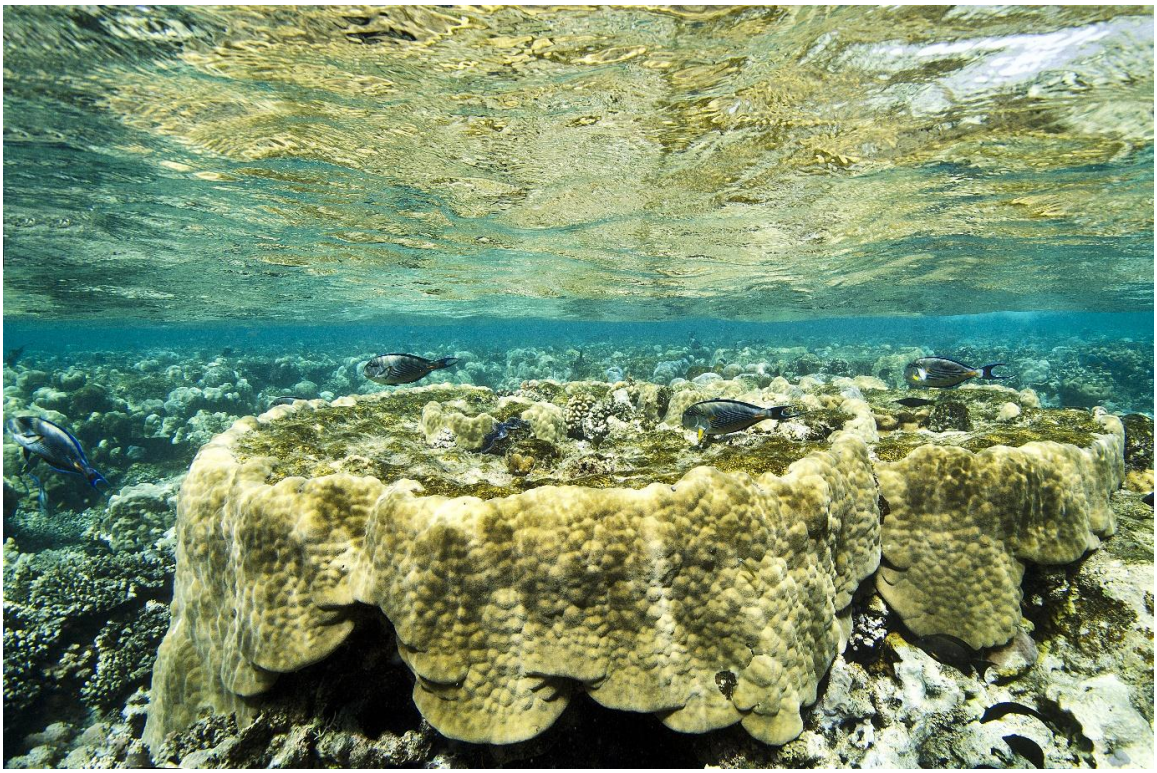
Nomination of
Sanganeb Marine National Park
And
Dungonab Bay/Mukkawar Island
Marine National Park
(Sudan – Red Sea)

For Inscription
On the World Heritage List



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Acronyms and abbreviations

APF: African Parks Foundation

Cots: Crown - of - Thorns Starfish.

DMNP: Dungonab Bay-Mukkawar Island Marine National Park.

GoS: Government of Sudan.

HCENR: Higher Council for Environment and Natural Resources.

IBA: Important Bird Area.

IUCN: World Conservation Union (Formerly: The International Union for Conservation of Nature and Natural Resources.)

Khor(e): Small freshwater river.

Kokian: *Trochus dentatus* (Mollusc).

Mersa: A small bay or inlet where boats anchor and shelter.

MPA: Marine Protected Area.

Najil: (Spotted coral grouper) fish.

NGO: None - Governmental Organization.

PERSGA: Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden.

Sabkha: Coastal flats subject to periodic flooding and evaporation.

SCUBA: Self -Contained Underwater Breathing Apparatus.

Shuab: Scattered reef complex

SMNP: Sanganeb Marine National Park.

UNEP: United Nations Environment Programme.

Wadi: Old freshwater river.

WCGA: Wildlife Conservation General Administration.

WHC: World Heritage Centre.

Plate 1: Overview of Sanganeb Lagoon

Photos, maps and figures credits:

- PERSGA Photo-library
- Hans/Dirar Nasr

Cover photo: Strange growth of *Porites* forming a (dining table) with the surgeon fish *Acanthurs* shoal feeds on algae at Shuab Rumi.

Executive Summary

State Party **Sudan**

State, Province, or Region **Red Sea State - Sudan**

Name of property:

Sanganeb Marine National Park and Dungonab Bay-Mukkawar Island Marine

National Park

Geographical coordinates to the nearest second

The geographical coordinates of Sanganeb Marine National Park (SMNP), Dungonab Bay-Mukkawar Island Marine National Park (DMNP) and the whole serial site are:

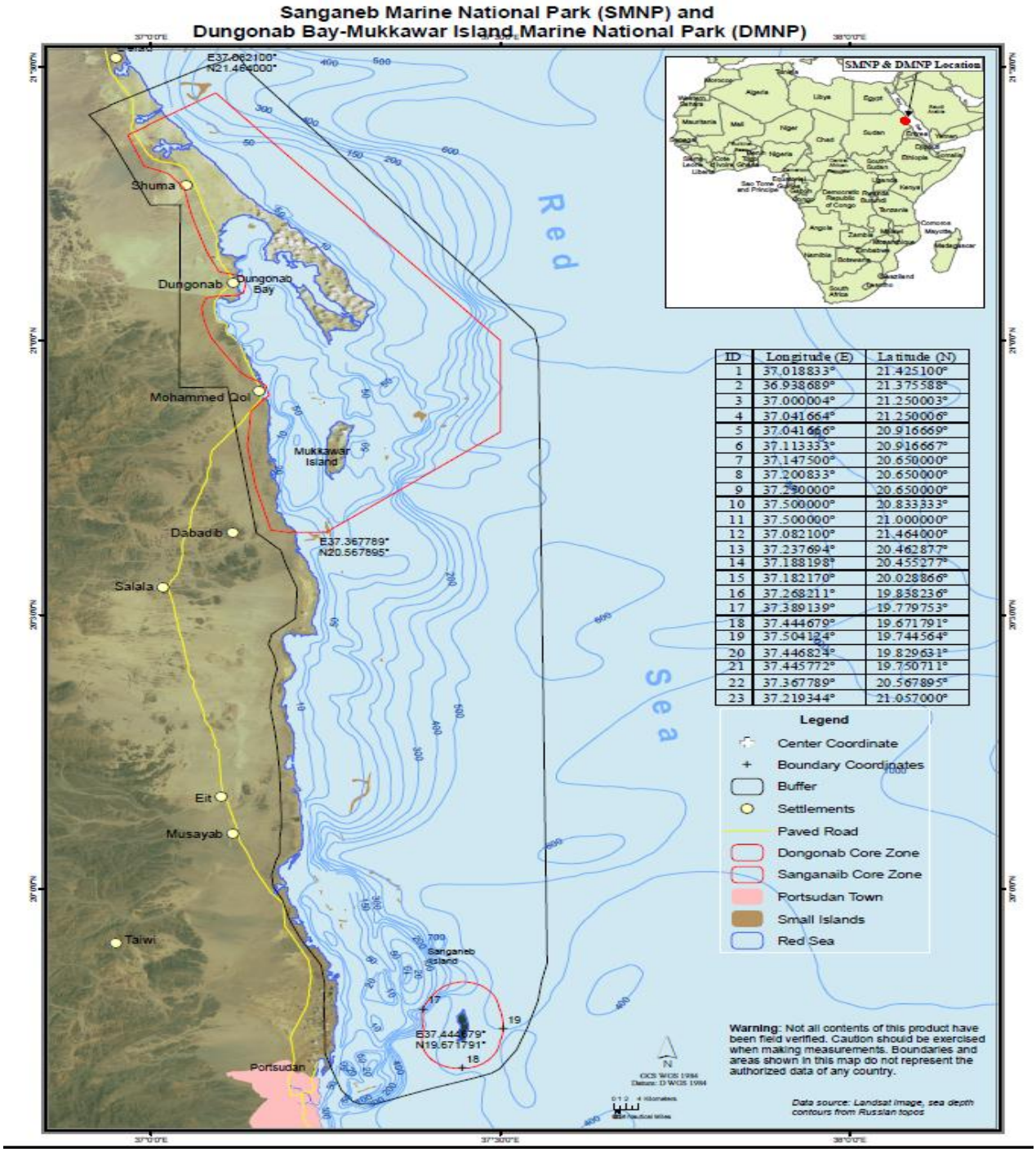
Id №	Name of the component part	Region(s) Districts(s)	Coordinates of the Central Points	Area of Nominated component of the Property (ha)	Area of the Buffer Zone (ha)	Map №
001	SMNP	Sudanese Red Sea Coast	E 37° 44’4689” N 19° 67191”	17400		2
002	DMNP	Sudanese Red Sea Coast	E 37°08’2100” N 21°46’4000”	24330		3
003	The buffer zone	Sudanese Red Sea Coast			504600	1
004	The whole serial site		E 37°36’7789” N 20°56’7895”			1
			Total area	765300		

Textual Description of the Boundaries of the Nominated Property

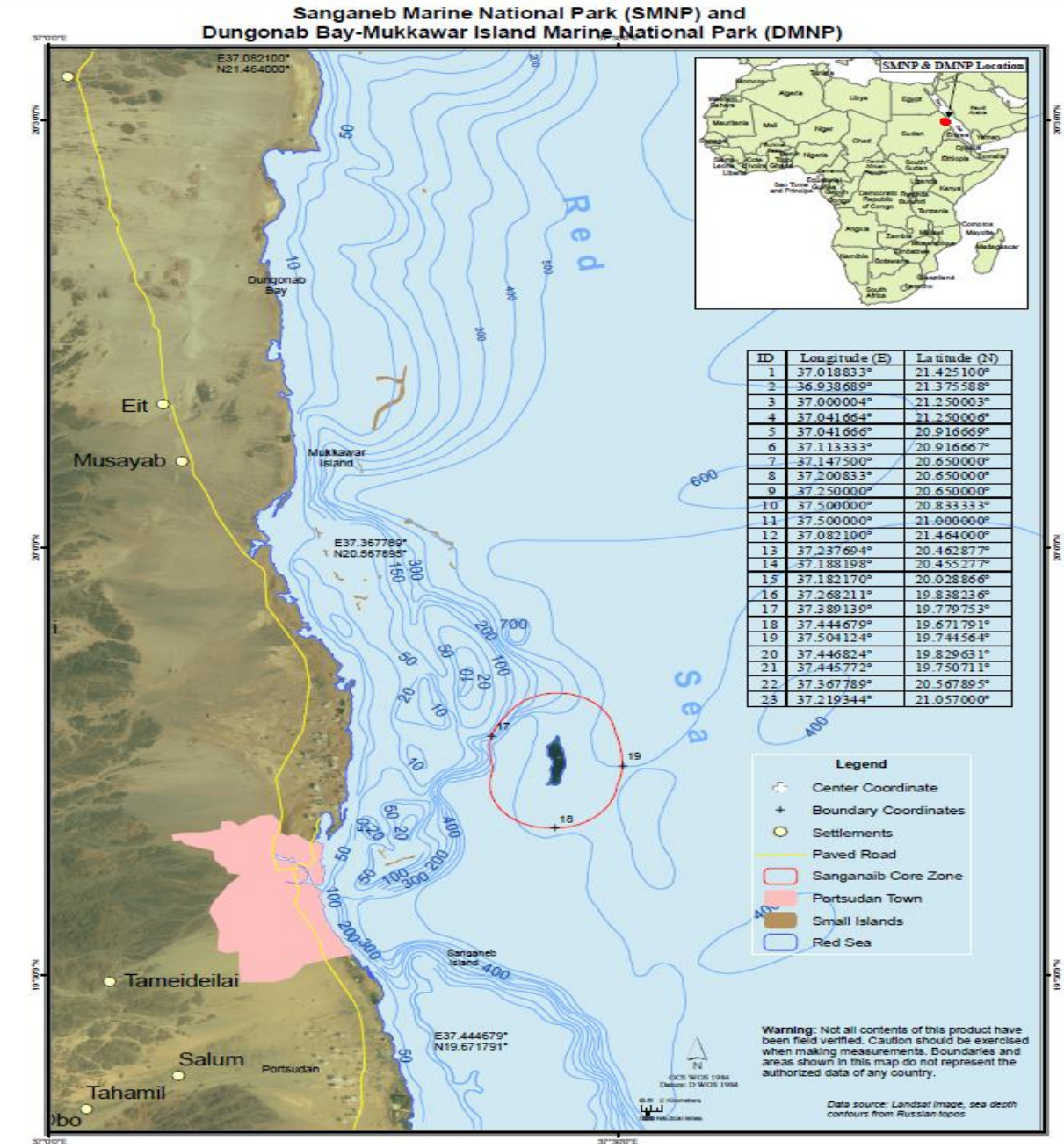
The boundaries of the nominated serial property include Sanganeb Marine National Park (SMNP), Dungonab Bay- Mukkawar Island Marine National Park (DMNP) as core areas and portions also contribute to the buffer zone.

SMNP is located in the central Red Sea, about 30 km north-east of Port Sudan. The boundaries of SMNP are those of the Atoll and the 5 Km of marine waters around it. DMNP lies on the central Sudanese Red Sea coast, with its southern boundary approximately 125 km north of Port Sudan. DMNP boundary contains the Bay and its Peninsula, Mukkawar Island, several small islands and islets, and extensive coral reef complexes.

The two National Parks are linked by coastal waters extending for approximately 125Km.



Map 1: The nominated serial site


Sanganeb Marine National Park (SMNP) and
Dungonab Bay-Mukkawar Island Marine National Park (DMNP)
SMNP & DMNP Location
E37.082100°
N21.464000°
Dungonab Bay
Mukkawar Island
E37.367789°
N20.567895°
Red Sea
Eit
Musayab
Tameideilai
Salum
Tahamil
Portsudan
Sanganeb Island
E37.444679°
N19.671791°
ID | Longitude (E) | Latitude (N)
1 | 37.018833° | 21.425100°
2 | 36.938689° | 21.375588°
3 | 37.000004° | 21.250003°
4 | 37.041664° | 21.250006°
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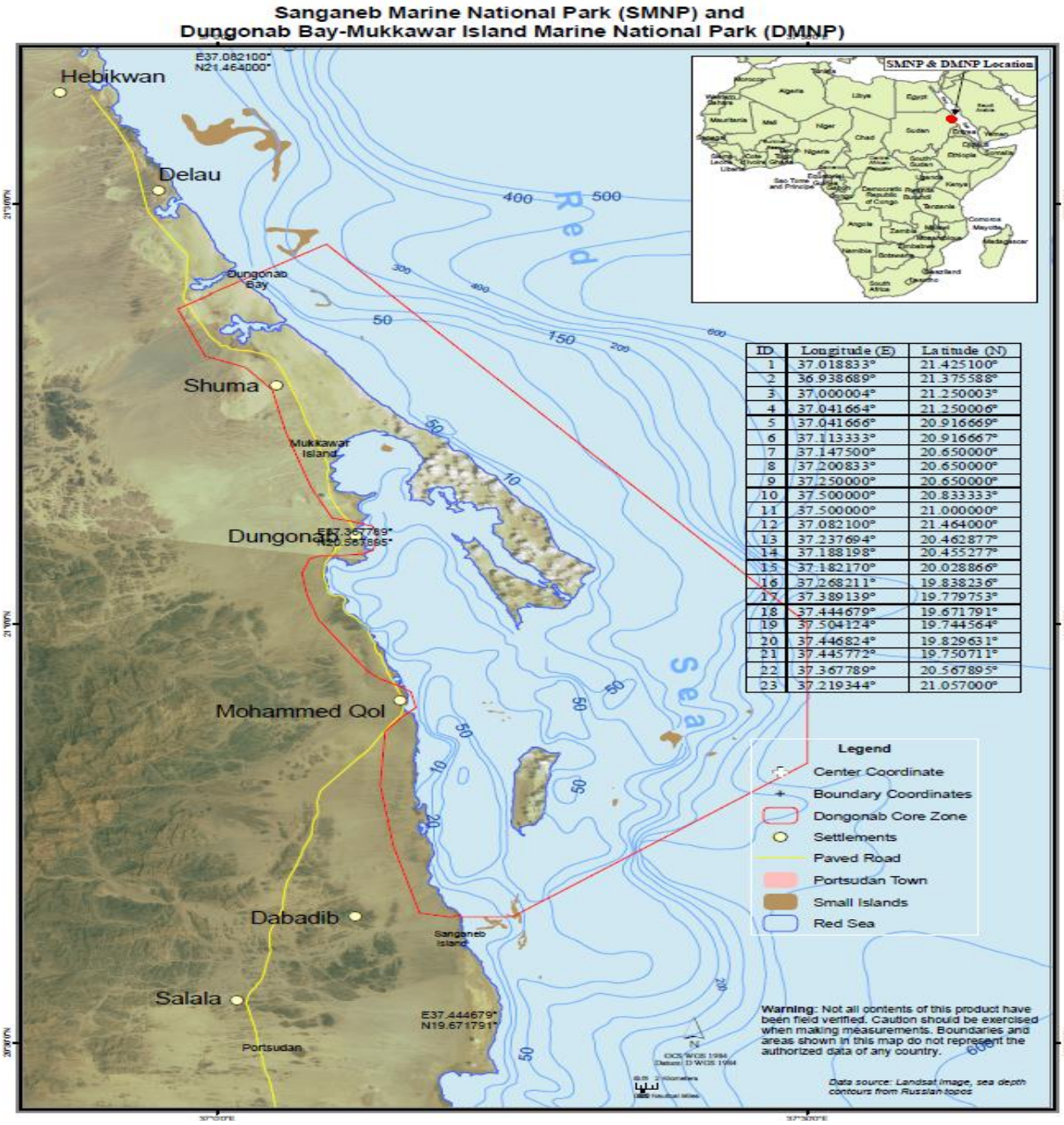
Data source: Landsat image, sea depth contours from Russian topos

Map 2: SMNP



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Map 3: DMNP

Criteria under which property is nominated

Criteria **vii – ix – x.**

Draft Statement of Outstanding Universal Value

Breef synthesis

An expanse of coastline, containing two protected areas and encompassing very significant formations of an atoll and a large bay that contains islands, several small islets and some of the most northerly coral reefs in the world associated with species (including seagrass and mangroves) at the limits of their global range, evolutionary expansion, and thus are important from a scientific and conservation perspective. The two protected areas are naturally, geologically and ecologically connected and functionally linked by open flow and exchange.

The only atoll in the Red Sea, Sanganeb atoll is a submerged and over hanged predator dominated coral reef ecosystem of 13 different bio-physiographic reef zones, each providing typical coral reef assemblages. It supports a wealth of marine life and breathtaking underwater vistas, hosting at least 361 fish species with numerous endemic and rare species. Besides being a nurseries and spawning areas for key fishery species, it also hosts resident populations of dolphins, sharks and marine turtles, which also use the atoll as a resting, breeding and feeding area. .

Dungonab Bay, engulfing Mukkawar Island and other islands, contains an array of habitat types, including extensive coral reef complexes, mangroves, seagrasses and intertidal and mudflat areas which all enable the survival (Breeding, feeding and resting) of even endangered dugong, sharks, manta rays, dolphins and migratory birds. The Bay exhibits overlying fossil reef, sometimes up to 150m high, and contains fish and coral communities more usually separated by several hundred kilometers.

Justification for Criteria:

The proposed serial site meets the requirements stated in criteria: vii, ix and x.

Criterion vii: Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.

Sanganeb Atoll is the only atoll in the Red Sea rising up 800m exhibiting spectacular colorful diversity of coral, fish and invertebrates that rendered it a Mecca to divers and photographers of the world due to the clarity of the water.

Dungonab Bay contains diverse pristine habitats including colorful coral reef communities and marine species, some completely unique to Sudan's marine ecosystem.

The naturalness and the esthetic features gave the property an increasing interest both regionally and internationally.

Criterion ix: Be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.

The exceptional environmental conditions of the property provided coral growth and reef development in the Sudanese Red Sea with numbers of coral species higher than either the northern or the southern Red Sea. Such habitats in the Red Sea contain a high percentage of endemic species (Sheppard *et al* 1992) and it is logical that the property will support a unique and higher, on average, subset of the endemics available in the Red Sea.

The property serves as an important larvae export area and host important spawning sites for key fishery species. The property encompasses a variety of fish and coral communities more usually separated by several hundred kilometers. This wide range of intact marine ecosystems has proven resilience of reefs to coral bleaching.

