NASTNet
شبكة السلاحف البحرية
بشمال إفريقيا

WWF

Overview of sea turtles and the importance of the North African region

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CRITICAL ECOSYSTEM PARTNERSHIP FUND

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Background

I. Introduction

Turtles are one of the most primitive groups of vertebrates on Earth, they are found on every continent except Antarctica. The most ancient turtle fossil dates from the Triassic period, nearly 230 million years ago. They inhabit freshwater ecosystems (lakes, rivers, and swamps) and other terrestrial and marine environments. Turtles have adapted particular characteristics depending on the habitat in which they live.

Sea turtles have inhabited the Earth for over 100 million years, evolving from freshwater turtles. They are easily distinguished by the presence of flippers and paddle-like forelimbs that unite their elongated digits, helping them adapting to their predominately marine life. These powerful flippers and a more streamlined shell, enable them to become fast swimmers and carry out extensive migrations. Sea turtles have also lost the ability to retract their extremities (head, flippers, or tail) into their shell. Throughout their ancient history, sea turtles have survived drastic environmental changes, including those that caused the disappearance of the dinosaurs. Nonetheless, their present survival is now more than ever in danger.

Sea turtles are vertebrates, easily recognized by their shell, which protects their internal organs. The shell is made up of two parts, the upper half called the carapace and the lower part known as the plastron. The leatherback turtle (*Dermochelys coriacea*) is distinguished by their soft carapace, similar to a thick, leathery skin coat. Sea turtles have a modified jaw but lack teeth. They have primitive hearing, an excellent sense of smell, and their vision is good underwater. There are one or two claws on each of their long front flippers, except the leatherback turtle lacking claws. The female's tails are shorter than the males, which house the male reproductive organ and help in the mating process. Sea turtles are cold-blooded animals; therefore, they cannot maintain a constant body temperature and must use the sun to regulate their temperature. Only the leatherback turtle can regulate their body temperature by using changes in the blood flow to the skin and periphery. This allows them to travel to cold waters in search of food. Also, the leatherback's great layer of adipose (fatty) tissue acts as an effective thermal insulator preventing excess loss of accumulated heat. Sea turtles use lungs for breathing air and therefore need to emerge periodically. They can dive to great depths, especially the leatherback, with a maximum recorded depth of 1300 meters (Eckert et al., 1989). Sea turtles have a slow metabolic rate that allows them to conserve oxygen and stay immersed for extended periods of time.

II. Life cycle

All species of sea turtles are long-lived, slow growing species, characterised by a complex life cycle and utilizing a wide range of habitats (Fig .1).

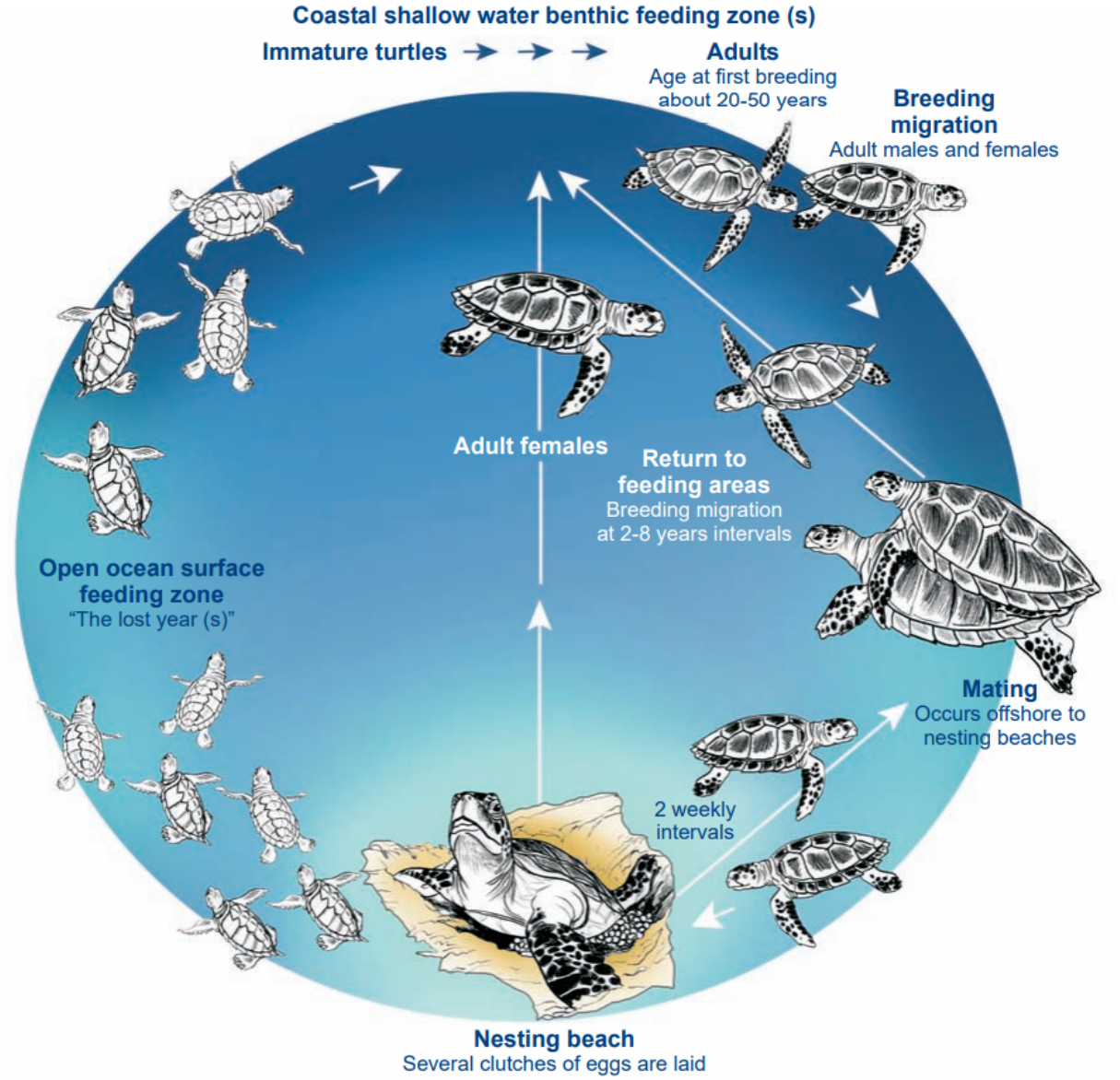


Figure 1: Life cycle and main habitats of sea turtles (FAO, 2009)

Sexual maturity is late in all species, with estimates varying in different species and populations but usually exceeding 20, even 50 years. After mating, females dig nests on sandy beaches, laying between 50 to 130 eggs per nest. Hatchlings crawl to sea water and swim towards the open ocean. After a period which varies according to species, juveniles generally return in coastal waters to feed on benthic organisms (except the leatherbacks, that remain pelagic throughout their life cycle and the flatback turtle, which remains neritic throughout its life). As the turtles grow and reach sexual maturity, males and females leave their feeding grounds and migrate to the nesting beach. This periodic migration will continue throughout their lives. Females dig nests on dry sand, returning faithfully to the same beach each time they are ready to nest and returns to the sea either to rest before nesting again later that season or before beginning her migration back to her feeding ground.

III. Threats

Threats to marine turtles vary in time and space and relatively to different populations. Threat categories affecting marine turtles were described by Wallace et al. (2011) as:

- Fisheries bycatch: incidental capture of marine turtles in fishing gear targeting other species;

- Take: direct catch of turtles or eggs for human use (i.e., consumption, commercial products);
- Coastal Development affecting critical turtle habitats: human-induced alteration of coastal environments due to construction, dredging, beaches modification, etc.;
- Pollution and Pathogens: marine pollution and debris that affect marine turtles (i.e., through ingestion or entanglement, disorientation caused by artificial lights), as well as impacts of pervasive pathogens (for example, f*ibropapilloma* virus) on turtle health;
- Climate change: current and future impacts from climate change on marine turtles and their habitats (increasing sand temperatures on nesting beaches affecting hatchling sex ratios, sea level rise, storms frequency and intensity affecting nesting habitats, etc.).

As a result, all sea turtle species whose conservation status has been assessed are threatened or endangered.

During incubation, the eggs are predated on by wild and domestic animals such as crabs, dogs, birds, etc. After hatchlings leave the nest, they fall easy prey to crabs, birds, and fish, among other animals. During their juvenile and adult stages, the number of potential predators decreases as they get larger with a hard carapace; however, they may occasionally be attacked by sharks. Environmental factors, such as climate change, hurricanes and beach erosion, negatively impact the hatching of sea turtles. Even so, impacts from human activities prove to be the greatest threats to the survival of the sea turtles. Turtles are captured at sea for their meat, falling victim to commercial and artisanal fisheries, and commercializing their eggs and shell. Thousands of turtles are killed when incidentally captured by long lines, gill nets, and various fishing gear. Another significant threat to the turtles is chronic pollution from industrial and agricultural wastes as well as urban runoff. At sea, the turtles ingest plastic bags and other debris that may be confused for their prey, such as jellyfish. Furthermore, physical barriers and construction along the beach may reduce the amount of nesting beach available to the sea turtles as well as generate artificial lighting. Tourism may disturb nesting females and emergent hatchlings on nesting beaches where no appropriate training is offered to guides that provides them with the knowledge of what care should be taken when finding and approaching a turtle.

IV. Species

Scientists recognize seven living species of sea turtles (Fig. 2). Each sea turtle has both a scientific name and a common name. The scientific name identifies the genus and species, and the common name typically describes some characteristic of the turtle's body: the Loggerhead (*Caretta caretta*), the green turtle (*Chelonia mydas*), the hawksbill (*Eretmochelys imbricata*), the Kemp's ridley (*Lepidochelys kempii*), the olive ridley (*Lepidochelys olivacea*), the flatback (*Natator depressus*) and the leatherback turtle (*Dermochelys coriacea*). In the areas where they co-occur, they can easily be distinguished.

Most sea turtles are widely distributed in tropical and subtropical waters. A few species have a more restricted distribution, such as the Kemp's ridley with adults occurring in the Gulf of Mexico, juveniles with a broader distribution reaching northern European waters, and the flatback, confined to northern Australian waters.

Figure 1: Sea turtle species of the world (Adapted from SWOT report, 2019)

V. Sea turtles in the Mediterranean

Three sea turtle species frequent the Mediterranean Sea, two of which nest there and once boasted abundant populations: the Loggerhead *(Caretta caretta)* which is the most common, the green turtle *(Chelonia mydas),* and the leatherback *(Dermochelys coriacea)* which is a visitor from the Atlantic ocean (Fig. 3). Some rare observations of olive ridley *Lepidochelys olivacea* and Kemp's ridley turtles *Lepidochelys kempii* were also registered.

Marine turtle species found in the Mediterranean are classified under the IUCN Red List of Threatened Species as being:

- Vulnerable [Vu] (Globally) and Least Concern (LC) since 2015 in the Mediterranean Sea: the loggerhead turtle (*Caretta caretta*)
- Endangered [EN] (Globally): the green turtle (*Chelonia mydas*);
- Vulnerable [Vu] (Globally): The leatherback turtle (*Dermochelys coriacea*).

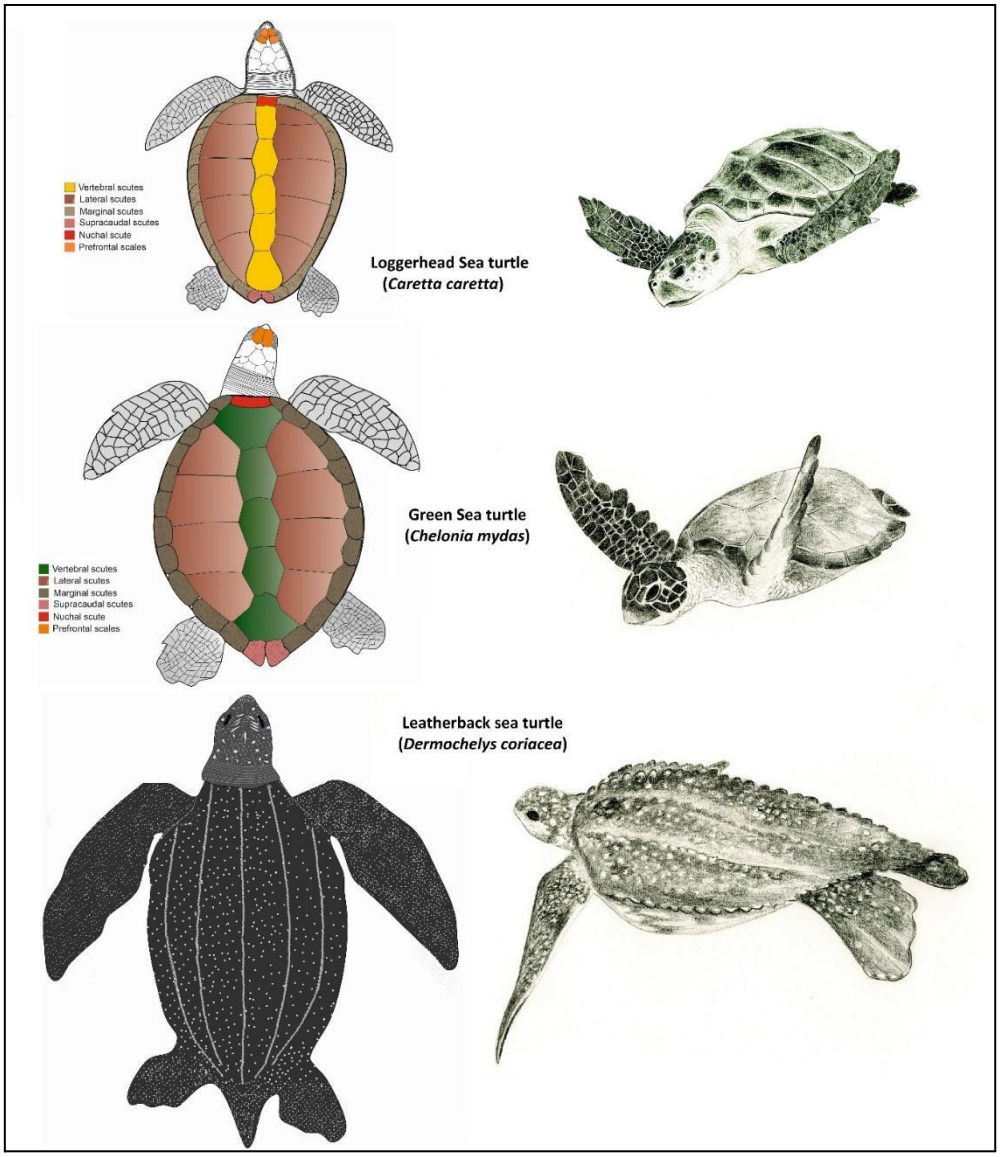


Figure 3: Marine turtle species of the Mediterranean

For the Loggerhead sea turtle, major nesting sites are in Greece, Turkey, Libya and Cyprus, where more than 96% of the clutches laid. Lower levels of nesting occur along the Mediterranean coasts of Egypt, Italy, Lebanon, Syria, and Tunisia, with minor and infrequent nesting occurring along the western basin coastlines of Spain, France, Italy, and their offshore islands (Casale et al., 2018).

For the green turtle, the primary green turtle rookeries are located in Turkey, Cyprus, and Syria, with minor nesting aggregations occurring in Egypt and Lebanon. Three exceptional green turtle nesting events were recorded in Crete (Greece) in 2007 and 2019, Libya in 2021, and Rejich (Tunisia) in 2019. The latter represents the westernmost nesting record in the Mediterranean. The largest nesting rookery for green turtles is Akyatan beach (Turkey), hosting about 20% of the total number of clutches recorded in the Mediterranean (Casale et al., 2018)

In marine areas, the highest density of loggerhead turtles appears to occur in the westernmost part of the Mediterranean (from the Alboran Sea to the Balearic Islands), the Sicily Strait, the Ionian Sea, and the wide continental shelves in the north Adriatic, off Tunisia-Libya, Egypt, and off the southeast coast of Turkey. Green green turtles mostly frequent the Levantine basin (Turkey, Syria, Cyprus, Lebanon, Israel, Egypt) and have foraging areas in Greece and Libya. Some green turtles can be occasionally found in the Adriatic Sea (Italy, Croatia, and Albania), in Tunisia and very rarely in Malta and the western basin (Casale and Margaritoulis, 2010).

The leatherback turtle has been recorded from almost every area and country in the Mediterranean, but available data suggest that specimens concentrate in specific areas, probably for trophic reasons, like the Tyrrhenian and Aegean Seas and the area around the Sicily strait (Margaritoulis, 1986; Casale et al., 2003; Bradai et al., 2004).

The Mediterranean is an exciting place for sea turtle research, with prospects of range expansion and new colonization and with long-term conservation projects that have achieved stable or even positive population trends. Nevertheless, researchers and conservationists still have a long way to go before turtles in the Mediterranean can be called safe. Indeed, many significant threats, particularly fisheries bycatch and climate change, still urgently need solutions. To that end, a solid network of conservationists, researchers, and stakeholders must continue to focus their energies on the actions needed to ensure that Mediterranean sea turtles survive and thrive into the future.

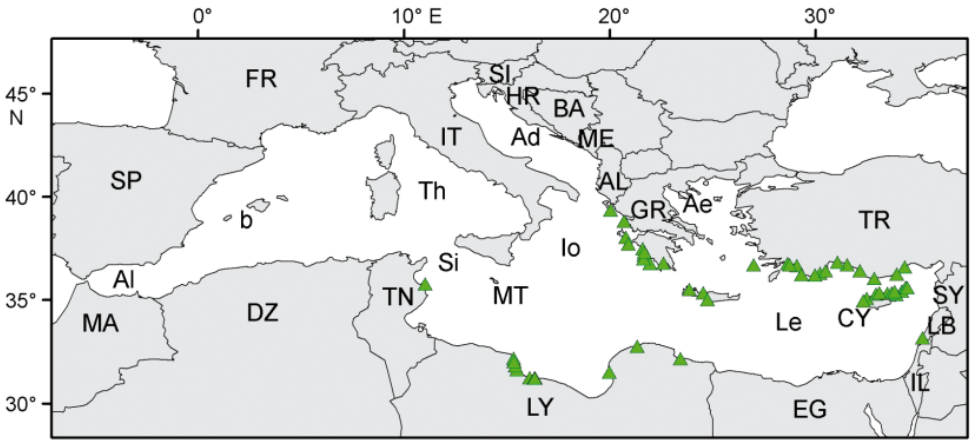
VI. Conservation and need of NASTNet

Sea turtle conservation in the Mediterranean started in the early 1970s (Cyprus). The 1980s saw the inauguration of important national and international grassroots turtle conservation organizations in the Mediterranean, including ARCHELON and MEDASSET, in addition to projects supported by the World Wide Fund for Nature (WWF) and others. In 1989, all the Mediterranean countries adopted an Action Plan for the Conservation of Marine Turtles within the Mediterranean Action Plan (MAP) framework (Hochscheid et al., 2019 (SWOT)).

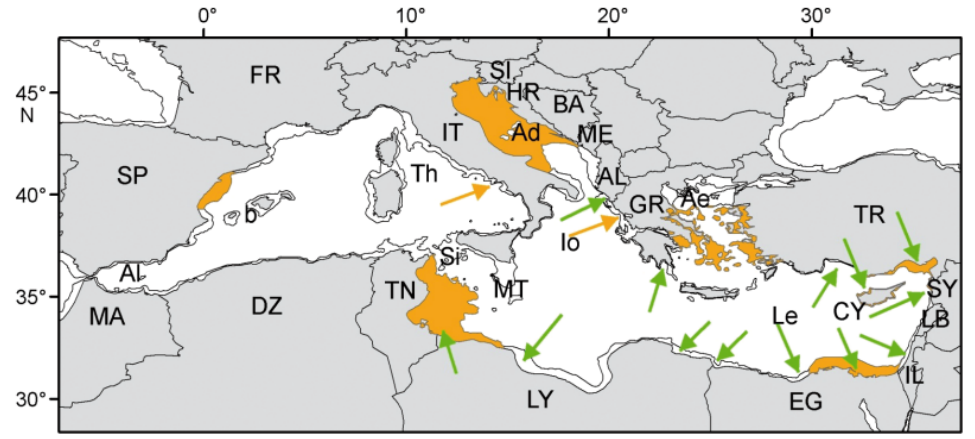
Effective conservation of sea turtles in the Mediterranean, the required collective effort must be shared by all countries, organizations, and actors. Any relaxation in one area would have severe consequences for all the populations in the basin, and all the efforts deployed would be wasted. To this end, all national, sub-regional, and regional synergies must be encouraged to achieve shared conservation objectives.

Given the importance of the North African area for sea turtle populations as shown by several studies and particularly that of Casale et al. (2018), (fig. 4), (Nesting area mainly in Libya; Neritic foraging and

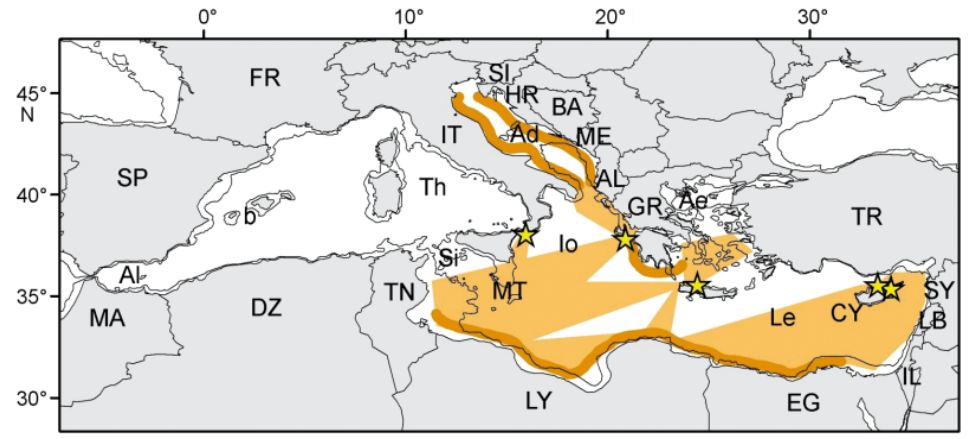
wintering sites such as the gulf of Gabès; Migratory corridors for Loggerhead and green sea turtles), the gathering and coordination of efforts in the area would be very important.



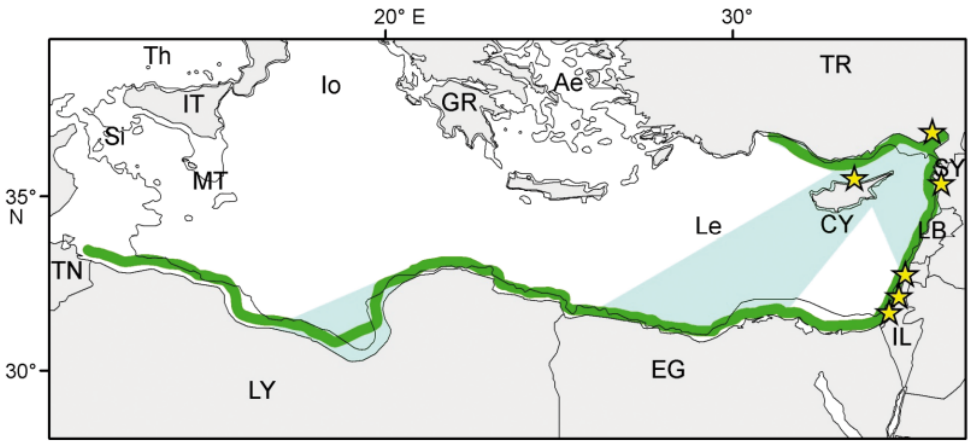
Major nesting sites (i.e. ≥10 clutches yr^{-1} and ≥2.5 clutches km^{-1}) of loggerhead turtles *Caretta caretta* in the Mediterranean. Countries: AL: Albania; DZ: Algeria; BA: Bosnia and Herzegovina; HR: Croatia; CY: Cyprus; EG: Egypt; FR: France; GR: Greece; IL: Israel; IT: Italy; LB: Lebanon; LY: Libya; MT: Malta; ME: Montenegro; MA: Morocco; SI: Slovenia; SP: Spain; SY: Syria; TN: Tunisia; TR: Turkey. Marine areas: Ad: Adriatic Sea; Ae: Aegean Sea; Al: Alboran Sea; Io: Ionian Sea; Le: Levantine Basin; Si: Sicilian Strait; Th: Tyrrhenian Sea; b: Balearic Islands (Spain)



Neritic foraging and wintering sites for loggerhead turtles *Caretta caretta* (orange areas and arrows) and green turtles *Chelonia mydas* (green arrows). Neritic areas correspond to the continental shelves, which are conventionally delimited by the 200 m isobath (solid line).



Main known migratory corridors for adult loggerhead turtles *Caretta caretta* (females and males) during reproductive migrations from and to the breeding sites (☆). Light brown areas represent migratory funnels in the open sea while darker strips represent paths along the coasts, typically in shallow waters.



Main known migratory corridors for adult female green turtles *Chelonia mydas* during reproductive migrations from the breeding sites (☆). Light green areas represent migratory funnels in the open sea while darker strips represent paths along the coasts, typically in shallow waters. Adapted from Stokes et al. (2015).

Figure 4: Importance of the North Africain coasts for sea turtles in the Mediterranean (A: Nesting; B: Foraging and wintering sites; C: Migratory corridor for loggerheads; D: Migratory corridor for Green turtles) adapted from Casale et al., 2018.

In the North African countries, the Sea turtle conservation effort started at the end of the 1980s and the beginning of 1990s by prospectors lookingg for nesting sites in the frameworks of projects supported by SPA/RAC (Special Protected Areas Regional Activity Centre) and MEDASSET (Mediterranean Association to Save the Sea Turtles). These prospections allowed locating important nesting sites mainly in Libya and others less important (number of nests and density) in Egypt and Tunisia. Based on that, two monitoring programs of the main nesting sites in Tunisia and Libya were lunched since 1997 and 2005 respectively. The one in Libya called the Libyan Sea Turtle Program was set by EGA (Environment Genral Authority) and supported by SPA/RAC aiming to monitor the long sandy beaches in Libya. In Tunisia, the Kuriat islands nesting site (Tunisia) are monitored within the frame of an MoU signed annually between INSTM (Institut des Sciences et Technologies de la mer) , APAL (Agence de protection et d'Aménagement du littoral), SPA/RAC, and recently the NGB (Notre grand bleu) association.

Studies and initiatives were then launched in the different countries but very unevenly. Furthermore, the involvement of civil society in awareness-raising activities has made the conservation of sea turtles a national and sub-regional concern.

Studies concerning sea turtles in the North African countries concerned mainly:

- Nesting programs and related studies such as genetics, sex ratio (Tunisia, Libya, and Egypt);
- Interaction with fisheries (Tunisia and Morocco);
- Stranding and related studies such as pollution (all countries but only Tunisia has established its national network);
- Rescue centers (Only Tunisia has a rescue center established in Monastir in 2004 and a new first aid centre established in Sfax in 2021);

Several training sessions on sea turtle conservation supported by SPA/RAC have been carried out in recent years, especially in Tunisia. During these training, North African conservationists and actors have met and established collaborative relationships.

Based on the foregoing and the factors of geographical proximity and unity of language and culture, the idea of creating a North African Sea turtle Network appears to support conservation measures and effort in the hole Mediterranean and worldwide.

In july 2019, the WWF NA and SPA/RAC supported the idea and brought together actors from different countries in Tunis to concretize the idea.

The NAST-Net was established because of the urgent need to coordinate protection, awareness and research efforts in the region and the scarcity of long-term data available on sea turtle populations in the Mediterranean, particularly in North Africa. During the meeting of launching the network, the participants were fully convinced to coordinate actions to protect sea turtles and their habitats in the region, as their protection is a collective responsibility that requires synergy and coordination between the different actors.

The NAST-Net aims to share experiences and build capacity to develop a network strategy to support partners in conservation, awareness and scientific research; and solicit funding opportunities for sea turtle conservation as well as coordinate with the Mediterranean and international organizations and initiatives active in the marine environment fields.

The NAST-Net comprises a steering committee with eight members representing experts from North African countries and an Advisory Committee with the role of providing technical and organizational support. It is composed of the following institutions: SPA / RAC, WWF NA, CEPF (Partnership Fund for Critical Ecosystems), MedPAN (Network of Managers of Marine Protected Areas in the Mediterranean), and RASTOMA (Network of Actors for the Conservation of Marine turtles in Central Africa).

Currently, NAST-Net is an independent organization working under the umbrella of WWF NA, which supports it. When it is officially legal and autonomous, it will be open to all experts and NGOs from North African countries who share the same network objectives.

Address: WWF , Immeuble SAADI, Avenue Habib Bourguiba, l'ARIANA, premier étage, Tour CD N°C1 et C2 1082 Ariana, Tunisie

Web site: nast-net.org

Logo:

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Egypt

Mohamed Said Abdelwarith

I. General data

1. General data on the southern coasts of the Mediterranean basin In Egypt

Egypt located in the northern corner of Africa with a total area reached Approximately One Million km^2 (Fig. 1), it has the entire northern part of the country bordering the Mediterranean Sea (EDBI, 2014). The Egyptian coastline extends some 1100 km from Rafah to Salloum (Saleh, 2002). The main Egyptian cities overlooking the Mediterranean are Alexandria, Port Said, North Sinai, and Marsa Matruh (Abaza, 2015).

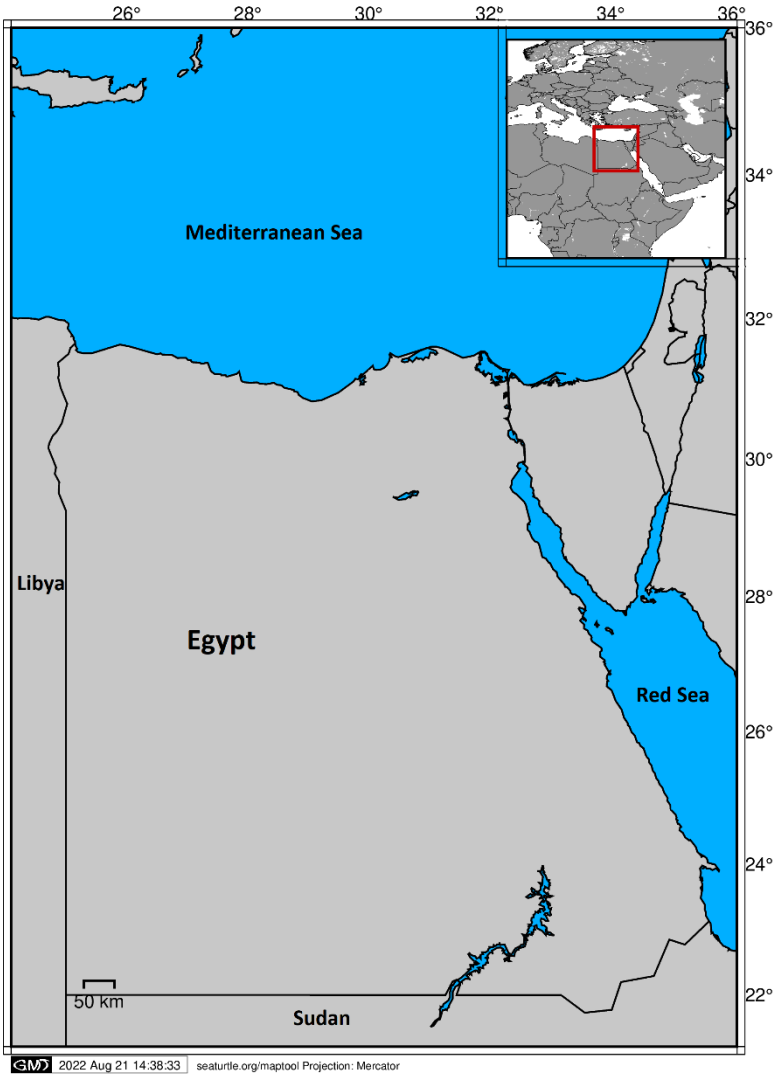


Figure 1: Map of Egypt

(The map was created thanks to the Maptool program. Maptool is a product of SEATURTLE.ORG)

Egypt has substantial marine and coastal resources along its Mediterranean coast with a number of urban centers situated along the coast (Saleh, 2002), the biodiversity of the coastal and marine waters of the Egyptian Mediterranean Sea provide valuable services for its people, as well as crucial nursery habitats for marine animals and sanctuaries for endangered species. (Fouda, 2020), that supporting living of more than 20% of Egypt's total population along the northern coastal zone of the country, with more than 40% of its economic activities concentrated along the coast. Main economic activities in the northern coastal area include industry, fisheries, agriculture, tourism, petroleum and mining activities, and urban development (Abaza, 2015 and Fouda, 2020).

