

Marine Protected Areas along Libyan coast

D. A. Haddoud* and A. A. Rawag

Abstract

The Libyan coast and its lagoons play an important role in the biodiversity and productivity of Mediterranean marine life; it is fairly, unpolluted, and includes gigantic beds of marine plants, which are used by different fauna species for shelter and nursery grounds during breeding and other stage of their life cycle. This makes the Libyan coast profitable for fish production, and other edible marine organisms.

In 1993, a study was initiated by the Marine Biology Research Centre (MBRC) to designate certain sites as Marine Protected Areas (MPAs) along the Libyan coast. In this paper, the most important established and proposed MPAs (El Kouf National Park, Ain Gazala MPA, Farwa MPA, El Burdi MPA, Ain -Ziyana MPA) are presented and discussed.

1. Introduction

Natural marine habitats and ecosystems are being lost as a result of human activities. Therefore, there is a need for Marine Protected Areas to preserve the natural habitat of marine ecosystems. Some specialists believe that at least 10% of the total marine area should be protected. In the Mediterranean, which is one of the seas with great biodiversity, under 0.01% of its surface area is considered protected. Thus, there is a need for more Protected Areas in the Mediterranean (Kelleher *et al.*, 1995).

Marine Protected Areas (MPAs) are necessary as fisheries management tools. Because of an increase in fishery pressure, due to the use of more effective modern instrumentations and variety of different gear types, in addition to powerful vessels, MPAs are needed. MPAs conserve biodiversity and variability of exploited populations. Some of the main objectives of MPAs are to protect spawning stocks and endangered species, and to promote basic and applied research, which is important in fisheries management. However, the main problems facing MPAs effectiveness are their protection and management (Foster and Lemay, 1989).

There are four important lagoons on the Libyan coast: Farwa, Ain Zayana, Ain Gazala and Elburdi. These are well described in Kerambrun (1986), Lemoalle & Saad (1987), Reynolds *et al.* (1995), MBRC (2000), and Gashout and Haddoud (2001). There are also, some coastal studies from an ornithological point of view by Meininger *et al.* (1994a, b). The avifauna of the coastal fringes was studied by Bundy (1976), and Haddoud and Zagozi (1998). Turtle survey data on the El Kouf National Park coast, were also studied (Armsby, 1980; Schleich, 1987 and Laurent *et al.*, 1995).

The fishing sector is still very little developed in Libya. Total catch for the Libyan coast is low, estimated in 1991 as 7,700 tons, whereas it was 90,710 tons in Tunisia and 40,192 tons in Egypt in 1991. In 1994 Libyan production was estimated as 33,469 tons (Lamboeuf and

* Marine Biology Research Centre, P.O. Box 30830, Tajura, Libya; Tel.: 00218 21 3690001/3; Fax: 00218 21 3690002; E-mail: daw_hadod@yahoo.com

Reynolds, 1994; Reynolds *et al.*, 1994). The total fleet in Libya during 1995 was 1911 and 1,866 during the year 2000; and trawlers were 105, however, the number of trawlers was only 65 boats during the year 2002.

There are six main types of fishing in Libya: coastal fishing, Lampara fishing, bottom trawling, tuna fishing with seines, longlining, and Tunaras. Coastal fishing is mainly practiced in the east and west of the country, and occasionally in the Gulf of Sirte, using trammel-nets, gill-nets, and bottom and drifting long lines. There are about 3,000 small craft of varying lengths. Lampara fishing catches small pelagics such as sardines and mackerel by using lights, it occurs only on the west coast (Lamboeuf and Reynolds, 1994; Reynolds *et al.*, 1994).

In 1993, a study was initiated by the MBRC to select special sites along the Libyan coast as MPAs. Before this initial study, the Libyan authorities issued Law No 14 with Articles 75- 78 concerning MPAs. This Law was outlined in 1991, and came into force in 1992.