Criterion x: Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

The property diverse habitats host significant populations of globally-important and endangered species, including sharks, manta rays, dugong, dolphins, napoleon wrasse, groupers and marine turtles. The property is home to whale sharks, and the largest aggregations of manta rays in the Red Sea.

The property has been internationally-recognized as an Important Bird Area (IBA) for both resident and migratory birds.

Statement of Integrity

The property is an outstanding marine ecosystem that sustains intact ecological setup and interacting biological processes which in need of long-term conservation support for its unique diversity and endemism. It covers both shallow habitats and reef formations and deep-sea areas that ecologically interacting by natural exchange. The occurrence of seagrass beds, mangrove forests and sand beaches has regulated nutrient and sediment input into these reef complexes.

The property size is appropriate to contain the different features which sustain the intactness and the long-term conservation of its biodiversity. Sanganeb atoll is rather remote from land-based activities and the traditional artisanal fishing around it is under the control of fisheries and Wildlife Administrations.

Dungonab Bay marine waters are also protected by Wildlife Administration and Fisheries regulations. If these regulations are not promptly enforced, Dungonab Bay is likely to suffer negative impacts on the biota from activities on the two villages at the coast. Species which are likely to be affected are coral and fish species, turtles, manta rays, sharks, dolphins, dugongs, and birds.

Although the whole coastline of the property is subject to negative impacts from future developmental activities, the property has not shown any invasive or non-resident species as yet. However, with the increasing oil shipping tankers at the Sudanese coast, caution must be taken to monitor any effect from ballast water of these tankers.

Requirements for protection and management

There is a demonstrable commitment from the Government of Sudan towards the protection and conservation of the resource in the coastal waters. Several laws and regulations are in force and Sudan has signed and abides to regional and international protocols and conventions. The proposed site is protected by defined state and federal laws and administered by Wildlife Conservation General Administration (WCGA) and supported by an increasing awareness of the stakeholders. WCGA is aware of that the serial site will have a common management plan, if inscribed in the World Heritage List. There are currently two separate Management Plans for the two components. PERSGA (as it is currently updating DMNP Management Plan) has offered in December 2015 to support producing a common integrated management plan for the property.

The buffer zone is under protection by several legal mandates issued by the State Local Government (ICZM), and executed by Fisheries Aminstration , WCGA , Navy (Marine Security) and Tourism Ministry.

Name and Contact Information of Official Local Institution/ Agency

Organization: Sudanese National Commission for UNESCO

Address: **P. O. Box 2324 Khartoum – Sudan.**

Tel: **+249 183 779888**

Fax: **+249 183 776030**

E-mail: **sudannatcom @ hotmail.com**

Plate 2: The Red Sea is home to many endemic species, found only in this region, such as this pair of blue-cheeked butterfly fish *(Chaetadon semilarvatus)*

1. Introduction

The Red Sea is an embryonic ocean with spreading and rifted sea floor created as a result of the gradually increasing separation of the African and Arabian tectonic plates. This striking geological phenomenon has rendered the Red Sea partially isolated from the rest of the global ocean, and became a globally significant marine ecosystem. It is renowned for its unique and beautiful marine and coastal environments and species richness which includes many species found nowhere else on earth.

The waters of the Red Sea are warm, and it is the most saline of any ocean body of water. A lack of terrestrial fresh water runoff, combined with relatively low productivity, gives rise to low levels of turbidity in the central and northern Red Sea, including most Sudanese coastal waters. Sea water clarity is particularly high in deeper water areas and around offshore reefs, where visibility typically ranges between 20 and 30m, but may reach 70m (PERSGA 2001).

The Red Sea is probably one of the most biologically diverse tropical seas in the world outside the Indo-Pacific centre of marine biodiversity in the Indo-Malay region (Spalding et al 2001). There are more than 200 species of corals recorded from the Red Sea, of which about 6% are endemic, and 170 species of Echinoderms, of which 5.3% are endemic (Sheppard et al 1992). About 500 species of benthic algae have been recorded (Chiffings 1995) and over 1000 species of fish (Sheppard et al 1992, Goren and Dor 1994). The level of endemism among Red Sea fish is about 17%, a mean value which varies greatly between fish families.

The Sudanese Red sea coast is about 750 km long, including bays and inlets extending from 18^0 N to 22^0 N. Three distinct depth zones are recognized: Shallow reef-studded shelves less than 50 m Deep, deep shelves 500 to 1000 m deep and a central trench more than 1000 m deep, reaching a maximum of 3000 m off the city of Port Sudan.

The Sudanese coast is characterized by the most diverse reefs of the Red Sea. Most of the coast is bordered by fringing reefs 1-3 km wide separated by deep channels from a barrier reef 1-14 km wide. The outer barrier reef drops steeply to several hundred meters depth.

Coral species richness in Sudanese water is high. The number of species found in Sudan compares favorably with: The total of 340 species reported by Veron (2000) to occur within the whole Red Sea. The preliminary species list suggests that the reefs of Sudan support almost 80% of the species previously reported from the Red Sea. These coral species are either, (i) widespread across the Indo-Pacific, (ii) the Indo-West pacific, (iii) the Indian Ocean or (iv) the Western Indian Ocean, or are (v) endemic to the Red Sea, or (vi) thought to only occur in the northern Red Sea. Coral species considered to be endemic to the Red Sea are well represented and widely distributed across the Sudanese reefs (Appendix 1).

The global conservation values of the Red Sea include-inter alia- the diversity of coral reef habitats in central Red Sea of Sudan and Saudi Arabia, its distinct zoogeography and number of endemic species, the Atoll-like formation of Sanganeb Atoll in Sudan, the extensive stands of mangroves and populations of dugong and turtle in Southern Red Sea.

The use of the Red Sea as a transit route for a significant percentage of the world's petroleum, dry bulk and other cargoes gives the region a global strategic focus. This strategic focus became one of the major challenges to the sustainable use of the Red Sea natural resource. The other uses for the coastal and marine environments by the inhabitants of the Red Sea with a much longer heritage and indigenous knowledge have proven to be both ecologically and socially sustainable. However, increasing coastal populations, rapid development and human exploitation threaten the sustainability of current uses and the special conservation values (PERSGA 2006).

It is within these settings and features we are nominating a serial site, composed of two protected areas, for inscription in the World Heritage List. The property includes Sanganeb Atoll and Dungonab Bay-Mukkawar Island areas (Figure 1), which both lie within Ramsar Site No. 1859, indicating their conservation value. They are nominated in a serial site because of the natural, ecological and geological connectedness and functionally linked by open flow and exchange along the coast. Nevertheless, the area is protected by one administration; The Wildlife Conservation General Administration (WCGA) as an overall management framework for all the components.

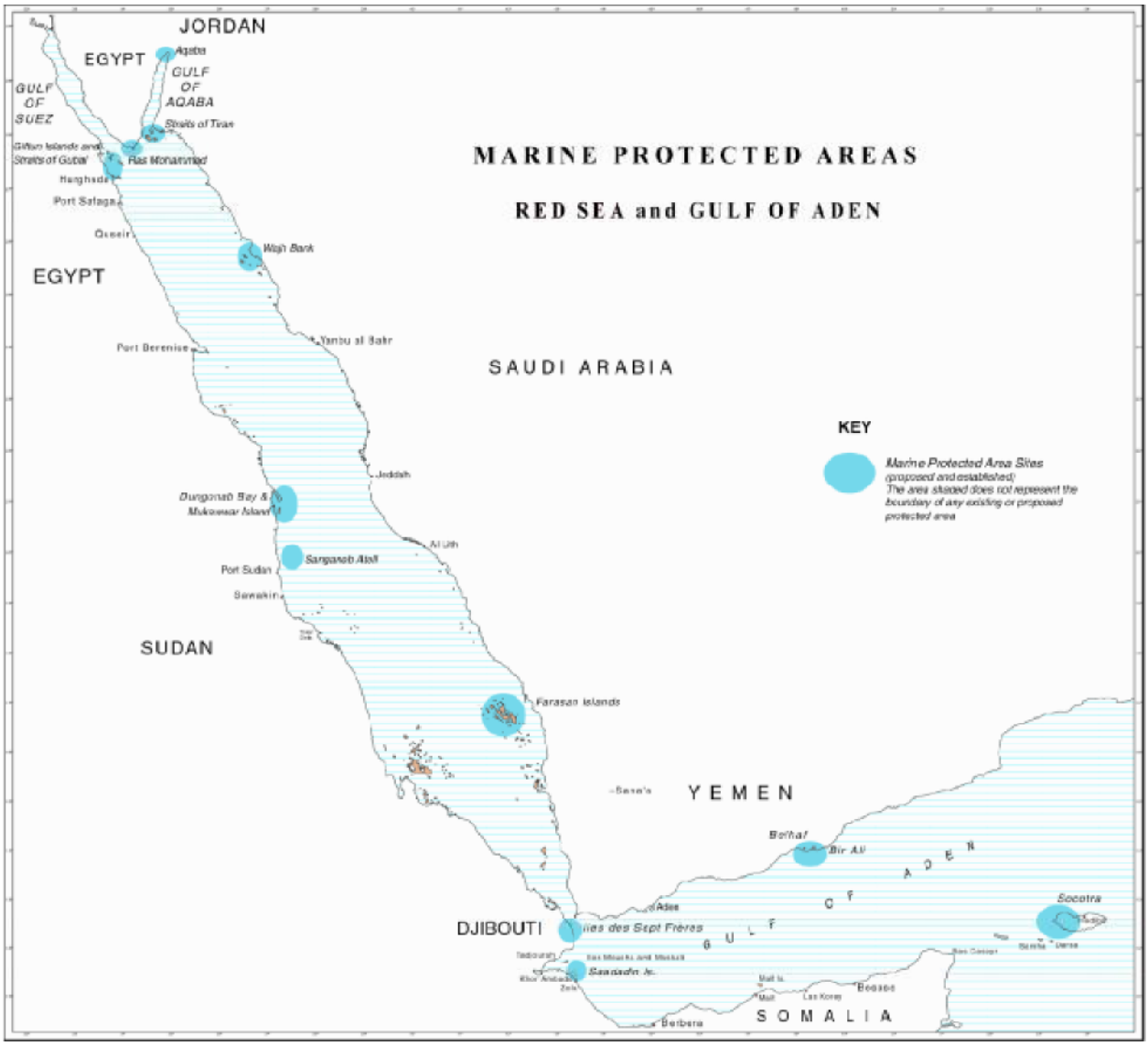


Figure 1: Key areas selected to create a regional network of marine protected areas in the Red Sea and Gulf of Aden including SMNP and DMNP.

1) Identification of the Property

1. a State Party: Sudan

1. b State: Red Sea state

1. c Name of property:

Sanganeb Marine National Park and Dungonab Bay- Mukkawar Island Marine National Park.

The nominated serial site contains two marine protected areas along the Sudanese Red Sea coast. These are the Sanganeb Marine National Park (SMNP) and the Dungonab Bay-Mukkawar Island Marine National Park (DMNP). Both sites are state property of the Red Sea state - Sudan (Figure 1). Ramsar Site No. 1859 (RIS 2009) (Appendix 4 and 5), lies within the nominated property.

1. d Geographical coordinates to the nearest second

The geographical coordinates of SMNP, DMNP and the areas of the nominated components of the serial site are shown in Table 1:

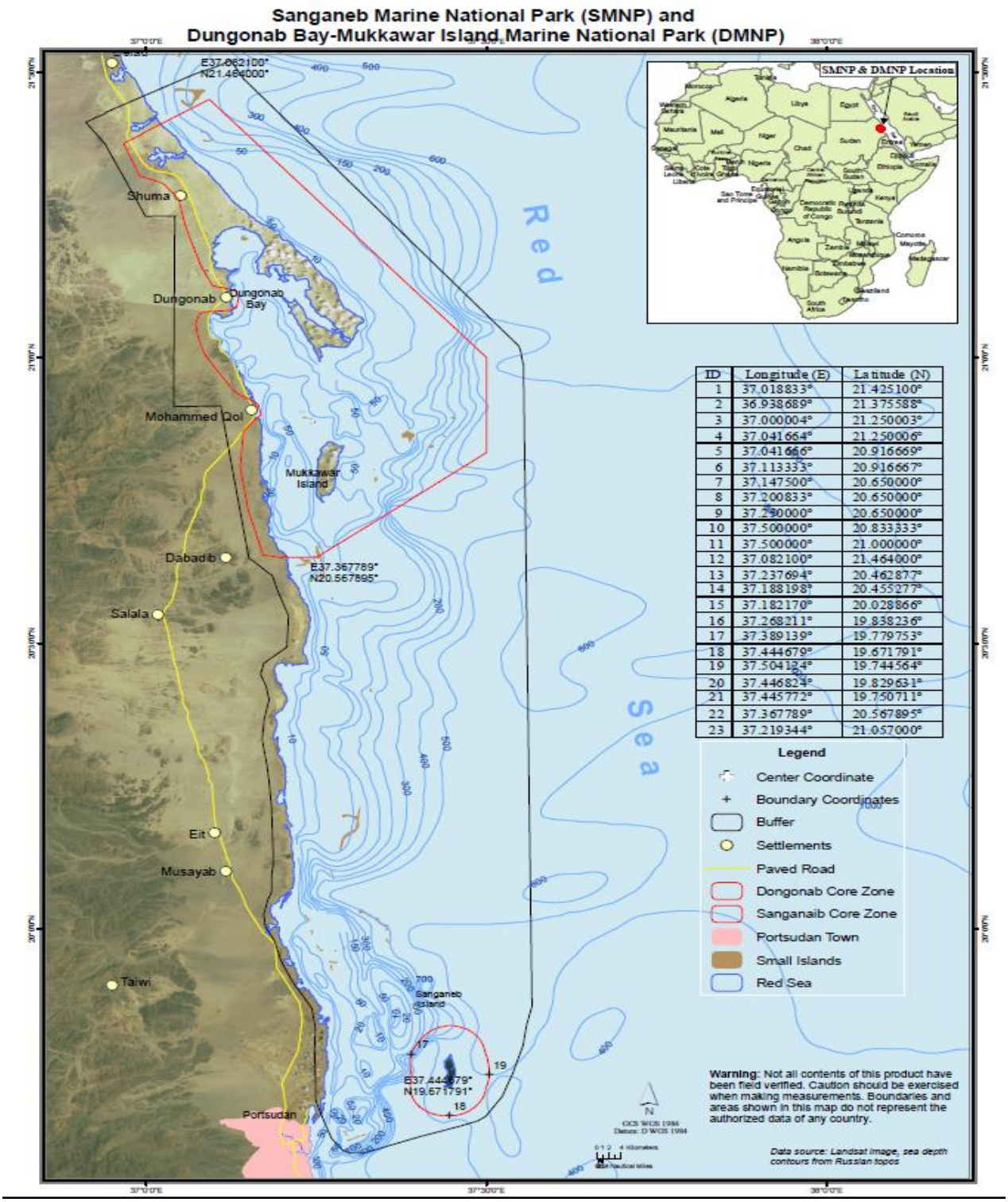
Table 1: Geographical coordinates to the nearest second

Id №	Name of the component part	Region(s) Districts(s)	Coordinates of the Central Points	Area of Nominated component of the Property (ha)	Area of the Buffer Zone (ha)	Map №
001	SMNP	Sudanese Red Sea Coast	E 37° 44’4689” N 19° 67’1791”	17400		2
002	DMNP	Sudanese Red Sea Coast	E 37°08’2100” N 21°46’4000”	243300		3
003	The buffer zone	Sudanese Red Sea Coast	-		504600	1
004	The whole serial site		E 37°36’7789” N 20°56’7895” Total area 765300			1

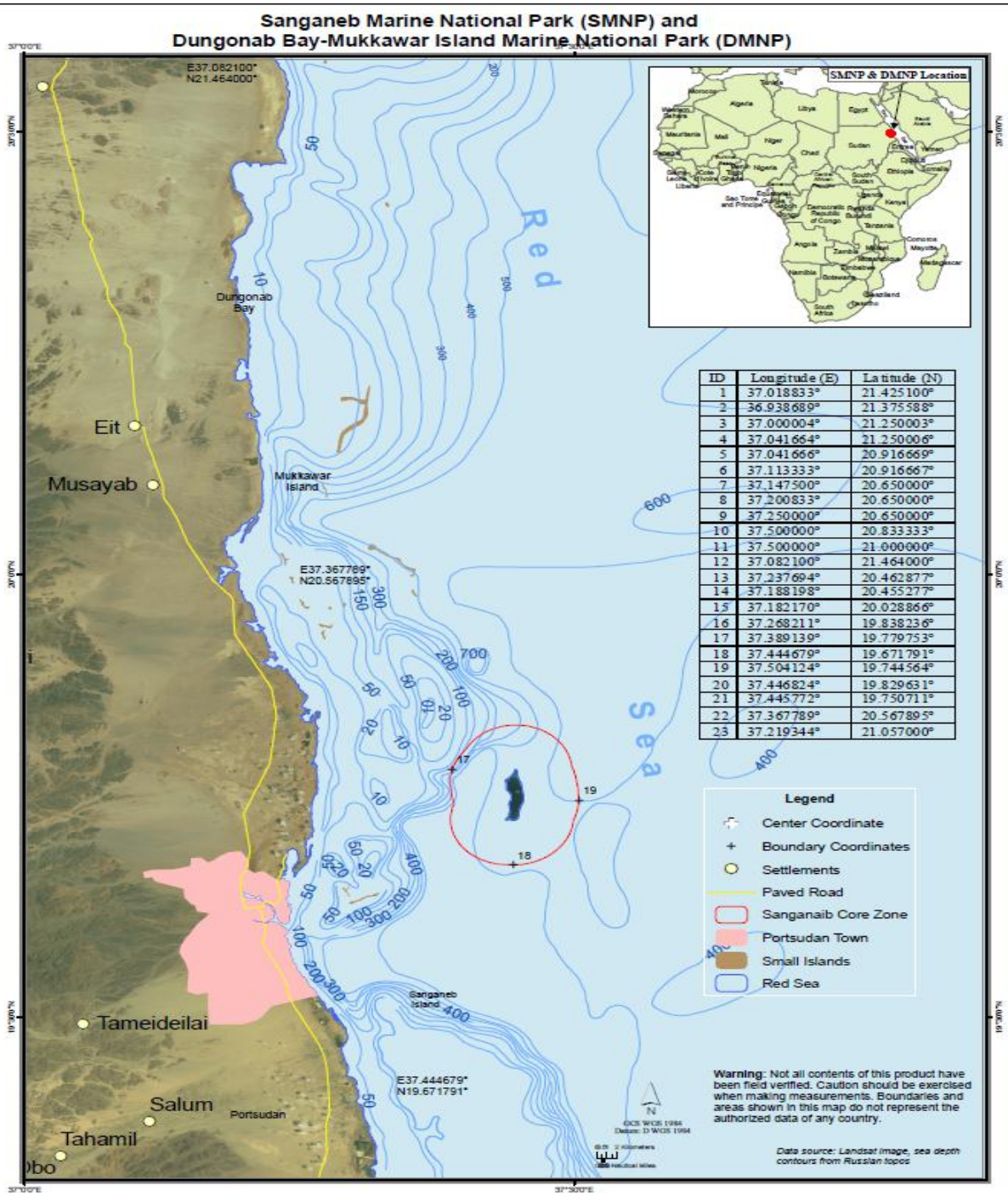
1. e Maps and plans

The maps and plans annexed and included in this nomination file are:

Management Plans – including respective Maps - (Appendix 6 and 7) and related Action Plans are annexed in Appendices 8, 9, 10, 11 and 12.



