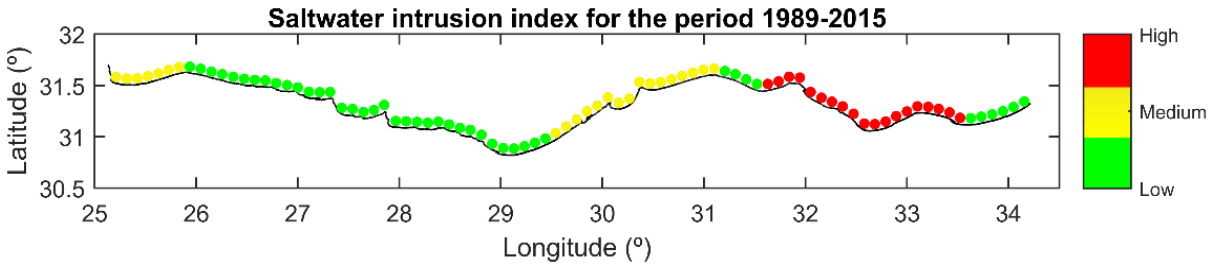


Figure 43. Saltwater intrusion index for the period 1989-2015

Projections

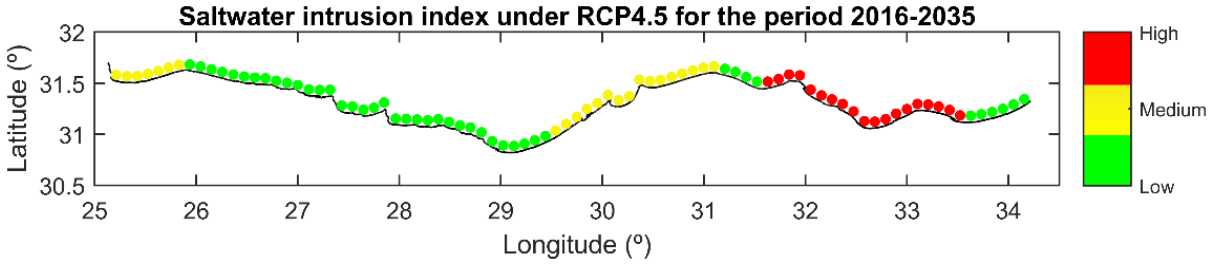


Figure 44. Saltwater intrusion index under RCP4.5 for the period 2030-2040

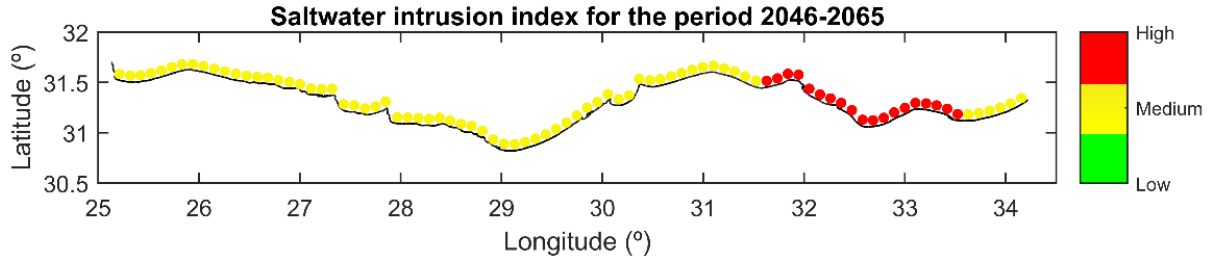


Figure 45. Saltwater intrusion index under RCP4.5 for the period 2050-2070

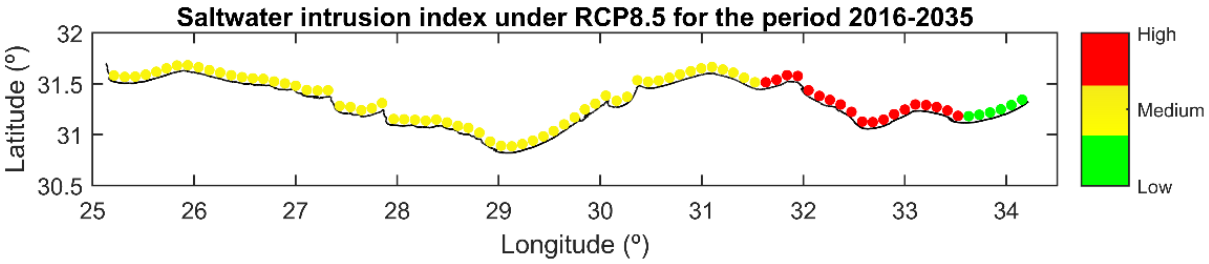


Figure 46. Saltwater intrusion index under RCP8.5 for the period 2030-2040

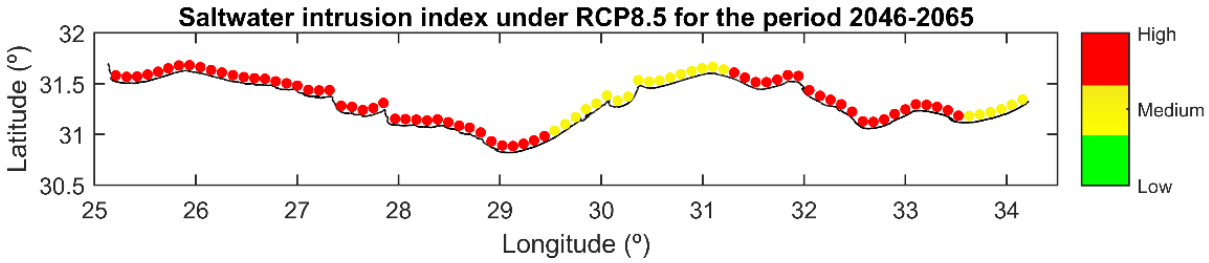


Figure 47. Saltwater intrusion index under RCP8.5 for the period 2050-2070

5.4. Abiotic stress

Abiotic stress has been characterized based on the rate at which Posidonia oceanica meadows can decline due to climate change.

5.4.1. Probability of occurrence of Posidonia oceanica

The rate at which Posidonia oceanica meadows are declining due to climate change and human activities is alarming (Telesca et al., 2015). A Posidonia oceanica indicator has been constructed upon its probability of occurrence. For that purpose presence/absence data across the Mediterranean basin has been derived from the COCONET project. The application of the Maxtent model has enabled us to obtain present and future probabilities of occurrence over the 21st century, based on sea surface temperature projections. In addition to the sea surface temperature, the simulation involves a set of variables whose contribution to the model reaches 5% (Coro et al., 2015), including the maximum photosynthetically available radiation, the mean turbidity, the mean significant wave height and the salinity. This work developed by IHCantabria was presented at the Coastal and Estuarine Research Federation (CERF) Congress in 2015 (Puente et al., 2015). The following figures show the probability of occurrence (values between 0 and 1) of Posidonia oceanica for the present and for the periods 2040-2070 and 2070-2100, under RCP4.5 and RCP8.5.

Historical characterization

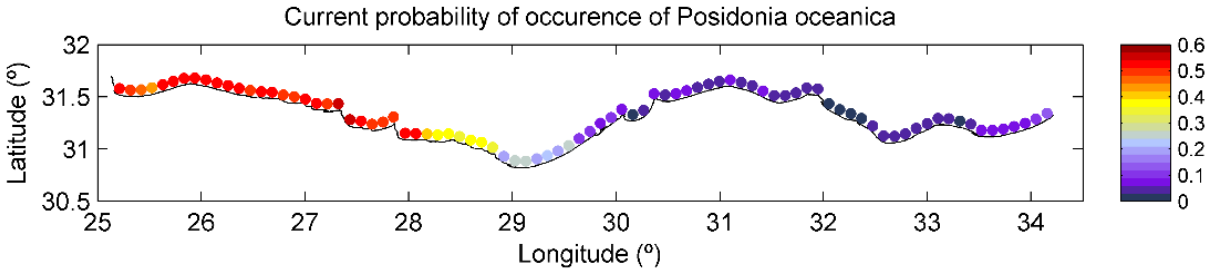


Figure 48. Current probability of occurrence of Posidonia oceanica

Projections

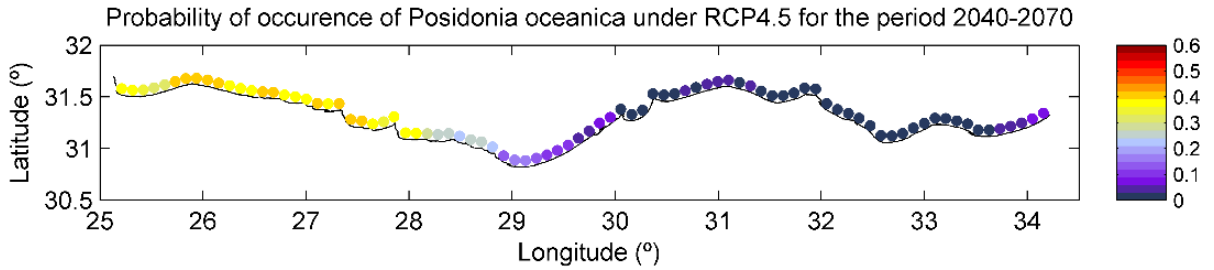


Figure 49. Probability of occurrence of Posidonia oceanica under RCP4.5 for the period 2040-2070

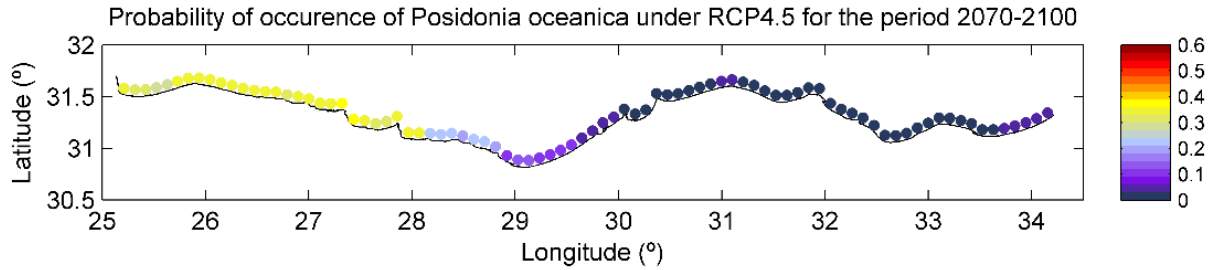


Figure 50. Probability of occurrence of Posidonia oceanica under RCP4.5 for the period 2070-2100

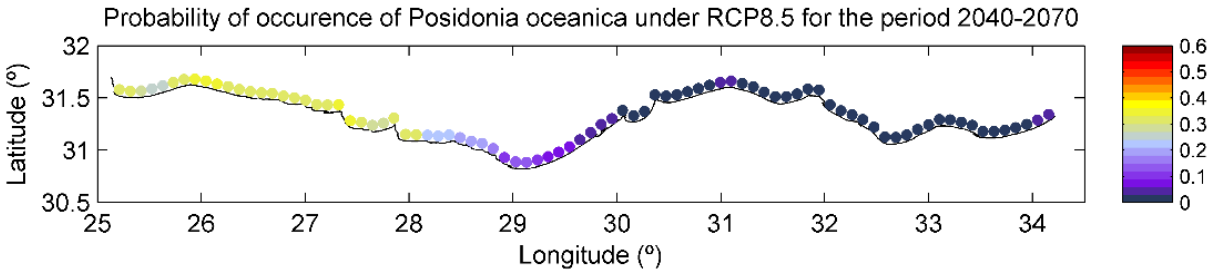


Figure 51. Probability of occurrence of Posidonia oceanica under RCP8.5 for the period 2040-2070

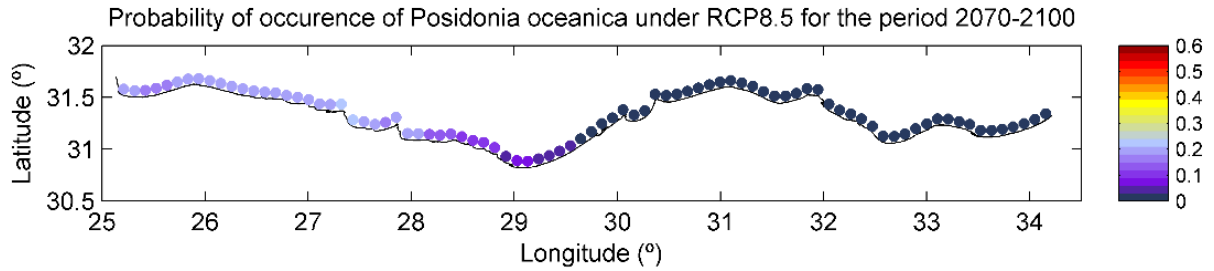


Figure 52. Probability of occurrence of Posidonia oceanica under RCP8.5 for the period 2070-2100

5.4.2. Posidonia oceanica index

Based on all the results above presented, a Posidonia oceanica index has been herein developed. Such index indicates the degree at which Posidonia oceanica occurs in the Egyptian coast (low, medium or high) and how it declines over time (or even disappears). Thresholds between high-medium presence and medium-presence-absence have been established as 0.4 and 0.2 probability of occurrence, respectively.

Historical characterization

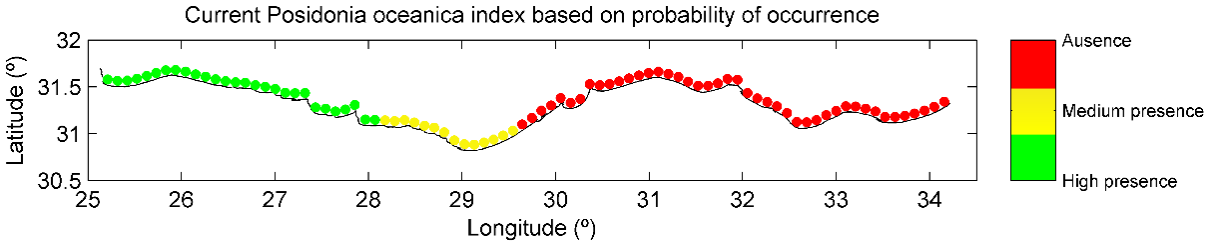


Figure 53. Current Posidonia oceanica index based on probability of occurrence

Projections

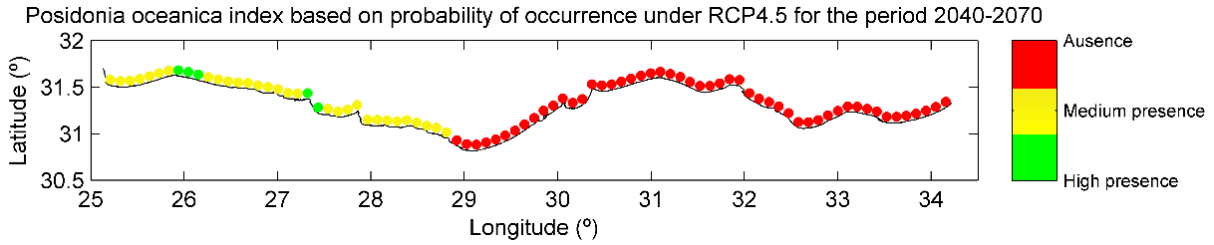


Figure 54. Posidonia oceanica index based on probability of occurrence under RCP4.5 for the period 2040-2070

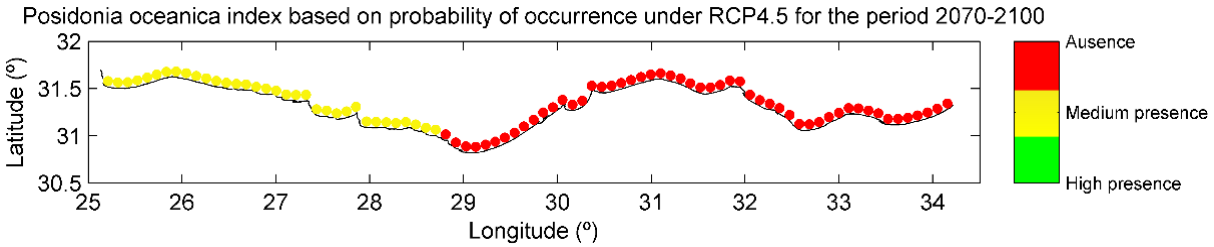


Figure 55. Posidonia oceanica index based on probability of occurrence under RCP4.5 for the period 2070-2100

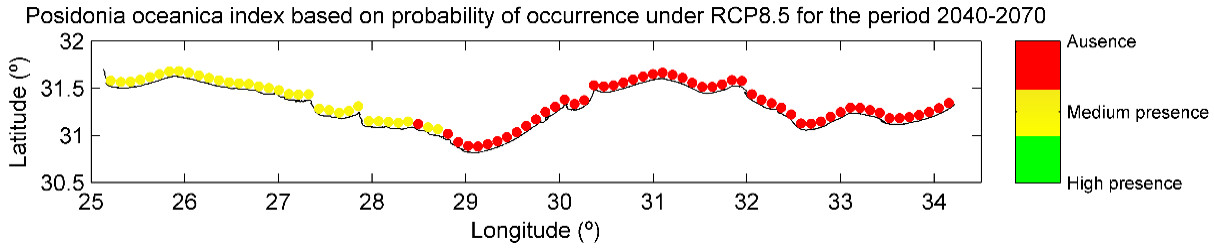


Figure 56. Posidonia oceanica index based on probability of occurrence under RCP8.5 for the period 2040-2070

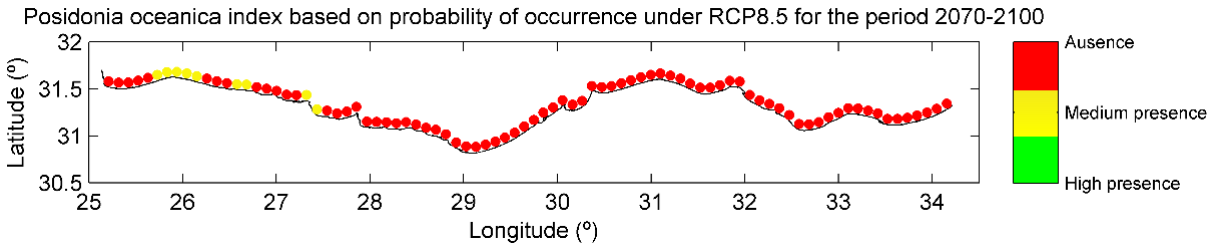


Figure 57. Posidonia oceanica index based on probability of occurrence under RCP8.5 for the period 2070-2100

5.5. Drought

Two indicators developed by Sillmann et al. (2013a, 2013b) have been herein applied. The first one responds to a consecutive dry days (CDD) indicator that counts the largest number of consecutive days where precipitation is lower than 1 mm (measured in days); the second one is a very wet days (R95p) indicator where, being the daily precipitation amount on a wet day (precipitation > 1 mm), R95p is defined by the authors as the 95th percentile of precipitation wet days in a period (measured in mm). Both indicators have been derived for the historical period 1981-2000 (Sillmann et al., 2013a) and under the RCP4.5 and RCP8.5 scenarios for the period 2081-2100 (Sillmann et al., 2013b).

5.5.1. Consecutive dry days and very wet days

The following figures show the results of the consecutive dry days and of the very wet days for the Egyptian coast. Results for the near-term are not available.

Consecutive dry days, historical characterization

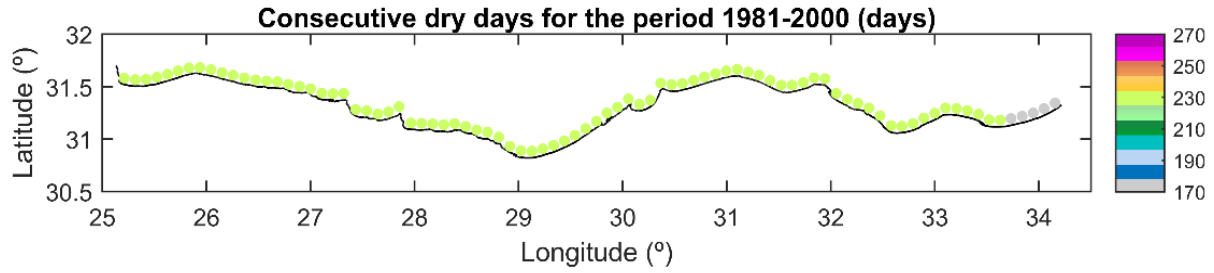


Figure 58. Consecutive dry days (days) for the period 1981-2000

Consecutive dry days, projections

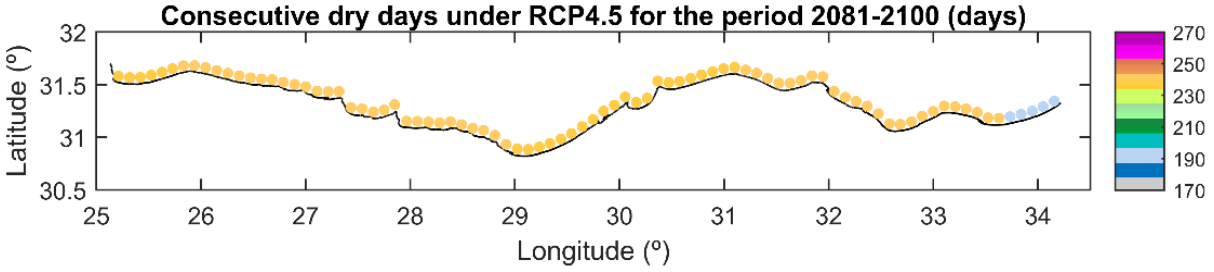


Figure 59. Consecutive dry days (days) under RCP4.5 for the period 2081-2100

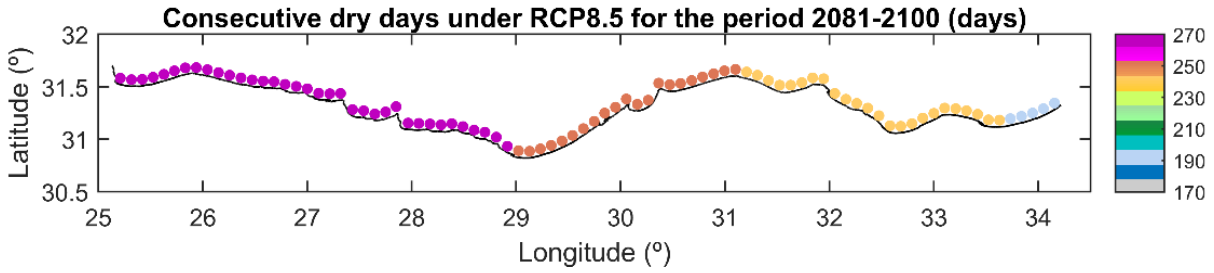


Figure 60. Consecutive dry (days) in days under RCP8.5 for the period 2081-2100

Very wet days, historical characterization

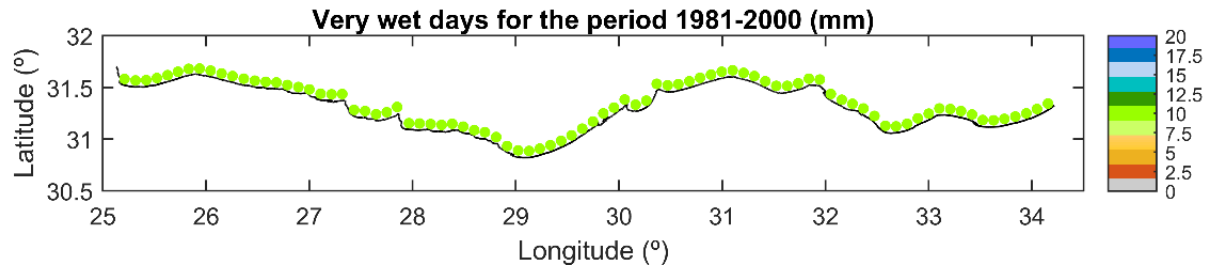


Figure 61. Very wet days (mm) for the period 1981-2000

Very wet days, projections

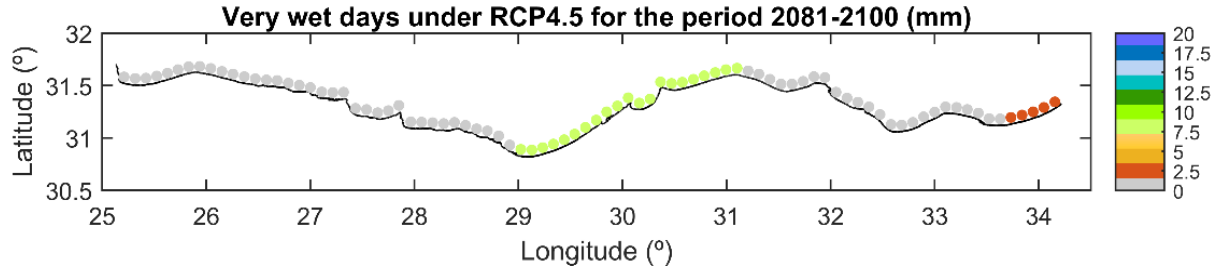


Figure 62. Very wet days (mm) under RCP4.5 for the period 2081-2100

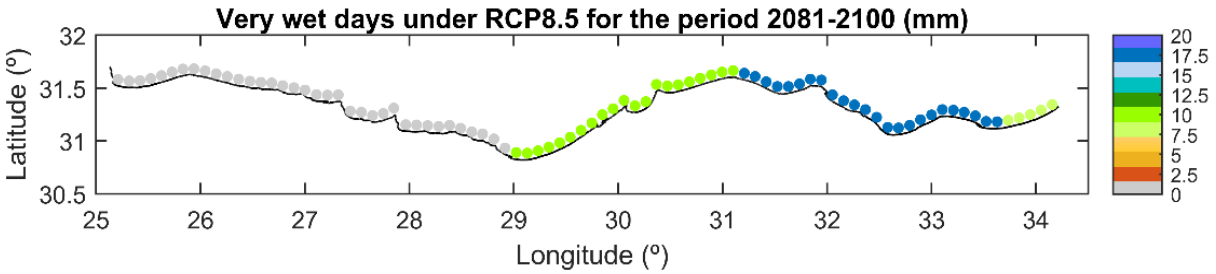


Figure 63. Very wet days (mm) under RCP8.5 for the period 2081-2100

5.5.2. Consecutive Dry Day (CDD) and very wet day indicators

The Consecutive Dry Day (CDD) indicator and the very wet day indicator indicate the level at which droughts threat the Egyptian coast (low, medium or high) and how it varies for different horizons. Based on existing literature, thresholds between low-medium and medium-high have been established as 222 days and 240 days, respectively, for the CDD indicator; and as 10 mm and 0 mm, respectively, for the very wet day indicator.

CDD indicator, historical characterization

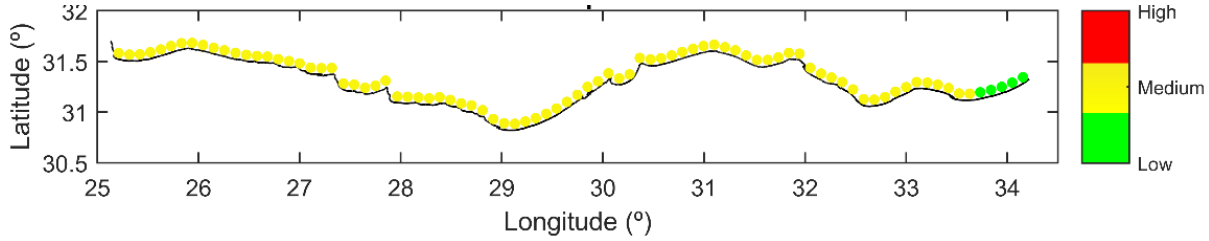


Figure 64. Consecutive dry day indicator for the period 1981-2000

CDD indicator, projections

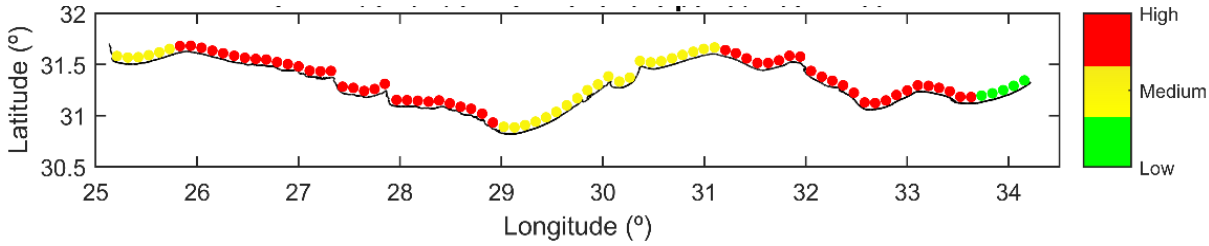


Figure 65. Consecutive dry day indicator under RCP4.5 for the period 2081-2100

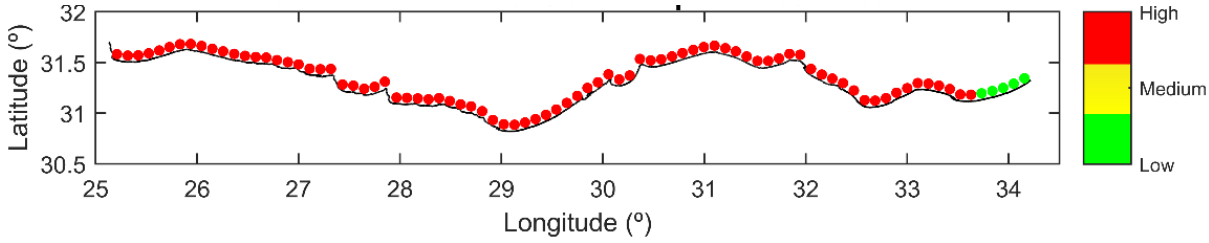


Figure 66. Consecutive dry day indicator under RCP8.5 for the period 2081-2100

Very wet days indicator, historical characterization

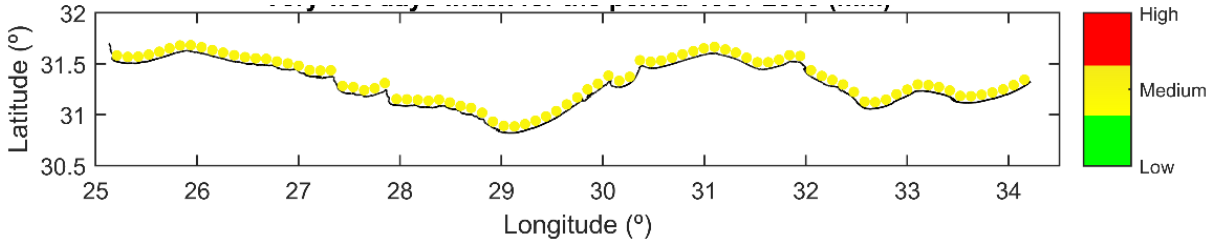


Figure 67. Very wet day indicator for the period 2981-2000

Very wet days indicator, projections

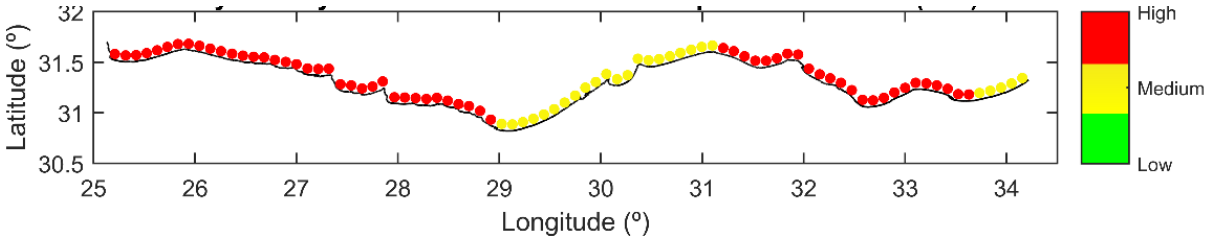


Figure 68. Very wet day indicator under RCP4.5 for the period 2081-2100

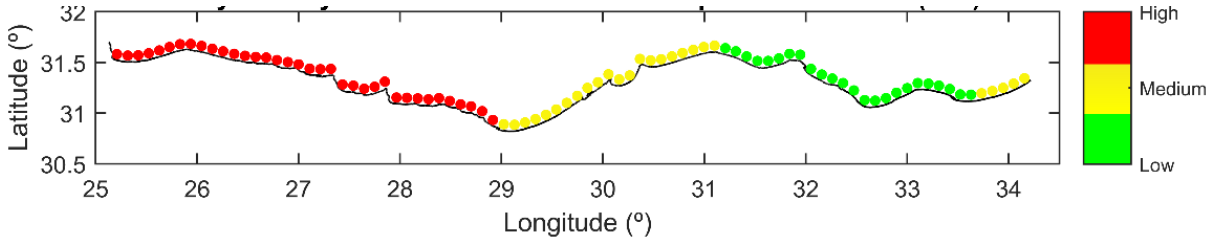


Figure 69. Very wet day indicator under RCP8.5 for the period 2081-2100

5.5.3. Drought index

To compute the drought index, the values of the Consecutive Dry Day (CDD) indicator have been used as they are systematically higher (more pessimist) than the values of the very wet day indicator. The results are shown in the previous section.

5.6. Heat waves

A strong stress heat wave (SHW) indicator developed by Amengual et al. (2014) has been herein applied. It has been defined as a spell of at least 6 consecutive days with daily maximum physiologically equivalent temperatures exceeding a thermal sensation of 35°C. Frequency and duration of SHW (days) in summer have been developed for the historical period 1990-2009 and under SRES A1B scenario (equivalent to RCP2.6) for the periods 2015-2034 and 2045-2064. Results for RCP4.5 and RCP8.5 scenarios are not available.

5.6.1. Strong stress heat wave frequency and duration

Strong stress heat wave frequencies, historical characterization

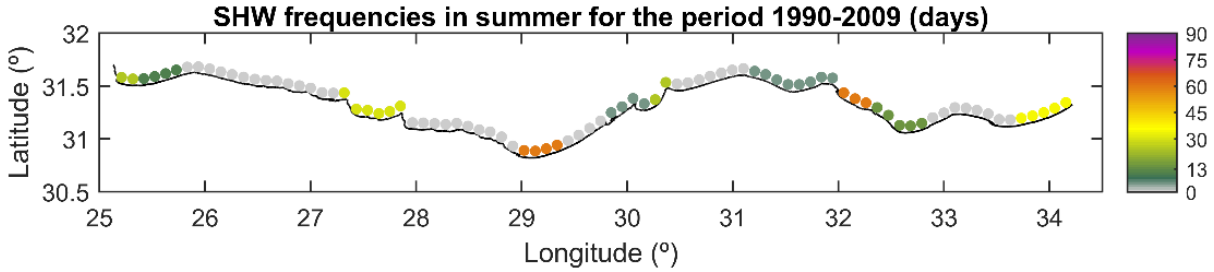


Figure 70. Strong stress heat wave (SHW) frequencies in summer (days) for the period 1990-2009

Strong stress heat wave frequencies, projections

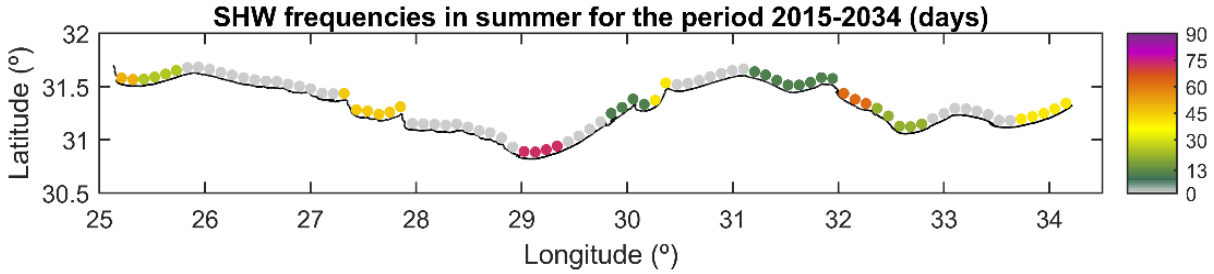


Figure 71. Strong stress heat wave (SHW) frequencies in summer (days) for the period 2015-2034

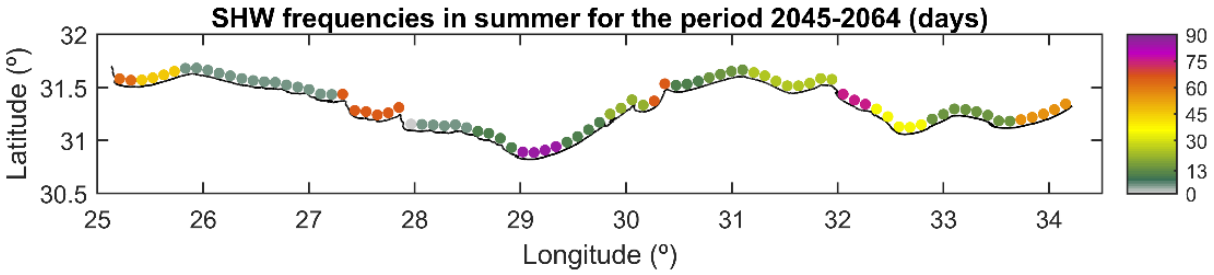


Figure 72. Strong stress heat wave (SHW) frequencies in summer (days) for the period 2045-2064

Strong stress heat wave durations, historical characterization

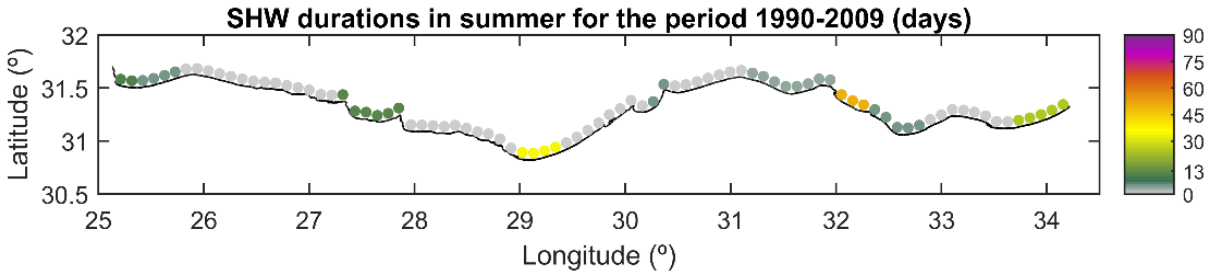


Figure 73. Strong stress heat wave (SHW) durations in summer (days) for the period 1990-2009

Strong stress heat wave durations, projections

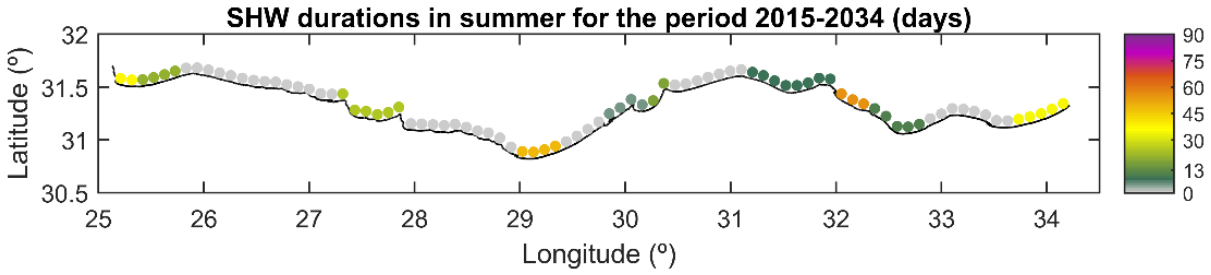


Figure 74. Strong stress heat wave (SHW) durations in summer (days) for the period 2015-2034

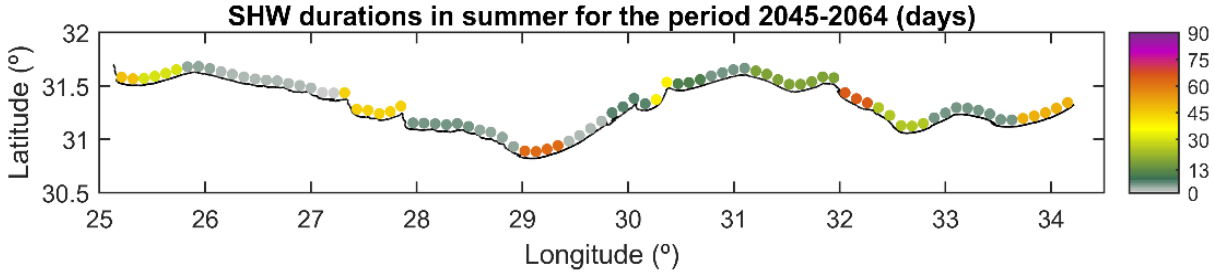


Figure 75. Strong stress heat wave (SHW) durations in summer (days) for the period 2045-2064

5.6.2. Strong stress Heat Wave (SHW) frequency and duration indicators

The SHW frequency indicator and SHW duration indicator indicate the degree at which frequency and duration of heat waves impacts on human health (low, medium or high) and how it varies for different horizons. Based on the results for the historical period, thresholds between low-medium and medium-high have been established based on existing literature as 15 days and 60 days, respectively, for the SHW frequency indicator; and as 10 days and 50 days, respectively, for the SHW duration indicator.

SHW frequency indicator, historical characterization

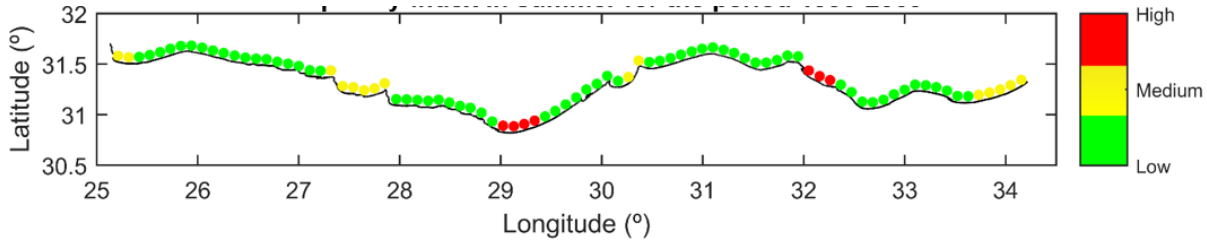


Figure 76. Strong stress heat wave (SHW) frequency indicator in summer for the period 1990-2009

SHW frequency indicator, projections

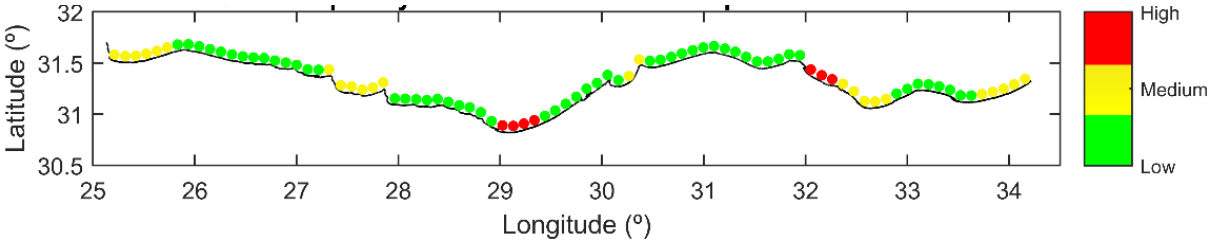


Figure 77. Strong stress heat wave (SHW) frequency indicator in summer for the period 2015-2034

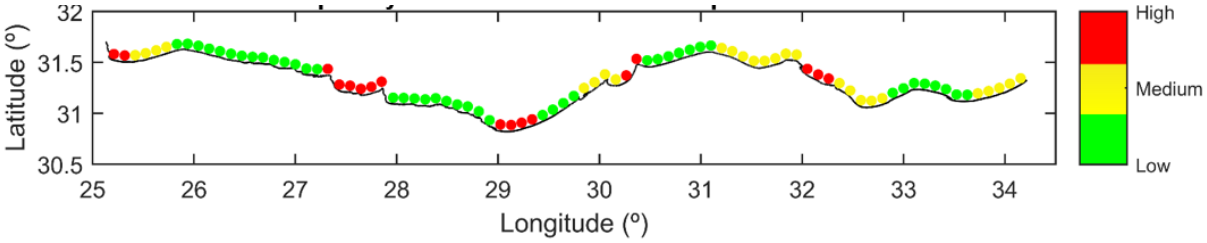


Figure 78. Strong stress heat wave (SHW) frequency indicator in summer for the period 2045-2064

SHW duration indicator, historical characterization

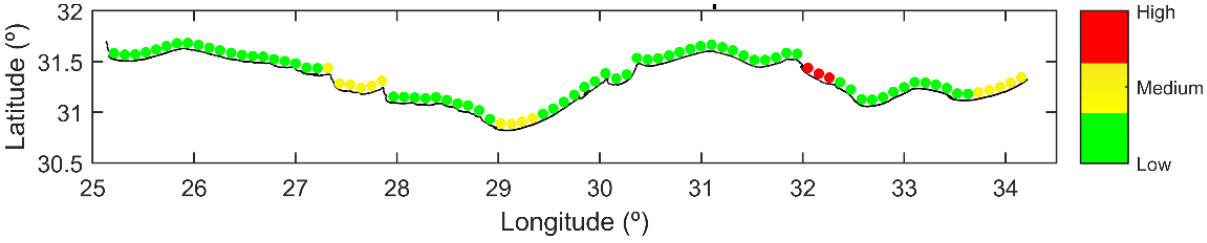


Figure 79. Strong stress heat wave (SHW) duration indicator in summer for the period 1990-2009

SHW duration indicator, projections

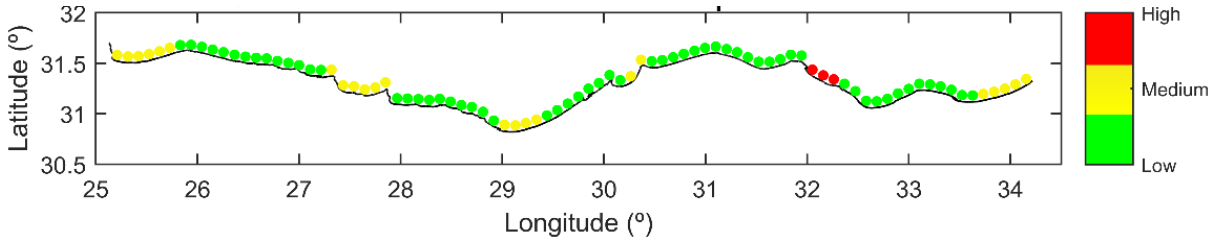


Figure 80. Strong stress heat wave (SHW) duration indicator in summer for the period 2015-2034

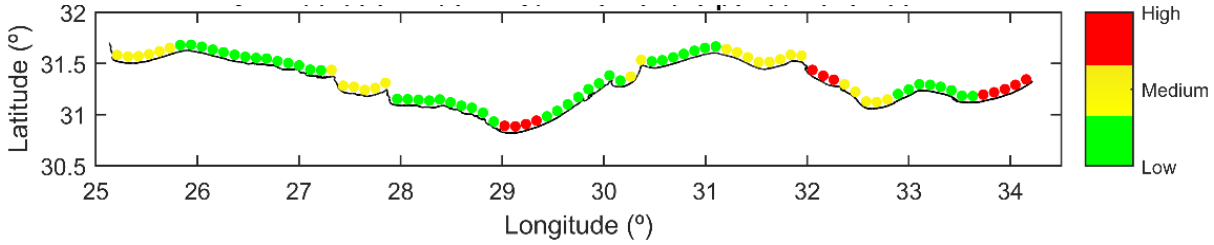


Figure 81. Strong stress heat wave (SHW) duration indicator in summer for the period 2045-2064

5.6.3. Heat wave index

To compute the heat wave index, the values of the Strong stress Heat Wave (SHW) frequency indicator have been used as they are systematically higher (more pessimist) than the values of the SHW duration indicator. The results are shown in the previous section.