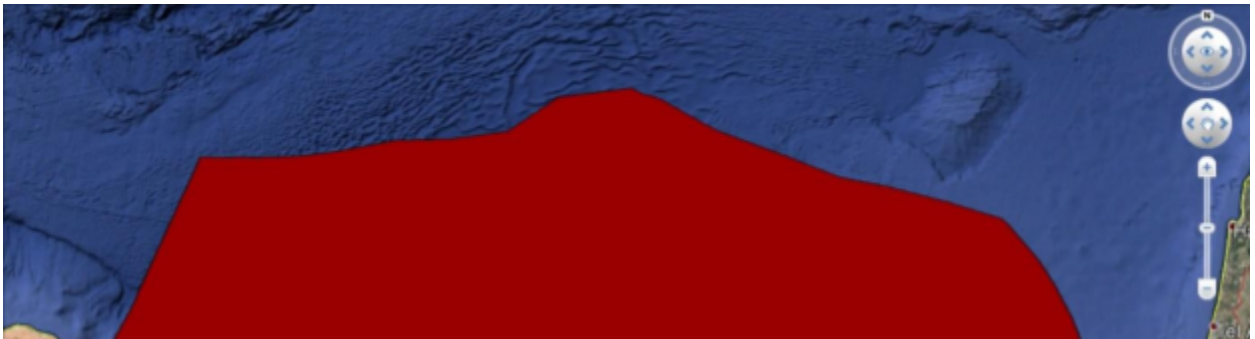
2. EEZ

Article 55 of (UNCLOS) identified the exclusive economic zone (Fig. 2) as an area beyond and adjacent to the territorial sea, subject to the specific legal regime established in this Part, under which the rights and jurisdiction of the coastal State and the rights and freedoms of other States are governed by the relevant provisions of this Convention (UNCLOS, 1982).

Exclusive Economic Zone is considered as a nascent one relatively, when compared to other marine zones, where the United Nations Convention on the Law of the Sea (UNCLOS) for the year 1982, legally governs its provisions. The (EEZ) extends on an area of 200 nautical miles starting from the baseline where the regional sea of the coastal state is measured. The coastal state is entitled to the number of rights and adhered to the number of commitments in the Exclusive Economic Zone related to that state which are stipulated in and organized by the said conviction. Establishing and organizing exclusive economic zones between opposite and adjacent states in the marine extensions arise many problems, whereas the United Nations Convention on the Law of the Sea for the year 1982 ,stipulates that delimitation of such zone between those states is based on the agreement on the basis of the international law, as referred to "in article 38 of the article of association of Court of International Justice", in order to reach a fair solution which is not a factual easy option , because it opens the door for unlimited number of disputes. In fact, this issue is located in the southeastern Mediterranean region with special political dimensions

However, ecologically, the Egyptian sea bottom at the inshore (extending to 50 m depth) varies from coarse sand in the western locations to coarse gavels and mud in the eastern sections. Most of the shore is interrupted with patches of rocky nature. The offshore region (50-100 m depth) shows the homogenous types of sediments; frequently silt with different quantities of mud, which decrease towards the west. There are no sharp boundaries, however, between the different zones. The bottom between Alexandria and El Arish is mostly silty sand resulting from the accumulation of the Nile flood sediments (Fouda, 2020).

The Egyptian government has deposited the Presidential Resolution No. 27 of 1990 at the United Nations Headquarter, to determine the baseline from which the marine areas of the Arab Republic of Egypt are measured.



Currently, preparations are undertaken to issue a presidential decision by 2023, to update the previous decision, based on political priorities, information, and modern technologies, for depositing it at the United Nations headquarter.

3. Populations of Egypt and Percentage of populations on the coastal strip

The current population of Egypt is 105,600,932 as of Monday, March 14, 2022, based on Worldometer elaboration of the latest United Nations data, with the expectation of rising Egypt's population to 190 million by 2050 if current growth continues.

The north coast is home to several cities, towns, and villages. Main population concentrations are in Alexandria, Port Said, Sallum, Marsa Matruh, El Dabaa, Damietta and many more. The largest Egyptian city on the Mediterranean is Alexandria. It hosts around (5.3 million) inhabitants. Other large cities in the region are Damietta (1.5 million), the Beheira Governorate (6.5 million inhabitants with about 1 million spread across the Mediterranean coast), the Kafr el-Sheikh Governorate (3.5 million with about 800mn on the coast), Port Said Governorate (772.299), Matrouh Governorate (481.718) and North Sinai (470.707) (CAPMAS, 2020). These figures increase by more than 1 million during the summer season due to local visitors to the north coast. (Abaza 2015).

4. Fishing and other economic activities

The main economic activities in the northern coastal area include fisheries, tourism, urban development, maritime activities, etc. these activities including:

a. Fishery

(Type, fleet, number of maritime registrants)

The fishery is one of the socio-economic activities practice in the coastal zone. It is an important activity for local coastal communities, providing employment opportunities and a major pillar in food security and economic-social development, as well as, the main source of cheap protein for a growing population. The Mediterranean Sea and the area surrounding it represent the grounds for the majority of fishing activities taking place in Egypt. In addition to the coastal belt along the Mediterranean Sea in the north of Egypt, there are a number of Egyptian Mediterranean brackish water lakes and lagoons situated along the Nile Delta, those are Manzala, Borollus, Edku, and Mariout, and to the east of the Suez Canal, Port-Fouad and Bardawil. (Abaza, 2015, El-Haweet, 2020 and Fouda, 2020)

Egyptian Mediterranean capture fisheries are important for local coastal communities, providing employment opportunities and a major pillar in food security and economic-social development. Due to the depletion of the inshore or coastal fisheries resources in the Mediterranean Sea, countries like Egypt make many fishermen suffering and detriment. This depletion also reduces the supply of seafood materials to many fish processing industries in the region. Fishery policymakers have searched for new fishing ground through research works that need to get full support in funding. It was clear that the new regime of Economic Exclusive Zones (EEZ) would challenge the capacity of many coastal countries to respond adequately to either the opportunities or the responsibilities that lay ahead. Currently, most living marine resources are exploited on the continental shelves at depths of less than -400m, but in recent years, deep-sea fisheries have been developed all over the world

and by time transferred to Egypt. Bottom trawl and longline fisheries capable of reaching depths down to nearly -1000m have been operating in the Mediterranean Sea in recent years.

According to the General Authority for Fish Resources Development (GAFRD, 2018) reported that about 15,000 are licensed fishermen for this the Mediterranean Sea. The licensed motorized fleet was 3158 vessels equipped by inboard engines more than 50 up to 1,000 HP, additionally 959 non-motorized boats (most of them using outboard motor) operating at Egyptian Mediterranean Sea.

The main fishing ports along the Egyptian Mediterranean coast are: Salloum and Marsa Matrouh (Matrouh province), Al Max, Al Anousheh, Mena Sharki and Abu Qir (Alexandria province), Meadea and Rashid (Behera province), Aljazeera ElKhadra and Borge Al Burullus (Kafr Al Sheakh province), Al Borge (Dumyat province), Port Said (Port Said province), and El Arish (North Sinai province). In addition, there are several others small landing sites.

Fishermen are usually targeting more than one fish species at the same time. Thus, it could be affirmed that fishing fleet operating in the Mediterranean region are oriented toward catching a high variety of species, up to one hundred different demersal fish species, crustaceans, and some small or large pelagic species. Target species are depending on the distance from the coast to the fishing grounds, water depth, bottom characteristics, and the different seasons of the year. Fisheries production is of high economic value as the catch is generally sold fresh in local markets or directly to private consumers or restaurants. In some fisheries, parts of the high-quality catch are exported (FAO EastMed., 2014). Many other commercial and other species that are endangered are considered by-catch, while discards are mainly composed of small-sized fish and species with no commercial value, including some invertebrates.

b. Maritime

Egypt's geographical location, at the junction of three continents and bordering two seas, gives it several advantages. It has a total length of coasts reaching about 2,000 km, which gives it easy access to external trade and foreign countries. Furthermore, Egypt has the Suez Canal, which connects the Mediterranean Sea with the Red Sea and makes maritime transport from East to West much quicker and easier. Egypt's foreign seaborne trade makes up about 90% of its total foreign trade volume, which is an indication of how important maritime transport is for the economy. The table below shows the total volume of traffic through the Egyptian ports in 2013.

Maritime Transport represents one of the important sectors in Egypt. The strategic location of Egypt and the Suez Canal connecting the Mediterranean Sea with the Red Sea linking East to West attracts a great deal of maritime traffic along the Egyptian Mediterranean coastal zone. Major ports in Egypt are located in Alexandria, New Damietta, and Port Said. These ports also have oil and natural gas terminals. Smaller fishing ports are located at a number of designated fish landing facilities in addition to most major ports.

Port facilities are along the Mediterranean coast. Egypt has 6 commercial ports on the Mediterranean out of a total of 15 ports, 3 petroleum ports out of the total 11, and 3 out of the 4 fishing ports. There are no mining or tourist ports on the Mediterranean (Abaza, 2015 and Fouda, 2020).

The state's plans also continue to construct many new ports along the Egyptian Mediterranean coast. Increased maritime transport due to an increase in the volume of trade and tourist activities is likely to further increase pressures on the Egyptian coastal areas and marine megafauna if necessary measures are not introduced. Fouda, 2020).

There are significant negative impacts of maritime transport/cruising and pleasure boating on the marine and coastal environment, namely: (1) seawater pollution caused by ship and vessel maintenance, (2) pollution from marine accidents and from antifouling-paint biocides (3) illegal and accidental waste dumping from ships into the sea, (4) noise and sound pollution caused by shipping and marine transportation that generate disturbances and noise, which can affect sensitive marine species, (5) marine and coastal ecology degradation as well as changes of water quality, and (6) the introduction of alien and invasive species.

Unsustainable maritime transport practices and the potential increase in related activities as a result of increased global trade and potential increase of local and international tourism along the Mediterranean coast are expected to exacerbate the level of pollution and environmental damage along the Mediterranean. This is very much likely to have a negative impact on marine life, fisheries, tourism, quality of life, and the health of the population.

An adequate monitoring system to track accidents and oil spills should be made available. in order to track accidents immediately with proper response measures and actions taken in order to reduce the extent of the damage to the environment and the ecosystem. Necessary up-to-date equipment and technologies should be used to deal with accidents resulting in oil spills and dangerous chemical substances, with enhanced capacities of local personnel for monitoring, assessment, and dealing with pollution resulting from maritime activities.

c. Offshore Oil and Gas Industry

Historically, the oil and gas industry in Egypt has always been of particular importance. According to the US Energy Information Administration, Egypt is the largest consumer of both oil and gas in Africa. It is also the largest non-OPEC oil producer and the second-largest dry natural gas producer in Africa, after Algeria. The country also serves as a major transit route for oil shipped from the Arab Gulf to Europe and the United States. Egypt plays a vital role in international energy markets through the operation of the Suez Canal and the Suez-Mediterranean (SUMED) Pipeline as previously mentioned (US Energy Information Administration).

The oil industry plays a pivotal role in the Egyptian economy. It used to be one of the main sources of foreign exchange. Oil production in Egypt comes from four main areas: the Gulf of Suez, the Western Sahara, the Eastern Desert, and the Sinai Peninsula (Fig. 3). Egypt has the potential that qualifies it to increase its production capacity of oil and natural gas and with increased investments in solar energy increase its export potential of energy to the outside world. At the moment, refining capacity exceeds production rates, resulting in the need to import crude oil for processing and re-export. Egypt is still exporting petroleum products to key countries, including India, Italy and China. It is also possible to increase the storage capacity in Egypt on the Red Sea and the Mediterranean ports so that they can take advantage of the infrastructure of national networks for exporting oil and gas to meet international demand, particularly for the European Union

Most oil and gas fields in Egypt are in the Western Desert, on the Mediterranean Coast and in the Gulf of Suez. The map below shows existing oil and gas fields (each made up of several blocks) in the Mediterranean area. The majority are gas fields where the Government plans on offering them for exploration in the next couple of years.

The country's gas production still has the potential to grow in the coming years with the following fields to overcompensate for the decline of more mature fields:

- The Western Desert

- The Nile Delta and Mediterranean Sea
- Offshore North Sinai

Most oil and gas fields in Egypt are in the Western Desert, on the Mediterranean Coast and in the Gulf of Suez. The map below shows existing oil and gas fields (each made up of several blocks) in the Mediterranean area. The majority are gas fields where the Government plans on offering them for exploration in the next couple of years.

Main environmental implications resulting from the targeted socio-economic activities have been identified, that particularly focus on pollution and environmental damage associated with offshore-related activities, with emphasis on negative impacts on biodiversity. Offshore drilling for instance endangers the sea's biodiversity and pollutes the water of the Mediterranean. Though natural gas fields may be less dangerous than oil wells, an accident is still possible (in the form of an explosion after a gas leak). The first environmental hit occurs at the beginning of oil exploration activities. Oil exploration involves seismic surveys that stun marine animals and diving birds, interfering with their navigation and communication abilities. This can be deadly for individuals and species.

The second largest volume of waste is produced through drilling. This includes extracted water mixed with oil and other contaminants, drilling "muds" (including toxic chemicals and heavy metals) to cool and lubricate the equipment, and other forms of industrial waste. These inevitably end up in the ocean and are ingested by marine life of all sizes.

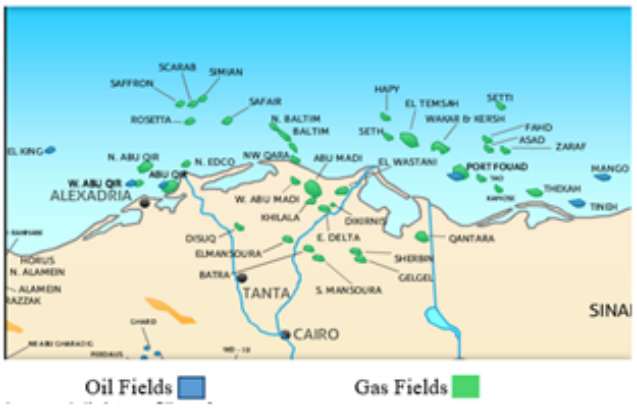


Figure 3: The oil and gas fields in the Egyptian Mediterranean Waters.
Source: Ministry of Petroleum

Some of the smallest marine creatures, foundational to our ecosystems and generally known as plankton, are particularly susceptible to crude oil pollution and suffer population reductions. The third environmental hit occurs as a result of inevitable oil spills, and the fourth is the carbon dioxide emission from the consumption of fossil fuel.

All forms of pollution (air, soil and water) represent another threat to the Egyptian Mediterranean coastal zone. Marine pollution results from oil exploration and exploitation in both the Mediterranean coast and desert area, oil spillage from the ever increasing ships working in the territorial waters as well as those that cross the Suez Canal into the Mediterranean thus threatening both marine and terrestrial habitats. Solid waste, due to the limited number of landfills is also causing considerable damage to all natural habitats and ecosystems. Air pollution from quarrying can be seen

from the roads. Although all forms of pollutions are prohibited by Law 4/1994 (amended by Law 9/2009), law enforcement is rather limited.

d. Other activities

- Extraction of coastal resources

Sea-sand is necessary for beach formation and to protect from storm surges and waves. This affects weather micro-patterns, tourism, swimmer safety, fish habitat and reproduction, invertebrate animal habitat and as a heavy metal and toxin sink. Thus, extraction of sand from shorelines has large impacts on the structure of beaches and on marine biodiversity.

Sea-sand mining may cause serious ecological changes that could affect the entire continental shelf ecosystem. In addition, sand extraction affects the ecosystem of the seabed, which support fisheries. Most larval species of fish use this area as nursing grounds. By disturbing this ecosystem, the livelihood of fishermen is negatively impacted.

There is very limited data when it comes to extractions of marine resources in Egypt. Moreover, when it comes to the Mediterranean coast, there is very little extraction of marine resources, including salt extraction, and the Government is taking necessary measure to try to keep the coast intact without removing any resources from it or altering its natural state. There are though a number of activities along the Mediterranean coast that have negative environmental impacts on the marine ecosystem. These are represented in the following main activities:

- Submarine Telecommunications (Fig. 4)

Due to its strategic location, Egypt is a hub for submarine cables. The relatively small land area between the Red Sea and the Mediterranean Sea has allowed for cables to connect Asia with Europe and North America. There are four main landing locations for cables in Egypt: Zaafarana, Suez, Abu Talaat and Alexandria. The two landing locations that are on the Mediterranean are Abu Talaat and Alexandria through which 11 cables go through. The cables mostly come from Asia and then go to Europe.

The first risk that comes from marine cables is in the installation, as they disturb the habitat and create a change in the ecosystem when they are being installed. Installed cables disturb the seabed and the environment itself as the machine work to lay the cables.

The main long-term impact of submarine cables is the presence of the cable itself and any accompanying protective structures. These can provide artificial hard habitats that attract flora and fauna that may not be typical of the area. However, since it is confined to the cable route itself, such change in the surrounding area and natural habitat is not likely to be significant (OSPAR Commission, 2009).

Figure 4: the submarine cables in the Egyptian Waters.

Source: http://www.submarinecablemap.com/#/country/egypt

Many other economic activities are considering major pressure facing sea turtles in the Mediterranean region in general and Egypt in particular, as follows:

- Tourism

Tourism is a vital part of Egypt's economy and an extremely important source of employment and foreign currency (when it is foreign tourism). It is also a big contributor to GDP (also mostly in the case of foreign tourism). Tourists come to Egypt from many countries around the world with the aim of enjoying all of the different attractions the country has, including its sandy beaches and rich history.

The Egyptian Mediterranean tourism sector depends very little on foreign tourists and mostly on domestic tourists. It includes Egyptians returning to their homeland (from Gulf countries and Europe) during the summer holiday period, which produces a noticeable flow of visitors over a short period of time. In addition, millions of resident Egyptians mostly from Cairo and the Nile Delta visit the coast. Initially, Alexandria city was the main attraction, but over the last 4 decades, there has been a significant increase in the number of resorts stretching from Al-Arish (Sinai), Port Said, Damietta, Baltim, Gamasa, Alexandria and up to Matrouh city. In addition to resorts and hotels, a huge number of private houses along the coasts were built recently over at least 500 km2 of the coast, particularly from Port Said to Matrouh. Furthermore, the Government is currently implementing a development plan along the northern coast to attract international tourists, where several cities such as Al-Alamein, and Al-Omayed, will be established.

Tourism in the Egyptian Mediterranean basin is primarily seasonal, peaking between July and October; which overlaps with the nesting seasons of sea turtles.

Tourism contributes to CO_2 emissions, mostly through increased use of air and road transportation. Beyond that, the major direct pressure from coastal tourism on the marine and coastal environment is the demand for space, both in the coastal zone, resulting mainly in urbanization, and on the coastline itself, through construction of marinas and other infrastructure. Increased tourism also results in an increase of cruising and pleasure boating with its negative environmental consequences. The concentration of tourism in specific locations, particularly cities, within a limited time period increases pressure on natural resources and leads to higher rates of wastewater and solid waste generation and underwater consumption. Coastal tourism is by definition located in sensitive habitats within the coastal zone, such as beaches, sand dunes, and wetlands. The unavoidable result is a change in the state of habitats and their associated ecosystems, as well as economic impacts on other activities that benefit from coastal ecosystem services. Unsustainable development of mass tourism will result in the rapid degradation of fragile natural habitats. Five protected areas were therefore demarcated along the northern coast (Zaranik, Ashtom El-Gamil, Burullus, Al-Omayed, and Salloum).

Tourism, especially mass tourism threatens biodiversity not only in tourism development zones, but also within both operationalized and planned protected areas. Pressures vary across the landscape in time and space. Some areas only experience seasonal impacts, while other areas are not heavily impacted, with no guarantee that they remain so in future. The threats from tourism may be divided into direct and indirect categories (Fouda, 2014).

The threats from tourism on the Mediterranean coast are very high in several areas. Tourism development means extensive construction, which causes the loss, degradation and fragmentation of natural ecosystems. This can occur in the area where the activity is being undertaken, but also occurs as a result of the disposal of building debris and on site extraction of the resources in the area.

Other problems can occur when tourist operators carry out unsustainable activities in sensitive environments such as off-roading and other similar activities. Solid waste accumulation is also an issue as hotels and resorts generate a significant amount of diversified solid waste, which is often just dumped and not treated.

- Urbanization

Urban development is taking place in the north coast at a very rapid pace, to the extent that most of the structures found currently along the coasts of the region have been erected in the past five to ten years, and new developments are being established at an accelerated rate. Many of these developments were built as a result of land speculation, with the expectations that real estate prices will be higher in the future.

In fact, the Egyptian Mediterranean coast from Alexandria to El Alamein has witnessed a sweeping rate of resort development. The area which was once an empty wilderness has undergone a building boom with thousands of vacation villas and flats being constructed. These tourist villages, however, remain virtually unoccupied during most of the year as the peak season is between June and September. There are plans to develop the rest of the north coast to absorb future population increase in Egypt. Only a few hotels have been developed in the area, and mostly on the Sinai coast and in Alexandria. While privately owned summer homes are the dominant type of development throughout the western sector of the coastline, Northern Sinai and Alexandria are more dominated by hotels and time-share resorts.

The rapid development and urbanization of the coast has led to the complete destruction and degradation of vast areas of habitats in the development area and its surroundings. The degradation of coastal habitats, which are considered essential for many of the marine species such as marine turtles, has reduced water quality, as well as led to high levels of pollution and wastewater resulting from touristic and coastal development activities.

II. Sea turtles in Egypt

1. Context

a. Description of the coast

The Egyptian Mediterranean coast has different geomorphologic aspects ranging from steep-slope-rocky cliffs to gentle sloping deltaic sediments (Fig. 5). The landward limit may be several kilometers in sedimentary beaches and tens to hundreds meters in rocky and cliffy beaches. The Nile Delta, which extends from Alexandria to Port Said, consists of deltaic sandy beaches of medium to very fine sand. It hosts the majority of the country's population and constitutes the bread basket of the country. Coasts along the Mediterranean Sea are relatively extended and comprise deltaic sediments, sand dunes, lakes and lagoons, salt marshes, mud flats, and rocky beaches.

The Egyptian Mediterranean coast is divided into three different geomorphologic regions the western region, which constitutes the coastal 550 km of the Western Desert (known as the North Coast); the middle region represents the Nile Delta coast with a length of 250 km; and the eastern region extends for 200 km in North Sinai.

Saleh (2002) reported that the northern coastal zone of Egypt consists of three geographically distinct regions:

1. The north western coast stretching from the border with Libya up to Alexandria;
2. The Nile Delta coast, which stretches from Alexandria eastwards to Port Said; and
3. The north eastern coast stretching from Port Said to the border with Gaza.

The coastal geomorphology of the entire Mediterranean coast are:

- (rocky cliftedcoasts) for the region extending from El-Alamine to El-Salloum along the North Coast (about 450 km);
- (low cliffs) for the region between Alexandria and El-Alamine (about 100 km);
- (lagoons) for the Bardawil Lagoon (85 km) in North Sinai; and
- (deltaic and sandy coasts) for the remaining coast (365 km), which represent the Nile Delta coast and the delta of Wadi El-Arish in North Sinai extending to Rafah.

b. Marine protected Areas

The Protected Areas have been Egypt's most important and effective tool to conserve its biodiversity, prevent ongoing losses of species and habitats and fulfill its international commitments. As well as, the ecological and social benefits offered by Egypt's PA system are high; they have expanded over the past 30 years in both number and area. By 2013, 30 protected areas were established, covering about 146,000 km^2 or 14.6 % of the total land and marine areas of the country (Fig. 6). At the Mediterranean region, Egypt has relatively good proportion of its as Marine Protected Areas (MPAs)

along the Mediterranean coast Egypt, they are: Salloum, Omayed, Burullus, Ashtoum El-Gameel, and Zaranik.

It is important to be noted that work is currently underway to amend the coastal protected areas that declared on the Egyptian Mediterranean coast to avoid overlapping with various economic activities. It is expected that the effectiveness of protected areas in implementing monitoring programmes will be improved. In addition to the special status of some reserves that are difficult to access on a regular basis, and the implementation of survey activities in them.

1. **Salloum MPA**: It was declared as the first MPA on the Mediterranean in Egypt about 383 Km². The protected area is mainly offshore with a coastal area covering the first 500 m of the coast along 45 km on coastline. This area with frequent evidence of nesting cases of sea turtles, and it needs to carry out regular surveys, and coordination with actors and the local community to monitor the nesting, feeding, stranding, or interaction with fisheries.
2. **Omayed Biosphere Reserve**: It is located some 83 km to the west of Alexandria (or 200 km east of Matrouh). It incorporates a variety of habitat types, animal and plant communities, traditional Bedouin settlements, and patterns of land use. In 1981 it was declared a biosphere reserve by UNESCO.
3. **Burullus (RAMSAR site):** It has a number of environments including saline and cane swamps as well as sand plains. On the Lagoon shores there are high sand dunes. Each of these environments has its own soil characteristics. This reflects on the importance of these environments as a natural place for almost 135 amphibious plant species. The wetland environments have a significant role in receiving immigrating wild birds.
4. **Ashtoum El-Gameel (Lake Manzala):** It occupies the northeastern corner of Lake Manzala close to Port Said, and covers an area of about 35 km2, extending southwards for 3 km into the Lake (thus including Tennees Island) and westwards for 7 km along the Mediterranean shore. This protectorate is regarded as an internationally important wetland owing to the fact that large numbers of birds winter in it.
5. **Zaranik and the Bardawil Lake (RAMSAR site)**: The Bardawil is a shallow water body in the northern coastal part of Sinai Peninsula. It extends between 31° 3' and 31" 14' N, 32°40' and 33°30' E and covers an area of 595 km2. A narrow sand bar separates the shallow lake from the Mediterranean, with a number of openings joining them. One of these openings is found in the outermost eastern section of the lake at Zaranik. This protectorate is an internationally important site for resident and migratory birds and had recently been predictable as a RAMSAR site.
   It is also among the important locations for fishing and quail hunting that attract tourism and traditional Bedouin. The scientific papers and observations prove that the Bardawil area is one of the most famous and important nesting areas for green sea turtles in the southern Mediterranean coasts, as well as many strands have been recorded along the northern shores of the lake.

c. *Sea turtles diversity in Egypt (at the Mediterranean region)*

All the three marine turtle species occurring in the Mediterranean are regularly present along the Egyptian Mediterranean coast too. These species are the Loggerhead turtle (*Caretta caretta*) and the Green turtle (*Chelonia mydas*) that nest on some beaches and the Leatherback turtle (*Dermochelys coriacea*) which is recorded regularly in the Mediterranean with nearly no nesting activity. The Egyptian coast is considered to host important loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) foraging grounds and migratory corridors from/to multiple nesting areas (Laurent et al. 1996; Clarke et al. 2000; Broderick et al. 2007; Rees et al. 2008; Nada and Casale 2011; Nada et al. 2013; Schofield et al. 2013; Stokes et al.2015; Snape et al. 2016). Data on stranding and by-catch also indicates the presence of the leatherback turtle (*Dermochelys coriacea*) (Clarke et al.2000; Nada and Casale 2008; Nada et al. 2013; Rabia and Attum 2015). Two other visitor sea turtles were recorded sporadically in the Mediterranean: the Kemp's Ridley (*Lepidochely skempii*) and the hawksbill (*Eretmochelys imbricata*) (Jribi and Abdelwarith 2017).

Egypt hosts important foraging areas for both loggerhead and green turtles (Margaritoulis et al., 2003; Casale and Margaritoulis, 2010). This information could be confirmed by the high bycatch and dead turtle stranding levels (Nada and Casale, 2008; Clarke et al., 2000; Rabia and Attum, 2015). For the Loggerhead turtles, Clarke et al. (2000) suggested that this species congregate in front of the area between Alexandria and Port Said to feed on the inshore continental shelf. Moreover, genetic markers indicate that loggerhead turtles frequenting Egyptian waters originated from multiple rookeries, such as those in Turkey, Cyprus and Greece (Casale et al., 2008).

For Green turtles, waters in front of the eastern region from Port Said to Rhafa are the most frequented for trophic and reproductive reasons (Clarke et al., 2000). Egypt probably hosts important foraging areas or migratory corridors, as suggested by a satellite tracked nesting turtles from north Cyprus (Godley et al. 2002; Broderick et al., 2007) and Syria (Rees et al., 2008).

d. Sea turtles nesting beaches

The nesting activities along the Egyptian coast was described as low-density and scattered. As mentioned before, the northern coastal zone of Egypt consists of three geographically distinct regions: I) The north western coast stretching from the border with Libya up to Alexandria, II) The Nile Delta coast, which stretches from Alexandria eastwards to Port Said, and III) The north eastern coast stretching from Port Said to the border with Gaza.

The north western coast stretching from the border with Libya up to Alexandria:

The west of Alexandria coast has already been affected by tourist development, and very few beaches remain there that are used for nesting (Kasparek 1993a, 1993b). This region is characterized by high economic importance, which extends from Salloum in the west to Alexandria governorate in the east, especially with the intensive use for coast during summer by domestic tourists, and well as the coastal developments. All of these pressures reduce the nesting probabilities, however, a few nests sites were recorded during the last few years. These sites mainly are Salloum MPA, and Rixos hotel.

The Nile Delta coast, which stretches from Alexandria eastwards to Port Said

From Alexandria to Port Said, no evidence was found to suggest that nesting occurs in the area, probably because the soil has high mud/ silt content and might have rendered these beaches unsuitable for nesting activities (Clarke et al., 2000), however, the highest density of dead stranded turtles (0.138/km) of both species (18 loggerheads, 1 green, 4 unidentified) was recorded in 1998, suggesting that sea turtles frequent inshore waters (Nada et al., 2013).

The north eastern coast stretching from Port Said to the border with Gaza.

- Practically nothing is known regarding the population and ecology of sea turtles in lake Bardawil. Loggerhead (*Caretta caretta*) and green turtles are known to inhabit lake Bardawil, while the sand bar that separates the lake from the Mediterranean Sea is an important nesting site for both species (Rabia and Attum 2015). However, Nada et al., (2013) and Clarke et al. (2000) reported that this area is considered as the main nesting area for both species (Loggerhead & Green turtles) along the entire Egyptian Mediterranean coast is a 22 km stretch of sandy coastline of the Sinai Peninsula, west of Arish city, of which 8 km lies within the boundaries of the Zaranik Protected Area, a protected section of Bardawil Lake.
- Lake Bardawil is one of the most important sources of fisheries in Sinai and Egypt in general. in addition to, specific importance to feeding and nesting for sea turtles mainly green turtles as reported by scientific papers and survey reports of Nature Conservation Sector. Recent changes in the biodiversity of the Bardawil hypersaline lake have led recently to growth in numbers of loggerhead turtles, perhaps because of the increase of their favorite food (shrimps and crabs). Additionally, the Bardawil lake has become an attractive wintering ground for turtles due to the closed fishing season (January – April). Lake Bardawil is connected to the sea through outlets that is about 100 meters wide each. In winter, the whole lake consists of a single water surface and then recedes from its eastern sector in summer (Fouda, 2020).

e. Cultural heritage of Seaturtles (or turtles) in the country folklore

- For more than 100 million years, sea turtles have covered vast distances across the world's oceans. The turtle is an important symbol in the mythologies of many

indigenous cultures, usually representing creation, longevity, and wisdom in these beliefs. Turtles are thus truly ancient beings-both in geological and mythological terms (Jribi and Abdelwarith 2017).

- Both loggerhead (*Caretta caretta*) and green turtles (*Chelonia mydas*) are targeted and there is a higher impact on adults, which are the most valuable reproductive segment of the populations. Alexandria where sea turtle trade was observed or reported. The main points are: El Max, Anfoushi area ‑ includes El Medan market and Eastern harbour and Omar Basha, Abu Qir. Al Miaddiyyah and Idku, where respondents claim there is trade and a storage facility (Boura et al., 2016).
- Blood is consumed in addition to meat. Young women believe that turtle blood (which is usually offered free) will make them gain weight and enhance their appearance. Some others believed that the blood had fertility characteristics. Fewer men drank turtle blood believing it to be an aphrodisiac and general tonic. During 2017, the interviews with the local fishermen indicate that consumption of blood had declined rapidly in recent years. Religion was the reason that 83% of the interviewed didn't consume blood (Jribi and Abdelwarith 2017).

2. Studies on sea turtles

Despite the implementation of monitoring activities for components of marine biodiversity along the Egyptian Mediterranean coasts, especially sea turtles, for more than 20 years, the monitoring process is not continuous, consistent, and uniform.