2. Methods of study

Libyan MPAs were selected according to generally known universal criteria, based on the biological, physical, and socio-economic features. This information was collected from fixed stations at each chosen location. Previous information on the locations was taken into consideration for MPA evaluations.

The established and proposed Libyan MPAs (Figure 1) were selected according to the initial study indicated above. In addition, the selection of each MPA was based on its biodiversity, occurrence of endangered species such as nesting sea turtles, sea birds and others, and over fishing (e.g., Farwa MPA).

3. Results and discussion

Established Marine Protected Areas:

El Kouf National Park

The El Kouf National Park was projected with the aid of the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD). A Secretariat of the State for Marine Resources, established in 1975, gave a high priority to the creation of protected sectors in the sea.

This Park is located in the north-west Flank of the Jabel Al Akhdar, near the town of El Beidha in north-eastern Libya. The park surface area is about 32,000 ha with about 20 km of coastline. The Park has a large conservation area of 100,000 ha which includes the wider catchments of Wade El Kouf. It covers the northern slopes and plateau of the Jabel Al Akhdar, bordering on the Mediterranean. Jabel Al Akhdar is the only naturally forested mountain range of the entire North African coast between the Gulf of Gabs and Haifa Gulf.

The rectangular watershed of Wade Al Kouf is part of Jabel Al - Akhdar Mountain which is of deep layers of limestone rock with carsick caves and cracks (max. altitude 860 m). Wade Al Kouf, with its tributaries Wade Beit Saleh and Wade Sudan, make up the main Jarjarumah Wade which flows its water into the Mediterranean Sea during the rainy season. Wade had made its paths through many rocky high and narrow valleys. Some valleys are about 200 m

deep. Springs are restricted to the coastal area and ground water can be obtained between 100 and 400 m. Beaches, sand dunes and seasonally inundated lagoons are found on the eastern edge of the coast, a rocky low cliff formation characterizes the western part of the frontage.

The land vegetations in the Park are mainly, *Juniperus, phoenicea, pistacia lentiscus, Arbutus pavarii, Olea europaea, Myrtus communis,* and *Quercus coccifera*. In few protected localities, good groves of *Cupressus sempervirens* can be seen. Its Fauna has been considerably reduced by hunting and includes *Hyaena hyaena, Canis aureas, Vulpes vulpes, Genetta genetta, Felis libyca,* and *Hystrix cristata*. In the sea *Delphinus delphis* and *Tursiops truncatus* have been recorded. Bird species include *Phoenicopterus ruber* and several birds of prey.

Libya, being one of the Mediterranean States and at the same time occupying a large space of the Mediterranean southern shore, deserves to have some studies conducted on its more significant shores as an attempt to estimate the real stock of marine turtles latent in the Mediterranean. The recent available information lacked sufficient and adequate accuracy and details. Part of such information was logging of existence of loggerhead marine turtles on the shores of natural protectorate at Al-Kuf Valley (Herbert, 1979, Armsby, 1980; Schleich, 1987) as well as the information already logged about the locations of marine turtles nesting as well as the information already surveyed about the locations of marine turtles nesting during the field visits the shores of the eastern region (Haddoud *et al.*, 1995; and Laurent, *et al.*, 1995). Several archaeological remains, including Greek and Roman ruins linked to the ancient cities of Apollonia and Cyrene located 40 km east of the Park.