5.7. Port downtime

A port operability indicator has been defined on those ports that are more relevant based on the number of hours per year that 1) agitation exceeds 2.5 m in the maneuvering zone, and 2) overtopping exceeds 0.1 m3/s/m leading to dangers for pedestrians and possible structural deterioration (Franco et al., 1994).

5.7.1. Agitation and overtopping exceedance

The overtopping performance of seawalls has been undertaken by a number of studies. In this work the formulation proposed by Owen (1980) has been applied:

$$qt = \sqrt{g H_s^3}\, 8 \cdot 10^{-2} \exp\left(\frac{-b R_c}{H_s}\right) \exp(3.5\, br)$$

Where is g the gravity; H_s is the significant wave height propagated at the toe of the wall; b is a coefficient that depends on the typology of the seawall; R_c is the freeboard; and r is the roughness coefficient. According to Owen (1980) b and r have been set as 3.1 and 0.55, respectively.

The following figures show the results obtained for the present, for the near-term and for the long-term, under the GHGs emission scenarios RCP4.5 and RCP8.5 (IPCC, 2013).

Agitation, historical characterization

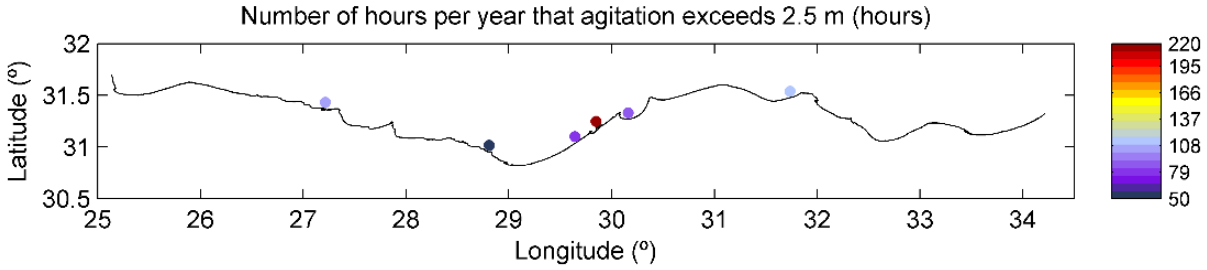


Figure 82. Number of hours per year that agitation exceeds 2.5 m

Agitation, projections

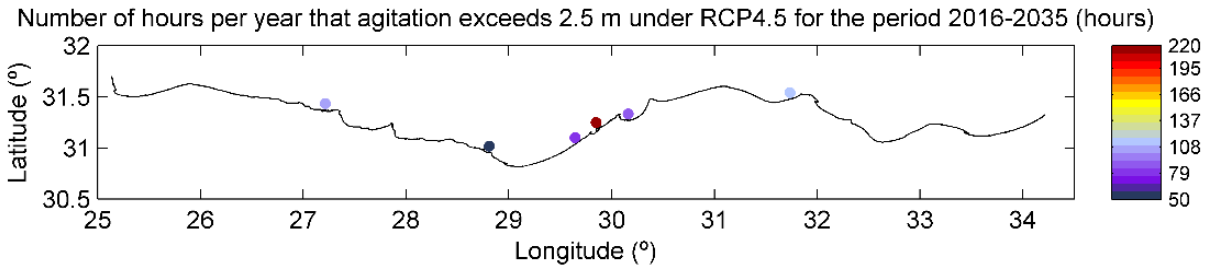


Figure 83. Number of hours per year that agitation exceeds 2.5 m under RCP4.5 by 2025

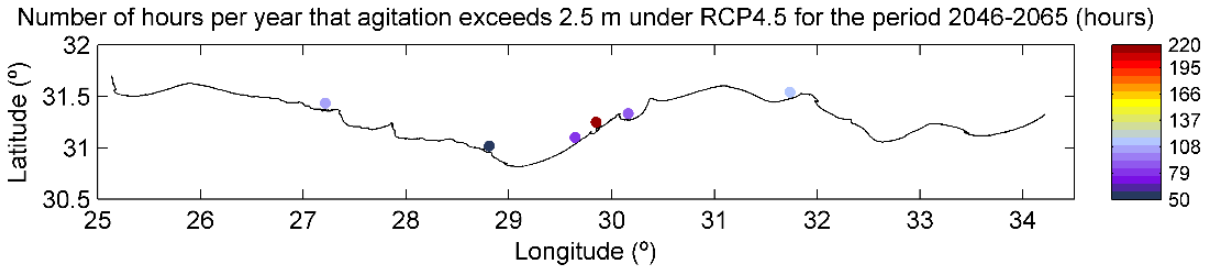


Figure 84. Number of hours per year that agitation exceeds 2.5 m under RCP4.5 by 2050

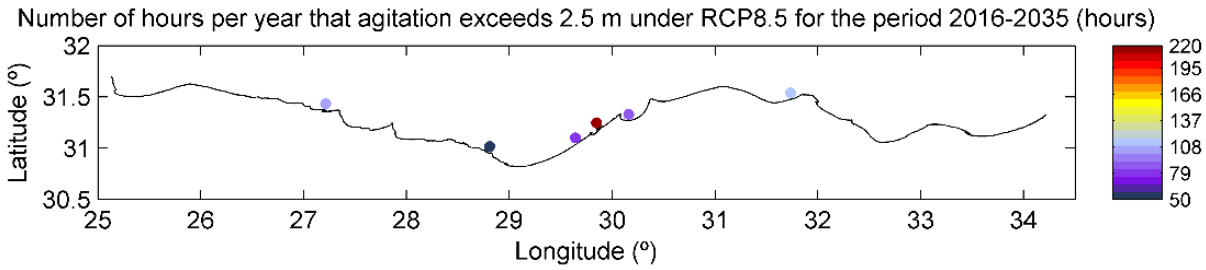


Figure 85. Number of hours per year that agitation exceeds 2.5 m under RCP8.5 by 2025

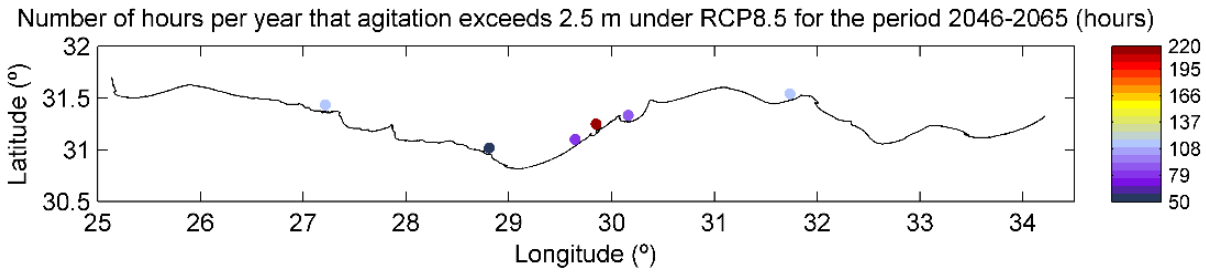


Figure 86. Number of hours per year that agitation exceeds 2.5 m under RCP8.5 by 2050

Overtopping, historical characterization

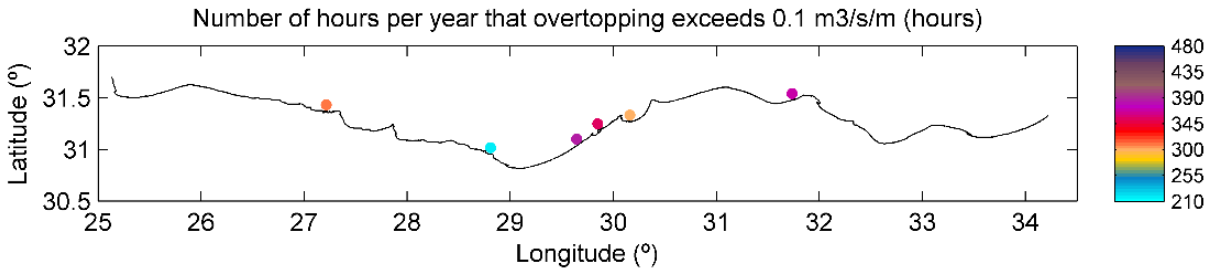


Figure 87. Number of hour per year that overtopping exceeds 0.1 m3/s/m

Overtopping, projections

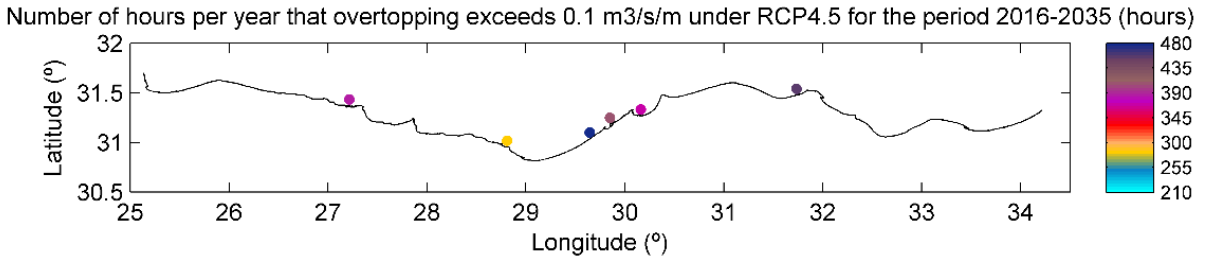


Figure 88. Number of hour per year that overtopping exceeds 0.1 m3/s/m under RCP4.5 by 2025

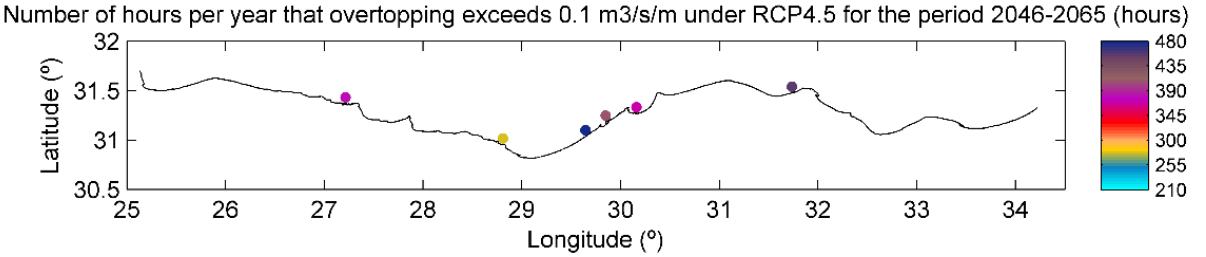


Figure 89. Number of hour per year that overtopping exceeds 0.1 m3/s/m under RCP4.5 by 2050

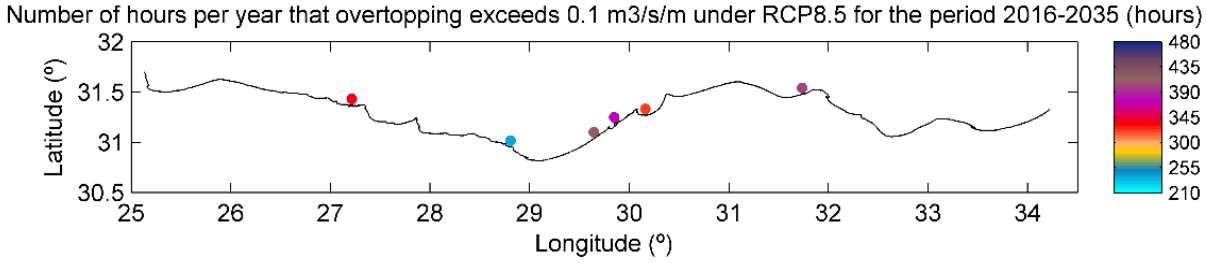


Figure 90. Number of hour per year that overtopping exceeds 0.1 m3/s/m under RCP8.5 by 2025

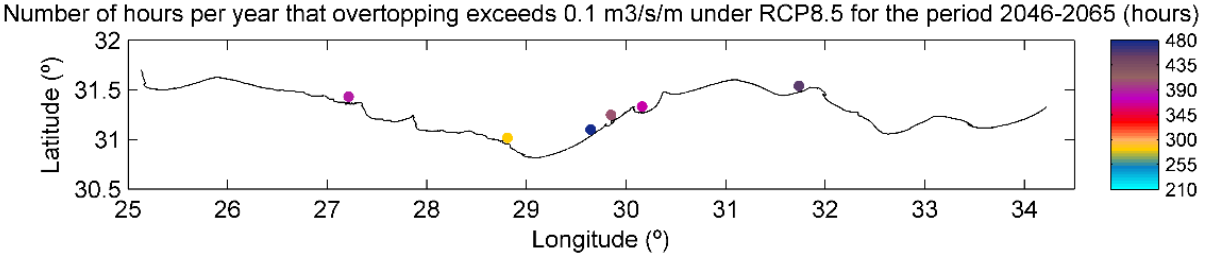


Figure 91. Number of hour per year that overtopping exceeds 0.1 m3/s/m under RCP8.5 by 2050

5.7.2. Agitation-based and overtopping-based operability indicators

The agitation-based operability indicator and the overtopping-based operability indicator indicate the degree at which the loss of operability that may affect the Egyptian ports (low, medium or high) and how it varies for different time horizons. Thresholds between low-medium and medium-high have been established as 200 hours (according to ROM3.1-99, 2000) and 300 hours, respectively.

Agitation-based operability indicator, historical characterization

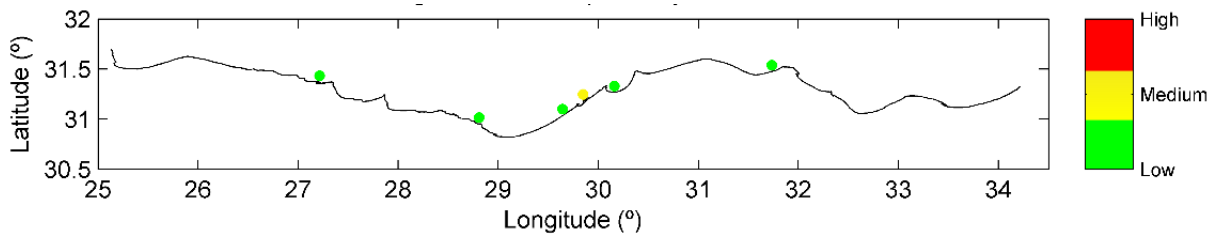


Figure 92. Agitation-based operability indicator

Agitation-based operability indiactor, projections

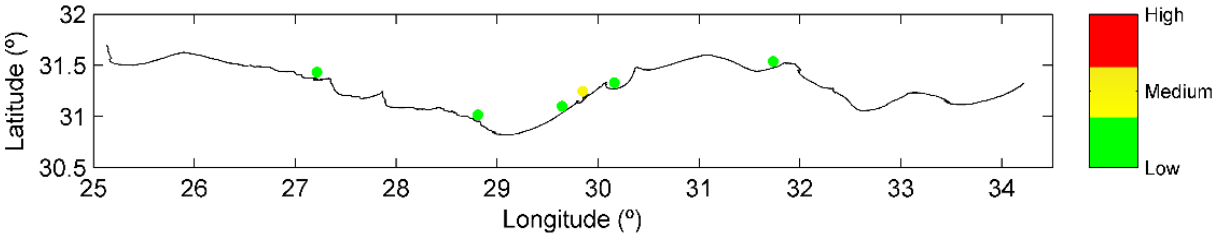


Figure 93. Agitation-based operability indicator under RCP4.5 by 2025

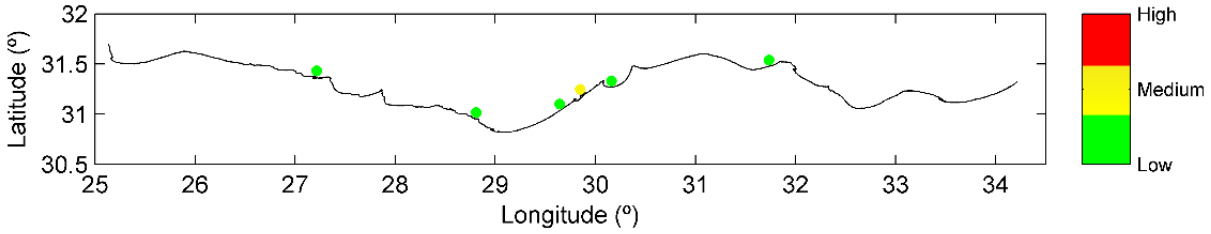


Figure 94. Agitation-based operability indicator under RCP4.5 by 2050

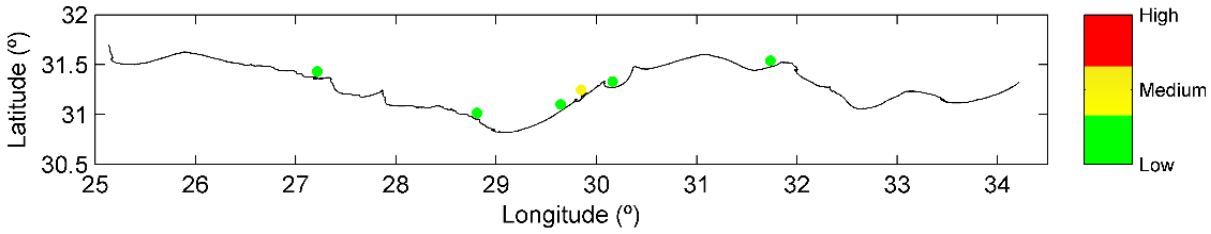


Figure 95. Agitation-based operability indicator under RCP8.5 by 2025

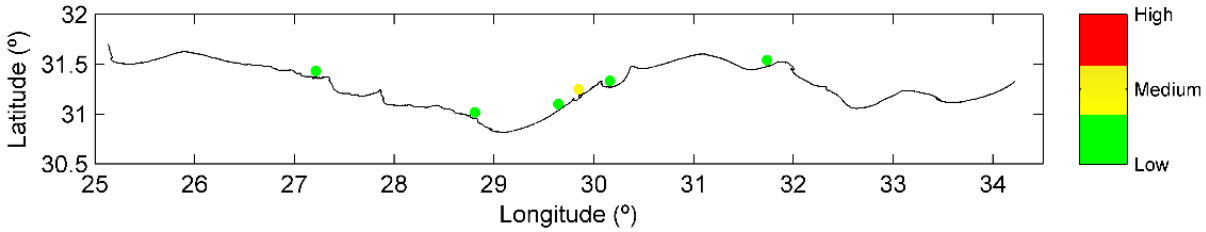


Figure 96. Agitation-based operability indicator under RCP8.5 by 2050

Overtopping-based operability indicator, historical characterization

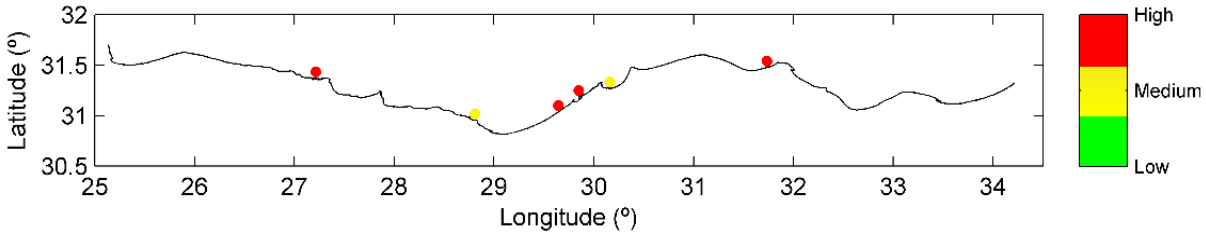


Figure 97. Overtopping-based operability indicator

Overtopping-based operability indicator, projections

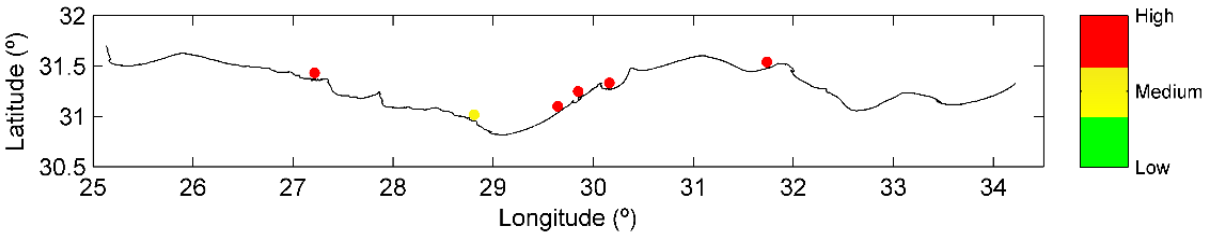


Figure 98. Overtopping-based operability indicator under RCP4.5 by 2025

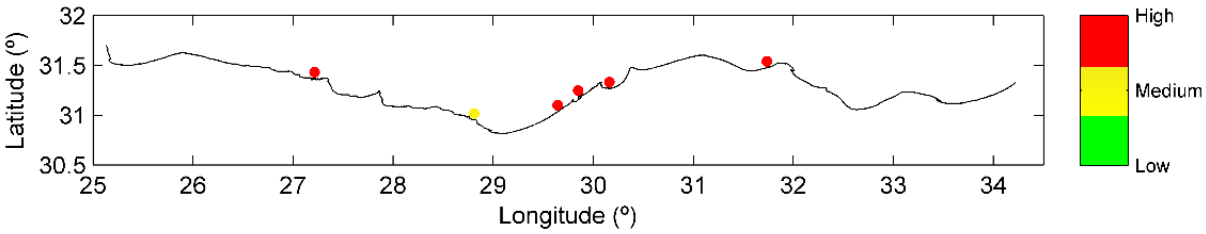


Figure 99. Overtopping-based operability indicator under RCP4.5 by 2050

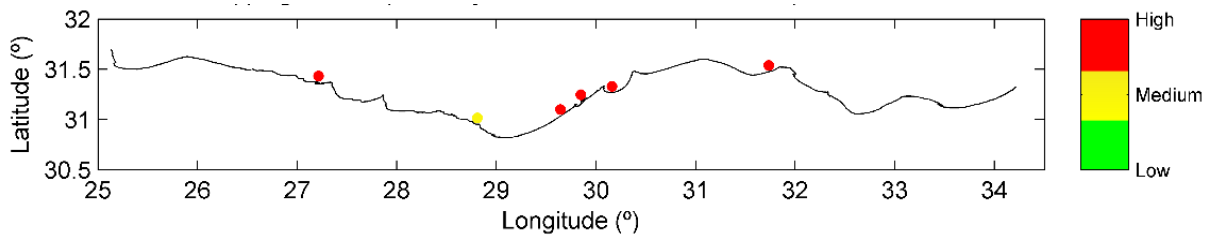


Figure 100. Overtopping-based operability indicator under RCP8.5 by 2025

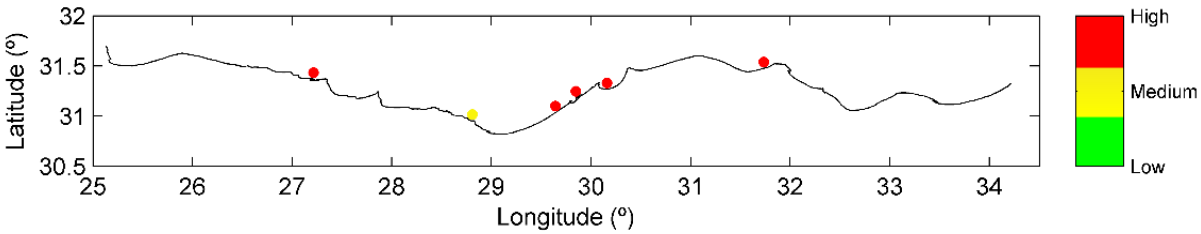


Figure 101. Overtopping-based operability indicator under RCP8.5 by 2050

5.7.3. Port downtime index

To compute the port downtime index, the values of the overtopping-based operability indicator have been used as they are systematically higher (more pessimist) than the values of the agitation-based operability indicator. The results are shown in the previous section.

5.8. Siltation

A **Channel Siltation Indicator (CSI)** has been computed in the area where an inlet (or channel drainage) or a port has been identified. It is based on the gross sediment transport computed in the corresponding coastal stretch and in its closest neighboring stretches. The gross sediment transport values have been grouped following the criteria previously introduced. It is important to notice that this indicator do not take into account the presence of coastal structures built for navigation purpose or to reduce siltation issues. However, it is a good indicator to identify the potential issues and to identify those areas where mitigation measure are the most difficult to apply (that are the coastal stretches where sediment transport is strong).

The final siltation index is then obtained in the corresponding coastal points for the historical and future characterizations following the criteria previously introduced.

Historical characterization

The siltation index has been obtained from the historical climate dynamics based on the results previously described.

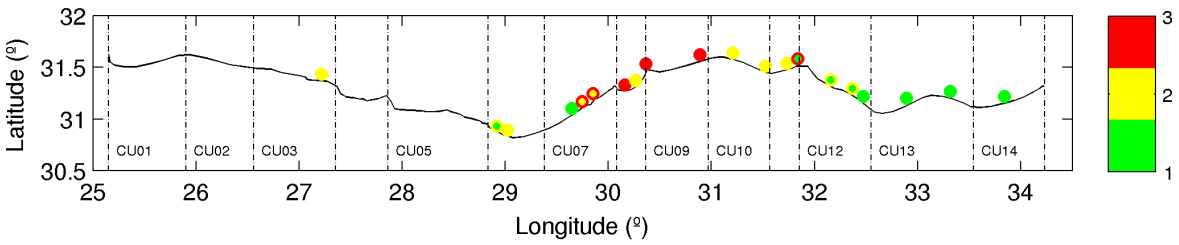


Figure 102. Siltation index along the Egyptian Northern coast. Historical characterization. When a coastal point is assigned to multiple coastal stretches, the minimum and maximum values of the indicators are given.

Projections

The siltation index has been calculated for the four different scenarios studied (RCP 4.5 near-term, RCP 4.5 long-term, RCP 8.5 near-term, and RCP 8.5 long-term).

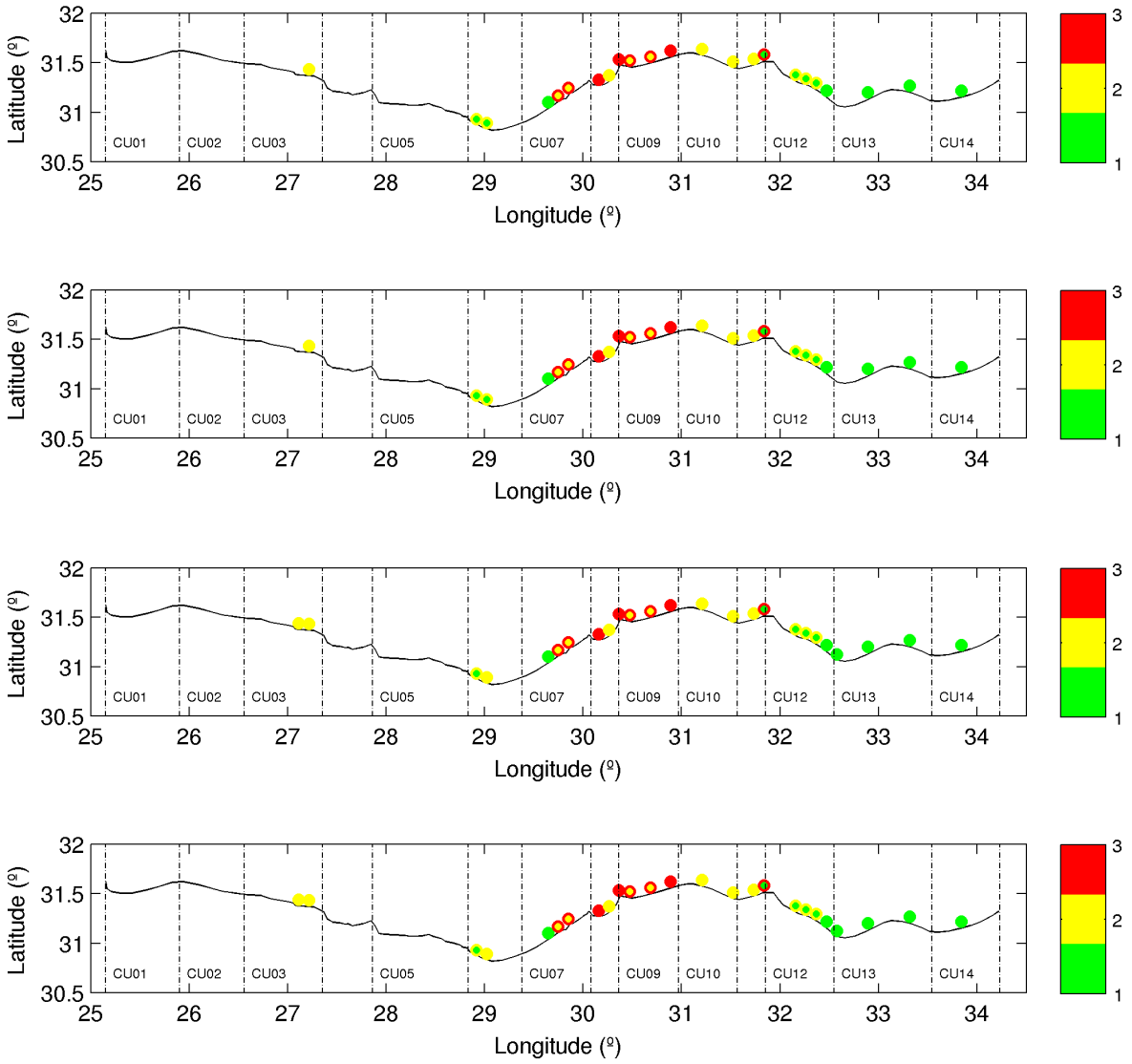


Figure 103. Siltation index along the Egyptian Northern coast for different projected scenarios. When a coastal point is assigned to multiple coastal stretches, the minimum and maximum values of the indicators are given. From top to bottom: 2030-2040 (RCP4.5), 2030-2040 (RCP8.5), 2050-2070 (RCP4.5), 2050-2070 (RCP8.5).

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ADAPTATION TO CLIMATE CHANGE IN THE NILE DELTA THROUGH INTEGRATED COASTAL ZONE MANAGEMENT PROJECT

INTEGRATED COASTAL ZONE MANAGEMENT IN THE NORTHERN COAST OF EGYPT
– A SCOPING STUDY –

ANNEX III:

ANNEX III: ECOLOGICAL ASSESSMENT OF THE NORTHERN COAST OF EGYPT

DECEMBER 2016

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ANNEX III. ECOLOGICAL ASSESSMENT OF THE NORTHERN COAST OF EGYPT

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1. BACKGROUND

The Northern Coast of Egypt represents a mosaic of rich and diverse ecosystems and natural resources of vital importance for the economy and social welfare of the country.

However, the coastal area faces multiple and conflicting activities and demands affecting the sustainability of the area. Therefore, it is important to define the scope for establishing an Integrated Coastal Zone Management (ICZM) Plan. Accordingly, the present study aims at defining the coastal issues and challenges that would lead to establishing the management priorities of the Northern Coast of Egypt in a forthcoming ICZM Plan. In this respect, the study would provide the baseline information for developing ICZM plans along the North Coast of Egypt.

This Annex presents the ecological aspects characterizing the different eco-regions of the Northern Coast of Egypt. It presents the different habitat types and biodiversity richness, and highlights current implemented conservation actions such as protected areas, Important Bird Areas (IBAs), main species of concern and their local and international status, as well as current impacts and threats on the ecology of the area.

2. METHODOLOGY

The present ecology report is based on a comprehensive desk study of the Mediterranean Coast of Egypt. The desk study mainly relies on previous detailed specialist studies and field surveys of the area carried out by Environics. External technical reports and literature covering the same area, as well as satellite images have been also utilized.

The Northern Coast of Egypt has been geographically divided into four main eco-regions. Each eco-region include two or more Coastal Units (CUs), based on the physiographic division carried out by IH Cantabria (2016).

Habitats of each sector and main characteristics of each CU have been emphasized. Species of concern were highlighted. These included threatened and/or protected species as well as species of ecological and/or economic importance. The CITES[1] appendices and the Red List issued by the International Union for the Conservation of Nature (IUCN) were used to indicate the international status of species. The local status was based on Boulos (1999; 2000; 2002; 2005; 2009) and Shaltout and Khalil (2005; 2006) for flora, Baha El Din (2006) for amphibians and reptiles, Tharwat (1997) for avifauna and Basuony *et al*. (2010) for mammals. The status of species is determined according to the IUCN Red List categories[2].

An overall assessment of the whole Northern Coast of Egypt (excluding the marine environment) has been carried out. CU status indicators were selected from a set of guidelines and adapted to the current study. Selection of indicators was also subjected to a set of criteria. Accordingly, a simple Ranking Matrix was developed and utilized to categorize the value of each CU. The assessment also presents the status of the main species of concern as well as current impacts and threats on biodiversity.

An account on the marine environment of the eastern Mediterranean is provided in a separate section. The marine environment is provided as a whole and is not divided into coastal sectors and/or units, as:

- This would require detailed localized surveys which are not available in literature
- It is virtually impossible to categorize the marine biodiversity according to coastal sectors and/or units due to the mobility of fish and other large marine organisms that travel great distances.

On the other hand, locations of specific habitats and/or records of particular species are provided, whenever available.

[1] Convention on International Trade of Endangered Species of Fauna and Flora, Washington D.C., 1973
[2] EX: Extinct; EW: Extinct in the Wild; CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; LC: Least Concern; DD: Data Deficient; NE: Not Evaluated

3. ECO-REGIONS OF THE NORTHERN COAST OF EGYPT

The Northern Coast of Egypt can be broadly divided into four main eco-regions lying on a west-east axis; as follows:

1. The Western Mediterranean Coastal Desert, sub-divided into:
    a. a Western Province from El Sallum to Ras El Hekma and
    b. an Eastern Province from Ras El Hekma to Alexandria;
2. The Deltaic Mediterranean Coast;
3. The Eastern Mediterranean Coastal Desert; and
4. The Mediterranean Coastal Desert of SinAIII.

Each eco-region has been divided into several Coastal Units (CUs) for a total of 14 CUs covering the entire Northern Coast of Egypt from El Sallum at the Libyan borders in the west to Rafah at the Gaza borders in the east (IH Cantabria, 2016), as shown in Figure 1.

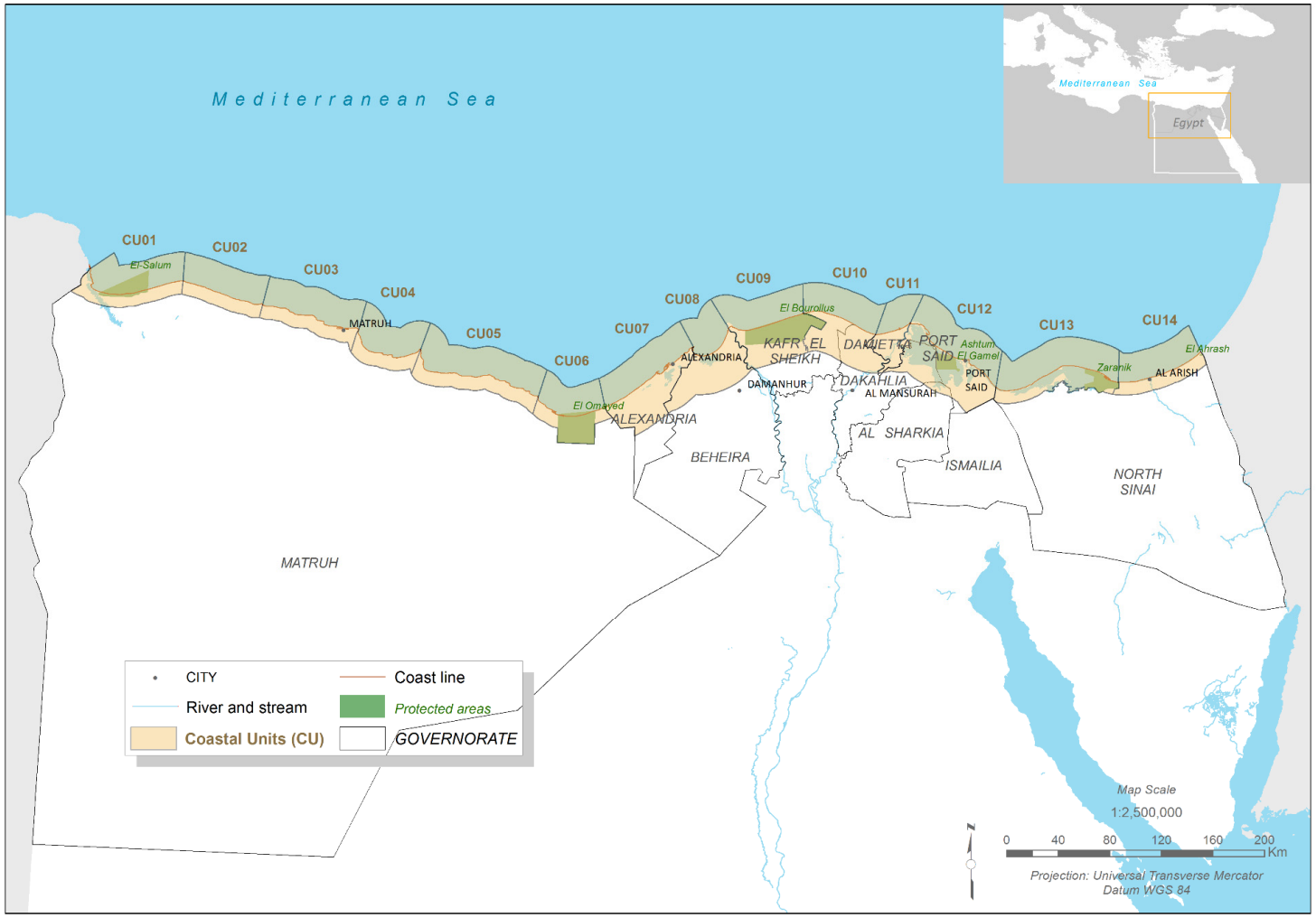

Figure 1: Coastal Units of the Meditrranean Coast of Egypt (IH Cantabria, 2016)

3.1. The Western Mediterranean Coastal Desert

The Western Mediterranean Coastal Desert is the northern part of the wider Western Desert eco-region. It includes seven CUs (CU01 to CU07). This coastal belt stretches from Salloum in the west to Alexandria in the east, bounded by the shoreline on the north and the Qattara Depression to the south. It is less arid than the rest of the western desert and its distinctive feature is the relatively high, and more consistent, rainfall (about 150-180 mm/year) and low temperature compared to the rest of Egypt. However, the rainfall decreases very rapidly inland from the coast, giving this zone a maximum width of 50 km along its 600 km length (Hoath, 2003; EEAA/UNEP, 1993).

The region may, on geomorphologic grounds, be divided into two parts:

- a western province between Salloum and Ras El-Hekma (CU01 to CU04); and
- an eastern province between Ras El-Hekma and Alexandria (CU05 to CU07) (Selim, 1969 in EEAA/UNEP, 1993).

In general, the coastal belt comprises a coastal plain and a tableland. In the western province the coastal plain is narrow or missing and the limestone inland tableland reaches the shoreline. This plateau is traversed a number of drainage systems (wadis) that run northwards to the sea. In the eastern province, the coastal plain is wide and characterized by a series of long ridges (bars) alternating with long depression all running parallel to the coast. In certain parts, nine limestone ridges may be noted; they represent a Pleistocene sequence of shoreline bars (EEAA/UNEP, 1993).

3.1.1. Habitats

Habitat types and plant growth relate to physiographic conditions. In the eastern province, the shoreline is fringed by bodies of coastal sand followed by a series of ridges alternating with furrow-like depression. The first (northeast) depression is partly occupied by the westward extension of Lake Mariout (CU07). It is a saline depression while inland depressions are not saline. Further inland is the limestone plateau. The coastal dunes and associated near-shore ridges provide room for fig and olive orchards; the non-saline depressions provide room for barley cultivations in year of good rain, while the rest are rangelands for herds of sheep and goat (EEAA/UNEP, 1993).

3.1.2. Flora

Of the over 2000 species of plants in Egypt, about 1000 occur within 30 km of the Mediterranean coast (IUCN, 2003). However, a large number of Egypt's plants have become locally rare or extinct, due to habitat destruction, overgrazing, and over-harvesting.

The eastern province may be ecologically organized into five main groups, representing a sequence of zones lying on a north-south axes starting from the shoreline. These zones as well as their principal floral characteristics are herein presented (EEAA/UNEP, 1993).

a. Coastal Dunes

Ammophilia arenaria is found on active baby dunes at the shoreline, while the plant is associated with *Euphorbia paralias* and *Lotus polyphyllos* on partly stabilized sand dunes near the shoreline. Stabilized sand dunes support *Pancratium maritimum* and *Thymelaea hirsuta* while *Pituranthos turtuosus* and *Echiochilon fruticosum* are present on coastal limestone ridge.

b. Inland Dunes

In inland dunes, plant life is dominated by *Urgina maritima* and *Thymelaea hirsuta*.

c. Inland Ridges

In inland ridges, the following sub-divisions are recognized:

- Summits of ridges (rocky sites) with chasmophytes and lythophytes including *Thymus capitatus*, *Globularia arabica* and *Helianthemum lippii*;
- Intermediate slopes with *Gymnocarpos decandrum* and *Reaumeria vermiculata*;
- Lower slopes with *Plantago albicans*, *Asphodelus microcarpus* and *Salvia lanigera*.

d. Saline Depression

This is a habitat of a variety of salt marshes communities; habitat types vary in relation to depth of the saltwater level and often show zoned pattern that seem to depend on ground level and surface accumulation of deposits (e.g. phytogenic mounds). Most common dominant species include *Arthrocnemum macrostachyum*, *Halocnemum strobilaceum*, *Sarcocornia fruticosa*, *Suaeda vermiculata* and *Limoniastrum monopetalum*. Sites with surface salt crusts are usually sterile.

e. Non-saline Depressions

Plant communities seem to differ in relation to the nature (such as texture, depth and chemistry) of the surface deposits. Accordingly, the following plant communities are dominant:

- *Anabasis articulata* and *Echiochilon fruticosum* on sandy soils;
- *Plantago albicans* and *Noaea mucronata* on calcareous (often saline) soils;
- *Asphodelus microcarpus*, *Thymelaea hirsuta* and *Artemisia monosperma* on soft (fine textured) soils;
- *Stipagrostis ciliata* and *Hammada scoparia* in the more arid (inland) areas.

The area is also important for medicinal and aromatic plants, which are either wild or cultivated. On the other hand, virtually all trees seen in semi-urban environments are exotic, and, in rural areas, the ubiquitous *Eucalyptus* spp. is an import from Australia. *Casuarina* trees are widely used as wind-breakers and to border fields while *Ficus* sp. is commonly used as ornamental plant.

3.1.3. Fauna

- ***Amphibians and Reptiles***

Figure 2: Green Toad, Borg El Arab (CU07)

The Western Mediterranean Coastal Desert possesses one of the richest herpetofauna in Egypt. A total of 32 species of reptiles and two species of amphibians have been recorded from this area. The Green Toad (*Bufotes viridis*) is capable of tolerating very dry conditions. One reptile, the Mediterranean Hooded Snake (*Macroprotodon cucullatus*), has been recorded only from this habitat in Egypt (EEAA/UNEP, 1993). Saleh (1997) collected several specimens of this reptile at El-Hammam, Dabaa and Sidi Kreir. Characteristic species of this habitat type include the Moorish Gecko (*Tarentola mauritanica*) and Starred Agama (*Laudakia stellio*) in rocky areas, Changeable Agama (*Trapelus mutabilis*), Nidua Lizard (*Acanthodactylus scutellatus*), Javelin Sand Boa (*Eryx jaculus*), Lesser Cerastes Viper (*Cerastes vipera*) and the Egyptian Tortoise (*Testudo kleinmanni*) in sandy areas, Bosc's Lizard

(*Acanthodactylus boskianus*), Gold Skink (*Eumeces schneiderii*), Eastern Montpellier Snake (*Malpolon insignitus*), Schokari Sand Snake (*Psammophis schokari*), Clifford's Snake (*Spalerosophis diadema*) and European Chameleon (*Chamaeleo chamaeleon*) in mixed rocky and sandy habitats (Flower, 1933; Marx 1968; Saleh and Saber, 1992 *in* EEAA/UNEP, 1993; Saleh, 1997).