The monitoring activities carried out depend on individual activities and the availability of financial support from NGOs or relevant regional and international organizations, or otherwise, to implement a specific researching programme for a short period. However, currently, work is underway to provide financial support from governmental agencies. However, these opportunities are very limited due to many administrative procedures and insufficient political support, as well as the limitation of the financial availability to implement those programmes related to the preservation of marine biodiversity in the Mediterranean waters and coasts of Egypt.

The Mediterranean Association to Save the Sea Turtles (MEDASSET) who represents the most active NGO working on this subject. It took the lead to explore the status of sea turtles' nesting in the western region of the Egyptian Mediterranean coast in 1993 in collaboration with SPA/ RAC and the National Institute of Oceanography and Fisheries of Egypt (Kasparek, 1993a, b). Moreover, MEDASSET with Friends of The Environment Association undertook a long-term awareness campaign that targeted the fishermen community in Alexandria.

In 1998, Darwin Initiative for the Survival of Species conducted a three years survey along the Egyptian Mediterranean coast, their main aim was to assess the status of sea turtles nesting there and the threats they encounter. The project undertook awareness campaigns to some of the local communities and organized a workshop on Marine Turtle Biology and Conservation in 2001 with the participation of several governmental representatives.

The World Wildlife Fund (WWF) also commissioned two projects in 1996 and 2007. They were to assess (respectively) the impact of trawling activities on sea turtles, the status of sea turtles along the Egyptian Mediterranean Coast, and the major threats they encounter. The sea turtle by-catch and consumption in Egypt, also studied by Nada and Casale (2011), moreover, Egypt made a pilot study

funded by the Egyptian Environmental Affairs Agency and implementation of The General Authority for Fish Resources Development about the interaction with fisheries during 2021 – 2022.

On status and conservation of sea turtles along the Egyptian Mediterranean Sea coast: results of the Darwin Initiative Sea Turtle Conservation Project 1998–2000, is one of the main surveys that have been implemented by Campbell et al., (2001).

In 2010, the IUCN issued the sea turtles in the Mediterranean (distribution, threats, and conservation priorities) report authored by Casale and Margaritoulis (2010) as one of the very important reports aimed to value and evaluating efforts of marine turtle protection at the regional and national levels in the Mediterranean region.

In 2013, Egypt's Bardawil Lake: Safe Haven Or Deadly Trap For Sea Turtles In The Mediterranean? Issued by MEDASSET as an important assessment included: the collection and analysis of all data and photographic evidence of the rapid sea turtle stranding surveys undertaken over a one-month period (2 October - 3 November 2012) by local authorities and co-authors; interviews with relevant local stakeholders; roundtable discussion with key experts at the national level; and a desktop literature review to define context and background.

Rabia and Attum (2020) studied the size distribution, age, sex ratio, and proportion of sexually mature green and loggerhead turtles that were recently investigated in the Bardawil lake. A total of 30 green turtles (8 males, 4 females, and 18 juveniles/sub-adults) and 14 loggerheads (one male, 8 females, and 5 sub-adults) were captured. Forty percent of the green and 64 % of loggerhead turtles were believed to be sexually mature. The green turtles had a mean curved carapace length of 65.23 (15 – 100) cm range), and the loggerhead turtles 68.79 cm with a much narrow range of (60 – 80 cm) reflecting the absence of juveniles. Results provide evidence that Lake Bardawil is an important feeding and development area for green turtles, and a feeding area for loggerhead turtles and expand our knowledge of such important sites in the Mediterranean basin.

The recent studies indicated to the changes in the biodiversity of the Bardawil Hypersaline Lake have led recently to growth in the number of loggerhead turtles, perhaps because of the increase in their favorite food (shrimps and crabs). Additionally, the Bardawil Lake has become an attractive wintering ground for turtles due to the closed fishing season (January – April) (Attum and Rabia, 2021).

The subject of illegal trade and intentional killing of sea turtles in Egypt and particularly in Alexandria, a hotspot of the phenomenon in the Mediterranean, was investigated for several years by MEDASSET (Mediterranean Association to Save Sea Turtle) (Nada, 2001; Nada, 2003; Nada and Casale, 2008; Nada and Casale, 2011; Venizelos and Kallonas. 1999; Venizelos and Nada, 2000 and Boura et al., 2016).

Rabia and Attum (2015) studied the nesting distribution of sea turtles along the Mediterranean coast and North Sinai region such as

There is also research currently underway on the genetic documentation of the marine turtle community in the Egyptian Mediterranean Sea Naguib et al., (2020).

Many reports, studies, and papers have been issued, but as previously mentioned, they depend on the availability of financial funding for their implementation. There is needed to prepare a bibliography for all studies and research conducted in this field to document the efforts made, facilitate the research and compare results.

Institutions and scientists involved in the study of sea turtles in Egypt

There are many Egyptian national institutes and authorities interested in studying sea turtles in the Egyptian Mediterranean coast, including:

- The Egyptian Environmental Affairs Agency (EEAA), which is concerned with the management and protection of sea turtles at the national level, represents the national focal point in many related agreements.
- The National Institute for Oceanography and Fisheries (NIOF) is the national body concerned with studying the scientific aspects of the marine environment and marine biodiversity especially those endangered species in Egypt.
- The General Authority for Fisheries Resources Development (GAFRD), which is the national authority concerned with managing economic fisheries, is able to easily access and communicate with the marine fishing sector, provide all information, and study and assess the interaction of fishing with sea turtles.
- Faculties and departments of marine sciences in the coastal universities in the Egyptian Mediterranean cities, through their interest in enrolling post-graduate studies in various marine ecology fields, including marine biology.
- Faculties of veterinary, through their interest in the study of marine wildlife.
- Research centers related to genetic studies.

Fields of study

The scientific research and field studies are very limited in Egypt and are carried out through individual efforts. Most of these studies are done on monitoring or stranding animals, etc., and all of other scientific research areas still need more interest from the administrative and scientific bodies in Egypt. These areas include:

- By-catch,
- Beaches survey & nests monitoring Climatic changes,
- Anatomy and pathology,
- Genes and isotopes,
- Satellite tracking

3. Nesting

Loggerhead and Green turtles nest along the beaches of the Egyptian Mediterranean coast. However, despite the presence of several hundred kilometers of seemingly suitable nesting beaches; nesting activity is considered low compared to other Mediterranean sites. The data available indicates that; (i) low nesting activity occurs in the western coast of Alexandria. (ii) No evidence indicates nesting activity in the area from Alexandria to Port Said, (iii) The most important nesting area along Egypt's Mediterranean coast is in the beaches of North Sinai (Rabia and Attum, 2015). In North Sinai area, a survey carried out in 2012 by Rabia and Attum (2015) indicates a similar number of Loggerhead (N=66) and Green turtles (N=7) nests to the records in 1998 (Loggerhead N=67, Green Turtle N=7) (Clarke et al., 2000; Campbell et al., 2001). Of the entire Egyptian Mediterranean coast, this main nesting beach is a 22 km stretch of sandy coastline located west of El-Arish city, of which 8 km lies within the boundaries of the Zaranik protected area (Clarke et al., 2000).

During periods from 2018 to 2022 many surveys have been conducted mainly with the support of the Regional Activity Center for Specially Protected Areas (SPA/ RAC) through the conservation of marine turtle MAVA funded project.

During 2018, a new nest was recorded in the km 142 at the Rexos Hotel area within Sector B "from Matrouh to western Alexandria". It was considered a new active nesting site. As well, one stranded loggerhead turtle has been recorded in El-Salloum MPA.

In 2019, a detailed survey aimed to cover the areas that were visited in 2018 and to survey new areas covering approximately 50 - 60% of the total length of the Egyptian Mediterranean coast. This survey covered; parts of Bardawil Lake (about 59.94 km) with three nests, Port Said, Damietta, El-Deeba village as one of the active areas for nesting in the past (from 15 – 20 years ago), Nile delta coasts including Gamasa, Baltim, Rashid, and Alexandria and west coast including Abu Qir, Alexandria city, Al Hammam, Sidi Abdel Rahman, El-Alamein, Dabaa, Bagoush, Marsa Matrouh, Al Mathani, Al Nigila, Sidi Barani, Baqbaq, and Salloum. Along the Egyptian Mediterranean coast, several cases of live-stranded sea turtles were recorded by the national network.

From 2020 to 2022, a quick beach survey and contacts have been implemented (due to the situation of Covid-19 at that time) based on the contribution of the stakeholders and previous studies. Four new nests were recorded during this survey resulted.

a. Describe nesting beaches

Table 1 indicates the most important nesting beaches that have been recorded over the few past years as nesting and/ or tracking by sea turtles, taking into account the special situation of some of the famous recorded areas previously:

Table 1: Description of the most important nesting beaches along the Egyptian Mediterranean coast

Serial	Beach name	Location	Coordinates (index point)		nature of the beach	distance to nearest town	current status
1	Rafa	North Sinai - Mediterranean coast	31° 19' 16"N	34° 13' 01"E	Fine grained Sand	Closed to Rafah city	Non -protected
2	El-Shikh Zwayed	North Sinai - Mediterranean coast	31° 13' 11"N	34° 02' 47"E	Fine grained Sand	About 10 km to Rafah city	Non -protected
3	El-Shalak	North Sinai - Mediterranean coast	31° 11' 45"N	33° 58' 29"E	Fine grained Sand	About 15 km to Arish city (East)	Non -protected
4	El-Kharruba	North Sinai - Mediterranean coast	31° 09' 27"N	33° 51' 36"E	Fine grained Sand	About 5 km to Arish city	Non -protected

5	El-Masida	North Sinai - Mediterranean coast	31° 06' 47"N	33° 36' 56"E	Fine grained Sand	About 15 km to Arish city (West)	Non -protected
6	Abo Felfel	North Sinai - Mediterranean coast (East of Bardawil Lake)	31° 07' 24"N	33° 29' 17"E	Fine grained Sand	About 30 km to Arish city	Protected
7	Zaranik Protected Area	Bardawil Lake Beach - North Sinai	31° 011' 34"N	33° 21' 34"E	Fine grained Sand	About 45 km to Arish city	Protected
8	Bughaz 2 (East)	Bardawil Lake Beach - North Sinai	31° 12' 6.92"N	33° 18' 31.60"E	Fine grained Sand	About 5o km to Arish city	Protected
9	Bughaz 2 (West)	Bardawil Lake Beach - North Sinai	31° 12' 52.91"N	33° 16' 9.15"E	Fine grained Sand	About 60 km to Arish city	Protected
10	Kals	Bardawil Lake Beach - North Sinai	31° 13' 43.88"N	33° 8' 15.08"E	Fine grained Sand	About 65 km to Arish city	Protected
11	El-Shagra	Bardawil Lake Beach - North Sinai	31° 05' 06"N	32° 47' 46"E	Fine grained Sand	About 18 km to Bir al-abd	Protected
12	Bardawil Lake Beach - North Sinai	Bardawil Lake Beach - North Sinai	31° 11' 8.15"N	33° 0' 58.41"E	Fine grained Sand	About 18 km to Bir al-abd	Protected
13	Bughaz 1	Bardawil Lake Beach - North Sinai	31°10' 2.60"N	32° 58' 28.96"E	Fine grained Sand	About 17 km to Bir al-abd	Protected
14	Bughaz 1 - Dahab	Bardawil Lake Beach - North Sinai	31° 8' 39.84"N	32° 55' 23.40"E	Fine grained Sand	About 16 km to Bir al-abd	Protected

15	Aghzaiwan	South Bardawil Lake - North Sinai	31°10' 53.11"N	33° 5' 37.75"E	Fine grained Sand	About 18 km to Bir al-abd	Protected
16	Mohmadyet	North Sinai - Mediterranean coast	31° 03' 34"N	32° 41' 05"E	Fine grained Sand	About 30 km to Bir al-abd	Non -protected
17	Romana	North Sinai - Mediterranean coast	31° 04' 19"N	32° 33' 47"E	Fine grained Sand	Closed to Romana city	Non -protected
18	El Karawan Beach	West Alexandria	30° 52' 16.81"N	29°19' 20.07"E	Fine grained Sand	About 65 km to Alexandria city	Non -protected
19	Rixos Beach	West Alexandria - Dabaa	31° 02' 16.3"N	28° 35' 15.5"E	Fine grained Sand	About 50 km to Dabaa city	Non -protected
20	Bagoush beach	East of Matrouh city	31° 10' 43"N	27° 39' 53"E	Fine grained Sand	About 50 km to Matrouh city	Non -protected
21	East of Salloum city	Baqbaq beach	31° 32' 16.58"N	25° 34' 4.13"E	Fine grained Sand and mixed with sand stones	About 40 km to Salloum city	Protected
22	East of Salloum city	Abu zeriba beach	31° 30' 17.31"N	25° 24' 46.32"E	Fine grained Sand and mixed with sand stones	About 25 km to Salloum city	Protected

From the regular observation, in most of those areas mentioned above in the table, the nesting seasons start from the end of the spring and continue throughout the summer season of each year. The hatching starts to leave their nests from the middle of the summer season until the middle of the autumn season. Moreover, there is no shifting was recorded in the mentioned periods.

In the North Sinai, Clark et al (2000) implemented a general division of the beaches in this area, started from the Rafah city to Romana, where Rabia and Attum (2015) followed the same divisions

(Table 2). The results of the nest surveys were compared during the period from 1998 to 2012 as shown in the following table:

Table 2: Distribution and density of sea turtle nests in North Sinai between 1981 - 2012

	1998	2012	1998	2012	1998	2012
Rafa	3	2	0	0	0	0
El-Shikh Zwayed	7	6	0	0	0	1
El-Shalak	8	3	0	0	0	0
El-Khorouba	2	18	0	2	1	0
El-Masida	5	3	0	1	0	0
Abo Felfel	22	5	7	0	0	0
Zaranik Protected Area	1	0	0	0	2	0
Boghaz 2 (East)	0	2	0	0	0	0
Boghaz 2 (West)	8	11	0	2	0	0
Kals	4	2	0	1	0	0
El-Shagra	5	3	0	1	0	0
Mohmadyet	1	0	0	0	0	0
Romana	1	6	0	0	0	0
Total	67	66	7	7	3	1

There is still needed to implement a programme of regular monitoring of sea turtle nesting areas and to prepare continuous databases.

4. Threats

Although sea turtles live most of their lives in the open water, adult females must return to land in order to lay their eggs. Threats while on land that mainly affect the females who are coming to lay their eggs or the new hatchlings after they emerge and are on course to the sea, these threats affect all the population and therefore affect juvenile and adult males.

There is clear evidence of important human-caused negative impacts on the populations of sea turtles. The most serious current threats/effects to turtles in Egypt's Mediterranean coasts as for other Mediterranean areas are:

- Deterioration of the critical habitats for the life cycle of sea turtles, such as nesting, feeding, and wintering areas, including key migration passages.
- Direct impacts on turtle populations, by incidental capture in fisheries, intentional killing, meat, blood and egg consumption, and boat strikes.

- Pollution, which can have an impact on both habitats and species.

Threats concerning sea turtles can be divided thus into two categories: Threats in terrestrial habitats and threats in marine habitats, as follows:

a. On nesting beaches

- Coastal development

Beaches of the Egyptian Mediterranean coasts are the destination of millions of local and foreign visitors during summer, coinciding with the nesting season of sea turtles. The extensive urbanization of the coastline, especially in areas with sandy beaches, constitutes a serious threat. Many causes can make certain beaches unsuitable for turtle nesting, for the incubation of eggs, or for the successful emergence and movement of hatchlings to the sea. Hotels, touristic villages, restaurants, and cafes, overlooking beaches are characteristic of much of the Egyptian coasts. The number and extension of existing and new buildings near the beaches in Egypt is enormous.

Many areas near nesting beaches are occupied by marinas and other kinds of infrastructure. The western part of the Egyptian Mediterranean coast is heavily developed for tourism and the sea defense constructions on the Nile Delta beaches seems to deter nesting. Beachfront developments are likely to impact and degrade important nesting beaches in Egypt (Campbell et al., 2001).

In addition, the pressure on the most important nesting beach located west of Areash City is increasing, which is significantly affecting the number of nesting records every year (Nada and Casale, 2008).

The problems caused by such development include stationary lights (streetlights, hotels, apartments, houses, etc.), moving lights (cars, etc.), movement of holidaymakers on beaches at night (and day) and barriers of sunbeds and umbrellas, physical alteration of nesting beaches and environment (Jribi and Abdelwarith, 2017).

The environmental impacts on coastal areas will be further exacerbated by increased levels of urbanization, the volume of transport and consequently fuel consumption and CO_2 emissions, cruising and pleasure boating, as well as increased levels of groundwater consumption and wastewater and solid waste generation and disposal. It is evident that from current and expected future urban development in general and that which is associated with tourism along the Egyptian Mediterranean coast, that if proper measures and actions are not introduced, environmental damage to the coastal zone will continue with irreversible damage to some of the natural ecosystem. Policies, therefore, need to be developed and implemented to promote sustainability and ecotourism that recognizes the importance of the environment and natural resources as being the backbone for the economic viability and further development of the sector and the economy (Abaza, 2015).

- Predation

Ghost crabs preying on hatchlings were reported on nesting beaches in Egypt. This predation presents a massive threat to the turtle population; the mean of the different estimates of predation is 66.6%, which can be taken as the level of predation along the entire Mediterranean coast of Egypt (Simms et al., 1997).

- Human exploitation

Evidence was found that in addition to human predation on adult turtles caught at sea, nests in northern Sinai were also raided for eggs; signs of human disturbance were found at ten nests during a survey conducted in 1998 (Clarke et al., 2000). Nada and Casale (2008) found that this practice was still continuing in 2007. A case of collecting turtle eggs was recorded in North Sinai during quick survey in 2020.

- Intentional killing and Illegal trade

Sea turtles in the eastern Mediterranean suffered severe exploitation until about the mid-1960s (Margaritoulis et al., 2003). The Trade of sea turtles in Egypt has been known to occur since the early 20th century and turtle consumption in Alexandria has been recorded since the 1970s (Boura et al., 2016). Before this date, it is unclear if the consumption of turtles in Egypt was due to local people's habits or via Europeans living in Egypt. However, at least since the 1970s, in some places (especially Alexandria) turtle consumption has become a tradition (Nada and Casale, 2010). According to this report's investigations and surveys, trade, and consumption of turtles are also important in other localities such as Damietta and Port Said. However, this behavior is almost absent on the western Egyptian coast approaching the Libyan borders. Both Loggerhead and Green turtles are sold in some fish markets, despite legislation prohibiting this. It is estimated that several individuals are killed each year in Egypt. The impact on adults, which are the most valuable reproductive segment of the population's proportion (Crouse et al., 1987; Heppell et al., 1996), is high (Laurent et al., 1996; Boura et al., 2016). There was a couple of observations for using carapace of dead sea turtles in the production of artifacts for good luck and by asking those who had them they said it was a gift from their great grandparents. There is both public and hidden trade of sea turtles for consumption and for accessories/ decorations.

Fishermen land 90% of by-caught turtles instead of releasing them and reported an annual catch rate of 4.51 turtles/vessel (total 216.5 turtles/year by 48 interviewees). Fishmongers and artefact sellers also reported obtaining turtles from other Egyptian fisheries. Both loggerhead (*Caretta caretta*) and green turtles (*Chelonia mydas*) are targeted and there is a higher impact on adults, which are the most valuable reproductive segment of the populations. The rare leatherback (*Dermochelys coriacea*) is also traded, as revealed by a police operation that was carried out by Egyptian authorities in May 2015 after MEDASSET submitted preliminary survey results. Fishermen either slaughter turtles on-board and consume or sell the meat directly to customers, or land turtles alive and sell them to fishmongers. Three fishmongers are specialized in turtle trade and at least 36 trade sporadically. Turtles are kept alive and emaciating from 1 to 30 days until slaughter. Interviews indicate that trade has increased by 60-120% in comparison to surveys in 1998-9 and 2007. Eighty-six percent of interviewees have consumed sea turtle meat, even though 90% were aware it is illegal and 79% knew sea turtles are endangered. Main drivers are tradition or alleged health benefits. The survey indicates that the community does not depend on turtles as a food source and the trade is not considered an important income, except by the few "specialized" fishmongers.

Blood is also consumed in addition to meat. Young women believe that turtle blood (which is usually offered free) will make them gain weight and enhance appearance. Some others believed that the blood had fertility characteristics. Fewer men drank turtle blood believing it to be an aphrodisiac and general tonic. Interviews with the local fishermen indicate that consumption of blood had declined rapidly in recent years. Religion was the reason that 83% of the interviewed did not consume blood.

In fact, the establishment of the Egyptian Environmental Affairs Agency (EEAA) and its branch in Alexandria, in 1994 had a great impact in increasing interest in eliminating these wrong behaviors. In addition to, the international commitment on Egypt to protect these species, pressure from national

NGOs, and the enhanced capacity on marine turtle issues of a group of government officers who were involved in a survey by research institutes and the EEAA (Clarke et al., 2000). The recent enforcement of law has probably reduced the total number of turtles traded but it has not stopped the trade completely which continues in the black market.

b. On Sea threats

- Pollution

Feeding grounds often occur in shallow, near shore, or shoreline coastal areas, which are heavily threatened by human activity such as fishing, recreational activity, chemical and marine debris pollution, and physical habitat degradation (Groombridge and Luxmoore 1989).

The Egyptian coastline is severely polluted with non-biodegradable debris such as plastics, rubber, and oil tar (Clarke et al., 2000). A survey on eight beaches along a 135 km stretch from the town of Rafah to the first inlet of Bardawil Lake reveals that plastics and polythene were the dominating pollutants and beach surface areas covered by pollutants ranged from 5.3 to 9.3%. There was also a significant correlation between pollution and the presence of ghost crabs as predators (R = 0.88) (Simms et al., 1997).

- Interaction with Fisheries (By-catch)

There is no fishery that targets sea turtles in Egypt directly. Almost all fishermen stated that they do not intentionally aim for sea turtles and they just found them in their nets or hooks accidentally. In a few cases, the fishermen of Alexandria do catch turtles swimming on the surface near their boats (Nada and Casale, 2010; Boura et al., 2016).

The little information on the interaction between sea turtles and fishing gears in Egypt were based on interview studies targeting the fishermen. The total number of captures by different fishing gear was estimated to be 5278 per year and the most involved gears were trawls and long lines (Nada and Casale, 2008). Boura et al. (2016) also stated a catch rate of 4.06 unique turtle captures/vessel. Fishermen reported that some of the caught individuals were dead and the incidence of mortality is particularly high in long lines and gillnets. Laurent et al., (1996) reported also a mortality rate among turtles captured by trawlers of 0-10%.

- Other threats

Among the many natural threats that affecting marine biodiversity, including sea turtles, the climate changes accompanied by sea-level rise, and the introduction of non-Indigenous Species are considered as the additional threats facing sea turtles (Fouda, 2020).

5. Stranding

Stranding cases are considered as sources of a primary source of information and knowledge of marine turtle populations living in any area. Such knowledge is important to understand the ecological and ecological situation of this endangered species and assist in the development of sea turtles conservation programmes. It is also an opportunity to implement the tagging programme before releasing sea turtles (if they are stranded alive).

In general, and due to the lack of advanced research programmes related to sea turtles at the national level, there are no continuous recordings of sea turtle stranding cases (live or dead) based on the scientific base. The stranding sea turtles are recorded during coastal surveys by MPAs rangers or

through reporting from one of the stakeholders to the Environmental Affairs and Marine and coastal protected areas along the Egyptian North Coast, including fishermen, border guard points, tourist villages, volunteers, etc.

Stranding of sea turtles occur along the Egyptian Mediterranean coast, although they may be higher in the delta region. The number of dead turtles recorded is increasing on beaches with high density.

Some of these cases enjoy official registration at the state level, due to the association of the delinquency case with strange circumstances, either in terms of number, location, or otherwise. Among these cases, what happened along the Bardawil Lake in October 2012, over 90 sea turtles were found dead and in various stages of decomposition on the shores of Lake Bardawil, suggesting that their deaths may have been occurring for several months (Sarant, 2012; Yahia, 2012, and Nada et al., 2013). Lake Bardawil is one of the less polluted bodies of water in the country, so pollution seems improbable as a major source of mortality. In addition, the dead turtles were counted in a single small area and not found dead randomly across the lake. Of the 96 dead turtles found, only 74 could be clearly identified through photographic evidence. The vast majority found were Loggerheads. However, a few Green Sea Turtles and one Leatherback were also identified. Four turtles had been decapitated and one died from a head trauma caused by a blunt object. The conclusion reached was that turtles interfered with the catch of fishermen, driving fishermen to eliminate their competition (Zedan, 2014 Zonkle, 2014 and Fouda, 2017).

A recent survey occurred between 2 July 2018 and 30 August 2018 on the public beach of El-Arish, Egypt's Mediterranean coast through the participation of the trained lifeguards were on the identification of the local cetacean and marine turtle species as part of a citizen science program that incorporated volunteers for shoreline surveys. The main results represented by no recorded live observations of loggerhead turtles *Caretta caretta* but nine dead have been recorded stranded turtles (three in July and six in August), for an average of a stranding occurring roughly every seven days (Rabie and Attum, 2019).

In addition, there are many stranding cases that are either just only recorded irregular (without any scientific actions) or not reported at all. These cases are dealt with through the local community or border guard on beaches. In fact, the stranding data is not based on recording the stranded turtles only, but also on the turtles that came out by-catch or during controlling campaigns of markets (illegal trade).

In this context, and given the importance of gathering the efforts to deal with stranding cases in a scientific manner, the sea turtle stranding network was prepared along the Egyptian Mediterranean coast within the framework of a MAVA project and supporting of Specially Protected Areas Regional Activity Center (UNEP/ MAP - SPA/ RAC)

This will improve communication and information flow, specimen collection, provide regular reporting on stranding, and improve the scientific research on the different biological and ecological fields.

<u>The actors involved in the management of stranding</u>

- The border guards through their points who are stationed along the Mediterranean coast.
- Environment police and water bodies and their departments in the various northern lakes.

- Researchers and rangers working in the five protected areas along the Mediterranean Sea (Zaranik, Ashtoum Gamil, Burullus, Omayed, and Salloum).
- Representatives of the fishermen and their associations and unions along the Egyptian Mediterranean coast.
- National Institute of Oceanography & Fisheries (NIOF).
- Marine scouts branches along the Egyptian Mediterranean coast.
- Students and teachers in the faculties of science, agriculture, and veterinary in different universities along the Mediterranean coast.
- Representatives and contact points for the tourist villages that occupy a large area along the Mediterranean coast.
- The main and regional offices of the General Authority for Fish Resources Development (GAFRD) at different ports.
- Communities of local people and Bedouins who live in villages and sites adjacent to or close to the Mediterranean
- Non-governmental organizations (NGOs), civil society associations and, volunteers, as well as, individuals who interested in marine life issues and natural resources.

6. Conservation efforts

a. National level

Egypt has a large national, regional, and international agenda aimed to protect components of marine and coastal biodiversity, including sea turtles. Egypt issued laws and regulations at the national level, as well as, ratified relevant international and regional conventions.

On the national scale, the protection of sea turtles is currently applied through the enactment of several laws, and regulations as follow:

- Law No. 53/1966 (the Agriculture Law): Species protection, mainly birds beneficial to agriculture, but also those which are globally threatened.
- Law No. 102/1983 for Natural Protectorates establishing the legal framework for the creation and management of protected areas. The law explicitly prohibits any action that would endanger species or destroy landscapes within the protected areas. The Egyptian Environmental Affairs Agency (EEAA) is the competent body for the implementation of the law.
- Law No. 124/1983 on Catching Fish and other marine creatures: Regulates hunting at lakes, fish farms, and other inland wetlands.
- Minister of Agriculture Decree 1403/1990 which provides protection of 14 reptiles' species including the green turtle.
- Law No. 4/1994 for the Environment which amendment by law No. 9/ 2009 and their amendments: This law is the most significant law of all the legislation concerning the conservation of the environment in Egypt. It includes provisions concerning international conventions, Environmental Impact Assessment procedures, hunting management, and species protection. It also explicitly forbids the hunting, shooting, catching, possession, transport, and sale of wild birds and other animals including sea turtles.
- National Action Plan for the Conservation of Sea Turtles in the Egyptian Mediterranean Coast (2017 - 2022): This national Action Plan (NAP) for the

conservation of marine turtles in the Egyptian Mediterranean waters was prepared in the context of the implementation of the Action Plan for the Conservation of Sea turtles in the Mediterranean elaborated by the Regional Activity Centre for Specially Protected Area (SPA/RAC).

- In cooperation between EEAA and the Dar Al-Iftaa, the fatwa of prohibiting hunting, consuming, or trading in sea turtles was issued. This document is take into account all relevant national laws and legislation (environmental and fisheries laws), religious position, and the social aspects.

b. International level

Egypt is committed to the conservation of sea turtles through the signed and ratified relevant regional and international conventions that focus on biodiversity conservation, which include specifications for the protection of sea turtles:

- The Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean in 1976 and its amendments in 2000, including the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean. Egypt also adopted the updated Action Plan for the Conservation of Marine Turtles in the Mediterranean (UNEP-MAP RAC/SPA, 2007).
- Convention on Biological Diversity (CBD) 1992. Entered into force in 1993.
- Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS) 1979. Entered into force in Egypt in 1983.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1973. Entered into force in 1975.
- The Agreement on the Conservation of Marine mammals of the Black Sea, Mediterranean Sea, and Contiguous Atlantic Area, also known as ACCOBAMS (Monaco, 1996), a special agreement established under the framework of CMS, its "parent convention", aimed at the protection of all marine mammal species found in the Agreement area. Ratified by Egypt in June 2010. This agreement also considers the negative effects related to human activities on sea turtles as well as cetaceans, including interaction with fisheries, underwater noise, pollution, ship strike, etc.
- Convention on Wetlands of International Importance (Ramsar) (1971). Entered into force in 1975.
- Convention concerning the Protection of the World Cultural and Natural Heritage (WHC) (1972).
- African Convention on the Conservation of Nature and Natural Resources (1968).
- Egypt is a member of the General Fisheries Commission for the Mediterranean (GFCM) of the United Nations Food and Agriculture Organization (FAO) since 1951 and supports all decisions related to insure sustainable fishing and protecting the marine turtles and reducing by-catch.
- Egypt becomes a member of the International Commission for the Conservation of Atlantic Tunas (ICCAT) since 2007, and support for all decisions to protect and monitor marine organisms, including sea turtles.

The importance of preparing a national action plan has been confirmed as a result of the limited and individual efforts to implement activities related to sea turtle management, in addition to the absence of a general framework with a clear vision, targets, activities, and priorities that combine to protect sea turtles.

The NAP was prepared based on a field survey in 2017 and through concentration meetings with the main stakeholders (sea users, professionals, fishermen, administrators, researchers, NGOs) held during January 2017 from Port Said to Salloum. This NAP was adopted in 2017.

The Action Plan aims to achieve a favorable conservation status for marine turtle species and their habitats in the Mediterranean Sea, and enhance their protection in the Egyptian Mediterranean area through legislative and management actions, research, capacity building, and awareness-raising and education (Table 3). In order to reach these conservation goals, the following targets were set: (i) Identifying anthropogenic impacts on sea turtles and their habitats, and undertaking mitigation measures; (ii) ensuring that human activities are managed, so that human-induced mortalities are reduced; (iii) monitoring, protecting and restoring marine turtle habitats, if needed; (iv) enhancing the governance and capacity framework for marine turtle conservation, and (v) enhancing cooperation and coordination at national and regional levels. The National Action Plan was adopted at the national level in consultation with relevant stakeholders at the validation workshop held in Cairo in October 2017, for a period of five years (Abdelwarith and Jribi, 2020).

The action plan addressed many important points that define the general framework of the monitoring programme, the importance of filling information gaps, building capacities, and providing the necessary tools to protect sea turtles, including the establishment of a care center and a gene bank (if possible), in addition to raising public awareness and law enforcement, etc.