Map 1: The nominated serial site


Sanganeb Marine National Park (SMNP) and
Dungonab Bay-Mukkawar Island Marine National Park (DMNP)
SMNP & DMNP Location
E37.082100°
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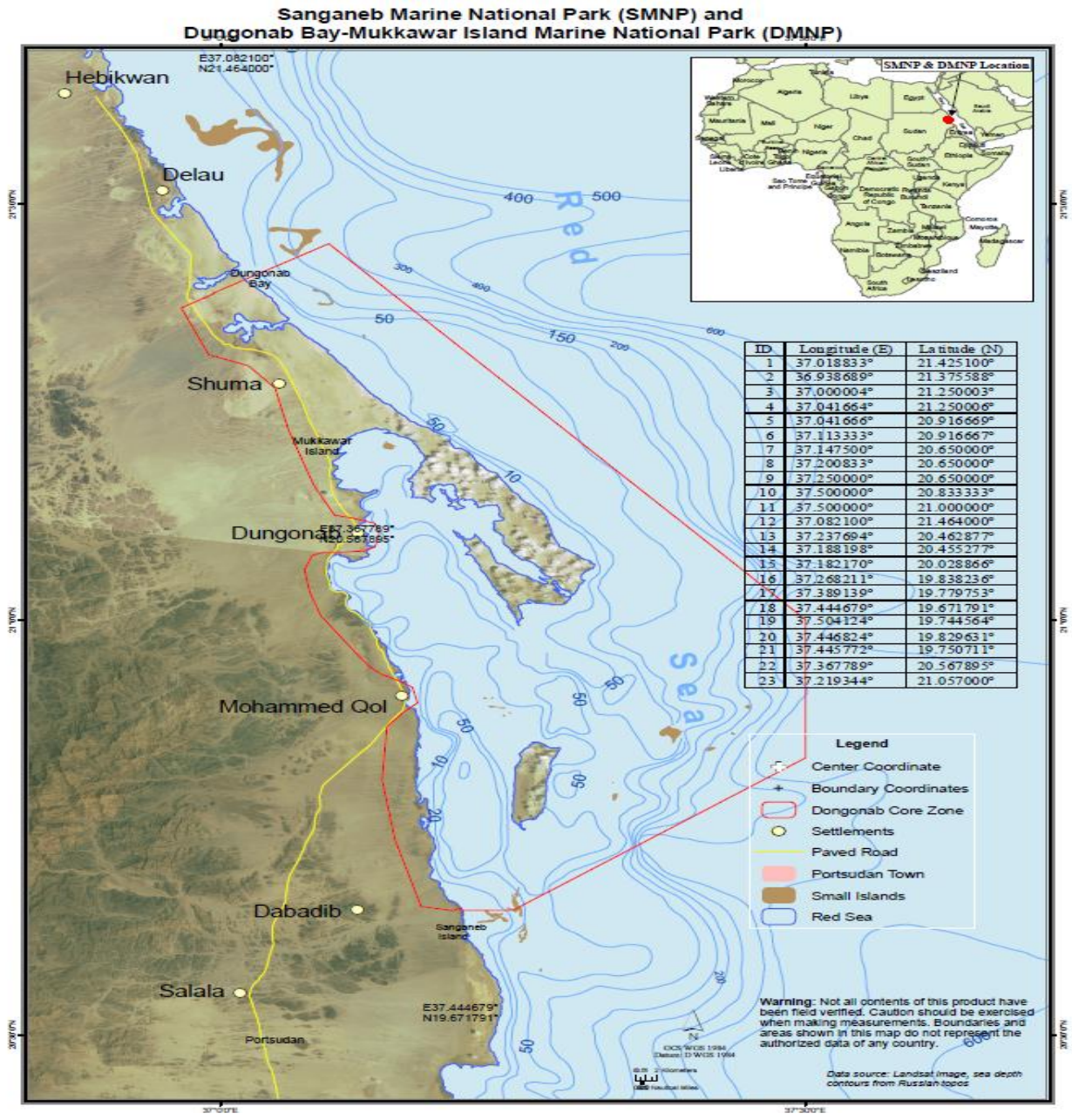
Data source: Landsat image, sea depth contours from Russian topos

Map 2: SMNP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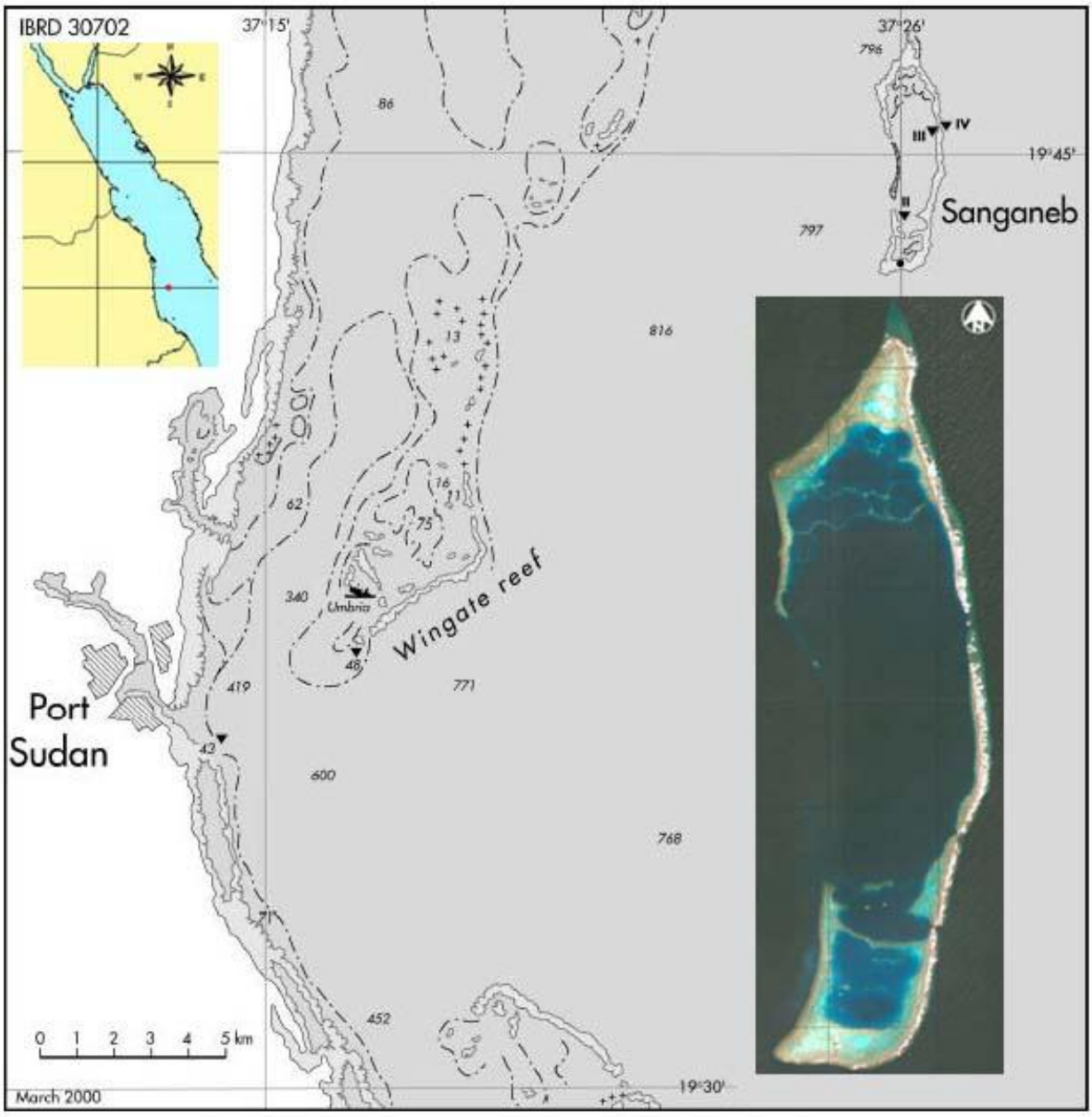
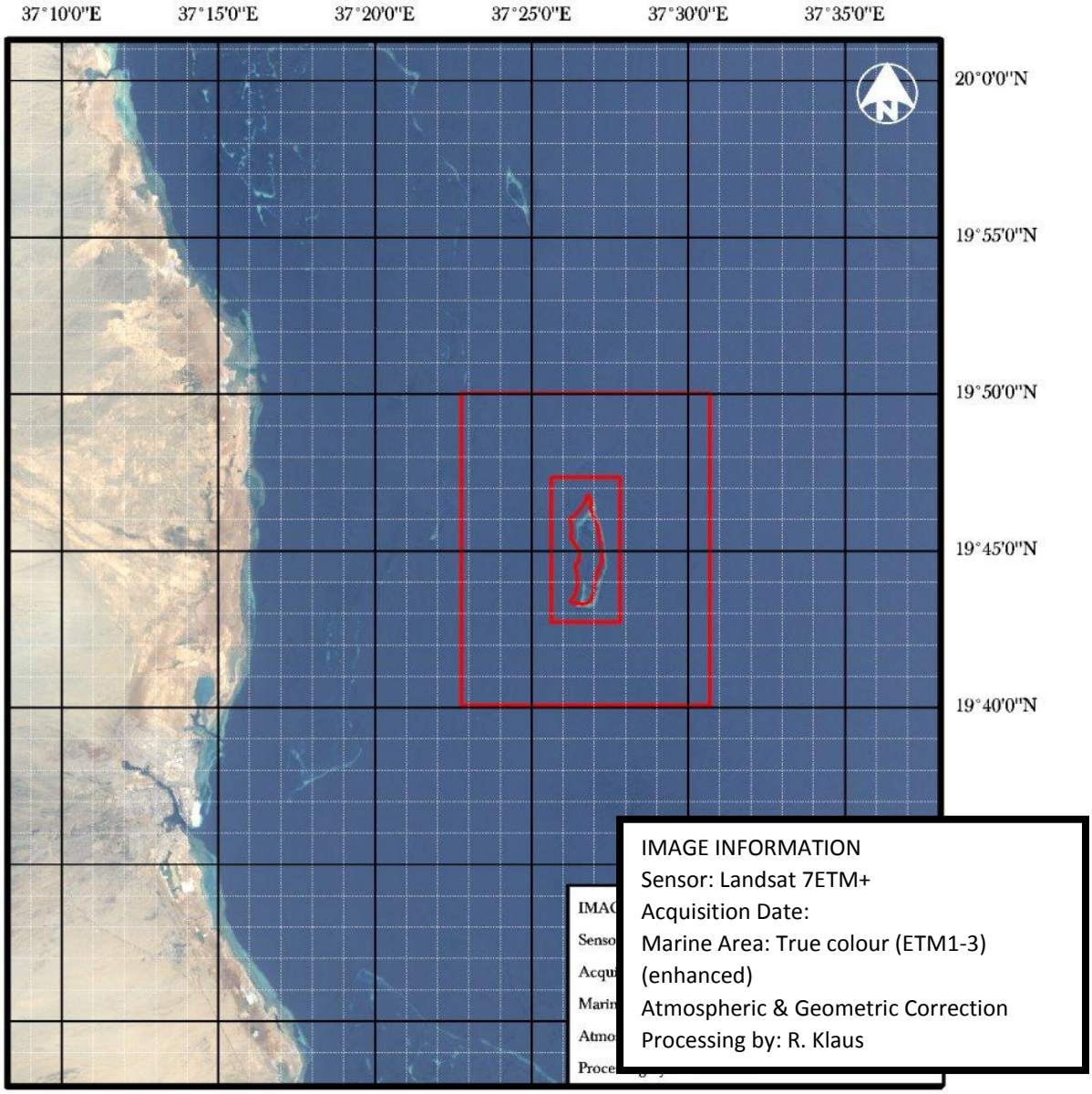
Map 3: DMNP

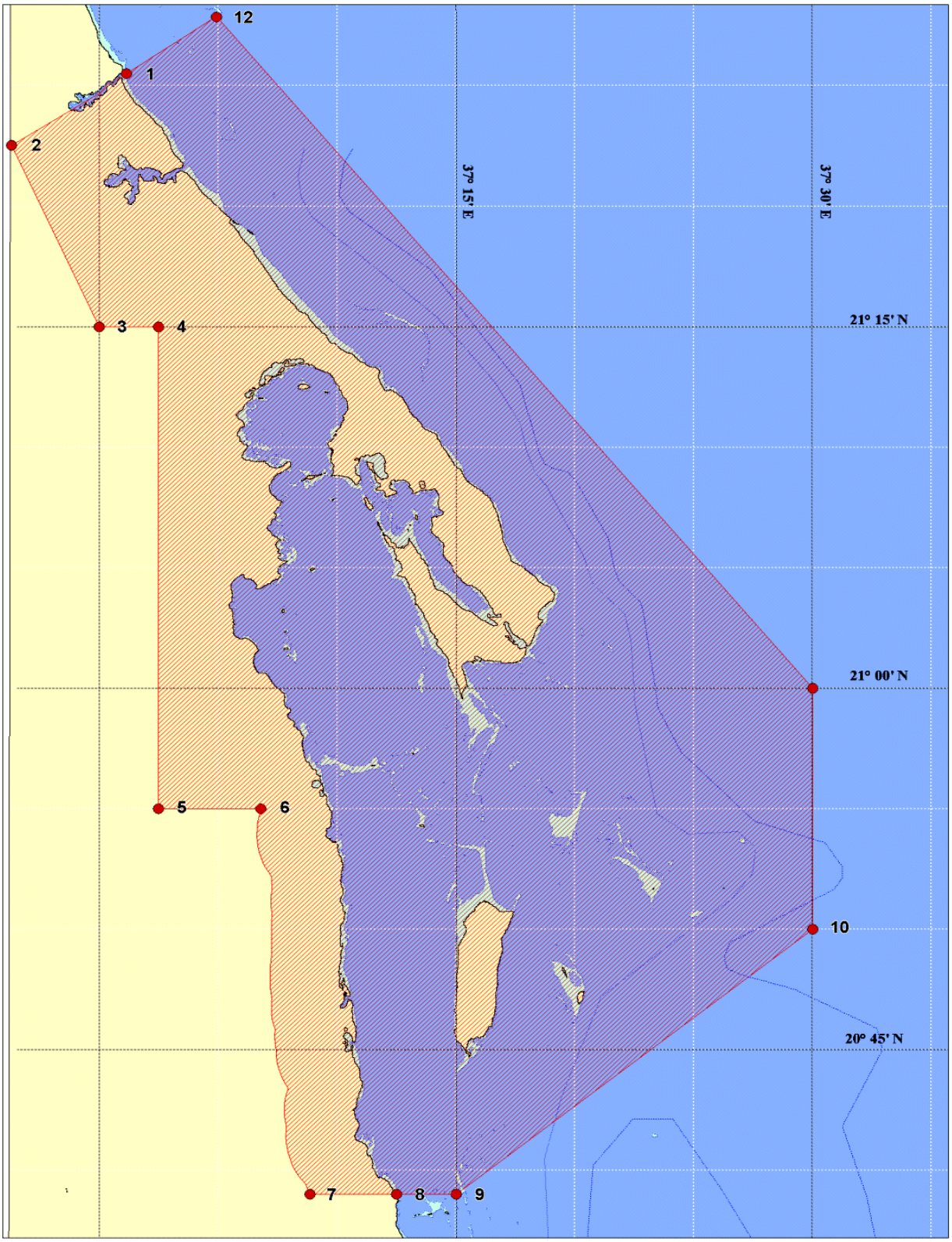


Map 4: Location map for Sanganeb Marine National Park (SMNP).



Map 5: Location and extent of the earlier suggested buffer zone by PERSGA around SMNP.

Map 6: Showing Dungonab Bay and Mukkawar Island.



Map 7: DMNP map and boundary lines.

Plate 3: Well developed coral reefs thrive on the edge of steep drop-off to deep water in SMNP.

1. f Area of nominated property

Area of SMNP and DMNP	**260700** ha
Buffer zone	504600 ha
Total	765300 ha

Sanganeb Marine National Park (SMNP)

Sanganeb Atoll is located approximately 30km north-east of Port Sudan (Map4). Its maximum length along the north-south axis is 6.5km, and its maximum width is 1.6km. The area of reef flat and shallow fore reef is approximately 2km^2, and the area of enclosed lagoon is approximately 4.6km^2 (Map 5).

Dungonab Bay- Mukkawar Island Marine National Park (DMNP)

Dungonab Bay is approximately 13 km across at its southern end, and extends 31 km from north to south, enclosing a total area of 284.5 km^2 (Map 6) and containing several islands and islets (Table 2). The Bay has three notable features:

1. A large southern basin separated from the deeper water outside the bay to the south by a wide shallow sill;
2. An almost circular northern basin partially isolated from the southern basin by islands and another shallow sill;
3. The long narrow basin of Khor Naitaib (13 km long and 1.5 km wide along most of its length).

Table 2: Area mapped for Dungonab Bay and Mukkawar Island (from the Landsat 7ETM satellite data). (PERSGA)

Name	**Area (km^2)**
Islands within Dungonab Bay	
Hysoit	0.28
Umm-Tarda Island	0.18
Brasit Kabir	0.24
Umm-ar Sheikh	0.04
Islands outside of Dungonab Bay	
Mukkawar Island	29.71
Mayteb Kabir	0.30
Mayteb Sarir	0.06
Mishareif	0.04
Total Area Land (islands and mainland)	**1580.00**
Total Area inside Dungonab Bay	**284.50**
Total Area Sea	**2745.44**
Total Area Mapped	**4325.45**

Plate4: Soft coral (Alconarian)

2) Description

2. a Description of Property

The Red Sea has resulted from the gradual increasing separation of the African and Arabian tectonic plates; a process which began approximately 70 million years ago (Sheppard *et al* 1992). This process of rifting has created a stepped profile to the continental margins either side of the Red Sea. The maximum depth of the Red Sea is over 2000m, but the shallowest of the rift valley steps lies less than 5m below sea level in the northern Sudanese coast. In the southern part, the continental shelf extends over 50 km offshore.

The nominated site is an expanse of coastline including coral reef, mangroves, off-shore islands, soft-bottom mud flats, sand beaches and hard-bottom rocky shores in addition to salt marshes, sabkhas and khore basins. As a result the site is rich in biological diversity and provides permanent habitats, breeding grounds and areas of refuge for various marine animals, and it also provides support to several threatened species. The main water uses within the site are fisheries, oyster farming and touristic activities. The land use is animal breeding, mainly of camel, goats and sheep.

The nominated site comprises two Marine National Parks (SMNP- DMNP) and a buffer zone. .

2. a. 1 SMNP

Sanganeb reef is widely reported to be the only atoll in the Red Sea because it encloses a large central lagoon and it rises 800m from a base on the continental shelf. There is some debate over what strictly constitutes an atoll. To be technically precise would require both a rigorous definition of the term ‘atoll’ and an investigation into the geological origins and structure of the Sanganeb reefs. There have been no specific investigations into the sediments of SMNP but, being composed entirely of the remains of calcareous organisms, the sediments of Sanganeb Atoll are likely to be almost 100% carbonate with a very small contribution from wind- blown dust from both the Arabian and African landmasses.

HABITATS

The structure and zonation of Sanganeb reef is typical for the Red Sea and has been reasonably well studied (Vine and Vine, 1980; Mergner and Schumacher, 1985), and a habitat map derived from satellite imagery is presented in Figure 2.

In areas where the reef is wider than about 20m there is an area of back reef that supports a lower coral cover (less than 15% live coral cover) with patches of sand, coral rubble and exposed reef framework. Massive growth forms of *Porites* and *Goniastrea* dominate here. Such areas are most extensive to the north of the atoll and in the area around the lighthouse.

The majority of the reef flat is in shallow water, particularly in the summer months when sea levels are about 15cm below those occurring in winter. Coral cover is moderate (10-30%) and dominated by massive and encrusting growth forms, particularly colonies of *Porites*, *Goniastrea* and *Montipora*, but there is a greater diversity of coral species compared to the back reef. The reef flat supports numerous herbivorous fish particularly surgeonfish *(Acanthurus sohal)* and parrotfish *(Scarus* sp. and *Bolbometopon muricatum).* Around the northern point of Sanganeb there is an area of slightly deeper reef flat, with an average depth of 2-3m, which is exposed to the higher wave energy arriving from the north.

Around most of the outer rim of Sanganeb the reef drops vertically by 5-10m to a debris slope that continues to fall away at a steep angle, often 40º or more, to another shelf at 20-30m. In some areas (e.g. on the south eastern edge) these drop-offs continue down to depths of at least 50m. The drop off from the reef flat to the reef slope is spectacular because of the diversity of fish life and the variety of coral. From a diver's perspective these drop-offs represent some of the best dive sites because of the rich marine life and the sense of exposure that comes with diving on vertical cliff walls in very clear water. This zone supports the greatest diversity of life and is without question the most important part of the reef from a conservation point of view.

Little research work has been carried out on the deeper outer slopes that fringe the atoll. Sharks are known to inhabit this depth range, and more search effort in this zone will undoubtedly reveal the presence of fish and coral species that have not yet been recorded at SMNP.

The lagoon contained by the atoll's reefs is open to the west. A sill lying at around 10m separates the deeper parts of the central lagoon from open water, rising in places to form small pinnacles and patch reefs. No information is available concerning the nature of this sill or the benthic life that it supports. A bathymetric survey across the lagoon opening would provide useful information that might assist the safe navigation into and out of the lagoon.

The lagoon itself is a complex of semi-enclosed areas that are partially isolated from each other by reefs. The southernmost lagoon is the most sheltered and the shallowest, with depths no more than 20m. Access to the north is possible through a small pass no more than 3m deep and 5m wide, and on its southern limit there is access to the lighthouse via the northern jetty. The whole lagoon is fringed with coral and rising from the lagoon floor are small patch reefs and coral bommies, making navigation moderately hazardous particularly at night. Sediments here are likely to be of silt because very little wave energy can disturb the seabed.