The Egyptian Tortoise, once very common, has been mostly eradicated from the region due to commercial over-exploitation and habitat destruction (Saleh, 1997). In an attempt to verify its status in the North Coast, Baha El Din and Baha El Din (1994) undertook an exhaustive survey of the region, but no animals were found, nor was there any evidence of their existence (scats, tracks or dead animals) in any of the surveyed areas.

- ***Birds***

Concerning birds, at least 38 species are known to breed in the Western Mediterranean Coastal Desert. One resident species, the Common Raven (*Corvus corax*) is known only from this habitat in Egypt. Characteristic resident bird species include the Cream-colored Courser (*Cursorius cursor*), the Bar-tailed Desert Lark (*Ammomanes cincturus*), the Hoopoe Lark (*Alaemon alaudipes*), the Crested Lark (*Galerida cristata*) and the Goldfinch (*Carduelis carduelis*) (EEAA/UNEP, 1993; Tharwat, 1997; Baha El Din and Atta, 2002; Bruun and Baha El Din, 2002). It should be noted that the resident population of the Houbara Bustard (*Clamydotis undulata*) has been subjected to a very severe hunting pressure, which has driven the species near to extinction. Besides several birds of prey such as the Common Kestrel (*Falco tinnunculus*) and the Barn Owl (*Tyto alba*) are regularly seen in the area and its hinterland.

During the autumn and spring migrations, Western Mediterranean Coastal Desert receives vast numbers of palearctic migrants. The region provides the first available resting and feeding area for huge numbers of individuals of many species after their Mediterranean crossing. Most famous of these are the Quail, (*Coturnix coturnix*) and the Golden Oriole (*Oriolus oriolus*).

- ***Mammals***

Thirty-eight species of mammals have been recorded from this eco-region. Three species of rodents, namely the Lesser Molerat (*Spalax ehrenbergi*), the Four-toed Jerboa (*Allactaga tetradactyla*) and the Lesser Short-tailed Gerbil (*Gerbillus simoni*) are restricted to this habitat type, with the latter two found only in littoral salt marshes (EEAA/UNEP, 1993). Characteristic mammals also include the Long-eared Hedgehog (*Hemiechinus auritus*), Ethiopian Hedgehog (*Paraechinus* (*aethiopicus*) *deserti*), Cape Hare (*Lepus capensis*), Anderson's Gerbil (*Gerbillus andersoni*), North African Gerbil (*Gerbillus campestris*), Shaw's Jird (*Meriones shawi*), Fat Sand Rat (*Psammomys obesus*) and Greater Egyptian Jerboa (*Jaculus orientalis*). The Jungle Cat (*Felis chaus*) is found in areas with thick cover such as farmlands, marshes and reed beds, while the Wild Cat (*F. silvestris*) inhabits dryer areas with cover. The Golden Wolf (*Canis anthus*)[3] and, particularly, the Red Fox (*Vulpes vulpes*) occupy a variety of habitats though they are not true desert species, while the Striped Weasel (*Poecilictis libyca*) is found in sandy but vegetated desert and semi-desert (Hoath, 2003; EEAA/UNEP, 1993).

Figure 3: Lesser Molerat

[3] The Golden Wolf was previously erroneously reported as a subspecies of the Golden Jackal (*Canis aureus*) and listed as LC by the IUCN, but it is currently classified as a distinct species, representing the first new species of Canidae found in 150 years (Koepfli *et al.*, 2015; Arnold, 2015).

3.1.4. Coastal Units Characteristics

a. Western Province

The Western Province of the Western Mediterranean Coastal Desert includes CU01 to CU04.

- ***Coastal Unit 01***

This CU includes the town of El Sallum at the Egyptian-Libyan borders and the Sallum Protected Area.

El Sallum Protected Area

It was established according to Prime Minister Decree 533/2010. It is mainly a marine protected area and covers an area of 383 km^2. It is the first marine Protected Area on the country's Mediterranean coast. The area encompasses marine and coastal habitats including tidal flats, coastal plains, seagrass meadows, and shallow and intermediate depth marine habitats. The marine zone includes 57 species of macrobenthic organisms and at least 55 commercial species including molluscs, crustaceans and fish. It is an important conservation area for threatened and declining species. Fishermen are the most important category of users of the marine resources of the Gulf of Sallum, and depend on these resources as a major source of income.

- ***Coastal Unit 02***

This CU includes the town of Sidi Barrani. It is a very pristine sector with few developments and extended natural habitats. No protected areas or IBAs are present in this CU.

Figure 4: View of El Sallum

Figure 5: Flora near Sidi Barrani

- ***Coastal Unit 03***

This CU includes the city of Marsa Matrouh and several summer resorts. The eastern part of this CU is affected by urbanization and tourism activities, while the western part is more pristine but includes agricultural activities.

Figure 6: Vegetated beach, western part of CU03

Figure 7: Agiba Beach, Marsa Matrouh

b. Eastern Province

The Eastern Province of the Western Mediterranean Coastal Desert includes CU04 to CU07.

- ***Coastal Unit 04***

This CU includes natural areas intersected by summer resorts. The eastern part of this CU includes more natural and pristine areas, while most tourism activities are concentrated in the middle part at Bagoush and in the western part.

Figure 8: Fig tree in the coastal area

Figure 9: The beach at Bagoush

- ***Coastal Unit 05***

This CU includes extended natural areas intersected by some summer resorts. Agriculture is present in this area. Construction of a nuclear plant is planned in the area of El Dabaa representing a major threat to this CU.

Figure 10: Etap Resort, Ras El Hekma

- ***Coastal Unit 06***

This CU is characterized by the presence of an almost continuous coastal strip of summer resorts. It also includes El Omayed Biosphere Reserve which is heavily affected by anthropogenic activities. The dunes of white sand along the seashore are followed further inland by limestone ridges separated by wadis in some of which salt marshes are found. When getting much inland of these, there is a relatively flat strip of sand and clay interspersed with exposed rocky surfaces. Local Bedouins graze their livestock and practice small scale agriculture, growing dates, olives and figs among other crops. In addition there is a considerable tourism development along this stretch of the coast. Human activities have excluded many species and fauna is found in areas away from human activities.

El Omayed Biosphere Reserve

It was established according to Prime Minister Decree No. 671 of 1986 amended by decree 3276 of 1996. It covers an area of about 700 km^2, and is located in Matrouh Governorate, about 80 km west of Alexandria. Being a biosphere reserve, the area is expected to serve as a site for sustainable development of natural resources by rationalizing ecotourism, rangeland management, propagating multipurpose woody species, and promoting local industries. It also has an important function in long-term ecological monitoring. However, most of the impacts affecting this CU also directly affect El Omayed reserve too, due to a lack of funds and efficient management procedures.

- ***Coastal Unit 07***

This CU is of reduced ecological value due to heavy pollution and continuous land reclamation for urbanization. The eastern part of this CU mainly includes urban and suburban environments, including the city of Alexandria, where Lake Mariout (although heavily polluted and impacted by land reclamation) represents one of the few natural spots of the CU. Close to Burg El Arab, city the soil is composed of maritime calcareous sand dunes. The area is characterized by high limestone rocks. The lower elevations of the coastal dune are planted with rain-fed fig trees. West of Alexandria, the coast is mostly occupied by summer resorts.

Figure 11: El Omayed Biosphere Reserve

Figure 12: Limestone Plateau cultivated with fig and clover

Figure 13: Limestone Plateau with date palms and barley cultivations

Lake Mariout IBA

Lake Mariout is the westernmost of the northern Delta wetlands, though its history and origin are different. The lake has been reduced by over 75% of its original area and is still shrinking. Formerly, the lake was fairly large but late in the nineteenth century the western half was cut off by a railway embankment and transformed into an extensive Salina, now known as Malahet Mariout, which is seasonally flooded (usually during winter). Today, the remaining part of this lake is made up of several fragments, dissected by roads and embankments, and lies practically within the boundaries of greater Alexandria and its sprawling suburbs. The lake has no direct connection with the Mediterranean, and is maintained at a level of about 2.8 m below sea level by a pumping station at El Max. The importance of Lake Mariout for birds has diminished greatly over the last two or three decades due to habitat loss, ecological changes and increased disturbance and hunting pressure. Numbers of wintering waterbirds are modest; however, the lake is included among the "Important Bird Areas" (IBAs) of Egypt (IBA Criteria: A4i). Several waterbirds are known to breed in the lake, but it is not expected that there would be any significant concentrations. A total of about 10,000 waterbirds were counted in winter 1989/90. Little Grebe, Purple Gallinule, Moorhen, Little Bittern, Kentish Plover and Little Tern are known to breed in the lake. The population of Little Tern is in the order of 150 pairs. The lake still supports a fishery, with *Tilapia* sp. making up most of the production. The main causes of the lake's area reduction are urban encroachment and solid waste dumping from Alexandria. What remains of the lake proper is brackish, receiving agriculture drainage water through several drains (the most important of these is the Qalaa Drain), as well as large quantities of municipal and industrial effluent from the city of Alexandria. The lake is eutrophic and is the most polluted wetland in Egypt. Agricultural drainage water, discharged into the lake, is heavily contaminated with pesticides and fertilizers, as are the huge quantities of largely untreated municipal and industrial wastewater.

IBA Categories Applying to Lake Mariout

A4i 1% or more of Population
Great White Egret (348 wintering)
Little Gull (866 wintering)

Source: Baha El Din (1999)

Figure 14: Lake Mariout

3.1.5. Current Impacts and Threats

Rain-fed agriculture is practiced in the area in addition to livestock grazing. With the introduction of irrigation water via canals, the area has rapidly changed. Several desert areas have been reclaimed and new agricultural settlements have appeared in the last years. Except for the small reserve of El-Omayed (CU06), which is also threatened by agricultural land reclamation and grazing activities, the natural vegetation and wildlife are in highly degraded conditions. Haphazard tourism expansion, land reclamation, industrial development and urbanization have resulted in the destruction of natural habitats, particularly from Alexandria to Matrouh.

In fact, the area near the coast, west of Alexandria, is actually characterized by intensive strip development (CU06 – CU07). In a continuous band for 120 km, the coast has been totally transformed into intensive summer-home apartment housing developments, surrounded by continuous walls which block public access to the beach, and interactions between the sea and the coastal lands. In addition, the coastal ridges have been quarried for building materials, destroying the habitat of rocky-land species. Accordingly, the coastal dunes, together with their species and the ecological interactions between the sea and the inland areas, have been almost completely lost.

The presence of buildings along the coast affects birds' landing. Quails were observed to direct to the west away from concrete constructions and their inhabitants; some birds have been observed dashing into buildings and being unable to fly again (Batanouni, 2001). Besides, quails are decimated by locals, which use nets to capture them.

Figure 15: Dorcas Gazelle

Up to the early 1970s, the Western Mediterranean Coastal Desert supported very large populations of the Dorcas Gazelle (*Gazella dorcas*), possibly the largest in Egypt. Very few gazelles, if any, are now found in the area as a result of uncontrolled hunting and habitat destruction (EEAA/UNEP, 1993).

Main threats and impacts include:

- Urbanization and Tourism Development;
- Domestic wastewater;
- Industrial pollution;
- Solid waste;
- Agriculture and Grazing;
- Over-cutting and Collection of Medicinal Plants;
- Hunting and Commercial Exploitation of Wildlife;
- Construction of a nuclear plant is planned in the area of El Dabaa (CU05).

3.1.6. Biodiversity Value

Despite the human impact, the distinctive geography of the Mediterranean Coastal Desert allows it to host Egypt's most prolific flora, both in terms of absolute numbers and of species diversity. Unsurprisingly, this rich flora supports a wide range of animal life.

a. Flora

There is one rare endemic species in this region, *Helianthemum sphaerocalyx*, found in coastal dunes. Many wild plants have economic and medicinal value contributing to locals' livelihood. In fact, livestock grazing is a widespread activity in the area and several ligneous plants, such as *Thymelaea hirsuta* and *Anabasis articulata*, are collected as fuel wood (Batanouni, 2001). Besides, Bedouins, with a strong traditional culture, have a real interest in medicinal plants as they collect and use them. Although most Egyptians rely on modern medicines, there is a big demand for medicinal plants in Egypt, but most of these are for export to the USA and Europe.

Matrouh Governorate and surroundings count for more than 50% of the wild medicinal and aromatic plants existing in Egypt, i.e. more than 1000 wild species (ESDF, 2002). This floral wealth is currently misused and over-harvested by residents who use them for folk medicine, human nurturing and animal grazing, thus subjecting the plants to the risk of extinction. The conservation of medicinal plants is a component of Egypt's National Biodiversity Strategy and Action Plan.

b. Fauna

At least 11 terrestrial and five marine species are of special and global concern.

- ***Reptiles***

The Mediterranean Coastal Desert is reported to possess the richest reptilian fauna of Egypt. The Loggerhead Turtle (*Caretta caretta*) nests in the area. The Leopard Lizard (*Acanthodactylus pardalis*) (VU) is threatened due to commercial exploitation and the last individuals of Egyptian Tortoise (*Testudo kleinmanni*) (CR), which has otherwise been eradicated from the rest of the Western Mediterranean Coastal Desert, can be possibly found in the westernmost part of this eco-region. The Mediterranean Hooded Snake (*Macroprotodon cucullatus*) (LC) is known in Egypt only from this eco-region.

Figure 16: Egyptian Tortoise

Figure 17: Houbara Bustard

- ***Birds***

Thekla Lark (*Galerida theklae*) (LC) and Thick-billed Lark (*Ramphocoris clotbey*) (LC) are restricted to this area in Egypt. The Houbara Bustard (*Chlamydotis undulata*) (VU) has been subjected to a very severe hunting pressure and is locally rare. During the autumn and spring migrations, the Western Mediterranean Coastal Desert receives vast numbers of palearctic migrant birds.

- ***Mammals***

Figure 18: Saharan Striped Polecat

Three species of rodents, namely the Lesser Molerat (*Spalax ehrenbergi*) (DD), the Four-toed Jerboa (*Allactaga tetradactyla*) (Global Status: VU, Status in Egypt: EN) and the Lesser Short-tailed Gerbil (*Dipodillus simoni*) (NE) are restricted to the Western Mediterranean Coastal Desert, with the latter two found only in littoral salt marshes. The Greater Egyptian Jerboa (*Jaculus orientalis*) (LC) is listed as VU in Egypt. The Saharan Striped Polecat (*Ictonyx libyca*) (LC) is EN in Egypt. The Crested Porcupine (*Hystrix cristata*) (LC) is possibly EX in Egypt. The Fennec Fox (*Vulpes zerda*) is reported from El Omayed Biosphere Reserve. Until the 1970s, the Dorcas Gazelle (*Gazella dorcas*) (VU) was very common along the western part province of the Western Mediterranean Coastal Desert, but now few individuals remain. The Mediterranean Monk Seal (*Monachus monachus*) (EN) can possibly be still found in the Western Province of this eco-region.

Figure 19: Greater Egyptian Jerboa

Figure 20: Four-toed Jerboa

3.2. The Deltaic Mediterranean Coast

The Deltaic Mediterranean Coast is located in the middle part of the Mediterranean Coast of Egypt. It includes three CUs (CU08 to CU10).

Few parts of the world have been subjected to such a prolonged and intensive human influence, and, except for some few parts of the delta coast, the modern Nile environs are a product of this influence turning it into an essentially man-made ecosystem (Hoath, 2003). On the other hand, parts of the Deltaic coastal area and related habitats as well as Lake Burullus (CU09) represent one of the few remaining fragments of wilderness of the Nile Delta.

3.2.1. Habitats

From a bio-geographical perspective, the northern Nile Delta represents a unique meeting point for biological elements from three bio-geographical regions: the Mediterranean (extending along the coastal zone), the Saharo-Sindian (relicts isolated in the sand dunes) and the Afro-tropical (extending northwards along the Nile Valley). The main habitats of the Deltaic Mediterranean Coast can be classified as follows:

- Beach;
- Sabkha;
- Salt marshes;

- Sand formations;
- Cultivations;
- Man-made wetlands (irrigation canals and drains);
- Natural wetlands (Lake Idku, Rosetta Nile Branch and Lake Burullus)
- Towns and villages

3.2.2. Flora

Mashaly (1987 in FAO, 2005) recorded 225 species from the Deltaic sector (FAO, 2005). The rich Mediterranean coastal vegetation has been mostly eradicated, with only degraded patches remaining. Coastal dunes are dominated by *Zygophyllum aegyptium* with *Calligonum comosum*, *Salsola kali* and *Tamarix tetragyna* co-dominants whilst halophytes (i.e. *Halocnemum strobilaceum*, *Nitraria retusa* and *Arthrocnemum macrostachyum*) dominate coastal saltmarshes (WWF, 2001; EEAA, 2004)

The following plant species were recorded in the Idku area (CU08):

The leeward slopes of the loose dunes support only a small number of species, such as *Elymus farctus* and *Ifloga spicata*. The fixed dunes exhibit a richer habitat, with common perennials such as *Echinops spinosissimus*, *Echium sericeum*, *Ephedra alata* and *Artemisia monosperma*, and annuals such as *Rumex pictus*, *Ifloga spicata*, *Daucus litoralis*, *Centaurea glomerata* and *Plantago squarrosa brachystachys*. New sand depositions cover vast saltmarsh areas and are co-dominated by *Stipagrostis lanata* and *Inula crithmoides*. Common annual species include *Ifloga spicata*, *Ononis serrata* and *Erodium gruinum*. The maritime saltmarshes extend from the foot of the youngest dunes to the seashore to the true sabkha and are co-dominated by *Arthrocnemum macrostachyum*, *Halocnemum strobilaceum*, *Juncus acutus* and *Salicornia fruticosa*. The most common annuals are *Halopeplis amplexicaulis*, *Spergularia marina* and *Senecio desfontainei*. The inland saltmarshes are co-dominated by *Schanginia aegyptiaca* and *Salicornia fruticosa*.

There are 197 species of plants recorded from the Burullus wetland (CU09), divided into 100 annuals and 97 perennials, including 12 hydrophytes. Reedbeds within Lake Burullus are estimated to cover about 7,000 ha and represent one of the most important reedbeds in the Mediterranean region (Shaltout and Khalil, 2005). *Pancratium maritimum* is restricted to the area of Tell El Aqoula (Environics, 2016).

Three main sub-habitats are recognized along the coastal sand dune formations of CU10 (Environics, 2006; Galal and Fawzy, 2007): the top of the dune, the slopes and the interdunal sand sheets. A total of 69 plant species (27 perennials and 42 annuals) were recorded along the different sub-habitats. The interdunal sand sheets have the highest vegetation cover (ranging from 50 to 80%) and 21 species were recorded exclusively from this sub-habitat such as *Herniaria hemistemon*, *Limbarda crithmoides* and *Solanum nigrum*. They were followed by the dune slope (vegetation cover: 25 to 35% on the north-facing slopes; up to 70% on the south-facing slopes), with three species recorded only from this sub-habitat: *Cyperus capitatus*, *Frankenia pulverulenta* and *Nicotiana glauca*. The top of the dunes has the lowest vegetation cover (25-35%), with *Calligonum polygonoides*, *Plantago squarrosa* and *Schismus barbatus* being recorded only from this sub-habitat. Cultivations are also present in interdunal areas.

Figure 21: *Pancratium maritimum*, Tell El Aqoula

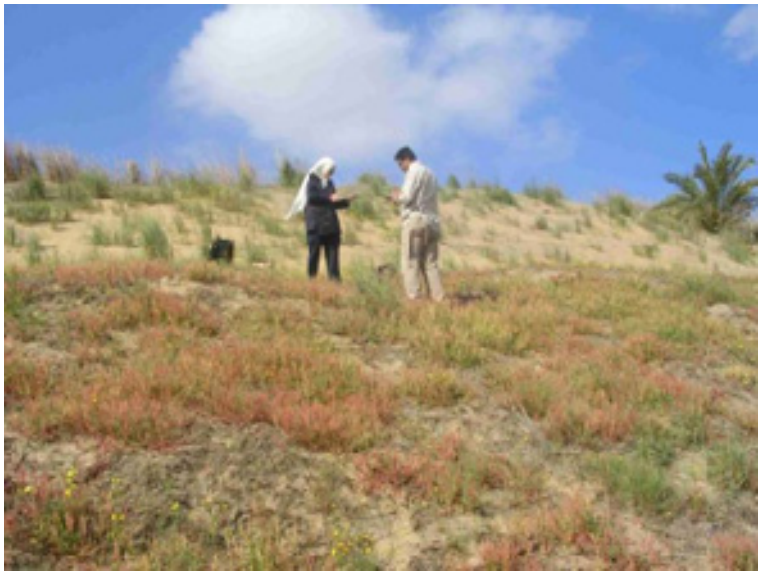

Figure 22: Flora of the dune slope south of Baltim resort (CU10)

3.2.3. Fauna

- ***Amphibians***

Characteristic amphibians include the Square-marked Toad (*Amietophrynus regularis*), the Mascarene Frog (*Ptychadena mascareniensis*) and Lake Frog (*Rana bedriagae*)[4]. Besides, the endemic Nile Delta Toad (*Amietophrynus kassasii*) is also widespread in the area.

- ***Reptiles***

The Loggerhead (*Caretta caretta*) and the Green Turtle (*Chelonia mydas*) are present in coastal waters and live Loggerhead individuals were seen in the Alexandria Central Fish Market (Sarwat, 1999). Bosc's Lizard (*Acanthodactylus boskianus*) is very common and widespread allover the dunes and is closely associated with densely or sparsely vegetated sand dunes. The presence of Nidua Lizard (*Acanthodactylus scutellatus*) is reported from the area by Saleh (1997) and Shaltout and Khalil (2005); and a specimen was collected by Environics (2006) during a summer survey in the coastal area located east of El Gharbeya Drain. Other common terrestrial reptiles include the Turkish Gecko (*Hemidactylus turcicus*), the Eyed Skink (*Chalcides ocellatus*), the Flowered Snake (*Coluber florulentus*) and the Egyptian Cobra (*Naja haje*). The Bean Skink (*Mabuya quinquetaeniata*), the African Chameleon (*Chameleo africanus*), the African Beauty Snake (*Psammophis sibilans*) and the Diced Water Snake (*Natrix tessellata*) are restricted to this habitat in Egypt (EEAA/UNEP, 1995). The Eastern Montpellier Snake (*Malpolon insignitus*) is found in sandy areas of the northern Delta, around vegetated saltmarshes and in cultivated lands (Saleh, 1997).

Figure 23: Eyed Skink collected from the sand dunes south of Baltim resort (CU10)

[4] Vast numbers of *Rana bedriagae* are collected every year for export as frog legs. The figure of three tons annual product has been mentioned casually. It is not known if these animals are reared for the purpose or collected from the wild. The impact of this business is not clear (Baha El Din, 2006).

- ***Birds***

Prominent seabirds of the area include the Black-headed Gull (*Larus ridibundus*), the Yellow-legged Gull (*L. cachinnans*), the Little Tern (*Sterna albifrons*) and the Lesser Crested Tern (*S. bengalensis*) (Tharwat, 1997; Baha El Din and Atta, 2002; Bruun and Baha El Din, 2002). Also, The Pied Kingfisher (*Ceryle rudis*), Little Egret (*Egretta garzetta*), Little Tern (*Sterna albifrons*) and Kentish Plover (*Charadrius alexandrinus*) are known to breed in the area. The Spur-winged Lapwing (*Vanellus spinosus*) is common and frequently encountered in the backshore area.

Characteristic species of the Delta include the Black-shouldered Kite (*Elanus caeruleus*), the Black Kite (*Milvus migrans*), the Common Kestrel (*Falco tinnunculus*), the Painted Snipe (*Rostratula benghalensis*), the Palm Dove (*Streptopelia senegalensis*), the Senegal Coucal (*Centropus senegalensis*), the Barn Owl (*Tyto alba*), the Little Green Bee-eater (*Merops orientalis*), the Crested Lark (*Galerida cristata*), Barn Swallow (*Hirundo rustica*), the Egyptian Wagtail (*Motacilla flava*), the Graceful Warbler (*Prinia gracilis*), the Hooded Crow (*Corvus corone*), the House Sparrow (*Passer domesticus*) and others (EEAA/UNEP, 1995; 1997). The Cattle Egret (*Bubulcus ibis*) is strongly associated with human activities and is omnipresent in agricultural fields, gardens and even in waste dumping areas. Very prominent aquatic avifauna is found in Lake Burullus.

The North Delta coast is an important migration route for birds, particularly during the autumn migration season when birds are in transit between breeding grounds in Europe and Asia and winter quarters in Africa. Hundreds of millions of birds cross the Mediterranean Sea into Egypt during the autumn, the numbers swelled by recently fledged nestlings. Historical migration surveys on the North Coast using radar have calculated that in the peak 60 days of September to October, there is an average of 325,000 birds passing per night over every kilometer of the Egyptian coastline. It was estimated that half the migrating birds, after having flown non-stop across the sea, land on Egypt's Mediterranean coast to feed and rest before departing the next evening to continue their journey south.

- ***Mammals***

Common commensal animals of agricultural and urban areas include the House Mouse (*Mus musculus*), the Brown Rat (*Rattus norvegicus*) and the House Rat (*R. rattus*). It is interesting to note that the Egyptian Weasel (*Mustela subpalmata*) is an almost entirely urban animal in Egypt (Hoath, 2003). Other mammals include the Long-eared Hedgehog (*Hemiechinus auritus*), the Giant Shrew (*Crocidura flavescens*), the Nile Rat (*Arvicanthis niloticus*) and Anderson's Gerbil (*Gerbillus andersoni*). Bats are common in the region and inhabit old monuments, caves and abandoned buildings. Predators comprise the Golden Wolf (*Canis anthus*), the Red Fox (*Vulpes vulpes*), the Egyptian Mongoose (*Herpestes ichneumon*) and the Wild Cat (*Felis silvestris*). Wild carnivores have suffered a great deal of decline in the recent years as a result of intense urban development and secondary poisoning with pesticides widely used to control *Arvicanthis niloticus* and other rodent pests (EEAA/UNEP, 1995; 1993; Hoath, 2003). The Jungle (Swamp) Cat (*Felis chaus*) inhabits areas with thick cover such as agricultural lands, marshes and reed beds. Shrews such the Egyptian Pigmy Shrew (*Crocidura religiosa*) and Flower's Shrew (*C. floweri*), populate fields near current water and drains banks. However, the first is very rare and the latter, an endemic species, is close to extinction.

Figure 24: Carcass of Anderson's Gerbil on the International Coastal Road (CU10)

3.2.4. Coastal Units Characteristics

- ***Coastal Unit 08***

This CU is subject to heavy pollution due the presence of numerous industrial establishments, affecting species' quantity and diversity. The CU comprises a zone of arid coastal land, intensive coastal development, farmlands, the Rosetta Branch of the Nile and Lake Idku. The Abu Qir area, where almost continuous succession of industrial establishments and other structures are present, is the less interesting in biodiversity due to human disturbing and polluting activities that have highly affected the coastal zone. Nelson Island is an important touristic feature. The Idku area is also characterized by the presence of numerous industrial establishments, particularly in the Oil & Gas Sector. In less impacted areas of the Idku zone, some species of concern can still be found.

Lake Idku IBA

Lake Idku is a shallow coastal wetland located west of the Rosetta Nile Branch. Three main drains discharge into the lake, while Boughaz El Maadia provides a connection with the sea. The water in the lake is mainly fresh, but increases in salinity towards the *Boughaz* and during summer. Salt marshes, Salinas and high dunes as well as some orchards are found on the sandbar separating the lake from the Mediterranean. The lake supports a fishery of moderate importance. Lake Idku is of moderate importance for both wintering and breeding waterbirds. However, it is included among the "Important Bird Areas" of Egypt (IBA Criteria: A4iii). The lake probably supports important numbers of breeding birds associated with reed swamps such as: Purple Gallinule (*Porphyrio porphyrio*), Little Bittern (*Ixobruchus minutus*) and Senegal Coucal (*Centropus senegalensis*).

Figure 25: Disturbed vegetated sand mounds, El Tabia

IBA Categories Applying to Lake Idku

A4iii More than 20,000 Waterbirds
22,549 waterbirds counted in the winter of 1989/90

Source: Baha El Din (1999)

Figure 26: Lake Idku

Nile River

It empties into the Mediterranean Sea at Rosetta. There is a considerable amount of urbanization along the Nile. The water level is subject to annual and seasonal fluctuations, highest in summer and lowest in winter, playing an important role in the ecology of the river ecosystem.

Figure 27: The final portion of the Rosetta Nile Branch before discharging into the Mediterranean Sea

- ***Coastal Unit 09***

This CU has a high percentage of natural habitats and includes Lake Burullus Protected Area. Lake Burullus and the adjacent coastal zone are a Protected Area, an IBA, a Ramsar Site and an Important Plant Area (IPA). The area constitutes an important and fragile ecosystem isolated from several thousand years and contains remarkable habitats populated with a variety of species of concern and relict desert species with substantial genetic divergence.

Figure 28: Lake Burullus

Lake Burullus Protected Area, IBA, Ramsar Site and IPA

The Protected Area was established according to Prime Minister's Decree 1444/1998. It currently includes the lake and the coastal area to the Mediterranean shoreline. Lake Burullus is one of Egypt's most important wetlands for wintering waterfowls. It is a Ramsar site and is included among the "Important Bird Areas" (IBAs) of Egypt (IBA Criteria: A1, A4i, A4iii). It is also an Important Plant Area (IPA) according to PlantLife International. The lake is a shallow brackish lake, connected with the sea by a small outlet (*Boughaz*), about 50m wide near Burg El Burullus. The length of the lake is about 65 km, and the width varies between 6 and 16 km, with an average of about 11 km. The depth of the lake ranges between 0.42 and 2.07 m. The lake is separated from the sea by a broad, dune-covered, sand barrier, which varies in width from a few hundred meters in the east to five km in the west. The present area of lake Burullus is 420 km^2 of which 370 km^2 is open water. There are some 50 islands scattered throughout the lake with a total area of 0.7 km^2. Three groups of habitat types are common in this lake:

- Reed swamps in brackish water sites. These are often adjoined with submerged hydrophytes in deeper water areas;
- Salt marsh habitat in islands and coastal fringes of the lake; and
- Sand formations (sheets and dunes) in sea coastal belt.

IBA Categories Applying to Lake Burullus

A1 Globally Threatened Species
Ferruginous Duck (VU at time of designation, now NT)
Regular winter visitor, maximum count 576 in winter 1989/90

A4i 1% or more of Population
Wigeon (24,997 wintering)
Northern Shoveler (15,427 wintering)
Avocet (2,949 wintering)
Purple Gallinule (500 pairs breeding)
Common Pratincole (2,000 pairs breeding)
Redshank (3,378 wintering)
Little Gull (3,906 wintering)
Little Tern (600-800 pairs breeding)
Whiskered Tern (3,530 wintering)

A4iii More than 20,000 Waterbirds
98,887 waterbirds counted in the winter of 1989/90

Source: Baha El Din (1999)

- ***Coastal Unit 10***

This sector has a high percentage of natural habitats and includes the Burullus sand dune belt north of the coastal road (known as the "Black Sands" area), farmlands south of the coastal road, and the northeastern part of Lake Burullus Protected Area, whose boundaries are currently being modified. The sand dunes represent one of the few remaining fragments of natural habitats of the Nile Delta, and contain rare sets of floral and faunal communities. The sand dunes represent a geographically isolated island of dune habitat cutoff from other similar habitats by the Nile branches. These dunes and their largely arid land biota have been isolated for probably several thousand years, and contain substantial genetic divergence, rare sets of floral and faunal communities as well as distinct endemic subspecies which have not been documented yet. This gives to the sand dune belt an additional ecological value as a relict desert environment confined in the Nile Delta.

Figure 29: Interdunal cultivations, western part of CU10

3.2.5. Current Impacts and Threats

In CU08, the coastal zone is highly affected by anthropogenic activities. Major landscape changes have taken place during the last decades. The area is almost entirely occupied by factories and other establishments which prevent access to the beach in many parts of the sector. As a result, the main subsystems that characterize the Deltaic Mediterranean Coast are absent or partially represented.

CU09 and CU10 are better preserved, mainly due to the presence of El Burullus Protected Area which occupies the majority of CU09. However, the protected area boundaries are currently being modified by the EEAA to exclude the coastal area. Current modification of the protected area boundaries will result in the exclusion of the sandy biotopes of the coastal area, which are, from an ecological perspective, of even greater importance than Lake Burullus itself. Moreover, construction of a power plant inside the Protected Area has resulted in the destruction of valuable habitats containing important sets of biodiversity. Lake Burullus is subject to a strong salinity gradient and suffers from the inflow of large amounts of water contaminated with fertilizers and pesticides causing nutrient-enrichment.

CU10 includes a sand dune belt known as "Black Sands" of high ecological value. This" area has been identified for future sand dune mining and this represents a major threat to this unique area.

Main impacts on the Deltaic Coast include:

- Atmospheric pollution;
- Wastewater discharge;
- Solid waste;
- Impacts on Lake Idku and Lake Burullus;

- Fishing and aquaculture;
- Agriculture and land reclamation;
- Sand dune collection for construction activities;
- Use of pesticides;
- Grazing of domestic animals;
- Feral animals;
- Invasive species;
- Hunting and commercial exploitation of wildlife.

3.2.6. Biodiversity Value

The sand dunes represent one of the few remaining fragments of natural habitats of the Nile Delta, and contain rare sets of floral and faunal communities. The sand dunes represent a geographically isolated island of dune habitat cutoff from other similar habitats by the Nile branches. These dunes and their largely arid land biota have been isolated for probably several thousand years, and contain substantial genetic divergence, rare sets of floral and faunal communities as well as distinct endemic subspecies which have not been documented yet. This gives to the sand dune belt an additional ecological value as a relict desert environment confined in the Nile Delta.

a. Flora

Sonchus macrocarpus (DD) and *Sinapis allionii* (locally EN) are endemic to Egypt. *Zygophyllum aegyptium* is found in Egypt and three other countries (Tunisia, Libya and Cyprus). Its presence in Egypt is currently confirmed only along the coast of Baltim (CU10). Three perennial species have a distribution restricted to the Nile Delta: *Ipomoea carnea*, *Vossia cuspidata* and *Ranunculus marginatus* and there are 18 rare perennials and 15 annuals.

Several plants have commercial and social applications. 59 species (92.19% of the total recorded species) had at least one potential or actual economic use. Economic uses are: 45 medicinal species (70.3% of the total economic species), 43 grazing species (67.2%), 21 species used for human consumption (32.8%), 15 species used as fuel (23.4%) and three species used as timber (4.7%).

b. Fauna

- ***Amphibians***

The endemic Nile Delta Toad (*Amietophrynus kassasii*) is widespread in the area.

- ***Reptiles***

The Desert Monitor (*Varanus griseus*) was recorded for the first time in the Delta from the Idku sand dunes (CU08). It is NT in Egypt and listed under CITES Appendix I. In general, reptiles of the area (particularly in CU09 and CU10) face severe collection for the pet trade. The African Chameleon (*Chamaeleo africanus*) is VU in Egypt although it is globally listed as LC by the IUCN. It is listed under CITES Appendix II. The status of Eastern Montpellier Snake (*Malpolon insignitus*) requires assessment. Javelin Sand Boa (*Eryx jaculus*) is CR in Egypt. Its global status has not been

Figure 30: Desert Monitor

evaluated by the IUCN. It is listed under CITES Appendix II. Audouin's skink (*Sphenops sepsoides*) and the lizards *Acanthodactylus boskianus* and *A. scutellatus* are of particular interest from the biogeographic point of view and attest to the specificity of the location and its unique qualities and isolation. It is significant to note that many specimens of *A. boskianus* collected from the Burullus sand dunes (CU10) showed morphological features different from those of individuals located in other geographic areas. Therefore, it is probable that these specimens belong to an undescribed local subspecies.

Figure 31: Javelin Sand Boa

Figure 32: Bosc's Lizard collected from the Burullus sand dunes showing morphological variations (note the yellow lateral strip)

- ***Birds***

Lake Idku (CU08) is of moderate importance for waterbirds. On the other hand, Lake Burullus (CU09) supports very significant numbers of wintering waterfowls and is also an important breeding site for several waterbirds and wetland species. The endemic Delta subspecies of the Lesser Short-toed Lark (*Calandrella rufescens nicolli*) probably has its largest population in the vicinity of Burullus.

- ***Mammals***

The Jungle Cat (*Felis chaus*) and the Wild Cat (*Felis silvestris*), both listed under CITES Appendix II, are present in in the Burullus area (CU09 and CU10). Anderson's Gerbil (*Gerbillus andersoni*) is listed as VU at the national level due to its narrow range. The Egyptian Pigmy Shrew (*Crocidura religiosa*) (DD) is very rare and only two specimens were collected from the neck of the Nile Delta and further down the Nile. Flower's Shrew (*Crocidura floweri*) (DD) is endemic to the Nile Delta of Egypt. Records of African Golden Wolf (*Canis anthus*) are also reported from area. Its conservation status needs evaluation (NE). The Pale Gerbil (*Gerbillus perpallidus*) (LC) is endemic to the desert west of the Delta. The species has been reported from the Idku area (CU08).

3.3. The Eastern Mediterranean Coastal Desert

The Eastern Mediterranean Coastal Desert is located in the eastern part of the Northern Coast of Egypt, separated from North Sinai by the Suez Canal. It includes two CUs (CU11 and CU12).

Figure 33: Dead Wild Cat found on the seashore near Burg El Burullus

3.3.1. Habitats

The farmlands, fields, canals and drains provide habitat for a variety of plant and animal species. However, due to the intense human impact within this sector, most biodiversity of concern tend to concentrate in and around Lake Manzala, which is a particularly important wetland for avian fauna.

Sparse vegetation is found in the Port Said area, while very little flora and fauna exist at the Damietta area due to extensive urbanization and industrial activity. Vegetation cover is sparse and mainly limited to marginal vegetation and reed plants. The following habitat types were recognized in this sector:

- Bare sandy beaches and sandy flats with or without shell fragments and gravel;
- Sand formations (sand flats, mounds and dunes);
- Salt marshes
- Sabkha flats;
- Swamps with reeds and aquatic vegetation
- Man-made wetlands (irrigation canals and drains);
- Natural wetlands (Damietta Nile Branch and Lake Manzala);
- Towns and villages

3.3.2. Flora

This sector is characterized by a sparse vegetation cover composed mostly of coastal, obligate and halophytic shrubs. The latter are mostly found in sand hammocks scattered on the backshore sabkha flats. This shrub vegetation cover traps wind-drifting sands and act as a barrier against sand encroachment on the Port Said to Damietta Road during active northerly and northwesterly winds. Major plant communities recorded in June 2002 at Port Said area were (ERM, 2003):

- *Arthrocnemum macrostachyum* community, occurring within the Sabkha flats and vegetated sand sheets;
- *Halocnemum strobilaceum* community, forming the vegetation cover of the sand sheets and sand drifts;
- *Zygophyllum* sp. community, a succulent shrubby halophyte occurring in a narrow belt that runs parallel to the coastline;
- *Inula crithmoides* community, dominating the saltmarshes along the shore of Lake Manzala;
- *Tamarix nilotica* community, occurring within the coastal sand drifts;
- Bushes of *Juncus rigidus* associated with *J. acutus*, growing on the shore of Lake Manzala;
- Bushes of *Bassia indica*, growing densely along the roadside.

Figure 34: Halophytic coastal vegetation

Figure 35: Salt flat with dense vegetation cover, south west of Ras El Barr (CU11)

3.3.3. Fauna

- ***Amphibians***

Amphibian species are associated with freshwater and brackish water environments. Freshwater species include the Square marked Toad (*Amietophrynus regularis*), Lake Frog (*Rana bedriagae*) and Mascarene Frog (*Ptychadena mascareniensis*). Species more commonly associated with brackish water include the Green Toad (*Bufotes viridis*).

- ***Reptiles***

The Loggerhead Turtle (*Caretta caretta*) and the Green Turtle (*Chelonia mydas*) have been recorded west of Port Said (Saleh, 1997). The National Institute of Oceanography and Fisheries reported in 1992 the presence of turtle breeding sites in the area between Ashtoum El Gamil and Damietta. During an ecological walkover carried out in 2002, local inhabitants at El Mansra village informed that sea turtles used to nest on the beach extending from Astoum El Gamil to El Deeba before 1967. After 1975, sea turtle nests disappeared due to increased human activities (ERM, 2003).

A number of reptiles have been recorded around Lake Manzala (Osborn and Helmy, 1980 *in* ERM, 2003; Saleh, 1997). These included the Turkish Gecko (*Hemidactylus turcicus*), Egyptian Gecko (*Tarentola annularis*), Pale Agama (*Trapelus pallida*), Savigny's Agama (*Trapelus flavimaculatus*), Bosc's Lizard (*Acanthodactylus boskianus*), Egyptian Leopard Lizard (*Acanthodactylus pardalis*), Red Spotted Lizard (*Mesalina rubropunctata*), Eyed Skink (*Chalcides ocellatus*), Audouin's Sand Skink (*Sphenops sepsoides*), Bean Skink (*Mabuya quinquetaeniata*), European Chameleon (*Chamaeleo chamaeleon*), Flowered Snake (*Coluber florulentus*), Eastern Montpellier Snake (*Malpolon insignitus*), Schokari Sand Snake (*Psammophis schokari*) and African Beauty Snake (*Psammophis sibilans*). However, these data are not recent and the increasing anthropogenic influence in the region is likely to have further affected species distribution and abundance, making species scarcer in number and diversity lower.

- ***Birds***

Few numbers of birds are observed in the coastal area. There were no observations of nesting or breeding birds, probably due to the thin vegetation cover. On the other hand, Lake Manzala plays an important role as bird habitat. It is also likely that birds frequent the Port Said coastal area to feed in coastal waters.

Figure 36: Little Egret (*Egretta garzetta*), Lake Manzala

- ***Mammals***

The main recorded species belonged to rodents and included the Black Rat (*Rattus rattus*), the Norway Rat (*R. norvegicus*) and the House Mouse (*Mus musculus*). However, many mammal species have been previously recorded around Lake Manzala and included the Long-eared Hedgehog (*Hemiechinus auritus*), the Fat Sand Rat (*Psammomys obesus*), Anderson's Gerbil (*Gerbillus andersoni*), Henley's Gerbil (*Gerbillus henleyi*), Golden Wolf (*Canis anthus*), Jungle Cat (*Felis chaus*), Red Fox (*Vulpes vulpes*), Egyptian Weasel (*Mustela subpalmata*) and the Egyptian Mongoose (*Herpestes ichneumon*).

3.3.4. Coastal Units Characteristics

- ***Coastal Unit 11***

This CU is mostly developed and includes Ras El Barr, Damietta Port, New Damietta and Gamasa. In the few undeveloped areas (halfway between New Damietta and Gamasa), the seashore is sandy with few shells and scattered algae; while shells and shell fragments increase landwards. Southwards, the landscape is characterized by the presence of numerous vegetated small sand dunes and sand mounds.

Figure 37: Fishing boats at Drain No.1, Izbet Gamasa

Damietta Nile Branch

It empties into the Mediterranean Sea at Ras El Barr (western Nile banks) / Izbet El Borg (eastern Nile banks). The amount of fresh water and silt discharged into the sea has been significantly reduced since the building of the Aswan High Dam. There is a considerable amount of urbanization along the Nile, where extensive stretches of banks have been sealed with concrete and limestone or sandstone blocks to protect them from erosion.

- ***Coastal Unit 12***

This CU includes the Damietta promontory, which is a narrow barrier island extending to Port Said, separating the Mediterranean Sea from Lake Manzala on the south. The soil supports limited plant vegetation and is therefore highly prone to wind and water erosion, especially in the coastal zone.

Lake Manzala IBA

Lake Manzala is the largest of Egyptian wetlands and the most productive for fisheries. The lake is about 60 km long and 40 km wide and is separated from the Mediterranean Sea by a sand bar which has three *Boughaz* connecting it with the sea. Salinity in the lake varies greatly: it is low in the south and west near drain and canal outflows and saline in the northwest. Brackish conditions predominate over much of the rest of the lake. Over

1000 islands of different size are scattered throughout the lake (Abu El Izz, 1971). The lake is an IBA (IBA Criteria: A1, A4i, A4iii).

Lake Manzala is the most important Egyptian wetland for wintering waterbirds, hosting about 40% of all wintering waterfowl counted throughout Egypt's wetlands and including the largest concentrations of wintering Little Gull (*Larus minutus*) and Whiskered Tern (*Chlidonias hybrida*). The lake is also of great importance for passage populations, particularly Avocet (*Recurvirostra avosetta*), Little Stint (*Calidris minuta*), Dunlin (*C. alpina*) and Ruff, *Philomachus pugnax* (Meininger and Atta, 1994; Baha El Din, 1999). According to Baha El Din (1999), Lake Manzala is also of importance for several breeding waterbirds, 35 species of which are known to breed in the lake. These include the Little Bittern (*Ixobruchus minutus*), Little Egret (*Egretta garzetta*), Common Squacco Heron (*Ardeola ralloides*), Purple Gallinule (*Porphyrio porphyrio*), Little Tern (*Sterna albifrons*), Kentish Plover (*Charadrius alexandrinus*), Spur-winged Plover (*Hoplopterus spinosus*), Common Pratincole (*Glareola pratincola*), Egyptian Nighjar (*Caprimulgus aegyptius*), Pied Kingfisher (*Ceryle rudis*) and Clamorous Reed Warbler (*Acrocephalus stentoreus*). For some of these species, Lake Manzala is one of the most important breeding areas in the entire Western Palearctic Region (P. Lane Ltd, 1992 *in* Baha El Din, 1999).