Table 3: Structure of the National Action Plan (NAP) for the conservation of marine turtles

Categories/Actions	Sub-actions
1.Legislativeactions	
1.1Harmonizing national legislation with the SPA/BDP protocol, ratify conventions, obligations and provisions	
Analyzis of the current relevant national legislation concerning marine turtles' conservation	
Harmonization of the legislation with the National Action Plan, if needed	
2.2Management actions	
2.1Launching national stranding network	
The preparation of a stranding programme	
The establishment of a tissue bank	
Periodical publication of an Egyptian Mediterranean Coast stranding report	

	2.2 Implementation of nesting monitoring programme	
		Preparation of a national monitoring programme
		Training of Egyptian personnel into on-beach monitoring techniques
		Implementation of the national monitoring programme
		Annual publication of the activities carried out by the programme
	2.3 Establishing a tagging programme	
		Launch of a national tagging programme
		Organization of a training course on tagging techniques, nesting monitoring, Fishing interaction assessment and strandings
	2.4 Establishment of Marine Turtle First Aid Centre	
		Search for an appropriate local for the center
		Acquisition of materials and necessary equipment
		Training of veterinary personnel into sea turtle medical care
		Selection of personnel for training on running and managing the rehabilitation center
	2.5 Establishing specially protected areas for marine turtles	
		Identification of hot-spots for sea turtles' in Egyptian Mediterranean waters
		Evaluation of the existing and potential threats to sea turtles in indentified critical habitats
		Establishing of specially protected areas ,if needed
3.Research		
	3.1 Investigating turtle biology and mortality based on strandings cases including pathology, mortality, biology and genetics	
		Creation of a tissue bank for pathological, toxicological and genetic studies
		Necroscopical analysis of all possible stranded turtles for the determination of the cause of death
		Promote of studies by Egyptian specialists on the pathology, mortality, biology, and genetics of sea turtles
	3.2 Studying sea turtles– fishery interactions	
		Conduct interview-based surveys with the local fishing community along the Entire Mediterranean coastline of Egypt
	3.3 Studying nesting activity	

		Assignment of a national coordinator to oversee the teams, gather the data and prepare annual nesting reports
		Tagging programme underway and operating
4. Capacity building		
	Institutional capacity building	
		Aimed at public administration, management bodies of existing protected areas, research and teaching institutions, and advocacy organizations
	4.2 Individual capacity building	
		Aimed at law enforcers, researchers and media
5. Awareness and education		
		Aimed at decision makers, fishing communities, schools and general public

Actors of conservation (administrations, universities, association, international organizations)

The National Action Plan indicated the most important sectors that are concerned and have to be integrated into the protection processes of sea turtles in the Egyptian Mediterranean areas, which include all concerned parties and stakeholders, including administrative, research, and civil society bodies, etc. These entities have been previously mentioned as:

- Protected areas along the Mediterranean Sea (Zaranik, Ashtoum Gamil, Burullus, Omayed, and Salloum).
- The General Authority for Fish Resources Development (GAFRD) at different ports.
- The border guards.
- Environment police and water bodies.
- National Institute of Oceanography & Fisheries (NIOF).
- Coastal Universities and marine science faculties.
- Fishermen and their associations.
- Bibliotheca Alexandrina.
- Marine scouts branches along the Egyptian Mediterranean coast.
- Tourist villages.
- Non-governmental organizations (NGOs)
- Local community & volunteers.

Monitoring Network, nesting beaches, stranding, etc.

In 2017, the SPA/ RAC provided the necessary support for the preparation of the National monitoring programme for biodiversity and non-indigenous species in Egypt with the aim of implementing the Ecosystem Approach (EcAp).

This programme included a special part for designing a monitoring network for sea turtles along the Egyptian Mediterranean coast, identifying the most important proposed areas, monitoring periods, necessary tools, etc. The turtle monitoring program was prepared and approved by the participation of all administrative and scientific bodies, researchers in MPAs, fishermen, civil society, etc.

The headline of this monitoring programme included the following:

- Main Goal:

Integrated Monitoring programs for Marine Turtles along Egyptian Mediterranean Coast.

- Specific objectives:

- Establish a tagging marine turtles program in the proposed sites (when possible).
- Establish a long-term monitoring program for nesting beaches and standardization of monitoring methods.
- Mapping known nesting sites on national land use map (spatial planning).
- Study ecology, biology and behavior of marine turtles.
- Carrying out genetic analysis (when possible).
- Establish data collection methods on stranding.
- Setting up a stranding network.
- Agree on standardization of methodologies to estimate demographic parameters for population dynamics analysis, such as modeling.

- Sites

Based on the above, the proper sites for monitoring marine turtles in the Egyptian Mediterranean Sea are along the northern Sinai, particularly at Bardawil Lake and Zaranik protected area. The representative sites criteria and the basic questions mentioned in indicator monitoring apply to Bardawil and Zaranik, such as these sites suffering from human pressures (fisherman), historic data are available, the sites have biodiversity importance and conservation interest, as well as the presume of experts on marine turtles. Other sites along the Egyptian coast will be explored.

There exist considerable experiences in turtle monitoring in Egypt, where Rangers of Protected Areas in both the Red Sea and Mediterranean Sea have been involved in marine turtles for more than 10 years particularly in the Red Sea. Rangers can work together in monitoring of the 3 marine turtle species Loggerhead *Caretta caretta*, Green *Chelonian mydas* and Leatherback *Dermochelys coriaca*. They will need basic equipment including a differential GPS (DGPS), and tagging equipment.

- Frequency:

Double surveys will be carried out annually as:

- Form 1st May to 15th July, first priority, and
- From 1st August to 15th October.

1. Habitat distribution range

1.1. Locating and assessing habitats of marine turtles

The monitoring program will focus on only Bardawil and Zaranik Protected Areas. Visits will be also made to the fish markets in Alexandria and Port Said where marine turtles are frequently sold to the public for superstitious preseason (e.g. women believe they can be pregnant if they drink turtle blood).

Evaluating the status of habitat areal extent

Efforts will be made to identify and assess all human pressures in the two sites, as well as the surrounding coastal and marine areas. Areal extent will be calculated based on the pressure of turtles, by using a differential GPS to generate maps. Methods used for habitat mapping will be used.

1.2. Assessment (Generate maps and vulnerability)

Maps will be generated based on the pressure on every site, based on the results of habitat mapping.

2. Conditions of habitat's typical species and communities

This will be done by examining the overall biota (benthic fauna and flora, and fishes) with a focus on the favorite food of sea turtles. Information gathered will be assessed to be able to report on the condition of the turtle habitats.

3. Species distribution range

A minimum information standards will be made using different methods such as location of each of the 3 species of turtles per unit areas using boats, data from fishermen sighting, specific known breeding and wintering areas. Assessment will be based on annual comparison.

4. Population abundance

Parameters used to estimate population abundance are population size (number of individuals), population density (number of individuals / unit area), breeding are census, wintering area census, foraging census (when possible), migration monitoring, tagging, and satellite tracking (when possible).

5. Population demographic characteristics

Parameters use will include body size, age structure (when possible), sex ratio, fecundity and mortality.

<u>Resources needed</u>

- Research / or fishing boats
- Adequate equipment needed for condition of habitats (e.g. DGPS, Cameras, core samplers, grabs, dredges, etc).
- Basic laboratory infrastructure for turtles.
- Qualified personnel for field work, data processing and interpretation.
- Human resources.
- Permissions,
- Tagging system,
- Capacity building.

With regard to the stranding network, it was previously mentioned that a stranding network has been prepared for sea turtles with the support of (SPA/ RAC).

This network has been prepared in 2022, and aims to achieve many objectives, included:

Data collection according to STSN protocols.

- Improving understanding of the causes of death and threats to sea turtles in the marine environment.
- Linking the impact of human activities on sea turtle stranding rates.
- Monitoring stranding trends.
- Provide initial assistance to stranded sea turtles.
- Providing samples and parts of sea turtles for conservation research (pathogenic, genetic, isotopic samples, etc.).
- Availability of data in a timely manner for preservation management purposes.

In this plan, 17 main and subsidiary points were identified, distributed along the Egyptian Mediterranean coast (Figure 7).

Figure 7: The seventeen points of the stranding networks that identified along the Egyptian Mediterranean Coast.

Rescue centers

There is no denying the importance of establishing care centers for caring for sea turtles along the Egyptian Mediterranean coast, which reaches nearly 1,100 km.

Despite this, Egypt does not yet have an independent center for providing this care and rehabilitation for the live-stranded sea turtles. All turtle care efforts are based on personal experiences and often self-financing, which limits the ability of sea turtles to be well protected.

It is important to the establishment at least two turtle care centers cover the entire Mediterranean coast, in Ashtoum El-Gamil Protected area in Port Said Governorate, and the second in Alexandria Governorate, given the importance of these sites for providing the necessary care for stranded sea turtles along the Egyptian Mediterranean coast.

Tracking of beach temperatures

The study of beach temperatures and linking the effect of climatic changes on the sex ratio in hatching is very important to determine the current status of sea turtle communities and to predict, on a scientific basis, future scenarios for sea turtle trends. Egypt has to places a priority on studying beach temperatures within its national monitoring plans.

Awareness actions and capacity building

In the framework of the implementation of the monitoring programme and the national action plan, many measures and activities have been implemented to support the protection of sea turtles, integration of the scientific and local communities in the protection operation and, raise public awareness of the importance of these endangered species. These activities includes:

- Awareness and capacity building

A national training was taken place during 2018, with the participation of relevant stakeholders (MPA Managers, Research centers "NIOF & GERC", Academic and Universities Professionals, GAFRD, Marine Scout, NGOs, etc.). the main areas of this training were related to; (a) sea turtles' biology (b) methods of monitoring, c) requirements for fieldwork, d) scientific research; e) sampling and data analysis.

This training was as the trainers training (ToT), where the participants of the training session carried out many training sessions and raising awareness with several partners and stakeholders who interested in the protection and management of sea turtles including the national experts civil society, local community, NGOs, fishermen, MPAs researchers, volunteers, veterinarians, etc. as follow:

Border guards

This sector is very important to enhance the conservation and control measures due to they are the first points that see either marine turtles or their track on the beach, and the first monitoring report comes from them.

Protected Areas (PAs)

The protected Areas have a major role in terms of protecting and monitoring biodiversity, and contributing to law enforcement.

The General Authority for Fish Resources Development and Fishermen

In frame of mutual cooperation with the General Authority for Fish Resources Development (GAFRD) and fishing community in the main two cities located in the Egyptian Mediterranean coast Alexandria and Port Said. Two meetings have been conducted with the different stakeholders that related to monitor, conserve, and deal with the marine turtles. these meetings advantaged by participation of the GAFRD, fishermen uonin, fishermen association, academic bodies (The Arab Academy for Science, Technology and Maritime Transport, and Marine science faculties of Alexandria, Port Said, and Kafr El Sheikh)

These meetings dealt with presentation of the importance of marine turtles in keep the balance of the marine ecology and its health sustainability. As well as, discussed on the steps have to be taken when marine turtles get out as by-catch.

The education sector

Coordination was made with the education sector in the coastal governorates to plan to facilitate the implementation seminars for students of schools on the marine biodiversity and conservation of sea turtles.

Fishermen Associations in the coastal Governorate (Port Said, Kafr El-Sheikh Alexandria, and Matrouh Governorates)

Due to the great importance of Alexandria and other coastal governorates for the presence of the largest fishermen and the largest markets for the trade of illegal sea turtles in Egypt, a number of actors have been held with the fishermen community to raise awareness about the importance of sea turtles to the marine environment, and the ways of dealing with them in the event of interaction with fishing gears, in addition presenting the legal measures against any illegal activity.

Marine Scouts

The Marine Scouts organization is one of the main partners during the stages of preparing the National Action Plan for the Protection of sea turtles along the Egyptian Mediterranean Coast, as well as during the implementation stages of this campaign. Many branches of the Marine Scouts were targeted to the awareness and capacity building campaigns in the cities of Marsa Matrouh, Alexandria, Burj Al Burullus, Damietta, and Port Said.

Hunting Club (Alexandria and Port Said branchs)

The hunting club is one of the clubs that have branches in many coastal governorates in addition to Cairo. A meetings were held with the club's environmental committee and club members and to raise awareness of the importance of sea turtles. Publications were distributed in the Alexandria and Port Said branches.

Bibliotheca Alexandrina

The Bibliotheca Alexandrina represents one of the active partners in the Egyptian civil society in general, and Alexandria in particular, as the Bibliotheca was one of the main stations during the preparation of the national action plan to protect the sea turtles along the Egyptian Mediterranean coast. The Bibliotheca expressed its willingness to participate effectively in the mobilization of youth and civil society In favor of the cause of marine turtle conservation, in addition to the possibility of hosting a meeting on the development of marine turtle research.

Cleaning campaigns & save sea turtles

Participation in beach cleaning campaigns and activities to save live stranded sea turtles and back them into their natural habitat. The working team takes advantage of these events in addition the national days to increase public awareness about sea turtles.

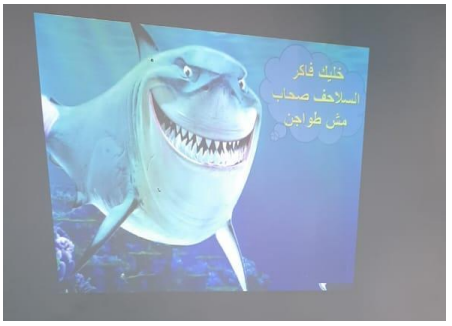
7. Flagship initiatives of the country (success story)

Recently, many success stories have been achieved in regard to the protection of the sea turtles, starting from preparing the national action plan for the conservation of the Marine turtles along the Egyptian Mediterranean waters, including the implementation of continuous awareness campaigns over three years, implementation of surveys for new areas in the Egyptian north coast (west of Alexandria), preparation of a description of the most important nesting areas recorded in the Mediterranean coast Egypt, integration of civil society in protection measures, launching of a tagging programme of sea turtles, rehabilitation and releasing the sea turtles, implementation of a pilot study on the by-catch of sea turtles and the marine mega fauna, etc.

Hereinafter, two models will be presented, as follow:

- Engaging and building the capacity of the civil society for sea turtle awareness

- As indicated above, and within the framework of recognizing the role of civil society in supporting and making national efforts to protect sea turtles successfully, and facilitating access to different groups.
- Coordination with the Franciscan Center was initiated to implement a training of trainers (ToT) programme, where a series of training sessions on marine biodiversity and the biological and ecological characteristics of sea turtles and their importance were implemented.
- This center owns many social centers located in the big cities along the Egyptian Mediterranean coast, and it has significant social activity.
- Through those seminars, a qualified team was formed able to present the basic information about sea turtles in a simplified (non-academic) way using the modern means of communication and social media to raise awareness of the sea turtle issues.
- The qualification lectures/ seminars for the working team were completed, and the team members presented the first seminar prepared by themselves after scientifically reviewing and revising.
- The work team is currently considered ready to deal with marine turtle issues with continuing to provide technical and scientific support to them.
- The same effort was repeated in a miniature way with the marine scout teams along the northern Egyptian coast.



- Launching the tagging programme

As part of establishing the marine turtles tagging programme, SPA/RAC provided tagging marks and applicators. Many sea turtles, most of them were green turtles "*Chelonia mydas*", have been tagged in Ashtoum El-Gamil PA, El-Burllous PA, and Alexandria in collaboration with NIOF.

These sea turtles are collected from markets as "illegal trade", stranded alive or by-catch. These sea turtles released by the national team after the rehabilitation process in their own capacities. Many other sea turtles were released by efforts of civil society.

Sea turtle releases are a good opportunity to raise awareness and involve civil society in sea turtle conservation measures and encourage them to report any sea turtles in the markets or stranding on beaches.



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Libya

Abdelmaula Hamza and Salih Deryaq

I. General data

1. Geographic location and attributes of Libya

Libya is located in North Africa on the coast of the Mediterranean Sea (Fig. 1). It is bordered on the east by Egypt; on the south by Sudan, Chad, and Niger; and on the west by Algeria and Tunisia. Libya's total area is 1,759,540 square kilometers of landmass, which is approximately three times the size of France. Libya is bounded by Algeria (982 kilometers), Chad (1,055 kilometers), Egypt (1,115 kilometers), Niger (354 kilometers), Sudan (383 kilometers), and Tunisia (459 kilometers)

The Libyan coastline lies between 11°.33' and 25°.10' East. It extends along the Mediterranean basin for about 1770 Km, i.e. nearly 32.5% of the total coastline of the North African countries on the Mediterranean (Howege and Hamza, 2002).

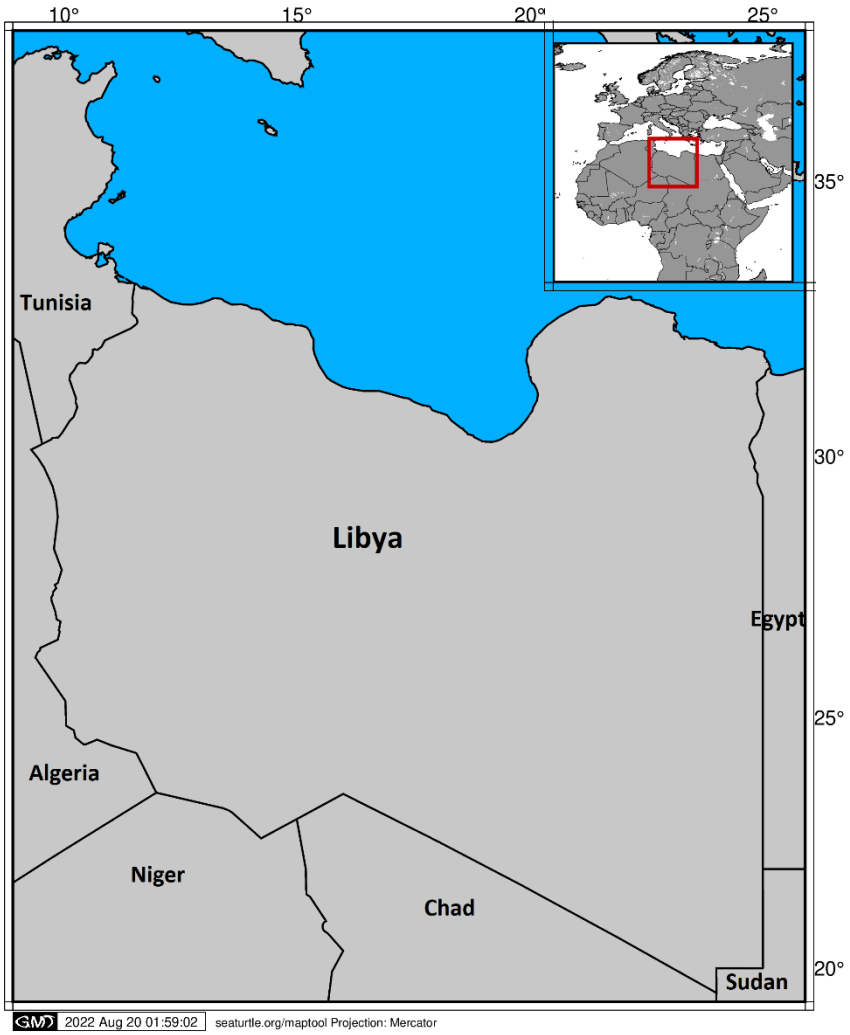

Figure 1: Map of Libya
(The map was created thanks to the Maptool program. Maptool is a product of SEATURTLE.ORG)

2. Libyan Exclusive Economic Zone

Libya's territorial sea extends 12 nautical miles and to the Gulf of Sidra closing line of 32º 30' north. The General People's Committee (prime minister) Decision No. 260 of 2009 concerning the declaration of the exclusive economic zone of the Great Socialist People's Libya specified the following coordinates as the borders of the Libyan EEZ (Fig. 2).

Figure 2: Libyan EEZ

Source : Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at http://www.marineregions.org/. https://doi.org/10.14284/386 (look up in IMIS)

Latitude	33° 8' 34.8" N (33.143°)
Longitude	18° 29' 57.6" E (18.49934°)
Precision	739117 meter
Min. Lat	30° 16' 1.4" N (30.2671°)
Min. Long	11° 33' 41" E (11.5614°)
Max. Lat	35° 25' 30.5" N (35.4252°)
Max. Long	26° 11' 32.1" E (26.1923°)

3. Populations

Libya's estimated population in 2020 was 6,931,061 million, the country's (source: Bureau of Statistics and Census). The UN estimates the July 1, 2022 population at 7,040,745.

Percentage of populations on the coastal strip is 76.7% (5.314,801), and the ovrall density per the country area is 4 persons/km (Fig. 3).

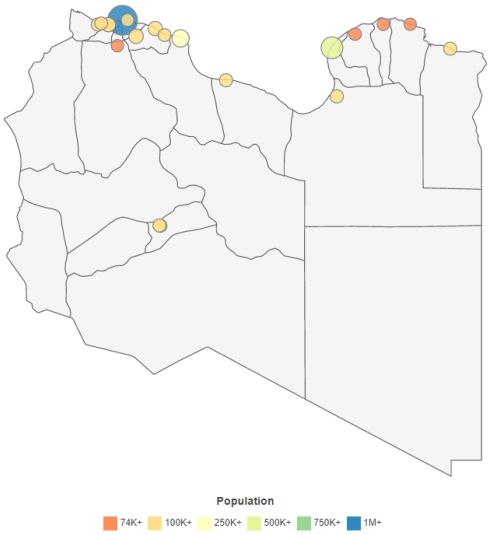

Figure 3: Percentage of populations on the coastal strip

https://worldpopulationreview.com/countries/libya-population

4. Fishing activities (Type, fleet, number of maritime registrants)

The total marine area of Libya is 364,524 km^2. The fishing sector in Libya consists of the following activities; artisanal fishing (Batah, Flouka, Mator), Lampara fishing, industrial trawling, and tuna fishing, most of them concentrated in western region 55% followed by 23%, 22% in the Gulf of Sirt and Jabal-Aghdar respectively. The number of artisanal craft raised up from 220 in 1950 to 2,465 in 2008 including 165 Lampara. The industrial fishing fleet was composed of 93 units, most of which (63 units) were steel stern trawlers, whose size, in terms of tonnage, ranged from 150 to 250 GRT. The others were 30 trap setters, with an average size of less than 50 GRT. Lengths varied from 13 to 33 m. The most commonly used gear, which represents for about 79% of total fishing equipment used, are trammel net, three longlines with small, medium and large hooks (khashin, deshi and rgig) and 40mm mesh size gillnet (mashruah). Most of the Libyan catch is freshly sold on major urban markets, with the exception of a portion of the small pelagic fish that are transported to the canneries. (Filogh, 2019)

Libya has many long-established ports, some of which serve as oil terminals, including Benghazi, Al Khums, Marsa al Burayqah, Marsa al Brega, Marsa al Hariqah, Misratah, Ras Lanuf, El Sider, Tobruk, Tripoli, and Zuetina.

Main offshore activities are related to oil and gas production. Al-Buri oil and gas field off the Libyan coast northwest contains important reserves of oil and gas, amounting to 2 billion barrels of oil, and produces 30,000 barrels per day, as it is the first offshore oil field in Libya, after it was discovered in 1976. As for the Bahr al-Salam field, which is located off the western coast of Libya, it produces about one billion cubic feet of natural gas, and the Sabratha floating platform was built near it, in which there are facilities to process gas before converting it to Mellitah and then re-exporting it to Italy, through the "Green Stream" pipeline. . Because of the deteriorating conditions on Libyan soil, the Oil Corporation gives special priority to offshore oil and gas fields.

5. Tourism, industrial, urbanization, pollution

The economy of the Libya is based on the exploitation of crude oil. Major mineral deposits of the country include iron ore, potassium, magnesium, Sulphur and phosphate. The agricultural sector in The Libya has been developing, but the climatic conditions and irrigation problems limit the output. Main agricultural products are wheat, barley, olives, dates, vegetables, citrus fruits, and peanuts. Manufacturing activities are mostly limited to food processing, cement and steel industries. There is a significant potential for a fishing and fishing based industry by canning tuna and sardines.

6. Marine Protected areas

Two marine protected areas were declared in Libya so far, the Gulf of Ain Alghazala (292,78 km²) and Farwa Island and Lagoon (55,91 km²), both areas were officially declared as MPAs in 2011. They are important for mating, nesting and feeding of both loggerhead and green turtles. Other Protected areas include coastal sections such as Kouf National Park, Garabulli National Park and El-Hisha (Fig. 4). Other MPAs were declared but under development for full data, via a GEF funded project 2022-2024.

Figure 4: Map of the Protected areas along the Libyan coast. Note the two MPAs of Ain Al-Ghazala (East) and Farwa (West), source Etayeb et al., 2018.

II. Sea turtles in Libya

1. Contexte

a. Description of the coast (Fig. 5)

The coast, in terms of turtle nesting importance, can be divided into three different areas as follows:

Area I (from Tunisian border to Misratah): this area is characterized by a broad continental shelf of 55.000 sq Km, which starts from the Gulf of Gabes to Misratah . (Sogreah, 1977). This area is generally

low elevated, extends to 407 km long, representing 22.5% of the coastline, and has 160 km of sandy beaches (Laurent *et. al*. 1999). It exhibits mostly sandy beaches. Salt marshes characterize the western limit of it up to the East of Zuwara, including Farwa island, then sandy coastline covering the area up to Sabratah, with some rocky low elevated areas with little development and human activity. From Sabratah to Tajoura the coastline becomes rockier and highly developed in the area of Tripoli's capital city. From Tajura to Mistratah, the coast is mostly sandy, then its changes to long rocky cliffs with diverse habitat types, i.e. Dunes, estuaries of wadies, agricultural landscapes, and Mediterranean shrubby lands. Based on phase III of nesting activity assessment (Laurent et. al.; 1999) the most important nesting sites in this area are the northern coast of Farwa Island, Zuwara and Tillil.

1- **Area II (from Misratah to Sirte):** This area is generally low sandy coast, representing 11.5% of the total Libyan coasts, and has 186.3 km of sandy beaches. This extended area is wild beaches with very low human activity and hosts a vast salt marsh area separating the main road away from the coastline, making access to it very difficult. The coast between Fnar Qaser Ahmed towards the East is rocky and then changes to flat sandy (See annexe 1). This area hosts an important nesting activity for loggerhead marine turtles, especially from Bouwerat Lahsun towards the west area of Sirte.
2- **Area III (Sirte to the Egyptian Border):** This area hosts the country's most important nesting grounds, being less populated. This area is diverse in its coastal area characteristics. it starts from east Sirte, mostly sandy shores with a vast salt marsh area isolating these shores from the desert fringe. These areas, in general, are known for their low fishing activity. Therefore it hosts most of the loggerhead nesting and feeding grounds of the country. On the other hand, the coasts start to be higher from Tolmeitha (Tukara) up to about 40 km long to the coast of Wadi Kouf National Park (KNP), where other shorter isolated sandy beaches are present (El-Ugla, Al-Hasi and Al-Bananes, Alhamama). The other low sandy coasts start from the East of Derna city towards the Egyptian border.

Figure 5. The land cover map of the Libyan coast

b. Sea turtle diversity in Libya

Among the eight species of sea turtles in the world's oceans, three species occur in the Libyan waters of the Mediterranean, these are: the Loggerhead *Caretta caretta*, the green turtle *Chylona mydas*, and the leatherback turtle *Dermochyles corinica*. Both the Loggerhead, and the Green Turtle are common in Libyan waters, as the main nesting species for loggerhead (Hamza, 2010) and the green turtles use Libya as post-nesting habitat (Snap et al., 2016). The Leatherback turtles are less common, they were recorded as bycatch at Tunnara nets used for Tuna fishing in Tripoli and Benghazi by Capra since 1949 (Hadoud and Elgomati, 1996), as well as in Misratah where it was caught incidentally in Gill nets (Hamza et al., 2009), and less frequently in stranding data.

More recently one nest of a green turtle was found in the summer of 2021 by LibSTP team at Al-Gardaba beach east of the country (LibSTP FB page https://www.facebook.com/LibSTP).

c. Sea turtle nesting beaches

Major nesting sites lie between Misratah and Ajdabiyah, covering all of the Gulf of Sirte, and further to the East, Shat Albadeen, Almagroon, Ergetah, Al-Agoriyah, Al-Hasi, Jarjarumah (Kouf National Park), to the beaches of Ain Al- Ghazala, and East of Tobruk. However, several of these beaches were surveyed for only a few years, and a focused annual full-season monitoring is needed to estimate nesting density at each of them. Furthermore, many gaps still exist within the region from Sirte to Ajdabiyah, as only a few kilometres were surveyed during the past years.

Lower nesting activity occurs on Tripoli's coast to Ras Ajdir (the primary monitored site here is Farwa Island's northern beaches and some of Zuwarah municipality's beaches). Also, less is known about the nesting activity to the west of Misratah to Tripoli, as the sandy beaches are restricted to a few bays within the high sandstone coastline and higher human population density related to anthropogenic activities.

d. Marine areas

Libya is one of the main foraging areas for both loggerhead and green turtles (Margaritoulis et al., 2003; Casale and Margaritoulis, 2010; Snape *et al.* 2016). This information could be confirmed through satellite tracked marine turtles from Cyprus and Greece, as they head during the post-nesting period towards Egyptian Mediterranean water, then the reside in Libyan waters to feed on extensive natural seagrass habitats (Bumbah bay and the Gulf of Sirte). Some turtles continue moving towards the Gulf of Gabes in Tunisia as a final destination.

e. Cultural heritage of Sea turtles (or turtles) in the country folklore

The cultural heritage of turtles in Libya is similar to that in most north African countries, Turtle carapace was used as a small bed for new-born babies and wall decorations at homes and restaurants near the seaside. During World War II, the Sea turtle eggs were used as a source of protein for locals in several coastal towns, and in eastern Benghazi, there is some record of that in the 1940s. traditional artisanal fishers used to believe that "The turtles are haunted, none of those who attacked them escaped their curse!", therefore they usually avoid capturing turtles and release them immediately if this happened. Turtles in Libyan dialect called Fakroona, a Berber name that is widely used for both turtles and tortoises. Some local proverbs used turtles such as : أتموت الفكرونه اوما حكت ظهرها i.e. The tortoise/Turtle dies and it doesn't scratch its back (Al-Amami, 2018). Other sayings is mentioning the nature of leaving eggs to develop in turtles without any parental care, saying فكرن اوجعنا ما فكرن , i.e. leaving something to develop on its own like turtle eggs.

2. Studies on Sea turtles in Libya

It is not clear what is the oldest publication on sea turtles in Libya. Most historic studies on wildlife in Libya in the 19th century focused on terrestrial species, rather than marine species, except for fish. Information on sea turtle nesting activity in Libya dates back to the late 1970s; several researchers have reported tracks of Loggerhead sea turtles on the beaches of Kouf National park (Herbert, 1979; Armsby; 1980; Schleich, 1987). The whole Libyan coast has been surveyed using a single prospecting method to identify important nesting beaches and nesting density, the first survey in 1995 covered 50 beaches (142 Km) from the Egyptian border to Sirte and revealed nests (Laurent et al, 1995), the second survey in 1996 targeted the area (209Km) between Sirte and Misurata (Hadoud & El Gomati, 1996); then in 1998, a survey completed the remaining distance (407Km) between Misurata and the Tunisian border (Laurent et al, 1999). The main findings of these surveys were: Loggerheads are the only nesting species in Libya; the pristine status of Libyan coasts and lower human activities allowed Libya to host one of the largest nesting sea turtle populations in the Mediterranean. However, the findings of the above-mentioned surveys (regardless of their significant importance), were based on single surveys, with no continuous monitoring of the nesting beaches throughout the nesting season, therefore it cannot reflect the actual size of the nesting turtle population.

Following the recommendations and priorities set by the earlier surveys, the actions listed at the MAP regional Action for the conservation of sea turtles in the Mediterranean (UNEP-MAP-RAC/SPA, 2007), the National Action Plan for the conservation of sea turtles and their habitats in Libya (UNEP-MAP-RAC/SPA, 2003, revised in 2019), The Nature conservation department at the Environment General Authority (EGA), in collaboration with the Marine Biology Research Centre (MBRC) and volunteers from the General Movement for Libyan Scouts (GMLS) and financial and technical support from the Specially Protected Areas Regional Activity Centre (UNEP-MAP-SPA/RAC), has established in 2005, a national program for the monitoring of nesting activity and conservation of loggerhead sea turtles, under the name of Libyan Sea turtle Program LibSTP. The start of monitoring work was initiated at three nesting beaches located to the west of Sirte, based on previous surveys as these three beaches showed relatively higher nesting density.

Institutions and scientists involved in the study of sea turtles in the country:

The main two institutions working on Sea turtle conservation in Libya are, the Libyan Sea turtle Program under the Ministry of Environment and the Marine Biology research centre. The LibSTP works via the regional offices of the MOE along the Libyan coast, and more recently with NGOs that became more involved in conservation work since 2011.

- Research activities

Several types of research on sea turtles are carried out in Libya in the past 15 years since the establishment of the LibSTP such as:

- Satellite tracking studies of turtles caught accidentally or from nesting sites in Libya to understand their post nesting movements in collaboration with Stazione Zoologica of Naples, Italy.
- Genetic studies; in collaboration with several colleagues in Spain, Italy and Turkey.
- Nest temperature and its effect on hatchling sex ratio, in collaboration with colleagues from Tunisia, Turkey and France.

Other areas of research should focus on assessment of bycatch at several fishing gears and locations, environmental studies such as ecotoxicological studies on heavy metal contamination in adult and hatchling Seaturtles, and plastic ingestion studies in adult turtles and how microplastic affecting the incubation of clutches.