Ain Gazala MPA

Ain Gazala MPA is a Lagoon located at latitude 32° 13' N and longitude at 23° 18' E, about 130 km east of Derna in the direction of Tobrok. The lagoon covers a surface area of about 180 ha with an average depth of 2m. Underground springs at the inner side of the Lagoon discharge water of low salinity (8‰) with a flow of about 1m³/sec. The lagoon's water temperature, salinity and pH ranges are: 12.5 – 28 °C, 37.5 - 40‰ and pH 8.2 - 8.5. The lagoon's Water of the springs having salinity of pH, 7.8 and temperature 18Co. The Lagoon's water has 5.6 mg/L suspended matter, Nitrogen compounds, 2.4 -7.8 mg/L and Phosphorus compounds, 0.9 –1.4 mg/L.(Gashout,S.F. and Haddoud, A.D. 2001)

The lagoon is a long cove 6.5 km long and 1.5 km wide, with on its north–east side a 10-m high cliff and on its southern side a 300 ha salt marsh. The water's physic-chemical properties and the presence of natural springs make it a suitable bed for the growth of marine plants and animals (Gashout and Haddoud, 2001).

The lagoon is used for fisheries by near villagers. Recently, aquaculture (fish cages and mussels) was introduced but the profit was very small. A development plan has been suggested to improve economic achievement by building hatchery and concrete tanks on its southern side.

Posidonia and *Cymodocea* species cover over 95% of the lagoon bed and serve as a protective and breeding site; this has been noticed in the diversification of species recorded from the lagoon (Table 1). Nesting sites of sea birds and turtles have been observed on its beaches and on the small island (El-Elba) nearby (Meininger *et al.*, 1994a, b; Laurent *et al.*, 1995).

Table 1. Check-list of species recorded from the Libyan lagoons (Gashout and Haddoud, 2001).