The Mediterranean shore of the lake is also a potential breeding site for endangered marine turtles, particularly the Loggerhead Turtle (*Caretta caretta*). The Jungle Cat (*Felis chaus*) is known to occur in good numbers (Baha El Din, 1999).

IBA Categories Applying to Lake Manzala

A1 Globally Threatened Species
Corncrake (VU)
Fairly common migrant during autumn
Pallid Harrier (NT)
Uncommon migrant and rare winter visitor

A4i 1% or more of Population
White-breasted Cormorant (22,500 wintering)
Little Egret (1,073 wintering)
Great White Egret (528 wintering)
Common Squacco Heron (300 pairs breeding)
Northern Shoveler (12,021 wintering)
Purple Gallinule (500 pairs breeding)
Avocet (8,981 wintering)
Ringed Plover (563 wintering)
Kentish Plover (4,323 wintering)
Kittlitz's Plover (35 wintering)
Spur-winged Lapwing (300 pairs breeding)
Redshank (3,247 wintering)
Little Gull (47,316 wintering)
Black-headed Gull (45,080 wintering)
Slender-billed Gull (2,269 wintering)
Armenian Gull (358 wintering)
Little Tern (1500 pairs breeding)
Whiskered Tern (39,331 wintering)

A4iii More than 20,000 Waterbirds
233,901 waterbirds counted in the winter of 1989/90

Source: Baha El Din (1999)

Figure 38: Lake Manzala

Ashtum El Gamil and Tanis Island Protected Area

It was established according to Prime Minister Decree 459/1988 amended by Decree 2780/1998. It covers an area of about 180 km^2 and includes Ashtum El Gamil located along the sandbar at Boughaz El Gamil, as well as Tanis Island (8 km^2). The protected area was originally created to protect gravid fish and fry during their passage in and out of Lake Manzala through the *Boughaz*. The actual extension aims at protecting also resident and migrant avian fauna, floral diversity and the archeological sites of Tanis Island.

El Mallaha IBA

El Mallaha (IBA Criteria: A4i) was formerly the easternmost extension of Lake Manzala from which it was cut off when the Suez Canal was constructed. It is composed of two hyper-saline lagoons connected to the Mediterranean via Boughaz El Kala (eastern lagoon) and El Mallaha (western lagoon). Despite its small size, it is considered one of the most important wetlands in Egypt for waterbirds.

IBA Categories Applying to El Mallaha

A4i 1% or more of Population
White-breasted Cormorant (5,300wintering)
Greater Flamingo (375-500 pairs breeding; 6,500 wintering)
Northern Shoveler (8,200 wintering)
Avocet ((8,910 wintering)
Kentish Plover (3,290 wintering)
Slender-billed Gull (5,700 pairs bred in 1990)

Source: Baha El Din (1999)

3.3.5. Main Impacts and Threats

Previous observations and collected information show that there have been significant ecological changes in Lake Manzala. A decline in the diversity and number of water birds and proliferation of Water Hyacinth, indicate that the health of the wetland has deteriorated. Furthermore, development is also leading to a loss of habitat. Other impacts include:

- Agriculture and land reclamation
- Use of pesticides
- Fishing and aquaculture
- Grazing of domestic animals
- Feral animals
- Impacts on irrigation canals and drains
- Invasive species

- Removal of aquatic vegetation
- Hunting and commercial exploitation of wildlife

3.3.6. Biodiversity Value

Except for some parts of coast, most of the area is composed of man-made agricultural, rural and urban habitats of moderate to low ecological value. On the other hand, BirdLife International has listed Lake Manzala as an IBA due to its international and regional significance as a wintering and refueling station for migratory waterbirds.

a. Flora

The presence of a Papyrus (*Cyperus papyrus*) stand downstream of the Damietta Branch of the Nile was reported in literature (EEAA, 2004); however the exact location of this stand is not specified. It was locally classified as EN by the IUCN Plant Red Data Book (1978) and is listed as regionally (Mediterranean area) VU by the IUCN (Daoud-Bouattour, 2010). On the other hand, at the global level, *Cyperus papyrus* is described by the IUCN as a widely distributed species with no threats, and hence it is assessed as LC (Kumar, 2013).

b. Fauna

Fishing is a major source of livelihood, particularly in Damietta Governorate and for Lake Manzala fishermen.

- ***Amphibians***

The endemic Nile Delta Toad (*Amietophrynus kassasii*) is widespread in the area, particularly in rice fields. A single specimen of Sudan Ridged Frog (*Ptychadena schillukorum*) was recorded in September 2002 from the western margin of Lake Manzala near Fariskur (Damietta Governorate). Apparently, the species is localized and rare in Egypt.

- ***Reptiles***

The Mediterranean Chameleon (*Chamaeleo chamaeleon*) generally does not penetrate more than 30 km from the coast. It is listed under CITES Appendix II. The African Chameleon (*Chamaeleo africanus*) is VU in Egypt due to heavy collection for the pet trade, although it is globally listed as LC by the IUCN. It is listed under CITES Appendix II.

- ***Birds***

BirdLife International has listed Lake Manzala as an IBA due to its international and regional significance as a wintering and refueling station for migratory waterbirds. It is by far the most important wetland for wintering waterbirds in Egypt and includes the world's largest concentrations of wintering Little Gull (*Larus minutus*) and Whiskered Tern (*Chlidonias hybridus*).

- ***Mammals***

The Jungle Cat (*Felis chaus*) is listed under CITES Appendix II and is found in good numbers around Lake Manzala. The Egyptian Pigmy Shrew (*Crocidura religiosa*) (DD) is very rare and only two specimens were collected from the neck of the Nile Delta and further down the Nile. Records of African Golden Wolf (*Canis anthus*) are also reported from the coastal Nile Delta.

3.4. The Mediterranean Coastal Desert of Sinai

The Mediterranean Coastal Desert of Sinai consists of wide, sand-covered plains, gradually sloping northward. In comparison to the Western Mediterranean Coastal Desert, the region is not as distinctive, receives less rain, is more sparsely vegetated and is mostly low and featureless. Aeolian sand dunes are common throughout the region. The northward-flowing Wadi El Arish, a very large wadi with numerous tributaries drains extensive areas of the Central Sinai highlands and is one of the major geomorphologic features of the region. Lake Bardawil, a shallow lagoon bordering the Mediterranean coastline of Northern Sinai, is another important geomorphologic feature of the region.

Rainfall is generally higher along the Mediterranean coast than in the inland plateau. Within the coastal land, it is lowest at the western end (Port Said, 75 mm) and highest in the eastern bend of Rafah (200 mm).

3.4.1. Habitats

The coastal belt of North Sinai can be broadly divided in Mediterranean sands and salt marshes. This belt includes:

(1) the sandy shoreline with date palm beaches in the El Arish area;

(2) bodies of coastal dunes in the eastern part;

(3) bodies of saltmarshes associated with Lake Bardawil (a particularly important wetland site); and

(4) series of inland sand dunes with lows in between.

The delta of Wadi El Arish, a drainage system with an extensive catchment area, crosses this belt east of the city of El Arish.

Figure 39: Inland sand dunes, El Arish

3.4.2. Flora

Plant growth in the sand dunes shows an in-landward sequence dominated by *Zygophyllum album*, *Artemisia monosperma*, *Thymelaea hirsuta* and *Stipagrostis scoparia*. The salt marshes of Lake Bardawil, its islands and shores have vegetation types dominated by *Halocnemum strobilaceum*, *Arthrocnemum macrostachyum* and *Suaeda aegyptiaca*. On less moist saline areas *Nitraria retusa* abounds.

3.4.3. Fauna

Herpetofauna of this region includes 24 species and is dominated by those specially adapted to sandy substrates. Amphibians recorded from this region are the Green Toad (*Bufotes viridis*)[5], Levant Water Frog (*Pelophylax bedriagae*) and Middle East Tree Frog (*Hyla savignyi*), with the last species being recorded only from this region in Egypt. Reptiles include Leopard Fringe-fingered Lizard (*Acanthodactylus pardalis*), Nidua Lizard (*A. scutellatus*), Olivier's Sand Lizard (*Mesalina olivieri*), Ocellated Skink (*Chalcides ocellatus*), Schneider's Skink (*Eumeces schneideri*), Sandfish (*Scincus scincus*), Mediterranean Chameleon (*Chameleo chameleon*), Desert Monitor (*Varanus griseus*), Diademed Sand Snake (*Lytorhynchus diadema*), Schokari Sand Racer (*Psammophis schokari*) and Negev Tortoise (*Testudo werneri*)[6].

At least 27 bird species are known to breed in the Mediterranean Coastal Desert of SinAIII. One resident species, the Syrian Woodpecker (*Dendrocopos syriacus*), is known only from this habitat type in Egypt (Goodman *et al*., 1989 in EEAA/UNEP, 1993). Characteristic resident birds include Cream-coloured Courser (*Cursorius cursor*), Turtle Dove (*Streptopelia turtur*), Bar-tailed Desert Lark (*Ammomanes cinctura*), (*Alaemon alaudipes*), Greater Hoopoe-lark (*Galerida cristata*), Red-rumped Wheatear (*Oenanthe moesta*), Eurasian Blackbird (*Turdus merula*), and European Goldfinch (*Carduelis carduelis*). During the autumn and spring migrations the Mediterranean Coastal Desert of Sinai receives vast populations of Palearctic migrants.

Mammals of the Sinai Mediterranean Coastal Desert include a total of 20 species (Osborn and Helmy, 1980 in EEAA/UNEP, 1993). Characteristic species of northern Sinai sandy plains include Cape Hare (*Lepus capensis*), Anderson's Gerbil (*Gerbillus andersoni*), Lesser Egyptian Gerbil (*G. gerbillus*), North African Gerbil (*G. campestris*), Fat Sand Rat (*Psammomys obesus*), Lesser Egyptian Jerboa (*Jaculus jaculus*), Crested Porcupine (*Hystrix cristata*)[7], and Fennec Fox (*Vulpes zerda*)[8]. Three species, Buxton's Jird (*Meriones sacramenti*), Tristram's Jird (*M. tristrami*) and Marbled Polecat (*Vormela peregusna*)[9], are recorded only from this region in Egypt (Osborn and Helmy, 1980 in EEAA/UNEP, 1993).

3.4.4. Coastal Units Characteristics

- ***Coastal Unit 13***

This CU includes Lake Bardawil, the eastern end of which includes Zaranik Protected Area. Zaranik is also a Ramsar Site and an IBA. Sand formations are located west of the lake.

Lake Bardawil IBA

[5] The status of the Green Toad in Sinai is currently unclear, and it is possible that these populations should be included within either *Bufotes variabilis* or *Bufotes boulengeri* pending further review (Aghasyan *et al*., 2016).
[6] Sinai populations formerly assigned to T*estudo kleinmanni*
[7] Possibly extinct in Egypt (Grubb *et al*., 2010)
[8] This species has been included in the genus *Fennecus* (e.g., Coetzee 1977), but is retained in *Vulpes* by the IUCN following Wozencraft (2005).
[9] Two localities in the northern part of the Sinai Peninsula (south-east of Bir El Abd and just north of Gabal El Maghara) constituted the first records from Egypt (Saleh and Basuony, 1998).

The lake is an IBA (IBA criteria: A1, A4i, A4iii). It is bordered from the north by a convex sand barrier that separates it from the Sinai Mediterranean coast and from the south by the sand dune belt, which extends inland to the region of fold and anticlinal hills. The main water body of the lake lies towards the east with an area of 58,000 Feddan. Sea water enters the lagoon through two artificial tidal inlets (*Boughaz*) of 270 and 300 m wide and 4-7 m deep, maintained open by periodic dredging, and a natural eastern inlet at Zaranik which is occasionally closed by silting. Fish production of Bardawil Lagoon depends on the water exchange between the lagoon and sea, which regulates lagoon salinity. Common commercial fish include Gilthead Bream (*Sparus aurata*), mullets (Mugilidae), Sea Bass (*Dicentrarchus labrax*) and Common Sole (*Solea solea*). Six major habitat types are clearly distinguished in this lake: salt marshes, saline sand flats, sand hillocks, stabilized sand dunes, inter-dunes depressions, mobile sand dunes and mud flats. The salt marshes of Lake Bardawil, its islands and shores have vegetation types dominated by *Halocnemum strobilaceum*, *Arthrocnemum macrostachyum* and *Suaeda aegyptiaca*. On less moist saline areas *Nitraria retusa* abounds.

IBA Categories Applying to Lake Bardawil

A1 Globally Threatened Species
Corncrake (VU)
Fairly common migrant during autumn
Pallid Harrier (NT)
Regular migrant and winter visitor

A4i 1% or more of Population
White-breasted Cormorant (5,000 – 30,000 wintering)
Greater Flamingo (13,000 wintering)
Little Tern (1,200 pairs breeding)
Kentish Plover (1,900 pairs breeding)

A4iii More than 20,000 Waterbirds
26,968 waterbirds in winter of 1989/90 and up to 30,000 White-breasted Cormorant in winter 1993/94.

Source: Baha El Din (1999)

Lake Bardawil is bordered from the north by a convex sand barrier that separates it from the Sinai Mediterranean coast and from the south by the sand dune belt, which extends inland to the region of fold and anticlinal hills. The lake has an elliptical shape representing a major morphological feature along North Sinai coast. Its area is about 164,000 Feddan and extends for a distance of 80 km along N-S axis. Its maximum width is 20 km and maximum depth is 3 m. The main water body of this lake lies towards the east with an area of 58,000 Feddan of which Zaranik Lagoon occupies about 10,000 Feddan. Several geomorphic and landform features produced by marine and aeolian processes characterize Lake Bardawil: shore landforms represented by foreshore slope, backshore flats, playas, sand sheets and dunes; lagoonal landforms represented by the Bardawil lagoon, islands, inlets, barrier sand flats, and sabkhas; and aeolian landforms represented by the sand accumulation and sand dunes. Considering these landforms and the biota that inhabit them, six major habitat types are clearly distinguished in this lake: salt marshes, saline sand flats, sand hillocks, stabilized sand dunes, inter-dunes depressions, mobile sand dunes and mud flats. Wintering and migrant birds are strongly dependent on these habitats and their vegetation for foraging, refuge and breeding.

Sea water enters the lagoon through two artificial tidal inlets (270 and 300 m wide and 4-7 m deep), maintained open by periodic dredging, and a natural eastern inlet at Zaranik which is occasionally closed by silting. Fish production of Bardawil Lagoon depends on the water exchange between the lagoon and sea, which regulates lagoon salinity.

Figure 40: Greater Flamingos, Lake Bardawil

Zaranik Protected Area, IBA and Ramsar Site

The Protected Area was established according to Prime Minister Decree 1429/1985 amended by Decree 3379/1996. It is located at the eastern end of Lake Bardawil and encompasses an eastern extension of that lake, the Zaranik Lagoon, covering an area of 25,000 ha. It is an IBA according to BirdLife International (IBA criteria: A1, A4i) and a Ramsar Site.

Zaranik Protected Area is located at the eastern end of Lake Bardawil and encompasses an eastern extension of that lake: the Zaranik Lagoon. The lagoon is shallow, with numerous small islets scattered throughout it, most of which are covered with dense saltmarsh vegetation. Extensive mudflats and saltmarshes are found along the lagoon's shores, merging into sabkha and sand-dunes further inland. A saltworks was established at Zaranik in the early 1980s, prior to its declaration as a protected area, consisting of a pumping station, extensive evaporation pools and saltpans. The facility only became active in 1997.

IBA Categories Applying to Zaranik Protected Area

A1 Globally Threatened Species
Corncrake (VU)
Fairly common migrant during autumn
Pallid Harrier (NT)
Regular migrant and winter visitor

A4i 1% or more of Population
White-breasted Cormorant (5,000 wintering)
Greater Flamingo (10,000 wintering)
Slender-billed Gull (2,000 wintering)

Source: Baha El Din (1999)

Zaranik's importance is primarily as a bottleneck area for migrant Palearctic waterbirds. Every autumn, hundreds of thousands of waterbirds flying along the eastern Mediterranean coastline concentrate at Zaranik or pass through the area, many landing to rest and feed before resuming their journey southwards across Sinai or westwards to the Nile valley.

Vast numbers of passerines and near-passerines also arrive at the coast, as they do everywhere along the Egyptian Mediterranean shoreline, but here hunting and persecution is illegal and controlled. Some 270 bird species have been reported in Zaranik. Only 10 species are known to breed in the Protected Area, of which Sterna albifrons and Charadrius alexandrinus are the most numerous and prominent. Zaranik is also the only locality in Egypt where Recurvirostra avosettais known to breed on a regular basis (five pairs in summer 1994), and large numbers also winter (up to 700, December 1998).

Non-bird biodiversity include Reptiles: *Caretta caretta* (EN) was recently found to have its largest breeding concentration along the Egyptian Mediterranean in the Protected Area. *Chelonia mydas* (EN) is suspected of breeding locally and *Dermochelys coriacea* (EN) has been recorded once. Islets and littoral dunes fringing the southern margins of the Zaranik Lagoon and adjacent sabkha are said to have held a small population of *Testudo kleinmanni* (EN). *Trapelus savignii*, endemic to the Isthmic Desert and the western Negev, is found throughout the sandy habitats of the region. Among mammals, the rare *Vulpes zerda* (DD) has been recorded.

- ***Coastal Unit 14***

This CU includes the city of El Arish and El Ahrash Reserve at its easternmost borders. Large parts of the coastal area are still pristine and undeveloped. The date palm beach at El Arish is also an important feature characterizing this CU.

El Ahrash Reserve

It was established according to Prime Minister Decree 1429/1985 amended by Decree 3379/1996. It is located at north-easternmost borders of Egypt and covers an area of 8 km^2. It is an area of marshes characterized by sand dunes, of approximately 60 m height above sea level. Plants include a high density of Acacia trees, Tamarix trees, camphor trees, bushes, grass, pastoral and fodder plants. The area includes important resources for pasture and timber and constitutes a shelter for wildlife. Vegetation helps in sand dunes stabilization.

Figure 41: El Ahrash Reserve

3.4.5. Current Impacts and Threats

Considerable ecological changes have occurred to Lake Bardawil due to the extension of salt extraction and the constant formation of sand bars (siltation), which close the channels connecting the lagoon with the sea.

Moreover, there has been dramatic change in the catch composition of the lagoon during the last two decades. Crustaceans (shrimps and crabs) production has greatly increased in the lagoon, reaching about 60 % of the total catch in 2005, affecting the catch of other economic fish species like sea bream and sea bass. This serious change in catch composition can be attributed to a number of factors including: change in ecological conditions of the lagoon, increased fish export and overexploitation since the late 1980s.

In addition, a high sea turtle mortality rate has been noticed; the causes are unknown although some fishermen admitted to deliberately kill turtles profiting of poor law enforcement. Other impacts include:

- Rubbish and uncontrolled access to sea turtle nesting sites
- Agriculture and land reclamation
- Grazing of domestic animals
- Hunting and commercial exploitation of wildlife
- Collection of medicinal plants by locals
- Excessive withdrawal of groundwater and increased salinity
- Decrease of numbers of palm trees in El Arish beach
- Invasive species

3.4.6. Biodiversity Value

Lake Bardawil is so far the cleanest marine water body in Egypt, as well as in the entire Mediterranean region. It is an important source of local fishery in north Sinai and the country.

a. Flora

Six threatened species are recorded in Lake Bardawil four of which are categorized as EN (*Astragalus camelorum, Bellevalia salah-eidii, Biarum olivieri* and *Salsola tetragona*). One species is indeterminate (*Lobularia arabica*), while another one is rare (*Iris mariae*). In addition, 5 species (3.7% of the total recorded species) are endemic taxa: *Zygophyllum album, Astragalus camelorum, Allium papillare, Bellevalia salah-eidii* and *Iris mariae*.

Special emphasis should be given to the Palm Groves at El-Arish, which are man-made but can be included among the valuable sub-habitats of the area. In addition to forming spectacular and attractive landscapes, the dense vegetation of the Date Palm Groves contributes to the natural protection of the habitat. In particular, they avoid soil erosion and form a natural barrier against desertification. The Date Palm possesses adventitious roots which do not penetrate deep into the soil, which makes its presence without much stress on the deeper levels of the soil.

Figure 42: Palm beach at El Arish

b. Fauna

Common commercial fishes of the Bardawil Lagoon include the Gilthead Bream (*Sparus aurata*), grey mullets (Mugilidae), Sea Bass (*Dicentrarchus labrax*) and Common Sole (*Solea solea*).

Figure 43: Loggerhead Turtle, Lake Bardawil

- ***Amphibians***

  The Middle East Tree Frog (*Hyla savignyi*) is recorded in Egypt only from the coastal area of North SinAIII.

- ***Reptiles***

The Loggerhead Turtle (*Caretta caretta*) (VU) was recently found to have its largest breeding concentration along the Egyptian Mediterranean in the Zaranik Protected Area. Green Turtle (*Chelonia mydas*) (EN) is suspected of breeding locally and Leatherback Turtle (*Dermochelys coriacea*) (VU) has been recorded once. Islets and littoral dunes fringing the southern margins of the Zaranik

Lagoon and adjacent sabkha are said to have held a small population of Negev Tortoise (*Testudo werneri*) (DD). The Negev Tortoise (*Testudo werneri*) was formerly assigned to the Egyptian Tortoise (*Testudo kleinmanni*), listed as CR by the IUCN. As *Testudo werneri* the species' status requires assessment.

Savigny's Agama (*Trapelus savignii*) (VU), endemic to the Isthmic Desert and the western Negev, is found throughout the sandy habitats of the region. The Leopard Fringe-fingered Lizard (*Acanthodactylus pardalis*) is listed as VU at the global level by the IUCN. In Egypt, it is EN or possibly CR. The Desert Monitor (*Varanus griseus*) is NT in Egypt. Its global status has not been evaluated by the IUCN. It is listed under CITES Appendix I. The Mediterranean Chameleon (*Chamaeleo chamaeleon*) is subjected to heavy collection by animal dealers. It is listed under CITES Appendix II.

- ***Birds***

The Syrian Woodpecker (*Dendrocopos syriacus*) is a resident species known only from this area in Egypt. The Turtle Dove (*Streptopelia turtur*) is listed as VU by the IUCN and included in CMS Appendix II.

Zaranik's importance is primarily as a bottleneck area for migrant Palearctic waterbirds. Every autumn, hundreds of thousands of waterbirds flying along the eastern Mediterranean coastline concentrate at Zaranik or pass through the area, many landing to rest and feed before resuming their journey southwards across Sinai or westwards to the Nile valley. Vast numbers of passerines and near-passerines also arrive at the coast, as they do everywhere along the Egyptian Mediterranean shoreline, but here hunting and persecution is illegal and controlled. Some 270 bird species have been reported in Zaranik. Only 10 species are known to breed in the Protected Area, of which Little Tern (Sterna albifrons) and Kentish Plover (*Charadrius alexandrinus*) are the most numerous and prominent. Zaranik is also the only locality in Egypt where Pied Avocet (*Recurvirostra avosetta*) is known to breed on a regular basis (five pairs in summer 1994), and large numbers also winter (up to 700, December 1998).

Populations of IBA trigger species include:

- Greater Flamingo (*Phoenicopterus roseus*), 10,000 individuals, LC
- Great Cormorant (*Phalacrocorax carbo*), 5,000 individuals, LC
- Pallid Harrier (*Circus macrourus*), NT
- Corncrake (*Crex crex*), 2,000 individuals, LC

- ***Mammals***

The Marbled Polecat (*Vormela peregusna*) was recorded from two localities (south-east of Bir El Abd and just north of Gabal El Maghara, about 7 and 38 km south of Lake Bardawil respectively) and constituted the first records from Egypt.

Figure 44: Fennec Fox

Anderson's Gerbil (*Gerbillus andersoni*) is listed as VU at the national level due to its narrow range. Buxton's Jird (*Meriones sacramenti*) is assessed precautionarily as VU by the IUCN, but needs to be assessed. It is recorded only from this region in Egypt. Tristram's Jird (*Meriones tristrami*) is recorded only from this region in Egypt. The Crested Porcupine (*Hystrix cristata*) is reported but may have been extirpated in Egypt. Fennec Fox (*Vulpes zerda*) is listed in CITES Appendix II and is legally protected in Egypt with the last record of the animal occurring in North Sinai in 2005 at El-Queseima.

4. OVERALL ASSESSMENT

4.1. Status of Coastal Units

4.1.1. Selection of Indicators

In order to carry out an overall assessment of the whole Northern Coast of Egypt, CU status indicators have been selected from a set of guidelines (Government of Catalonia, 2007; OECD, 2003; UNESCO, 2003; UNESCO, 2006) and adapted to the current study. Selection of indicators has been subjected to a set of criteria, as follows:

- Be simple and easy to interpret;
- Based on available supporting data;
- Supporting data should be adequately documented and of known quality;
- Have a numerical value as a basis for comparison;
- Provide a representative picture of ecological conditions and pressures on biodiversity.

Accordingly, the following indicators have been selected:

- ***Indicators to highlight the status of biodiversity***
- Extension of natural habitats
- Loss of natural habitats
- Existence of protected areas
- Extension of protected areas
- Existence of IBAs:
- Existence of Ramsar Sites:
- Number of endemic/threatened species
- Number of protected species
- ***Indicators to highlight the status of natural water bodies***
- Pollution and contaminants
- ***Indicators to highlight the importance of natural resources***
- Inland fisheries stocks
- Species with potential use:

4.1.2. Value of Indicators

The following indicators are categorized into High, Medium, Low, and Not Applicable and each category has been given a numerical value (where High = 3; Medium = 2: Low = 1 and NA = 0):

- Extension of natural habitats
- Extension of protected areas
- Number of endemic/threatened species

- Number of protected species
- Inland fisheries stocks
- Species with potential use:

The following indicators are categorized into High, Medium and Low and each category has been given a numerical value (where High = 1; Medium = 2 and Low = 3)

- Loss of Natural Habitats
- Pollution and contaminants

As the absence of natural water bodies does not decrease the value of a CU, in case the "Pollution and contaminants" criterion is NA it is not counted in the assessment.

The following indicators are categorized into Yes and No and each category has been given a numerical value (where Yes = 3 and No = 0):

- Existence of protected areas
- Existence of IBAs:
- Existence of Ramsar Sites:

4.1.3. Coastal Units Ranking

Based on the previous numerical values, a simple Ranking Matrix has been developed to assess the ecological value of the 14 coastal units and to rank them in a descending order, from the most valuable to the least valuable (Table 1).

- A value ranging from 0 to 1 indicates a Low Ecological Value of the CU. This applies to CU11, CU07 and CU08.
- A value ranging from 1 to 2 indicates a Medium Ecological Value of the CU. This applies to CU04, CU03, CU05, CU02, CU06, CU10, CU01, CU12 and CU14.
- A value ranging from 2 to 3 indicates a High Ecological Value of the CU. This applies to CU09 and CU13.

The results also indicate that CU13 and CU09 are the most valuable coastal units. CU13 is located in North Sinai and includes Lake Bardawil, which is the most pristine lake among the Egyptian coastal lakes and a Ramsar Site. Moreover, this coastal unit includes Zaranik Protected area, two IBAs and important sets of threatened and protected species.

CU09 is located on the Delta coast and includes Lake Burullus which is a Protected Area, an IBA, Ramsar Site, and an IPA and includes rare sets of endemic, threatened and protected species. Moreover, the Protected Area covers the majority of this coastal unit.

On the other hand, CU11 is the least valuable coastal unit, as it is mostly developed and includes Ras El Barr, Damietta Port, New Damietta and Gamasa, with very few natural habitats remaining.

It should be noted that the results of the Ranking Matrix provide a simple qualitative and indicative assessment of the different coastal units. Therefore, although some coastal units are classified as habitats of Medium Ecological Value (due to the absence of protected areas, IBAs and/or Ramsar sites), some of these require consideration as they are characterized by other important ecological features. This applies in particular to CU10 and CU14 and CU01.

CU10 has a high percentage of natural habitats and includes the Burullus sand dune belt north of the coastal road (known as “Black Sands”). These sand dunes represent a relict desert habitat confined in the Nile Delta and contain substantial genetic divergence and rare sets of floral and faunal communities and distinct endemic subspecies which have not been documented yet.

CU14 includes El Ahrash Reserve which is a protected area of small dimensions, but large parts of this coastal unit are still pristine and undeveloped with species characteristic of areas located beyond the Egyptian northeastern borders and recorded only from this region in Egypt.

Similarly, CU01 includes the recently established El Sallum Protected Area which is mainly a marine protectorate and covers only few fragments of coastal habitats, although it contains species characteristic of areas located beyond the northwestern borders of Egypt.

Table 1: Coastal Units' Ranking Matrix

CU Indicators	Coastal Mediterranean Eco-regions													
	Western Mediterranean Coast							Deltaic Mediterranean Coast			Eastern Mediterranean Coast		Sinai Mediterranean Coast	
	Western Province				Eastern Province									
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**
Biodiversity														
Extension of natural habitats	3	3	2	2	3	2	1	1	3	3	1	2	3	3
Loss of natural habitats	2	3	2	2	2	1	1	1	2	1	1	1	3	3
Existence of protected areas	3	0	0	0	0	3	0	0	3	3	0	3	3	3
Extension of protected areas	1	0	0	0	0	2	0	0	3	1	0	1	2	1
Existence of IBAs	0	0	0	0	0	0	3	3	3	0	0	3	3	0
Existence of Ramsar Sites	0	0	0	0	0	0	0	0	3	0	0	0	3	0
Number of endemic/threatened species	3	2	2	2	2	2	1	1	3	3	1	2	3	3
Number of protected species	3	2	2	2	2	2	1	1	3	3	1	2	3	3
Natural Water Bodies														
Pollution and contaminants	NA	NA	NA	NA	NA	NA	1	1	1	NA	1	1	3	NA
Natural Resources														
Inland fisheries stocks	0	0	0	0	0	0	1	2	3	0	1	3	3	0
Species with potential use	3	3	3	3	3	3	1	2	3	3	1	2	3	3
Overall Value	**1.8**	**1.3**	**1.1**	**1.1**	**1.2**	**1.5**	**0.9**	**1.0**	**2.7**	**1.7**	**0.6**	**1.8**	**2.9**	**1.9**
Rank	**5**	**8**	**10**	**11**	**9**	**7**	**13**	**12**	**2**	**6**	**14**	**4**	**1**	**3**

High: 3; Medium: 2: Low: 1, Not Applicable (NA): 0; Yes: 3: No: 0

Loss of Natural Habitats: High: 1; Medium: 2; Low: 3

Pollution and contaminants: High: 1; Medium: 2; Low: 3; if NA: not counted in the assessment

4.2. Biodiversity Value

The Northern Coast of Egypt is very heterogeneous in terms of ecological value, mainly due to anthropogenic impacts that have affected the coastal habitats and, in many cases, eradicated several species leaving entire eco-regions with few spots of fragmented natural habitats. The main species of concern mentioned in the present report are herein presented.

4.2.1. Flora

Of the over 2000 species of plants in Egypt, about 1000 occur within 30 km of the Mediterranean coast (IUCN, 2003). However, a large number of Egypt's plants have become locally rare or extinct, due to habitat destruction, overgrazing, and over-harvesting.

Helianthemum sphaerocalyx is a rare species found in the coastal dunes of the Western Mediterranean Coast. In the Deltaic Coast, *Sonchus macrocarpus* (DD) and *Sinapis allionii* (locally EN) are also endemic. *Zygophyllum aegyptium* is found in Egypt and three other countries (Tunisia, Libya and Cyprus). Its presence in Egypt is currently confirmed only along the coast of Baltim (CU10). Three perennial species have a distribution restricted to the Nile Delta: *Ipomoea carnea*, *Vossia cuspidata* and *Ranunculus marginatus* and there are 18 rare perennials and 15 annuals. The presence of a Papyrus (*Cyperus papyrus*) stand downstream of the Damietta Branch of the Nile was reported in literature (EEAA, 2004); however the exact location of this stand is not specified. Six threatened species are recorded in Lake Bardawil four of which are categorized as EN (*Astragalus camelorum, Bellevalia salah-eidii, Biarum olivieri* and *Salsola tetragona*). One species is indeterminate (*Lobularia arabica*), while another one is rare (*Iris mariae*). In addition, 5 species are endemic: *Zygophyllum album, Astragalus camelorum, Allium papillare, Bellevalia salah-eidii* and *Iris mariae*.

Several plants have commercial and social applications. Matrouh Governorate and surroundings count for more than 50% of the wild medicinal and aromatic plants existing in Egypt, i.e. more than 1000 wild species (ESDF, 2002). This floral wealth is currently misused and over-harvested by residents who use them for folk medicine, human nurturing and animal grazing, thus subjecting the plants to the risk of extinction.

The Date Palm is native to Egypt and possesses adventitious roots which do not penetrate deep into the soil, which makes its presence without much stress on the deeper levels of the soil and allow side cultivations. Palm Groves are man-made valuable biotopes. In addition to forming spectacular and attractive landscapes, the dense vegetation of the Date Palm Groves contributes to the natural protection of the habitat. In particular, they avoid soil erosion and form a natural barrier against desertification.

4.2.2. Fauna

This section presents an account on the status of faunal species of concern. In addition, Table 2 provides a brief description of the ecology, status and potential presence of these species in the different eco-regions / coastal units.

- ***Amphibians***

  Although amphibians seem to be not particularly affected by anthropogenic activities, at least four species are of concern.

Green Toad (*Bufotes cf. viridis*)

Egyptian populations of the Green Toad were formerly included in the genus *Bufo* but have now been moved to *Bufotes*. However, the status of the Green Toad in Sinai is currently unclear, and it is possible that these populations should be included within either *Bufotes variabilis* or *Bufotes boulengeri* pending further review (Aghasyan et al., 2016). Both *Bufotes viridis* and *B. boulengeri* are listed as LC by the IUCN, while *B. variabilis* is listed as Data Deficient (DD).

Nile Delta Toad (*Amietophrynus kassasii*)

The endemic Nile Delta Toad (*Amietophrynus kassasii*) is reported from the Delta and is widespread in stagnant freshwater bodies. It is listed as Least Concern (LC) by the IUCN, because although its Extent of Occurrence is less than 20,000 km^2, the species is adapted to cropland and does not appear to be facing any serious risk (Mills and Baha El Din, 2004)

Sudan Ridged Frog (*Ptychadena schillukorum*)

The Sudan Ridged Frog (*Ptychadena schillukorum*) is apparently common where it occurs, but is patchily distributed. Although this species is reported from a very wide area in Africa, there are very few records from most of its range, and it has not been recorded from many countries where it is likely to occur. It is listed as LC by the IUCN in view of its very wide distribution, its tolerance of a broad range of habitats and its presumed large population. There are still no clear indications of its local abundance and status in Egypt. Apparently, it is localized and rare in Egypt where it is currently only known from two specimens. Its populations (localities in the Nile Delta and El Fayoum) appear to be genuinely isolated. Given the fact that the species has remained undocumented for such a long time, it is likely to be a localized and rare inhabitant of wetlands of Lower Egypt (Baha El Din, 2005, 2006; IUCN, 2013).

Middle East Tree Frog (*Hyla savignyi*)

It is listed as Least Concern (LC) by the IUCN in view of its wide distribution, tolerance of a broad range of habitats, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category. However, it has restricted range in Egypt as it is recorded only from this region where it was first recorded in the early 1990s (Sergius *et al*., 2009).

- ***Reptiles***

Reptiles are among the most affected taxa by human activities, mainly due to habitat loss and commercial exploitation for the pet trade.

Egyptian Tortoise (*Testudo kleinmanni*)

This species is possibly EX in Egypt and listed as CR by the IUCN, although it was previously assessed as CR in Egypt and EN by the IUCN. However, northeastern populations that were previously assigned to *T. kleinmanni* recently have been accepted as a separate species, *T. werneri* (Perälä, 2001). The species' extent of occurrence covered an estimated area of 123,610 km² less than three generations ago. Today it is estimated at around 16,600 km². Within the same period population sizes are estimated to have reduced by over 85% from around 55,600 to 7,470 individuals, of which approximately 5,000 are mature individuals. This figure is less than the number of animals recorded from the illegal pet trade in the 1990s alone. Fairly good habitat patches still exist in Libya but the global population of *T. kleinmanni* could realistically face extinction in less than 20 years or around one generation if degradation of landscape and trade cannot be stopped (Perälä, 2003). *T. kleinmanni* was very heavily affected by the (eventually illegal) national and international pet trade that began using the Libyan stock after Egyptian subpopulations were harvested to extinction (Baha El Din, 1994). The species is included in CITES Appendix I.

Mediterranean Hooded Snake (*Macroprotodon cucullatus*)

It is listed as LC by the IUCN in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Corti *et al*., 2009). In Egypt, *M. cucullatus* is significantly threatened and is considered to be EN (Baha El Din, 2005). The species is threatened by commercial collection for the international pet trade, urbanization and development of tourism, overgrazing, collection of firewood and quarrying. There is a need to develop national legislation to protect this species and to create new protected areas (Corti *et al*., 2009).

Leopard Fringe-fingered Lizard (*Acanthodactylus pardalis*)

The species is listed as Vulnerable (VU) by the IUCN because of a serious population decline, estimated to be more than 30% over the last three generations, inferred from observed shrinkage in distribution and habitat destruction and/or degradation. The species has an extent of occurrence of less than 20,000 km², with few fragmented populations present in the Egyptian part of its range. The population of this species in Egypt has significantly declined (possibly by 80%) since the 1970s, and it is now known only from a few localities. However the status of populations in Libya is unclear and it is difficult to determine what percentage the global population has declined by. It has almost certainly declined by 30%, but it is uncertain if it has declined by 50% or more over the last 10 years or three generations. If the species has recently declined in Libya to the extent that it has in Egypt, then the species will qualify for Endangered (EN) or possibly CR. Further studies are urgently needed for this species (Böhme and Baha El Din, 2006).

Eastern Montpellier Snake (*Malpolon insignitus*)

The eastern population of Montpellier Snake (*Malpolon insignitus*) was formerly allocated to *M. monspessulanus* but is now included by the IUCN within *M. insignitus*, following Carranza *et al*. (2006). As *M. monspessulanus*, it was formerly considered common but rather localized at the local level and listed by the IUCN as LC. However, the local and global statuses of *M. insignitus* have not been evaluated yet. It is threatened by commercial over-exploitation for the pet trade.

Desert Monitor (*Varanus griseus*)

The Desert Monitor (*Varanus griseus*) is mostly found in desert plains and large wadis with some vegetation. Large numbers are collected for the pet trade and occasionally for leather. According to Baha El Din (2006) it is Near Threatened (NT) in Egypt. Its global status has not been evaluated by the IUCN. It is listed under CITES Appendix I.

Mediterranean Chameleon (*Chamaeleo chamaeleon*)

Generally, it does not penetrate more than 30 km from the coast. It is widespread and fairly common, but subjected to heavy collection by animal dealers (Baha El Din, 2006). At the global level, the species is classified as Least Concern (LC) by the IUCN in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a threatened category (Vogrin *et al*., 2012). It is listed under CITES Appendix II.

African Chameleon (*Chamaeleo africanus*)

The African Chameleon (*Chamaeleo africanus*) is restricted to the Nile Delta and lower Nile Valley. It is fairly common in the northern Delta. It is a popular pet animal in trade. Until 2006, Baha El Din reputed the impact of collection on this species not significant, but numbers collected appeared to be larger than the past and classified the animal as Vulnerable (VU) in Egypt (Baha El Din, 2006). It is also probably threatened by the reclamation of wetlands in the northern Nile Delta. An updated targeted study is required to be able to assess the current local status of the animal. The animal is listed as LC by the IUCN in view of its wide distribution,

presumed large population, and because any declines are likely to be localized (Wilms *et al*., 2014). It is listed under CITES Appendix II.

Negev Tortoise (*Testudo werneri*)

Populations east of the Nile Delta in Egypt and in Israel were formerly assigned to the Egyptian Tortoise (T*estudo kleinmanni*) but have been shown to encompass a separate species, *Testudo werneri*, according to Perälä (2001). As T*estudo kleinmanni*, the species was listed as Critically Endangered (CR) at the global and local levels. According to the new taxonomic classification, the status of *Testudo werneri* requires assessment, while *T. kleinmanni* is possibly extinct in Egypt. On the other hand, Baha El Din (personal communication, 2016) deems T*estudo kleinmanni* and *T. werneri* too much similar at the genetic level to be considered as two separate species and could be at most regarded as subspecies of the same animal.

- ***Birds***

Several migrating birds including birds of prey are severely affected by hunting and commercial exploitation. Anthropogenic impacts on coastal lakes also constitute a threat to wintering and resident waterbirds.

Moreover, all Falconiformes (falcons) and Strigiformes (owls) are protected species, included in CITES Appendices I or II. Most birds of agricultural areas (although common and widespread) are protected as useful to agriculture as listed in Ministerial Decree 28 of 1967 issued in accordance to Article 117 of Law 53 of 1966 (known as "The Law of Agriculture").

Houbara Bustard (*Clamydotis undulata*)

North African populations may be sedentary or partially migratory, moving relatively short distances to find recent plant growth. It is listed as VU by the IUCN and included in CITES Appendix I. Although this species showed a steady decline of c.25% in the 20 years preceding 2004, this trend may since have been reversed by a captive breeding and release programme in eastern Morocco and western Algeria, and the overall population of *C. undulata* is said to be increasing. However, research is required into the efficacy of such releases at improving the demographic trends of the entire population without compromising its genetic integrity (BirdLife International, 2016b).

Pallid Harrier *(Circus macrourus)*

The Pallid Harrier (*Circus macrourus*) is an uncommon migrant and rare winter visitor of Lake Manzala (Baha El Din, 1999), listed as Near Threatened (NT) by the IUCN, as the species is known to be undergoing steep population decline in Europe, although numbers in its Asiatic strongholds are thought to be more stable. Thus, it is probably experiencing a moderately rapid population decline overall (BirdLife International, 2016b). This raptor is listed under CITES Appendix II and CMS[10] Appendix II.

Corncrake (*Crex crex*)

The Corncrake (*Crex crex*) is a fairly common migrant during autumn (Baha El Din, 1999). It was previously listed as Vulnerable (VU) by the IUCN but it is currently classified as LC. This is justified by the fact that data from monitoring in Russia (which holds the vast majority of the global population) indicate that the predicted declines have not taken place and that numbers have remained stable since 2002 or are even increasing. On the other hand, in Egypt, thousands of migrating birds (0.5-2.7% of the European population) are susceptible to capture each autumn in nets set for the Quail (*Coturnix coturnix*) with which they often migrate (Birdlife International, 2016b). The Corncrake is listed under CMS Appendix II.

[10] Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979

Turtle Dove (*Streptopelia turtur*)

This species has been listed as VU by the IUCN. It has undergone rapid declines in much of its European range whilst in Russia and Central Asia it is thought to have experience more severe declines. Declines are thought to be driven by a number of factors including loss of foraging and nesting sites as well as disease and hunting along its migration (Birdlife International, 2016b). It is also included in CMS Appendix II.

- ***Mammals***

Several mammals have disappeared from the Northern Coast of Egypt or are on the verge of extinction as a result of habitat loss and fragmentation.

Jungle Cat (*Felis chaus*)

The Jungle Cat (*Felis chaus*) is listed under CITES Appendix II, but classified as LC by the IUCN, as the species is widespread, and common in some parts of its range, particularly India (Duckworth *et al*., 2008). However, population declines and range contraction are of concern elsewhere, particularly in Egypt. Basuony *et al*. (2010) have classified this felid as LC at the national level, but with need of population studies and monitoring. *Felis chaus* is found in the Burullus area where it inhabits areas with thick cover such as agricultural lands, marshes and reed beds in and around Lake Burullus. Globally, it has a broad but patchy distribution. In Africa, it is found only in Egypt, along the Nile River Valley south to Aswan, and in El Fayum, Farafra, Dakhla and Kharga oases (Glas, in press). Reclamation and destruction of natural wetlands, ongoing throughout its range but particularly in the arid areas, poses a threat to the species, as density in natural wetlands is generally higher (Nowell and Jackson, 1996).

Wild Cat (*Felis silvestris*)

The Wild Cat (*Felis silvestris*) is the most common and widely distributed wild felid, and thus listed as LC by the IUCN. However, introgressive hybridization with domestic and feral cats is considered extensive and taking place across almost the entire range, potentially resulting in cryptic extirpations of some populations (Nowell and Jackson, 1996; Macdonald *et al*., 2004, 2010; Driscoll *et al*. 2007, 2011). This introgression with domestic cats makes an estimation of Wild Cat population size very difficult. The animal is listed under CITES Appendix II.

African Golden Wolf (*Canis anthus*)

The African Golden Wolf (*Canis anthus*) was previously erroneously reported as a subspecies of the Golden Jackal (*Canis aureus*)[11] and listed as LC by the IUCN, but this canid is currently classified as a distinct species, representing the first new species of Canidae found in 150 years (Arnold, 2015). Moreover, there is a confused situation between this species, feral dogs, Wolf (*Canis lupus*) and intermediates, which could be hybrids (Basuony *et al*., 2010). As the IUCN's Golden Jackal page has not been updated since 2008, it has yet to recognize the distinctiveness of the African Golden Wolf; thus its conservation status has not been evaluated, and no reliable population estimates are available.