From historical listing, Schleich, H. (1984) presented the reptile diversity of Kouf National Park in the late 1970's. It mentioned the nesting activity of the loggerhead sea turtle and the predation of both adult turtles and clutches by Jackals and foxes respectively. It is one of the earliest studies that indicated the nesting activity there. Laurent et al (1995) conducted the first survey of the Libyan coast for Sea turtle nesting activity, from the Egyptian border to Sirte, and identified several important beaches for loggerhead nesting, as well as noted on the amount of natural predation by foxes on nests. The second survey of the Libyan coast for Sea turtle nesting activity, from the Sirte to the Tunisian border (Laurent et al, 1999) where they completed the remaining sections of the coastline and found lower nesting in the northwest of Libya compared to the central and eastern beaches. The plan to establish the Libyan Sea turtle Program was presented during the 23rd Annual Symposium on Sea Turtle Biology and Conservation held in Kuala Lumpur, Malaysia (Hamza, 2003). A Mediterranean assessment of Seaturtle nesting have included data on Libya, mainly extracted from Laurent surveys (Margaritoulis et al., 2003). In 2005 the Libyan Seaturtle Program was established and the results of the first full season monitoring of Sirte beaches and volunteer training sessions were published (Hamza and Elghmati, 2006). The second LibSTP monitoring results at west of Sirte results were published (Hamza, 2007). The results showed an increase in nesting density at the three sites since 2005. Al Ghbeba is the most important nesting site in Libya so far, with 8.8 nests/km in 2005, 18.5 nests/km in 2006 and 30.6 nests/km in 2007 (Saied et al., 2007). Satellite telemetry to investigate the movements and behavior of turtles found in neritic Libyan waters. Turtle 1 parted from Tajura, East of Tripoli, and went straight to the north towards Sicily where it remained for one year circling the Ionian Sea in deep waters. Turtle 2 remained for one month in the Misurata area and moved then to shallow waters in the offshore area 120 km east of the Gulf of Gabes (Tunisia). Turtle 3 always remained in the Misurata area (Bentivegna et al, 2008). Tagging results of the previous seasons were presented at (Hamza et al, 2009) where seventeen nesting loggerhead females, and other two entangled turtles in fishing nets: one juvenile near Al Ghbeba nesting site of Sirte, and in May 2009, one leatherback sea turtle delivered by a local fisherman near El Khowada beach SE of Misratah were tagged using National Band Inconel metal tags on front flippers. Hamza (2010) presented a review chapter on marine turtle status in Libya, including nesting areas, density, and threats, within IUCN MTSG book on the marine turtles in the Mediterranean. Hochscheid et al (2010) investigated the location, timing and duration of extended surface times (ESTs) in 10 free-ranging loggerhead turtles (*Caretta caretta*) and the possible relationship to water temperature and diving activity recorded via satellite relay data loggers for 101–450 days. This is the first evidence that loggerhead turtles may refrain from diving for at least two reasons: absorb solar radiation or recover from anaerobic activity. Several sites important for Seaturtle nesting and feeding were included in the plan to establish a national network for MPAs in Libya under MedRAS project of IUCN Med (Hamza et al., 2011). The genetic structure of Libyan loggerhead turtles qualifies for an independent management unit, as found from mtDNA analyses by Saied et al (2012). The population nesting in Libya emerged as the oldest population in the Mediterranean, dating from the Pleistocene ca. 65,000 years ago (20,000–200,000). This reveals that the Libyan population might have settled in the Mediterranean basin before the end of the last glacial period. The haplotype network showed a divergent sub-group with two unique haplotypes in Libya (CC-A26.1 and CC-A65.1), therefore Libya as the most diverse nesting area in the Mediterranean (Clusa et al., 2014). Another study by Cardona et al (2014) tested

whether differences in clutch size among rookeries in the Mediterranean Sea are related to differential use of foraging grounds of contrasting productivity. Stable isotope ratios of carbon and nitrogen of turtle hatchlings from 8 Mediterranean rookeries were used to characterize their mothers' foraging grounds. Average clutch size in each rookery was positively correlated to the proportion of females accessing highly productive areas such as the Adriatic/Northern Ionian Sea. While Clusa et al., (2018) concluded that five management units identified within the Mediterranean (Libya and Cyprus) is one of them. The genetic similarity between distant nesting areas (i.e., Libya and Cyprus) suggests a more complex breeding behavior pattern.

A study on sex ratio in Sirte beaches found that a female-dominated sex ratio at 85.4% based on incubation duration and 70.4% based on mean temperature. These findings support the reported highly female-skewed sex ratios in the Mediterranean and elsewhere (Jribi et al., 2013). Another study compared Libyan and other Mediterranean beaches found that the different populations are separated because of time (< 12,000 yrs) and very different thermal habitats; it is hotter on the southern coast (Libya) than on the northern ones (Cyprus, Greece, and Turkey), both populations have similar thermal reaction norms for embryonic growth rate (Monsinjon et al., 2017).

More recently all studies and conservation works between 2005 and 2019 were published in a book titled Marine Turtle Research and Conservation in Libya: A contribution to safeguarding Mediterranean Biodiversity, by RAC/SPA (2021).

Following the ratification of many international conventions by the Libyan government, several research and conservation activities increased, and strengthened by the technical support recived from regional organisations, such as the RAC/SPA and MedPAN, in addition to bilateral collaboration with several Mediterranean researchers from Italy, Spain, Tunisia and Turkey, to accumulate knowledge on sea turtle conservation.

Libya was the first country in North Africa to adopt a national action plan on Seaturtles and their habitats in 2002, after the adoption of the regional Action Plan for the Conservation of Marine Turtles in the Mediterranean Sea (UNEP/MAP) within the framework of the Barcelona Convention and the recommendations of the GFCM and ICCAT.

3. Nesting activity of sea turtles in Libya (2005-2019)

a. Nesting beaches and nesting densities

The nesting activity is spread along the coast of Libya, monitoring efforts in the period of 2005-2019 showed that the nesting density was variable among the three monitored zones. The variability can be caused by inter-seasonal nesting activity (number of turtle emergence), in addition to the amount of monitoring effort (number of monitoring trips/season), number of monitored beaches at each season, the means of monitoring (walking vs. car), and the number of human activities on the beach, which can erase nesting tracks (Fig. 6).

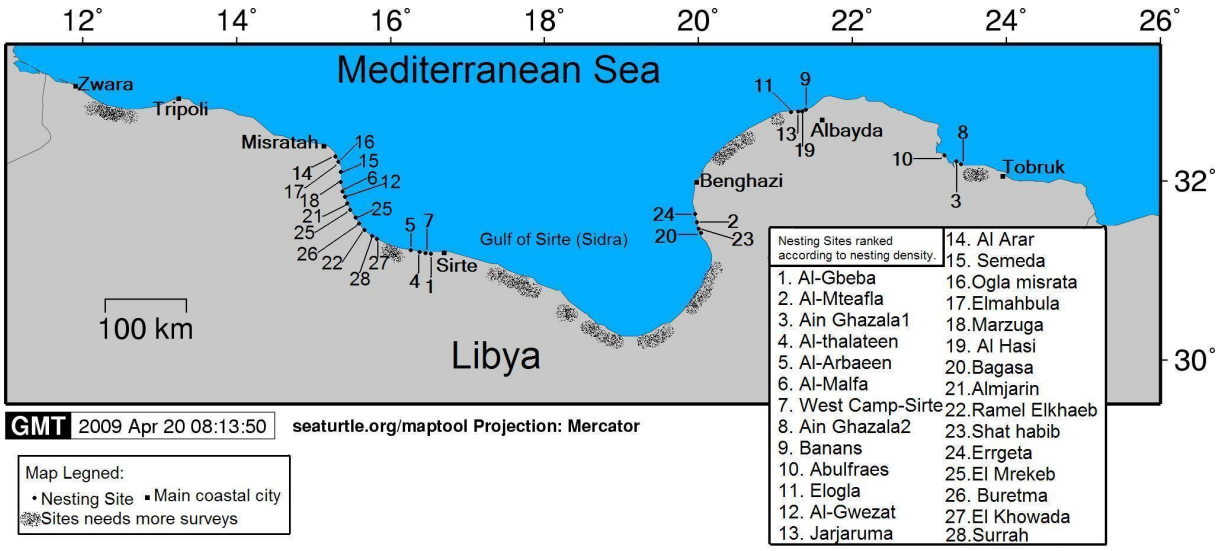

Figure 6: Map of main nesting sites along the Libyan coast.

The highest mean track density was at Sirte beaches, with 14.5 ±8.5 tracks/Km (range 1.8-24.4 tracks/km). In contrast, the lowest density was reported from Misurata nesting beaches with 2 ±2.1 tracks/km (range 0.1-5.9 tracks/km). Relatively lower monitoring effort and higher human activity (driving vehicles on sandy beaches of this area) prevented recording an essential proportion of nesting activity and nests. This low track nesting activity trend (and consequently the number of nests) in Misurata beaches can be seen in decreasing trend from 5.9 track/km in 2007 to less than 0.1 tracks/km in 2018. Track density in Cyrenaica was in the middle area between Sirte and Misurata nesting beaches (Fig. 7). However, other problems occur there, mainly natural predation of nests, and more importantly, the common practice of illegal sand mining and intrusion of seawater to the cleared beaches is changing the geomorphology of nesting beaches of Cyrenaica dramatically.

Nest density followed similar trend like in tracks density (Fig. 8), Sirte had the highest mean nest density with 10.1 ±5.1 nest/Km (range 4.1-17.2 nest/Km), while the lowest mean nest density was also in Misurata with 1.3 ±1.0 nest/Km (range 0.4-2.9 nest/Km). To standardize results, the tracks and nest density were calculated for each year at each zone based on the total length of the monitored beach at that particular season (Table 1).

Monitoring was not conducted in 2005 at Misurata and Cyrenaica as the LibSTP was just founded at Sirte. In 2008 no monitoring was conducted in Sirte and Misurata due to administrative and financial constraints. A similar situation was in 2019 at Misurata. In 2011-2016 no monitoring due to the security situation in Libya after the 2011 change.

The total number of nests across the monitored seasons (Table 1) varied from 10 at Al-Jabal Al-Akhdar to 393 at the Gulf of Sirte nesting beaches. In all cases, the highest nesting density was at the Sirte nesting zone.

Regardless of the already identified nesting zones, the overall length of monitored nesting beaches in Libya is 192.56 km. This represents 17.7% of the total sandy beach length (1089 km) in the country.

Therefore, several other nesting beaches need to be discovered and monitored regularly, especially in the area between Sirte and Ajdabiya, Ajdabiya to Benghazi, north of Benghazi to Aljabal Alakhdar, and the area to the east of west and Tobruk. Nesting beaches can be ranked upon their respective nesting density (nests/km, Table 2). The beaches of Sirte were the top four sites, this is due to the relatively high nesting activity and intensive monitoring effort between 2005 and 2019 (RAC/SPA, 2021).

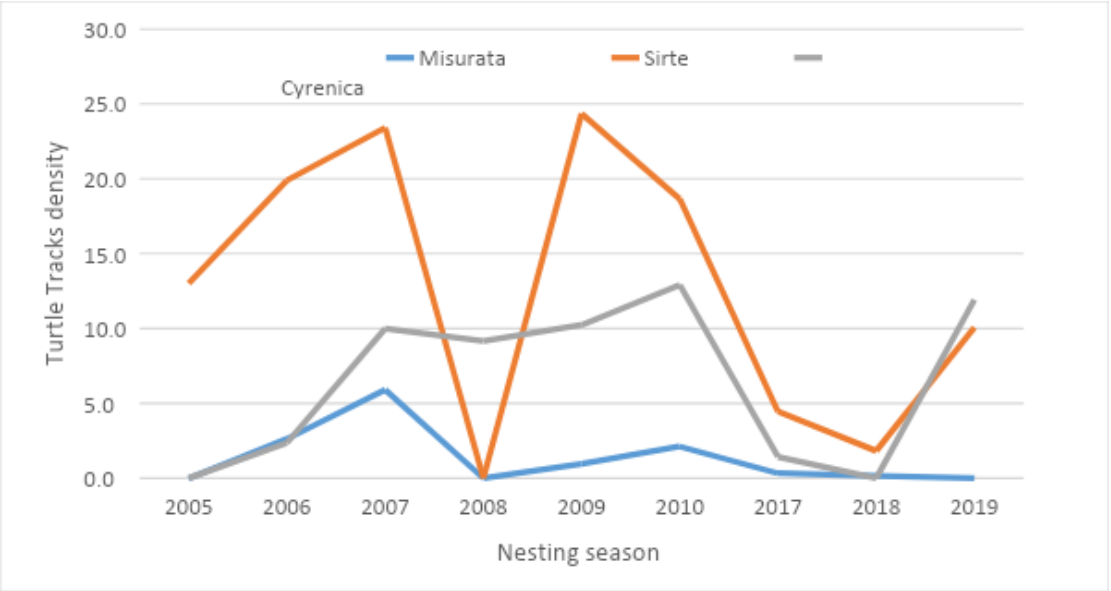

Figure 7: Tracks density at annually monitored loggerhead turtle nesting beaches from Misurata, Sirte and Cyrenaica, Libya

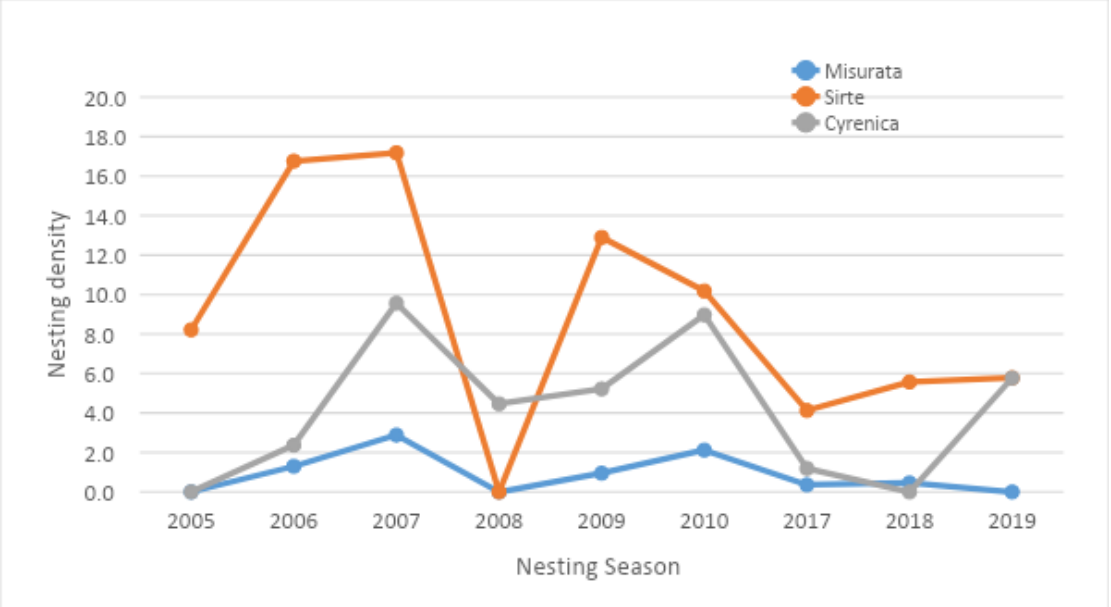

Figure 8: Nesting density at annually monitored loggerhead turtle nesting beaches from Misurata, Sirte and Cyrenaica, Libya

Table 1. Mean Nest (nest/km) and track (track/km) densities of loggerhead sea turtles in Libya (2005-2019), NS= no surveys conducted.

Zone	Nest or track	2005	2006	2007	2008	2009	2010	2017	2018	2019	Max	Min	Mean	± SD
Misurata	Nests/km	NS	1.3	2.9	NS	0.9	2.1	0.4	0.5	NS	2.9	0.4	1.3	1.0
	Tracks/km	NS	2.6	5.9	NS	0.9	2.1	0.3	0.1	NS	5.9	0.1	2.0	2.1
Sirte	Nests/km	8.2	16.8	17.2	NS	12.9	10.2	4.1	5.6	5.8	17.2	4.1	10.1	5.1
	Tracks/km	13.0	19.9	23.4	NS	24.4	18.7	4.5	1.8	10.1	24.4	1.8	14.5	8.5
Cyrenaica	Nests/km	NS	2.4	9.6	4.5	5.2	9.0	1.2	0.0	5.8	9.6	1.2	5.4	4.0
	Tracks/km	NS	2.4	10.0	9.2	10.2	12.9	1.4	0.0	11.9	12.9	1.4	8.3	5.3

Table 2. Ranking of monitored turtle nesting beaches in Libya based on Average number of nests per kilometres (nest/km)

	Beach-Length	Beach name	2005	2006	2007	2008	2009	2010	2017	2018	2019	Average nest/season	seasons
1	8.54	Al-Arbaeen		154	84		65	84				96.8	4
2	4.85	Shash					105	94	49	66	70	76.8	5
3	5.12	Al-Gbeba	30	139	154		81	35	28	43	22	66.5	8
4	12.94	Al-Khamseen							42	64	78	61.3	3
5	5	Zouitina						61				61.0	1
6	5.43	Al-Thalateen	47	66	80		49	65	50	72	43	59.0	8
7	5.84	Tamet						19	29	61	67	44.0	4
8	5	Mtefla		16	104		22	28				42.5	4
11	2.7	Ain Ghazala			36	33	59	22				37.5	4
9	3.82	West Camp	41	25	10		58	45	31	37	41	36.0	6
10	5	Boutraba					4	66				35.0	2

12	9.42	Smeda		14	54		27	50		4		29.8	5
13	6.07	Arar		7	37		4	34				20.5	4
14	5	Al-bouwerat							20	7	31	19.3	3
15	17.7	Almjaren		29	22		17	20	6	2		16.0	6
16	5.49	Al-Ghwezat		13	33		11	7				16.0	4
17	12.9	Zaafaran							9	13	20	14.0	3
18	5.1	Al-Nakhla							17	1	21	13.0	3
19	3.8	El-Ogla		4	30	7		27	3		5	12.7	6
20	10.9	Khawada		10	2			34	3			12.3	4
21	2	Bananes		10	18	8	16	17			3	12.0	6
22	5.32	El-Mahbula		10	22		1	15				12.0	4
23	3.3	Jarjaruma		5	22	5	4	20	5		16	11.0	7
24	1.5	Al-Malfa		3	37		9	5		1		11.0	5

25	7.09	Asswawa							6	15		10.5	2
26	1.3	Al-Hasi		4	8	5	3	11	2		36	9.9	7
27	1.4	Abulfraes			9							9.0	1
28	5.46	Marzouga		8	17			2				9.0	3
34	12	Farwa									9	9.0	1
29	8.11	Al-Ramel Al-Khaieb		6	11		4	6		1		5.6	5
30	0.95	Ugla Misrata		4	2		4	4		12		5.2	5
31	5.87	Buretma		5	4		4	3		1		3.4	5
35	1.5	Benaweda beach									3	3.0	1
36	2.5	Bukishfa beach									3	3.0	1
32	4.8	Elmerekeb		2	6		1	2	3	1		2.5	6
33	4.84	Surra		1	2			1				1.3	3

	208.56	Total	118	532	796	58	547	774	300	400	465		

b. Reproductive parameters

The nesting season of loggerhead sea turtles in Libya follows the general trends of the species nesting dates; with nesting, the peak occurs in June-July. The nesting activity starts usually by mid-May and extends until early September.

- Curved Carapace Length of nesting females

The Mediterranean nesting loggerhead turtles are significantly smaller in size than other nesting loggerheads in the World (Broderick and Godley, 1996). Curved Carapace Length (CCL) and Curved Carapace Width (CCW) were measured for nesting females when found on the beach during the egg-laying process or by measuring stranded and injured turtles when encountered (Fig. 9). The mean Curved Carapace Length (CCL) of nesting loggerhead females in Libya was 77.9 ±8.5 (range 67-110 cm). This length is even slightly smaller than the average (CCL 79.1 cm) of the Mediterranean nesting loggerheads (Casale et al., 2018), while the mean Curved Carapace Width (CCW) was 68.7 ±6.1 (range 58-93 cm). Detailed carapace sizes per nesting zone and sample size are shown in Table 3.

Table 3. Curved Carapace Length (CCL) and width (CCW) of nesting loggerhead female turtles in Libya

Nesting Area	**No. of seasons**	**Mean CCL**	**CCL Range**	**Mean CCW**	**CCW Range**	**Sample size**
Misurata	3	78.8	58-110	69.6	54-88	5
Sirte	6	69.4	42-85	61.8	36-74	40
Cyrenaica	2	88.8	72-100	77.3	68-95	6

Figure 9: LibSTP staff measuring sea turtle CCL and CCW

- Clutch size

Clutch size is the total number of eggs in a nest, it is either determined at the time of egg-laying or during the inspection of nest contents after hatchlings emergence is completed. Table 4 shows collected data on clutch size in four nesting zones of Libya. The clutch size ranged from 11 to 160 eggs/nest, with an overall average of 79.32 eggs/nest. This average is similar to most Mediterranean nesting loggerhead clutch sizes but smaller than those recorded in Greek nesting sites (Margaritoulis et al., 2003).

There is a positive correlation between clutch size and adult female body size reported for most turtle species. However, in loggerhead, conflicting reports exist about this aspect. For example, Hirth (1980) found no significant linear relationship between carapace length and clutch size, while in Kefalonia, Greece, Hays and Speakman (1992) found a significant positive relationship. This aspect still needs to be explored for the Libyan nesting populations.

Table 4. Mean clutch size of Loggerhead Turtle nesting in Libya

Nesting Area	No. of seasons	Mean	Range	Sample size (nests)
Misurata	4	83.24	38-132	69
Sirte	5	83.21	11-160	932
Cyrenaica	4	74.93	30-117	31

- Incubation duration

The incubation period is defined as the period in days between a newly laid nest and the first record of emergence by either direct observation of hatchlings or their crawl tracks emerging from nests (Jribi et al, 2013).

In the Mediterranean Incubation duration of Loggerhead sea turtles is shorter compared to the rest of the world (Margaritoulis et al 2003). The incubation duration in Libyan nesting beaches follows the general trend in other Mediterranean beaches, producing more females than males (see the chapter on sex ratio). The available data from Sirte and Misurata nesting zones indicates that incubation duration ranges from 45-72 days (Table 5). Further information is required to investigate any differences in incubation duration lengths between Libyan nesting beaches.

Table 5. The incubation period of Loggerhead Turtle clutches in Libya				
Nesting Area	**No. of seasons**	**Mean (day)**	**Range of individual nest**	**Sample size (nests)**
Misurata	1	53,17	46-60	34
Sirte	4	50,5-58,02	45-72	160

- Mass and morphometrics of hatchlings

Data collected on weight and morphometrics of sea turtles in Libya are restricted to one nesting zone of Sirte (Table 6). Mean hatchling carapace length was 3.92 cm, this is close to data collected in other Mediterranean beaches, such as in Tunisia 4.30 (Jribi et al 2002), 4.10 cm in Cyprus (Demetropoulis and Hadjichristophorou, 1995), 4.04 cm in Greece (Margaritoulis, 1982). The mean Carapace length for hatchlings in Libya was 3.04cm, while it recorded 3.21 Cm in Tunisia (Jribi et al 2002), and the mean weight was 13.91g compared to 14.26g in Tunisia and 16g in the whole Mediterranean (Demetropoulis and Hadjichristophorou, 1995).

Table 6. Mass and dimensions of hatchlings								
Nesting Area	**No. of seasons**	**Sample size**	**Mean SCL-hatchling**	**SCL Range**	**Mean SCW-hatchling**	**SCW Range**	**Mean weight (g)**	**Weight range (g)**
Sirte	1	498	3,92	3,1-4,5	3,04	2-3,1	13,91	7,9-17,5

- Female Turtle tagging

A total of 38 adult female loggerhead turtles were tagged on the trailing edge of either one or both front flippers to provide a means of unique identification of these nesting females using Inconel explicitly made for the Libyan Seaturtle Program. The tag code starts with two letters (LY) for Libya, followed by a three-digit number (001). A contact email of Libyanstp@gmail.com is provided on the tag for reporting these turtles once they are encountered in Libya or abroad (Fig. 10).

The majority of these tagged turtles are from Sirte (n=33), followed by 4 in Misurata and a single turtle at Ain Al-Ghazala in Cyrenaica. Most tagging was conducted in 2009 and 2010, coinciding with Satellite tagging work, detailed in Chapter 3 of this book. On May 27th, 2009 a female leatherback turtle of CCL 122 Cm was found by a local fisherman, entangled in fishing nets near Al-Kowada beach in the Misurata zone was rescued and given tag numbers LY0016- LY0017 on both front flippers.

Figure 10: Tagging of female nesting Loggerhead sea turtle.

4. Threats

a. Nest predation

Foxes, feral dogs and Jackals cause nest predation in Libya, the levels are are high (44.8% during 1995 survey; and 45.4% during 1998 survey; see Laurent et al., 1996 and 1999). The following Table 7 shows the results of the annual impact of predation on Libya's nesting zones.

Table 7. Mean and range of predated loggerhead turtle nests in Libya

Nesting Area	No. of seasons	Mean	Range	Sample size (nests)
Misurata	4	12,35	(10,07-15,26)	656
Gulf of Sirte	4	16,24	(0,50-29,1)	838
Benghazi	3	22,33	(8,45-58,62)	197
Al-Jabal Al-Akhdar	4	33,66	(17,39-44,00)	210
Tobruk	3	71,42	(69,70-85,71)	105

The results show that the highest predation levels are found at Cyrenaica zone, as 71.42% of the nests at Ain Al-Ghazala beaches were depredated by foxes (Fig. 11) and Jackals, followed by beaches of Al-Jabal Al-Akhdar and Benghazi (33.66 and 22.33% respectively). Predation levels in Sirte and Misurata beaches were significantly lower. Foxes, feral Dogs, and Jackals tend to be more frequent at the beachside during the egg-laying period. Jackals are found exclusively at both Ain Al-Ghazala and Al-Jabal Al-Akhdar nesting zones, and there are field observations in 2007 of a Jackal attack on a female nesting turtle at Al-Jabal Al-Akhdar nesting zone.

The other predator of an un-quantified impact yet is the Ghost Crab *Ocypode cursor* to a lesser extent, represents another active nocturnal predator on both eggs and hatchlings; holes used by this species have been observed at different densities in most nesting beaches of Libya.

In the Mediterranean, predation is responsible for losing 36% of nests in Cyprus (Broderick and Godley, 1996) to 70-80% of nests in Turkey's Dalyan beaches (Erkakan, 1993). Further studies are needed to quantify the density distribution and predation effect of the different predator species on both nests and nesting females in Libya.

Figure 11: Predated sea turtle nests by Red fox Vulpes vulpes

b. Poaching of clutches

Poaching of sea turtle nests is illegal in Libya; however, due to low enforcement of regulations, it became a common problem at some nesting beaches. Data shows some notable increase of egg poaching even within the monitored zones (Fig. 12).

Believes of the medical benefits of turtle products is the main driver for the trade of this species. However, the EGA office in both Misurata and Sirte (where poaching levels are the highest, 13.08 and 13.11%, respectively) had conducted several efforts with local authorities to enforce regulations prohibiting turtle product trading local fish markets. No update on the trend of poaching after 2010, however, we anticipate that after the events of 2011 and the weakened enforcement of regulation by the state, such practices might have increased, and their impact might also cause more loss of turtles produced from the Libyan coast.

Figure 12: Poached sea turtle nest in Misurata beaches.

5. Strandings

A total of 151 stranded loggerhead turtles were found on monitored nesting sites along the Libyan coast, between 2005 and 2019 (Table 8 & Fig.13), with an overall mean CCL of 67.8±14.3 Cm and mean CCW of 59.2±11.9 Cm. A 61% (n=93) was reported from the most monitored zone of Sirte, followed by 25.2 (n=38) from Zuwara in eight months of Feb-September 2019, While 9.9% (n=15) and 3.3% (n=5) were reported from Cyrenaica and Misurata, respectively. The mean CCL at Sirte zone was 67±13.8 Cm (range 33-114 Cm), Misurata zone was 78.8±19.1 Cm (range 58-110 Cm), in Zuwara was 66.5 ±10.3 Cm, and at Cyrenaica, it was 76.7±20.6 Cm. Data for CCW fall within the range of other Mediterranean nesting populations (Margaritoulis et al., 2003).

Table 8. Curved Carapace Length (CCL) and width (CCW) of stranded turtles in Libya.

Zone	Seasons	N° of turtles	Measure	min	max	Mean	SD	SE
Cyrenaica	2008-2009 & 2019	15	CCL	38	100	76.7	20.6	0.3
			CCW	34	95	65.0	17.7	0.3
Misurata	2008-2009 & 2017	5	CCL	58	110	78.8	19.1	0.7
			CCW	54	88	69.6	21.1	0.6
Sirte	2005-2010, 2017& 2019	93	CCL	33	114	67.0	13.8	0.0
			CCW	24	74	66.3	11.5	0.0
Zuwara	2019	38	CCL	42	87	66.5	10.3	0.1
			CCW	33	76	57.9	9.0	0.1

Figure 13: Stranded Loggerhead sea turtles

6. Conservation efforts

a. Legislation and protection tools on national level

The Libyan legislator has specified marine turtles in a special decree of Secretary of Peoples committee of Agricultural Reclamation and Animal wealth; the decree No.453/1993, stated at its first paragraph that "hunting and catching of marine turtles and tortoises of different species, by any means, are banned in the State of Libya, nor trade and export are forbidden". This decree is considered as the clearest regulation concerning sea turtles. Another act No.6/1996 was issued by the Minister of Agriculture and marine wealth, which prohibited the hunting activities for terrestrial animals and some marine animals in Libya after the relevant authorities noted the fast decrease in biodiversity elements of the Libyan habitats.

A draft law on Marine Protected areas was drafted in 2014, with cooperation with SPA/RAC. The draft law was revised through but still pending adoption by the Libyan legislative authorities.

There are other laws, which includes articles on conservation and protection of wildlife and endangered species, this is:

1. Law No.15/2003 on Environment Protection and Enhancement, section 9 articles 60 and 61 stated, "All animal species (aquatic and terrestrial) must be protected from extinction"; this section includes other recommendations on establishing nature reserves and protected areas.
2. Law No. 14/1989 on the utilisation of marine wealth, section 6 on marine protected areas there are four articles concerning:

- Definition of marine protected areas (MPAs).
- The management of MPA.
- Marine Biology Research Centre is the responsible body for identification, studying, and technical management of MPA's.
- Implementing plans and programs to conserve marine endangered species, and follow- up collaboration efforts with regional and international organisations.

b. Legislation and protection tools on regional /international levels

The State of Libya is a contracting party to the following relevant regional and international conventions:

- Convention on Biological Diversity (CBD).
- Convention on Migratory Species of Wild Animals (Bonn Convention).
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
- The Barcelona Convention on the Protection of Mediterranean Sea against pollution. And the Protocol concerning Specially Protected Areas and Biodiversity in the Mediterranean.
- The African Convention of Nature conservatorium (Algiers Convention).

c. National Action Plan

- Revision and updating of the National Action Plan

As the old National Action Plan was issued 20 years ago, in the year 2002, and due to the new developments in research and conservation of sea turtles in Libya during that period, it was necessary to revise, discuss and adopt the NAP in a participatory way, as all stakeholders were consulted during and after the editing of the NAP. The new NAP takes into account also the development of several

concepts in conservation at the regional level including the EcApp approach and the new technologies that became effective tools in conserving these endangered species and their habitats.

The NAP revision came after seventeen years of conservation work on marine turtles in Libya and after the Establishment of The Libyan Seaturtle Program, since 2005, which is considered the first step towards instu conservation of marine turtle and their nesting beaches in Libya.

The preparation of the Action Plan was based mainly on expert opinions, which will be later reviewed and adopted by the main stakeholders in Libya (Sea users, professionals, fishermen, public institutes, individual researchers, NGOs active in marine conservation) during a national consultation workshop to be held in 2020. The research results conducted by LibSTP in cooperation with other researchers and programs in Italy, Spain, and Tunisia was also considered.

The primary objectives of this revised Action plan are to promote the favourable conservation status of marine turtle species and their habitats in Libya through:

- The improving and updating of national legislations,
- The monitoring of known nesting beaches and newly less-known nesting areas. The monitoring should be in line with the National monitoring programme for marine Biodiversity in Libya.
- The appropriate protection, conservation and management of the marine turtle habitats, including nesting, feeding, wintering areas and migration routes, in coordination with other Mediterranean efforts.
- The Improvement of scientific knowledge by research and monitoring.