<p>Sea grass and weeds <i>Posidonia oceanica</i> <i>Cymodocea nodosa</i> <i>Caulerpa prolifera</i> <i>Padina pavonica</i> <i>Halimeda tuna</i> <i>Valonia aegagropila</i> <i>Cladophora sericea</i> <i>Lithothamnion fasciculatum</i> <i>Chaetomophora</i> sp. <i>Diplophus spiralis</i> <i>Pterocladia pinnata</i> <i>Bangia fuscopurpurea</i> <i>Derbessia</i> sp. <i>Dasyopsis</i> sp. <i>Neria</i> sp. <i>Lamourouxi</i> sp. Phylum Porifera <i>Calcarus sponge</i> <i>Corals</i> sp. <i>Verongia aerophoba</i> Phylum Cnidaria <i>Actinia equina</i> Phylum Echinodermata <i>Asterina gibbosa</i></p>	<p>Amphiura chiajei <i>Porania puvillus</i> <i>Thyone fusus</i> Phylum Nemertina Tubulanidae sp. Phylum Sipunculida <i>Sipunculus nudus</i> Phylum Annelida <i>Eunice harassi</i> <i>Euphrosine folisa</i> <i>Sternaspis scutata</i> <i>Sternaspis scutata</i> Lumbrinereinae <i>Arenicola marina</i> <i>Polyophthalmus pictus</i> <i>Alciopa contrainii</i> Syllidae sp. <i>Arnicola eudata</i> Glyceridae sp. Eunicidae sp. <i>Ophryotrocha puerilis</i> Hesionidae sp. <i>Dorvillea rubrovittata</i> <i>Vermiliopsis infundibulum</i></p>	<p>Capitellidae sp. Nereidae spp Aphroditidae sp. <i>Nephtys hombergi</i> Neries pelagica <i>Neries diversicolor</i> <i>Sabella pavonina</i> <i>Nerocila bivittata</i> <i>Ophelia bicornis</i> Phylum Arthropoda <i>Carcinus maenus</i> <i>Squilla mantis</i> Gammaridea sp. Stomatopoda sp. <i>Gammarus locusta</i> <i>Palaemon serratus</i> <i>Orchestia gammarella</i> <i>Nerocila bivittata</i> <i>Megacyclops thalassae</i> <i>Hypreria</i> sp. <i>Sphaeroma serratum</i> Maldanidae sp. Pasiphaeidae sp. Mysidae sp.</p>
<p>Phylum Mollusca <i>Diodora italica</i> <i>Dentalium dentale</i> <i>Dentalium rubescens</i> <i>Gastrana fragilis</i> <i>Abra tenuis</i> <i>Parvicardium papulosum</i> <i>Acanthocardia tuberculata</i> <i>Venericardia antiquata</i> <i>Modiolus barbatus</i> <i>Lithophaga lithophaga</i> <i>Mytilus edulis</i> <i>Venerupis pullastra</i> <i>Venerupis aurea</i> <i>Venerupis rhomboides</i> <i>Rissoa monodonta</i> <i>Pinna hydatis</i> <i>Littorina nerilodes</i> <i>Cerithium vulgatum</i> <i>Bittium reticulatum</i> <i>Conus mediterraneus</i> <i>Strombus</i> sp. <i>Neverita josephina</i> <i>Tricolia speciosa</i> <i>Buccinidae</i> sp. <i>Euthria cornea</i> Nassariidae sp. <i>Cylichna cylindracea</i> <i>Nassarius reticulatus</i> Hexaplex trunculus</p>	<p><i>Dicentrarchus labrax</i> <i>Striarca lactea</i> <i>Naticarius millepunctatus</i> <i>Lima lima</i> <i>Smaragdia viridis</i> <i>Tillena planata</i> <i>Pyrene</i> sp. <i>Trochus erythreus</i>, <i>Donax venustus</i> <i>Clathrella clathrata</i> Phylum Chordata (Fishes) <i>Dentex dentex</i> <i>Sparus auratus</i> <i>Lithognathus marmyrus</i> <i>Diplodus anuularis</i> <i>Diplodus sargus</i> <i>Boops salpa</i> <i>Diplodus vulgaris</i> <i>Bolinus brandaris</i> <i>Janthina janthina</i> <i>Haminea hydatis</i> <i>Turritella triplicata</i> <i>Turritella communis</i> <i>Loripes lacteus</i> <i>Hyalina secalina</i> <i>Anadara corduloides</i> <i>Puntazzo puntazzo</i> <i>Epinephelus alexandrinus</i> <i>Mugil cephalus</i> <i>Mugil auratus</i> <i>Mugil</i> sp. Epinephelus aeneus</p>	<p><i>Umbrina cirrosa</i> <i>Sciaena umbra</i> <i>Mullus surmuletus</i> <i>Muraena helena</i> <i>Trachinotus glaucus</i> <i>Uronosopus scaber</i> <i>Siganus luridus</i> <i>Solea lascaris</i> <i>Scorpaena notata</i> <i>Torpedo torpedo</i> <i>Trygon pastinaca</i> <i>Balistes capriscus</i> <i>Anguilla anguilla</i> Sea turtles <i>Caretta caretta</i> <i>Chelonia mydas</i> Water Birds <i>Phalacrocorax aristotelis</i> <i>Haematopus ostralegus</i> <i>Charadrius alexandrinus</i> <i>Charadrius leschenaultii</i> <i>Pluvialis squataros</i> <i>Calidris minuta</i> <i>Calidris alpina</i> <i>Numenius arquata</i> <i>Tringa glareola</i> <i>Tringa ochropus</i> <i>Tringa nebularia</i> <i>Actitis hypoleucos</i> <i>Arenaria interpres</i> <i>Larus cachinnans</i> <i>Sterna bengalensis</i> <i>Sterna albifrons</i></p>

Geziret Elba is an island about 2 km from the coast in the mouth of the Ain Ghazalah lagoon. It is a low island, with a maximum length of 2.5 km and a width of up to 1 km. The northern more rocky part is the highest (1.5 m above sea level), gradually sloping into a salt marsh at sea level on the southern part. Vegetation is dominated by thinly distributed *Salicornia fruticosa* and *Halimione portulacoides*, and most of the shore is covered by dense mats of accumulated sea grass *Posidonia oceanica*, washed ashore.