Egyptian Weasel (*Mustela subpalmata*)

The Egyptian Weasel (*Mustela subpalmata*) is endemic to Egypt. However, it is listed as LC by the IUCN as, although it has a restricted distribution in the Nile Delta of Egypt, the species is common and adaptable, widespread in the Delta urban and semi-urban environments, commensal with humans, and there are currently no known major threats (McDonald and Hoffmann, 2008). On the other hand, Basuony *et al.* (2010) consider the species VU because of its small distribution area (EOO: 16,470 km^2; AOO: 84 km^2), but very common and not likely to be at risk

[11] *Canis aureus aureus* (in the Nile Valley, Delta and Western Desert) considered rare and with a narrow range, and *Canis aureus lupaster* (widespread) considered common but near-endemic (Basuony *et al*., 2010).

Giant Red Musk Shrew (*Crocidura olivieri*)

The Giant Red Musk Shrew (*Crocidura olivieri*) is listed as LC by the IUCN in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Baxter, 2008); but the species is considered VU at the national level (Basuony *et al*., 2010). Hoath (2003) calls this shrew *Crocidura flavescens* but this is now the valid name of a species restricted to South Africa (Hutterer, 2005; Basuony *et al*., 2010).

Egyptian Pigmy Shrew (*Crocidura religiosa*)

The Egyptian Pigmy Shrew (*Crocidura religiosa*) is very rare and only two specimens are known from the British Museum; these were collected from the neck of the Nile Delta and further down the Nile. Mummified specimens have also been found further south. It is possibly found in degraded habitat, based on Hoogstraal (1962). However, specific habitat preferences, current population size and trends are unknown. More information is needed on population status, ecology, range, and potential threats to be able to assess *C. religiosa* in a category other than Data Deficient (DD) (Hutterer *et al*., 2008). Basuony *et al*. (2010) have assessed the national status of the species as Vulnerable

Flower's Shrew (*Crocidura floweri*)

Flower's Shrew (*Crocidura floweri*) is endemic to Egypt. It has been recorded from Giza and the southern region of the Nile Delta, as well as records from Wadi El Natrun, and from the Upper Nile Valley. It has an EOO of 27,541.3 km^2 and an AOO of 16.38 km^2 (Basuony *et al*., 2010). Very little is known about the habitat requirements of this shrew, although it is found in man-made habitats in the Nile Valley. The population may have been impacted by environmental pollution caused by the widespread use of agricultural insecticides during the 1960s and 1970s, which is known to have had a very adverse effect on the Nile Valley wildlife. It is also possible that its habitat has changed drastically since the Aswan dam was built; this has had a great impact on small mammal species, partly due to the increased prevalence of pest rats. However, such an effect on *C. floweri* is undetermined (Saleh and Hutterer, 2008). Moreover, Flower's Shrew appears to have a restricted range, although M. Saleh (*in* Saleh and Hutterer, 2008) believes that this may be due to the restricted sampling range of the commercial collectors from the village of Abu Rawash in Giza, from whom many of the specimens have originated. The species apparently has a very small population, although it may not be as rare as it currently appears to be. According to Saleh and Hutterer (2008), there is insufficient information regarding distribution and population numbers available to assess Flower's Shrew in a category other than DD. Surveys may reveal this species to be more widely distributed and common than previously thought. However, it is also possible that surveys will confirm the restricted range of this species, and it may be classifiable as Critically Endangered (CR) or Endangered (EN). On the other hand, Basuony *et al*. (2010) classify this endemic species as EN.

Anderson's Gerbil (*Gerbillus andersoni*)

Anderson's Gerbil (*Gerbillus andersoni*) is listed as LC by the IUCN as it is reported as common in suitable habitats with no serious threats known at present, although the animal has a restricted global range and overgrazing may be a problem in some parts of its range. On the other hand, the animal is listed as VU at the national level by Basuony *et al*. (2010) due to its narrow range (North Sinai, Delta, Mediterranean Coast and Siwa Oasis), with an Extent of Occurrence (EOO)[12] of 157,924.3 km^2 and an Area of Occupancy (AOO)[13] of 289.8 km^2 and a possible decline in occurrence after 1950.

[12] EOO is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy (IUCN 2001 Categories & Criteria, version 3.1).
[13] AOO is defined as the area within its EOO (see footnote above) which is occupied by a taxon, excluding cases of vagrancy (IUCN 2001 Categories & Criteria, version 3.1).

Buxton's Jird (*Meriones sacramenti*)

There has been a 15% decline in extent of available habitat over a fifteen year period since 1990 (G. Shenbrot, pers. comm.). The species' EOO is less than 20,000 km² and has been assessed precautionarily as VU by the IUCN, but the extent of fragmentation and the number of locations needs to be assessed (Hutterer *et al*., 2008). Its AOO is assessed at 8.4 km^2. Its status in Egypt needs assessment (DD) and the animal should be probably classified as EN (Basuony *et al*., 2010).

Crested Porcupine (*Hystrix cristata*)

Globally, this species is very widespread, although it is a favoured food item for humans in many parts of its range, and there should be some investigation into harvest levels in these areas (e.g. North and West Africa). It is therefore listed as LC by the IUCN. On the other hand, the species may have been extirpated in Egypt since 1980 (Grubb *et al*., 2010). According to Basuony *et al*. (2010) the species is not a resident and might be considered as an accidental visitor of the country.

Fennec Fox (*Vulpes zerda*)

This species is listed as LC by the IUCN as it is relatively widespread in the sandy deserts and semi-deserts of northern Africa to northern Sinai, and there are currently no known major range-wide threats believed to be resulting in a population decline that would warrant listing in a threatened category. It is listed in CITES Appendix II and is legally protected in Egypt (Wacher *et al*., 2015). On the other hand, Basuony *et al*. (2010) list the animal as EN in Egypt. Its EOO is 348,659.6 km^2 and its AOO is 176.4 km^2, with the last record of the animal occurring in North Sinai in 2005 at El-Quseima (Basuony *et al*., 2010).

Table 2: Main faunal species of concern of the Northern Coast of Egypt

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
Amphibians							
Nile Delta Toad	*Amietophrynus kassasii*	An adaptable species, living in cropland, including rice fields, swampy areas and floating vegetation.	LC	LC	NL	Deltaic Mediterranean Coast (08, 09, 10) Eastern Mediterranean Coast (11, 12)	Endemic to the Nile Valley and Delta of Egypt, extending as far south as Luxor. Restricted range (less than 20,000 km^2)
Sudan Ridged Frog	*Ptychadena schillukorum*	Swampy habitats with shallow waters. Found in grassland, partially flooded rice fields and dry yam fields. Often seen near rivers and lakes.	DD	LC	NL	Eastern Mediterranean Coast (12)	A rare species in Egypt, known from only two records, one of which in the Nile Delta on the western margin of Lake Manzala.
Middle East Tree Frog	*Hyla savignyi*	Vegetation in and near wetlands; also in gardens, orchards and cultivations in close proximity to wetlands.sometimes found quite a long distance from water.	VU	LC	NL	Sinai Mediterranean Coast (13, 14)	Recorded only from North Sinai in Egypt. Uncommon and localized. Habitat available is locally very limited and could be easily lost.
Green Toad	*Bufotes cf. viridis*	Semi-desert with some scattered mesic microhabitats, oases, cultivations on the desert margin. Found in wells, cisterns and brackish marshes. Capable of tolerating very dry conditions and it is the only amphibian in much of the Egyptian deserts.	NE	LC	NL	Western Mediterranean Coast (01, 02, 03, 04, 05, 06, 07) Eastern Mediterranean Coast (11, 12) Sinai Mediterranean Coast (13, 14)	Status and taxonomy currently unclear

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
Reptiles							
Loggerhead Turtle	*Caretta caretta*	Warm and temperate marine waters. Undergoes extensive migrations from and to nesting beaches, feeding grounds and seasonally to escape low temperatures.	Uncommon, declining, but still widespread	VU	App. I	Western Mediterranean Coast (01, 02)	The commonest marine turtle in the Egyptian Mediterranean, with few records from the Red Sea. Used for human consumption when caught
Green Turtle	*Chelonia mydas*	Warm marine waters. Use a wide range of broadly separated localities and habitats during their lifetimes. Nesting evidence found near Zaranik, North Sinai	Uncommon, localized and declining	EN	App. 1	Sinai Mediterranean Coast (13)	Known from both the Mediterranean and Red Sea. Used for human consumption when caught
Leatherback Turtle	*Dermochelys coriacea*	Highly pelagic, spending much of its life far offshore, but often close to shore.	NE	VU	App. 1	Sinai Mediterranean Coast (13)	Recorded from the Mediterranean and Red Sea
Egyptian Tortoise	*Testudo kleinmanni*	Inhabits fairly arid and semi-arid deserts fringing the Mediterranean coast, largely within 50 km from the coast. Previously found in awide range of habitats, from vegetated coastal dunes, to sandy and stony steppe and even hilly country.	CR (EX?)	CR	App. I	Western Mediterranean Coast (01?)	Mostly eradicated by commercial over-exploitation. Imported from Libya after Egyptian stocks have been harvested to extinction
Negev Tortoise	*Testudo werneri*	Associated with desert and semi-desert habitats characterized or dominated by compact sand and gravel plains with scattered rocks and shallow sandy wadis, although populations are also known to occur in or adjacent to coastal salt marsh habitats.	CR	NE	App. I (listed as *Testudo kleinmanni*)	Sinai Mediterranean Coast (13, 14)	North Sinai populations formerly assigned to *Testudo kleinmanni* (CR)

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
Mediterranean Hooded Snake	*Macroprotodon cucullatus*	Mediterranean sub-deserts, usually within the coastal zone. Found in fairly mesic stony or rocky areas with light scrub.	EN	LC	NL	Western Mediterranean Coast (01, 05, 06, 07) Sinai Mediterranean Coast (13, 14)	Uncommon and declining as a result of habitat degradation and destruction.
Leopard Fringe-fingered Lizard	*Acanthodactylus pardalis*	A lowland species restricted to semi-arid regions, in steppes with hard clay soils, adjacent to saline coastal areas.	CR	VU	NL	Western Mediterranean Coastal Desert (01, 02, 03, 04, 05, 06) Sinai Mediterranean Coastal Desert (13, 14)	Restricted to the Mediterranean coastal region of northern Egypt and northeastern Libya
Desert Monitor	*Varanus griseus*	Mostly found in desert plains and large wadis with some vegetation cover but also in regions almost completely devoid of vegetation, in fairly humid coastal salt marshes and dry cultivated areas.	NT	NE	App. I	Deltaic Mediterranean Coast (08) Sinai Mediterranean Coastal Desert (13, 14)	Large numbers are collected for the pet trade and occasionally for leather.
Mediterranean Chameleon	*Chamaeleo chamaeleon*	Arboreal species found on trees and bushes, when food becomes scarce they move away, even on the ground. It also occurs on vegetation	NE	LC	App. II	Western Mediterranean Coast (01, 02, 03, 04, 05, 06, 07)	Threatened due to commercial over-exploitation

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
		in sparsely vegetated open gravel plains. Fairly common in coastal areas, generally not penetrating more than 30 km from the coast.				Sinai Mediterranean Coastal Desert (13, 14)	
African Chameleon	*Chamaeleo africanus*	Cultivated areas, orchards, often near or at the margin of wetlands. Seems to prefer short dense trees and reeds.	VU	LC	App. II	Deltaic Mediterranean Coast (09, 10)	Threatened due to commercial over-exploitation
Birds							
Thekla Lark	*Galerida theklae*	Inhabits stony and hill grounds with some bushes or small trees	LC	LC	NL	Western Mediterranean Coast	Restricted to the Western Mediterranean Coastal Desert. Common resident but declining
Thick-billed Lark	*Ramphocoris clotbey*	Inhabits stony deserts, grassy wadis, rocky slopes and marginal ploughed land	LC	LC	NL	Western Mediterranean Coast	Restricted to the Western Mediterranean Coastal Desert although Tharwat (1997) locates the species in Cairo, Suez road and SinAIII. Rare and irregular passer and winter visitor
Houbara Bustard	*Chlamydotis undulata*	Inhabits sandy and stony semi-desert and is specialised to arid conditions where trees are absent and both shrub cover and herb layer are sparse	CR	VU	App. I	Western Mediterranean Coast	North African populations may be sedentary or partially migratory, moving relatively short distances to find recent plant growth
Quail	*Coturnix coturnix*	Cultivated land, grassland and untilled fields.	VU	LC	NL	Western Mediterranean Coast (01, 02, 03, 04, 05, 06) Deltaic Mediterranean Coast (08, 09, 10)	Scarce resident, common passer and uncommon winter visitor. One of the main target species of autumn bird trapping along the Mediterranean coast

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
						Eastern Mediterranean Coast (12)	
						Sinai Mediterranean Coast (13, 14)	
Short-toed Snake Eagle	*Circaetus gallicus*	Inhabits scrubby vegetation, not very wooded open terrain, woods with large clearings and rocky reliefs.	Rare	LC	App. II	Deltaic Mediterranean Coast (09, 10)	Rare resident. Fairly common passer
Stone Curlew	*Burhinus oedicnemus*	Stony and sandy areas, barren hills, areas with sparse vegetation, marshlands and cultivated areas.	Fairly common	LC	NL	Deltaic Mediterranean Coast (10)	Atypical for the Nile Delta; generally found in desert areas. Recorded by Environics (2006) in the sand dunes east of Burg El Burullus. Elsewhere, fairly common resident and winter visitor
Lesser Short-toed Lark	*Calandrella rufescens*	*Calandrella rufescens nicolli* found in saltmarshes of the Nile Delta	Common	LC	NL	Deltaic Mediterranean Coast (09, 10)	Common resident. Sub-species *nicolli* is endemic
Corncrake	*Crex crex*	Meadows, grasslands, cultivated fields and marshlands with plenty of plants.	VU	LC	NL	Sinai Mediterranean Coast (13, 14)	Scarce passer; fairly common migrant during autumn
Pallid Harrier	*Circus macrourus*	Found in open natural grasslands in plains and dry steppe and close to lakes and marshlands. A native non-breeding species in Egypt	VU	NT	App. II	Sinai Mediterranean Coast (13, 14)	Uncommon migrant and rare winter visitor
Turtle Dove	*Streptopelia turtur*	Uses a wide variety of woodland types, as well as steppe and semi-desert, all with agricultural areas	NE	VU	NL	Deltaic Mediterranean Coast (09, 10)	Strongly migratory wintering south of the Sahara from Senegal east to Eritrea and Ethiopia

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
		nearby for feeding. It tolerates humans but does not breed close to towns or villages				Sinai Mediterranean Coast (13, 14)	
Syrian Woodpecker	*Dendrocopos syriacus*	Found in shrublands in Mediterranean-type shrubby vegetation, arable lands and plantations	NE	LC	NL	Sinai Mediterranean Coast (13, 14)	Restricted to North Sinai in Egypt
Mammals							
Four-toed Jerboa	*Allactaga tetradactyla*	Found in sparsely vegetated plains near the coast	EN	VU	NL	Western Mediterranean Coast (01,02, 03, 04, 05)	Localized range (AOO: 46.2 km^2; EOO: 2,245.5 km^2). Facing serious habitat loss. Latest records in Marsa Matrouh, Ras El Hekma and El Dabaa. Near endemic (Libya and Egypt)
Lesser Short-tailed Gerbil	*Gerbillus simoni*	Found in littoral saltmarshes in salty sandy loam with halophytic vegetation, olive groves, barley fields and on clay soil with *Thymelaea* and *Anabasis* vegetation.	VU	LC	NL	Western Mediterranean Coast (02, 03, 04, 05, 06)	Uncommon and localized (AOO: 58.8 km^2; EOO: 3,443.6 km^2). Affected by habitat loss.
Anderson's Gerbil	*Gerbillus andersoni*	Sandy areas, palm groves, cultivated semi-deserts and coastal deserts. Prefers grazing in open areas eating green parts of shrubs.	VU	LC	NL	Western Mediterranean Coast Deltaic Mediterranean Coast (09, 10)	Restricted world range.

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
Pale Gerbil	*Gerbillus perpallidus*	Generally sandy areas from coastal dunes to sandy margins in stands of *Thymelaea hirsuta*, to agricultural areas. In Wadi Natrun, recorded from sandy and muddy lake shores with vegetation.	Uncommon	LC	NL	Deltaic Mediterranean Coast (08)	Narrow range (AOO: 88.2 km^2; EOO: 31,558 km^2). Endemic to the Western Desert of Egypt but also recorded from the Idku sandy biotopes.
Flower's Shrew	*Crocidura floweri*	Collected from fields.	EN	DD	NL	Deltaic Mediterranean Coast	Endemic to the Nile Delta of Egypt
Giant Red Musk Shrew	*Crocidura olivieri*	Recorded from moist areas including canal embankments, irrigated fields, cultivated areas and gardens	VU	LC	NL	Deltaic Mediterranean Coast	*Crocidura olivieri* is the valid name for large African shrews previously known as *C. flavescens* (now restricted to South Africa).
Fat Sand Rat	*Psammomys obesus*	Saline soils and salt marshes with stands of succulent halophytic plants such as *Anabasis articulata*.	Uncommon	LC	NL	Deltaic Mediterranean Coast	Narrow range, Eastern and Western Desert and North Sinai; mainly along the coastal area (AOO: 310.8 km^2; EOO: 80,173.7 km^2). Local EN status could apply according to IUCN regional criteria, as AOO is small and population fluctuates; by this downgraded by the possibility of migration from other countries (Basuony *et al.*, 2010).
Jungle Cat	*Felis chaus*	Areas with thick cover such as agricultural lands, marshes and reed beds. Also recorded from sea cliffs along the north coast.	LC	LC	App. II	Deltaic Mediterranean Coast	Probably the cat species that has adapted best to the disturbed habitats created by human activities. Subspecies *nilotica* endemic to Egypt.

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
Wild Cat	*Felis silvestris*	Dry areas with cover including cultivated land; also rocky areas in mountains.	LC	LC	App. II	Deltaic Mediterranean Coast	Status difficult to ascertain because of confusion with domestic and feral cats. Hybridization with the feral cat is considered to present the biggest threat to the species and it is unlikely that pure populations exist around areas of human activities.
African Golden Wolf	*Canis anthus*	Desert, farms and gardens. Scattered in the Western Desert and Delta	NE	NE	NL	Western Mediterranean Coast Deltaic Mediterranean Coast (09) Eastern Mediterranean Coast (12)	Previously reported as a subspecies of the Golden Jackal (*Canis aureus*), but currently classified as a distinct species. Represents the first new species of Canidae found in 150 years. Confused situation between this species, feral dogs, Wolf (*Canis lupus*) and intermediates, which could be hybrids. The distinctiveness of the species has not been recognized yet by the IUCN; its conservation status has not been evaluated and no reliable population estimates are available.

Common Name	Scientific Name	Habitat	Status in Egypt	Global Status		Eco-region & Potential CUs	Comments
				IUCN	CITES		
Egyptian Weasel	*Mustela subpalmata*	Commensal with humans, and often trapped in human habitations, including underground larders and even in cars	VU	LC	NL	Western Mediterranean Coast (07) Deltaic Mediterranean Coast (08, 09, 10) Eastern Mediterranean Coast (11, 12)	Endemic to the northern Nile Valley and Delta of Egypt
Buxton's Jird	*Meriones sacramenti*	Lives in coastal dunes with limited vegetation cover in small family groups. Also reported to be more generalist, inhabiting clay and sandy deserts, bush country, arid steppes, low plains, cultivated fields, grasslands, and mountain valleys.	DD (EN?)	VU	NL	Sinai Mediterranean Coastal Desert (14)	Endemic to the Negev and the coastal region of northern Sinai (Egypt) and Israel, including Palestine.
Crested Porcupine	*Hystrix cristata*	Inhabits dry Mediterranean shrubland, maquis, abandoned farmland, steppe, forest and dry rocky areas	NE (EX?)	VU	NL	Sinai Mediterranean Coastal Desert (13, 14)	Possibly extirpated in northern Egypt; little information from southern parts of Egypt.
Fennec Fox	*Vulpes zerda*	Lives in arid sand dunes spending daylight hours in small tunnels. Able to live without access to water.	EN	LC	App. II	Western Mediterranean Coast (06) Sinai Mediterranean Coast (13, 14)	Hunted and trapped for trade
Mediterranean Monk Seal	*Monachus monachus*	Once hauled out on open beaches but today they use marine caves with sea entrances for hauling out	CR (EX?)	EN	App. I	Western Mediterranean Coast (01?)	One of the most endangered pinniped species in the world

EX: Extinct; CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; LC: Least Concern; DD: Data Deficient; NE: Not Evaluated; NL: Not Listed.

4.3. Current Impacts and Threats on Biodiversity

Drastic ecological changes have taken place on the Northern Coast of Egypt over the past decades, as a direct result of intensive human interventions and manipulation of the natural environment, as well as a growth in population and associated environmental deterioration. Human development is leading to a rapid loss of habitat. As a result, many species have either changed their distribution or disappeared completely.

Ecological changes continue to occur as a result of local and national policies and corresponding development activities. The lack of effective conservation or land use legislation compounds these problems.

4.3.1. Agriculture and Urbanization

Land reclamation for agriculture, urbanization and road construction is the main cause of habitat loss, modification and fragmentation and has transformed natural habitats into agricultural fields or urban centers not suitable for their original inhabitants. Agriculture has also introduced exotic floral species that were inadvertently introduced and have now become naturalized, or by deliberately introduced species such as *Eucalyptus* and *Casuarina* trees. Accordingly, many native animals are being replaced by commensal, more adaptable pest species, such as mice and rats. Garbage and human refusal disposed along canal banks and natural wetlands, and open dumping areas near villages attract not only several opportunistic species such as Cattle Egrets, Red Foxes and feral animals but also numerous pests and disease vectors such as rodents, flies and mosquitoes.

An example of intensive development is given by the coastal area west of Alexandria (CU06 – CU07). In a continuous band for 120 km, the coast has been totally transformed into intensive summer resorts, surrounded by continuous walls which block public access to the beach, and interactions between the sea and the coastal lands. Further west (CU01 – CU05), summer resorts decrease and are intersected by areas of natural habitats. However, this trend still continues and additional resorts are built every year.

4.3.2. Use of Pesticides

Intensive cultivation and the use of pesticides have eliminated many of the native animals of the region. These pollutants may finally reach apex species via the food chain, including protected species such as raptors. Pesticides have, therefore, detrimental impacts on biodiversity, particularly birds. During the 1980s, due to the widespread misuse of rodenticides, a sharp decline in bird populations occurred throughout the arable lands of Egypt. While the Ministry of Agriculture has made great strides in reducing the use of pesticides, particularly toxic substances, pesticides harmful to the environment continue to be applied.

4.3.3. Impacts on Coastal Wetlands

Although it is considered the healthiest wetland in Egypt, considerable ecological changes have occurred to Lake Bardawil (CU13) due to the extension of salt extraction and the constant formation of sand bars (siltation), which close the channels connecting the lagoon with the sea. Moreover, all indications are that the Delta lakes are wetlands in distress. The lakes are subjected to a host of human activities that have cumulative impacts that are difficult to assess.

Major environment problems affecting the Delta lakes include:

- A reduction in size due to land reclamation, land fill, fish farming, garbage disposal and road construction;
- Pollution, which is contaminating the lake with heavy metals, pesticides and other harmful substances.

- A reduction in the carrying capacity of the lakes to treat pollution[14].
- Increasing sedimentation of the lakes and siltation of the *Boughaz* and channels;
- Changes in the water circulation and salinity regime due to the siltation of the *boughaz*, construction of roads, reduction of fresh water into the lakes and partitioning of the lake into pans for fish farming;
- Proliferation of reed beds, Water Hyacinth and other invasive species;
- A decline in the diversity and number of water birds indicating that the health of wetlands has deteriorated;
- Coastal erosion which moves the lakes' sand bars inland; and
- Deteriorating water quality, leading to eutrophication.

The net impact of these threats undoubtedly affects the lakes' economic productivity.

Figure 45: Fish farms at Lake Manzala (CU12)

4.3.4. Grazing

Grazing animals include sheep, goats, cows, buffaloes and donkeys. Over-grazing of sheep and goats affects native vegetation with subsequent impacts on small herbivorous animals. Annual vegetation is more affected by grazing than dominant woody perennials which are not browsed heavily by sheep and goats, while annuals are heavily browsed. Moreover, over-crowding of domestic animals may result in soil compaction, impacts on fossorial species, and in the destruction of burrows and dens.

Figure 46: Sheeps and goats grazing in the grasslands of the Burullus area (CU10)

[14] For example, industries, agriculture and municipalities in Damietta discharge untreated wastewater into Lake Manzala and other wetlands contributing to water pollution. The pollution also originates from sources further south; for example, the Bahr El Bakar Drain, the largest drain on the lake, discharges untreated industrial and domestic wastewater from Cairo.

4.3.5. Feral Animals

Feral dogs and cats compete for food resources with local wild carnivores and may affect threatened species. The African Golden Wolf is reported to decline in areas where it competes with local feral dogs. Feral cats abound in towns and villages, but the degree to which they interact with the populations of Wild Cats in Egypt is not known. The two animals are very similar and difficult to differentiate and some authors claim that they interbreed, although there is no confirmed record of wild/feral hybrid specimen from Egypt. In Sub-Saharan Africa, hybridization with the feral cat is considered to present the biggest threat to the species and it is unlikely that pure populations exist around areas of human activities (Hoath, 2003).

Figure 47: Stray dog cubs near El Sheikh Mobarak Village, El Burullus area (CU10)

4.3.6. Fishing and Aquaculture

The Delta lakes' fisheries are affected by illegal fishing practices, including fry catches near the *boughaz.* The fast growth of fish farming also has numerous impacts on the lakes and their biota due to fish feeding practices, dispersion of resulting waste and the use of hormones and antibiotics. Moreover, fish escaping from fish farms could affect indigenous fish due to food competition, disease transmission and genetic changes as a result of potential mating between wild individuals and captive ones (Younes, 2000). Individual fishing is also practiced along the seashore and in irrigation canals and drains. Catches in canals and drains are almost exclusively composed of Cichlidae (*Oreochromis* and *Tilapia* spp.) and catfishes from the Families Clariidae (*Clarias gariepinus*) and Bagridae (*Bagrus bayad* and *Bagrus docmac*). Fishing risks from these canals are mainly related to the consumption of fish contaminated by pesticides which tend to bioaccumulate in the tissues of aquatic organisms. In addition, protozoan parasites are reported to infect *Clarias gariepinus* in Dakahleya Governorate (El-Tantawy and El-Sherbiny, 2010).

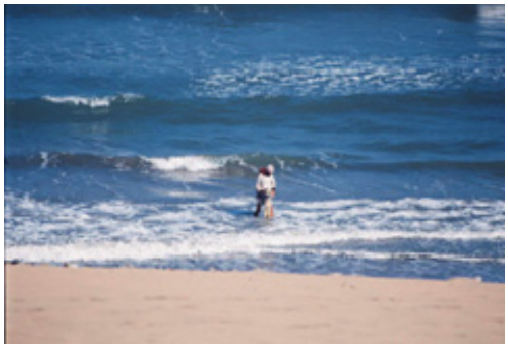

Figure 48: Sea fishing near Burg El Burullus

Figure 49: Fishing activities in Bahr Mortada Drain, near Burg El Burullus

4.3.7. Impacts on Irrigation Canals and Drains

Pollution of irrigation canals and drains is mainly due to disposal of solid waste and discharge of sewage water. Irrigation canals are also used by locals for bathing and washing laundry, food and kitchen utensils, in addition to irrigation. Solid and liquid wastes that accumulate in water bodies affect the physical, chemical and biological characteristics of the aquatic ecosystem, resulting in depleted water quality, introduction of pathogenic organisms into the aquatic environment and obstruction of water courses. The life form in the aquatic ecosystem is adversely affected and the impact can range from less reproduction and also reduction in total population of various plants and animals to the extinction of a few species which cannot survive in the changed environment. Nutrients enrichment of aquatic courses results in a dramatic increase of aquatic plant productivity, a process referred to as "eutrophication". As a result of increased aquatic plant productivity, more organic material is added to the system, which eventually dies and decays. The decaying organic matter produces unpleasant odors and depletes the oxygen supply required by aquatic organisms. Prolonged episodes of depressed dissolved oxygen concentrations of 2 mg/L or less can result in "dead" watercourses.

4.3.8. Invasive Species

Several invasive species occur in the area. The most serious and prevalent of these is the Water Hyacinth (*Eichhornia crassipes*), which was originally introduced into Egypt from South America. Water Hyacinth represents one of the most serious environmental problems threatening the Delta lakes, particularly Lake Manzala. The infestation at the lake is one of the worst cases of this invasive species known in the country and perhaps even in the Middle East/North Africa. Furthermore, it is contributing to the eutrophication and sedimentation of this wetland affecting its viability. Fishing is severely obstructed by the plant, affecting the livelihoods of local fishermen. Water Hyacinths are also noted to be a problem along the Nile River and in the canal-drainage network.

Figure 50: Water Hyacinth infesting Abu Qir Drain (CU08)

4.3.9. Removal of Aquatic Vegetation

Mechanical removal of aquatic vegetation is a common practice in Egyptian irrigation wetlands, particularly to eliminate invasive introduced invasive plant species (such as the Water Hyacinth) that decrease the dissolved oxygen content and are responsible of wetland eutrophication. However, mechanical removal of vegetation is an unselective practice which also eliminates the invertebrate fauna (such as snails and worms), juvenile fish and other aquatic organisms, thus affecting aquatic predators and fish stocks.

Figure 51: Mechanical removal of aquatic vegetation from Hammad Canal, El Burullus area (CU10)

4.3.10. Hunting and Commercial Exploitation of Wildlife

Commercial exploitation is the most significant threat facing herpetofauna. The Egyptian Tortoise has disappeared from the Western Mediterranean Coast of Egypt. The Mediterranean Chameleon, African Chameleon, Javelin Sand Boa and Eastern Montpellier Snake are heavily collected for pet trade, particularly by professional collectors from Abu Rawash. Other wildlife is probably being caught for commercial sale, but the status of these practices is difficult to ascertain.

A high sea turtle mortality rate has been noticed along the Mediterranean shores of Lake Bardawil (CU13); the causes are unknown although some fishermen admitted to deliberately kill turtles profiting of poor law enforcement.

Bird hunting is a serious problem particularly in Damietta Governorate (CU11), perhaps more so than any other Governorate in the country. Damietta is unique in the fact that bird hunting takes place year around and is indiscriminate with resident birds being hunted as well as winter visitors and passage migrants.

Bird trapping takes place from late August to early September primarily along the Mediterranean coast. Quail (*Corturnix coturnix*) is one of the main target species of autumn bird hunting, but all species of bird including the Corncrake, song birds and birds of prey are trapped. In North Sinai, where 500 families are involved in quail netting every season, the activity has probably a most economic value compared with the other netting areas in Egypt. Small birds are trapped accidentally as non-target birds in the trammel quail nets (Shaltout and Khalil, 2006). Waterbird hunting takes place at Lake Manzala from autumn into spring, with the main hunting season during winter. While ducks are among the most desirable species sought by the hunters, the nets catch all species of birds and appear to be raised all the time.

Figure 52: Quail net, Idku area (CU08)

Figure 53: Bait pigeon, Idku area (CU08)

Illegal falcon trapping using tied pigeons (*Columba livia domestica*) as baits, is a common practice along the Deltaic Mediterranean Coast and has been previously observed by Environics' team (A. Sarwat, personal observations). Trapping birds of prey is also practiced along the Mediterranean Coast of SinAIII. North Sinai with its position on the major migration routes is considered as one of the best areas in Egypt, if not in the whole Middle East, to trap falcons. The trapping season lasts approximately 45 days during October and November (Baha El Din and Salama 1991 *in* Shaltout and Khalil, 2006). Large falcons are the main target of this activity, such as Lanner (*Falco biarmicus*), Saker (*Falco cherrug*), and Peregrine (*Falco peregrinus*), the latter species is the most demanded and valued by the rich falconers from the Arab Gulf States (Shaltout and Khalil, 2006).

5. MARINE ENVIRONMENT

The Mediterranean Coast of Egypt is located on the eastern Mediterranean Sea. Given the mobility of fish and other large marine organisms that travel great distances, such as marine mammals and turtles, it is virtually impossible to categorize the marine biodiversity according to coastal sectors and/or units. Accordingly, the wider eastern Mediterranean is examined in this section. Locations of some specific habitats and/or records of particular species are sometimes available, based on accidental records and planned surveys carried out for specific projects such as the study for the declaration of Sallum Marine Protected Area (Environics, 2009) covering the Sallum offshore area (CU01), the West Nile Delta Gas Development Project (ERM/Environics, 2013) covering the offshore Abu Qir Bay area (CU08), and the East Nile Delta Gas Development Project (ERM/Environics, 2015) covering the area offshore of Damietta/Ras El Barr and Port Said (CU11/CU12).

5.1. Marine Habitats

Analysis of the 2012 survey data identified the following six biotopes (ERM/Environics, 2013), for the Abu Qir Bay offshore area (CU08):

- Infralittoral sandy mud;
- Circalittoral sandy mud;
- Deep circalittoral mud;
- Circalittoral mixed sediments;
- Maerl beds; and
- Infralittoral rocks.

A brief account on each of these habitats is herein presented; seagrass meadows were not recorded in the Abu Qir Bay offshore area, but are present in other sectors of the Egyptian Mediterranean Coast and are, therefore, also presented.

5.1.1. Infralittoral Sandy Mud

This biotope is present is in the shallow waters in the offshore Abu Qir Bay area (CU08) and is expected to be present along most of the Egyptian Mediterranean coastline. Although, this biotope does not typically support high diversity communities its benthic fauna may provide food for a number of commercially important fish species. This biotope may provide important feeding and nursery grounds for marine birds and fish. It is listed as endangered natural habitat type in the Council of Bern Convention Resolution no. 4 (1996): *Sublittoral soft seabeds* (code 11.22)[15] (Salomidi *et al*.; 2012).

5.1.2. Circalittoral Sandy Mud

This biotope is widespread across the offshore Abu Qir Bay area and the only epifauna identified was one mantis shrimp. Other sites in the Mediterranean with this biotope are known to support a variety of species, which includes a rich epi- and infauna. Species composition at a particular site may relate, to some extent, to the proportions of the major sediment size fractions. Greater quantities of stones and shells on the surface may give rise to more sessile epibenthic species, some of which are important in the diets of many commercially important fish and invertebrate predators. Circalittoral biotopes may be less susceptible to human impacts related to coastal alteration when they occur at large distances from the shore. However, due to the relatively

[15] Salomidi, I, Katsanevakis,S., Borja, A., Braeckman, U., Damalas, D., Galparsoro, I., Mifsud, R., Mirto, S., Pascual, M., Pipitone, C., Rabaut, M., Todorova, V., Vassilopoulou, V. and Vega Fernandez, T. (2012) Assessment of goods and services, vulnerability, and conservation status of European seabed biotopes: a stepping stone towards ecosystem-based marine spatial management, Mediterranean Marine Science, 13/1 49-88.

stable conditions that characterise this biotope, recovery from disturbances may be particularly slow. It is listed as endangered natural habitat type in the Council of Bern Convention Resolution no. 4 (1996): *Sublittoral soft seabeds* (code 11.22) (Salomidi *et al*.; 2012).

5.1.3. Deep Circalittoral Mud

Although no epifauna were identified during the survey offshore of Abu Qir Bay, the epi- and infauna of this biotope may be rich and diverse and may serve as food for several demersal fish species. Circalittoral biotopes may be less susceptible to human impacts when they occur at large distances from the shore. However due to the relatively stable conditions that prevail in these biotopes, they may show slow recovery in the case of serious disturbance. They are commonly subjected to disturbance from trawling activities. It is listed as endangered natural habitat type in the Council of Bern Convention Resolution no. 4 (1996): *Sublittoral soft seabeds* (code 11.22) (Salomidi *et al*.; 2012).

5.1.4. Circalittoral Mixed Sediments

The presence of benthic invertebrates in this biotope increases habitat complexity through the creation of tubes and burrows. Few marine sedimentary habitats have been thoroughly sampled and it has been argued that the biological diversity of this biotope is often underrepresented since it appears to support a relatively diverse and abundant benthic fauna Particularly, the high densities of infaunal polychaete and bivalve species that exist here have been attributed to the relatively low rate of natural physical disturbance and the heterogeneity of the habitat. It is listed as endangered natural habitat type in the Council of Bern Convention Resolution no. 4 (1996): *Sublittoral soft seabeds* (code 11.22) (Salomidi *et al*.; 2012).

5.1.5. Maerl Beds

Maerl is a slow growing coralline alga which aggregates to form beds. Maerl is long-lived and is associated with localised increased biodiversity and is the most sensitive habitat identified within the West Nile Delta area, offshore of Abu Qir Bay (CU08). Live maerl beds consist of a top layer of live maerl where photosynthesis occurs and beneath the live maerl the beds normally consist of dead maerl. The calcareous structures that remain once the maerl is dead provide substrate for colonisation by invertebrates and shelter. Accordingly, dead maerl beds also provide important habitat on the seabed. The extensive beds (live and dead) are slow growing so are sensitive to physical damage and they are considered to be of ecological importance due to the very high diversity of associated organisms. Maerl beds are found throughout the Mediterranean Sea, and in Egyptian waters maerl beds have been recorded off the Nile Delta on the outer shelf between the Damietta and Rosetta (Rifaat, 2005). Moreover, maerl beds were identified at a number of locations during marine surveys carried out in 2009 and 2012 offshore of Abu Qir Bay by Fugro Survey Limited (ERM/Environics, 2013). The survey samples that contained maerl were taken between 60-200 m depth contours. The survey identified areas of live and dead maerl. The marine survey identified areas of dead maerl where it is assumed the top layer of live maerl is also dead. Seabed photography indicated that the maerl is patchy in distribution and it is likely that the patchiness will exist across the entire maerl area.

5.1.6. Infralittoral Rocks

Hard substrate on a predominantly sandy seabed creates complexity in the benthic environment and attracts colonising organisms by providing niches for species to inhabit. The faunal communities colonising the rocky surfaces will enhance biodiversity by attracting predators and species that can use the structure as shelter. Stable rocky surfaces within this biotope were densely covered with epilithic sessile fauna such as sponges and hydroids. Two areas of rocky seabed were recorded offshore of Abu Qir Bay (ERM/Environics, 2013). These areas contrasted strongly to the surrounding soft sediments and are thought to be cemented sand features. Large polychaetes (Eunicidae) were also regularly seen.

5.1.7. Seagrass Meadows

Seagrass is an important habitat, providing food and shelter for a wide diversity of flora and fauna, including young turtles, prawns and fish. Some turtle species, including Loggerhead Turtle (*Caretta caretta*) also use seagrass meadows as nurseries. Seagrass is also important as a primary producer providing food for plant grazers and detrivores both in the local area and through sediment transport, offshore. Since seagrass beds have not been systematically mapped in Egyptian waters, there are no definitive data on their distribution. Generally, seagrasses are most commonly found in water depths to 20 or 30 m. Seagrass meadows have not been identified during the surveys carried out offshore of Abu Qir Bay (CU08) and Ras El Barr (CU11/CU12). On the other hand, large parts of the seabed in El Sallum Bay (CU01) are covered with seagrass. These include *Posidonia oceanica*, which is reported at 6-26 m depth forming monospecific aggregations, as well as *Cymodocea nodosa*. Both are found on sandy or rocky substrates (Environics, 2009).

5.2. Marine Biodiversity

5.2.1. Phytoplankton

Within the Delta area, phytoplankton concentrations are greatest in winter and lowest in the summer. Concentrations and diversity decrease considerably offshore, the greater values being found closer to shore and near to discharges such as the River Nile.

Offshore of Abu Qir Bay (CU08), the near shore community is characterised by high densities of the coastal species *Skeletonema costratum* and species of the genus *Chaetoceros*. The offshore community is dominated by dinoflagellates of the genus *Gymnodinium*; dinoflagellates display a competitive advantage over diatoms in nutrient-limiting environments (ERM/Environics, 2013).

Samples from a 2009 survey offshore of Ras El Barr (CU11/CU12) included 15 species of diatom and dinoflagellates from the genera *Ceratium* (*Ceratium fusus*, *C. macrooceros*, *C. tripos*, *C. contartum*), *Ornithocercus*, *Scrippsiella*, *Amphisolenia* and *Gymnodium*. Diatoms dominated samples, ranging from 62 to 100% of the total, dinoflagellates making up the rest (NIOF, 2009; ERM/Environics, 2015).

The phytoplankton assemblage is not particularly sensitive and can adapt to minor changes to the physical properties of the water column and nutrient concentrations relatively readily. However, extreme changes over a large area may result in large increases or decreases in primary productivity.

5.2.2. Zooplankton

Herbivorous species of zooplankton are primary consumers of phytoplankton and are important links in the marine ecosystem. Zooplankton communities are important as they allow the transport of energy from primary producers into the food chain and to higher trophic levels. Zooplankton abundance is often closely linked to phytoplankton abundance, particularly as most species' main food is phytoplankton. Blooms in phytoplankton are often followed by increases in zooplankton as they make use of the extra resources and increase their growth and reproduction rates.

In the offshore survey of Abu Qir Area (CU08), the zooplankton community was found to comprise predominantly representatives of the phylum Crustacea. As observed in zooplankton communities worldwide, copepod crustaceans were both numerically and taxonomically dominant comprising seven of the ten most abundant taxa throughout the survey area. The juvenile calanoid copepods (copepodite) were the most dominant taxa throughout the survey area, which is characteristic of oligotrophic seas such as the Mediterranean, which typically comprise juveniles and small zooplankton. Zooplankton communities throughout the site generally displayed fairly high evenness and diversity, with calanoid copepodites, calanoid copepods of the family paracalanidae and cycopoida copepodites all occurring in 100% of samples.

Zooplankton communities were also sampled during a 2009 survey offshore of Ras El Barr (CU11/CU12). Within the study area the zooplankton community, in terms of species, was represented by 27 Copepoda, one Ostracoda, 11 Protozoa, 6 Appendicularia, 2 Cnidaria, 2 Polychaeta, 2 Mollusca species and one species of Chaetognatha. Copepoda were the most dominant group in the study area and represented 87.94% of the total zooplankton population in the study area (ERM/Environics, 2015).

Figure 54: Sponges collected from El Sallum Bay (CU01)

5.2.3. Benthos

Benthic organisms play an important role in the food web of marine communities and provide another important link from primary production to higher trophic levels. These organisms feed mostly upon detritus, sedimentary phytoplankton, zooplankton and / or other members of the benthic community. In addition they also provide an important source of organic matter to other organisms that prey on them, particularly fish. Planktonic larval stages of benthic organisms serve as food for Planktonic organisms and some pelagic fish species. They comprise a diverse number of animal groups, including polychaete worms, crustaceans and molluscs. Most of them serve as a diet for many species of fish.

The benthos of the eastern Mediterranean Sea, particularly the southeast, is relatively impoverished when compared to the western Mediterranean Sea. The fact that nutrient-rich floodwaters no longer enter the area since the construction of the Aswan High Dam is thought to have reduced productivity in this region.

Cold seep biological communities relying on methane and associated with mud volcanoes and faults have recently been discovered north of the Egyptian coast, near the border between Egypt and the Gaza Strip, where communities of polychaetes and bivalves have been found at depths of 500-800 m (IUCN, 2004).

Analysis of the infaunal (organisms that live within the seabed sediment) abundance (per 0.1 m^2) from the sediment grabs taken during the 2009 and 2012 offshore and nearshore surveys of Abu Qir Bay (CU08) indicate that values are low across the majority of the survey area (ERM/Environics, 2013).

Detailed information on offshore benthos is limited; however more data are available closer to the Egyptian coast. A 1999 study (EIMP, 2000) found a clear correlation between the abundance and numbers of species and the silt/clay content of the sediment, and a trend for increasing numbers of species when moving westwards along the coast. Highest species abundance was recorded around El Burg and Port Said (CU12), where there is a greater proportion of silts and sands in the sediment (ERM/Environics, 2015).

In El Sallum Bay (CU01), recorded benthic organisms included the following taxa (Environics, 2009): Porifera (9 species), Cnidaria (1 species), Annelida (8 species), Mollusca (16 species), Crustacea (7 species), Echinodermata (10 species) and Ascidiacea (6 species).

5.2.4. Crustaceans

The whole area off the Nile Delta, to a depth of at least 100 m, is likely to be important for shrimp spawning, with the main spawning period from April to September. Larger and more valuable prawns may migrate into deeper water to breed but this has not been investigated. The Red Shrimp (*Aristeus antennatus*) is present in the entire Mediterranean Sea (except the Adriatic). It is found at depths of between 100 and 200 m off the Egyptian coast, but elsewhere may be found down to 3300 m. Abundance is greatest between 600 and 800 m, where fishing takes place. The growth rate of *A. antennatus* is much lower than that of other penaeids as are estimates of natural mortality. Hence, *A. antennatus* is a typical deep-sea species of low productivity.

There are 7 penaeid shrimp species in eastern Egyptian coastal waters. These are *Penaeus japonicus*, *Penaeus semisulcatus*, *Penaeus kerathurus*, *Metapenaeus monoceros*, *Metapenaeus stebbingi*, *Parapenaeus longirostris* and *Trachypenaeus curvirostris*. Several species (*P. japonicus*, *P. semisulcatus* and *T. curvirostris*) reached the Egyptian and Turkish coasts through the Suez Canal and are currently only found in this area of the Mediterranean Sea. *P. kerathurus*, *M. monoceros*; *M. stebbingi* and *P. longirostris* are found throughout the Mediterranean Sea and are native species (Holthuis, 1980).

After the regulation of the Nile flow following the construction of the Aswan dam, small sized shrimp species dominated the landed catch. Three species; *M. stebbingi*, *T. curvirostris* and *P. longirostris*, contribute the main bulk of shrimp yield.