To the north lies another semi-enclosed lagoon, separated from the main lagoon by a patch reef that rises from about 20m depth. This area is the preferred anchorage of the live-aboard dive vessels visiting SMNP. The seabed here is between 20-25m deep and has a high cover of coral, particularly massive colonies (dominated by *Porites lutea)* that can rise 5m from the seabed. Conditions at the seabed are moderately turbid, resulting in low light levels and a degree of sediment stress for the corals. Further north is the main lagoon, which has an average depth of more than 20-25m. Most of the reefs that fringe the lagoon drop vertically to a debris strewn slope at 5-10m which descends eventually to the lagoon floor. There is very little available information about the nature of the lagoon floor, and this warrants more investigation to establish the distribution of flora, particularly seagrass, and fauna. In the very northern section of the main lagoon there is a complex of ribbon reefs that have semi-isolated shallow pools and provide very sheltered habitats. Overall, the diversity of hydrographic conditions encountered within the lagoon area is high and this is reflected in the ecology it supports. Important amongst the ecological roles that the lagoon plays is that of a fish nursery and spawning ground, for species including sailfish.

The open water surrounding SNMP is also an important component of the Park. Average water depths are 500-800m so marine life here is pelagic, and includes cetaceans, marine turtles and commercially important fish species. Vine and Vine (1980) also reported a pinnacle rising to within 20m of the sea surface immediately to the north east of the atoll that attracts large numbers of schooling pelagic fish (PERSGA, 2004).

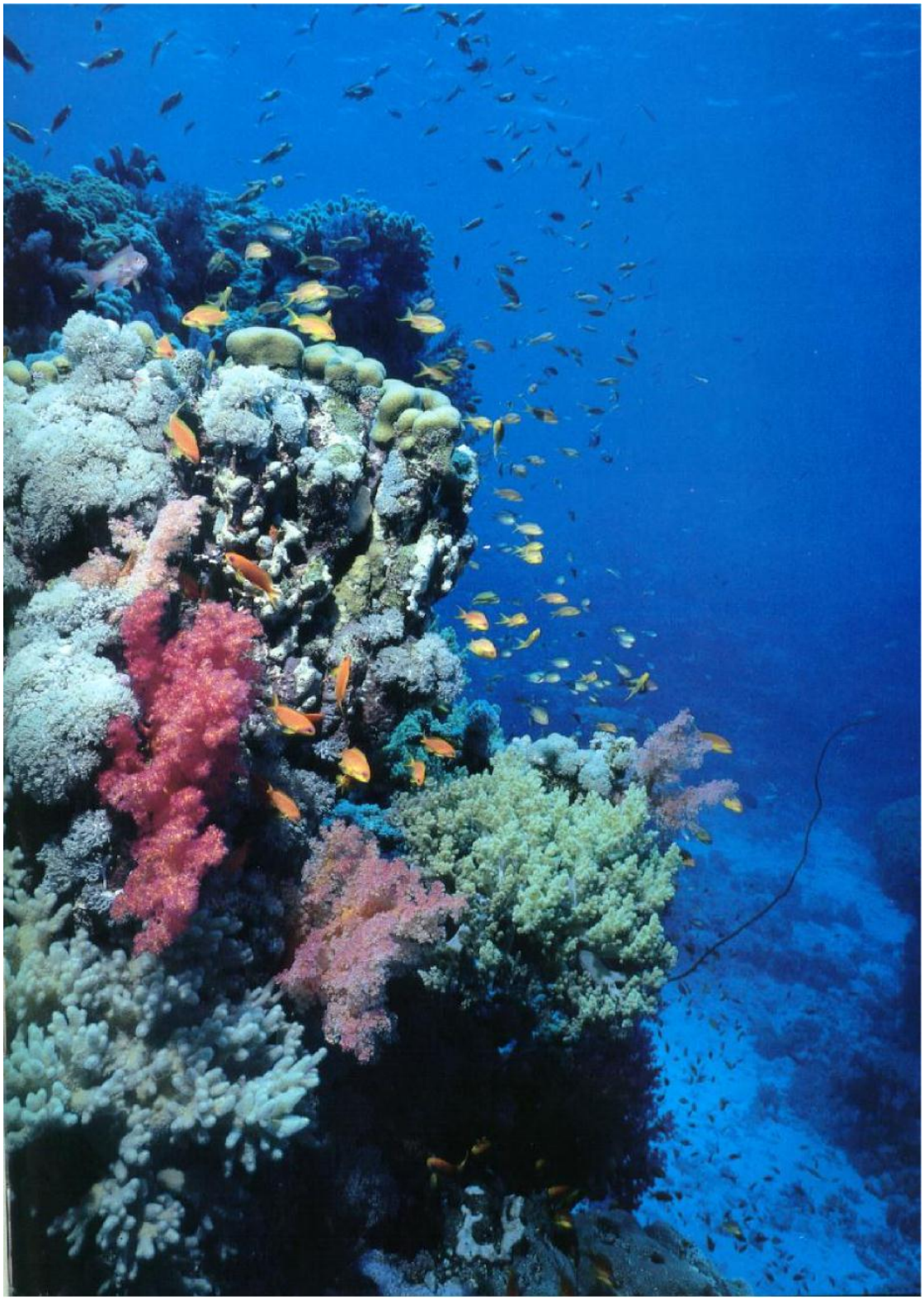
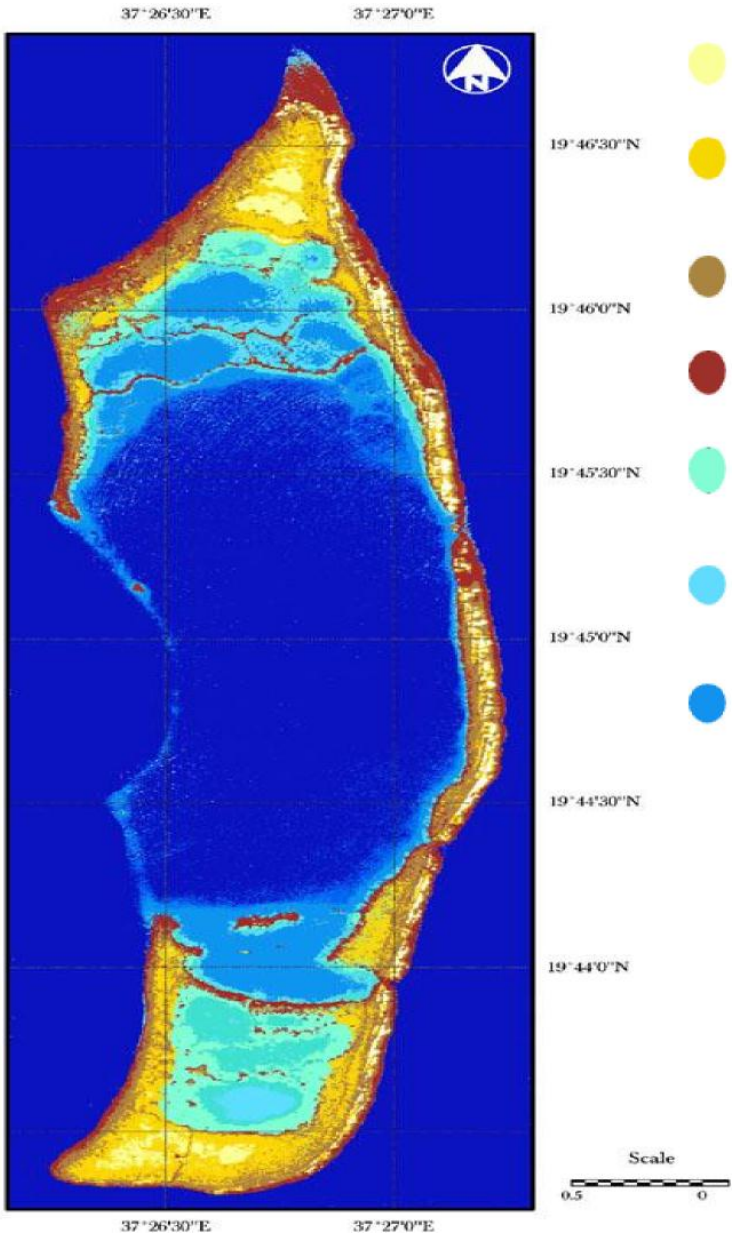


Plate 5: Sanganeb reef.

Key to Habitat Map



Very shallow sand on reef flat

Back reef - sandy areas with occasional coral colonies

Reef flat with high coral cover

Reef Slope (down to 3-5m depth)

Shallow lagoon with predominantly sandy seabed

Scattered coral on sand 5-10m depth

Coral on sand / reef rock ~10-20m

Image Information

Sensor: Digital Globe Quickbird

Acquisition Date: 18th November 2002

Unsupervised Classification (ETM1 -3)

Atmospheric and Geometric Correction

Processing by: Rebecca Klaus

Figure 2: Habitat map of SMNP

Flora

The algae of SMNP have been studied by El Hag (1994) and a list of species is presented in Appendix 2. The findings show that the flora of Sanganeb Atoll is typical for coral reefs of the Indian Ocean and all species have a wide distribution in the tropical Indian Ocean. There is no published information regarding the occurrence of seagrass in the lagoon at SMNP.

Fauna

Hard and Soft Corals

Abiotic conditions in the central Red Sea are optimal for coral growth and reef development. Perhaps due to these optimal conditions, the number of coral species observed in the Sudanese Red Sea is greater than that for either the northern or the southern Red Sea. To the north conditions are sub-optimal due to the low winter temperature extremes occurring there. To the south higher concentrations of nutrients imported to the Red Sea from upwelling in the Gulf of Aden probably limit reef development by increasing rates of bioerosion, concentration of phytoplankton in the water column and macroalgal biomass. The hard and soft coral fauna at Sanganeb Atoll is therefore likely to be amongst the richest in the Red Sea. To date a total of 124 cnidarian species, including scleractinians, have been recorded at SMNP (Mergner and Schumacher 1985). The composition of coral assemblages within SMNP and elsewhere in the Sudanese Red Sea are generally well known.

Plate 6: Some of the Red Sea endemic corals including: (a) *Acropora maryae (* Veron, 2000), (b) *Stylophora wellsi* (Scheer, 1946), (c) *Echinopora fructilosa* (Ehernberg, 1834) (d) *Mycedium umbra* (Veron 2000) (e) *Symphyllia erythrea* (Klunzinger, 1879), (f) *Favia Iacuna* (Veron *et al,* 2000).

Commercially-Important Invertebrates

There are populations of a number of commercially important invertebrates present within SMNP and of these the most important are *Trochus (Trochus dentatus,* locally known as kokian) and sea cucumbers.

Average national exports (in tones) of kokian for 1980-1997 suggest a harvest of almost 300t/year[1]. This places Sudan as the third largest producer of *Trochus* shells, behind the Solomon Islands at 578t/year and New Caledonia at 349t/year over the same period. Sudan is therefore by far the largest producer of *Trochus* outside the Pacific Ocean (Eltayeb 1999). The popularity of the fishery probably stems from the lack of fisheries infrastructure along most of the mainland, particularly the lack of ice-making facilities and cold storage. However, catch per unit effort and the total catch landed has fallen recently, and there are strong signs that this is due to over-collection. *Trochus* was observed at normal population densities on the reef flat during May 2003, suggesting that they have not been over-exploited within SMNP.

Exploitation of sea cucumber (bêche-de-mer) along the Sudanese coast was initiated in the late 1970s and since then production has been based on two species *(Holothuria* sp. and *Actinopyga sp.).* In 1981, 15 tones of dried sea cucumber were exported. Thereafter, production stopped because of low prices on export markets and difficulties in collecting. However, in the present situation of declining fish and kokian landings, sea cucumber exploitation has resumed and it is likely that bêche-de-mer is over-exploited in Sudan (PERSGA/GEF 2002). Recently PERSGA has approved a project to demonstrate the viability of a sea cucumber hatchery. Both commercial species of bêche-de-mer were observed on the reef flat in SMNP at low population densities, suggesting that there has been some exploitation in the recent past. Research on the natural distribution and abundance of both *Trochus* and sea cucumbers is currently in progress in Sudan.

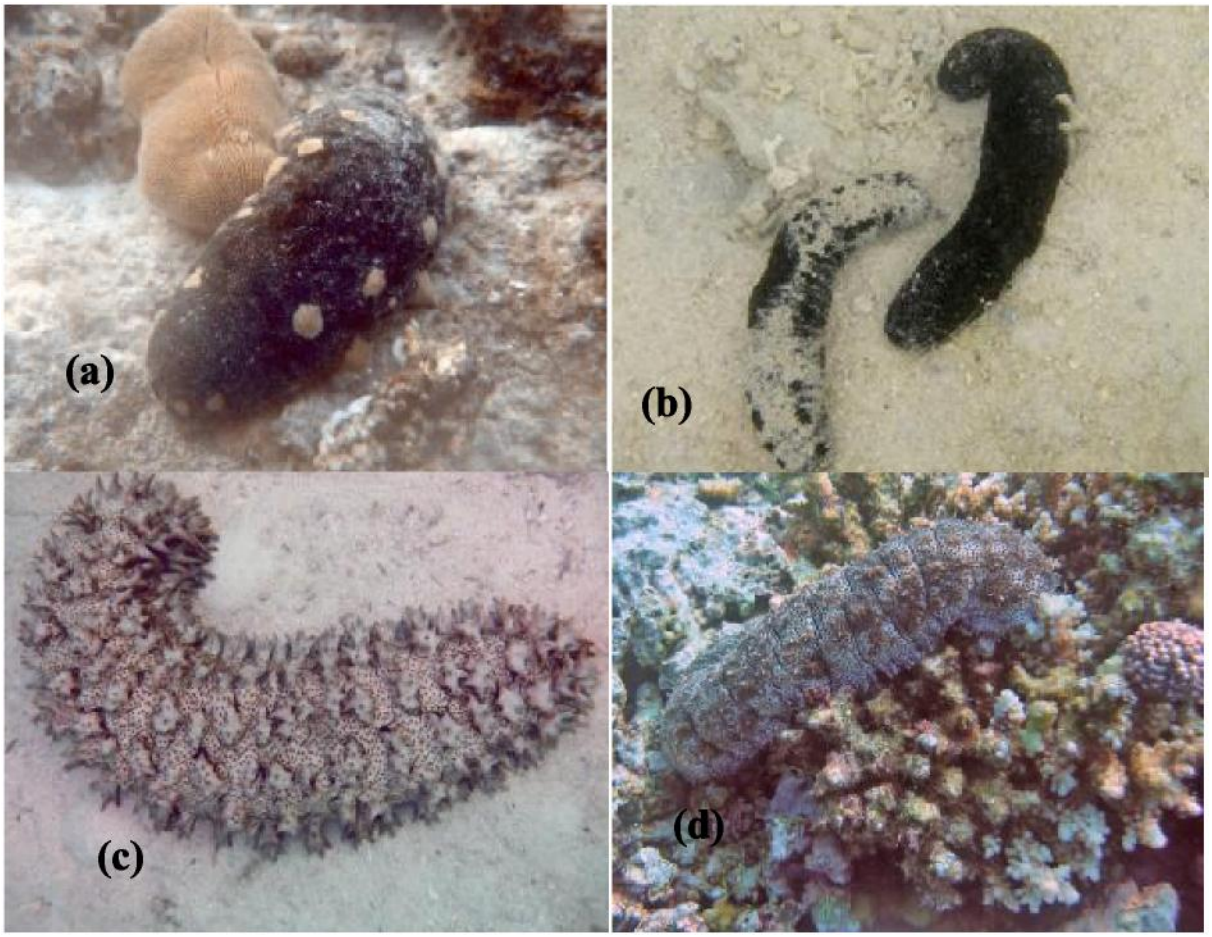


Plate 7: Some sea cucumbers on the reefs: (a) *Holothuria nobilis*, (b) *Holothuria atra* (c) *Thelenta ananas* (d) *Pearsonothuria graefei.*

Pearl oyster *(Pinctada margaritifera)* and ornamental seashells (mainly *Strombus* and *Lambia* species) are also collected in Sudan, particularly from the fringing reefs inshore. Giant clams *(Tridacna squamosa* and other species) are very abundant on the reef and may represent a totally unexploited population. Other invertebrates with commercial potential, particularly from a medical research point of view, include sponges, nudibranch molluscs and ascidians. No research has been conducted at SMNP on these groups.

Coral Predators

Outbreaks of Crown of Thorns Starfish (CoTS, *Acanthaster planci)* occurred in Sudan in the 1980's and were extensively researched by the Cambridge Starfish Research Group. This species can cause severe damage to coral reefs, and while occasional outbreaks are probably a natural occurrence, it is important that they are controlled in areas where the reefs are of direct commercial value e.g. dive sites, as has been successfully achieved at Ras Mohammed National Park in Egypt. CoTS feeding scars were observed on a few *Acropora* tables in SMNP during May 2003, indicating that while they are present, CoTS are presently at normal background population densities.

Other feeding scars were also observed on coral colonies, particularly between the south-west headland and the lighthouse. The most likely cause is *Drupella*, a corallivorous gastropod that can cause widespread damage to corals in much the same way as CoTS.

Fish

The coral reef fish fauna of SMNP has been surveyed by Krupp et al. (1994) and has shown to be highly diverse with over 251 species so far identified, with an estimate of the actual number of species put at over 300. In addition to reef associated species, a large number of pelagic fish can be observed in the open waters of SMNP including species of tuna, barracuda, sailfish, manta rays and sharks. Of particular interest are the sailfish that are reported to spawn in Sanganeb lagoon during the early summer months.

As with the coral reef itself, the diversity and abundance of fish life is one of the key natural resources within SMNP and must be treated accordingly in the Park's management plan. A checklist of coral reef fish is presented in Table 4, but below is a description of some of the more valuable species.

Bump-head parrotfish *(Bolbometopon muricatum)*

This species of parrotfish is becoming increasingly rare throughout its range due to its value as a food fish in Asia. As it is so vulnerable to over-fishing yet very distinctive and easy to identify, it has been included as an indicator species in the Reefcheck survey protocol.

Bolbometopon muricatum is the largest of the parrotfish, reaching 120cm in length, and forms schools of 25-30 fish. This species feeds on encrusting algae, benthic algae and live coral. It is the only parrotfish whose diet is more than 50% live coral, and a single large individual will consume approximately one cubic meter of coral skeletons per year, releasing the material again as fine sand. Schools of this fish typically occur on coastal coral fringing reefs and outer reef slopes where it is most commonly observed on reef fronts and reef flats. Juveniles most frequently inhabit lagoons, while adults occur in clear lagoons and on seaward reefs in depths to over 30m. During the field visit in May 2003 a school of 25 bump-head parrotfish were observed feeding over the shallow reef flat in the eastern section of the atoll.

Individuals of this species live for at least 35 years (maximum age probably 38-40 years), but do not reach maturity until about 9 years of age making them vulnerable to over-fishing. As a result of its high value and slow rate of reproduction, this fish is seriously over-fished and is now becoming increasingly rare. Recently, it was reported from only 11% of reefs in the Indo-Pacific (Wilkinson, 2002).

Napoleon (Bump-head) wrasse *(Cheilinus undulatus)*

The bump-head or Napoleon wrasse, *Cheilinus undulatus,* is one of the largest of all reef fishes and the largest in the wrasse family. It can reach well over two meters in length and 200 kilograms in weight. Like many large reef fishes, the Napoleon wrasse does not appear to be particularly common. Its lifespan (of at least 20 years) and low replacement rate make it susceptible to even low levels of fishing pressure.

This species is considered a gourmet food fish particularly in South East Asia where it is appreciated for the fine taste and texture of its flesh. It has become a small, but significant component of the international luxury trade in live reef fish that has expanded rapidly within the last decade in developed areas of South East Asia. With the advent of night spearing and the growing demand for exports, there is considerable concern that this widespread but scarce species is now threatened. It was included in the 1996 IUCN Red List as vulnerable, and is now a species on which the Grouper and Wrasse Specialist Group of the IUCN Species Survival Commission is focusing. Reefcheck reports that it is present on only 12% of reefs in the Indo-Pacific Ocean.

Groupers

So far a total of nine species of grouper have been recorded within SMNP of which the spotted coral grouper *(Plectropomus maculatus,* known locally as najil) is the most important commercially and from a conservation perspective. This is a key species for the Saudi export market and the largest of Sudan's seafood products. Catches of this fish now show a high percentage of small individuals because of the widespread use of small meshed nets, indicative of over-fishing. This species is the focus of grow-out aquaculture in South East Asia (e.g. Australia, Indonesia, Malaysia and Thailand) but the supply of fingerlings is from wild-caught stocks. The size of the stock within SMNP is not known, but is likely to be relatively healthy because of the low fishing pressure, and should therefore be totally protected.