In July 1993, 40 pairs of lesser crested Tern were found breeding on the island, and small numbers of waders were seen, (Meininger et al., 1994a, b). Geziret Elba holds one of the two known colonies of lesser crested tern in Libya. The population does not seem to be directly threatened by disturbance or otherwise, both the island and the salt marshes along the shore are potentially suitable areas for migrating and wintering water birds. The fishermen use Drena (surrounding nets) in this area to collect the fingerlings of Sea bass and Sea bream. Two endangered species of turtles *Chelonia mydas* and *Caretta caretta* were recorded in the area (Laurent et al., 1995).

There is no source of organic pollution in the area but the introduction of aquaculture, over fishing, the catching of migratory sea turtles and sea birds are the main threats in the lagoon and sea birds should be monitored (Meininger et al, 1994 a).

Farwa MPA

This MPA is located at latitude 33° 04' N and longitude at 11° 50' E to 33° 08' N and 11° 32' E (Approx) from Abu- Kamash east to the Tunisian border in the west. It comprises Farwa lagoon which is the largest lagoon on the Libyan coast, covering an area of 32 km². Farwa MPA, especially Farwa lagoon, has meadows of *Posidonia* and *Cymodocea* sp., due to certain economical important species (Sponges, shrimp, and fishes) in addition to some endangered species which makes it an important area for larva and juvenile protection. In the biodiversity of Farwa MPA we can recognize many economically important species and certain endangered species. Thus, it is of great importance that this area is protected.

The maximum altitude of the land on both sides of the lagoon is about 2-3 m (Sand type). Mean annual temperature varies from one month to another due to the recent closing of the east side of the lagoon. The minimum mean temperature in winter is 10°C, while the maximum mean temperature in summer is 27°C. Prevalent wind direction and speed wind direction is mainly NW and NNW, but a hot southern wind sometimes blows from the Sahara.

The Meteorological conditions of the area are those of the western part of Libyan coast: winter season extends from November to April and is generally cold and rainy with unstable winds blowing from different directions. The summer season (June to September) is rather hot and dry. The wind is more stable N and NW. Spring and autumn are very short transitional periods.

The lagoon is separated from the sea by an 11-km long narrow sand bar. The eastern part of the lagoon is very shallow with no aquatic vegetation and is bordered at its 1 km side tip by a semi-desert land (now closed). The southern shore of the lagoon (13 km long) is shallow, and made of sand and clay, its minimum depth is 0.5 m. on the sides while, its maximum depth is 4 m in the centre of the Lagoon. Salinity range in summer is from 38 to 44,5‰, and in winter is from 40 – 41.5 ‰.

On the uninhabited peninsula of Farwa nests of sea turtles (Laurent *et al*, 1999), gulls and migratory Terns were observed. A systematic list of birds observed in Farwa lagoon was given by Haddoud and Zgozi (1998).

In May, current velocities are between 15-60 cm/Sec., in June 7-40 cm/Sec. and in August 28-52 cm/Sec. In general, the current velocities in the inner part of the lagoon are greater than in the outer part. The island's flora is mainly made up of palms and desert trees and grasses, there are no fruit trees on the island or nearby main land, many different wild animals were recorded on the island as it is uninhabited island. The marine fauna of the lagoon is very rich; its marine flora is composed mainly of *Posidonia*, *Zostera* and many species of green and brown algae. The type of the soft bottom allows many burrowing organisms to live there (Table 1).

It should be indicted here that the trawlable area of the Libyan coast is from Musrata to Tunisian border. However, in this area, including Farwa lagoon, trawling is prohibited during July and August of each year. Despite the fact that Farwa MPA has been established (meanings all kinds of fishing gear are prohibited) nothing has been achieved in this respect. About 50 fishermen use the lagoon only for fishing and mooring their boats. It might be interesting here to point out that, the population of the nearby village (Abukamash) is about 1,000.