5.2.5. Molluscs

Cuttlefish and squid are also important resources within the Egyptian waters of the Mediterranean Sea. The Common Cuttlefish (*Sepia officinalis*) is the most common cephalopod in catches, followed by the European Squid (*Loligo vulgaris vulgaris*). *S. officinalis* is found throughout the Mediterranean Sea on sandy to muddy bottoms from the coastline to about 200 m depth.

L. vulgaris vulgaris is found throughout the coastal waters of the Mediterranean Sea. It generally lives at depths between 40 and 550 m. Between November and April spawning occurs in shallow waters where the eggs are attached to macroalgae, rocks and bottom substrates. The diet includes algae, bivalves, other cephalopods, crustaceans, polychaetes and fish[16]. European Squid (*L. vulgaris vulgaris*), Common Octopus (*Octopus vulgaris*) and cuttlefish (*S. officinalis*, *S. pharaoni* and *S. prashadi*) are all caught offshore of Ras El Barr (CU11/CU12) (ERM, 2015). The Common Cuttlefish and the European Squid are also among the common catches in El Sallum Bay (CU01) (Environics, 2009).

5.2.6. Fish

The Mediterranean Sea is host to approximately 830 marine species of fish belonging to more than 170 families (Frause and Pauly, 2014). The fish community is a diverse assemblage characterised by Atlantic elements, endemic Mediterranean elements and Lessepsian[17] migrants from the Red Sea. Historically, the eastern Mediterranean Sea, particularly around the Nile Delta, has been characterised by large populations of pelagic species, especially small clupeids, sardines and their relatives. The construction of the Suez Canal has led to invasions of Red Sea species and the Aswan High Dam has led to reduced nutrient flux to the sea and has negatively affected fish stocks as a consequence. Thus, the fish populations in the eastern Mediterranean Sea have been subjected to a number of changes, and continue to be exploited by fisheries.

Fish species off the Egyptian coast can be divided into four main groups, namely:

- Small pelagic[18] species;
- Large pelagic species (tuna and billfish);
- Demersal (bottom dwelling) species; and

- ***Small Pelagic Fish Species***

The small pelagic fish stocks off the Mediterranean coast of Egypt are a major resource for fisheries, particularly non-commercial fisheries. The main pelagic species found in Egyptian waters are as follows:

- Anchovy (Engraulis *encrasicolus*);

[16] www.cephbase.utmb.edu
[17] Movement of species from the Red Sea to the Mediterranean as a result of the Suez Canal linking the two (refer to Section 5.3)
[18] Pelagic species spend most of their life swimming in the water column with little contact with or dependency on the bottom

- Sardine (Sardina *pilchardus*); and
- Sardinella (Sardinella *aurita*, *Sardinella maderensis*).

A number of other pelagic species are also caught in much smaller numbers but are nonetheless important to local fisheries. These include Bogue (*Boops boops*), Narrow-barred Spanish Mackerel (*Scomberomorus commerson*), Chub Mackerel (*Scomber japonicus*), Mediterranean Horse Mackerel (*Trachurus mediterraneus*), the carangid *Trachinotus ovatus*, small tunas such as Bullet Tuna (*Auxis rochei*), Frigate Tuna (*Auxis thazard*) and Atlantic Bonito (*Sarda sarda*).

- ***Large Pelagic Species***

Within the Mediterranean Sea the main large pelagic species are tunas and billfish and include:

- Atlantic or Northern Bluefin Tuna (*Thunnus thynnus*);
- Swordfish (*Xiphius gladius*); and
- Albacore (*Thunnus alalunga*).

- ***Demersal Species***

A number of demersal species are also present in the Mediterranean and are also important commercial species for inshore fishermen. These include the Red Mullet (*Mullus barbatus*), Grey Mullet (*Mugil cephalus*), Saprids or Sea Bream, particularly *Sparus aurata* and *Pagrus caeruleostictus*, Sole (*Solea solea*), Egyptian Sole (*Solea aegyptiaca*) and Atlantic lizardfish (*Synodus saurus*). The Picarel (*Spicara smaris*) is a benthic species preferring offshore water, especially in winter; over muddy or vegetated bottoms in water depths between 15 and 170 m. The Common Pandora (*Pagellus erythrinus*) is an important food fish inhabiting inshore waters, on various bottom types (rock, gravel, sand and mud) up to 200 m deep but during winter populations migrate to deeper waters

5.2.7. Sea Turtles

Three species of sea turtle are known to inhabit the southeastern Mediterranean Sea: the Green Turtle (*Chelonia mydas*) EN, the Loggerhead Turtle (*Caretta caretta*) VU and the Leatherback Turtle (*Dermochelys coriacea*). *Chelonia mydas* is listed as EN, while *Caretta caretta* and *Dermochelys coriacea* are listed as VU in the IUCN Red List.

During a study along the Mediterranean coast of Egypt 22 dead turtles were found along the stretch of coast between Alexandria and Port Said. In addition, east of Port Said evidence of nesting turtles was seen, particularly between Bardawil Lagoon and the town of El Arish (Nada and Casale, 2008). This information suggests that turtles may be moving along the Mediterranean Coast of Egypt to reach nesting beaches on the Sinai Peninsula.

5.2.8. Seabirds

Prominent seabirds include the Black-headed Gull (*Larus ridibundus*), Yellow-legged Gull (*L. cachinnans*), Little Tern (*Sterna albifrons*) and Lesser Crested Tern (*S. bengalensis*) (Tharwat, 1997). Also, the Little Tern (*Sterna albifrons*) and Kentish Plover (*Charadrius alexandrinus*) are known to breed in coastal area but are more likely to be found closer to the shore. The Spur-winged Lapwing (*Vanellus spinosus*) is common and frequently encountered in the backshore area. Audouin's Gull (*Larus audouinii*) is an endemic seabird to the Mediterranean Basin.

Figure 55: Little Terns on the seashore (CU11)

Figure 56: Spur-winged Lapwing (CU11)

5.2.9. Marine Mammals

The Mediterranean Monk Seal (*Monachus monachus*) is the only seal found within the Mediterranean Sea. It is very scarce off the Egyptian coast and could be found in the Sallum area, close to the Libyan borders. However, there are no recent records of the animal.

Information on the distribution of cetacean species is patchy and heavily dependent on sightings by local sailors and fishermen. Twenty cetacean species have been recorded in the Mediterranean Sea as a whole, eight of which are residents, and eight of the cetacean species are found in the south-eastern area. These are the Sperm whale (*Physeter macrocephalus*), Cuvier's Beaked Whale (*Ziphius cavirostris*), Rough-toothed Dolphin (*Steno bredanensis*), False Killer Whale (*Pseudoorca crassidens*), Risso's Dolphin (*Grampus griseus*), Bottlenose Dolphin (*Tursiops truncates*), Short-beaked Common Dolphin (*Delphinus delphis*) and Striped Dolphin (*Stenella coeruleoalba*).

Figure 57: Dead Risso's Dolphin found on the seashore of Marsa Matrouh

Recent records

In October 2010, a dead Risso's Dolphin, victim of a shark attack, was found by beachgoers on the seashore of Marsa Matrouh. On May 16 2016, the carcass of a Sperm Whale was washed ashore approximately ten kilometers west of Marsa Matrouh (CU03). In July 2016, a non-identified whale (possibly a Fin Whale, *Balaenoptera physalus*) was seen swimming in the artificial waterways of Marina Resort (CU06) on the Western Mediterranean Coast.

Figure 58: Dead Sperm Whale washed ashore, west of Marsa Matrouh (Source: Al-Wafd)

5.3. Lessepsian Migration

The invasion of Red Sea organisms through the Suez Canal is known as "Lessepsian Migration". It is now known that more than 300 invertebrate species (Ahyong and Galil, 2006) and 55 indo-pacific fish species have succeeded in crossing the canal and establishing themselves in the east Mediterranean Sea where the salinity and temperature conditions are nearest to their original environment (Edelist *et al*. 2013).

They include active organisms such as fish and macro-crustaceans, as well as passive ones such as microplankton forms, microcrustaceans, bivalves, ascidians and macroalgae. The rate of immigration or the rate of population increase of migrants seems to be accelerating. New records of migrants are increasing in number and their area of extension is also increasing (Halim, 1990).

5.4. Fishing and Fisheries

There are nine fisheries centers along the Egyptian Northern Coast with four developed fishing ports: Alexandria (CU07), El Maadiya (CU08), Damietta / Izbet El Borg (CU11/CU12) and Port Said (CU12). The busiest ports in the region are Izbet El Borg and Port Said. The fishing industry has a relatively minor direct role in the Egyptian economy. However, domestic fish production makes a valuable contribution to the national food supply and traditional ways of life, in which fish eating plays an important role. It is also a significant source of food for the tourist industry.

Fishery production in the Arab Republic of Egypt is derived from three main sources: offshore, inshore and aquaculture. The fishing grounds along the Egyptian Northern Coast can be split into four regions: Western, Eastern, Damietta, and the Nile Delta.

Landings have increased over the 10 year period but peaked in 2008 with 88,882 tonnes. Since 2008 landings have decreased and in 2012 there was a decrease of more than 8,000 tonnes. Landings have been dominated by clupeids (*Sardina, Sardinella*); there was an increase of almost 3,000 tonnes landed in 2012, and coastal fish, shrimps and prawns have also been important species for fisheries in the past four years.

The major fisheries of the area have traditionally been sardines (*Sardina pilchardus*) and penaeid shrimps (principally *Penaeus kerathrus*). These species continue to be important for Mediterranean fisheries. Fishing

activity is generally restricted to the inshore water of the continental shelf. It is thought that the vessels and gear available to the Delta fishing fleet do not allow exploitation of the deeper waters beyond the shelf.

The main fishing grounds used by Egyptian vessels are found within the continental shelf off the Nile Delta, which extend to the eastern side of Port Said and, rarely, to the western side of Alexandria. Landings into Damietta / Izbet El Borg contributed with 24% of the fish catch from the Egyptian Mediterranean in 2012 while landings into Port Said contributed with 17% of the total landed in 2012 (GAFR, 2012). Landings into Eastern Delta harbors were more than 28,000 tons in 2012. *Sardinella* spp., shrimp spp., marine molluscs, meagre and grey mullet fish were the most commonly landed fish in Eastern Delta ports. The grouping of "Other" species was the largest total landing.

The majority of catches in Matrouh Governorate were represented by fifteen species (Environics, 2009). These included the groupers *Epinephelus aeneus* and *E*. *alexandrinus*, the seabreams *Pagrus spp* and *Pagellus spp*, cartilaginous fish including rays and *Mustelus spp*, red mullets *Mullus spp*. other catches include Wide-eyed Flounder (*Bothus podas*), Comber (*Serranus cabrilla*), Streaked Gurnard (*Trigloporus lastoviza*), Red Scorpionfish (*Scorpaena scrofa*), Blotched Picarel (*Spicara flexuosa*) and Marbled Spinefoot (*Siganus rivulatus*).

Figure 59: Izbet El Borg Port

5.5. Marine Sensitivities

Some threatened species have been recorded from El Sallum Bay (CU01). These include the sponges *Hippospongia communis*, *Spongia zimocca* and *Spongia officinalis* (Porifera), in addition to *Ophidiaster ophidianus* (Echinodermata) and *Pinna nobilis* (Mollusca) (Environics, 2009).

5.5.1. Fish and Shellfish

The area off the Nile Delta, to a depth of at least 100 m, is likely to be important for shrimp spawning. Spawning extends between April and September, with the peak spawning period occurring between May and August. Shrimps are available all year, however peak fishing activity occurs in spring.

Sardine spawning occurs throughout the area between May and August, with the peak spawning season occurring in June and July. From an ecological perspective, the summer months, in particular June and July, are the most sensitive months for these species.

Under Egyptian fisheries law, the use of nets, including trawl nets, is prohibited from 1st April to 15th May.

5.5.2. Turtles

Sea turtles are known to feed in Egyptian coastal waters during the summer months (May to September). Late May to mid-September is the main turtle nesting season in the eastern Mediterranean Sea, when turtles may be closer inshore and on beaches to nest and lay eggs. The majority of nesting activity is to the east of Port Said. However, this means that turtles may be in the offshore area while they migrate to or from their nesting beaches from other parts of the Mediterranean.

5.5.3. Birds and Marine Mammals

Relatively little information is available regarding the seasonal activities of sea birds and marine mammals. The waters of the eastern Mediterranean Sea, however, seem to support relatively few marine mammal species, and the area off the Nile Delta is not considered an important calving ground for cetaceans. Recent records of stranded whales indicate that the area offshore of Matrouh Governorate seems to be more important in terms of cetaceans' presence.

6. CONCLUSION AND RECOMMENDATIONS

The Northern Coast of Egypt has faced years of mismanagement resulting in the destruction of valuable habitats and the disappearance of an important number of species. Ecology was and is still regarded as a low priority and this trend still continues.

The intensive development of summer resorts west of Alexandria has deprived the Western Mediterranean Coast from large parts of its original sandy biotopes. Urban and industrial development from Alexandria to Port Said has also strongly affected native species, turning the majority of the coast into a man-made habitat.

Artificial habitats are responsible of changes in species composition and diversity as indigenous species are replaced by invasive commensal species able to tolerate habitat disturbance and to live in close contact with anthropogenic activities. Hunting and commercial exploitation of wildlife, occurring along the remaining natural spots of the Egyptian Northern Coast, intensify the pressure on biodiversity. In the Delta lakes, reclamation for urbanization, road construction and fish farming as well as environmental pollution resulting from garbage disposal and wastewater discharges are also playing a major role in biodiversity loss and have resulted in the decrease in numbers of waterbirds and fish species.

6.1. Main Aspects Affecting Coastal Biodiversity

Actually, the economic value of pristine habitats and biodiversity is usually under-estimated or not taken into account at all. In addition to the moral and ethical concerns related to biodiversity loss, natural habitats and biodiversity furnish a variety of environmental services, biological resources and social benefits, which provide biodiversity with a significant intrinsic value.

There is a lack of communication between governmental bodies resulting in the creation of environmental and ecological problems that could, otherwise, be avoided. A good example of such miscommunication is given by the Burullus Power Plant, which is currently under construction within the Burullus Protected Area and has led to the destruction of valuable coastal habitats. Shifting the selected location a few kilometers westwards outside the boundaries of the protected area and inside Motubas Industrial Area would have prevented an important ecological loss while saving financial resources allocated to offset this loss. Moreover, despite the recognized importance of the coast of the Burullus Protected Area, the EEAA is planning to modify the boundaries of the protected area, which could result in the potential exclusion of the coastal zone from the protected area boundaries. In this case, it would appear as a justification to the construction of the power plant rather than a decision based on solid scientific grounds. This would also open the gates to additional development in the area leading to increased habitat loss and fragmentation and affecting the remaining species.

Another element that needs to be highlighted is the fact that planning is usually performed in terms of financial profit rather than economic value. The sand dune belt known as “Black Sands” which has been identified for future sand dune mining represents an example of short-range financial planning. Although the extraction of minerals from the sand dunes might provide good financial revenues in the short term, the long-term economic loss resulting from the removal of vegetation, sand dune flattening and disappearance of sand dune specialist species is not taken into account.

Assessment of habitat loss is usually performed on a case-by-case basis. Although single projects might not constitute a major impact to the ecology of a specific area, cumulative impacts on a specific area might be massive on the long-term and should be taken into account in future assessments.

For example, during the last two decades, the Idku coastal area (CU08) has been subjected to extensive land reclamation for industrial development. EIA studies for the single projects usually asserted that natural habitat loss would represent a minimal part of the surrounding area and that species would relocate in the environs. On the other hand, in a study performed by Environics (2015), it was assessed that only 9.5 km^2 of undeveloped coastal lands remain in Beheira Governorate (from El Tabia Village in the west to the Rosetta Nile Branch in the east), out of a total area of 27.25 km^2, representing about 35% of the total coastal area of the Governorate. In Markaz Idku, about 11% only of its coastal area is still undeveloped (1.5 km^2 out of 13.5 km^2)[19]. The following figure shows the undeveloped lands along the coastal area of Beheira Governorate in general and Markaz Idku in particular.

Figure 60: Undeveloped lands along the coastal area of Beheira Governorateand Markaz Idku (Environics, 2015)

Therefore, as habitat loss and fragmentation constitute the main threats to biodiversity, these exert pressure on any remaining natural habitats and elevate their ecological value. However, the remaining habitat patches may be too small, too isolated and too influenced by edge effects to maintain viable populations. As these patches often do not provide the food and cover resources for many species that attempt to use them, species' relocation may be unsuccessful.

[19] These undeveloped areas are found in the coastal area facing Idku town and are probably affected by human activities. Therefore, the percentage of undisturbed pristine or semi-pristine lands within Markaz Idku and Beheira Governorate may be even lower.

6.2. Proposed Actions and Recommendations

The significance of natural habitats and related biodiversity should be enhanced and their economic value emphasized in future development projects targeting pristine coastal areas. As previously mentioned, natural habitats and biodiversity provide a variety of environmental services, biological resources and social benefits of significant intrinsic value. However, it is difficult to protect land from development if the monetary value of biological resources is not highlighted. Therefore, if monetized, several natural habitats would be preserved.

Ecosystem services include:

- Protection of water resources;
- Soils formation and protection;
- Nutrient storage and recycling;
- Pollution breakdown and absorption;
- Contribution to climate stability;
- Maintenance of ecosystems; and
- Recovery from unpredictable events.

Biological resources provide:

- Food;
- Medicinal resources and pharmaceutical drugs;
- Wood products;
- Ornamental plants;
- Breeding stocks and population reservoirs;
- Future resources; and
- Diversity in genes, species and ecosystems.

Social benefits include:

- Research, education and monitoring;
- Recreation and tourism; and
- Cultural values.

All the above aspects could be monetized. On the other hand, some conservationists believe that biodiversity should be preserved only for its ethical and aesthetical value and that placing a monetary value on biodiversity is inappropriate and potentially corrupting.

Based on the above, the sand dune mining project should be reconsidered taking into account the “Black Sands” environmental and ecological value. However, if implemented, sand dune restoration would be a minimal requirement. In addition, the potential exclusion of the coastal area from the Burullus Protected Area should be reexamined given its importance not only in terms of habitats and biodiversity, but also as a protective zone buffering Lake Burullus.

Future development of the Western Mediterranean Coast should be reconsidered or at least restrained. In addition to destroying natural habitats, coastal resorts are occupied by nationals during the summer season only, while they remain vacant during the rest of the year. Moreover, they do not attract foreign tourists or foreign investments.

There are only two protected area along the Western Mediterranean Coast (El Sallum Protected Area and El Omayed Biosphere Reserve), and the EEAA is planning to declare another two protected areas, namely El Shweila (CU03) and Ras El Hekma (CU04/CU05). These areas could safeguard some spots of the Western Mediterranean Coast from urban development, although there are other valuable areas that deserve to be protected. However, given the insufficiency in communication and cooperation between the different governmental entities, these areas could be reached by development activities before the protected areas are decreed. Therefore, it is important to establish communication channels between the different stakeholders involved in coastal zone management. The present ICZM project should improve such cooperation.

Assessment studies for single projects in specific areas should consider cumulative impacts due to habitat loss to avoid pressure on the remaining natural fragments which could result unsuitable to maintain viable populations.

Based on the above, safeguarding coastal natural habitats and associated biodiversity in the light of an ICZM program requires investigating the following aspects:

- Enhancing stakeholders' coordination and cooperation;
- Reconsidering some development projects taking into account the value of biodiversity;
- Establishing protected areas and biodiversity offsets to preserve valuable habitats and compensate habitat loss;
- Establishing gene banks as well as captive breeding and release programmes to prevent threatened biodiversity from the risk of extinction;
- Enforcement of national legal and regulatory framework as well as international conventions to prevent the degradation of natural habitats as well as hunting and commercial exploitation of threatened and protected species;
- Undertaking assessments taking into consideration cumulative impacts; and
- Developing biodiversity monitoring programs in targeted areas.

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ADAPTATION TO CLIMATE CHANGE IN THE NILE DELTA THROUGH INTEGRATED COASTAL ZONE MANAGEMENT PROJECT

INTEGRATED COASTAL ZONE MANAGEMENT IN THE NORTHERN COAST OF EGYPT
– A SCOPING STUDY –

ANNEX IV:

LEGAL AND INSTITUTIONAL ASSESSMENT

APRIL 2017

IH cantabria
INSTITUTO DE HIDRÁULICA AMBIENTAL
UNIVERSIDAD DE CANTABRIA

Environics SAE
ENVIRONMENT & DEVELOPMENT ADVISORS

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I. INTRODUCTION

1. BACKGROUND

Effective development and protection of natural assets necessitates the adoption of integrated approaches. Integrated approaches can be successful only when the overall development aims and particular roles are clearly defined and understood by all those involved at the institutional, collective and individual levels. Such clarity and commitment is even more critical for coastal zone development and management given the sensitivities, dynamics and uncertainties.

Coastal environments are generally characterized by both value and threat. They are among the highest biodiversity value environments with most vulnerable ecosystems, as well as the most being impacted by human activities. The expansion and increase of economic activities, urbanization, and resource depletion, as well as population growth, have continuously amplified the vulnerability of coastal zones.

This vulnerability is complicated because of the dynamic, interrelated and interdependent processes that affect coastal environments. Effective management must, therefore, embrace a holistic approach that takes into account the complex and dynamic interactions among all factors affecting coastal environments. Uncertainty is a further challenge to add; for our knowledge of the exact functioning of coastal systems remains restricted, while the impacts of climate change are becoming more evident by the day, urging pro-activity in addressing coastal threats.

The present document will exhaustively demonstrate the multiple actors and stakeholders that operate within a coastal zone in the case of Egypt. National laws and regulations that govern coastal zones distribute their management responsibilities among different entities based on their mandates, as well as provide decision making and implementation guidelines. For Integrated Coastal Zone Management (ICZM) to be achieved, cooperation among such actors and stakeholders is vital. This cooperation has to be based on the realization of a common goal that is focused around sustainability, as well as the appreciation of necessary interdependencies. This cooperation also has an international dimension reflected in Egypt being a signatory for a number of global and regional conventions and treaties related to the ICZM.

This scoping report presents the coastal governance baseline defining institutional, legal and policy context, as well as define the key stakeholders. It also addresses the key issues concerning the management of the northern coast of Egypt and summarizes the stakeholders' feedback. It thus provides the necessary base for future steps to establish an efficient coordination mechanism for ICZM.

2. AIM OF THE ASSESSMENT

The aim of the assessment is to provide a baseline and a high level assessment concerning the main legal and institutional opportunities and constraints for the development of ICZM in Egypt. The spatial scale of this analysis is the entire North Coast, since most of regulations and institutions are common for all the coastline management. However, the assessment is also extended to identify potential legal and institutional differences between the governorates, if any. This assessment is part of a larger scoping study and is thus considered as a precursor document guiding further activities, including detailed research, toward the establishment and subsequent implementation of ICZM in the northern coast of Egypt.

3. APPROACH

This report adopted the following approach;

- Reviewing the historical sequence of national initiatives and structures launched towards achieving ICZM;
- Reviewing the concerned and related legislations governing the ICZM (laws, decrees and strategies) related to different entities at the national level, highlighting key responsibilities;
- Analysing available data (regulatory and institutional);
- Interviewing key stakeholders playing important roles (including a number of coastal governorates along the northern coast) in order to gain from their experience, present lessons learned, illustrate the practical application of the regulatory framework and determine actual roles;
- Identification of key challenges and gaps hampering the proper implementation of ICZM.

The actual practice and progress of joint cooperation is analysed and elaborated based on input from interviewees. In parallel to the diagnostic analysis to the legal and institutional framework governing the ICZM in Egypt, stakeholder interviews have been conducted with Key actors in implementing activities related to the ICZM to discuss obstacles concluded through analysis, as well as explore additional issues from a practical point of view.

The Stakeholders interviewed have been selected according to a main criterion; the relevant authorities, which have the right of administration and decision-making regarding to the development of coastal areas, extracted from the land use map provided by the National Centre for Planning and land uses, interviewees must be at the higher levels and present the decision makers in the authorities to ensure that the interviewee is familiar with the legal and administrative process. (The interview guide, the list of interviewees and the record of interviews attached in Appendix I)

4. REPORT STRUCTURE:

Chapter I (this chapter) includes: Aim of the assessment and the approach of carrying out the assessment.

Chapter II: The coastal legal and institutional baseline on international, regional and national levels

Chapter III: Key stakeholders and integrated management committees

Chapter IV: Administrative procedures for the coastal management and development.

Chapter V: key issues for the integrated management of the coast.

Chapter VI: Concluding remarks of the assessment based on the analysis of Strengths, Weaknesses, Opportunities and Threats (SWOT) followed by recommended actions.

II. REGULATORY FRAMEWORK

Several regulatory instruments have been activated addressing the ICZM aspects in order to effectively engage essential partners on both the regional and national scale. Egypt has both moved towards formulating its own regulatory framework, and joined regional and international agreements related to the north coast of Egypt as outlined below.

1. REGIONAL & INTERNATIONAL LEVEL

Addressing trans-boundary issues requires appropriate international and national legal and institutional arrangements which provide the basis for cooperation among interested /affected countries and define the procedures to be applied and their institutional aspects.

Egypt is party to a large number of global and regional treaties, conventions and other agreements related to the marine and other aspects in the environment. These agreements can be divided into the following categories: marine global environment; marine regional environment (both Mediterranean and Red Sea), nature conservation; atmosphere; hazardous substances and waste as well as nuclear safety.

This section outlines the sub-regional, regional and global agreements and conventions that address the priority environmental concerns in the Mediterranean region. The most significant of these, is the Barcelona Convention along with its protocols. Additional legal and policy instruments relevant to the issues of seawater quality, biodiversity and fisheries in the Mediterranean are also discussed. Moreover, several of the following multilateral environmental agreements (MEAs) aim to combat pollution in the Mediterranean. The following are particularly relevant to ICZM, especially the protection of the marine environment, although as will be seen below order of ratification in reverse chronological order, Egypt did not take part of all relevant agreements.

- **The conservation of Small Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic area (ACCOBAMS), 1996** is a special agreement under the Bonn Convention that was made in 1996 and entered into force in 2001. It is the first consensus that integrated those regions to work on one common goal. The agreement recognizes that cetaceans are a crucial part of the marine environment and that it is necessary to conserve them and maintain their ecological benefits. Their conservation is a common concern and thus the agreement recognizes the importance of integrating management activities related socio-economic progresses such as fishing, marine activities etc.

Egypt ratified the agreement on 4 March 2010 and it was put into force on 1 July 2010.

- **The London convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972**, came into force in 1975 and is now superseded by its 1996 Dumping Protocol. The main goal is to protect the marine ecosystem and improve sustainable resource usage. In this regard, both the convention and the protocol aimed to manage and restrict any marine pollution source through the provision of two waste lists; grey and black. The black list includes all the prohibited materials and the grey list includes the materials that can be dumped into the sea but requires following specific guidelines and obtaining a special permission from statutory bodies. Dumping any materials that are not on the list needs a general permission. In addition to this common goal, the newly formed protocol is sterner than the convention in terms of requiring a general precautionary approach, a reverse list approach that forbids all waste with an exception of obtaining a clearly stated permission, waste incineration/combustion treatment by the sea is forbidden, lastly, transportation of any waste to be treated or dumped into the sea is not permitted. Only wastes that were generated on board can be combusted. Technical guidelines and procedures are provided for the newly involved stakeholders. The convention recognizes the importance of international collaboration between involved parties

without ignoring the needs and capacities of developing states. It also recognizes other related agreements such as the law of the sea.

The protocol was ratified by Egypt and entered into force on 24 March 2006

- **International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990** was issued in the Paris conference (1989) and was adopted on 30 November 1990 and entered into force on 13 May 1995. The aim of the convention is to provide innovative methods to eliminate wastes from ships and inhibit marine pollution. It includes a comprehensive obligations to establish national systems for preparedness and response, identifies a number of potential pollution sources all of which are required to have "local" oil pollution emergency plans which are to be coordinated with the national system); This implies that all ships and offshore units are obligated to have an emergency plan to take prompt effective actions in case of oil pollution. Any pollution incident needs to be reported to the authorities. Additionally, all involved parties in the convention are required to help others in case of pollution emergency and compensation should be given for any assistance. In 2000, a hazardous and noxious substances (OPRC-HNS Protocol) was adopted.

Egypt ratified the convention on 29 June 1992 and ratified the protocol on 26 May 2004 which entered into force on June 14 2007.

- **Stockholm Convention on Persistent Organic Pollutants (POPs),2000** The convention was adopted at the meeting of the intergovernmental negotiating committee for an international legally binding instrument for implementing international action on certain persistent organic pollutants in Johannesburg (December 2000). It recognizes that POPs are easily transported through evaporation and deposition. It also recognizes that many countries use a high amount of POPs. For instance, the African. Sahel countries apply a high amount of pesticides that are later on deposited in further away areas such as the Caribbean sea and in turn causes its pollution of their sea .The objective of this Convention is to protect human health and the environment from persistent organic pollutants. The selected list of POPs is of direct relevance to the UNEP assessment of Persistent Toxic Substances "PTSs". The Convention was opened for ratification signatures on 23 May 2001 in the Intergovernmental Conference held in Stockholm.

Egypt signed the agreement on 17 May 2002, ratified it on 2 May 2003 and it was put into force in the country on 17 May 2004.

- **The Conservation of African-Eurasian Migratory Water birds (AEWA), 1995** is a regional agreement part of the Bonn convention which entered into force on that aims to conserve migratory waterbirds and their habitats in many regions; Africa, Europe, the Middle East , Canadian Archipelago, Central Asia and Greenland but targets also international conservation efforts. It includes 225 birds that depend on wetlands.

Egypt ratified the convention on 1 January 1999

- **The United Nations Framework Convention on Climate Change (UNFCCC) 1992,** entered into force on 21 March 1994. It provides an intergovernmental framework to face climate change issues. Recognizing that the climate is a common shared resource affected by anthropogenic human emissions. It recognizes the importance of marine environments as well as terrestrial ones in acting as reservoirs for Carbon and greenhouse gases. It also emphasizes the importance of scientific, economic and practical sectors in tackling climate change problems and the importance of continuous monitoring and assessment.

Egypt signed this convention on 9 June 1992 and ratified it on 5 December 1994. It entered into force on 5 March 1995.

- **Global Convention on the Protection of Biological Diversity, 1992** was founded in Rio and entered into force in December 1993. It recognizes the importance of biological diversity in offering ecosystem services such as re-creational, ecological, economic, educational services etc. and its importance in maintaining life. The convention emphasizes that countries and states are responsible to preserve their biological diversity and that specific human activities negatively affects their presence. It also recognizes the challenge in lack of information and studies. It as well emphasizes the importance of in-situ conservation to maintain biodiversity and notes that ex-situ conservation also has a role in its preservation. It recognizes as well that the priority of developing countries include social and economic progress and lowering poverty. It highlights the importance of sustainable use as the answer to poverty elimination and development.

Egypt ratified the convention on 31 August 1994.

- **The Basel Convention, 1989** strictly regulates the transboundary movements of hazardous wastes and provides obligations to its Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner when moved across national boundaries. Thus, it emphasizes the importance of integrating socio-economic development policies at global, regional, and local scales to face risks from hazardous wastes. Moreover, it recognizes the rise of threats caused by this type of waste on coastal zones such as the increase in the loss of coral reefs and the economic cost to restore it and restore other affected habitats. The Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal was adopted in 1989 and entered into force on 5 May 1992. Most countries of the region comply with the Basel convention.

Egypt ratified the agreement on 8 January 1993 and it was put into force on 8 April 1993.

- **International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969,** entered into force on 6 May 1975 which recognizes the right of coastal cities on high seas to take preventative measures in order to avoid any pollution from a marine accidental causality. The coastal state also is encouraged to consult the ship owner and experts before taking any action. Any damage caused by the preventative means implemented by the state will be penalized. In 1973 a protocol was issued in the London conference on the intervention on the High Seas in Cases of Marine Pollution by Substances other than Oil. The protocol entered into force in 1983 and has an updated list of substances.

  Egypt ratified the convention and the protocol on 3 February 1989 and entered into force on 4 May 1989

- **The International Convention on Civil Liability for Oil Pollution Damage, 1969,** entered into force 1975, aims to compensate affected individuals by pollution of the marine caused by the oil carrying ships. The ship responsible of the spilling will be in charge in to compensate the damage. All ships that are part of the convention are required to have an insurance that can cover one incident. The convention was replaced by the 1992 protocol which entered into force on 30 May 1996. Several protocols were issued that aimed to higher the insurance limit. On October 2000 the amendments were adopted and put into force on November 2003.

  Egypt ratified the convention on 3 February 1989 and entered into force on 4 May 1989.

  Egypt then ratified the protocol on April 21 1995 and entered into force on May 30 1996.

However, there is no specific provision on sanctions for inadequate insurance or false insurance certificates (which is requested for tankers entering Egyptian territorial sea by Article 53 of Law No. 4/1994), which is particularly problematic given Egypt's decision not to become party to the Oil Pollution Fund Convention.

- **RAMSAR Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1971**. It was amended by the Paris protocol on 3 December 1982 and Regina Amendments on 28 May 1987. The agreement recognizes the inter-dependence of humans and the ecosystem. It also recognizes the importance of wetlands in regulating water flow as well as associated animals and plants such as waterfowl. It emphasizes as well the economic, social, recreational and scientific importance of wetlands. The agreement indicates that national and integrated international actions are necessary to preserve wetlands

  Egypt ratified the convention on 9 September 1988 and it was put into force on the same date.

- **International Convention for the Prevention of Pollution from Ships, 1973**, as modified by the Protocol of 1978, (MARPOL 73/78). The MARPOL Convention is a combination of two treaties adopted in 1973 and 1978. It covers all technical aspects of pollution from ships, except the disposal of waste into the sea by dumping, and applies to ships of all types. The Convention has five appendices covering oil, chemicals, sewage, garbage, and harmful substances carried in packages, portable tanks, freight containers, etc. It aims to prevent pollution of the marine ecosystem from ships, caused by operational or accidental spilling. The convention was amended several times.

  The convention was ratified by Egypt on 7 August 1986 and was put into force on 7 November 1986.

- **The Law of the Sea, 1982.** The United Nations Convention on the Law of the Sea (UNCLOS), also called the Law of the Sea Convention or the Law of the Sea treaty, is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), which took place between 1973 and 1982. The Law of the Sea Convention defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine resources. It also recognizes that marine problems are inter-related and emphasizes on the need for an integrated management. Under the United Nations Convention on the Law of the Sea "States have the obligation to protect and preserve the marine environment" (Art. 192) taking measures "necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life" (Art. 194, para. 5).The Convention, concluded in 1982, replaced four 1958 treaties. UNCLOS came into force in 1994,.. As of June 2016, 167 countries have joined in the Convention.

  Egypt was one of the first countries who ratified it on 26 August 1983.

- **The Bonn Convention on the Conservation of Migratory Species of Wild Animals, 1979** aims to globally conserve aquatic, terrestrial and avian migratory animals and it recognizes their crucial role in the stability of the ecosystem It recognizes that all boundaries where the species occur or pass through needs to be managed. Thus it requires coordination in management between governments. The convention was put into force on November 1983.

  Egypt ratified the convention on 11 February 1982 and it was put into effect on 1 November 1983.

- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973.** It is an international agreement between states that aims to ensure that international species trade does not affect their survival. It recognizes the importance of international cooperation in controlling animal trade to avoid over-exploitation. It was put on effect on 1 July 1975.

Egypt ratified the convention on 4 January 1978 and was put into force on 4 April 1978.

- **The Barcelona Convention, 1976**

The Barcelona Convention on the Protection of the Mediterranean Sea against Pollution (the original convention which entered into force on 12 February 1978) or the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (as amended in 1995), also known as the Barcelona Convention, is a notable instance of regional cooperation and is the most important regional instrument concerning the transboundary environmental problems in the Mediterranean.

Since 1995, several components of the Barcelona system have undergone important changes. The objective of the revision was to modernize the Convention to bring it in line with the principles of the Rio Declaration, the philosophy of the new Convention on the Law of the Sea (see section 1.2 below) and the progress achieved in international environmental law in order to make it an instrument of sustainable development. The revised Convention also aimed to progress from an essentially proclamatory form of law to a more prescriptive law setting out obligations. The scope of its protocols was extended and new protocols were adopted either to replace the existing ones or to cover new fields of cooperation. In addition, in order to ensure the effectiveness of the new provisions, the need for new capacities as well as public participation and access to information including the adoption of a reporting procedure was part of the revision process.

Egypt first signed the Barcelona convention on the 16 February 1976. Shortly after, it ratified and approved the Barcelona convention on 24 August 1978 and accepted its amendment on 11 February 2000 which entered to force on 9 July 2004. The present Barcelona structure includes the following instruments;

- **The Protocol Concerning Specially Protected Areas** concerning Mediterranean specially protected areas (Geneva, 1 April 1982; in force since 23 March 1986), was signed by Egypt on 16 February 1983 and ratified on 8 July 1983 and entered into force on 23 March 1986 .It was replaced by the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean "the SPA and Biodiversity Protocol", signed in Barcelona on 10 June 1995, (in force since 12 December 1999).

  Egypt has signed the replacement protocol on 10 June 1995 and ratified it on 11 February 2000. The protocol entered into force on 12 March 2000.

- **The Land Based Sources Protocol "LBS"** for the protection of the Mediterranean Sea against pollution from land-based sources (Athens, 17 May 1980; in force since 17 June 1983).. The protocol was amended in Syracuse on 7 March 1996, changes its name to the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities, "the LBS Protocol" (in force since 11 May 2008),. LBS applies to discharges originating from land based point and diffuse sources and activities in the Mediterranean, such discharges reach the sea through coastal disposals, rivers, outfalls, canals or other watercourses, including ground water flow, or through run-off and disposal under the seabed with access from land;

  Egypt ratified the protocol on 18 May 1983; however, it did not sign the amendment yet

- **The Dumping Protocol** for the prevention of the pollution of the Mediterranean Sea by dumping from ships and aircraft (Barcelona, 16 February 1976; in force since 12 February 1978), which, as amended in Barcelona on 10 June 1995, changed its name to the Protocol for

the Prevention and Elimination of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea. The Dumping Protocol applies to any deliberate disposal of wastes or other matter from ships or aircraft, with the exception of wastes or other matters deriving from the normal operations of vessels or aircraft and their equipment (which fall under the label of pollution from ships).

Egypt has signed the protocol on 16 February 1976 and ratified it on 24 August 1978 and accepted its 1995 amendment on 11 February 2000.

- **The Emergency Protocol** concerning cooperation in combating pollution of the Mediterranean Sea by oil and other harmful substances in cases of emergency (Barcelona, 16 February 1976; in force since 12 February 1978), which aims at introducing the provisions necessary to implement the Regional Strategy on Prevention of Marine Pollution of the Marine Environment by Ships, adopted by the Parties in 1997.

  Egypt has signed the protocol on 16 February 1976 and ratified it on 24 August 1978. It entered into force on 23 September 1978. The Emergency protocol was amended in 2002; however, Egypt did not sign nor ratify the amendment.

- **The Hazardous Wastes Protocol concerning** the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal, signed in Izmir on 1 October 1996, (in force since 18 January, 2008).

  Egypt only signed the protocol on 1 October 1996 but did not ratify it.

- **The Offshore Protocol** concerning pollution resulting from exploration and exploitation of the continental shelf, the seabed and its subsoil, signed in Madrid on 14 October 1994. All activities in the Offshore Protocol area including the erection of installations on site are subject to the prior written authorization of the competent authority of a party. Before granting authorization, the authority must be satisfied that the installation has been constructed according to international standards and practice and that the operator has the technical competence and financial capacity to carry out the activities. Authorization shall be refused if there are indications that the proposed activities are likely to cause significant adverse effects on the environment that could not be avoided by compliance with specific technical conditions.

  Egypt did not sign nor ratify this protocol.

- **The ICZM Protocol, a** new Protocol on Integrated Coastal Zone Management (ICZM) was signed in Madrid on 21 January 2008 at the Conference of the Plenipotentiaries on the ICZM Protocol. On 24th March 2011, the Protocol entered into force. The signing of the Protocol came after a six-year process of consultation, negotiation and refinement on the Protocol layout. The ICZM Protocol completes the set of Protocols for the Protection of the Marine Environment and the Coastal Mediterranean Region. It will allow the Mediterranean countries to deal with the emerging coastal environmental challenges, such as the climate change.

  The ICZM Protocol text is:

  - Innovative: it represents innovation in international law, since there is no precedent of regional initiatives.

- Forward-looking and proactive: it aims at preventing and not only reacting to coastal problems.
- Comprehensive: it covers all issues crucial for coastal environment and its protection in the 21st century.
- Integrated: it ensures the integrity of sea and land areas as well as institutional co-ordination, co-ordination of national, regional and local authorities, involvement of non-governmental organizations and other competent organizations.

The Protocol is very precise on:

- Defining of the coastal zone where it means "…the geomorphologic area either side of the seashore in which the interaction between the marine and land parts occurs in the form of complex ecological and resource systems made up of biotic and abiotic components coexisting and interacting with human communities and relevant socio-economic activities".
- Defining of the coastal setback as "…a zone where construction is not allowed. Taking into account the areas directly and negatively affected by climate change and natural risks, this zone may not be less than 100 meters in width".
- Formulation and development of coastal strategies, but also land-use strategies, plans and programs covering urban development and socioeconomic activities, as well as other relevant sectoral policies.
- Formulation of Environmental Impact Assessment for public and private projects, and Strategic Environmental Assessment for plans and programs which affect the coastal zone
- Developing policies for preventing natural hazards, particularly those resulting from the climate change.
- Applying the ecosystems approach to coastal planning and management so as to ensure the sustainable development of coastal zones, taking into account specificities of coastal ecosystems, in order to preserve coastal natural habitats, natural resources and ecosystems, landscapes…
- Reporting on the implementation of the Protocol, including measures taken, their effectiveness and the problems encountered upon their implementation

Fifteen Contracting Parties to the Barcelona Convention signed the Protocol up to date while ten contracting parties have ratified the protocol not including Egypt (nor did it sign it)..While all of the amended protocols of Barcelona convention are not yet in effect, this convention is still considered to be by far the most significant regional instrument concerning the transboundary environmental problems in the Mediterranean.

- **World Heritage Convention, 1972,** sets guidelines for parties to help them identify locations that can be world heritage sites and means to conserve them. Every state is required to protect the natural heritage. Regional frameworks, scientific research, and giving the heritage a cultural function for the community are encouraged. The convention provides managing guidelines and possibly financial assistance. Moreover, raising awareness and education is also encouraged in order to improve the protection of those sites.

Egypt ratified the convention on 7 February 1974.

- **The Rotterdam Convention, 1998** on the prior informed consent procedure for certain hazardous chemicals and pesticides in international trade. The Rotterdam Convention on the Prior Informed Consent (PIC) procedure for certain hazardous chemicals and pesticides in international trade was adopted at a conference of plenipotentiaries in Rotterdam on 10 September 1998. The Convention enables the world to monitor and control the trade in very dangerous substance and according to the Convention, export of a chemical can only take place with the prior informed consent of the importing party. The Convention covers a list of five industrial chemicals and 22 pesticides, including aldrin, chlordane, DDT, dieldrin, heptachlor, HCB and PCBs. The objective of this convention is to give responsibility to all parties involved in importing and exporting hazardous chemicals and to increase the coordination between them in order to facilitate knowledge exchange as well as increasing the protection of the ecosystem and human health.

  Egypt did not participate in this convention.

- **Bern Convention on the Conservation of European Wildlife and Natural Habitats, 1979** is an agreement that aims to conserve wild animals and fauna specifically endangered and vulnerable species. The convention entered into force in June 1982. All involved stakeholders are encouraged to protect the habitats of wild animals and fauna. The need to educate all involved parties is an important conservation tool. Management should target as well planning and development laws as well as pollution management and control. It highlights that governments need to set national goals to preserve wildlife and that global coordination is necessary to conserve migratory species.

  Egypt did not take part in this convention.

Conclusion

- Egypt is signatory to a large number of regional and international conventions and agreements which impose obligations, but also open opportunities for cooperation and knowledge transfer or exchange. However,, Egypt had not yet signed nor ratified some of the amended protocols of the Barcelona convention

- Egypt also did not yet sign the ICZM protocol, which is the most relevant to the subject of this report. This protocol could have added to the drive to establish a national ICZM process. Its requirements to formulate coastal land use strategies and the application of an eco-system approach for coastal planning and management would have been useful to reflect in national laws. However, as will be seen below, this did not totally prevent progress at the national level

2. NATIONAL LEVEL

Along with international actions aiming at achieving ICZM in the Mediterranean region in specific, the national framework matured through promulgating laws, establishing committees or drafting national plans. Moreover, the constitution of 2014 commits the state to environmental protection (Article 46), with special reference to fisheries (Article 30), natural resources (Article 32), ground water (Article 44), as well as seas, shores, lakes, waterways and natural protectorates (Article 45). It also commits the State to balanced spatial development (Article 236) and sustainable development in general (Article 27). It thus sets a strong base for a legal

framework conducive to integrated management, including ICZM, to achieve these principles. ***(The full text of these articles in the constitution is included in* Appendix *II).***

2.1. Laws and Regulations

Several laws with mandates towards CZM exist, assigning roles and responsibilities to different governmental entities which share the process of coastal management. The relevant legislations have been surveyed through an extensive search in the National Database for Egyptian Legislation[1] of keywords in Arabic; Coast, Coastal, Beach and Beaches. The results were 481 entries during the period from 1883 to 2016, which consisted of laws and decrees including royal, presidential and ministerial decrees, that were reviewed and filtered based on the subject and scope of the study. The laws regulating this issue are;

- **Environment Law No. 4/1994 amended by Law No. 9/2009**

  To protect the environment, a series of reforms have been taken by the Government of Egypt since the early 1980s among which ICZM in Egypt has been included. In the meantime the country has experienced fast economic and population growth bringing new environmental and socio-economic challenges. The endorsement of the first National Environmental Action (NEAP) in 1992 marked a turning point. As a result, an Environment Protection Law was enacted in 1994. The Egyptian Environmental Affairs Agency "EEAA" was established shortly thereafter and has gradually expanded its functions and responsibilities in all fields of environmental management. However, responsibilities for environmental protection in Egypt are distributed, among a number of Ministries and Governorates and can be classified in the following three categories:

  - The national environmental organization represented by the MOE, the EEAA and its Regional Branches Offices "RBOs" which are charged with overall monitoring and regulatory coordination;
  - Institutions with specific operational functions which are performed by line ministries, and by Environmental Management Units "EMUs" in the Governorates; and
  - Institutions with environment support role (mostly universities and research institutes).