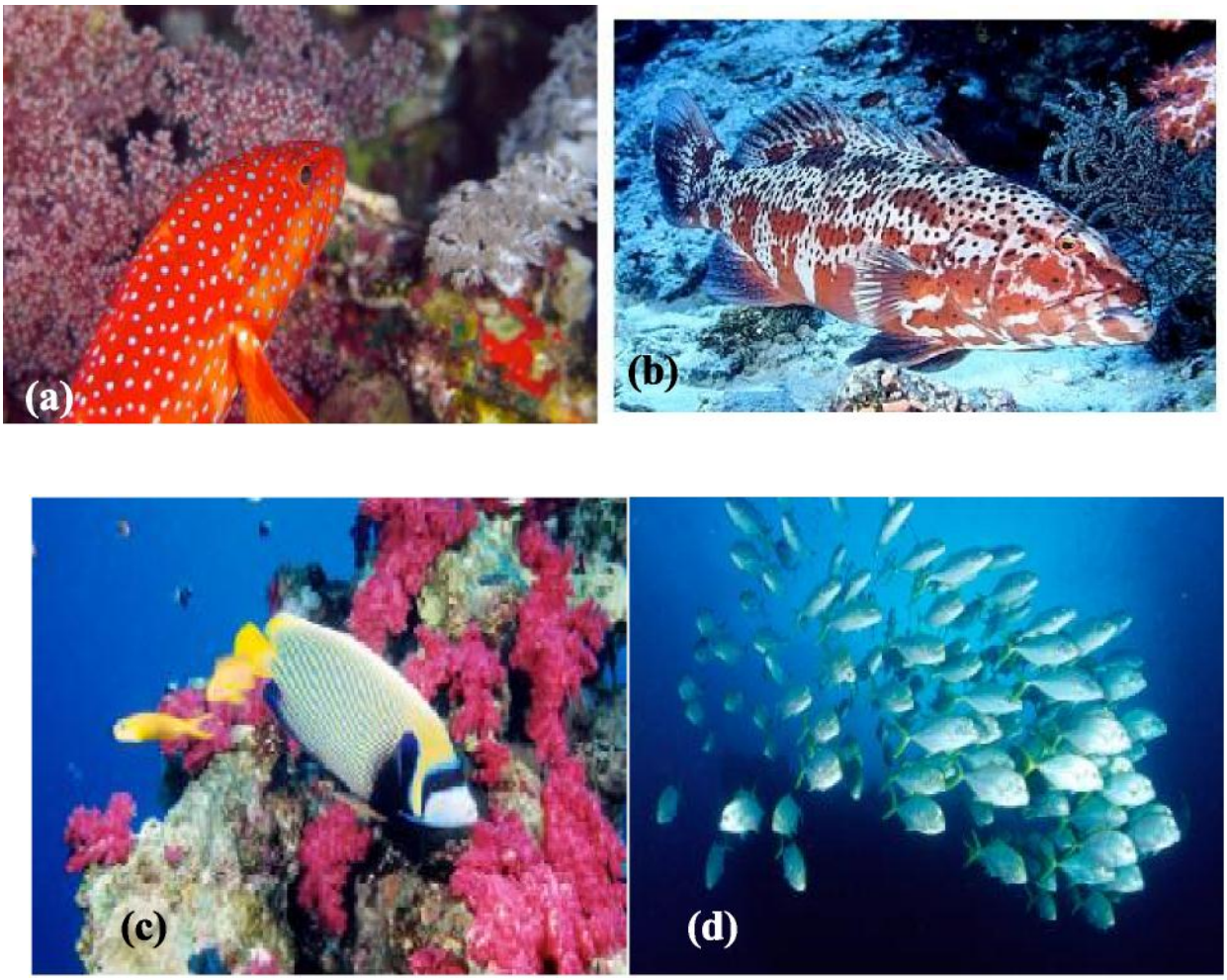


Plate 8: Groupers (a*) Cephalopholis miniata* (b) Najil (*Plectropomus pessuliferus*) (c) Emperor Angle fish *Pomacanthus impertor*) (d) Yellow Travelly (*Gnathodon speciosus*).

Sharks

In winter months, especially from November to April, hammerhead sharks tend to form schools at the south-west and north-east points of the atoll. These may be observed at shallower depths around 20m in the early morning (before 09:00) and in the evening immediately prior to sunset. At other times they remain in deeper water, at around 70-90m (VINE and VINE 1980). The reliable presence of sharks and other large pelagic fish contributes strongly to the value of a diving destination, and since diving is a non-extractive use of these resources it is completely sustainable. Indeed, there are significant conflicts between the diving and shark fishing industry in countries such as the Maldives where both fishing and tourism are very important sectors in the national economy.

Statistics on shark landings in Sudan show a sharp decline from 163tones in 1990/91 to 26tones in 1993/94, although landings from foreign vessels are not included in the database. Declines in the landings of sharks are probably due to intensive fishing efforts for the purpose of exporting dried shark fins, although they may reflect a reduction in fishing effort over this period. Further information is required to verify which explanation is true.

Marine turtles

Vine and Vine (1980) reported that turtles are frequently sighted in the waters around Sanganeb Atoll, but more recent anecdotal reports suggest that turtles are now uncommon. It is possible that SMNP is a feeding ground for hawksbill turtles, and that green turtles may be found periodically in the surrounding waters. Not enough information is available on the status of turtles in SMNP, or their use of its habitats. There are no turtle nesting sites within the SMNP.

Birds

Six bird species were recorded at Sanganeb, including the regional endemic species *Larus leucophthalmus* (The white-eyed Gull) in breeding plumage.

Cetaceans

There are very few data on the identity and distribution of cetaceans in the Sudanese Red Sea. Anecdotal observations suggest that humpback whales *(Megaptera novaeangliae)* and pilot whales or false killer whales occur around SMNP during winter months, and a pod of 8-10 bottlenose dolphins *(Tursiops truncatus)* was observed around the mouth of the lagoon in May 2003. This pod is probably resident and females from it have been observed to give birth inside the lagoon. Individuals from this pod will approach small boats and bow-ride, which adds greatly to the potential for dolphin watching tours.

More research is required to establish which species of cetacean are present in Sudanese waters and, in particular, those surrounding the SMNP. Furthermore, in order not to displace resident cetaceans from their home range in the face of increasing visitor numbers, it is important to develop a set of guidelines to control dolphin watching that take into account the welfare of the animals, particularly during the birthing season.

Non-indigenous species

No alien or introduced species are known to occur at SMNP.

2. a. 2 DMNP

The topography of the coastal plain at DMNP is characterized by a few relatively low features mostly of sedimentary rocks which are regarded of Tertiary age (Kabesh1962). However, Gass (1960) has stressed that the sedimentary series of the coastal strip and the off-shore islands are of Plio-Pleistocene age. The sedimentary rocks are followed upward by a lower evaporites horizon, interbedded variegated marls, sandstones and conglomerates, then reef limestones. These are followed upward by another horizon of evaporites and finally by recent reef and alluvium forming the top of the sedimentary series.

Plate 9: Raised fossil reef at DMNP

The area covers a straight-line distance along the coast of approximately 70 km. The southern edge lies 125 km north of Port Sudan (distance by road about 175 km). The complex coastline, which includes the very large bay at Dungonab, together with the large island of Mukkawar, means that the total length of coastline exceeds 200 km. Although the island is correctly called Mukkawar and the hill on the island is Jebel Magarsam, the distinction is seldom made locally, and the island as a whole is most commonly referred to as Magarsam or Jebel Magarsam. In addition to Mukkawar Island, there are numerous small islands at the southern end of Dungonab Bay, and to the south of the Bay towards Mukkawar.

The majority of the islands within the area are either very low-lying (generally < 1 m) sand with halophyte vegetation overlying biogenic reef rock, or slightly uplifted (1–2 m) flat–topped fossil reef demonstrating the classic central Red Sea undercut profile. The two notable exceptions are Mukkawar and Mayteb Kebir, both of which are higher rocky islands (about 100 m in the case of Mukkawar, and about 40 m in the case of Mayteb) composed of uplifted sedimentary rocks and fossil reef.

The mainland shore is, for the most part, backed by a gently sloping coastal plain varying in width from 5 km to the south of Mohamed Qol, to over 30 km north of Dungonab Bay and towards Khor Shinaab. The coastal plain is composed of sand and gravel deposits, in many places overlying fossil reefs (particularly close to the present day shoreline), and is backed by the Red Sea Hills that rise to over 1500 m (Farah 1982). In some areas, particularly south of Mohamed Qol, low raised areas of fossil reef up to 10 or 15 m high extend almost to the waters' edge, and such raised areas form the edges of some significant features such as Mersa Inkefal.

The eastern edge of Dungonab Bay is formed by the Ras Rawaya Peninsula (referred to here as the Dungonab Peninsula), a low-lying sand and gravel peninsula composed of extensive areas of fossil reef, with the low hills of Jebel Abu Shagrab and Jebel Tetwaib at its southern end.

Coastal and marine habitats and biotopes

The Landsat 7ETM+ satellite data for Dungonab Bay and Mukkawar Island (PERSGA / GEF 2004) was used to map the distribution and create the preliminary area estimates of the extent of different marine and coastal habitats and biotopes within the property (Figure 7). The total area mapped covered 4,325 km^2, which included 1,508 km^2 of land and 2,745 km^2 of sea.

The major physical features of the coastal area include:

1. Khor Shinaab (5.8 km long and approximately 1 km wide along most of its length),
2. Mukkawar island (12 km long and 3 km wide),
3. Mayteb Kabir (1 km long and 400 m wide),
4. Dungonab Bay (31 km long and 13 km wide, excluding Khor Naitaib),
5. Khor Naitaib - 13 km long and 1.5 km wide along most of its length.

The distance offshore of the large number of submerged reefs and islands throughout the area varies from less than one kilometer, to over 20 km east of the Dungonab Peninsula (i.e. over 30 km from the mainland shore). Some of these reef features are very large. The almost continuous reef complex extending from the northern end of Mukkawar Island to the southern end of the bay and to the Dungonab Peninsula is over 16 km long and up to 15 km wide. The reefs of Shambaya and Mishareif are each over 8 km long and between 1 km and 3 km wide, as is the reef area surrounding the island of Mayteb.

Table 3 lists the area (km^2) of the principal islands, the coastal land and other major features of the property.

Coastal habitats and biotopes

The coastal biotopes and landscapes mapped for the property fall into the following broad categories: mud, sabkha, sand/gravel, sedimentary rocks (including fossil reefs), mangroves and halophytes (Figure 3).

The Dungonab Peninsula, and the coastal plain between the peninsula and Khor Shinaab, is dominated by sandy and gravel substrates. Vegetation in these sand/gravel areas is sparse, consisting of a low cover of halophytes and grasses in scattered locations. In many areas, particularly on the coastal plain to the north of the peninsula and near to Khor Shinaab there are wide expanses of gravel plain (largely eroding fossil reef) completely devoid of vegetation.

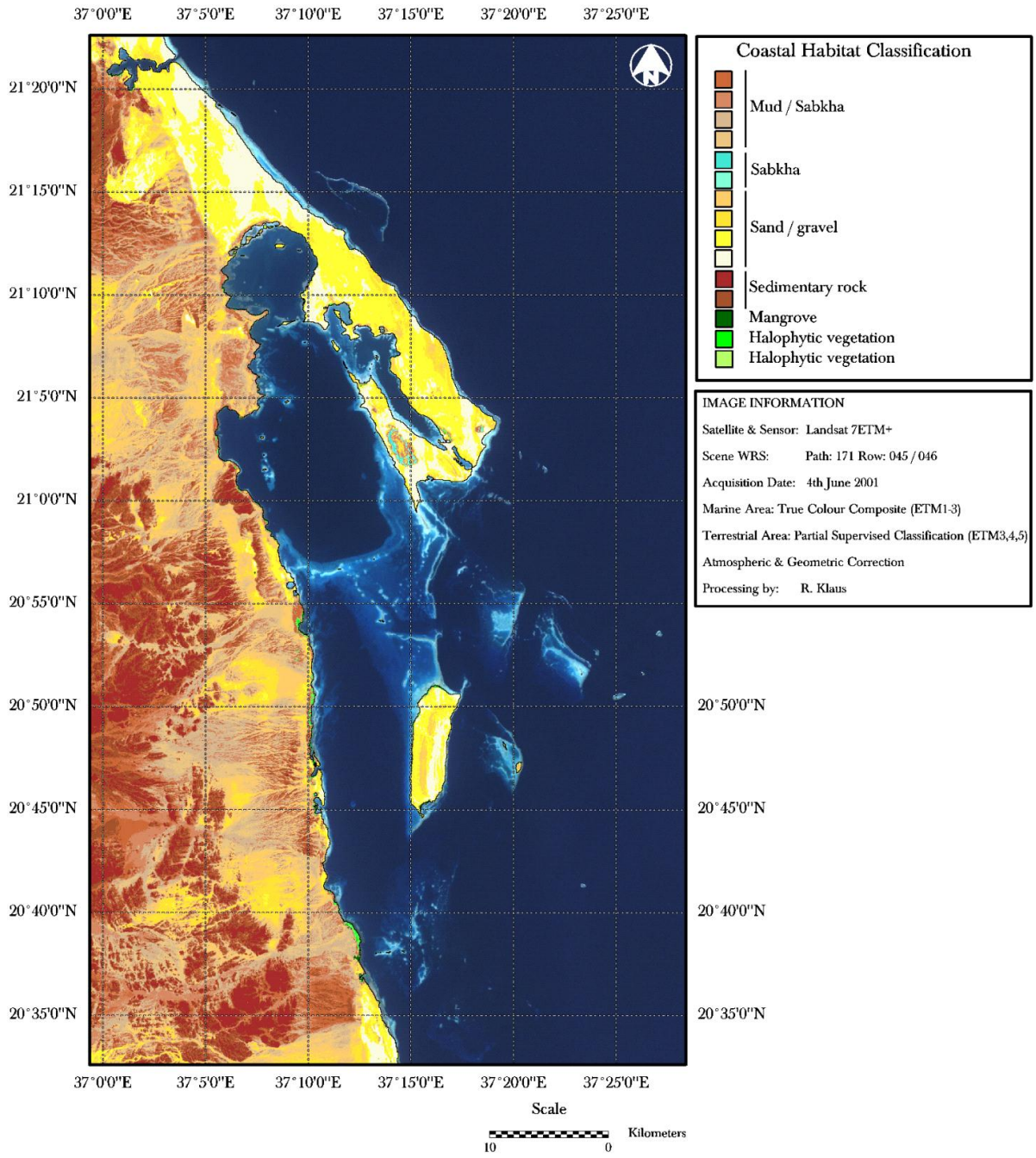


Figure 3: Coastal habitats of DMNP

Table 3: The total area of each marine biotope mapped by Landsat 7ETM+; each biotope as a proportion of the total area mapped (2745.46 km^2) and of the total area mapped excluding deep water classes (143.56 km^2); the cluster groupings identified from cluster and SIMPER analysis.

Marine Biotope Classification	Area (km^2)	Percent of Total Area Mapped	Percent of Total Area (excl. deep water)	Cluster Groups
Water (3 classes)	2601.766			na
Sand and carbonate rock (6 classes)	56.17	2.05	39.09	5, 12, 13
Carbonate platform	9.54	0.35	6.64	16
Silt	5.8	0.21	4.04	1
Seagrass (<50%) on sand / silt	6.1	0.22	4.25	2, 3, 6, 7, 8
Seagrass (>50%) on sand / silt	5.54	0.20	3.86	4, 7
Macroalgae (<10%) on sand / carbonate platform	4.19	0.15	2.92	17, 20
Macroalgae (10-50%) on sand / carbonate platform	6.06	0.22	4.22	18
Macroalgae (>50%) on sand / carbonate platform	6.29	0.23	4.38	9, 19
Sohal lawn	1.79	0.07	1.25	
Reef flat (coralline algae and sparse corals)	6.44	0.23	4.48	15
Reef flat (sparse *Acropora* and *Pocillopora*)	10.50	0.38	7.31	10, 14
Massive coral community (<10%) on sand (*Porites*)	4.73	0.17	3.29	11
Reef slope (*Acropora* / *Stylophora*) dominated	5.11	0.19	3.56	21, 22
Reef slope (*Porites* / *Galaxea*) dominated	5.67	0.21	3.95	23, 24,
Reef slope (*Porites* / *Stylophora* dominated)	7.05	0.26	4.91	25, 26
Reef slope (mixed encrusting corals and soft coral)	2.71	0.10	1.89	27
Total Area Marine Biotopes (excluding deep water)	**143.69**			
Total Area Marine Biotopes Mapped	**2745.46**			

Coral communities

A total of eight broad coral biotopes were identified and mapped in the satellite image. Figure 4 is a map of the combined areas for all the coral biotopes. The total area of coral habitats estimated from the Landsat 7ETM+ image is 43.96 km^2. Of this, 'sparse' coral habitats, where cover is ~10% (generally either on the reef flats, on sand or carbonate rock) cover 21.67 km^2, and 'dense' coral habitats cover an estimated 22.29 km^2 (this category generally consists of the combined area of the different coral communities on reef slopes). These figures will be a significant underestimate as many of the reefs, especially around the outer islands, were so steep that their slopes were not visible on the satellite image, which is a vertical view.

A very broad range of coral community types is present in the property. Within Dungonab Bay the three main coral communities recorded were those of the western shore; the western islands including Umm-ar Sheikh; the northern shore and Khor Naitaib. Each of these areas is different from the others, but all had a very healthy and high cover of corals (Figure 5). Outside the Bay coral communities are more typical of the northern and central Red Sea. Apart from the area immediately around Mohamed Qol (where monospecific *Galaxea* communities were found) monospecific coral communities were not recorded.

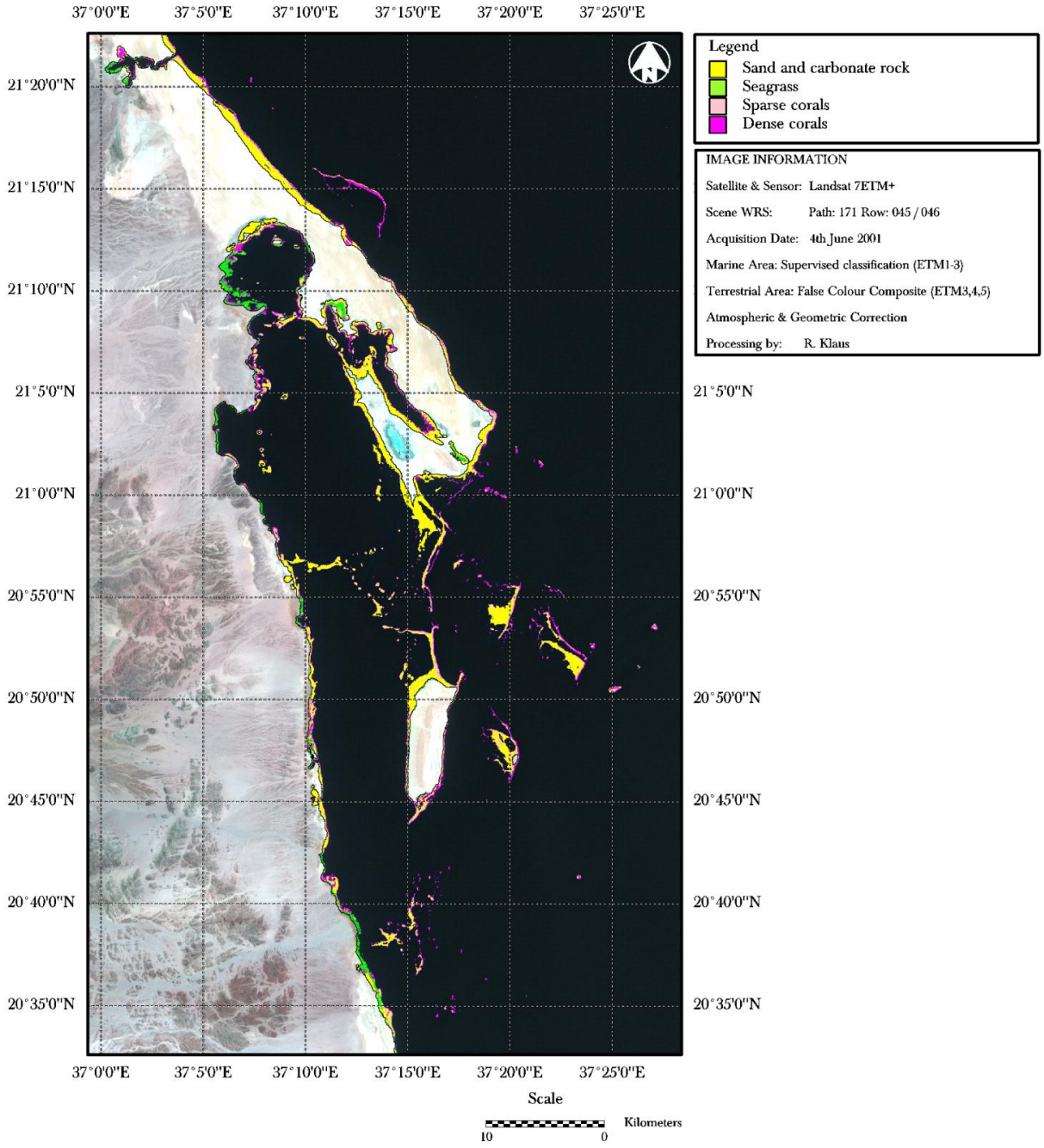


Figure 4: Distribution of coral habitat within Dungonab Bay: Dense coral habitat (bright pink) indicates areas dominated by corals. Pale pink indicates areas where corals are associated with other e. g. macroalgae or turf algae. Yellow indicates back reef or reef flats areas of sand and carbonate platforms.