This Action Plan will be reviewed every FIVE years, through a review process that should assess the implementation of planned activities, problems and shortcomings, to redesign this Plan accordingly in consultation with relevant national stakeholders.

d. Sea turtles and cetaceans stranding network

Within the support provided by MAVA and RAC/SPA, a national network to monitor sea turtle strandings was set up in 2021, with the participation of LibSTP teams along the coastline and partner NGOs at several points in the coastal area. More is needed to perform functional network of stranding in terms of online portal and provide training to personnel. The newly prepared protocol on strandings by NASTNet provides full details of this phenomenon and how to engage with the public in maximizing the information flow to the central portal.

e. Awareness activities

The LibSTP and its partner NGOs are conducting several awareness activities before and during the nesting season of sea turtles in Libya. These activities include the production of short documentaries, TV, Radio and Press interviews, open discussions with visitors to the nesting beaches, in addition to active social media movement and production of leaflets and posters. The themes include nest management and what to do when a citizen encounters a hatching nest or stranded turtle. More awareness and communication are needed with fishers to gain their participation in providing data and to train them on the rescue of entangled turtles in their fishing gear, to decrease the number of turtles and other endangered megafauna bycatch

f. Monitoring of nesting sites

Since 2005 the monitored beaches increased from 3 in Sirte to over 36 on the national level. The nesting activity assessment was based on field collected data by local researchers and more active members of partner NGOs, and this allowed us to have a more clear idea of the nesting densities, threats and hatchability of clutches, and made it easier to rank nesting sites to focus the future monitoring on the most important sites. Further details in the next section on nesting beaches.

g. Rescue center

There is no official recue centers for Seaturtles in Libya, some turtles used to be delivered to the Marine Biology Research Centre in Tajura, with limited facilities to care for Seaturtles. A new first aid center is under development in Sirte, with the support of a grant from CEPF. The new centre will act as the first dedicated centre for the rescue and rehabilitation and awareness on sea turtles. The work is conducted by AMWAJ NGO. The nearby centre just opened in Sfax university by Imed Jribi can act as a regional hub for training on rescue and rehabilitation operations.

7. Flagship initiatives of the country (success story)

Libya has made several activities in the field of marine turtle conservation as part of the implementation of the National Action Plan and the Action Plan for the Conservation of Marine Turtles in the Mediterranean Sea (UNEP/MAP):

- Establishment of the Libyan Seaturtle Program (LibSTP)

This national program was established in 2005, and since then several achievements were made for the conservation of sea turtles in Libya, among them:

Provided hands-on training for more than 40 personnel locally. Trainees came from EGA, MBRC, the Universities, NGOs, beach monitoring techniques, and tagging, following standard methods used in other Mediterranean countries.

Taking part in training courses organised by the RAC/SPA related to nesting beach management (Cyprus), Genetics (Italy and Turkey) and marine turtle rescue training (Italy).

Participation in both the Mediterranean marine turtle conferences (Med Turtle Conf.) and the international Sea turtle Symposiums (ISTS), to publish the program results on nest monitoring, Genetic studies, sex ratio studies, tracking, physiology and public participation in conservation efforts.

Publication of several scientific studies with other researchers from Tunisia, Italy, and Spain.

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Morocco

Mustapha Aksissou, Wafae Benhardouze and Manjula Tiwari

I. General data

The Moroccan Mediterranean coastline stretches for 512 km from Sebta in the west to Saidia in the east (Fig. 1 and 2). There are many beaches and also rocky areas (Fig. 3). The marine waters of this area are home to a biological diversity including marine turtles. There is an important marine protected area of Al Hoceima (on an area of 48,460 ha of which 19,000 ha is marine area) in the center of this Mediterranean coastline of Morocco (Fig. 4).

Figure 1: Photograph of northern Morocco

Figure 2: Map of northern Morocco

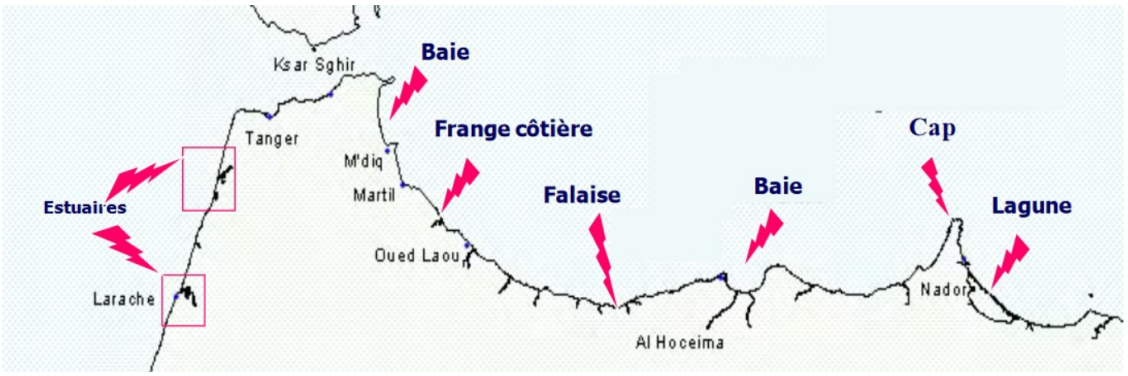

Figure 3: Geomorphological features of northern Morocco

Figure 4: Boundaries of Al Hoceima National Park

The sea turtles captured accidentally at sea or stranded on the beaches with their percentages are *Caretta caretta* (95%), *Dermochelys coriacea* (4%) and *Chelonya mydas* (1%). Seven harbours and 93 fishing stations are present on this coastline, suggesting an exploitation of fishery resources and a probability of interaction with marine turtles.

II. Sea turtle in morocco

1 State of knowledge

Since the year 2000, we started to take an interest in marine turtles in Morocco. These creatures are extraordinary in their way of life. A biological cycle that is marine but only a few hours for the laying phase by the female. The main studies conducted were interested on the Bycatch on the Moroccan Mediterranean coast and were on the following areas: the Strait of Gibraltar (Benhardouze et al. 2012; Derdabi and Aksissou, 2021), the western part (Kaddouri et al. 2018.) and the eastern part (Chahban et al. 2017; Keznine et al. 2021 and 2022). There are also studies on strandings (keznine et al. 2021; Benhardouze et al. 2009; Aksissou et al. 2006) or even on the sale of shells in markets (Benhardouze et al. 2004).

An approach based on questionnaires with fishermen and distribution of cards was used, to estimate the by-catch of marine turtles, as information and data were scarce and few. This approach is an effective method for collecting sufficient data to estimate the minimum annual by-catch, to identify high risk gears, seasons and areas, in order to implement adequate management measures.

We asked a series of questions mainly concerning:

- Socio-economic aspects: age, profession, etc...

- The incidental catches of turtles in the region: species, area, period and number of catches.

- The technical characteristics of the boats and fishing gear used (type of gear, seasons of use, length of the boat, engine power, crew).

We distributed photos of different species of sea turtles, to help fishermen discriminate between species (Fig. 5).

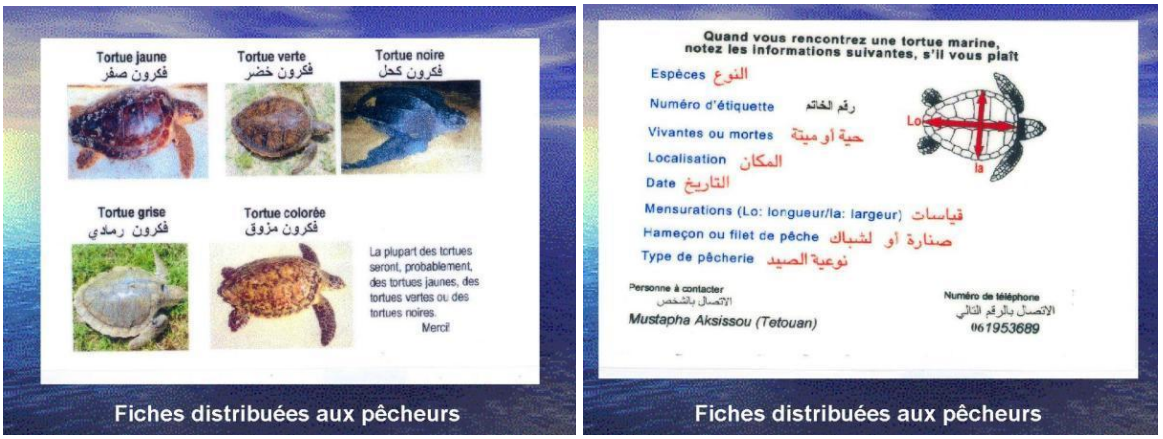

Figure 5: Cards distributed to fishermen

The fishermen use 5 types of fishing gear:

- the longline: fishing with hooks fixed on a main line

- the trawl: fishing with a bottom net in the form of a funnel

- purse seine: fishing for small pelagics using a circular surface net

- the beach seine: fishing for fish with a net pulled by the fishermen on the beach

- the trammel net: fishing with a net placed on the bottom with the help of metal supports

They can use two or three fishing gears at the same time, but each fisherman normally uses different fishing gears and techniques depending on the target species, the period of the year and the fishing area.

The main findings of these studies are:

a. Strait of Gibraltar

At the Strait of Gibraltar (Fig. 6), the Moroccan fishing port of Tangier on the Strait of Gibraltar occupies a strategic position between Africa and Europe. Fisheries and sea turtle populations inevitably interact in this area. The objective of this study is to assess the impact of fishing gears commonly used in Tangier (driftnets and surface and bottom longlines) on marine turtles in Moroccan waters.

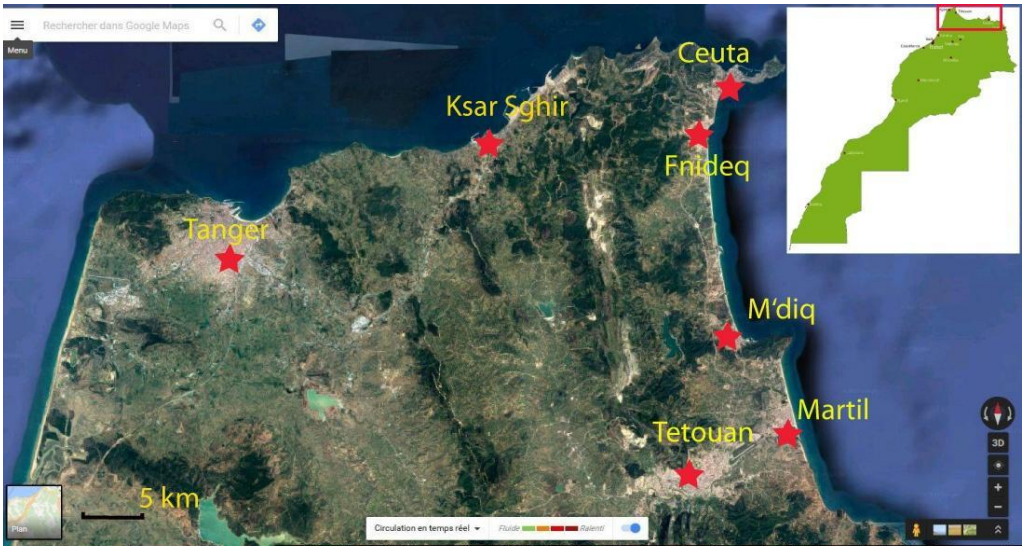

Figure 6: Carte du Détroit de Gibraltar et région Ouest de la Méditerranée du Maroc

Between 2003 and 2007, a total of 73 turtles were caught in the driftnets of the 7 vessels studied during 866 fishing days, and 13 turtles in the 4 artisanal longline vessels during 593 fishing days. The estimated average catch by the entire driftnet fleet in the Tangier area during the study years is 719 loggerhead catches/year and 101 leatherback catches/year. In both longline fleets, the estimated average catch of turtles in one year is 51 turtles per surface longline and 91 turtles per bottom longline. Drift gillnets appear to have the highest interaction with sea turtles, but new legislation has eliminated driftnets since 2012. However, increased vigilance is needed as the port of Tangier plans to expand and increase its capacity and driftnets will be replaced by commercial longlines and other gear types. Given that Moroccan fisheries impact sea turtles from several nesting populations in the western Atlantic and/or Mediterranean, assessing and mitigating sea turtle mortality in Morocco and creating greater awareness of their protection is crucial for the survival and nesting recovery of the populations (Benhardouze et al. 2012).

b. Western Mediterranean of Morocco

In the western Mediterranean region of Morocco, the contribution to the study of bycatch in marine waters in the area of the port of M'diq and the developed landing point of Martil (Fig. 5) indicates that 46 marine turtles (44 loggerheads and 2 green turtles) were caught in 2016 by 43 boats. The total number of boats in Martil and M'diq is 321 boats (Kaddouri et al. 2018). Mediterranean countries have an annual catch of more than 10,000 turtles (Casale, 2011). The loggerhead turtle is the most caught by the different fishing gears operating in this region, with the exception of the beach seine. The same observation was mentioned by Jribi et al (2007) in the Gulf of Gabes and Casale et al (2007) in the central Mediterranean. However, in our study, the green turtle is rarely caught, only 2 turtles were caught by trawl fishing. This result is consistent with that of Laurent et al (2001). In terms of the annual number of incidental catches, longline and purse seine are considered the most threatening fishing gears for marine turtles, especially the loggerhead turtle in this region. Longline fishing is a threat to sea turtles in the Mediterranean (Deflorio et al. 2005; Casale, 2011). Estimating the impact of fishing gears operating in the Moroccan Mediterranean on marine turtles, requires reliable and comprehensive information on bycatch, fishing effort and fleet size at large temporal scales. In this context, the integration of fishermen through awareness campaigns and training workshops on methods and techniques for the rescue of marine turtles is the best way to protect these endangered creatures.

c. *Eastern Mediterranean of Morocco*

In the eastern Mediterranean region of Morocco, we evaluated the bycatch and strandings from Al Hoceima in the west to Cap de l'Eau in the east (Fig. 7). The most captured species is the loggerhead (71.94%, n=41) as it is the most frequent turtle in the Mediterranean, followed by the green turtle (22.8%, n=13) and the leatherback (5.26%, n=3).

According to the questionnaire used, the estimated incidental catch rates for longlines, seines and trawls are successively (34%, n = 19), (34%, n = 19) and (32%, n = 18).

Figure 7: Map of the Eastern Mediterranean of Morocco

In addition, the estimation of by-catch of the vessels evaluated in this study remains difficult, because fishermen avoid reporting incidental catches of marine turtles and do not easily discriminate between species (loggerhead and green turtles). More than 5 old (60-70 years old) artisanal fishermen in the region Saidia and Nador recalled that in the 60s, they observed large turtles coming out of the sea to the beach to lay their eggs. The survey made in October 2015 with 2 fishermen of age 55-60 years stipulates the exit of a large brown turtle in the beach of Saidia (Marina) in 2014, in order to lay its eggs. Traces of its movement on the sand and also the nest are observed (Chahban et al. 2017). The most stranded turtles are loggerheads (n = 7) and leatherbacks (n =8). The causes of strandings are mainly fishing nets, propellers of fishing gear or oil pollution or unknown causes.

Currently, the National Institute of Fisheries Research (INRH) is involved in research projects on bycatch in general (sharks, sea turtles, marine birds and marine mammals).

2 Nesting

In Morocco, nesting sites are absent. Studies on the temperature of the sand during the summer season are underway to see the possibility of hosting nesting beaches.

3 Threats

Threats are at sea through interactions with fisheries and pollution by plastics and hydrocarbons. Accurate data on sea turtle mortalities are lacking.

4 Conservation

Several projects are underway to identify beaches likely to host nesting activities. INRH, through its observers at sea, has important data on the interactions likely to take place. The intervention of universities and NGOs in several occasions for the sensitization of fishermen through training workshops is continuing normally.

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Tunisia

Mohamed Nejmeddine Bradai and Imed Jribi

I. General data

1. Geographic location

Tunisia is a Mediterranean country in Northern Africa, bordering the Mediterranean Sea, having a western border with Algeria (965 km) and south-eastern border with Libya (459 km) where the width of land tapers to the south-west into the Sahara. The country's geographic coordinates are 34°00'N 9°00'E, It lies between latitudes 30° and 38°N, and longitudes 7° and 12°E (Fig. 1). Tunisia occupies an area of 163,610 square kilometers, of which 8,250 are water. The principal and reliable rivers rise in the north of the country with a few notable exceptions from north-east Algeria and flow through the northern plain where sufficient rainfall supports diverse plant cover and irrigated agriculture.

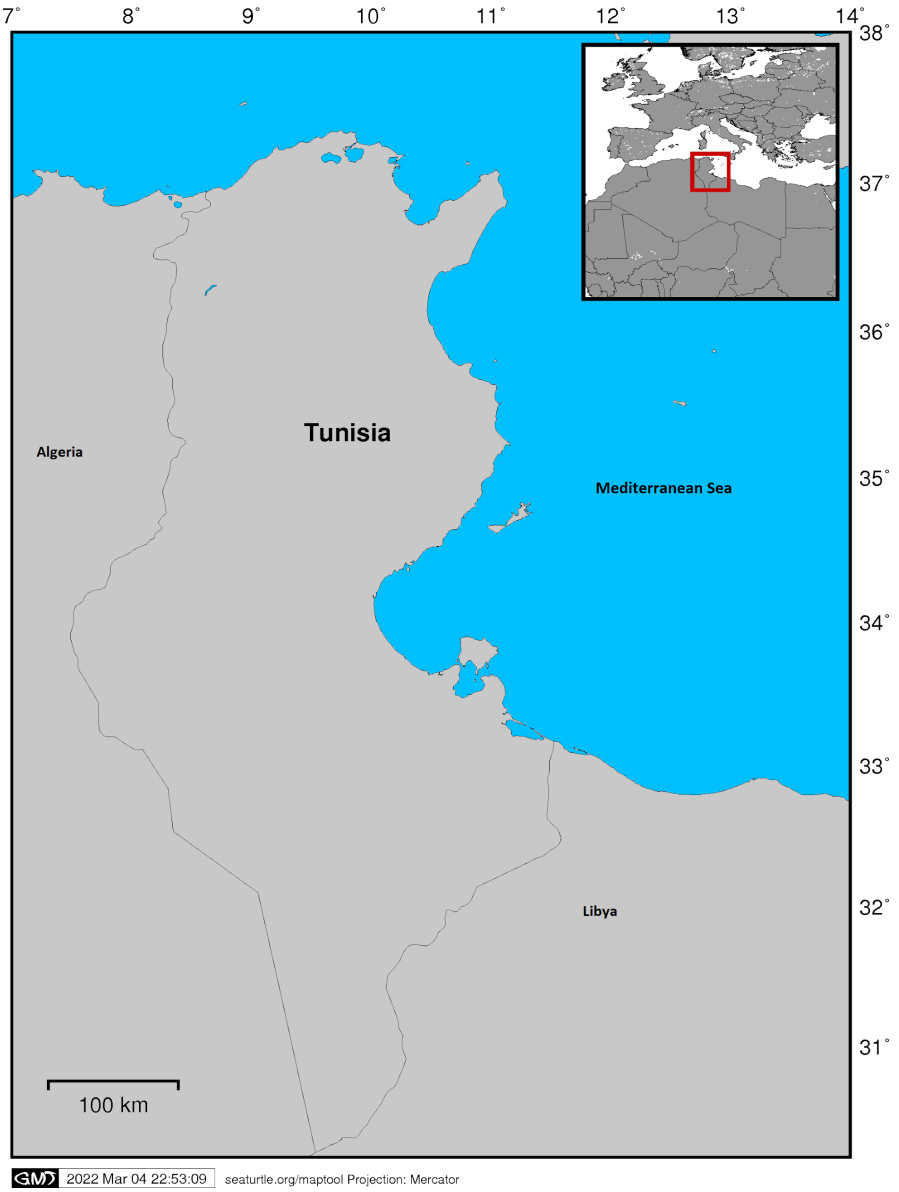

Figure 1: Map of Tunisia

(The map was created thanks to the Maptool program. Maptool is a product of SEATURTLE.ORG)

2. Coastal length and characteristics

The Tunisian total coastline extends for 2290 km with 1566 km of Coastline, 267 km of artificialized linear (Port, Marina, etc.) and a linear of 457 km of islands, islets and archipelagos (APAL, 2015) The north coasts are under influence of the Atlantic current. The continental shelf is reduced with presence of rocky bottoms.

The long of the eastern coasts, the bottom of the sea is homogeneous and the continental shelf is very large, especially at the Gulf of Gabes level. This region is characterized by a semi-diurnal tide with a high amplitude (until 2 m). In this sector, the Atlantic current loses its influence. The Gulf of Gabes presents hydro-dynamic and physical and chemical features different of those of the North. The temperature and the salinity are, for example, more elevated.

The important surface of the continental shelf of the Tunisian southeast coasts (Fig. 2), the easy access to fishing zones and the presence of the Posidonia sea bed that constitute nurseries for several species of vertebrates and invertebrates made of this region the most important fishing zone of Tunisia

From bio-geographic point of view, the zones Center and especially South, where dominate by sandy and muddy funds, have a subtropical affinity characteristic of the oriental basin.

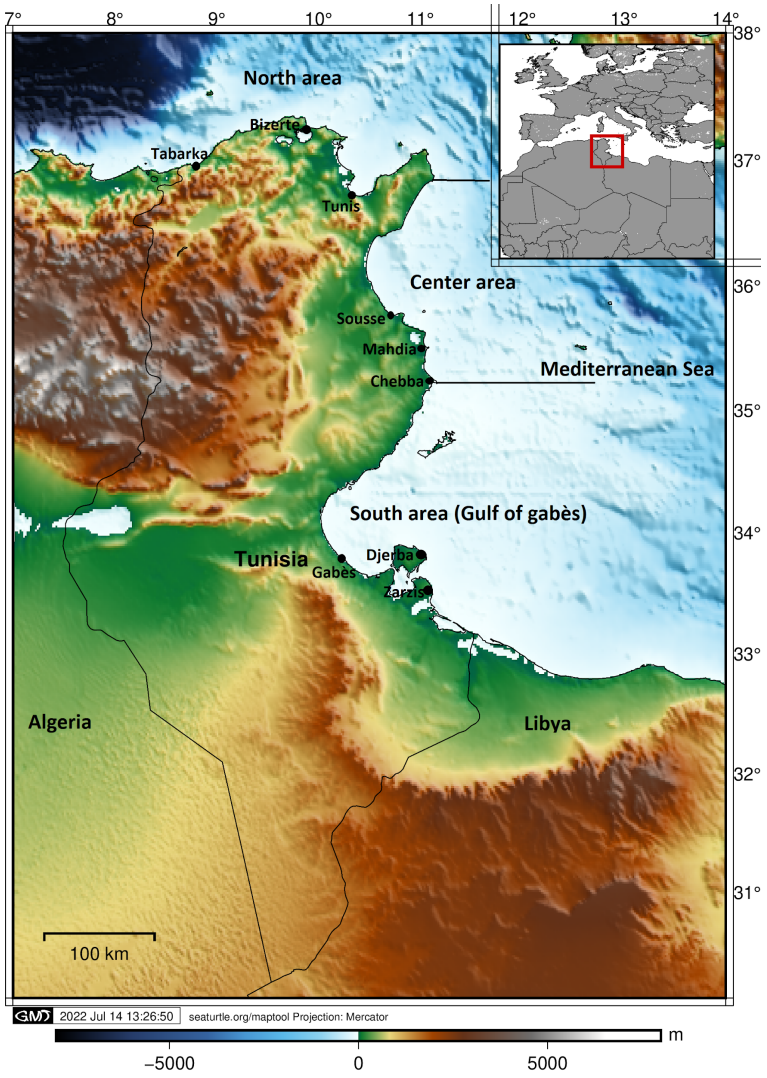

Figure 2: Characteristics of the continental shelf and maritime zones of Tunisia

(The map was created thanks to the Maptool program. Maptool is a product of SEATURTLE.ORG)

The Tunisian coast presents several well differentiated landscapes:

- the sandy beaches which occupy approximately 575 km, constitute the most present landscape on the Tunisian coasts and shelter the major part of the population, essentially in the bays and gulfs of the eastern side of the country;
- the cliff coasts of about 400 km, which are found mainly on the northern facade and to the east of the main capes;
- the coastline with sandy dunes, covered with forest plantations (Zoueraa, Bizerte, Gammarth, Oued Abid, Medfoun, Ghedhabna);
- wetlands.

3. Populations

Tunisia, with a population of 11,818,618 inhabitants in 2021, is ranked at 79th by population of 196 countries and has a moderate population density of 72 people per km^2.
Tunisian coastal zones home about 64% of the total population and concentrate most of the economic activities.

4. Fishing activities

The Tunisian port chain is made up of 40 ports: 10 deep-sea ports sheltering boats intended for trawling, tuna, purse seine and coastal fishing, 22 coastal ports and 8 landing sites: Ten ports at north of the country (GSA12: Northern Tunisia), 10 ports in the East (GSA13: Gulf of Hammamet) and twenty ports in the Gulf of Gabes region (GSA 14).
For trawlers, the highest concentration is in the Gulf of Gabes where the number of trawlers exceeds 61% of the national total. This concentration of the fishing fleet has led to overexploitation of fish stocks and contributes to bycatch of significant emblematic species, such as sea turtles, and generally to significant discards. This fishing activity contributes enormously to the degradation of the ecosystem in this region, which despite everything remains relatively healthier than several other Mediterranean marine regions, especially in the North (Bejaoui et al., 2019). Small scale fishery remains the most frequent type of fishing throughout the country (60% of small-scale vessels are concentrated in the Gulf of Gabes). The purse seiners, whose total number in 2018 amounted to 430 units, are mainly attached to the ports of Kelibia, Mahdia, Teboulba and Gabes. In the east of the country (GSA 13), they represent 57.9% of the national total.

fishing effort

The maritime fishing units active in Tunisia number 12,439 including 11,661 small-scale vessels (Table 1) generating a maritime population of around 100,000 fishermen and seafarers.

Table 1: Fishing effort (total number of vessels in 2018

	North (GSA 12)	*Center (GSA 13)*	*South (GSA 14)*	***Total***
Trawlers	53	80	215	348
Longliners				
Small-scale vessels (With and without engine)	2641	2022	6998	11661
Purse-seiners	57	249	124	430
TOTAL	**2 751**	**2 351**	**7 337**	**12 439**

GSA12 (Northern Tunisia) and GSA13 (Gulf of Hammamet)

Several types of fishing are practiced in the two sub-regions: trawl fishing, coastal fishing, purse seine fishing (small and large pelagic fish), lobster fishing, coral harvesting and lagoon fishing. The trawling activity, which essentially targets the Pink Shrimp, is an important component in this region. Benthic fishing targets species with high commercial value.

Small scale fishery is characterized by a diversification of fishing gears and consequently of metiers.

GSA14

The ease of access to fishing areas and the abundance of species with high commercial value (shrimps, octopus and cuttlefish), intended for export, have made the Gulf of Gabes the area most frequented by Tunisian maritime fishing boats.

Alongside benthic trawling and the purse seine, we have identified the following trades for small scale vessels: 13,400 trammel nets, 40,000 shrimp trammel nets, combined nets, bottom gill nets, shark nets, octopus stones and pots, traps, bottom and surface longlines, fixed fisheries (the "cherfia", the "jemma").

Bottom longline fishing targeting groupers is practiced during the summer throughout the Gulf of Gabès region. The other fish are targeted mainly in autumn and winter.

5. Maritime traffic, and offshore activities

Maritime traffic is very important in the entire world and mainly in the Mediterranean.

Tunisia has the highest number of cruise ports in entire Africa despite its small size, it has six commercial medium-size ports (Rades, La Skhira, Bizerte, Sfax, Gabes, and Sousse) but Tunisia plays a too little role in world trade. RADES is a Large-sized Port. The types of vessels regularly calling at RADES are Vehicles Carrier (12%), Oil/Chemical Tanker (12%), Cargo (12%), Bulk Carrier (9%), Passenger Ship (9%). The deepwater port at Enfidha begins the port relevance of Tunisia.

6. Pressure : tourism, industrial, urbanization, pollution, etc.

As known, tourism, industries and urbanization generate environmental problems (pollution, use of sandy beaches…). We focus in this document on tourism and its negative impact.

Tourism in Tunisia and its environmental impact

Tourism occupies an important place in the Tunisian economy. It is the third source of foreign currency for the country after the clothing textile industry and the mechanical and electrical industries. At the national level and at international level, a consensus was reached to consider tourism as a driver of economic development. Since independence, the sector promoter was at the heart of the issue of land. However, despite its positive impact on economic growth, tourism generates negative effects on the environment and thereby compromises the future of economic development. Excessive concentration of investments in tourism in coastal regions has generated an occupation of large areas of coastline in vulnerable sites and degradation of the urban and natural environment.

According to the report of the Tunisian national tourist office (ONTT, 2020), the Key figures for 2020 are illustrated by the figure 3. Tourists' entry is concentrated in summer months (Fig. 4)

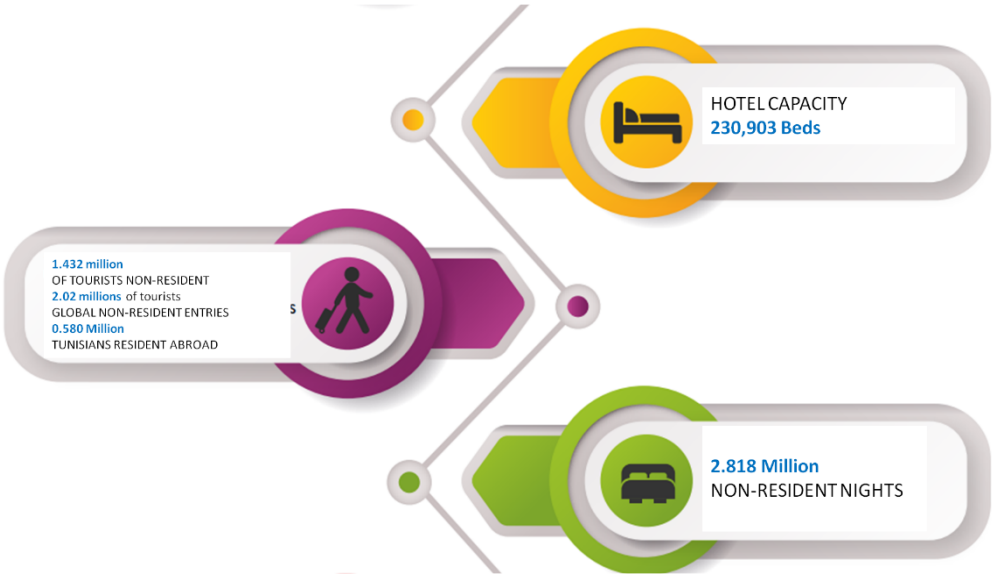

Figure 3: 2020 Key Figures (Extract ONTT – 2020)

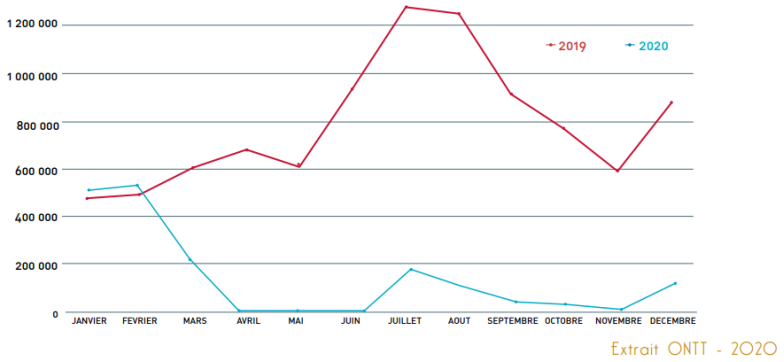

Figure 4: Arrivals at borders by non-residents per month

7. Marine Protected areas

Tunisia has a large number of protected or managed areas with a marine component (18 sites), the vast majority of which are Ramsar sites (15 sites). Four sites are in the process of being created as Marine and Coastal Protected Area (MCPA). Among the 4 sites being created, only the Kuriat islands site does not benefit from any other protection status to date (SPA/RAC et MedPAN, 2019) (Fig. 5). However this site represents the most important nesting site for sea turtles in Tunisia (Jribi et al., 2006; Bradai and Jribi, 2010)).