The proposed Marine Protected Areas:

El Burdi MPA

The El Burdi lagoon MPA is located near the Egyptian border at latitude 31° 45' N and longitude 25° 06' E (Approx) (Figure 1). This MPA characterized by its water deepness (4- 25 m.), and low diversity of animal species. The most common are Gastropods, Crustacean and Bivalves species. Also, there are a few plant species, mainly the sea grasses *Posidonia* and *Cymodocea* and *Chalorophyceae algae* (Table 2).

The low diversity of El Burdi lagoon is mainly due to its sandy substrate. It is well documented that, sandy substrates contain less organic matter, which result in low densities of micro-organisms, and hence low macro-organisms densities (Meadows and Campbell, 1988). The lagoon location suggests less human activities and its natural habitat (deep water and low diversity) makes it an ideal candidate for a MPA on the eastern coast of Libya.

Ain -Ziyana MPA

Ain -Ziyana Lagoon MPA is located at latitude 32° 06' N and longitude at 20° 05' E (approx), is a brackish water lagoon situated about 15 km east of Benghazi city, covering an area of 50 ha with an average depth of 2 m. It is connected to the sea by a canal made by the overflow of the water from underground springs in the lagoon.

The underground springs discharge brackish water of 10‰ into the Lagoon with a capacity of 4.5 m³ /sec. This discharge capacity lowers the Lagoon's water salinity giving it a range of 16-28 ‰. The lagoon water has a temperature range of 14-28C° and a pH of 7.8.

The lagoon is used as a harbour for several small boats. About 10 ha at the North West side of the Lagoon it is used for aquaculture, where a complex was built consisting of tens of metal tanks, rooms, hatcheries, stores, etc. The complex is still under operational trial (Reynolds *et al.*, 1995).

The presence of underground springs, which discharge water of low salinity (10 ‰) and the extensive tamarisk bushes around the lagoon, make it a niche site for migratory water birds: gulls, terns, ducks, swam and others. Kerambrun (1986) and Meininger et al.(1994a), recorded more than 1000 nests of water birds in the area, some species recorded for the first time (e.g. yellow wagtail). The opening of MBRC branch in Benghazi city will help in monitoring and conserving life in this lagoon.

Table 2. Check-list of species, recorded from El-Burdi lagoon (MBRC, 2000)

Gastropoda	Holothurioidea
Cerithiidae	Cucumaridae
Conidae	Crustacea
Coralliophilidae	Hoplophoridae
Rissoidae	Sphaeromidae
Truncatellidae	Gammaridae
Pyramidellidae	Corophiidae
Triphoridae	Mysidaceae
Retusidae	Pontoniinae
Vermetidae	Paguridae
Turridae	Palaemoniidae
Trochidae	Cnidaria
Phassionellidae	Sphaeromidae
Sascioloriidae	Gammaridae
Buccinidae	Corophiidae
Naticidae	Scaphopoda
Nassariidae	Dentaliidae
Cerithiopsidae	Scaphopoda
Collumbellidae	Dentaliidae
Epitoniidae	Annelida
Muricidae	Arenicolidae
Bivalvia	Nereidae
Carditidae	Arenicolidae
Cardiidae	Echinodermata
Glycymerididae	Echinoidea
Veneridae	Actinidae
Semelidae	Porifera
Peticolidae	Desmospongia
Pteridae	Polychaeta
Mytilliidae	Nereidae
Ostreidae	Pheophyceae
Lucinidae	
Tellinidae	<i>Dictyota linea</i>
Veneridae	<i>Padina pavonica</i>
Scaphopoda	Chlorophyceae
Dentallidae	<i>Valonia</i> sp
Asteroidea	<i>Cladophora</i> sp
Asteroidae	<i>Caulerpa prdifera</i>
Collumbellidae	<i>Anadyomene stellata</i>
Epitoniidae	Rhodophyceae
Muricidae	<i>Pterocladia capilaceae</i>
Bivalvia	<i>Jania adherens</i>
Carditidae	Sea grasses
Cardiidae	<i>Posidonia oceanica</i>
Glycymerididae	<i>Cymodoceasp.</i>