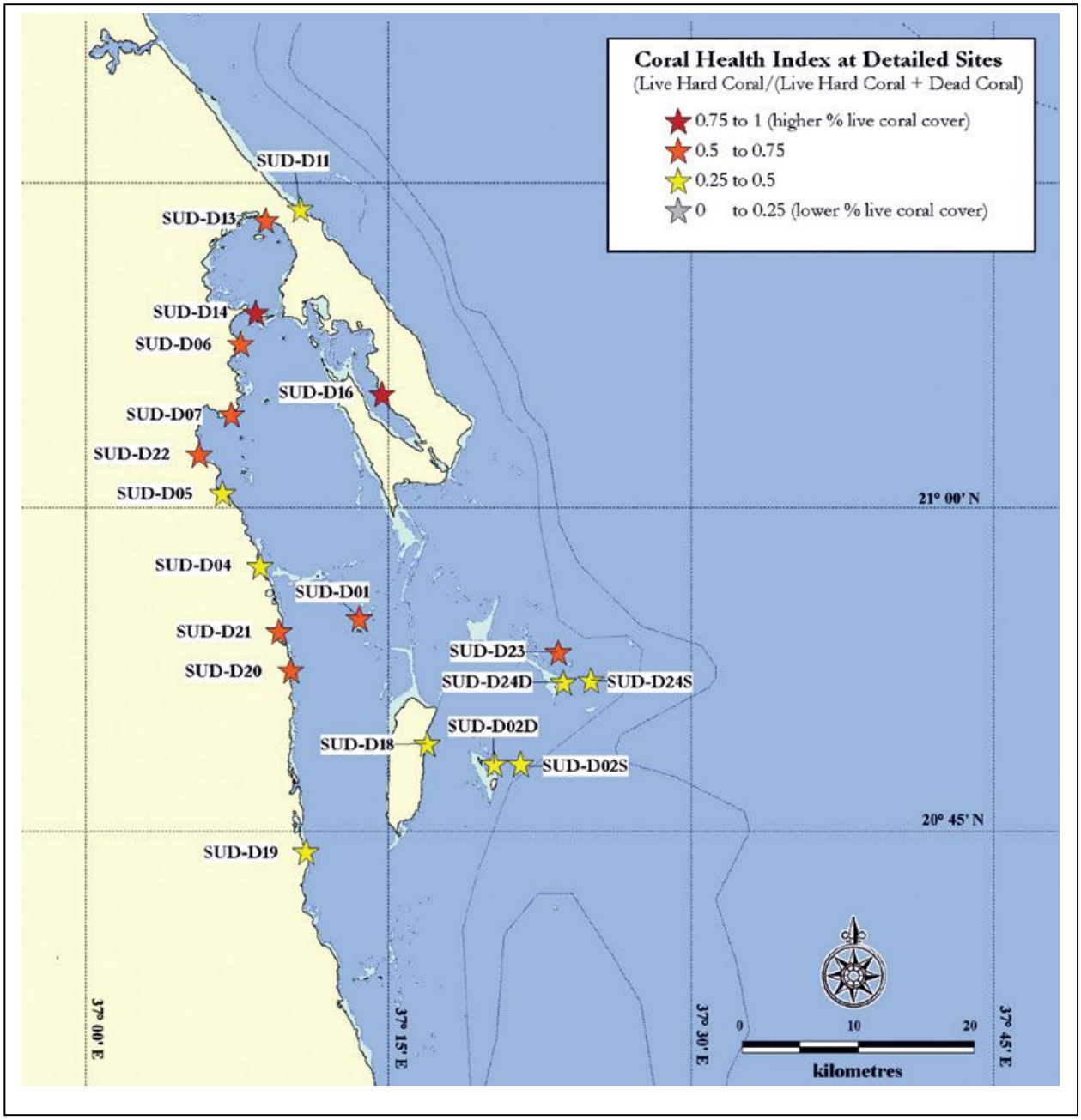


Figure 5: Coral health indices (cover of live coral/total cover of live and dead coral) in the Dungonab Bay–Mukkawar Island MPA in 2002 (source: PERSGA/GEF 2004f).

Seagrasses

Seagrasses are very widespread throughout the property. Seven species of seagrass were recorded *(Thalassia* sp., *Thalassodendron* sp., *Halophila stipulacea, H. ovalis, Halodule uninervis, Cymodocea* sp., *Enhalus sp.).* However, in a recent study (Gaiballa, 2013) has further identified *Thalassia hemprichi, Cymodocea rotundata,* and *Syringodium isoetifolium* in Dungonab Bay.

The total area of seagrass estimated from Landsat 7ETM image is 11.68 km^2; a very substantial area (Figure 6). The extensive seagrass beds are a nationally and regionally important feature of the Dungonab Bay – Mukkawar Island area, particularly given the probably substantial population of globally endangered dugong found here.

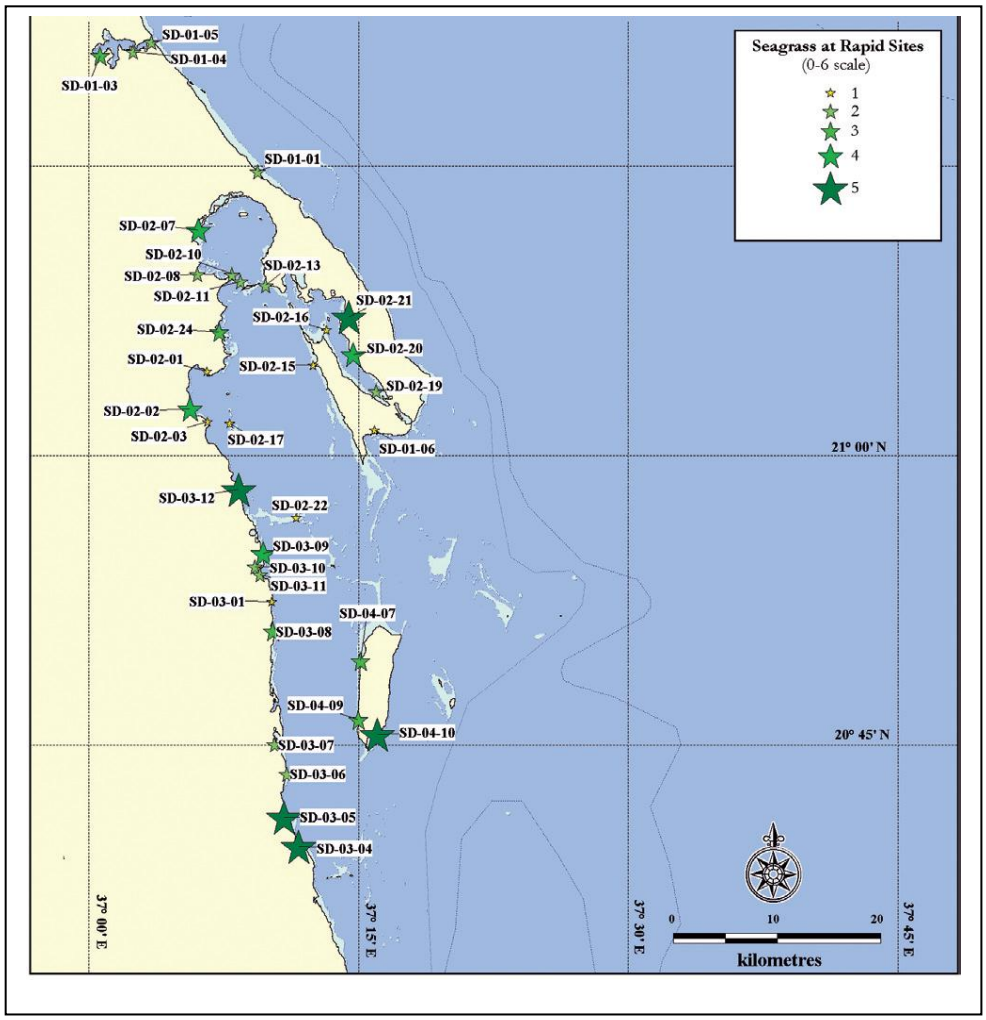


Figure 6: The distribution and relative abundance of seagrass around Dungonab Bay and Mukkawar Island.

Mangroves

Mangroves are found in three substantial areas: - At the southern tip the Dungonab Peninsula, - At the southern end of Mukkawar Island, - On the mainland coast at Mersa Inkefal (Figure 7).Total area of mangrove growing within the property, as estimated from the coastal habitat maps is 0.782 km^2. The mangroves of the property are generally in good condition. Camel grazing is a factor at all the mainland sites, and may be limiting their further expansion. The mangrove at the southern end of the Dungonab Peninsula is subject to cutting, probably for animal fodder and/or firewood for the salt works.Although this activity is moderately severe is being addressed in the Action Plan (Appendix. 11).

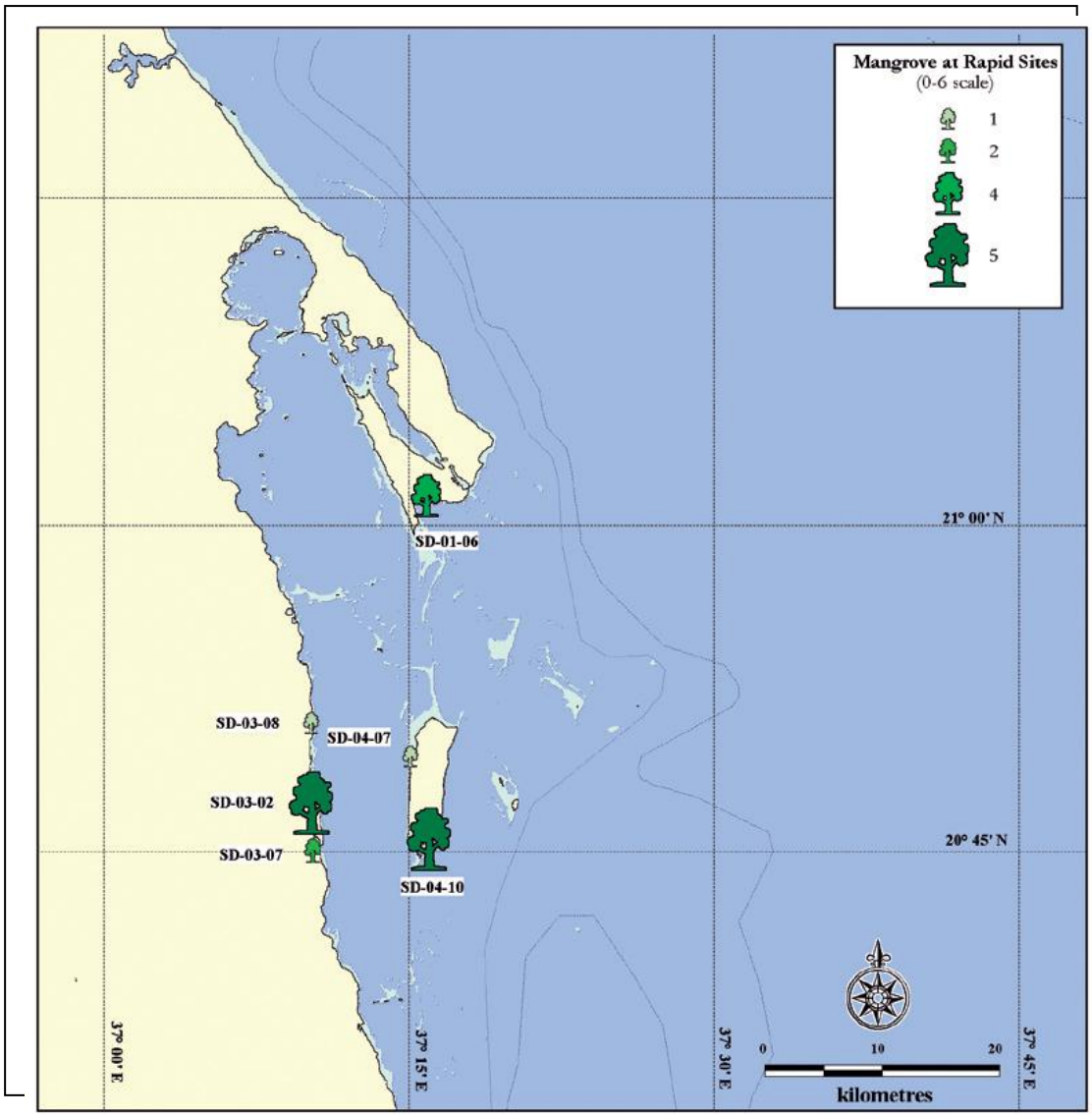


Figure 7: The distribution and relative abundance of mangroves around Dungonab Bay and Mukkawar Island, Sudan (source: PERSGA/GEF 2004f).

Plate10: Well developed, extensive and healthy mangrove, *Avicennia marina*, at the southern end of Dungonab Peninsula.

Fish communities

Fin fisheries

The fin fisheries of the area are typical of tropical reef fisheries in that they are multispecies in the extreme, although there are favored or more highly valued species which are preferentially targeted. The partially complete species list given below (Table 4) identifies over 25species or species groups that are important for the local fishery, from over 20 families. Highly multi-species fisheries such as this are notoriously difficult to manage for long term sustainability and maintenance of biodiversity.

Table 4: Partially complete species list of fin fisheries of Dungonab Bay.

Scientific Name	**English Name (World Fish Center)**	**Local Name**
Let hrinus fletus (Lethrinus laticaudis)	Grass emperor	Sha'oor
Epinephelus areolatus	Areolate grouper	Goushar
Caranx spp.	Trevally	Bayad
Plectropomus maculates	Spotted coral grouper, coral trout	Najil
Aprion virescens	Green jobfish	Farisi
Mugil spp.	Mullet	Arabi
Sardinella melanura	Black-tipped sardine	Sardine
Lutjanus bohar	Twospot red snapper	Bahar
Lutjanus gibbus	Humpback red snapper	Asmoot
Siganus lineatus	Golden-lined spine foot	Sigan
Argyrops spinifer	King soldier bream	Fofal
Cheilinus undulates	Humphead wrasse	Abu Jibba
Atule mate (Selar afinis)	Yellowtail scad	Habbot
Variola louti	Yellow-edged lyretail, Coronation Grouper	Rishal
Naso unicornis	Bluespine unicornfish	Abo grain
Chlorurus sp.	Parrotfish	Haread
Chanos chanos	Milkfish	Salamani
Pristipomoides filamentosus	Crimson jobfish, Pink snapper	Korape

Scientific Name	**English Name (World Fish Center)**	**Local Name**
Pomadasys opercularis (P. commersonnii)	Small- spotted grunter	Ka'koi
Acanthurus gahhm	Black surgeonfish	Gaham
Sargocentron rubrum (Holocent rum rubrum)	Redcoat, (soldier fish)	Jajaloorn
Acanthopagrus bifasciatus	Twobar seabream	Abo kohol
Albula vulpes	Bonefish	Bunji
Balistoides viridescens	Titan triggerfish	Faki Sharam
Ostracion cubicus (Ostracion argus)	Yellow boxfish	Abo Sandog
Sphyraena jello	Pick-handle barracuda	Agous
Leiognathus sp.	Pony fish	Eryan

Large scale patterns in fish community structure

At the largest scale, within the survey area a striking difference in the fish communities inside and outside the Bay is apparent. This difference resembles biogeographic differences more usually associated with distances of several hundred kilometers (Figure 8b). This finding is in agreement with the observations of Vine and Vine (1980) that *Chaetodon larvatus* is particularly abundant on reefs inside the Bay but not outside.

Figure 8a shows the results of a cluster analysis of the butterfly fish and angelfish survey data from the Dungonab Bay and Mukkawar Island survey, combined with survey data collected using identical survey methods in other regions throughout the Red Sea and Gulf of Aden by J. Kemp between 1996 and 1998. This illustrates the well known biogeographic division of the Red Sea from the Gulf of Aden (Klausewitz 1972, 1989, Blum 1989, Sheppard *et al*. 1992) and the internal division of the Red Sea into north-central and southern biogeographic regions (Winterbottom 1985; Roberts *et al* 1992).

The striking feature of this analysis is that the butterfly fish and angelfish communities inside Dungonab Bay are firmly within the southern Red Sea group, characteristic of Yemen and central Eritrea several hundred kilometers to the south, while those communities outside the Bay are very much north-central Red Sea communities. So pronounced is this difference that the Bay communities are more similar to those of the Gulf of Aden, over 1000 km away, than they are to those at local sites outside the bay, less than 10 km away.

This result is consistent for both abundance and presence-absence (P/A) data. A similar analysis cannot be carried out for the other four families of fish, because the wider geographic dataset is not comparable for these families.

The observations of Vine and Vine (1980) and the consistency of this result for both abundance and P/A data confirm that this result is not due to the differences in coral health.

Kemp (2000) commented on similar, although less pronounced, local differences in fish community structure in the Gulf of Aden, attributing them to localized differences in environmental conditions, particularly water quality. The differences in water quality and other environmental conditions (temperature, turbidity) inside and outside the Bay are likely explanations for this exceptional pattern.

This feature emphasizes the importance of the area for marine biodiversity conservation: the Dungonab Bay – Mukkawar Island area encompasses a variety of fish communities and coral communities more usually separated by several hundred kilometers.

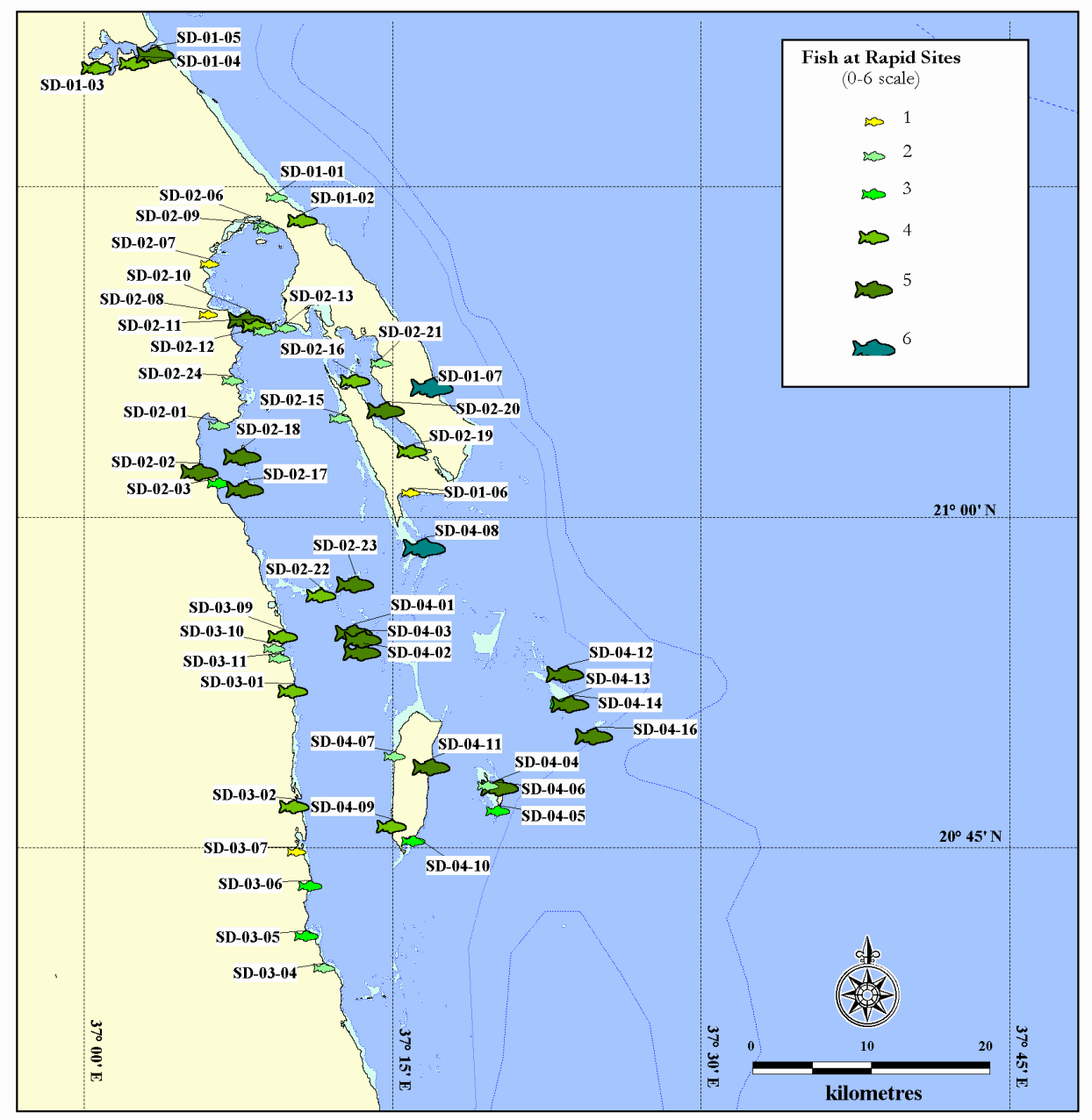


Figure 8 a : Relative fish abundance at Rapid Survey Sites; the wide distribution of abundant and diverse fish communities both inside and outside Dungonab Bay is clear from this figure.