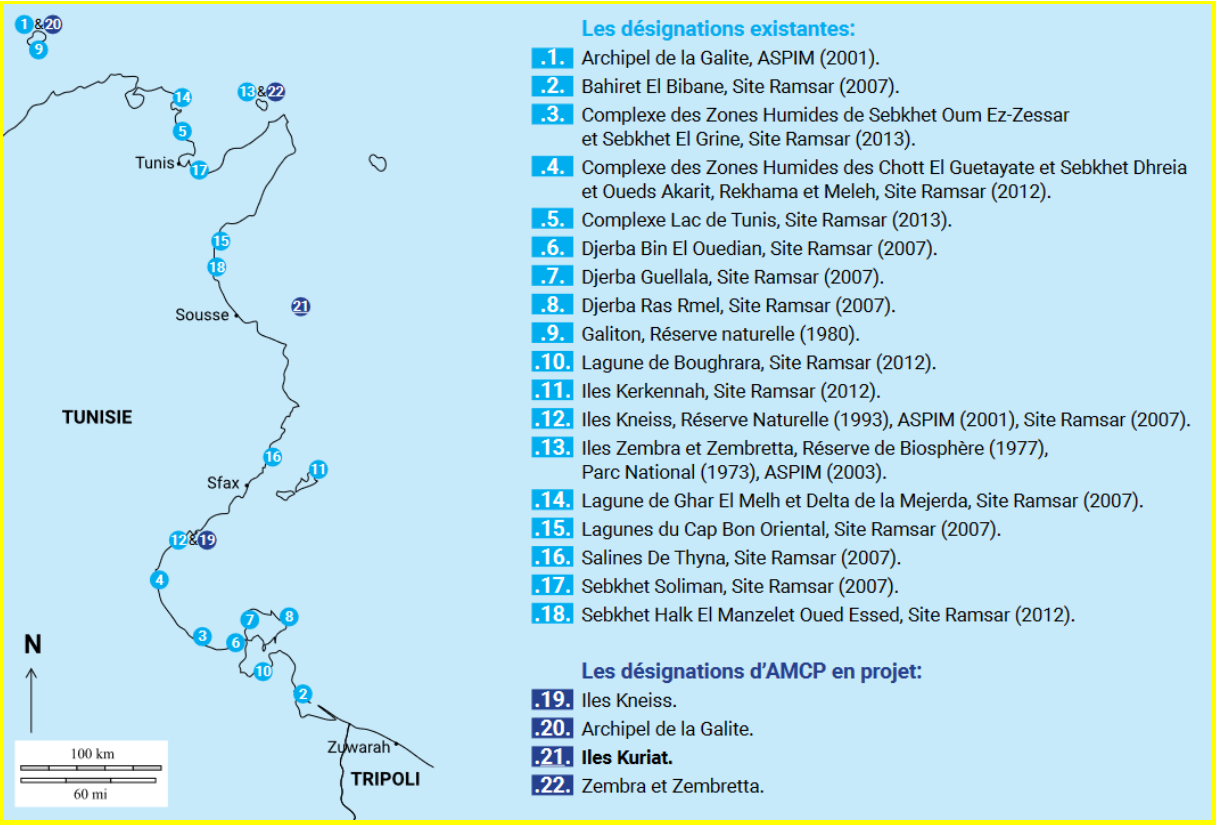

Figure 5 : Protected or managed areas with a marine component in Tunisia (SPA/RAC et MedPAN, 2019)

II. Sea turtles in Tunisia

1. Contexte

a. Sea turtle diversity

Three species of sea turtles are known in Tunisia; the loggerhead turtle *Caretta caretta*, the green turtle *Chelonia mydas* and the leatherback turtle *Dermochelys coriacea*. The first species is common and breeds there. The green turtle is rarely reported. The leatherback turtle is regularly observed (Bradai and Jribi, 2010).

The Tunisian coasts, and mainly the Gulf of Gabès, are of capital importance for the populations of sea turtles in the Mediterranean. The Gulf of Gabès is considered as a wintering and feeding area for *C. caretta* (Argano et al., 1992; Bradai, 1992; Bradai et al., 2009; Bradai and Jribi, 2010; Gerosa and Casale, 1999; Laurent et al., 1990; Laurent and Lescure, 1994; Margaritoulis, 1988; Margaritoulis et al., 2003). This importance has been confirmed by recaptures of tagged female loggerheads after laying on nesting sites in Greece or of ringed juveniles and subadults at sea in the northern Mediterranean. Similarly, satellite monitoring has confirmed such migrations. This migratory gathering is explained by the North-South thermal gradient of the surface waters. The turtles would seek warmer waters. The second reason could be trophic. Turtles feed in winter in southern Tunisia, they eat mainly benthic invertebrates (gastropods, crustaceans and sea cucumbers).

Moreover, regular nesting sites of the loggerhead *Caretta caretta* are known on Tunisian coasts (Kuriat and La Chebba) and benefit from a regular monitoring (mainly kuriat islands). Other sites of lesser importance have recently been discovered. It should also be noted that a green turtle nest was reported once on the beach of Rejich (Central East of Tunisia). This nest is the most eastern one discovered in the Mediterranean.

b. Cultural heritage of Sea turtles in Tunisia

Sea turtles were considered in ancient fisheries as exploited species. These reptiles are, indeed, found in the lists of captured species. In 1927, the sea turtle was even listed in the fisheries statistics for the Sousse, Nabeul sector (Monconduit, 1927).

The main use of turtles before its ban was for food: "It is often brought to the markets of all the maritime towns where it is used for food" (Blanc, 1935). Its oil is sometimes used as medicine (Servonet, 1889). André (1961) indicated that in the Kerkennah islands, the flesh is little sought after, but that the blood and the heart would be remedies against certain diseases. According to him, above all the carapace interests the Kerkenian to make a cradle of it (Fig. 6). According to Marinkelle (1959), dried eyes prepared as amulets or very young individuals associated with sponges in a basket hung over the head of a bed protect fishermen from shark attacks or improve fertility in women. According to Argano (1979) after a survey realised in 1978, the use of sea turtles is mainly for food and tourism (sale of shells) (Fig. 7).

Figure 6: Cradle for babies on Kerkennah Island

Figure 7: Use of sea turtle carapce for decoration

Despite its prohibition and efforts to protect sea turtles in Tunisia, the trade in a clandestine manner exists in certain regions. A strategy to combat this phenomenon was developed in 2020 (SPA/RAC - ONU Environnement/PAM, 2020a).

2. Studies on sea turtles

Scientific work on sea turtles in Tunisia began in earnest at the end of the 1980s following beach surveys which permit to report the first nesting in 1988 on the beach located between Ras dimas and Mahdia and on Great Kuriat Island (Laurent et al., 1990). Surveys in the early 1990s also showed the importance of loggerhead turtle nesting on the Kuriat islands and on Chebba beach where 3 nests on the beach of "Sidi Messaoud" were discovered (Ellouze , 1996). The monitoring of the nesting of the sea turtle *Caretta caretta* on the Kuriat islands and the surveys of the different coasts have shown that the Kuriat islands represent the most important nesting site in Tunisia. Scientific work on sea turtles were then diversified and touched on several themes. Several institutions and organizations have been involved in conservation efforts.

Following the ratification of many international conventions by Tunisian government, many aspect of conservation were developed and made it possible to improve knowledge of these protected reptiles (see Conservation effort chapter).

Among the legislative conservation tools adopted by Tunisia, there is the Action Plan for the Conservation of Marine Turtles in the Mediterranean Sea (UNEP/PAM) within the framework of the Barcelona Convention and the recommendations of the GFCM and of ICCAT.

Following the ratification of the international conventions mentioned above, Tunisia has developed national legislation. The protection of sea turtles is ensured, at the national level, by the promulgation of law n°94-13 of July 31, 1994 of the Ministry of Agriculture and its implementing decree of September 28, 1995 which organizes fishing activities and the annual decree of the Ministry of Agriculture organizing hunting. These pieces of legislation prohibit the capture, peddling and trade of sea turtles.

Moreover, and within the framework of the implementation of the Action Plan for the Conservation of Marine Turtles in the Mediterranean Sea (UNEP/MAP) and its National Action Plan, Tunisia has undertaken various actions in the field of marine turtle conservation:

- Sea turtles and cetaceans stranding network

The study of cetaceans and sea turtles stranded was reinforced at the beginning of 2004 by the creation of a national strandings network. This program is part of the activities of the INSTM marine biodiversity laboratories. Three teams have been set up for this purpose, the first based in the North, the second in the center and the third in the South. Strandings are reported by appropriate forms or transmitted online via the network's website (www.rne.tn).

- Awareness activities

Several educational activities aimed at the general public have been undertaken. The programs have mainly relied on the management of fishing activities targeted at the preservation of stocks, on the protection of threatened species and biodiversity and on the development of guidelines necessary for the management of incidentally caught endangered species. Seminars, leaflets, posters, books, radio and television broadcasts have been implemented for this purpose.

- Monitoring of the Kuriat islands nesting site

The beaches of Kuriat islands, which represent the most important nesting site, are monitored since 1997 with a seasonal scientific camp. The activity responds to two concerns:

- Herpetological research;

- The conservation of sea turtles.

This monitoring is done within the framework of an annual convention between the IINSTM, the APAL, the SPA/RAC and the NGB association.

- Sea turtles rescue centres

Given the importance of accidental captures of sea turtles and with the aim of helping those in difficulty, a Sea Turtle Rescue Center was created in 2004 at INSTM Monastir and a first aid centre was recently created in the Sfax faculty of Sciences (2020). The centres contribute to the treatment of turtles stranded alive or tired after accidental captures.

- Research activities

Several researches on sea turtles are carried out in Tunisia within the framework of the monitoring of nesting beaches and the activities of the rescue centres and the national sea turtle and cetacean stranding network. Other research activities were also carried out such as :

- Study of interactions with several fishing gears and mitigation measures to reduce bycatch;

- Studies of migration by metal tags and by satellite monitoring of turtles caught accidentally or on nesting sites;

- Genetic studies;

- Pollution by heavy metals;

- Studies on the ingestion of marine debris and particularly plastic.

3. Nesting

A third of the Tunisian coast, located in the north, corresponds to a rocky area dotted with small beaches. The remainder stretches in the east and south has different hydrological conditions (Laurent et al., 1990). The total length of sandy beaches for the entire Tunisian coastline is estimated at 593 km, 6% of which is bordered by a dune field (APAL, 2015).

An intense nesting activity of the Loggerhead turtle was reported since mid-twentieth century on Tunisian coasts. Already in 1935, Blanc (1935) wrote:

"The loggerhead lays its eggs in the sand of the islands, islets and deserted shores of Tunisia as well as throughout northern Africa.

Many other authors stated also that the eastern coast of Tunisia represented the most important region in North Africa for Loggerhead nesting activity, considering the immense range of uninhabited beaches (Knoepffler, 1962; Argano, 1979 and Parent, 1981)

This intense and widespread nesting of the Loggerhead turtle *Caretta caretta* mentioned in the literature along the Tunisian coastline, in particular in the south-east of the country, was not based on precise information.

Nevertheless, such activity of nesting was truly discovered for the first time in 1988 on the beach located between Ras Dimas and Mahdia and on the Great Kuriat island off Monastir (Laurent et al., 1990), at Sidi Massaoud beach in Chebba (Ellouze 1996) and at Zouaraa beach (Beja) in 2016 (Bradai and Karaa, 2017).

Currently, nesting activity of the Loggerhead turtle *Caretta caretta* occurs principally in Kuriat islands (Bradai, 1995 and 2000 ; Jribi, Bradai and Bouain, 2002 and 2006; Jribi and Bradai, 2014) and Chebba beaches (Ben Hasssine and Escoriza, 2013; Jribi, 2017; SPA/RAC - ONU Environment/PAM, 2020b) which are monitored. The first site is the most important in Tunisia. The two sites are located in the eastern coasts. Since 1997, an annual report is elaborated on the monitoring of the Kuriat nesting sites.

Although the smallness of the two nesting sites, Kuriat islands and Chebba, at the Mediterranean scale, the nesting activity is regularly registered, and the nests number increases since respectively 1997 and 1994.
Besides these documented loggerhead nesting sites in Tunisia, several testimonies mention the presence of other nesting sites. Inquiries about this phenomenon and an exploration of sandy beaches, along Tunisian coasts carried out in 2018 and 2019 confirmed such testimonies and discovered more nesting sites (Hrizi, 2019 ; SPA/RAC - ONU Environment/PAM, 2020b).

An exceptional nesting event of green turtle was also recorded in the summer of 2019 in Rejich beach (Mahdia – Eastern coasts) (SPA/RAC - ONU Environment/PAM, 2020b; Ben Ismail et *al.,* 2022). This nest represents the western most nesting record of the green turtle in the Mediterranean.

Tunisian beaches represent the westernmost nesting grounds for Loggerheads in the southern Mediterranean (Laurent et al. 1990) before the new nesting site recorded recently in Algeria (Benabdi and Belmahi, 2020).

a. Monitoring of the sea turtle Caretta caretta nesting on the Kuriat Islands

The Kuriat or Qûrya Islands (35° 48’ 05” N, 11° 02’ 05” E) are two small emergences, 2 km away from each other, located east-northeast of Cape Monastir, in front of the bay of Khnis at 11 nautical miles, or about 20 km. These are two small uninhabited islets, characterized by a flat and low morphology not exceeding 4.5 m with several low-pressure areas (Fig. 8).

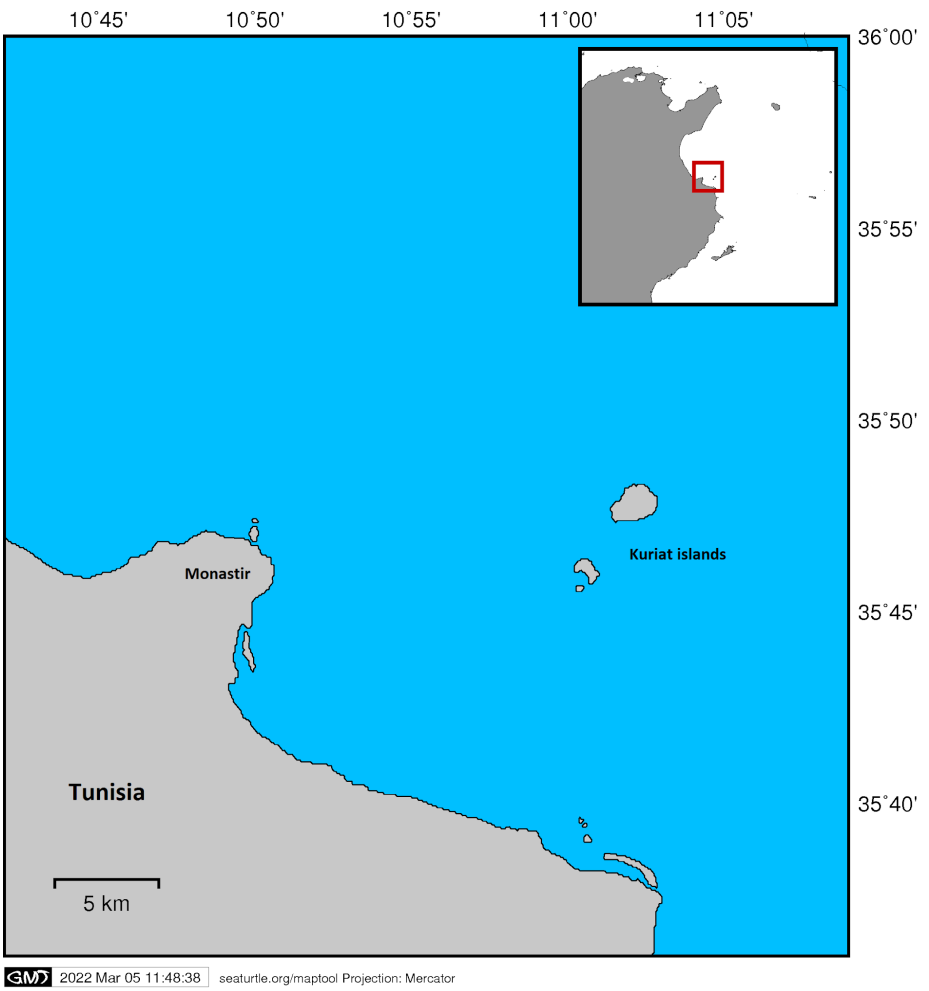

Figure 8: Geographic position of Kuriat islands off the coast of Tunisia.
(The map was created thanks to the Maptool program. Maptool is a product of SEATURTLE.ORG)

The largest one, the Great Kuriat called also Qûrya El Kbira, has an ovoid shape, it is 3.5 km long by 2 km wide and covers about 270 ha and extends over a perimeter of 6.9 km. The highest areas occupy the north of the island. The highest point reaches 4.2 m and is located at the level of the lighthouse.

Almost one third of the Great Kuriat shoreline is rocky and large deposits of sea grass (Posidonia oceanica) detritus further restrict the accessible nesting sites particularly in the south and the south-western beaches. The principal nesting beach lies on the western coast and it is almost 900 m in length.

The smallest one, Qûrya Sghira also known under the name of Cogniliera Conigliera (the island of the rabbits), has an area of 50 ha, most of which is made up of flat and low land exceedingly very rarely 0 m in the North and in the Northeast, as well as intertidal plains corresponding to the oscillation zone of the marshes. Small Kuriat has a total of 800m of sandy beach situated in the north-eastern part of the island whereas the rest of the coastline is rocky or marshy.

These two sites are monitored regularly since 1997.

Stakeholders

The main actors currently involved in the protection of marine turtles in Tunisia and the follow-up of the annual monitoring on the Kuriat Islands are:

- The National Institute of Sciences and Technologies of the Sea (INSTM) responsible for coordinating the execution of the monitoring program by assigning researchers and other necessary personnel;
- The Coastal Protection and Planning Agency (APAL) responsible to make contacts, in particular with the Ministry of National Defense and regional authorities in Monastir with view to obtaining the necessary authorizations for the stay on Kuriat Island. APAL is also responsible for ensuring the transport of the field team between the mainland and the islands;
- The Regional Activity Center for Specially Protected Areas (SPA / RAC) through the project, is responsible for financially assisting the organization and execution of the monitoring campaign nesting;
- The Sfax Faculty of Sciences (FSS) responsible for hiring researchers and students on the site and facilitating the training of students;
- The Notre Grand Bleu association, responsible for the logistics of the campaign and participating in the conduct and monitoring of training on the site.

Importance and period of nesting

The monitoring of nesting on Kuriat islands since 1997 permit to locate the egg-laying period of *Caretta caretta* mainly during months of June, July and August of each year with a pic during the first half of July (Jribi et al., 2006). The laying during the month of august was registered at first time during the nesting season of 2003 indicating a spreading of this period especially during the last years. The distribution of laying dates on the Kuriat Islands is found in the range of dates observed in the Mediterranean. Indeed, the Cauanne *Caretta Caretta* begins to lay at the end of May until the end of August, however some individuals continue to lay until early September (Demetropoulos and Hadjichristophorou, 1995). This parameter is very important to know for the implementation of any conservation activity. Indeed, its knowledge makes it possible to reduce anthropogenic disturbances, especially when the nesting phenomenon coincides with the frequentation of nesting beaches by summer visitors and tourists (Jribi et al., 2006).

The average number of nests deposited on the Kuriat Islands since 1993 is 20.34 (SD=12.44; N=29) (Fig. 9). The average number of nests deposited on the Great Kuriat and on the small Kuriat are respectively 14.78 (SD= 8.89; N=29) and 5.62 (SD= 5.82; N=29). It should be noted that the number of nests has recorded a marked increase over the past four years (Mean = 44, SD=2.16, N=4), which would be the result of the protection effort deployed since the start of monitoring.

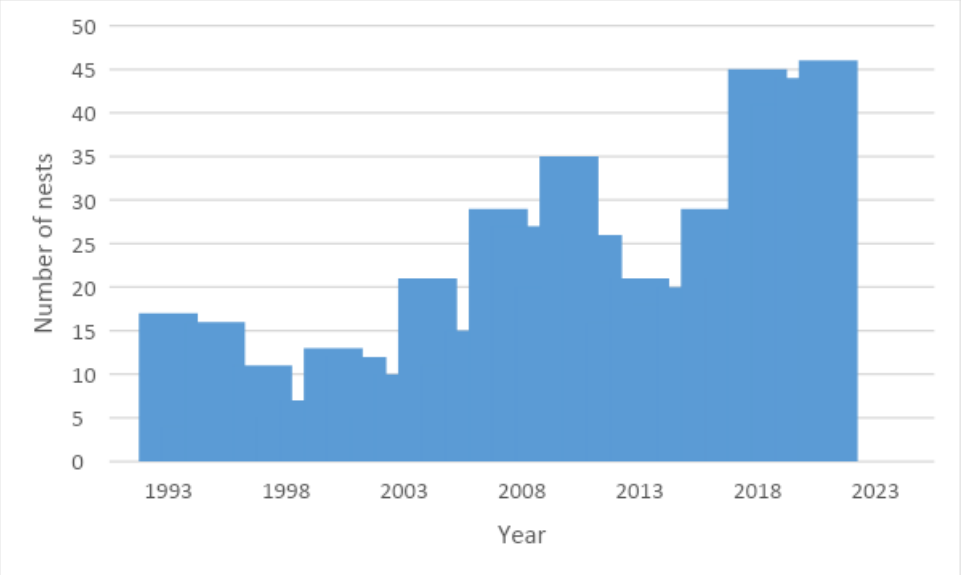

Figure 9: Number of nests yearly deposited on Kuriat islands

Reproductive parameters

The clutch size (the total number of eggs laid in a nest) on Kuriat Islands varies between 25 to 164 (individual nests) with a mean of 88.95 (N=375). The hatching and emergence rates for nests under normal conditions exceed usually 60%, which reveals the suitability of the beaches of Kuriat islands (Jribi et al., 2002a, 2002b, 2006; Bradai and Jribi 2010, 2020).

The females' remigration interval (years between breeding migrations) on Kuriat islands is of the order of two years, however, intervals of one year have been recorded in recent years, which shows the importance of satellite monitoring to see if there are turtles who don't migrate too far to come the following year to lay. In fact, this parameter and the clutch frequency (nests per breeding season), are associated with feeding conditions and related environmental factors.

Mediterranean nesting females are known to be the smallest in the world (Dodd, 1988; Margaritoulis, 1982, 1988; Broderick and Godley, 1996). During our monitoring since 1997, we were able to tag 81 nesting females. These tagged turtles had a mean CCLn-t (Curved Carapace Length) of 75.97cm (SD=4.13; N=81; individual range : 68-87cm) and a mean CCW (Curved Carapace Width) of 67.5cm (SD=3.86; N=81; individual range : 61-77cm). These data confirm that nesting females in the Mediterranean have generally curved lengths greater than 70cm (Margaritoulis et al., 2003).

The biometric and meristic characteristics of hatchlings in Kuriat islands were studied since the beginning of the monitoring. Scutes were examined with regards to variation within carapace scute series and variation in carapace scute pattern. The most commun scute pattern observed was: 5 vertebrals, 5 pairs of costals, 5 pairs of marginals and 3 pairs of infra-marginals. For mass and metric characters, the results shows that Kuriat hatchlings are close to their Mediterranean homologues but lighter and smaller than those from other parts of the world (Jribi et al., 2002)

Genetic

Genetic analysis has been undertaken on the main Tunisian nesting site of Kuriat. Freshly dead Hatchlings of loggerhead have been recently analysed for the long mtDNA control region sequences. Only the widespread Mediterranean haplotype CC-A2.1 has been detected when analysing the long

sequence of 800 bp. Anthropogenic impact linked mainly to fishing and touristic activities resulted in the observed reduced genetic diversity of the nesting population (Chaieb et al., 2010).

b. Chebba nesting sites

Chebba is located off Cape Ras Kaboudia which is the most easterly point of the Tunisian coasts (Fig. 10). It has the particularity to spread like a peninsula and the sea surround it on three sides. It has 29 km of coastline with some islets.

Two nesting sites are known in Chebba "Essir" and "Sidi Messaoud" beaches (Fig. 10)."Essir" is the main beach of Chebba. It has a length of approximately 600m and spreads between the two points with GPS coordinates: 35°14.386'N/011°08.557'E and 35°14.268'N/011° 08.892'E. This beach is very busy during the summer, day and night.

The beach of "Sidi Messaoud" is contrary to "Essir" less crowded. It is a small beach of about 200m length located behind the fishing port and adjacent to the Roman archaeological site "Borj Khdija". It spreads between the two GPS points: 35°14.108'N/011°09.442' E and 35°13.998'N/011°09.604'E.

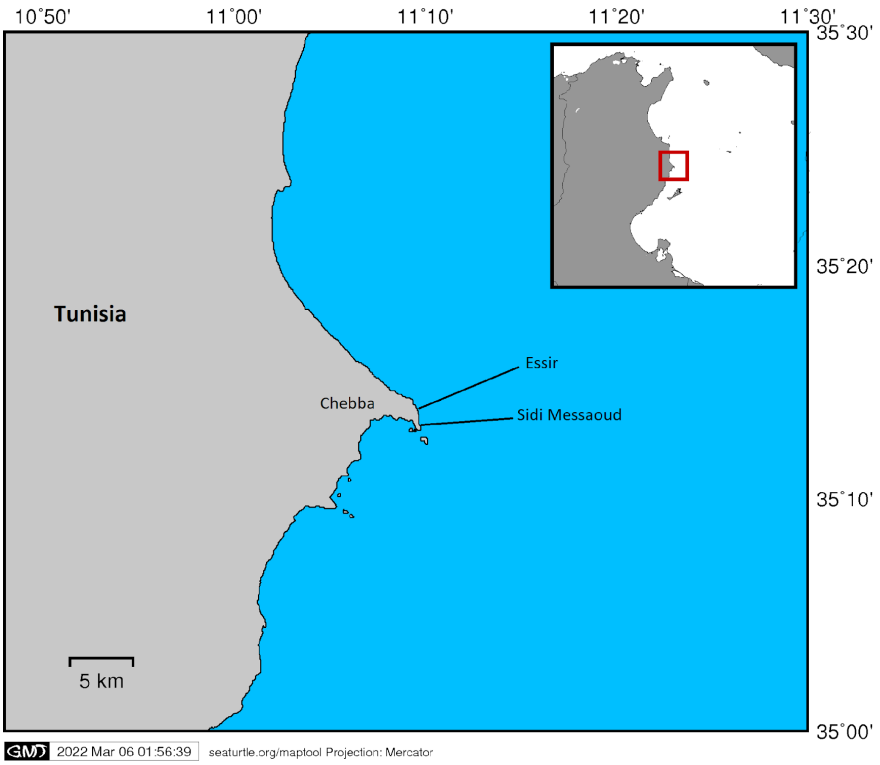

Figure 10: Geographic position of Chebba

After the initial record of Loggerhead nesting activity on Sidi Massaoud beach in Chebba in 1994 (two nests) and in 1995 (one nest) (Ellouze 1996), follow-up surveys during 1996–2000 recorded no further nesting activity (Ben Hassine and Escoriza, 2013). However, according to Ben Hassine and Escoriza (2013), during the summer of 2003, vacationers found hatchlings on the road close to Essir beach, about 1.24 km further north, probably due to artificial lighting behind the beach disorienting the hatchlings and drawing them inland. Since then and until summer 2013, hatchling turtles have been recorded emerging from the sand of Essir beach every summer; from mid-August to the mid-September). The crawl tracks of nesting females were recorded on Essir beach from late June to July

in 2005 and 2008. However, in 2013 nesting was recorded for the first time since 1995 at Sidi Massouad beach.
A survey was carried out in "Essir" and "Sidi Messaoud" beaches during summer 2013 to assess the actual state of the nesting population. Ten nesting events by loggerhead sea turtles were recorded suggesting that Chebba may host a much higher nesting activity than previously (Jribi, 2017).

During this survey a total of ten sea turtle nests were deposited in Chebba; six in "Sidi Messaoud" and four in "Essir". Sometimes, only hatchlings disoriented and attracted by light allowed to know the presence of nests. The available information on the nests deposited is presented in table 2.

Table 2: Information on the studied nests in Chebba (2013)

Nest	Beach	Laying date	Emerg date	ID (days)	Clutch size	Eggshell	infertile	Unhatched eggs		Dead in eggs	Dead in nests	Fertility success	Hatch success	Emerg success	Sex ratio (%♀)
								E	L						
A	S. Messaoud	05/07	31/08	58	83	77	2	2	1	1	0	96.4	92.8	92.8	8
B	S. Messaoud	05/07	01/09	59	126	31	90	5	0	0	0	28.6	24.6	24.6	1
C	S. Messaoud	13/07	14/09	64	65	35	6	16	8	0	0	90.8	53.8	53.8	0
D	S. Messaoud	18/07	17/09	62	82	66	6	2	5	3	0	89.0	80.5	80.5	0
E	S. Messaoud	31/07	06/10	68	78	69	0	4	4	1	0	98.7	88.5	88.5	0
F	S. Messaoud	15/08	27/10	74	51	44	3	2	2	0	2	94.1	86.3	82.4	0
G	Essir	-	17/08	-	120	52	59	5	3	1	0	50	43.3	43.3	-
H	Essir	-	25/08	-	-	-	-	-	-	-	-	-	-	-	-
I	Essir	-	01/09	-	-	-	-	-	-	-	-	-	-	-	-
J	Essir	-	13/09	-	-	-	-	-	-	-	-	-	-	-	-

The nesting season 2013 in Chebba started at the beginning of July and ended at the middle of August with duration of 42 days. The mean clutch size of the seven nests excavated in Chebba 2013 was 86.43 eggs.
The hatching success and hatchling emergence success are about 67.1% and 66.6% respectively. In "Sidi Messaoud", where there is the maximum of studied nests, these rates rise to 71.1% and 70.4%. The number of infertile in nest B is very important indicating that it would probably be that of a neophyte (new nesting female). Disregarding this nest, hatching and emergence rates amount to 80.4% and 79.6%. For the nest deposited in "Essir", there was a high proportion of infertile eggs and the hatching and emergence rates were low. The incubation duration registered in "Sidi Messaoud" beach is 64.2 days.

Chebba nesting sites were not regularly monitord last years but nesting occurs each year (except 2017). Four nests were deposited in 2019 at the Chebba, two on the beach of "Essir", one at "Sidi Messaoud" and one on another beach called "El Koucha" north of the other two beaches. The latter

was detected at the end of the season following its flooding and its dispersal by the waves. The results of monitoring these nests and the various survival parameters are shown in Table 3. Figure 11 shows Loggerhead nest detected on Sidi Messaoud beach on 06/09/2019

Figure 11: Loggerhead nest detected on Sidi Messaoud beach on 06/09/2019

Tableau 3: Survival parameters of nests deposited at Chebba during 2019

Nest	Cluch size	Egg shels	Infertile	Non hatched eggs		Dead in egg	Dead in nest	Fertility rate	Hatching rate	Emergence rate
				Early mortality	Late mortality					
Essir 1	87	44	43	0	0	0	1	50,57	50,57	49,43
Essir 2	87	48	28	5	3	3	1	67,82	55,17	54,02
Sidi Messaoud	91	81	8	1	1	0	0	91,21	89,01	89,01
Moyenne	**88,33**	**57,67**	**26,33**	**2,00**	**1,33**	**1,00**	**0,67**	**69,87**	**64,92**	**64,15**

c. Irregular and potential new nesting site

We consider in this study the nesting site definition of Girondot and Fretey (1996):"A marine turtle nesting site is considered to be any surface where at least one female of any species of sea turtle has laid eggs in historical times".

Global warming is affecting habitat quality and availability on our planet and some species are predicted or already being observed to change their distribution range. Marine turtles are a particularly interesting case to study in this respect, since they have already survived and adapted to several important climate change events throughout their >1 million years of evolutionary history and they colonized tropical and subtropical nesting habitats around the world notwithstanding their natal philopatry. However, current climate change is happening at a much faster rate and is expected to have profound effects on the adaptability of sea turtles whose life history is characterized by longevity, late age of maturity and temperature dependent sex determination. It seems that in the Mediterranean, loggerhead turtles have already started to expand their nesting range from the eastern to the western basin, which has only been known to host sporadic nests but reports of nesting activity have been increasing since the 2010's.

In Tunisia many testimonies and observations confirm this tendency and many nests were deposited even in sites no considered before by nesting activities.

In the frame of the project "Conservation of sea turtles in the Mediterranean region" coordinated by SPA/RAC and financially supported by MAVA (2018 – 2019), exploration of sandy beaches, along Tunisian coasts, looking for new and potential sea turtles nesting sites, was done.

Primarily results show that about 20 sites were identified as nesting sites for the loggerhead turtle, where previous or current nests were detected (Fig. 12).

Moreover, the study of the quality of beaches patrolled indicates that the majority of them are favourable for nesting activity which allows us to consider them as potential nesting sites.

As noticed, surveys on Mediterranean coasts and especially on the coasts of the western basin show that nesting activity increases recently from one year to another in many Mediterranean countries. Global warming phenomenon and increase of observation effort could be responsible of the extension of the nesting areas.

In Tunisia 65 nests were registered in 2020; 44 in Kuriat islands (Jribi et Bradai, 2020) and 21 nests in others beaches of Tunisian coasts.