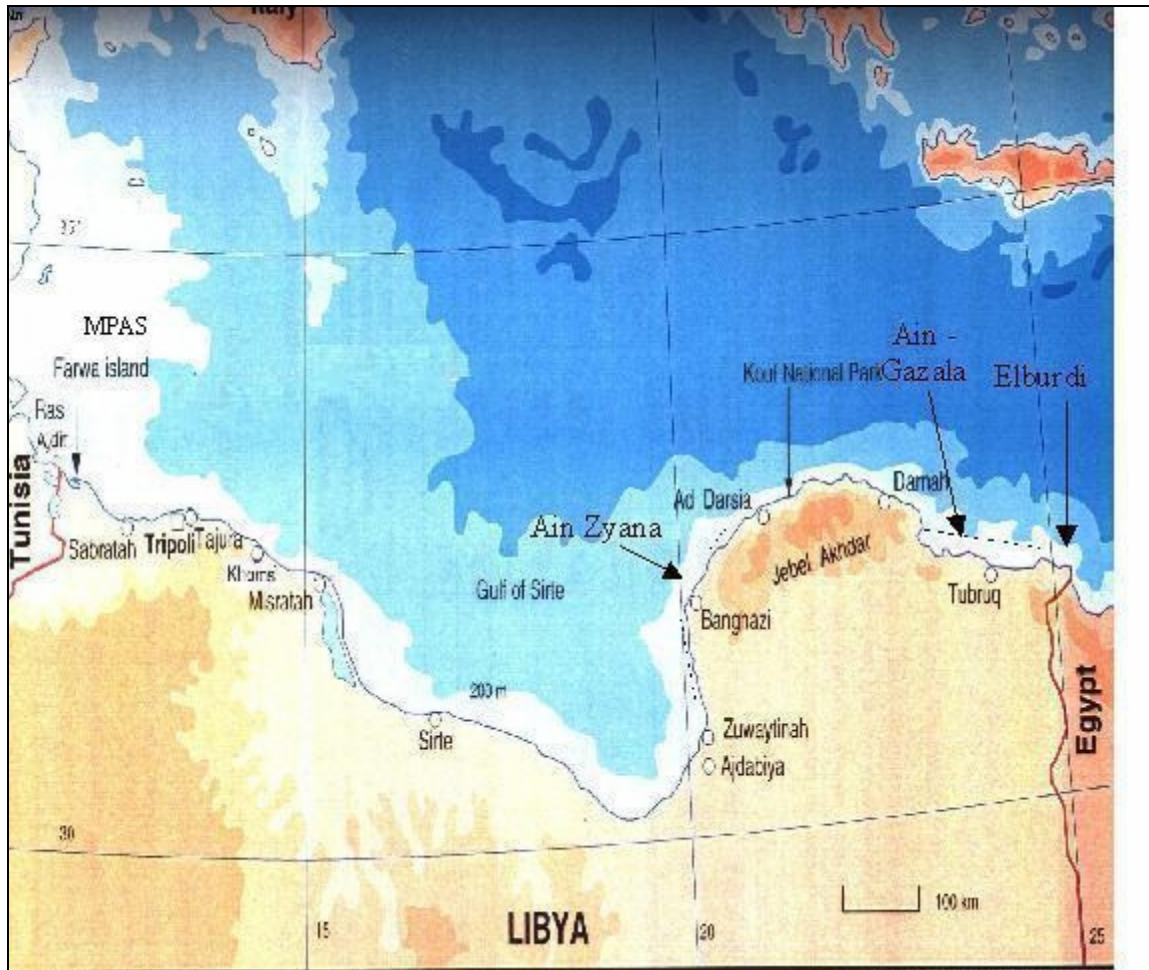


Figure 1. Established and proposed MPAs in the Libyan coast

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