  With the passing of Law No. 4/1994 for the Environment, EEAA was given the responsibility to initiate and coordinate National ICZM activities. Specifically, EEAA was given the authority to “participate with the concerned agencies and ministries in the preparation of a National ICZM Plan for the Mediterranean Sea and Red Sea coasts”. Law No. 9/2009 revisions of Law No. 4/1994 for the environment included, for the first time, the concept of ICZM as an integral part of environmental management. The Law, as amended, includes articles defining the coastal zones (art.1, item 39) as " the area extending from the coasts of Arab Republic of Egypt which encompasses the territorial sea, exclusive economic zone and continental shelf, and extending landward to areas of active interactions with the marine environment for that not exceeding 30 km in the desert areas, unless major topographical features interrupt this stretch, while in Nile Delta would extend up at contour (+3m). Each of the coastal governorates shall define their coastal zone according to its physical conditions and environmental resources, not in any case less than "10 km" landward from coast line ". The definition of Integrated Coastal Zone Management was included in (art.1, item 40) and defined as “a process by which all concerned authorities participate in coordinating their work in order to preserve the environment of the coastal zones. Moreover, the new amendments of the environment law under (art. 48, para. e) linked the main goals of ICZM and achieving Sustainable Development.

[1] Source: www.tashreaat.com , Information and Decision Support Association (IDSA), Information and Decision Support Center (IDSC)

The Environment Law provides important provisions for ICZM as well as provisions for Environmental Impacts Assessment "EIA". The law is quite detailed on certain coastal aspects, such as pollution from ships which is covered by more than 20 articles. Passing the Environmental Law sent important signals about the government policy regarding coastal development, but so does the implementation and enforcement of the law.

The executive regulations of the Law (prime minister's decree 338/1995 and amended in several iterations afterwards) detail a number of issues relevant to coastal protection, development and management. These include for example the disposal of wastewater from ships stating that "no ship is permitted to dispose of treated wastewater at a distance of less than four nautical miles from the shoreline. The competent bodies shall provide the necessary facilities for receiving waste. It must be disposed of according to the legal criteria and the movement of waves not in the direction of the beach".

It also includes the setback line form the coast, as it states that "It shall be prohibited to issue permits for the construction of any installations on the sea shores of the Arab Republic of Egypt up to a distance of two hundred meters inwards from the shoreline, except after obtaining the approval of the Shores Protection Authority and EEAA approval" and that " It is prohibited to license any work that may affect the natural shoreline or modify its configuration either inwards or outwards or carry out related works, except after obtaining the approval of the Shores Protection Authority and EEAA approval".

Additionally, a National Oil Contingency Plan has been developed on the basis of a broad interpretation of Article 25 of Law No. 4/1994 which mandates the Egyptian Environmental Affairs Agency (EEAA) to develop the Environmental Disasters Contingency Plan. To have legal force, the Plan needs the approval by the Cabinet of Ministers and Prime Ministerial decree. Proper legal basis for the national oil contingency plan would also need to include penalties for lack of sectoral or local contingency plans.

- **Water Drainage and Irrigation Law No. 12/1984**

Under this law, article 86 stated that "the construction of any structures on the country's northern coast overlooking the Mediterranean sea along its length from the republic western borders to its eastern ones for 200 meters inside the coastal water line is prohibited". Moreover, under article 87 of the same law the responsibility for determining the final prohibition line has been assigned to Shore Protection Authority "SPA". Based on its investigation, the setback area could be modified and has to be informed to all concerned authorities. Within the same law, article 88 highlights that approving certain establishments with special features are allowed under specific cases and upon prior approval from SPA as to include clear actions towards protecting the coasts.

It is noted that Law 4/94 reiterated the same limitations concerning the setback. This consistency is commendable; however, the fact that the two laws are implemented by different organizations has created overlaps reflected in administrative procedures. (see chapter 4)

- **Natural Protectorates Law No. 102 of 1983**

According to this law, the Nature Conservation Sector within EEAA becomes the governmental body responsible for nature conservation in Egypt, entrusted with managing the National Protected Areas Network and coordinating management activities inside them. The law provides the legislative framework for establishing and managing Protected Areas within the different geographical regions of Egypt including coastal zones. This Law has clearly stipulated under article. 1 the definition of

protected area as, “any area of Land, or coastal or inland water characterized by flora, fauna, and natural features having cultural, scientific, touristic or esthetic value. These areas will be designated and delineated by Prime Minister Decree upon the recommendation of the Egyptian Environmental Affairs Agency”. In addition, under article 2, it is prohibited to undertake actions (deeds or activities or undertakings) which will lead to the destruction or deterioration of the natural environment or harm the biota (terrestrial, marine or fresh water), or which will detract from the esthetic standards within protected areas.

The main target of this law is to maintain and preserve natural resources including the marine ones, a central component of ICZM. EEAA as the legal entity for applying such law is responsible for managing nearly 30 Protected Areas among which a number of coastal protectorates with different natural resources, where business and management plans are prepared and implemented.

Five protected areas have been declared in the northern coast of Egypt namely (Zaranik, Ashtom El gamil, Burullus, El Omayed, Sallum) by prime ministerial decress according to this law as follows:

- Prime Ministerial Decree No. 1429/1985, as amended by Decree No. 3379/1996,
- Regarding the Establishment of two national reserves in the area of El-Bardawil Lake and Al-Ahrash in the governorate of South Sinai.
- Prime Ministerial Decree No. 671/1986
- Establishes of a natural reserve in the area of El-Omayed in the governorate of Matrouh.
- Prime Ministerial Decree No. 459/1988, as amended by Decree No. 2780/1998,
- Regarding the Establishment of a national reserve in the area of Ashtoum El-Gamil in Port Said governorate.
- Prime Ministerial Decree No. 1444/1998
- Establishes of a natural reserve in the area of El-Burullus Lake in the governorate of Kafr El Sheikh.
- Prime Ministerial Decree No. 533/2010
- Establishes of a natural reserve in the area of El-Salum in the governorate of Matrouh.

o **Law No. 48/1982 on Protection of the Nile River and Waterways from Pollution**

The Ministry of Water Resources and Irrigation "MWRI" has sole legal responsibility for the planning and management of water resources in Egypt. Law No. 48/1982 has defined the waterways as spatial zone for application to include (Nile River, drains, lakes, ponds, ground water). In addition, MWRI is responsible to control the discharge of wastes and wastewater into the Nile and waterways and sets standards for the quality of these discharge effluents. The Law prohibits discharges to the Nile, canals, lakes, drains, and ground waters without a license issued by the Ministry. Licenses are issued to factories, sanitary sewage treatment plants, and river boats, upon application, as long as the effluents meet certain standards and other conditions. Discharging without a license or discharging in amounts or concentrations that exceed license limits is punishable by fine, jail sentence, or both. This licensing procedure is conditioned according to criteria and cases set by MWRI based upon recommendation from the Minister of Health (MOH). The law gives MWRI administrative and police authority over implementation and MOH has a standard monitoring role. MWRI has therefore the responsibility in combating pollution in lakes, which in term is an integral part of coastal management.

- **Law No. 124/1983 on Fishing, Aquaculture and Regulate Fish Farms**

  This law has been developed to regulate fishing, aquatic organisms harvest and regulating the establishment of fish farms. Consequently and according to the law the official responsible governmental entity in charge for implementing this law is General Authority for Fish Resources Development "GAFRD" affiliated to Ministry of Agriculture and Land Reclamation "MALR".. Article 15 of the Law which deals with the water pollution and fishing constraints clearly prohibits any actions that could pollute the water where it states "without prejudice, as required under any other law, it is not allowed to throw or discharge industrial waste and pesticides used in combating agricultural pests and similar toxic or radioactive materials in the Egyptian waters. The Law defined "marine waters" as the territorial waters of the Arab Republic of Egypt. Accordingly, GAFRD has the legal power and responsibility of preserving and protecting the coastal water and marine resources.

- **Law No. 106/2012 on amending some provisions of Law No. 38/1967 for General Public Cleaning**

  Punishes any person who throw construction wastes on beaches without prejudice to any more severe penalties imposed by other laws by a mulct not less than 20.000 (twenty thousand) Egyptian Pounds and not more than 100.000 (one hundred thousand) Egyptian Pounds, or one of either above mentioned penalties, any person who throw wastes construction or demolition or excavation in public places, squares, tunnels, places other than those allocated by the local authorities, bridges, railways, archeological sites, River Nile, canals, drains, beaches or their adjacent waters.

- **Law No. 43/1979 on local administration system**

  The nation is divided into local administration units are (Governorates, Markaz, Cities, Districts, Villages) each of them working on provision and management of all public utilities within the framework of national policy These exclude national facilities or special nature projects which establishment is by republican decree.

  The governors are appointed by decree of the President of the Republic and represent the executive power to oversee the implementation of the national policy, provide services and utilities and ensure food security, and are responsible for raising agricultural and industrial productivity and have to take all procedures in these respects within the applicable laws and regulations

  The Executive Council of Governorate, meeting on a monthly basis, is headed by the governor, and the membership of the secretary-general, aides of the governor, heads of Markaz, Cities and Districts, and the heads of public authorities. There are also executive councils at each Markaz, City and Village. These are the main vehicles to ensure coordinated actions at each of these administrative levels.

2.2. Relevant Presidential and Ministerial decrees:

- **Prime Ministerial Decree No. 1095/2011, amending some provisions of the Executive Regulation of Law 4, issued by the prime ministerial decree no. 338/1995**

  The executive regulations specified that the competent Minister for Environmental Affairs shall, after consulting the competent authorities, issue the environmental rules regulating the development of the coastal zone. The rules shall be updated periodically. It also stated that a local committee shall be formed by a decree of the Minister of Environmental Affairs and under the chairmanship of the Governor for the integrated management of coastal areas in each coastal governorate.

- **Ministerial Decree No. 758/1972, promulgating the Executive Regulations of Law No. 66/1953 concerning mines and quarries (petroleum resources), issued by the Minister of Commerce and Industry**

  Forbids discharging any oil polluting substances on the shores of the sea nor in public roads and water, taking into consideration that the seawater should not be polluted, and the Ministry of Industry is the body entrusted with the implementation of this decree.

- **Ministerial Decree No. 447/1988, regulating the establishment of tourism projects in the north coast region of Egypt**

  The decree provides rates and standards to be applied for tourist projects established at the north coast region. These include foot print, height, building density of buildings as well as population density. Its most relevant provision to the coastal land use is the following provision specifying a minimum setback of 100 m from the shore line

  "Without prejudice to provisions prescribed in laws and regulations, coastal setback extend typically up to at least 100 (one hundred) meters from shoreline and are meant to control human activities in the immediate coastal area .No human activities such as new constructions are permitted within the defined buffer area. Establishment of Marina is permitted. Public and private cars are banned from this area. Construction is restricted for a 120 m distance from the coastline. The area between the construction zone and defined setback could either be planted with grass or be laid as Boardwalks".

  Although it refers to other regulations, and specify the setback it includes as a minimum, it is noted that the figure is different than that imposed by both laws 12/1984 and 4/1994 set at 200 m, as well as the prime ministerial decree below [2]

- **Minister of new urban communities Decree no. 24/1993, regarding the Licensing Requirements and Procedures for construction at the northwest costal region**

  Works that require building permits shall be in conformity with designs, drawings and requirements attached to the resolution for adoption of planning and subdivisions as well as the standards and requirements of the North coastal region promulgated by the ministerial decree no. 447/1998 .

  Prime Ministerial Decree no. 1599/2006, concerned with the protection of Egyptian seashores that refers to "the Supreme Committee for Licenses on the Coastal area

  The seashores of the Arab Republic of Egypt at a distance of two hundred meters inwards from the shoreline are deemed vital areas of a special and specific nature in relation to the integrated management and protection and tourism development of seashores. The Egyptian General Shore Protection Authority shall, in coordination with EEAA, exert supervision over coastal areas. It is prohibited to license the construction of any facility on the seashores except after obtaining the approval of the Egyptian General Authority for the Protection of Shores, in coordination with EEAA.

  The consideration and approval of requests for the licenses of the construction of any maritime, tourist or services projects, such as tourist villages, marine walkway, etc., that may affect the natural shoreline or any works that may modify its configuration either inwards or outwards, such as (seawalls and offshore breakwaters, headlands, ports, marines) through application shall be submitted in writing to the Ministry of irrigation and water resources, indicating the type of establishment to be constructed, attached with all requirement studies, designs and maps.

[2] This more often than not causes confusion for tourist developers.

- **Prime Minister Decree No.1599/2006 and its amendment by Prime Minister Decree No. 2299/2016.**

  The decree No.1599 in 2006 was concerned with the establishment and the structure of The Supreme Licensing Committee (LSC) which is responsible for discussing and deciding about submitted projects, within the marine environment or that located inside the 200 meters from the shore line. In 2006 the Minister Decree No. 2299 was issued in order to amend it and the committee to be enlarged so that it includes further members from other concerned authorities. The new structure of the LSC with the ministerial level of representation is supported by technical secretariat chaired by SPA / chief with membership of 2 representatives from each ministry included in the LSC but at lower level of representation. The technical secretariat will be in charge for examining the projects, preparing the necessary reports and giving its recommendation as to be presented to LSC.

- **Decree of the Minister of Housing, Utilities and Urban Development no. 144/2009, regarding the executive regulation of Unified Building Law issued by the law no. 119/2008**

  The decree states, land subdivision projects which are related to the lands with a special nature such as lands which are located by the waterfronts of rivers, seas, lakes or water streams must have supplementary rules for its subdivision process. The rules are being set through coordination with the related authorities such as EEAA. Accordingly, the rules include;

  - Performing lowlands backfilling and soil sampling analysis, choosing an adequate backfilling material and grading procedures.
  - Surface water disposal mechanism.
  - Providing access paths to the waterfront for landowners, publics, and rear lands owners.
  - Providing data for water's levels and depths and the slopes of the shore area.
  - Determining the specifications of water blocks, bridges, and dams which are used to prevent beaches erosion.
  - Determining all necessary markings and signs which indicate to prohibited areas for sportive activities.
  - States the special requirements which have been issued by the responsible agencies for water resources protection.

- **Presidential Decree No. 108/2000, on State-owned lands which lie within the Nile Valley and Delta, as a designated area for the establishment of new urban communities**

  State-owned lands which lie within the Nile Valley and Delta, as a designated area for the establishment of new urban communities in accordance with Law no. 59/1979, 7/1991. This area extends from a distance of 5 Kilometers south the international road to the cost of the Mediterranean Sea at the north, with the exception of lands lie within existing lands.

- **Prime ministerial decree no. 206/1997, on the area in Gamsa city, south of the coastal international highway in Dakahliya, as an industrial zone in accordance with the provisions of the Investment *Guarantees and Incentives law***

  The area in Gamsa city, which has an area of 727 acres and 14 carat, south of the coastal international highway in Dakahleya, as an industrial zone in accordance with the provisions of the Investment Guarantees and Incentives law no. 230/1989.

- **Prime Ministerial Decree no. 250/1999, Establishes a public free zone for warehouse projects in Damietta**

  Establishes a public free zone, which has an area of 445 acres, for warehouse projects in Damietta.

Conclusion

- It is clear that the protection of the coastal zone is on the Egyptian regulatory agenda. The Egyptian regulatory framework refers to ICZM, and has clarified the concept and coordination requirements in the amendments of the Environmental law. It also specified the agency responsible for such coordination as EEAA. However, the means and mechanisms for this coordination are left to practice rather than specified by regulation.

- Laws referring to the coastal zone are mostly targeting the performance of specific projects, whether individual ones or related to land subdivisions. They impose specific studies and require the preparation of EIAs. They, however, do not impose the same level of scrutiny and verification on the higher level of planning and policies. Accordingly, the issue of planning for sustainability, including the rational allocation of land uses taking into account the specific nature of the coastal zone, is not regulated. This, together with the allocation of land areas on the coast for multiple agencies to manage, has created a situation where an over-arching planning framework responsive to the needs and constraints of the coastal zone becomes more critical.

- Although the extent of the coastal zone is specified by law 9/2009, regulations mostly focus on the protection of marine waters from pollution and the protection of the shore line. The latter has historical reasons, as it became necessary to address erosion after the building of the Aswan high dam, which prevented natural nourishment of the shore in the Delta region. However, different regulations refer to the setback differently. For example, while laws 12/84 and 4/94 considers it necessary for protection, ministerial decrees regulating tourist developments seem to be leaning more towards the beach as a public amenity. It is obvious that different criteria lead to different results. It has been reported in an interview that governorates sometimes allocate land to investors with only 30 m setback form the coastal line, creating issues for both SPA and the investors, as well as projecting an image of unfair treatment for investors on which a wider setback is imposed.

- The coordination mandate of EEAA and the longer expertise of SPA have created a situation where the two parties have been allocated a joint responsibility for the management of the shore line and the setback area. This will be seen later to reflect on licensing procedures.

- Finally, as laws cannot specify all cases that could be faced, they rationally should be stating that rules do not necessarily apply in special cases. The example of law 12/84 where the procedures to grant exceptions to special projects in the setback area is a case in point. Policies should be set transparently by the agencies in charge to provide the link between law and practice. The updated executive regulations of the environmental law (prime minister Decree 1095/2011) give the authority to set such rules to the minister of environment in coordination with other competent authorities. However, the rules are still missing in the Egyptian regulatory landscape, resulting in longer procedures and a weakened perception of fairness which shakes the credibility of the law.

2.3. FRAMEWORKS, PLANS AND STRATEGIES

Since it was mandated the coordination of ICZM activities, EEAA has spent considerable effort to fulfill its responsibility, part of which was directed to producing guiding documents. It is obvious that EEAA is not the

only party in Egypt producing such documents related to the coastal zone. However, as will be seen, none of these documents seem to be institutionalized as providing the unquestionable reference to others.

- **Sustainable development strategy 2030**

  The latest major planning document was "Egypt's sustainable development strategy 2030" developed by the ministry of Planning in January 2014 and launched in 2016. The aim is to create a plan that would help in reaching optimal benefits from sustainable resource management and improving the life of Egyptians. The strategy was developed through a participatory approach which includes ministers, experts, private parties and researchers as well as a number of international organizations.

  It aimed to take into account all the efforts made by organizations and ministers and integrated it into one framework. It also set SMART objectives with realistic indicators and performance measurements.

  It assessed the current situation in Egypt in terms of economy and environment such as water, air, biodiversity, minerals, coastal ecosystem, wastes and international conventions Egypt participated in. In addition, challenges such as poor protection of the coast against climate change threats are noted.

  Projects in the document related to the North Coast clearly reflect the aim to develop and protect. These include:

  - The North West coastal project, which ranges from Alamein to Saloum, is part of the sustainable development strategy and has a target to construct roads and routes to connect it with the other governorate to enhance transportation and economic activities. It also aims to resolve the lack of energy by increasing renewable energy plants specifically solar energy as well as using nuclear energy in Dabaa. Land reclamation is part of the project due to existence of groundwater. The establishment of mining ports in this region is also planned as well as tourism development.
  - Coastal protection tools to preserve the Northern lakes and prevent erosion of the beach due to the increase of sea level.
  - Enhancing coastal and marine zones is a project to face challenges affecting coastal and marine areas such as oil exploration urban, industrial, agricultural, and touristic expansion through developing plans for sustainable tourism and through developing strict management. The strategy suggests a program to adapt to threats by climate change, and especially in densely populated areas, promote sustainable fishing, and sustainable tourism etc. in cooperation with the private sector and civil society.

  The document clearly aims at balancing between development and protection in a framework of sustainable development, and is meant to provide the vision and guidance for development during the scope of time it covers.

- **National strategy for adaptation to climate change and Disaster risk reduction**

  The Egyptian strategy for adaptation to climate change and Disaster risk reduction provided by Egypt's Cabinet Information and Decision Support Centre (IDSC) and the UNDP (2011) described the effects of climate change on water resources, agricultural sector, health sector, urbanization, coastal zones and tourism. The strategy aims to protect from and adapt to Climate Change as a defense mechanism against global warming with pre-fixed plans in order to be prepared for any natural catastrophe that might affect coastal areas. The plans will be set based on anticipation and meteorological scenarios.

  Climate change is affecting water resources, agricultural sector, health sector, urbanization and tourism. The strategy recognizes that multiple challenges are hindering the integrated management of

resources in Egypt such as population increase, socio-economic and lack of proper sustainable resource usage, pollution, poverty, lack of centralized policies. Different sectors (tourism, oil, industrial development etc.) have different goals and usage of coastal areas, which resulted of an increase in competition over coastal zones and their resources.

Suggested strategies to tackle climate change and sea level rise effects on vulnerable coastal areas include:

- Act according to the previously prepared plans
- Conduct full research on the success of the strategies planned
- Formulate laws on climate change for coastal development such as limiting coastal constructions, producing EIAs etc.)
- Setting permits with threshold limit for groundwater extraction
- Constructing sustainable protection bodies and strengthening previous ones such as shore coating, barriers to protect coastal cities and roads from sea water penetration
- Use artificial nourishment with sand to replace eroded beach zones
- Maintaining natural barriers such as coastal dunes and coral reefs.
- The strategy takes into account the uncertainty factor and the rise of the Nile flow
- Add construction barriers to prevent flash floods from entering economic or populated zones.
- It emphasizes on enhancing capturing and utilizing water from precipitation and flash flood to tackle agricultural issues.
- Enhancing forecasting capacity and GIS data base on coastal zones and include the demography, infrastructure , vulnerable zones and economy
- Based on the sea level rise due to climate change as well as the different goals of different sectors, the national committee for integrated Management of coastal Zones needs to enhance its resource exploiting methods in order to be sustainable and decrease contradicting goals by different sectors.
- Any development strategy needs to take into account the effects of temperature rise in order to reduce the risk of threats.
- Monitoring and follow up

The Adaptation Strategy to Climate Change thus addresses relevant issues to coastal development and management, and synergies between their respective targets exist.

o **ICZM Strategy**

In 2009, EEAA prepared in cooperation with the Priority Actions Programme Regional Activity Centre (PAP/RAC) of the Mediterranean Action Plan (MAP) a national strategy for ICZM in Egypt.. The strategy presented major challenges facing the country, namely:

- Impact of climate change (erosion, seawater intrusion, flooding);
- Destruction of coastal habitats;
- Degraded fishing resources;

- Irrational land use;
- Deterioration of water quality.

The strategy proposed three strategic objectives to overcome the previous challenges, under each objective a set of actions has been determined as follows;

Objective	Recommended actions
• Strengthening ICZM policy by better coordination	▪ Integrated decision-making ▪ Commitment of relevant stakeholders ▪ Streamlining of pivotal existing laws and regulation
• Planning a sustainable use of coastal resources	▪ Appropriate development of ICZM plans for each governorate / governorates (sub-national).
• Promoting stakeholders' awareness	▪ Stakeholders are informed regularly at levels of governorates and community about sustainable coastal development; ▪ Quality of coordination collection and communication of information and data exchange between stakeholders; ▪ Promotion for a capacity building programmes for ICZM institutional forces at all levels; ▪ Dissemination of coastal management practices (guidelines, directives, codes of practice, etc.).

Such document with its contents could have presented a corner stone for acting towards ICZM. However, although it was reported that the document has been presented to the Cabinet more than once, no official endorsement could be achieved keeping the strategy as a draft document.

Interviews with key stakeholders have revealed that most of them are not aware of the existence of this strategy. This is to be expected on an institutional level, as the strategy was not adopted, and on an individual level, the time elapsed since it was developed has surely seen individuals moving to different positions and some of those involved could have been retired.

It should be noted that although the strategy was not adopted, its principles were already reflected in geographically confined ICZM regional plans, for both Alexandria (Mariut Lake and Valley ICZM PLAN) in 2015 and Matruh-Sallum regions in 2012.

- **Urban Strategic plans**

  The General Organization for Physical (GOPP) Planning is the responsible authority for preparing the strategic plans for all levels whether nationally or regionally or locally. Accordingly, GOPP has prepared a significant number of regional strategic plans between 2008 and 2010, besides, the National Strategic Plan, which was developed in 2009.

  A strategic plan aims to set the future vision of inclusive urban development nationally, regionally (economic regions-governorates) and locally at the level of cities and villages. It clarify the major and secondary development goals, In addition to setting development policies and sectorial development plans which include economic, social and urban aspects in order to achieve the development vision. Accordingly, it addresses issues of urban' expansion as well as land use jurisdictions and ownership as well as urban development related programs and projects such as roads, infrastructure, proposing new communities, expansion areas specialized industries and needed services. This is in preparation for subsequent implementation plans, programs and priorities as well as mobility mechanisms and funding resources for implementation at each planning level and scale

It compiles sectorial development programs and projects form different governmental authorities and organizations in order to form an integrated, inclusive physical plan. Strategic plans also propose detailed studies which targets specific development sectors to be performed by the responsible authority or organization.

Accordingly, Strategic development plans are the planning documents in which a national ICZM strategy should be reflected. Although as seen above, a national strategy has not been formally adopted, a review of physical plans in Egypt's Mediterranean coast has been revised to investigate how far principles of rational planning and management of the coast are materialized.

The Northern coastal zone falls within three economic regions according to the strategic plans (Suez Canal Region-North Delta Region-Alex Region), each one of these regions contains a number of coastal governorates.

Coastal Economic Regions	Coastal Governorates
Suez Canal	North Sinai
	Port Said
North Delta	Dakahlia
	Damietta
	Kafr Al Sheikh
Alexandria	Al Beheira
	Alexandria
	Matrouh

Appendix III includes a summary of the regional strategic plans review. As it is rather challenging to summarize these large documents, the focus is on what environmental and social threats were identified and how these are addressed in the plan.

In general, major environmental issues were identified, both natural and anthropogenic, and actions to address them were proposed. However, the over-arching reference to the coastal zone sensitivity and vulnerability requiring special approaches to development is not highlighted. Similarly, means to resolve land use conflicts as a major challenge to sustainable development are not adequately addressed.

Most of the strategic plans were published between 2008 and 2010 while the ICZM strategy was developed in 2009, and the national strategy for adaptation to climate change and disaster risk reduction was prepared by IDSC and UNDP was published in 2011. The latter can hardly be reflected in plans that preceded it. The developer of the strategic plans, the General Organization for Physical Planning (GOPP), is aware of the ICZM strategy as it participated in the process of its development[3]. However, the ICZM strategy was not adopted and thus cannot be referred to as an official document.

It should be noted that the Alexandria and the Matrouh regions have both a strategic development plan and an ICZM plan developed. The comparison between these plans and regional development plans developed for the same regions will provide stakeholders with a means to appreciate the differences. The thorough comparison between these two documents is outside the scope of this scoping study.

- **National Environmental Action Plan 2002-2017**

  EEAA has prepared an updated National Environmental Action Plan "NEAP" in 2001 employing a participatory and consultative planning modality to reach consensus on issues and priorities, and directions for future actions. Six main issues were highlighted (Water, Air, Land, Waste, Global Environmental Issues, Supportive Measures). Programs and projects proposed to address these issues

[3] Interview with GOPP

included preventive and/or corrective measures and supportive measures. The NEAP includes a program for managing national marine and coastal zones. The main objectives of this program included establishing a dynamic process for national comprehensive coastal zoning (land and sea), and achieving sustainable use of marine and coastal resources through a combination of scientific research, appropriate quotas and regulations, active monitoring and enforcement, and pilot projects allowing the use of certain resources by local citizens.

- **The ICZM Framework**

  The 1996 framework program for National Integrated Coastal Zone Management Plan "NICZMP" was the first comprehensive document prepared by the national committee of ICZM (addressed in details in the next section) discussing ICZM in Egypt at national level. It highlighted important characteristics of the coastal zone and provided an overview of challenging problems and issues. It identified 4 key areas of concern:

  - Shoreline Erosion and flooding
  - Irrational land use
  - Water pollution
  - Deterioration of natural habitats

As a response to these problems the framework had proposed a medium term objective to develop 4 national strategies / plans:

A. National Shore Protection Plan
B. National Coastal Land Use Plan
C. National and Marine Water Quality Plan
D. National Coastal and Marine Resources Preservation Plan

These national plans were to provide guidelines for regional and local development strategies. Considering short term priorities, consequently, the following was proposed:

- Identify most vulnerable coastal areas (hot spots);
- Quickly develop a set of urgent measures to stop irreversible environmental degradation;
- Build capacity and enhance the role of the National Committee for ICZM;
- Research and data collection;
- Problem analysis;
- Plan/project formulation;
- Plan/project execution;
- Operation, maintenance and enforcement;
- Monitoring and evaluation.

The four proposed national plans could not been elaborated at that time. As will be seen below, the National Committee for ICZM rarely met and the proper coordination among its members was not at the requested level.

Other relevant documents:

A. Guidelines for the EIA study for river ports and marinas.(developed in 2010)

B. Guidelines for the application of environmental management systems for seaports. (developed in 2010)

C. Guidelines for preventing pollution from ships. (developed in 2010)

Conclusion

- Major planning documents have been produced by different parties, including EEAA, GOPP, IDSC and ministry of planning. However, the relation between these documents is not sufficiently clear and potential synergies are not capitalized. A case in point is the climate change adaptation and the coastal zone management documents, whereby the former clearly addresses issues providing planning criteria for the latter. However, the chronology of production of these documents reveals that the latter preceded, and thus did not have this advantage. Another example is that of the sustainable development strategy proposing plans to address threats from climate change with no clear reference to the adaptation strategy issued a few years earlier.

- Finally, the physical development plans have addressed the perceived environmental problems at the level of actions addressing each, but not a holistic way of providing governing principles of development of the coastal zone taking into account its sensitivity, and the developmental pressures to which it is subjected by the multiple interests of different actors, resolving or at least controlling the resulting conflicts.

- The pattern perceived in the review of planning documents seems to be the same detected in the review of regulations. While each plan producing agency does its best to address the challenges it perceives and build on the opportunities it identifies, the adequate reference to preceding documents and focusing efforts to upgrade and refine them seems to be missing.

- Within the multiple documents produced, the most imminent is the “sustainable development strategy 2030”. Naturally, this should be the guiding document for all specific plans whether on a geographic or sectorial levels. In this context, the multiple documents produced will need to be compared and homogenized based on an agreed common vision

III. STAKEHOLDERS AND INTEGRATED MANAGEMENT COMMITTEES

1. INSTITUTIONAL STAKEHOLDERS

The institutional map of ICZM has several stakeholders to which the responsibility preserving the coastal natural resources is assigned each according to its competent authority. The key entities engaged in the ICZM institutional map include the following;

1.1. Ministry Of State for Environmental Affairs

- **Egyptian Environmental Affairs Agency (EEAA)**

  In 1982 a presidential decree No. 631 were issued in order to establish an agency for the environmental affairs, which would be headed by the Ministerial Council. Consequently, the Law of the Environment (Law No. 4 / 1994) was issued and stated the organizational structure of that agency and its responsibilities and moved its affiliation to the Ministry of Environment. However, in 2009 the law was amended, giving the agency (EEAA) the responsibility of achieving the goals of the ICZM.

  According to the Law of the Environment (Law No 4 / 1994) EEAA was given specifically the authority to "participate with the concerned agencies and ministries in the preparation of a NICZMP for the Mediterranean Sea and the Red Sea coasts" and the responsibility of initiating and co-coordinating national ICZM activities.

1.2. Ministry of Water Resources and Irrigation

- **Shore Protection Authority (SPA)**

  SPA was established in 1981 by the Presidential Decree No. 261/1981 under the Ministry of Public Works and Water Resources (recently MWRI). The main responsibility of SPA is to manage the shoreline in those coastal areas, which have socioeconomic value or natural resource value that are threatened by erosion.

  The mandates of SPA on CZM until 1994 was on a quasi-exclusive basis and was ruled by Law No. 12/1984 concerning irrigation and drainage as well as CZM (articles 86, 87, 88, 97 and 99). Law No. 4/1994 has engaged a new dimension and partner to that mentioned under Law No. 12/1984 to include environmental concerns in shoreline management and introduced the new authority (EEAA) into CZM as well as introduced ICZM planning as a strategic concept towards sustainable development of Egypt.

  The core role of SPA in CZM is as follows:

  1. Design projects for shore protection and all studies for shore protection
  2. Issue license for projects located coast set back areas

- **Coastal Research Institute (CORI)**

  CORI was established in 1973 by the President of Academy of Scientific Research and Technology Decree No. 179/1973 under the National Water Research Center (NWRC), which established in 1975 as a research entity within the Ministry of Water Resources and Irrigation (MWRI).

  The core role of CORI in CZM is as follows:

  1. Monitoring and assessment of morphological changes of the northern coast.

2. Measuring and analyzing coastal processes.
3. Applying physical and numerical models.
4. Proposing appropriate concepts to encourage active implementation of ICZM.
5. Engineering design to protect urban and agricultural lands from sea attack.

1.3. Ministry of Transportation

- **Egyptian Authority for Maritime Safety (EAMS)**

  Presidential decree no. 261 /1981 on establishment of Egyptian Authority for Maritime Safety reporting directly to the Minister of Transport to replace "Ports and Lighthouses Administration".

  According to the seventh article of the previously mentioned Decree, EAMS among achieving its targets should share in drafting rescuing, searching and combating maritime pollution plans. Moreover, additional function under the eleventh article authorized EAMS where it can propose legal projects related to maritime rescuing and maritime pollution with monitoring authority for the implementation in close coordination with concerned authorities.

- **Marine Transportation Sector (MTS)**

  The Marine Transportation Sector, Ministry of Transportation, is located in Alexandria and is responsible for the following:

  - Supervision of the main executive activities in the Maritime Transport Sector Headquarters.
  - Supervision of the implementation of general plans and policies of the Ministry concerning the Marine Transportation Sector (MTS).
  - Adoption of executive plans and work programmes of the entire Sector and its affiliated units' activities on behalf of the Head of MTS.
  - Performance of actions authorized by the Head of MTS.
  - Contacting different agencies which are affiliates of the sector and coordinating with them to ensure satisfactory and regular work progress and improvement in performance rates.
  - Contacting different foreign bodies to represent the sector in international conferences and conventions in various maritime transport fields develop the MTS.

  It also works closely with the Harbor Authority in the area of environmental protection and EIA

1.4. Ministry of Tourism

- **Tourism Developing Agency (TDA)**

  The Presidential Decree No. 374 of 1991 has established the TDA with the aim to develop tourism area in the frame of the general policy of the state and its economic plan, where it has the authority in order to achieve its objectives, to do the following;

  1. Setting up plans for developing tourism areas;
  2. Preparing and reviewing the assessment of projects, studies and programs necessary for developing tourism areas, its approval

The main department within the Ministry of Tourism dealing with coastal zone management is TDA. TDA is the competent administrative authority for all tourist activities in coastal zone areas.

In practice, the TDA developed guidelines for coastal areas development activities and provided assistance for EIA studies including check lists and guidelines.

1.5. Ministry of Agriculture

- **General Authority for Fish Resources Development (GAFRD)**

The main Authority dealing with the coastal zone in the Ministry is the General Authority for Fish Resources Development "GAFRD". Since, Law No. 124/1983 has authorized GAFRD to implement the acts and decrees related to fish production activities, where it provides licenses for fish farms and fishing activities. Moreover, with regard to the marine pollution, article no. 15 is prohibiting without any prejudice, as required under any other law, the discharge of factories waste, agriculture pesticides and similar toxic or radioactive materials used in combating agriculture pest or industrial liquid waste in the Egyptian waters.

1.6. Ministry of Defense

- **Coastal Guard Department and the Naval Forces**

The Coastal Guard Department and the Naval Forces are the main responsible departments for all coastal activities within Ministry of Defense. The actual role for both departments is very important for coastal zone protection for checking licenses in coastal areas before any project can start any action. They are also working closely with the GAFRD / Ministry of Agriculture to check fishing licenses.

1.7. Ministry of Scientific Research and Technology

- **National Institute for Oceanography and Fisheries (NIOF)**

The National Institute for Oceanography and Fisheries is one of the research bodies which are affiliated to the Ministry of Scientific Research and Technology by presidential decree 498 for 1968, NIOF is the responsible institute within the Ministry of Scientific Research and Technology for the coastal area. The Institute undertakes research and develops databases for marine ecosystems and sensitivities which support the decision makers. It provides the government, investors, and research institutes with data on the coastal zone.

1.8. Ministry of Housing

- **General Organization for Physical Planning (GOPP)**

The General Organization for Physical Planning "GOPP" has been established according to the Presidential Decree No. 1093/1973 affiliated to the Minister of Housing. GOPP is responsible for the preparation of urban development strategic plans at the national, regional and local levels. Also is responsible for the investigation of ensuring the application of those plans", with the issuance of law No. 2008 / 119 and its executive regulations, GOPP became the state body responsible for the overall policies of urban planning and sustainable urban development. The Regional centers for planning and urban development in each economic regions[4] undertakes the mandates of GOPP in each region. Within each Governorate administration there is a physical planning department technically affiliated to Ministry of Housing and administratively to the Governor.

[4] Egypt is divided into 7 economic regions under the Presidential Decree No. 945 of 1977 (Greater Cairo, Alexandria, Delta, Suez Canal, North Upper, Central Upper, South Upper)

- **The Central Agency for Reconstruction**

The Central Agency for Reconstruction was established in 1975 as one of the main implementation bodies affiliated to the Ministry of Housing, Utilities and Urban Development. The head of the Agency's Board of Directors, together with two assistants, are assigned by the Minister of Housing. The Agency has a number of regional sub-agencies with the same responsibilities and authorities that serve to achieve the Agency's goals and roles in a specific region. However, each regional sub-agency could have a different agenda based on the characteristics of its region and its needs. Three of these sub-regional agencies have authority within the project's scope. These are namely;

1. Sinai Reconstruction Agency:

   To connect Sinai with the Delta and Nile Valley, so as to effectively end its isolation, being the eastern main defense line for Egypt.

2. The Middle Northern Coast Reconstruction Agency:

   To develop and reconstruct the Northern Delta Governorates extending from the western border of Port Said Governorate to The western border of Alexandria Governorate. The International Coastal Road is one of this agency's main achievements.

3. The North West Coast Reconstruction Agency:

   To implement the reconstruction projects according to The Urban Development Strategic Vision of the Western Northern West Coast.

Additionally, the Central Agency for Reconstruction has other responsibilities, including assisting ministries and governorates through overseeing the implementation of their projects, which would contribute to the achievement of urban, economic and social development goals of the state. The agency is also involved in the implementation of major infrastructure projects, such as:

- Construction of developmental roads.
- Participating in sanitation and drinking water projects.
- Establishment of new development communities in remote areas.
- Participating in the development of informal settlements.

1.9. Council of Ministers

- **National Center for Planning State Land Uses**

The National Centre for Planning State Land Uses "NCPSLU" was established by the Presidential decree No. 153/2001 for planning the uses of state land through full coordination among state agencies aiming at achieving the best possible use of the land. Furthermore, to pursue the development of the land, ensure its oversight against any infringement and studying major national projects in order to ensure the maximum returns. NCPSLU has among its mandates the following responsibilities;

a) Deliver to each ministry a map for devoted land uses where it has the full power alone to use, overseeing and developing;

b) Participate in the selection and determination process of sites for implementing major projects in the country (roads - rail ways – ports -economic zones, etc...);

c) Prepare detailed maps to plan outside state land uses in light of the general planning map;

d) Express an opinion on requests from different ministries and state agencies to amend the previously allocated lands or adding new land to the requesting entity;

e) Express an opinion on the dispute between the ministries, public bodies, units of local administration or between public bodies and the individuals on the identification of the competent authority responsible for managing, exploitation and disposition of state land allocated to these entities.

1.10. Ministry of State for Antiquities

The principal mission of the Ministry of State for Antiquities "MSA", previously known as the Supreme Council of Antiquities, is to protect and promote the cultural heritage of Egypt, both independently and in cooperation with national and international organizations. To achieve its goals, it formulates and implements all policies concerned with antiquities, issues guidelines and permits for the excavation, restoration, conservation, documentation and study of sites and monuments and manages a country-wide system of antiquities museums. MSA is represented in the Licensing Supreme Committee (LSC) through Central Dept. for Sunken Antiquities and recently in light of the Prime Minister Decree no. 2299/2016 the Minister of Antiquities himself is joining the committee

1.11. The National Agency for Development of the Sinai Peninsula

The National Agency for Developing Sinai Peninsula has been established in 2012 by the law decree NO.14, which was issued by The Supreme Council of the Armed Force, and to be affiliated to the presidency of the Ministerial Council. The Agency is as public economic authority aims to separate the planning and supervision procedures from the implementation process which is carried out by ministries and governorates. Accordingly, The Law has stated the Agency' funding resources and the whole responsibilities of the Agency, specifically Article 8 which aims to achieve a complete and integrated development in Sinai Peninsula.

Subsequently, the organizational structure for the Agency was defined by the Ministerial Decree NO.915 in 2012; also the executive regulation of Law NO.14 in 2012 was released in 2012 by the Ministerial Decree NO.959. However, an amended law No.95 was released in 2015 in order to adjust some of Law NO.14 in 2012 clauses.

1.12. General Authority for Suez Canal Economic Zone

In 2002 Law No.83 with issued regarding Economic Zones with a Special Nature in order to give a specific national zones or regions which acquire special economic resources or characteristics a better developing and management mechanism. Consequently, Suez Canal Special Economic Zone was the first economic zone with a special nature to be established in Egypt by Presidential Decree NO.35 for 2003. Mainly to utilize foreign investment, develop industries and export to earn foreign currency as well as to commit itself to the development of new and high technology industries; it is an experimental Zone for opening up and carrying out reform, establishing and improving the structure of the market economy in Egypt. As, it is intended to provide an attractive environment for medium and light industries as well as logistics services, thus enhancing economic activity in the region and creating new employment opportunities.

Therefore, in 2015 by the Presidential Decree No.330 the special economic zone's authority and area have been expanded from 90 km2 to 460 km2 in order to includes further ports and facilities, also, law NO.35 in 2003 was amended by Ministerial Decree No.2282 for 2015 in order to improve its organizational structure.

1.13. Coastal Governorates

The Coastal Governorates are sharing the process of implementing development plans through different departments within the Governorate administration since different departments technically affiliated to number of previously mentioned entities are located within the same premises, such as; Environmental Management Units and Physical Planning Departments, as well as other entities represented within the Governorate through regional offices or directorates, such as health, agriculture and irrigation. From a practical point of view, the process clearly reveals a very long chain of action and procedures among the Governorate and the concerned entities each of them within its focal area / concern. Coordinated action on the local level is crucial for this process, and as clarified in the next section, the executive council is the main vehicle for this coordination. It was clear through the interview with some coastal governorates such as Matrouh that the SPA branches are not consulted with the Shore Departments in the governorates.

Conclusion:

- The institutional framework of the coastal zone management in Egypt includes multiple ministries and entities. Each has a specific mandate supported by the regulations which established it and those it has the responsibility to implement/oversee.
- According to interviews, the coordination with other concerned entities is mainly undertaken through correspondences and meetings. However, the interviewees differed in the effectiveness of these tools; while some considered it effective others considered them ineffective. Although interviews did not go into these details, this seems to be related to the specificity of cases.
- The coordination function for ICZM among these entities is assigned to EEAA among its other responsibilities to preserve the environment including the coastal resources, which are also shared by other entities.
- However, coordination with EEAA is not mandated on other entities. This could be the reason for EEAA's effort to ensure coordinated/integrated action in the coastal zone not to be totally effective.
- As a result, a number of decisions reflect the contradictions that are likely to occur between the objectives of different entities, of which clear examples were mentioned during interviews. The lack of coordination is reflected in the fact that GAFRD under MALR is issuing permits for the construction of fish ponds within the borders of the Burullus Protectorate which are in clear violation with the legislation that applies to the Protected Area for which the Ministry of Environment is responsible. A major power plant was also established within the borders of the same protectorate. A whole-of-government decision needs to be taken within an effective governance structure whether this area should be protected, or not.
- On the other hand, at Alexandria Governorate a clear example of this conflict of interest is the Governorate widening of the Cornish Road through direct order without consultation with SPA. Such actions require that SPA acts towards correcting the situation from its side with legal actions. However, it is obviously easier to take such actions against private parties than against the Governorate.
- Public projects and decisions concerning for example land use problems are the ones that require higher coordination at the outset, as legal sanctions are in practice less applicable
- The need to improve coordination on the planning level is detected in both horizontally, between central organizations, and vertically, between those and organizations at the local level.

2. COMMITTEES

The proper planning and implementation of ICZM implies the participation of, and coordination among, the multiple entities which mandates extend to the coastal zone. The existing institutional framework not only

includes committees specifically focused on ICZM, but also committees closely related to this issue, even if not clearly stated in their specific mandate.

2.1. ICZM Committees

After promulgating Law No. 4 /1994 for protecting environment, the EEAA was given specifically the authority to "participate with the concerned agencies and ministries in the preparation of a NICZMP for the Mediterranean sea and the Red sea coast". With this mandate the Ministerial Decree number 173/1994 was issued to form the first National ICZM Committee, as a first step for coordination of ICZM planning. In 1996, Ministerial Decree No. 200 extended the composition of this National Committee by adding new members.