Figure 5 shows all nesting sites known in Tunisia for the moment.

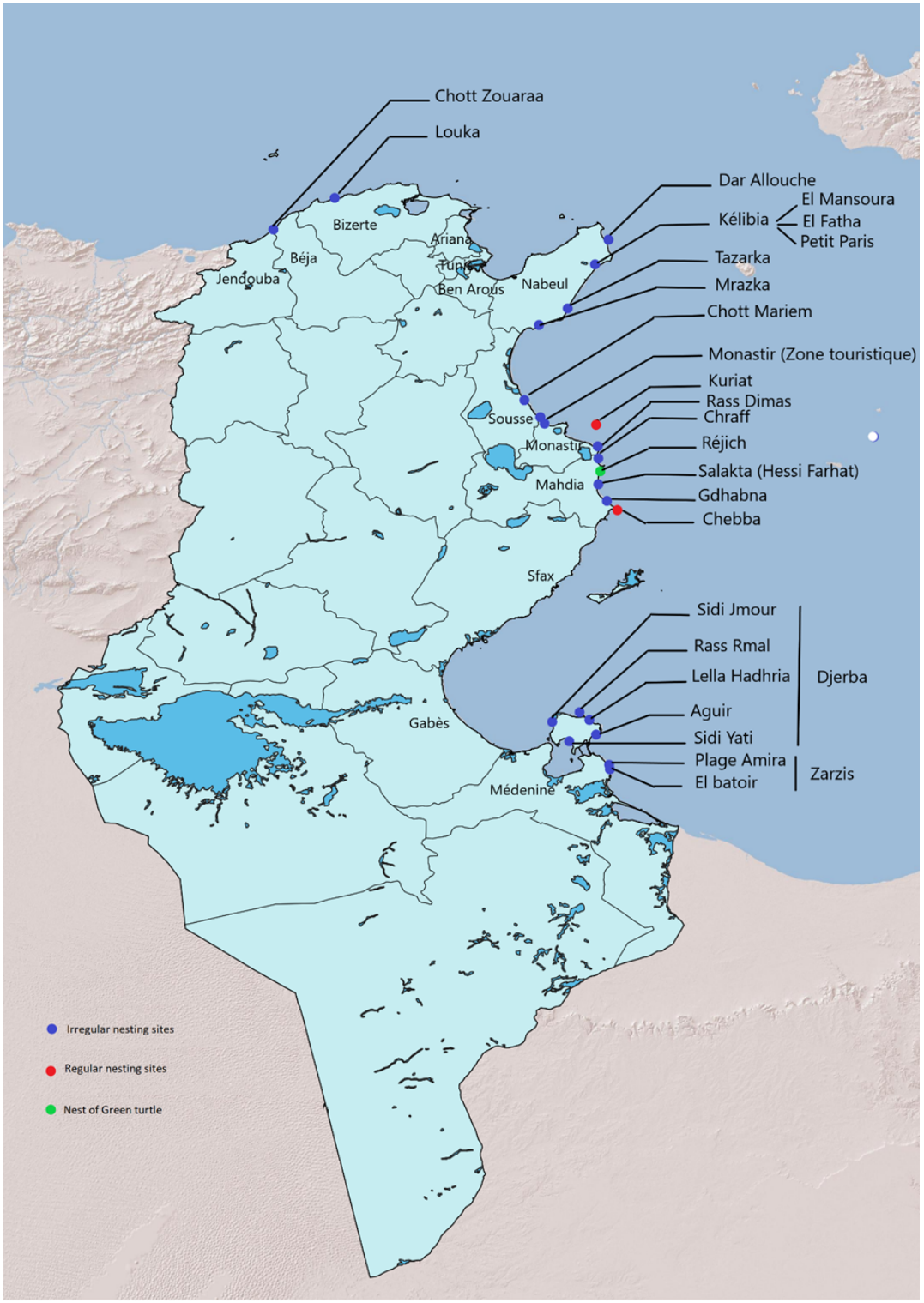

Figure 12: Map of Tunisia with locations of nesting beaches known and discovered in 2018-2020.

Besides Kuriat islands and Chebba beaches, those considered nesting sites during last five years and where nests were really observed are presented in table 4.

Governorate	Coordinates	eggs laying	Clutch size	E [%]	H [%]	Notes
Beach name: Zouaraa (Nefza)						
Béja	36° 59,5307N/8° 51,8809E	*29 july 2016*	*?*	*?*	*?*	*Bradai and Karaa 2017*
Béja	37° 01' 480N/8° 54' 409E	22 july 2018	?	?	?	Nest inundated by waves and lost
Béja	36° 59,5307N/8° 51,8809E	July 2019	N	?	?	Nest lost
Béja	36° 59,5308N/8° 51,8810E	July 2019	N	?	?	Nest lost
Béja	36° 59,5307N/8° 51,8809E	05 june 2020	138	49,0	50,0	30 Aug is the date of excavation of the nest
Béja	36° 59,5308N/8° 51,8810E	20 june 2020	N	?	?	04 Sept is the date of excavation of nest
Béja	36° 59,5307N/8° 51,8809E	21 july 2020	N	?	?	21 July is the date of detection of the nest
Béja	36° 59,5308N/8° 51,8810E	10 Aug 2020	N	?	?	10 Aug is the date of detection of the nest
Beach name: Louka 2						
Bizerte	37° 14,5735N/9° 21,6930E	2018	?	?	?	
Beach name: Fetha (Kelibia)						
Nabeul	36° 50' 622''N/11° 07' 309"E	24-July-2018	?	?	?	Flooded nest
Nabeul	36° 50' 622''N/11° 07' 309"E	2020	?	?	?	
Beach name: Mansoura (Kelibia)						
Nabeul	36° 51' 07''N/11° 07' 33"E	2018	125	19,2	19,2	
Nabeul	36° 51' 07''N/11° 07' 33"E	2020	?	?	?	Losted nest
Beach name: Petit Paris						
Nabeul	36° 50' 52''N/11° 07' 25"E	2020	?	?	?	
Beach name: Dar Allouche						
Nabeul	36° 58' 39''N/11° 04' 54"E	2020	?	?	?	
Beach name: Echraff						
Mahdia	35.601525 / 11.042869	2020	?	?	?	Chaieb et all (in press): vacationers observed twenty hatchlings crawling on the beach and one dead observed by authors On August 16th. Testimonies revealed sightings

						of several hatchlings few days before.
Mahdia	35.604894 / 11.044310	2020	?	?	?	Chaieb et all (in press): vacationers observed forty hatchlings on the beach On August 7th. A video on the event was done.
Beach name: Chott Mariem						
Sousse	35.929070 / 10.568549	2020	?	?	?	Chaieb et all (in press): Hatchlings observed on 19th August 2020

Table 4 : Nesting sites recorded and number of nest laid during 2016-2020

E: Emergence success / H: Hatching success

d. First record of Chelonia mydas nesting in Tunisia

Following a testimony reported to NGB (association Notre Grand Bleu) on the discovery of a sea turtle nest on Rejich beach in summer of 2019, an expedition of experts and volunteers discovers that it is a nest of green turtle *Chelonia mydas*, hatchlings (Fig. 13) gave more confirmation (Ben Ismail et *al*., in press).

Figure 13: Green turtle new born hatching in Tunisia (Rejich beach, 2019)

The nest has been laid on August 03, 2019 on the beach of Rejich, 35.449871°N; 11.044676°E (Fig. 14). Sea-nest distance was 19.5 m and cavity depth was 70 cm from the surface.

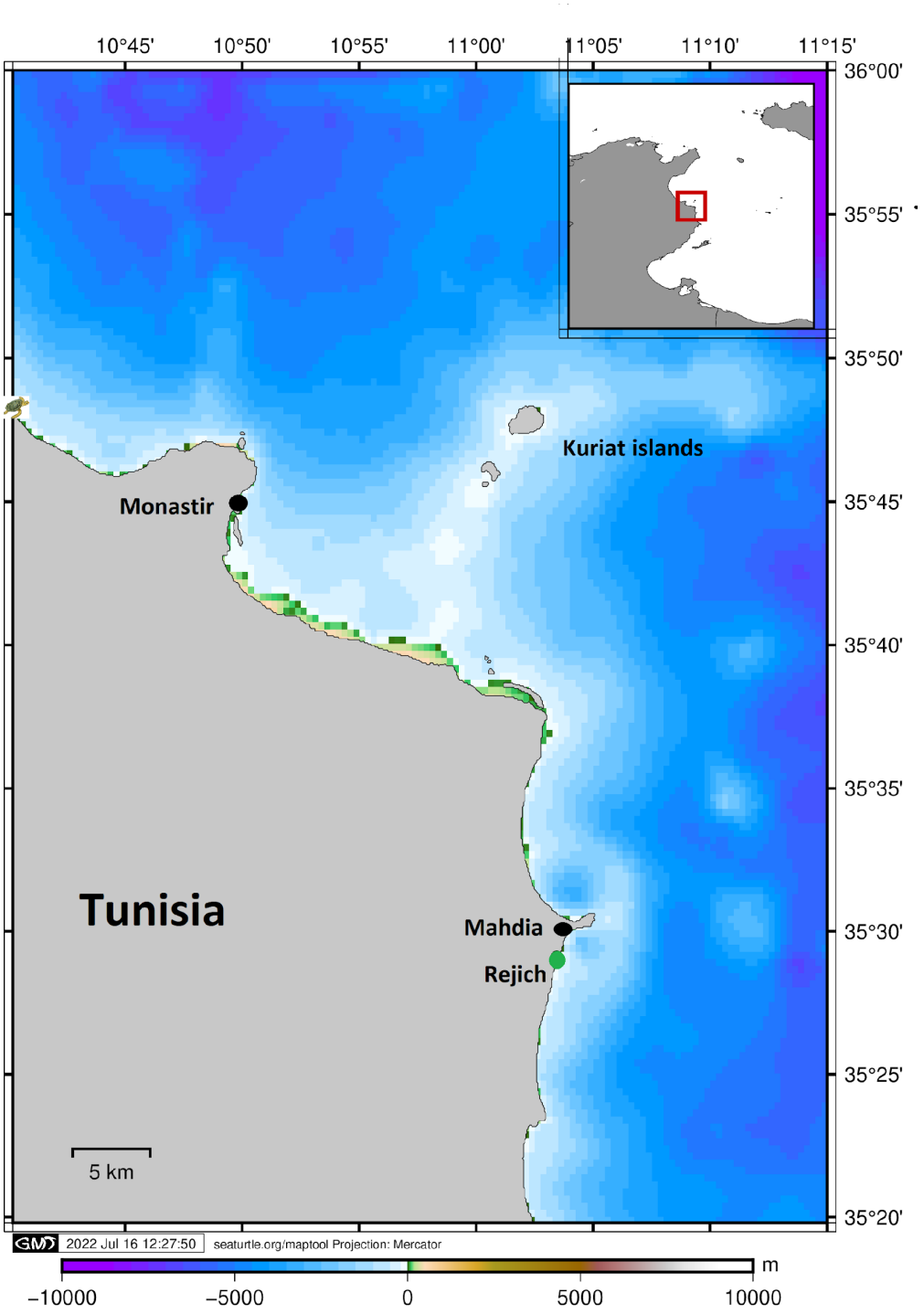

Figure 14: The location of the first nest of green Turtle in Tunisia (Rejich, Mahdia)

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Sixty hatchlings reached the sea securely, while no hatchlings were found dead either inside or outside the nest. Hatching success was calculated as 54.5% (Egg shells/The clutch size X 100). The remaining 50 eggs (unhatched eggs) were identified and included 14 early embryony's stage (12.73%), 2 late stage (1.82%) and 34 unfertilized eggs (30.91%) (Ben Ismail et *al*., 2022).

4. Threats

a. Threats on Kuriat Nesting sites

The nesting sites of small Kuriat are highly frequented by swimmers during nesting season (Fig 15). The beaches are heavily used by humans and disturbance of the sand may have impeded the detection of turtle tracks or nests (Bradai and Jribi, 2010, 2020).

Figure 15: Beaches of small Kuriat highly frequented

Non-human predation:

The black rat *Rattus rattus*, abundant on small Kuriat attacks hatchlings after emergence (Fig. 16). Deratization undertaken by « Notre Grand Bleu » association in 2016 has resolved the problem.

Sea gulls *Larus carchinans*, common on the Kuriat islands, seems to engender predation of hatchlings, mainly of those emerged during daytime.

Figure 16: Hatchlings on the small Kuriat attacked by rat on their heads

The tufted ghost crab *Ocypode cursor* (Fig. 17) is the only Ocypode species present in the Mediterranean Sea. The first observation of this crab, known to be a predator of sea turtles' hatchlings and eggs, in the Tunisian coasts was made by a hazardous observation of specimens emerging from their burrows on June 2018 near a nest of loggerhead turtle in the Kuriat Islands

(Karaa et al., 2019). More investigations are needed to study the impact of this crab on Kuriat islands and in the beaches of the south of Tunisia where some sporadic nesting activities were registered.

Figure 17: Specimen of Ocypode cursor from the south of Tunsia (Karaa et al., 2019)

Other threats

The large deposits of the phanerogam (*Posidonia oceanica*) on the beaches of great Kuriat (Fig. 18) mainly restrict the accessibility of nesting females to the site. These deposits of *Posidonia* hinder also the return of hatchlings to the sea after the emergence. However, the deposits constitute a natural protection of the beaches from waves and inundation.

Figure 18: Large deposits of sea grass (*Posidonia oceanica*) on the beaches of great Kuriat

b. Threats on nesting sites of Chebba

The nesting sites are highly frequented by swimmers during nesting season. The beaches are heavily used by humans and disturbance of the sand may have impeded the detection of turtle tracks or nests.

Light pollution concerns the two nesting beaches of Chebba (Ben Hassine and Escoriza, 2013; Jribi, 2017). The light of the cornice and the port behind Essir beach and Sidi Messaoud beach respectively attract the hatchlings after the emergence. Hatchlings, disoriented, finish on the road behind the cornice where they are crushed by cars (Fig. 19).

Figure 19: Hatchlings crushed by cars behind “Essir” beach in Chebba (Tunisia)

c. fishing bycatch

Bycatch assessments were limited, in Tunisia, to the Gulf of Gabès. This area is a “marine biodiversity hot spot” of significant regional importance and the most important fisheries area of the Tunisian

fishing fleet. The Gulf is the preferred habitat for many iconic Mediterranean vertebrate species such as the loggerhead turtle (*Caretta caretta*); it is a wintering and foraging area for this species.
The high concentration of the fishing effort in the Gulf of Gabès has led to overexploitation of fish stocks and is contributing to bycatches of several charismatic species as well as of many fish species. This along with several other pressures such as pollution and the spreading of alien species has contributed to the degradation of the ecosystems.

In this region, a large fishing fleet using many kinds of fishing gears operates during different seasons and targets a wide variety of commercially important species. These fishing activities interact with sea turtles. It is obvious that fishing poses a threat to loggerhead population in the Gulf of Gabès and mainly in the Zarzis zone.

Catch rates of loggerhead turtle registered by onboard observers in the Gulf of Gabès show variation across gears (Table 5). Estimated total capture in pelagic longline is among the highest for sea turtles recorded in the whole Mediterranean Sea.

Turtles are caught as juveniles and adults. Mortality rates recorded by pelagic longlines and trawls were lower. For the pelagic longlines, hooks are set close to the surface (4-5 m) and thereby a captured animal is more likely to reach the surface to breath. For trawls, the low mortality may be explained essentially by the relatively short haul duration (87 min on average) in the Gulf of Gabès.

Table 5: Observed catch rates (95% C.I), estimated yearly captures (in numbers), and mortality rates of loggerhead turtle registered by different gears in the Gulf of Gabès.

Fishing gear	**Observed catch rate**	**Estimated total captures**	**Recorded mortality**	**Reference**
Pelagic longline	**0.823** (0.568-0.158) turtle/1000 hooks	**486** (335 - 683)	0%	Jribi et al., 2008
	0.806 (0.802–0.810) turtle/1000 hooks	**437** (299 - 609)	12.1%	Echwikhi et al., 2010 a
	0.25 turtle/1000 hooks		3.45 %	Bradai et al., 2017
Bottom longline	**0.278** (0.179-0.415) turtle/1000 hooks	**733** (470 -1090)	33%	Jribi et al., 2008
	0.333 (0.236-0.591) turtle/1000 hooks	**142** (100 - 167)	43.7%	Echwikhi et al., 2012
	0.26 turtle/1000 hooks		9.41 %	Bradai et al., 2016
Trawl	**0.0063** turtle/h.d (lenght of the headrope * haul duration)	**5458** ± 1652	3.3%	Jribi et al., 2007
Gillnet	**0.527** (0.403–0.649)/km2/day	**444** (358 - 501)	69.4%	Echwikhi et al., 2010b

5. Stranding

The study of stranded marine turtles was strengthened in the beginning of 2004 through the creation of the National Stranding Network (RNE). This program was included in the activities of the National

Institute of Sea Sciences and Technology (INSTM), in the laboratory of marine biodiversity. Three groups of three to four persons have been set up to this effect, one based in the north (from the border with Algeria to Kélibia), a second group based in the center (from Kélibia to Chebba) and a third in the south (from Chebba to the border with Libya). Group members (researchers, veterinary doctors and students) can be reached at any moment by mobile phone. For each stranding event, many data were registered, such as dates, Global Positioning System coordinates or location, kind of coast (sandy, rocky), body measurements, sex and species identification. Animals' conditions were reported as live animals, freshly dead, moderately decomposed (organs basically intact), advanced decomposition (organs not recognizable) and mummified/skeletal remains. Necropsy was performed on fresh and moderately decomposed animals. Tissues were taken for histopathology, toxicological and genetic analyses; they were frozen at -20 ° C or preserved in ethanol and stored at INSTM; the presence and nature of parasites and epibionts were noted.

a. Percentage by species

In Tunisia, three species of sea turtles are known: the loggerhead *Caretta caretta*, the green turtle *Chelonia mydas* and the leatherback turtle *Dermochelys coriacea*. The first species is common and nests on many beaches. The green turtle is rarely reported, while the leatherback turtle is regularly observed (Bradai and Jribi, 2010).

From 2004 to 2017, 787 stranded turtles have been recorded along the Tunisian coasts, among them 13 turtles were unidentified given their advanced state of decomposition. The majority of identified turtles were loggerhead *Caretta caretta* (97 %), which is the most common species in Tunisian waters. The proportions of green and leatherback turtles recorded was respectively (1%) and (2 %) confirming their status as rare species.

In 2012 and 2013, the most important period for the analysis, the record period in the stranding report, 637 stranded turtles were registered; 611 of them were loggerheads Caretta carette, 8 (1.28 %) leatherbacks *Dermochelys coriacea*, 5 (0.08 %) green turtles *Chelonia mydas* and 13 unidentified (following reports of the RNE).

b. Grounding distribution map

Stranded marine turtle were recorded in Tunisian coasts and especially in the Gulf of Gabes (South) (Karaa, 2013; Bradai, 2000) (Fig. 20). The records allow the collection of biological and ecological data and determine causes of mortality.

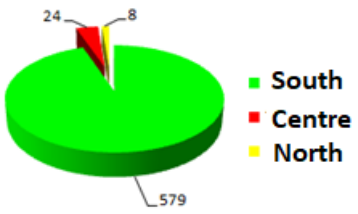

Figure 20: Spatial distribution of loggerhead strandings in 2012 and 2013

The analysis of seasonal distribution of the stranding in the Gulf of Gabes shows that most stranding occurred during the period between May and June (Fig. 21). The increasing of fishing activity in this period seems to be a potential cause of mortality. The oceanic conditions produce near shore currents could facilitate drifting turtle's carcasses (Karaa, 2013).

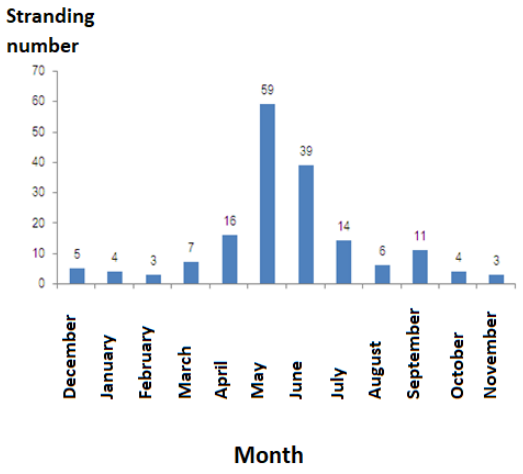

Figure 21: Monthly distribution of loggerhead strandings in 2012 and 2013

The distribution of stranded animals shows a dominance of juvenile individuals in the area, although some adult sized turtles were recorded (Fig. 22 and 23). The masculinity rate is 24.26%. The sex ratio is clearly in favor of females.

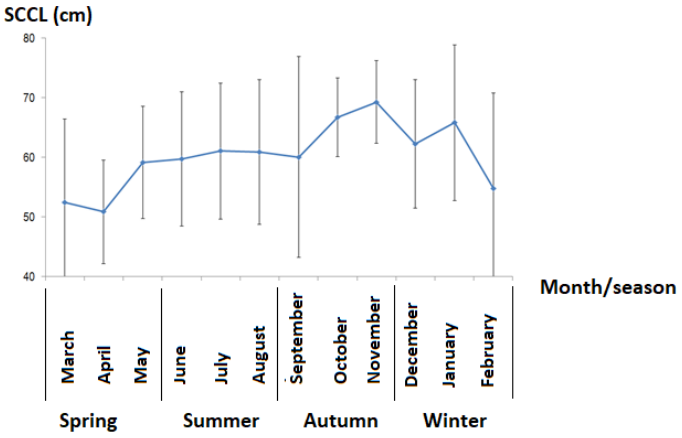

Figure 22: Mean sizes of stranded loggerheads by month during 2012 and 2013

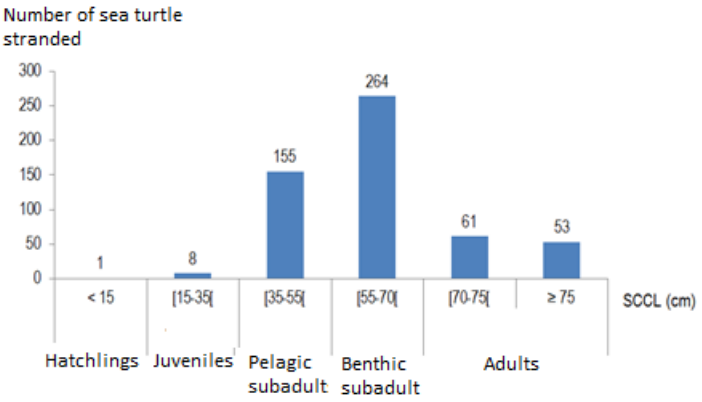

Figure 23: Development stages of stranded loggerheads in 2012 and 2013

c. *Causes of death*

Despite the necropsies and external examination, cause of stranding was not possible to be identified in 90% of the cases, due to the bad state of the turtles (Fig. 24). Ingestion of hooks and collision with boats have always been considered major causes of stranding. However, the results of the autopsies carried out in 2019 and 2020 on sea turtles stranded in the north and center of the country, showed that the number of sea turtles having ingested hooks has significantly decreased, this is probably related to the reduction in long liners activities in this area. Causes of death are illustrated by Figure 25, related to data analysis of strandings in 2012 and 2013.

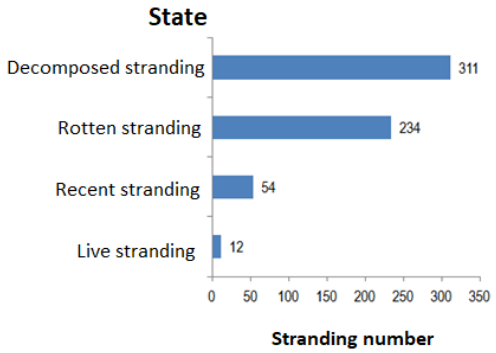

Figure 24: Physical states of stranded loggerheads (2012 – 2013)

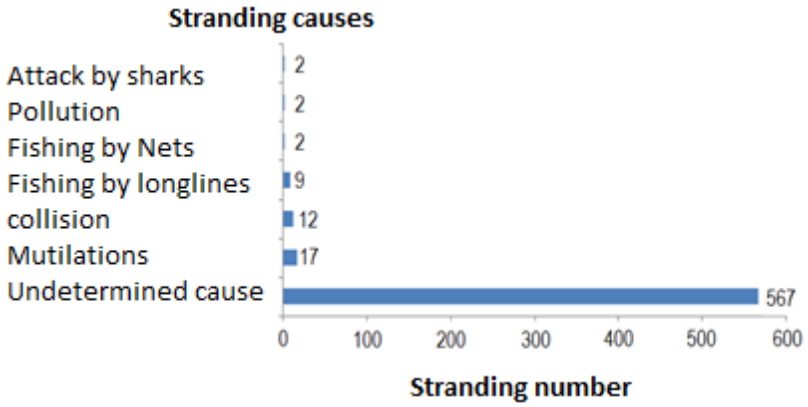

Figure 25 : Causes of Loggerhead Sea Turtle Strandings

- The actors involved in the management of strandings

The National Institute of Sea Sciences and Technologies (INSTM) coordinates and manages the National Stranding Network (RNE). As part of the formalization of the stranding network, an RNE network monitoring committee was created in 2014. This committee is composed by:

- INSTM: National Institute of Marine Sciences and Technologies;
- SPA/RAC: Regional Activity Centre for Specially Protected Areas;
- APAL: The Coastal Protection and Planning Agency;

- CNVZ : Centre National de Veille Zoo-sanitaire ;
- DGPA: Directorate General for Fisheries and Aquaculture;
- National Guard;
- UTAP: Tunisian Union of Agriculture and Fisheries;
- CRDAs: Regional Offices of Agricultural Development.

Many other actors are also involved in the records of strandings such as:

- The Sfax Faculty of Sciences (FSS);
- NGOs: The Notre Grand Bleu association and many others;
- The World Wildlife Fund-North Africa.

6. Conservation efforts

a. Legislation and protection tools

Tunisia ratified certain pertinent international conventions dealing with the conservation of sea turtles (table 6)

Table 6: International conventions and agreement ratified by Tunisia

Convention	Adoption	Ratification	Law n.
CITES	1973	1974	74 - 12 of the 11/05/74
Barcelona	1976	1977	77 - 29 of the 25/05/77
CMS	1979	1986	86 - 63 of the 16/07/86
Bern	1979	1995	95 - 75 of the 07/08/95
SPA Protocol new SPA Protocol (1995) and its Annexes (amendment)	1982 1995	1983 1998	83 - 44 of the 22/04/83 98 - 15 of the 23 /02/98
CBD	1992	1993	93 – 45 of the 03/05/93
ACCOBAMS	2001	2001	2001-68 of the 11/07/01

Following the ratification of international conventions, a special attention has been paid by Tunisia to improve the national legislation on the matter. The protection of these species is assured by a yearly decree of the agriculture minister relating to the organization of hunting, the law n ° 94-13 of January 31, 1994, relating to the exercise of fishing and the decree of the agriculture minister of 28 September 1995 relative to the organization of the fishing. This legislation stipulates mainly the ban capture and sell of marine turtles (Table 7)

Table 7: Legal and institutional framework

Legislative texts	Stipulations	Remarks

Annual Order (since 1992) of the agriculture minister relating to the organization of hunting	This decree stipulates that hunting, destruction, capture, sale, purchase, hawking and detention of marine turtles are prohibited in all time.	Stipulations included in a Text relating to land hunting.
Law n ° 94-13 of January 31, 1994 on the Fishing Activity.	The purpose of the law is to organize the fishing effort in the various fishing zones, to rationalize the exploitation of aquatic species, to protect them and to preserve their living environment.	This legislation does not properly reflect the recommendations of the various conventions ratified by Tunisia in this subject and particularly the Barcelona convention and its protocol relating to Specially Protected Areas and Biological Diversity in the Mediterranean (SPA / BD) and also the resolutions of the GFCM and ICCAT.
Decree of the agriculture minister of 28 September 1995 relative to the organization of the fishing activities.	It forbids the catch and the collection of marine turtles' eggs.	

In addition to the ratification of international conventions and the national legislation, Tunisia has also adopted the Action Plan for the Conservation of Mediterranean Sea Turtles (adopted in 1989 and revised in 1999, 2007 and 2020) and the Recommendation GFCM / 35/2011/4 on incidental bycatch of sea turtles in the area

In Tunisia, until 1989 sea turtles were sold to markets and consumed freely. After 1989 and following the ratification of international conventions and the drafting of national legislation to protect these endangered animals, such massacres are no longer seen, and turtles caught accidentally are often released at sea.

In the period 1989 – 2012 many efforts of conservation were undertaken:

- The monitoring of the main marine turtle nesting site in 1997;
- Launching of marine turtle's rescue center of Tunisia in 2004;
- the national stranding network, dealing with marine turtles and cetaceans, and the tissues bank of marine endangered species in 2004;
- Creation of the sea turtle first aid center in the framework of the Life Medturtles project co-financed by the EU.

Following political and social problems appeared in 2011- 2012, little illegal trade of loggerheads was observed in some localities. Faced with this situation, Tunisia elaborated:

- The National Action Plan for the Conservation of Sea Turtles https://www.rac-spa.org/sites/default/files/doc_turtles_project/pan_totues_2020.pdf

Following the recommendation of the Action Plan for the Conservation of Marine Turtles in the Mediterranean for the development of National Action Plans (NAPs) to strengthen marine turtle conservation measures, Tunisia has adopted its national action plan in 2020 (UNEP-MAP-SPA/RAC, 2020).

- The national strategy to reduce the illegal trade in sea turtles https://www.rac-spa.org/sites/default/files/doc_turtles_project/strat_tutles_2020.pdf

Eight priorities were developed in this strategy (Table 8).

Table 8: Priorities developed in the national strategy to reduce the illegal trade in sea turtles

	PRIORITIES
1	Actions to raise the awareness of schoolchildren in towns or localities where the turtle trade is worrying (example: Kerkennah)
2	Program for training students in fishing schools on the protection of endangered species
3	Application of the law in force
4	Amendment of the legislation in force
5	Mitigation of marine turtles' bycatch
6	Consumer awareness
7	Monitoring and control of the marketing circuit of marine turtles
8	Strengthening monitoring of existing nesting sites and launching others

b. Actors of conservation

Nesting beaches

The main actors currently involved in the protection of marine turtles in Tunisia and the follow-up of the annual monitoring on the Kuriat Islands are:

- The National Institute of Sciences and Technologies of the Sea (INSTM) responsible for coordinating the execution of the monitoring program by assigning researchers and other necessary personnel;
- The Coastal Protection and Planning Agency (APAL) has undertaken to make contacts with a view to obtaining the necessary authorizations for the stay on Kuriat Island. APAL is also responsible for ensuring the transport of the field team between the mainland and the islands;
- The Regional Activity Center for Specially Protected Areas (SPA / RAC) is responsible for financially assisting the organization and execution of the monitoring campaign nesting;
- The Sfax Faculty of Sciences (FSS) responsible for hiring researchers and students on the site and facilitating the training of students.
- The Notre Grand Bleu association, responsible for the logistics of the campaign and participating in the conduct and monitoring of training on the site.

Strandings

The study of stranded cetaceans and sea turtles was reinforced in 2004 with the creation of a national stranding network (RNE). This program is part of the activities of the marine biodiversity laboratory of the National Institute of Sciences and Technologies of the Sea (INSTM). Three teams have been set up for this purpose, the first based in the North (from the border with Algeria to Kelibia), the second in the center (from Kelibia to the Chebba) and the third to the south (from the Chebba to the border with Libya). Strandings are reported by appropriate forms or transmitted online via the RNE website.

Rescue centers

A sea turtle rescue centre was founded in 2004 by INSTM (National Institute of Marine Sciences and Technologies), in Monastir center, in collaboration with SPA/RAC (Specially Protected Areas Regional activity Center) and APAL (Agency of Protection and Management of Littoral). Its mission is conservation through rehabilitation of suffering sea turtle, education, awareness and research. A new center of first aids was launched recently (2021) in the Sfax Faculty of Sciences – University of Sfax.

Awareness actions and capacity building

Many actors are involved in awareness and capacity building, among them:

- The National Institute of Sciences and Technologies of the Sea (INSTM);
- The Coastal Protection and Planning Agency (APAL);
- The Regional Activity Center for Specially Protected Areas (SPA / RAC);
- The Sfax Faculty of Sciences (FSS);
- NGOs: The Notre Grand Bleu association and many others;
- The World wildlife Fund-North Africa (WWF NA);
- The National Institute of Agriculture-Tunis (INAT);
- The Agency of vulgarization and Agricole training (AVFA).

Main topics are: Identification of species / nesting / stranding / Necropsy / Marine litter / Bycatch.

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