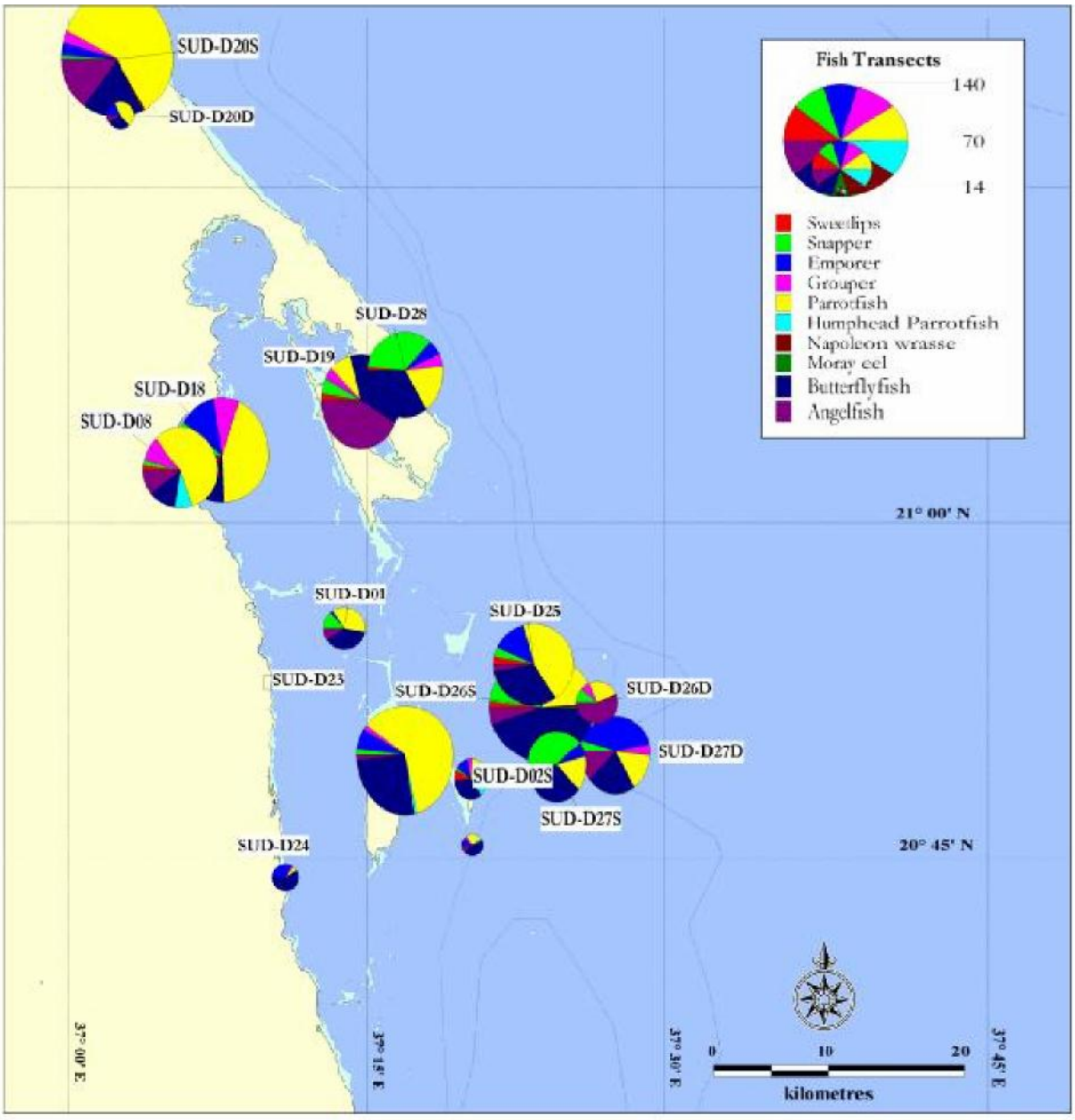


Figure 8 b: The relative abundance and distribution of fish from transects, as surveyed by the Reef Check Belt Transect method

Sharks and rays

Very few sharks were observed in the survey area. A number of small reef sharks (blacktip Reef shark, *Carcharhinus melanopterus)* were seen at several sites, most notably on the western side of Mukkawar Island and at site SUD/02/17 inside Dungonab Bay. Hammerhead sharks *(Sphyrna* sp.) were seen at the offshore reef at site SUD/04/1 6. At this and other deep reef drop-off sites these and other sharks should be common. Shark fishing however is apparently a common occurrence in the survey area, usually carried out by fishermen from Port Sudan or elsewhere (including occasional visitors from outside Sudan). Sharks were observed within the catch landed at Mohammed Qol and evidence of shark fishing was observed at a number of locations, including the sheltered anchorage of Mersa Inkefal. Shark fishing can severely deplete shark populations at such sites very rapidly.

The Dungonab Bay-Mukkawar area is well known as an area where whale sharks *(Rhyncodon typus)* and manta rays *(Manta birostris)* aggregate (Sheppard and Wells 1988). None were observed during the survey period, probably because the survey did not coincide with the aggregation period, reported to be over the summer months. Sharks are one of the most noteworthy attractions for high value international SCUBA diving tourism, adding to the already considerable potential that the deep water reefs of Sudan have for development of SCUBA diving tourism

Turtles

The entire area, particularly the islands and the Dungonab Peninsula, is regionally significant for nesting turtles. From the range of different egg sizes (assessed on the basis of old, empty shells) at least three species of turtle nest within the property.

The eastern shore of Mukkawar Island is one of the most important turtle nesting sites in the entire Red Sea region. Although unrecorded up to now this site is of at least regional (possibly global) conservation significance, and merits immediate protection and the application of a rigorous monitoring programme.

There is no deliberate capture of adult turtles in the property. Turtles caught accidentally in fishing nets are generally released unharmed if they have not already drowned; it is believed that this will bring good luck to the fisherman concerned. Turtle eggs are occasionally taken as food by local people, but this is a small scale activity at subsistence or opportunistic level and no trade or exchange in eggs takes place. It appears that the attitude of the local fishers towards turtles may be conducive to the adoption of a community-based monitoring and management programme.

Both green turtles *(Chelonia mydas)* and hawksbill turtles *(Eretmochelys imbricata)* were observed in the water throughout the area. Large numbers of green turtles were observed in the very extensive shallow areas of reef flat and sand at the northern end of Mukkawar Island.

This may be an area where green turtles gather during the day, waiting for nightfall when nesting takes place on the beaches of the island immediately to the south. Hawksbill turtles were particularly noticeable at the extreme northern end of Dungonab Bay.

The importance of Mukkawar Island as a turtle nesting site

The extensive sandy beaches on the eastern side of Mukkawar are a mass turtle nesting site of regional or perhaps even global significance (Figure 9). This importance has not previously been recognized. At site SUD/04/1 1 a total of 409 nest pits were counted along 800 m of beach (distance measured using a hand-held GPS). This represented less than half the total length of the beach. The beach is only one of several along that shore of the island. A cursory examination indicated that all or most beaches on this side of the island are likely to be similarly important for turtle nesting, with a total of perhaps several thousand nest pits along this 8-10 km stretch offshore.

Plate 11: View of one of the main turtle nesting beaches on Mukawwar Island.

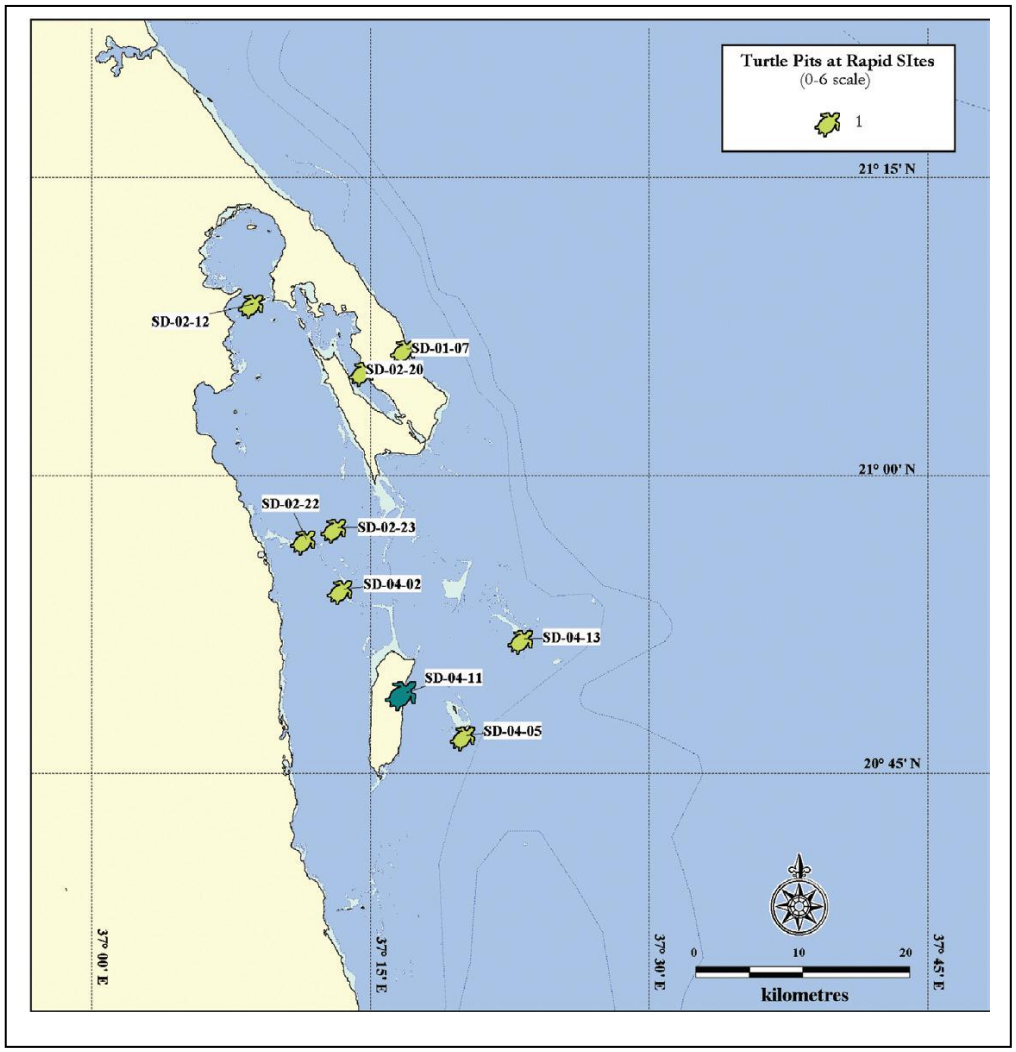


Figure 9: Distribution and abundance of turtle nesting pits in 2002 in Mukkawar Island and Dungonab Bay (source: PER SGA/GEF 2004f)

Plate12: Hawksbill marine turtle in DMNP.

Birds

The entire area is very significant for birds, and internationally recognized as an Important Bird Area (IBA) (Fishpool and Evans 2001). Every island visited during (PERSGA 2004) survey, from the largest to the smallest, was a nesting site for at least one, and more usually two, species of birds at the time of the survey (Figure10). Only two or three species were seen nesting during the survey phase (one or two species of tern, *Sterna* spp, and osprey *Pandion haliaetus)*.

The African Park Foundation Survey in 2006 has observed 20 bird species in Dungonab area. Two species, the bridle tern and the crab plover, were nesting in significant numbers. The crab plover *Dromas ardeola* is only found in the Red Sea and East Africa (A.P. Survey Exp. 2006). Several large and charismatic species were observed including the Goliath heron, spoonbills, flamingos and a number of Sooty Falcon. These summer 2006 records are in addition to those of winter 2002, which included vultures, pelicans and abundant Osprey.

Accounts from the village communities of Dungonab and Mohamed Qol indicate that all islands and mangrove areas are of great importance for nesting by numerous species at other times of the year. The peak nesting time is apparently the summer. Dozens of occupied osprey nests were recorded during the survey, with up to ten osprey nests (about 25-30% occupied) counted on some of the smaller islands. The occurrence of occupied osprey nests on flat and easily accessible areas of the mainland shore within 500 m of the larger villages provides an indication of the positive attitude of the local communities towards the environment.

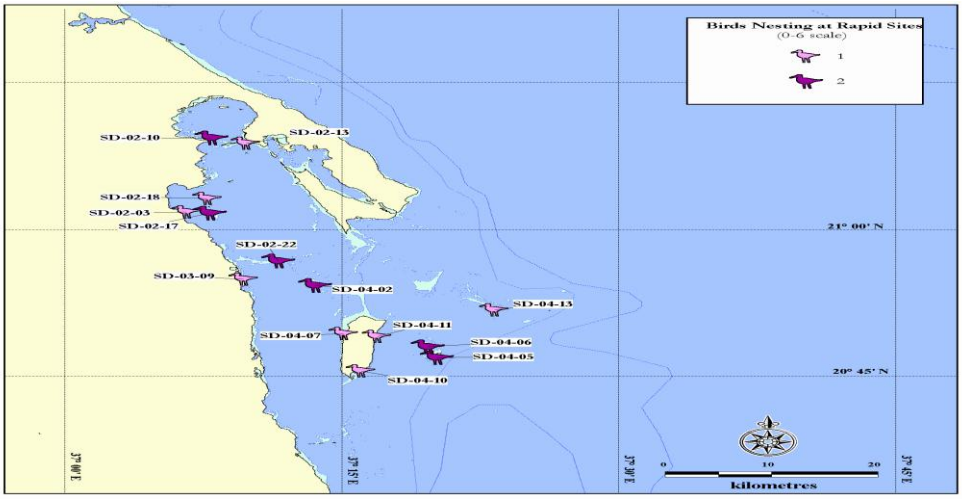


Figure 10: The distribution of nesting birds at Rapid Site surveys in January - February 2002. The seasonal nature of bird nesting means that this is not an exhaustive account.

Plate13: Rich bird life in DMNP.

Marine mammals

Dugong

The dugong *(Dugon dugon)* is a globally threatened species, with the Red Sea and Arabian Gulf being home to the last remaining healthy populations in the western Indian Ocean region. Three dugong sightings were made during the field survey, at three locations:

- Site SUD/02/01 (northern Dungonab Bay),
- Site SUD/03/05 (mainland coast to the north of Sheikh Okod),
- Site SUD/04/10 (southern Mukkawar mangroves).

This is a very large number of sightings, given the extremely shy nature of dugongs and the survey duration. The common occurrence of dugong throughout the survey area, as well as to both the north and south of the survey area was confirmed on numerous occasions by local fishers. The fishing communities of both Mohamed Qol and Dungonab indicated that the number of dugong (as represented by the frequency and distribution of their own sightings) is falling rapidly. This was blamed on their regular but accidental capture and the consequent drowning of dugong in fixed fishing nets. The number of sightings during the survey and the accounts of local fishing communities suggest that the property may be home to a globally significant dugong population. The very extensive areas of seagrass present will be a crucial factor in this, dugong being herbivores dependent upon seagrasses for their food.

Local fishers described the distribution of dugong as extending throughout the entire survey area and beyond, including Khor Shinaab. Regular sightings were said to occur throughout Dungonab Bay, along the mainland shore to the north and south of the Bay (but more frequently to the south), at Mukkawar and in the extensive shallow areas around the offshore reefs. Particular mention was made of concentrations of dugong in the northern Bay, in the area to the north and south of Sheikh Okod, and around Magarsam (Mukkawar).

Dolphins

The survey area is home to at least two species of dolphin. These are bottlenose dolphins *(Tursiops truncatus)* and common dolphins *(Delphinus delphis).* Both species were seen most frequently outside the Bay. Common dolphins were seen only at Shambaya reef where they are apparently resident year-round, having been seen over several years by local boat users from the commercial pearl farm. Only one pair of dolphins, probably a female bottlenose with calf, was seen inside Dungonab Bay, mid-way between Rapid Sites SUD/02/17 and SUD/02/18. There is apparently no deliberate fishing of dolphins, although they are occasionally caught accidentally.

2. a. 3 The buffer zone

The coastline(Map 8) lies in an area which has resulted from plate tectonic process passed through dynamic changes and deposition. Due to the natural, geological and ecological connectedness and functionally linked by open flow and exchange along the coast, the habitats, flora and fauna of this area are no different from those of the two parks. The area comprise of a coastal stretch with a variety of habitats including intertidal flats, inlets, bays, mangroves, seagrass beds, rocky shores and coral reefs.

Most of the coast is bordered by discontinuous fringing reef 1-3 km wide, separated by deep channels from a barrier reef 1-14 km wide. The outer barrier reef drops steeply to several hundred meters depth. Beside the fringing reef, a conspicuous reef formation is found at Shuab Rumi north of Sanganeb Atoll. Shuab Rumi reef is well known for the fascinating underwater life in the reef comprising of coral and fish fauna. The reef is famous for sharks, barracudas and fancy fish.

Several reef features could contribute to a more complete representation of the biodiversity of the property and efforts will be made in the future to select and evaluate potential sites for declaration as protected areas and eventual inclusion in the world heritage property as part of an extension nomination. Currently two reefs are in fact in the process of being declared protected areas.

The major mersas (Going south from Dungonab Bay to PortSudan) are Mersa Mohamed Qol (20° 47□ N,37° 10□ E), Mersa Arakyai (20° 18□ N), Mersa Arus (20° 00□ N), Mersa Darur (19° 50□ N), Mersa Halut (19° 48□ N) and Mersa Waiai (19° 45□ N). Mersas Mohamed Qol, Arakyai and Arus stand as natural harbors, touristic and fish landing areas while the others mersas are small fish landing areas.

A typical profile of the coast is that several lagoons are fringed by small mangrove stands. Seagrass beds are frequently found in the shallow waters of mersas and in lagoons between the coast and the fringing reef. Various soft-bottom habitats are dwelled by shorebirds and shore crabs. Mangroves and mersas are breeding and feeding grounds for several fish and shrimp species.