The NCICZM has reportedly met about ten times in eight years, and became inactive afterwards. The inactivity of this inter-agency committee means that the policy dialogue and consistency analysis between governmental stakeholders with different visions of the use of coastal areas is reduced, with apparent risk for continuous single sector and fragmented approaches to coastal management.

EEAA, as the focal actor had reestablished the NCICZM at the end of 2007 by ministerial decree number 266, after almost 6 years of inactivity ***(Appendix IV)***. Again, the national committee included almost all relevant ministries necessary to promote horizontal integration between ministries in relation to coastal conflicts.

The NCICZM in 2007 comprises top rank representatives of all concerned ministries with the participation of not only representatives from 20 entities representing the wide spectrum of governmental sectors involved but also including non-governmental actors, namely the following;

	Position	Member
1	Ms. Dr. / CEO of EEAA	President
2	Mr. / Chairman of the Egyptian Shoreline Protection Authority, as a representative of the Ministry of Water Resources and Irrigation	Member
3	Mr. / Head of Coastal Research Institute, as a representative of the Ministry of Water Resources and Irrigation	Member
4	Mr. /President of the Agricultural Research Center, as a representative of the Ministry of Agriculture and lands reclamation	Member
5	Mr. / President of the General Authority for Fish Resources Development	Member
6	Mr. / Head of Maritime Transport sector, as a representative of the Ministry of Transport	Member
7	Mr. / Chairman of the National Institute of Oceanography and Fisheries Department , as a representative of the Ministry of Higher Education and Scientific Research	Member
8	Mr. / Head of agricultural applications, soil and Marine Sciences Division, as a representative of the Ministry of Higher Education and Scientific Research - Remote Sensing Authority	Member
9	Mr. / Head of the General Organization of Physical Planning, as a representative of the Ministry of Housing, Utilities and Urban Development	Member
10	Mr. / Chief Executive of the General Authority for Tourism Development, as a representative of the Ministry of Tourism	Member
11	Mr. Brigade Admiral / Chief of Staff of the Navy, as a representative of the Ministry of Defense	Member
12	Mr. / assistant head of the industrial safety and environment representative of the Ministry of Petroleum	Member
13	A representative of the National Security Authority	Member
14	Representative of the Private sector chosen by Mrs. Dr. CEO of EEAA	Member
15	A representative of the NGOs chosen by Mrs. Dr. CEO of EEAA	Member
16	A relevant expert chosen by Mrs. Dr. CEO of EEAA	Member

	Position	Member
17	Mr. / Head of nature protection sector - EEAA	Member
18	Mr. / Head of the quality of the environment sector - EEAA	Member
19	Mr. / Head of Environmental Management sector	Member
20	Mr. / general manager of integrated coastal management and lakes	Member

The function of the committee was not only to draw-up a consistent policy and strategy for the future development but also to resolve conflicts between users' interests with further assignments as follows;

- Coordinate all coastal activities between the competent authorities and involved stakeholders to achieve an ICZM, through drafting and setting general guidelines for all activities that are planned to take place in the coastal area, as well as conducting EIAs;
- Make sure that all land use plans and development activities in the coastal areas take into account emergency arrangements;
- Harmonize between proposed development activity and the carrying capacity of the ecosystem in order to achieve sustainable development;
- Participate in drafting and preparing an ICZM plan to be presented to the board of directors of the Environmental Affairs Agency;
- Ensure efficient implementation of the commitments of the Egyptian government to regional and international conventions concerning the protection of marine environment and the coastal areas;
- Revise and approve programs and plans aiming at restoring and rehabilitating coastal ecosystem which suffered from environmental stressors caused by previous practice errors;
- Coordinate and specify mandates for different authorities in the coastal area;
- Approve national arrangements related to the protection of the environment and contingency plans in the coastal area prior to presenting it to the board of directors of the Environmental Affairs Agency;
- Study and evaluate all projects to be executed in the coastal zone, especially projects that may cause conflict of interest between ministries in order to reach a suitable final decision;
- Study any activities or projects relevant to ICZM;
- Provide opinion concerning the participation of Egypt in regional and international agreements and relevant protocols regarding ICZM;
- Provide opinion and review proposed national legislations executed for the regional and international agreements that Egypt is part of;
- Follow up with studies and precautionary procedures concerning the effect of climate change on sea level rise;
- Follow up with procedures concerning the protection of the marine environment from inland pollution sources;

The NCICZM is a coordinating body without major regulatory/administrative power or funding to actively promote ICZM issues. With each mandate, it was, inter-alia, expected to coordinate all coastal activities between the competent authorities towards ICZM, draft guidelines, prepare an ICZM plan, study and evaluate all major projects to be executed in the coastal zone, and resolve conflicts between ministries or other governmental bodies while reaching a final decision.

The Ministerial Decree establishing the committee stated clearly that NCICZM should meet once every three months. In reality, NCICZM had held one meeting from its setup to date in January 2009.

Similar to the lack of awareness of key stakeholders of the ICZM strategy, interviews have revealed that most of them are not aware of the NCICZM. This is obviously expected given its lack of activity. Some of the interviewees even expressed their surprise that this committee would exist, as it was perceived to replicate the work of the licensing committee addressed below[5].

2.1.1. The Supreme Licensing Committee

The Committee is structured under the Prime Minister decree No. 1599 of 2006 to discuss and decide about submitted projects, within the marine environment or that located inside the 200 meters from the shore line. It includes the following entities;

Ser.	Representative	Entity	Role
1	• MWRI Minister		Head
2	• SPA Chief • Head of Central Dept. for Researches and Studies • Representative from Investment Group for Shores Protection	MWRI	Reporter
3	Head of Environmental. Quality Sector	EEAA/MOE	Member
4	Head of Central Dept. for Environmental Affairs	TDA	Member
5	Representative	Armed Forces Operations Authority "AFOA"	Member
6	Head of Central Dept. for Sunken Antiquities	"MSA"	Member
7	Representative	"CG in which the project is located"	Member
8	Representative from Urban Planning General Authority	MOH	Member

The composition of the committee could be enlarged to include further members from other concerned authorities based upon the request from the committee reporter. After considering the opinion and feedback from all concerned entities,

The LSC used to meet on a monthly basis, or as needed, at the premises of SPA However, Since August 23rd, 2016 the Prime Minister has issued a new Decree No. 2299 modifying the structure of the LSC ***(Appendix V)*** to be in the following representation;

Ser.	Representative	Ministry/Entity	Role
1	Minister of WRI	Ministry of Water Resources and Irrigation "MWRI"	Chairman
2	SPA Chief	Ministry of Water Resources and Irrigation "MWRI"	Reporter
3	Minister of Environment	Ministry Of Environment "MOE"	Member
4	Minister of Housing	Ministry Of Housing "MOH"	Member
5	Minister of Antiquities	Ministry Of Antiquities "MOA"	Member
6	Minister of Local Development	Ministry Of Local Development	Member

[5] The difference between a planning and a licensing committee was clarified

		"MOLD"	
7	Minister of Tourism	Ministry Of Tourism "MOT"	Member
8	Representative from Military Forces	Ministry OF Defense "MOD"	Member
9	Governor of the Coastal Governorate	Coastal Governorate "CG"	Member

The new structure of the LSC with the ministerial level of representation is supported by technical secretariat chaired by SPA / chief with membership of 2 representatives from each ministry included in the LSC but at lower level of representation. The technical secretariat will be in charge for examining the projects, preparing the necessary reports and giving its recommendation as to be presented to LSC. This new Decree addressed a number of concerns:

- The engagement of the Minister of Local Development, who was not represented in the previous committee;
- The presence of the technical secretariat which in reality reflects the old structure of LSC under the Prime Minister Decree No. 1599/2006 with doubling the number of its members, since every entity is now represented by 2 members. Such structure can be seen as adding another layer in the administrative cycle, but could also be perceived as a separation between decision making and decision taking. In both cases, it is expected to , require additional time, details and documents;
- The presence of time limitation of three months as maximum duration for the committee to give the final decision regarding the submitted projects, this limitation was not mentioned in the old Decree for the previous LSC. This time limit will encourage the committee to give the final decision within official timing which in turn will minimize the overall time.

However some interviewees have clearly expressed their enthusiasm about this new composition of the LSC saying that this higher level of representation avoids the hesitation the previous LSC membership have had in taking decisions, some other interviewees believe that the composition of the old committee was more effective when it included the representatives of ministers that was more efficient and effective as the ministers are difficult to have convenient dates to meet.

2.1.2. The Supreme Council for planning and development

The Supreme Planning Council is an expressive example of committees not specifically related to ICZM, but which mandate clearly intersects with the issue.

Under the building law number 119 for 2008, the supreme council for urban planning and development has been established by a presidential decree number 298 for 2008, which was restructured later by a prime ministerial decree number 1754 in 2014[6], in order to involve a wider range of competent ministries to urban development.

The council is chaired by the Prime Minister and consists of the membership of the competent minsters, heads of the bodies authorized with urban development and use of State land, as well as ten experts specialized in the relevant issue minimum half of which shall not be civil servants chosen by the competent minister as shown in Table (1).

Table (1): The Organizational structure of the Supreme Council of Planning and Urban Development

Members	Members
The Prime Minister	The Council President
Minister of Defense and Military Production	Competent Ministers

[6] In principle, a prime ministerial decree should not modify a presidential decree . However, this is based on the delegation by the president of some presidential function to the prime minister

Members	Members
Minister of tourism	
Minister of Industry and Commerce	
Minister of Local Administration	
Minister of state of Upgrading Urbanism and Informal settlements	
Minister of Housing, Utilities and Urban Development	
Minister of Culture	
Minister of Environment	
Minister of Higher Education and Scientific Research	
Minister of Agriculture and Lands' Reclamation	
President Of The General Organization Of Physical Planning	Competent Authorities
Director of The National Centre For Planning State Lands Usage	
A Group of Ten Specialized Experts in Urban Development Issues	

The council has been established for the purposes of achieving the goals of urban development, coordinating between the bodies concerned with planning and urban development and linking between the state's economic development plan and urban development plans. However the council acquires many other responsibilities and competencies the most related are stated as follows;

- Approve the general goals and policies of the urban planning and development as well as the civil coordination at the national level.
- Coordinate between the ministries and bodies authorized with urban development and uses of state lands to prepare and implement the national strategic plan.
- Approve the identification of the areas of special value and adopt the restrictions and standard followed in identifying the same as well as maintenance programs, implementation priorities and mechanisms and sources of finance upon recommendation of the Minister of Culture.
- Propose and express the opinion in draft laws related to urban development.
- Evaluate the general results of implementing the national strategic plan.

It is noted that areas of special value are stated to have a different treatment, in terms of restrictions and standards. This is basically needed for the coastal zone. However, specifying these areas based on recommendation of the minister of culture reveals that these areas are only confined to urban areas with special historical or cultural value.

2.1.3. The Governorate Executive Council

At the local, governorate level, the main vehicle for the coordination of actions of the different entities represented locally is undertaken through the monthly meeting of the executive council. The council is headed by the Governor and includes in its membership the secretary general, the governor's aides, the heads of cities and markazes. It also includes all heads of departments and directorates in the governorate. This is where the development plans of the governorate are followed up, where all issues related to coordination between different departments and directorates are discussed, and conflicts addressed for resolution. However, in some cases, conflicts have to be resolved at the central level, between ministries. In other cases, the institutional arrangement itself could be the source of conflict. A clear is that is some coastal Governorates have a "Coastal Department" which is totally affiliated to the Governor and not to SPA. Decisions are taken without consultation with the organization mandated the protection of the coast.

2.1.4. Other Committees

The Marine Transportation Sector (MTS) convenes two committees with representatives from ports authorities, the first is permanent technical committee for issuing permits for dumping the dredging wastes and other materials in the Egyptian waters, and the second is committee for issuing permits for specialized seaports and also operation, management and supervision of the implementation the terms of safety and preservation of the marine environment.

Conclusion

- Committees and Councils are the typical vehicle applied for coordination in Egypt
- The ICZM national committee structured under the chairmanship of EEAA and with the membership of all concerned authorities is a vital tool that was meant to achieve the streamlining of activities of the multiple concerned entities The presence of representatives from each line ministry is very useful where the cross cutting feature of ICZM require the interaction among all concerned entities.
- However, the inaction of this committee is remarkable, and the reasons for this inaction seem to be clear. A committee is an effective streamlining mechanism between various different entities to achieve a common, and agreed, objective. However, it can never play the more basic role of unifying the vision and aims of multiple entities. With the lack of an agreed reference document; which should have been the ICZM strategy, the scope of conflict that the committee is required to resolve is higher than what a committee can handle. Accordingly, it can be unproductive or, as seems to be the case, not meet. An agreed strategy seems to be a necessary condition to re-activate this committee.
- Moreover, the means to reflect decisions taken by this committee should be clarified , as well as the relation between this committee and others, such as the Supreme Planning Council, that are meant to be more closely involved in the physical planning, including that of the coastal zone, where constraints and guidelines should finally take shape.
- Finally, coordination at the local level can hardly be achieved without talking into account the existing mechanism of the executive council at the governorate level

IV. ADMINISTRATIVE PROCEDURES FOR COASTAL PROJECTS

According to the legal instruments governing coastal development, it is prohibited to issue building permits for the construction of any establishment on the coasts of the Arab Republic of Egypt at a distance of two hundred meters inwards from the shoreline, except after obtaining the approval of the SPA, in coordination with EEAA. The administrative procedures that should be followed in order to approve the development of coastal projects are mentioned in the executive regulations of Law No. 4/1994 amended by law No. 9/2009 under article 59, the procedures that should be followed respectively are as follows;

1. The applicant should submit a written application to the coastal governorate "licensing authority" indicating the type of establishment proposed to be constructed within the prohibited zone "200m inwards from the shoreline", attached with an EIA study of the project or the new works required to be carried out, including their effect on the environmental balance of the coastal area, on the shore line and in particular on the following factors:
    - Erosion
    - Sedimentation
    - Coastal currents
    - Pollution resulting from the project or works

The application shall include a detailed statement of precautions proposed to avoid or treat these effects, if any.

2. The licensing authority shall forward the application to SPA to express its technical opinion towards the project, in coordination with EEAA.
3. The licensing authority shall also forward the EIA study of the project to EEAA for reviewing and expressing opinion within 30 days maximum starting from the date of receiving the said study.
4. In parallel, the application has to be presented to the LSC structured under the Prime Minister decree No. 1599 of 2006 for expressing opinion in light of the recommendations from EEAA, SPA and other concerned authorities.
5. After considering the opinion and feedback from all concerned entities, LSC could issue an approval accompanied with certain conditions to be implemented by the applicant, or could refuse the case.

The complete administrative procedures are presented in Figure 1 below, from practical point of view further approvals and studies may be required according to the features of submitted projects. Three different categories of coastal projects have been used below as examples for which comprehensive procedures are examined in order to highlight the requirements for each category; the three categories of coastal projects targeted to be examined are namely the following;

- Coastal projects where construction works are required "dike or dredging"
- Coastal occupancy to develop urban areas in the coastal front
- Environmental projects without construction "discharge license"

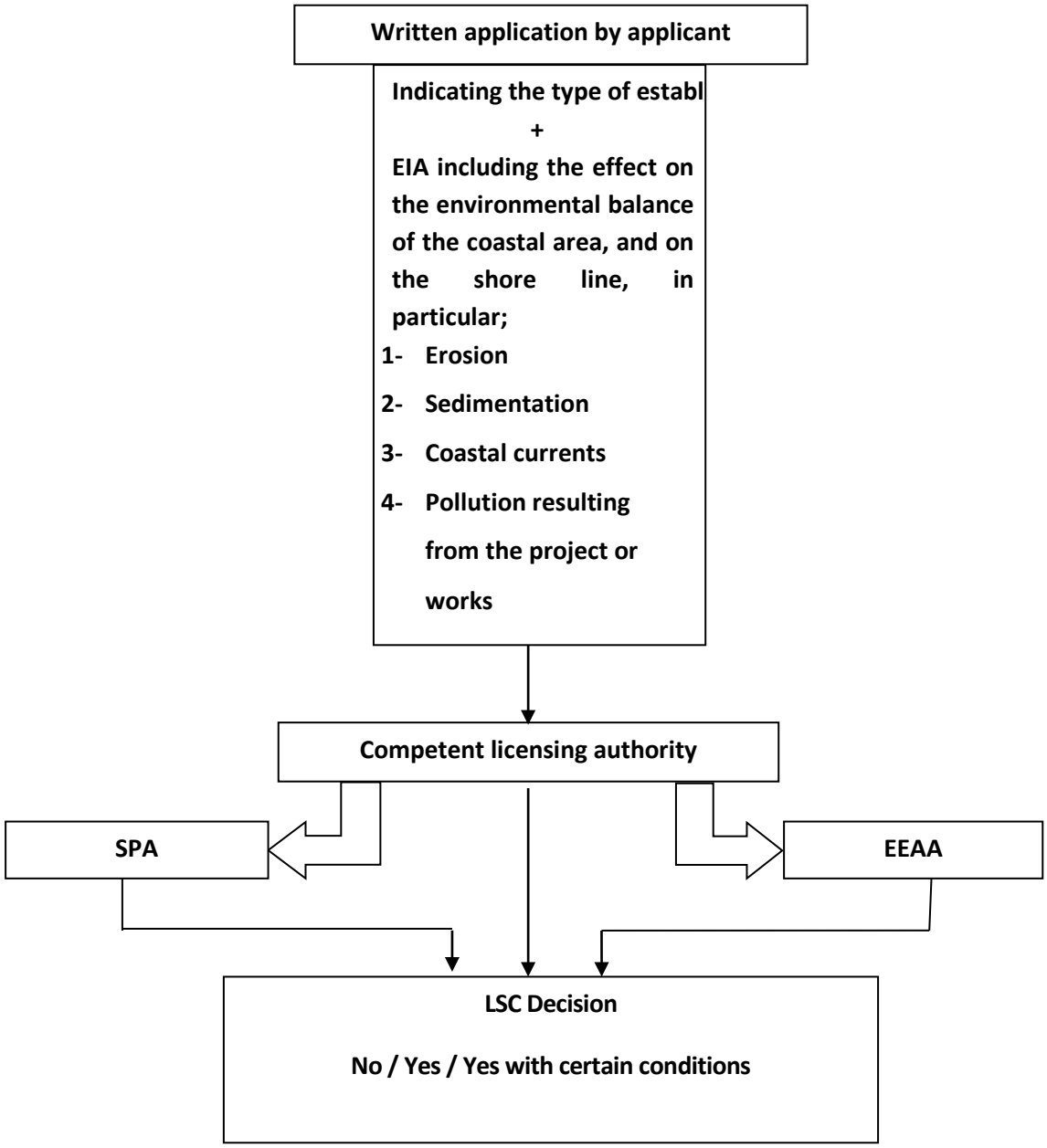

Figure 1: Project Licensing Administrative Procedures / Cycle

A. Coastal projects where construction works are required "dike or dredging"

The previously mentioned procedures starting from submitting written application to the competent licensing authority will be followed in such cases. The application should be accompanied by an EIA study. The EIA have to include among its sections the following;

1. The effect on the environmental balance of the coastal area and on the shore line, in specific;

a. Erosion
b. Sedimentation
c. Coastal currents
d. Pollution resulting from the project or works
e. Detailed statement of precautions proposed to avoid or treat possible effects, if any.

2. Water Dispersion model;
3. Bathymetric map;
4. Maritime environment profile of the zone area.

EEAA while reviewing the EIA study, Armed forces operations authority approval would have to be secured by the applicant, in reality this approval includes the feedback from three internal departments within the military institution, namely;

- Military Security dept.;
- Borders Guards; and
- Maritime Forces.

Unless this approval is secured, EEAA approval would be impossible.

In parallel to reviewing the EIA within EEAA, a separate application will be sent to SPA to express its opinion towards the project. After receiving the feedback by LSC from both EEAA and SPA the case will be sent to LSC to decide about in light of the feedbacks and available studies. The LSC has three options in responding;

1. Refuse the request for licensing;
2. Request more studies or information ; and
3. Approve with certain conditions to be followed at the implementation level.

Following the decision by the LSC the case should be sent to the Minister of MWRI for taking the decision, which in turn the SPA / Chief will be in charge to inform EEAA and the licensing entity about the final decision.

B. Coastal occupancy to develop urban areas in the coastal front

The nature of this project will follow the same procedures mentioned under projects of category C. In case the project includes as one of its components, coastal works (dredging or a dike), all previous documents should be included in the EIA study in addition to the following;

1. Cadastral maps;
2. Military survey maps;
3. Financial budget allocated for planned works;
4. Contour maps highlighting the earth attribution / levels;
5. Flood Protection actions study, in case the project area is near from flood zone.

The previous administrative cycle will be followed typically till the final decision form the LSC.

C. Environmental projects without construction "discharge license"

This type of projects will follow also the same procedures mentioned under projects of the categories above. The technical appendix of the executive regulations of Law No. 4/1994 amended by Law No. 9/2009 has clearly determined in appendix "no. I" the specification and limits of the discharged water contents (COD, BOD etc.....) to ensure its quality and to avoid any impacts on the marine environment. The technical specifications for the discharged water quality should be considered in the EIA study.

An environmental monitoring plan should highlight the timeframe and progress for conducting continuous monitoring. Furthermore, if swimming activity is allowed at the area of discharging, the water quality should comply with the specification mentioned in the Minister of Health Decree No. 64/1996, the full specification of discharged water is reflected in the Minister Decree appendix to the report (appendix IV).

The administrative procedures and supporting documents requested for obtaining the license for the three categories of coastal projects are seen to be similar. As for the time spent since the day from submitting the application until obtaining the license or receiving the final feedback, according to Law No. 4/1994 amended by Law No. 9/2009, a duration of 30 days is the maximum period available for EEAA to review the EIA study and express its opinion. In the case of missing document or essential part within the EIA structure an official completing request will be issued by EEAA launching a new duration of 30 days.

No response within this duration is considered an implicit approval from EEAA.

In parallel to the EIA process the screening action by the LSC is also considerable, especially in light of the new Prime Ministerial Decree limiting the duration for expressing its feedback by three months as the maximum period starting from receiving the case from the technical secretariat. Finally, the quality of the documents submitted, including all required documents and obtaining all the above approvals are the major factor controlling the spent time for the licensing process.

Conclusion

- The licensing procedures for different coastal projects have a very high similarity as it focuses on the protection of the shore line, and the marine environment. It reflects the duality of responsibilities between governmental agencies, namely in this case EEAA and SPA.
- An Important issue in this process is the confusion related to the sequence of decisions, as the representative of the EEAA is a member of the committee, while EEAA will not approve the submitted EIA unless the LSC express the primary approval on the project.
- The agreement to bring relevant parties in a single committee for collective decision making promised to be a good approach to streamline the procedures. However, the confusion still exists as more than one document is required from the project promoter, an EIA and a shore line study, submitted to different entities, while the decision is in fact taken by a committee in which both are represented.
- Moreover, as it was already mentioned under chapter 3, the exceptions for special projects in the setback area permitted by the law are not adequately specified through transparent policies. The case is again a trial to resolve conflicts, and legitimate interests of different parties, through establishing a committee in which conflicts should be resolved. As is usually the case, the lack of policy guiding the laws to be implemented, even-though, the SPA has already proposed a set of criteria concerning constructions close to the shore and has specifically defined a "Setback line "that separates the beach from any permanent constructions but could include possible environmentally friendly installations (Appendix VI). It is expected that this is the process through which the level of the LSC has been raised to ministerial level.

V. KEY ISSUES IN COASTAL MANAGEMENT

The previous review has shown the evolution of regulatory tools either on the regional or national level. Since the beginning of 1980s actions towards protecting the coastal zone through achieving the ICZM has been launched; several conventions and protocols have been drafted and adopted by member states. In parallel, at the national level, local efforts were exerted to manage the emerging issue and laws governing the coastal zone, to assign different roles to concerned entities and to issue plans and strategies. This review in the previous chapters, complemented by the knowledge acquired through interviews with key stakeholders, has delineated the institutional and legal system relevant to ICZM in Egypt.

In general, although good efforts have been expended to promote ICZM, practically it has a weak reflection on the ground further than shore protection works and efforts to control the impacts of specific projects through the licensing process including EIA procedures. The cumulative impacts of multiple projects are not addressed at this level, as this rationally has to come at a higher level of planning, land use and policy governing the actions along the Egyptian coastal zones.

This chapter builds on conclusions of the previous ones. It not only provides an understanding of the causes for stalled progress in the ICZM agenda, but also identifies points on which future progress could be based.

1. LIMITED KNOWLEDGE

Interviews have revealed the need to increase awareness of the definition of the coastal zone. Although the latest amendments of the Environment Law provide a clear definition, it did not trickle down to practical applications, and thus is not in the scope of the interviewees direct interest.

The limited knowledge thus extends to what this general definition really means for the specific governorate. It was noted in both Port Said and Damietta that according to this definition, the whole, or at least most of, the respective governorates are within the coastal zone. This definition needs to be reflected on the ground, and be refined/revised as needed.

For executives not involved in environmental issues, this limited knowledge also extends to the ICZM approach. Although during the interviews and discussions, it was always agreed that the coast has special features and pressures which would justify a special approach to management, ICZM seemed to be an alien concept, that brought with it sometimes worries of higher interference from central agencies.

Most interviewees in the coastal governorates are not aware of the statement in the executive regulations of the environment law that each governorate should establish a local committee for ICZM. This is to be expected as a direct result of the dormant status of the NCICZM of which the majority of the regional executive interviewees are also not aware. The specific role of the NCICZM in terms of policy and strategies is also not clear to all interviewees. More than one suggested that it is merged with the Licenses Supreme Committee (LSC), based on the presumed similarity of tasks and objectives. The raising of the LSC membership to ministerial level increases this confusion.

Finally, as the ICZM strategy was not ratified, the knowledge about its existence was not to be expected. In general, we can conclude that although efforts have been done, mostly at the central level, to establish the NCIZM, to draft a strategy and to provide legal backing, this is not adequately reflected on the ground. As one interviewee puts it, one cannot expect commitment prior to awareness and knowledge.

2. THE CRITICAL NEED FOR COORDINATION

As often mentioned in interviews, the multiplicity of actors affects the potential achievement of coordinated actions in the coastal zone, especially as related to the multiple land jurisdictions (governorate, Military, agriculture reform, TDA, EEAA, etc.). Nevertheless, a large number of administrative and decision making entities which mandates extend to the coastal zones seems unavoidable. However, having these entities acting based on different objectives and different regulatory instruments is a substantive cause of conflicts. The issue of inter-organizational conflicts was highlighted by interviewees, on both a horizontal level, between organizations of different scopes, and on a vertical level, between central and local organizations. It was generally agreed that proper coordination, clear planning and determining the roles for each entity, is a must for integrated management, without which bureaucracy and the long governmental procedures within each entity are real challenges facing both ICZM, investors and communities.

The focal issue is that without adequate integration and improved coordination it is not possible to avoid overlapping and/or conflicting decisions. Environmentally sound and sustainable development is by definition based on multiple criteria decisions, and single criterion decisions have more likely than not serious impacts on aspects not integrated in the decision. Institutional coordination might need to be regulated through setting modalities, means to agree on objectives, strategies and plans as well as the provision of information to concerned parties.

3. CENTRALIZATION, AN UNLIKELY APPROACH TO COORDINATION

None of the interviewees has considered the centralization of functions in a single agency as a proposed approach of choice in Egypt. Centralization has been historically adopted in Egypt in organizations implementing national projects, such as the Aswan High Dam in the 1960's, and recently for the Development of the Suez Canal Region. The advantages of centralization could include a focused vision, fast execution and efficient decision-making, easy coordination and limited conflicts.

Two authorities of a different nature currently apply a centralization approach. The first is the SCZone working under law No. 83 in 2002. This is an application of the centralization approach to coordinated actions as all relevant laws are implemented by SCZone in its designated geographic scope. The SCZone is affiliated directly to the prime minister which gives additional power to its decisions and overcoming the obstacles. The second is The National Agency for Development of the Sinai Peninsula which is also affiliated to the prime minister and work under the law No. 14 issued in 2012.The law declared the agency as a public economic authority, and aims to separate the planning and supervision procedures from the implementation process which is carried out by ministries and governorates. This gives the agency a coordinating function between all concerned entities. It does not have the same level of authorities of the SCZone concerning permitting and licensing. Nevertheless, it actually coordinates between all concerned agencies through planning and supervision. However, as The National Agency for Development of Sinai Peninsula and North Sinai governorate was not able to meet the consultant to date, the means and effectiveness of these arrangements could not be confirmed.

Nonetheless, centralization of the integrated coastal zone management in Egypt seems not to have been perceived as a valid option. Given the wide geographic area it covers, it will run against the current interests of multiple and well established institutions with specialized scopes working under much different legislation, as explained above and confirmed by interviewees. This will entail time and effort needed to overcome the resulting organizational resistance, as well as the investments needed to build organizational capacity, as not a single agency would have the full scope of knowledge and expertise needed in this respect.

4. STRENGTHENING OF THE NCICZM

The NCICZM was seen as a pivotal means to improve coordination, and avoid the complexity of a centralization approach. There was thus a keen interest to propose ways for its activation, based on perceptions of what could have prevented it in the first place. The proposals revolved around strengthening it in terms of membership and organizational level.

It was suggested that a committee established by the Prime Ministerial decree, as opposed to the current configuration by ministerial decree, will be much stronger to commit the different stakeholders for the integrated coastal management. The committee could be headed by development, rather than environment-related actors, and the Ministry of Local Development was proposed.

The membership of the committee was proposed to be extended to include the National Center for Planning State Land Uses (NCPSLU) as the economic and urban development translates to land-uses and the NCPSLU mandate is to guarantee complete coordination between state authorities to achieve the best exploitation of state lands. Other parties, reflecting a strong presence on the ground, were also proposed including the National Company for black sands, the National Company for fish farming, and mining sector of the Military National Service Organization.

The extended membership of the NCICZM was not universally agreed, as some interviewees perceived one of the problems that might have prevented its activation is its size together with its ministerial level membership. The time its members can put is thus limited.

The configuration and membership of the re-established NCICZM should be considered in the following phase. However, it is questionable whether these will be sufficient to activate it, as some national committees have been inactive although established by prime ministerial decrees[7]. Without addressing the reasons preventing the NCICZM to date from being an effective vehicle, it will be short-lived, falling back into inaction.

5. PREREQUISITE TO ACTIVATE THE NCICZM

Prior to considering membership and organizational level, some interviewees perceived the issue in a more strategic way which seems to suggest very clearly that although a number of building blocks are available, including the NCICZM, the main integrator between these building blocks - a whole-of-government vision for the coastal zone - is missing, resulting in a low effectiveness of the efforts expended in this respect. According to this view, an initial consensus among different stakeholders on the coastal zone management strategy and the coordinating rules as well as their respective roles, and responsibilities must be clear for a committee to operate. It is unproductive to bring conflicts to the table without ensuring that a common reference is shared among the parties

This whole of government visions should have been provided by the ICZM strategy, if ratified and adopted. Accordingly, a major effort should aim at considering the reasons it was not, and consequently what should be done to achieve consensus on this critical document. It might be advisable to address this deficiency in two consecutive steps. First, a national vision for the coastal zone should be announced by the highest authorities, and only them. Then, to develop a national ICZM strategy, building on the one EEAA developed in 2009, to be updated based on an announced vision and the developments on the ground over the last few years.

Finally, the common practice of separating between the steering committee of an activity, in this case re-issuing the ICZM strategy, and the committee activated in a subsequent implementation phase has proven to

[7] For example, the Supreme Energy council especially before the national energy strategy was adopted.

be unproductive and should be avoided. Accordingly, the NCICZM during the former phase is proposed to play the role of a steering committee, being fully aware that their agreement on the strategy binds their respective organizations during the latter phase.

6. REFLECTING THE SPECIFICITY OF THE COASTAL ZONE ON LAWS AND PROCEDURES

In order to make a real difference on the ground, policy and planning documents obviously need to be clearly reflected on the day-to-day work of executive agencies and communities. It was clear through the interviews with the stakeholders and number of representative coastal governorates that, there is no legal or administrative differences between governorates as all of them are working under one legal and institutional framework mainly the local administration law and the other specialized regulations. Several tools and means to transpose principles to actions were proposed by interviewees, which included:

- The licensing committee is formally added to the current three licensing committees (Environment, Occupational Safety and Health, and Civil Defense) for construction and operation of any project in the coastal zone, and not only for those interacting with the shore line.
- Special regulations according to the nature of development and sensitivities of the coastal zone need to be issued. These will provide a much needed guide for adequate planning and transparent licensing and will also ensure the effective protection of the marine and coastal environment:
- This legal revision is proposed to be deeper than practical needs for implementation to reflect ICZM concepts in light of the Constitutional mandates and the Sustainable Development Strategy 2030, considered by an interviewee as a golden opportunity to promote sustainable development in general.
- Establishing a unified law for the management of transactions in the coastal zone.
- Considering existing law violations, when planning for the full ICZM.
- Although not addressed by interviewees, this legal revision should also consider national commitments related to regional and international conventions, including
    - broader provisions on the protection of the marine environment based on the UN Convention on the Law of the Sea (UNCLOS), is the fundamental global framework for all activities related to oceans and seas;
    - Legal principles related to: sustainable use, prevention, precaution, polluter pays and public involvement, etc… should be instituted.
    - Provisions of marine biodiversity, such as ecosystem approach and integration of considerations linked with the establishment and management of marine protected areas and wetlands, in light of the following conventions to which Egypt is a party: Convention on Biological Diversity, Ramsar Convention on Wetlands, Bonn Convention on Migratory Species and its regional Agreement on the Conservation of African-Eurasian Migratory Water birds, and the World Heritage Convention;
    - Integration of concerns related to adaptation to climate change (including coastal erosion and beach protection, sea-level rise, etc.), in accordance with the UN Framework Convention on Climate Change (UNFCCC), to which Egypt is a party ;and

- A flexible mechanism for updating the Egyptian legal framework on marine and coastal protection in light of periodic amendments of relevant international conventions, as soon as these are ratified by Egypt.

This is surely not an exhaustive list of potential means and tools, but the principle needs to be considered more thoroughly in a subsequent phase following the current scoping phase. Furthermore, this legal revision can hardly be undertaken without a prior national commitment to ICZM which should be reflected in a common vision from which specific legal provisions, policies and actions would flow.

7. REGIONAL PLANNING

Regional plans are the pertinent vehicles to streamline ICZM principles. The current practice of having both a regional development plan and an ICZM plan for the same region should be discontinued. It is more effective to have a single development plan, the one produced by GOPP, in which the ICZM criteria are integrated.

However, and in conjunction with their revisions, they need to be enforced. Accordingly, an interviewee has suggested that the law needs to be more stringent in committing all bodies, including governmental entities, involved in the preparation of physical plans to their implementation.

8. STAKEHOLDER ENGAGEMENT

Stakeholder engagement was not thoroughly considered by the interviewees as the focus was on getting ICZM coordinated and streamlined among governmental stakeholders as a first priority. Nevertheless, the critical role played by the local communities still figured in the discussion. In Damietta, for example, where the fishermen community is important, it was proposed to prepare programs focused on building capacities of local communities as a critical and core part of ICZM.

The non-activation of some laws can have a tremendous impact on involved stakeholders. For instance, conflict of interests such as developing the coastal area for tourism or industrial purposes can affect environmental NGOs due to multiple reasons including the deterioration of sensitive habitats, (i.e. nesting sites for sea turtles). Additionally, those constructions can also have an impact on the local economy of the area as well as health. An example of this is seen in the release of heavy metals and pollution from industrial entities into lakes or the sea, which can cause the bioaccumulation of toxins in aquatic species, which in turn can negatively impact fisherman in terms of number of fish being caught and their safety in being sold and eaten by local consumers. Thus, local stakeholders are an important entity to be included and their rights should be considered.

Moreover, the need to establish a stakeholder engagement platform through which information would be exchanged and two way communications established, was expressed by another interviewee. There seems to be a general awareness that communities and stakeholders need to be involved. As suggested by one interviewee, all decisions and recommendations of different committees should be realistic, flexible and workable; this cannot be achieved without due consultation.

This provides a good basis for further development in subsequent phases to ensure awareness, access to information and public participation so that the public can contribute their knowledge and integrate their concerns into decision making, and promote the respect of legal and policy measures.

However, expectedly, the coordination between governmental entities, practically and as perceived by the interviewees, takes precedence.

VI. CONCLUDING REMARKS

1. SWOT ANALYSIS

The inputs from interviews complemented the analysis in the previous chapters to identify strengths and weaknesses of the existing institutional and legal framework as well as the opportunities and threats it faces as summarized below. In general, the points of strength reflect the fact that building blocks for ICZM exist, and the experience that has been accumulated over the last couple of decades in efforts to raise ICZM on the public agenda. The weaknesses are mostly a reflection of inactivated coordination mechanisms, and could be addressed through their activation. On the other hand, the focus in Constitution of 2014 and the recently adopted development strategy on sustainable development represent opportunities which need to be adequately utilized. Moreover, the threats that climate change represent on the coast, is in fact an opportunity for raising ICZM on the agenda.

Strengths	**Weaknesses**
• Although not specifically referring to the coastal zone, the constitution mandates the protection of the seas and the shores • The ICZM geographic extent, and concept, are legally defined • A number of Laws to protect the shore and marine water exist • The agency responsible for physical protection of the shore is specified as the SPA • The Agency responsible for ICZM coordination is identified as the EEAA • Vehicles for cooperation and coordination at multiple levels are established, including a national committee for ICZM • An ICZM strategy is drafted, and could represent a good basis for an updated document • ICZM plans were recently produced for specific regions (Alexandria and Matruh-Sallum), which give an opportunity for appreciation of how ICZM-based plans compare to standard regional plans. • The accumulated experience in raising ICZM on the national agenda, although hardly a success provides important lessons to guide future actions in this respect.	• The primacy of sustainable development, as stated by the constitution, is not clearly reflected in laws • Regulatory focus is on controlling individual projects, while public projects, usually of a larger scale and thus more prominent impact, are not similarly controlled • The legal definition of the coastal zone is not adopted by the applicable laws, as most of those were issued prior to this definition. • The responsibility of coordination is not symmetrical, as it is expected from EEAA but not formally imposed on other governmental agencies. Actions on the ground therefore reflect the relative power of each • The main vehicle of coordination, the NCICZM, is inactive • Vehicles for coordination mainly revolve around governmental actors with no effective involvement of communities directly affected by actions on the ground. The regulated consultation related to the EIA process is limited to large individual projects rather than plans and policies which have a larger, although delayed, impacts • Multiple development and protection oriented strategies, but which are not adequately cross referenced • The ICZM strategy is not adopted, and thus a

	common vision/approach to development in the coastal zone across the multiple actors is lacking. • Without a common base, a programmatic plan to which all parties contribute, each according to its role and responsibility, is currently unachievable, and multiple plans devised according to each organization's objective and mandate is sure to result in conflicts hardly resolvable at the level of implementation.
Opportunities • Interest in Climate Change impacts has grown higher during the last few years to the highest administration level; witness the involvement of the President in the Climate Change conferences. • The officially adopted sustainable development strategy clearly pointing at the challenges faced by the coastal zones • The revision of laws based on constitution, especially capitalizing on its focus on sustainability. • The obligations related to international conventions can provide a driving force to action.	**Threats** • Pressure on resources due to demographic and economic growth would stall regulatory and institutional actions • The delayed signature and/or ratification of a number of regional protocols.

The section below takes stock of the SWOT, and identifies required actions proposed to be in a certain sequence likely to increase their chances of success.

2. PROPOSED SEQUENCE OF ACTIONS

This scoping report culminated in a number of key issues distilled from the analysis of documents and interviews, and indicated a possible path to progress. This preliminary outline should be further validated during a subsequent phase. However, it confirmed that inter-agency cooperation and integration are critical areas for improvement, as necessary conditions for ICZM. Based on past experiences, it also indicated a certain sequence of actions in this respect.

- **Development of a National Vision**
  The recommended first step targets the development and announcement of a politically endorsed national vision for coastal development. In order to improve the chances of success in this regard, the accumulated experience in raising ICZM on the national agenda (as per the SWOT analysis above) should be adequately utilized. The opportunity represented by the high political interest in climate change should also be capitalized.

The activities undertaken to generate this national vision should be based on the recognition of the constraints related to the coastal zone as well as highlight the threats faced by the coastal zone by both sea level rise and extreme events as well as the growing pressure to redistribute an unprecedented population growth to coastal zones. This vision will not only provide a stronger base for the NCICZM through the political backing it has lacked so far, but will also commit all organizations to strive to achieve this vision, and thus provide the base for their coordination and cooperation of which the NCICZM is one of the means.

This vision should be adequately consulted, at least with local administration and parliamentary representatives. To qualify as a national vision, it should be later widely announced.

- **The reestablishment of the NCICZM**
  It was clear from the analysis in this report that a common reference will be conducive to better operation of the NCICZM. Accordingly, its reestablishment should not be considered before a national; vision is developed and announced.

  The coordination role of EEAA will be preserved. However, as proposed, its establishment by prime ministerial decree is likely to give it more clout. However, this political backing should not dissolve the committee from its primary responsibilities towards society, which should be reflected in pre-decision consultation and regular post-decision communication and monitoring..

  The establishment of a permanent technical secretariat (TS) for the NCICZM should also be considered. It is proposed that the TS be an integral part of the Cabinet general secretariat[8]. This TS will be responsible for all preparations for collective decision making, and provide the main technical coordination body especially in terms of data compilation from different organizations and the development of a common database, and forecasting assumptions as well as continuous monitoring to assess the effectiveness of implementation. This repository of knowledge generated at the national level, will highly contribute to the avoidance of data conflicts likely to represent a substantial source of organizational conflicts.

- **A National ICZM Strategy**
  On a more practical level, an approved ICZM strategy is another condition for an operational NCICZM. It should therefore come next in line. This strategy should capture the approach Egypt adopts to bring together the development needs from one side and the fragility and vulnerability of the coastal ecosystem from the other. It provides the general framework for local plans later developed to reflect the practical application of this approach within the specific local context.

  As previously noted, the separation between strategy development and implementation is revealed to be unproductive and should be discontinued. Accordingly, it is proposed that the development of this strategy be the first action item on the NCICZM's agenda to achieve the national vision. Only after this strategy is agreed, other activities should follow under the auspices of a NCICZM committed to implement the strategy it developed, and which agreement is understood to bind their respective organizations during the following phases.

It is recommended that other activities are initiated only after a common reference, provided by a national vision and strategy, as well as a robust vehicle for joint decision making, are in place. Lest, the effort put in some of these activities will be less effective, at best, and could also instigate resistance if not inter-organizational conflicts.

[8] This approach had recent precedents, e.g. the establishment of an energy conservation unit in the Cabinet General Secretariat.

These activities in which the technical secretariat should play a coordinating function, should include, but might not be limited, to:

- **Regulatory Review**
  The opportunity represented by the Constitution's focus on sustainability as well as the national sustainable development strategy 2030, would add to the drive to this regulatory review ensuring the compatibility of the regulatory framework with the vision and strategy, and the consistency of provisions across different regulations.

  Regulations should extend to impose the assessment of policies and plans from its current focus on individual projects. They should also integrate national obligations related to international agreements in the relevant regulatory requirements.

  It should be noted that this is a complex activity expected to take time for preparation, consultation and ratification.

- **local Plans**
  Regional development plans are critical vehicles to reflect the vision and strategy on the ground. These should, therefore, be updated to integrate ICZM. Although the currently developed ICZM plans for stretches of the coast provide a good basis for future development, the practice of having more than one plan for the same region should be discontinued and ICZM streamlined in development plans. Their current focus on transformation of the natural environment for human use, should be integrated with protection, rehabilitation, preservation and upgrading components

  Enforcement of physical development plans on all private and public entities is more likely given a common vision, an adopted strategy and a strong NCICZM as a vehicle for joint decision making. However, effective consultation and communication of the updated plans, their consistency with applicable laws, as well as tools for their proper enforcement should also be in place.

- **Monitoring, and Evaluation**
  All actions taken on the ground are based on the understanding of dynamic and complex coastal processes. The potential of refining and/or revising should always be preserved through a continuous learning process of monitoring and evaluation. As proposed above, the TS should play the role of the information hub, in full cooperation with other national and local entities.

- **International Cooperation**
  A clearer approach to international cooperation will also benefit from a nationally announced ICZM vision and an operational NCICZM. Egypt had an early start on the ICZM path but is a relatively late comer in its practical application. It could therefore highly benefit from the knowledge generated and experience accumulated elsewhere, within in a nationally devised framework. These potential benefits of a more active international cooperation are coupled with requirements as specified by the specific agreements and protocols. Their integration in local regulatory requirements and plans is a continuous process, and should be organized as such.

- **Capacity Building**
  Most of the activities preliminary proposed above have a very high similarity with the current practices of different organizations, but will be performed within a national framework conducive to ICZM. Capacity building , at the institutional and individual levels, should therefore represent an integral component of all activities, but will also include specific activities such as training or the dissemination of sound coastal management practices, including guidelines, directives and codes of practice.

This proposed sequence of activities is based on the knowledge acquired through the current scoping phase. It is thus preliminary and represents a potential reference to subsequent activities, without unduly constraining them. The next phase will validate the results of this scoping report, further detail them and develop a road map to establish an institutional and legal framework conducive to the sustainable development of the Egyptian coast within a clear ICZM approach.

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APPENDICES

APPENDIX I: THE INTERVIEW GUIDE, THE LIST OF INTERVIEWEES AND THE RECORD OF INTERVIEWS.

APPENDIX II: THE FULL TEXT OF RELEVANT ARTICLES IN THE CONSTITUTION.

APPENDIX III: SUMMARY OF THE REGIONAL STRATEGIC PLANS REVIEW.

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