Gaiballa (2013) has recorded seven species of seagrass from four sites along this coastline. He also encountered 47 epibenthic macroinvertebrate species belonging to seven faunal groups and 33 families. The highest abundance of invertebrates was recorded for Echinoderms and the lowest

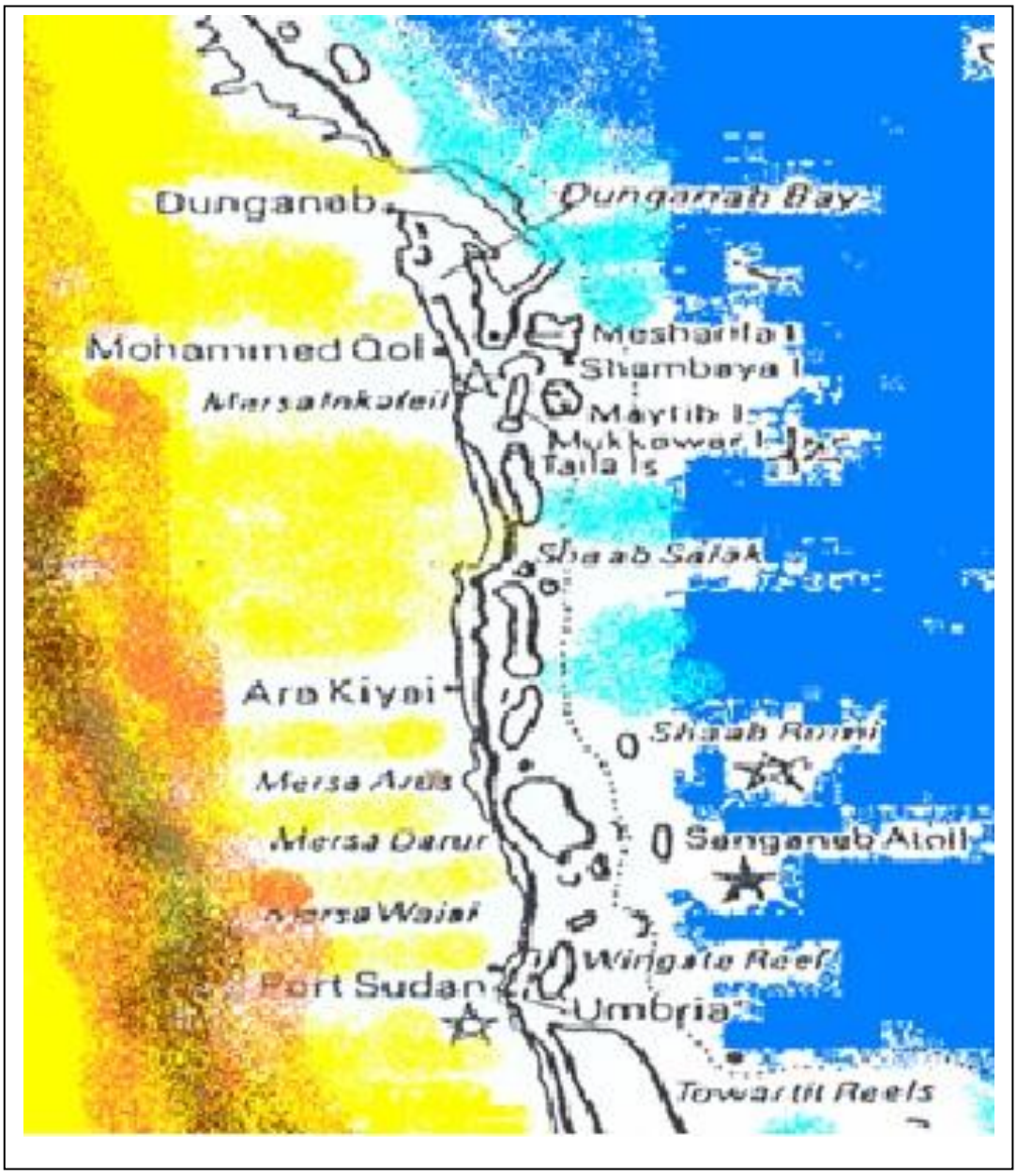
was Cephalopoda. However, Echinoderms and Gastropods amounted to 57% of the total abundance and encountered species.

80 fish species belonging to 34 families and 10 orders were recorded from this coastline. The dominant order is Perciformes (55 species) and the least is Torpediniformes (Gaiballa 2013). *Sardinella sp.* is abundant in both sea*gr*ass meadows and mangroves (Reed 1964, Ormond 1980 b).

Coral reefs in particular support a high fish diversity as in the two National Parks. Marine fishery and traditional aquaculture are of great economic and cultural value. Tourism in the area is at its infancy and Scuba diving is the only current significant practice.

The terrestrial part of the buffer zone at Dungonab area comprises mainly halophyte *Suaeda sp*. and the *zygophyllum sp.*which grew in sandy areas and sabkhas above the high water mark.

The coastline is under the threats of land-based developmental activities. Fish and shrimp farming, power plants and tourist resorts are some of the anticipated major changes in the land-use. The coastline includes a variety of biotopes of great basic and problem-oriented research potential as little is known about the status of the resource exploitation.



Map 8: The buffer zone(The area in-between the two Parks).

2. b History and Development

2. b. 1 SMNP (Map in Appedix 6)

Sanganeb Atoll is believed to originate from a longitudinal ridge lying along the axis of the Red Sea, and probably has resulted from a combination of normal faulting from the progressive opening of the Red Sea and of upward movement of underlying salt deposits (diapirs) along these faults. After rifting and salt deposit uplift, a ring of reef has resulted from progressive subsidence over a long period. However, Guilcher (1988) pointed out that Sanganeb Atoll could equally well be formed from upward growth of reef from the pre-Holocene reef substrate. Thus Sanganeb Atoll becomes a perfect site for further research on ridge reef and atoll formation.

Lighthouse and Shipwrecks

Sanganeb Atoll has been used as a safe anchorage for many thousands of years, probably from the earliest navigation of the Red Sea. It is therefore likely that there is significant marine archaeology in and around the reef. A dedicated search of the lagoon and the deeper reef slopes should be encouraged if the opportunity should arise.

The lighthouse at Sanganeb Atoll is a historic building and is an important part of Sudan's maritime heritage (Plate 14). Construction of the modern lighthouse was started in 1950, but there was a structure present at this site from at least 1907. It also offers visitors a unique opportunity to view Sanganeb Atoll from a spectacular vantage point, and gives Park rangers an excellent point from which to observe activities within the Park's boundaries.

Two significant shipwrecks are present within the property. The first is of a coastal dhow that struck the outer reef over 20 years ago and the other is of a luxury yacht that sank in the lagoon after years of neglect. Both are features of interest, particularly the luxury yacht, 'The White Elephant' since it was once owned by Elizabeth Taylor. Both should therefore be preserved for the benefit of future visitors.

Plate 14: View of Sanganeb lighthouse from the northern jetty

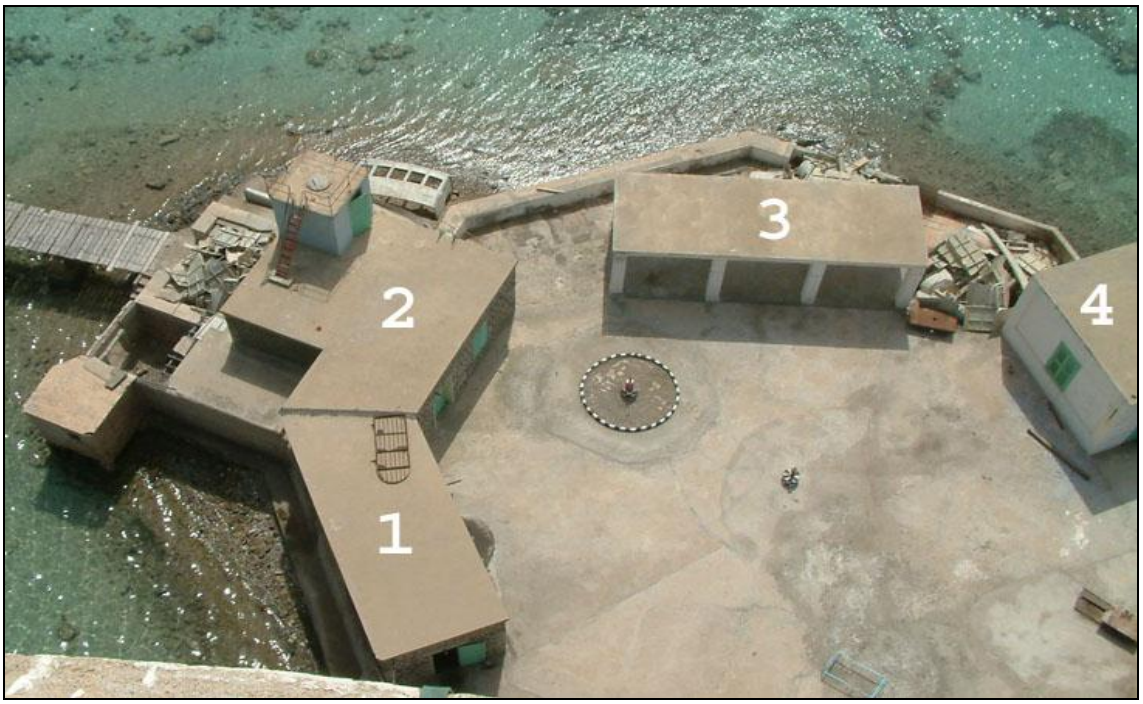


Plate 15: View of the generator room (1), Red Sea University research room/visitor centre (2), shaded area (3) and storeroom (4) at the lighthouse complex. Scrap aluminum recovered from the wreck of the White Elephant is scattered behind the storeroom.

Plate 16: The existing small, reclaimed area along the northern jetty offers a good opportunity to increase the beach area available for day-trippers.

SMNP is a good example (perhaps the best in the entire region) of the deep-water offshore reefs of the central Red Sea. It is considered to be within the Red Sea's centre of biodiversity. It has been regarded as an important area by marine biologists since at least the 1970s and was first identified as a viable World Heritage Site as early as the 1980s. During the World Heritage Marine Biodiversity Workshop (Vietnam, 2002) the MPA was identified by the attending international experts as an area displaying 'significant components of Outstanding Universal Value' (Hillary, Kokkonen and Max, Proceedings of the World Heritage Marine Biodiversity Workshop: Hanoi, Vietnam, February 25-March 1, 2002, World Heritage Paper No.4). Furthermore, the Atoll lies within one of two Ramsar sites identified along the Sudanese coast (UNEP, Post-Conflict Environmental Assessment, 2007).

Sanganeb Marine National Park (SMNP) was the first marine protected area (MPA) to be declared by Sudan (Appendix 6). As the only genuine atoll in the Red Sea, it is a regionally unique, geological structure. The Atoll is entirely submerged, with the Sanganeb lighthouse (Plate 14) and its few surrounding buildings being the only part of SMNP to occur above the sea's surface (Plates 15 and 16).

The government of Sudan, in recognition of its unique natural marine heritage, has established two nationally and internationally important flagship Marine National Parks to help protect and sustainably manage Sudan's marine resources. The Parks, (SMNP) and (DMNP), were gazette by official decree in 1990 and 2004 respectively.

As National Parks, both SMNP and DMNP fall under the overriding jurisdiction of the Federal Government. However, the Central Government designates and defines the involvement of the different State-level Ministries through the Interim National Constitution (2005), Part 13, Chapter II: 'rights in land owned by the government of Sudan shall be exercised through the appropriate or designated level of government'. The Red Sea State, therefore, has authority over certain decision-making regarding the Parks, especially in terms of basic management issues enforcement, development and land-use and day-to-day issues.

Most recently, African Parks Foundation (APF) was invited by the GoS to take primary management responsibility for the Parks and to work with the Sudanese Wildlife Conservation General Administration (WCGA) accordingly. APF signed a partnership agreement with the WCGA for the management and rehabilitation of DMNP and SMNP in 2005, and subsequently assumed full management responsibility over the Parks in July of the same year. APF and Sudan are currently negotiating the terms of a new 20-year Agreement.

2. b. 2 DMNP (Map in Appendix 7)

The region of DMNP belongs to the Nubian segment of the Arabian-Nubian shield, and underlined by volcano-sedimentary sequences into which granitoid batholiths have been intruded. The basement complex , comprising the Red Sea hills, is characteristically a series of volcanic structure separated by basement rock formation. The period of 30-110 thousand years BP saw at least eight periods, when sea level 30-60m below present level, and reef accretion proceeded vigorously. The alternating episodes of submergence and renewed growth, and of erosion, had a substantial shaping effect and significance to reef distribution, thickness and lateral extent (Behairy *et al* 1992).

The fame of Dungonab Bay is attributed to the pioneering marine biologist Cyril Crossland who stayed in the area from 1904 to 1922. He was able to carry out appreciable biological work including biological characteristics of the pearl oyster, *Pinctada margaritifera*, as well as the physical oceanography of Dungonab Bay which led to the creation of a viable farming system of this species.

It should be noted that the only successful attempt to cultivate pearl oysters on a commercial scale, for the value of their nacre, was made at Dungonab Bay by Crossland until 1922 (Vine & Schmidt, 1987). His work was followed up later by Bill Reed Who helped to re-start the scheme managing it from 1958 to 1964.

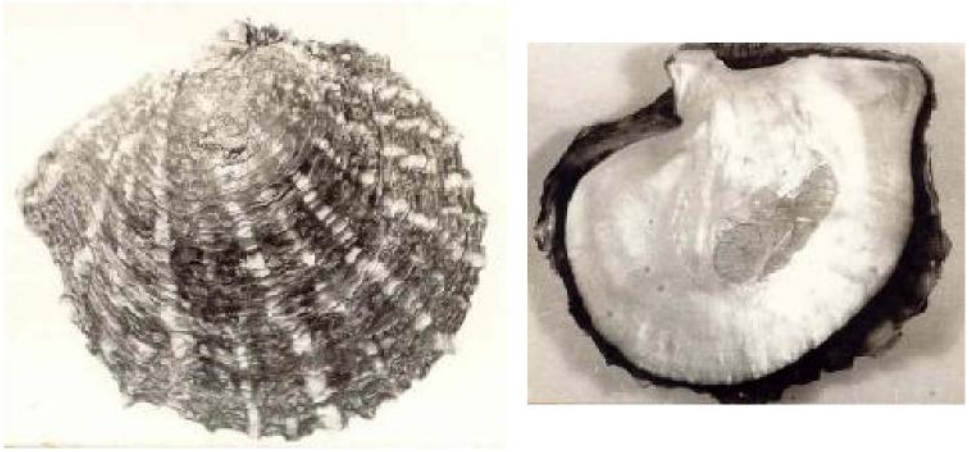


Figure 11: The outer and the inner shell of *Pinctada margaritifera*

The Dungonab Black-lip-Mother of pearl oyster, *Pinctada margaritifera*, (Figure 11) is a species which produces very few natural pearls. However, this species is successfully used in pearl farming which is carried out by inserting nuclei (usually half spherical plastic beads) into the living mantle of the oyster. In early stages of the farming system the abundance of naturally collected spat has permitted the farming of the shell themselves. Later, however, spat collectors, consisting of floating bundles of split bamboos (Figure 12), are set in the bay during July (the oyster spawning season). They are set so that the lowest part is at least 5 meters above the sea-bed in order to avoid the effects of siltation which discourages spat settlement. By late October they almost cover the bamboos and collectors are lifted, dismantled and spat transferred to trays for growing.

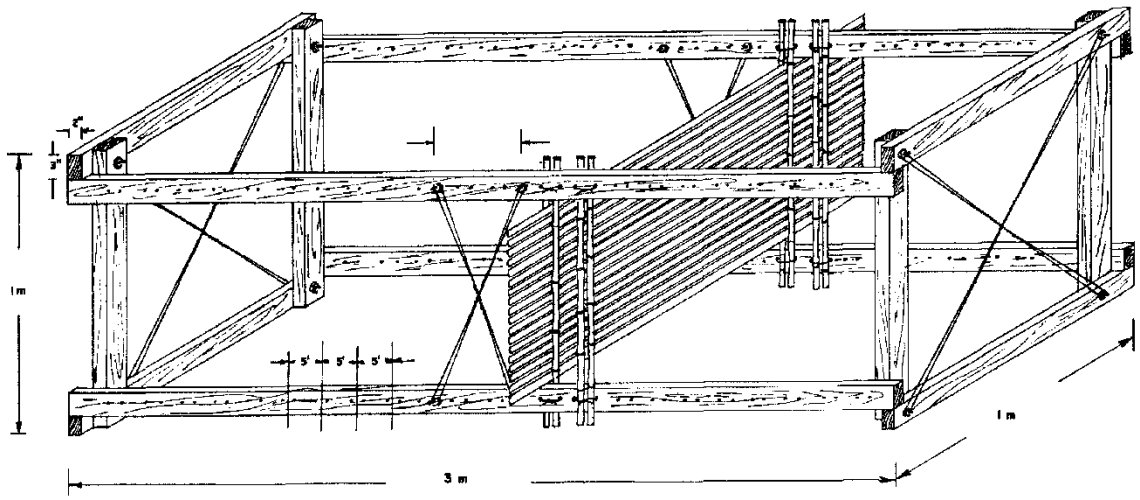


Figure 12: The spat collector

In the light of Dungonab Bay history and previous scientific research work Dungonab Bay/Mukkawar Island has been proposed Marine Protected Area by the GEF funded Strategic Action Programme for the Red Sea and Gulf of Aden executed by PERSGA. Two surveys followed this proposal: the PERSGA surveys which provided information on the spatial distribution and extent of habitats (coral communities, seagrasses, soft sediment and rocky shores, sabkha, and mangrove); the condition of benthic communities and associated fish assemblages; and the distribution of sea turtles and marine mammals and seabirds. Subsequently Draft Management Plans for both SMNP (Appendix 6) and DMNP (Appendix 7) have been developed

by PERSGA which provide a comprehensive first step towards the successful management of the two Parks. The African Parks Foundation took over the management of the SMNP and DMNP in 2005 and in 2006 carried out a research and survey expedition to the Parks.

2. b. 3 The buffer zone

The coastal waters of this area remained an important artisanal fishery source for the local communities. Mersas and inlets secured fish landing sites and shelter for the boats. The mersas and associated mangrove stands are the habitats for traditional shrimp and fish catching. There was very little developmental activity along this coast and remained undisturbed area for passage and wintering of shore birds, gulls and turns.

To the north of Sanganeb Atoll, Shuab Rumi is a prominent off-shore reef which gained fame when Jacques Cousteau built his "Underwater Garage". Ever since, Shuab Rumi has become a favorite site for underwater enthusiasts, fortunate enough to dive in the Sudanese Red Sea. Jacques Cousteau's 1965 film "World Without Sun" swept theater audiences into the Conshelf II experiment in underwater living at Shuab Rumi. In his book "The Red Sea" Peter Vine wrote: The famous Conshelf 2 underwater living experiment conducted at Shuab Rumi reef by the Cousteau team of divers in 1964 has provided a unique opportunity to study growth rates of various corals and to investigate the factors affecting their settlement and development on what has turned out to be an almost perfectly designed artificial reef. Five aquanauts lived in the Starfish House at 36 feet for a month, and two others stayed lower down in the Deep Cabin at 90 feet for a week, working as deep as 165 feet. The success of the mission opened the doors to hyperbaric stations that allow people to operate today much longer and deeper than they can in surface-to-surface dives.

Plate 17: Cousteau's Underwater Garage

Plate 18: Vertical growth of *Acropora*

3. Justification for inscription

3.1. a. Brief synthesis

SMNP is characterized by 13 different bio-physiographic reef zones, each providing typical coral reef assemblages (Anon 1981 in Sheppard and Wells 1988) that supports a wealth of marine life and breathtaking underwater vistas, with reef slopes rising from depths of 800m from the seafloor. SMNP's diverse coral reefs and habitats support at least 361 fish species, as well as resident populations of dolphins, sharks, and marine turtles, which also use SMNP as a resting, breeding and feeding area. SMNP also hosts nurseries and spawning areas for key fishery species, which help support biological processes farther a-field throughout the Red Sea. Hydrographical, oceanographic and ecological conditions also make SMNP an optimal coral reef growth area and the recovery from the 1998 coral bleaching impacts is evident. The combination of these above-mentioned features has for long, granted Sanganeb Atoll the reputation of being amongst the best dive sites world-wide and makes the Park an excellent candidate for World Heritage status.

The importance of DMNP cannot be overemphasized. The Park is not only aesthetically spectacular, with its unspoilt coastal landscapes and diverse seascapes, but it also supports high levels of biodiversity, including many endemic and endangered species. DMNP contains an array of habitat types, including extensive coral reef complexes, mangroves, seagrasses and intertidal and mudflat areas, which all enable the survival (breeding, feeding and resting) of significant populations of endangered dugong, sharks, manta rays and dolphins, not to mention numerous other fish and invertebrate species. In fact, the Park encompasses a variety of fish and coral communities more usually separated by several hundred kilometers. DMNP's extensive beaches, islands and coastal plains support large populations of seabirds, which have granted the entire area the international recognition as an 'Important Bird Area' (IBA) by BirdLife International. These beaches also serve as important nesting areas for at least three species of marine turtle.

The two Parks are connected by a coastal stretch extending 125Km including mersas, inlets, fringing reefs and off-shore reef formations, and the whole serial site is interconnected by natural flow and exchange.

3. 1.b. Criteria under which inscription is proposed

The proposed serial site for nomination meets variably the requirements stated in criteria vii- ix and x ; used by WH committee.

Criterion vii: Contain Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.

The rise of 8oom mount from the continental shelf to form the only Atoll enclosing a large central lagoon in the Red Sea is an exceptional formation creating a vertical slope that exhibits a spectacular diversity of fish, coral and other invertebrate species. This topographical feature, the rich biodiversity and the crystal clear of the Red Sea water, rendered the area among the best dive-sites worldwide.

DMNP comprises a highly diverse complex of pristine habitats, including coral reefs, overlying fossil reefs (sometimes up to 150m high), mangroves, seagrass beds, extensive unspoilt beaches, bays and lagoons. The coral colonies harbor a colorful marine species, some completely unique to Sudan's marine ecosystem.

The nominated property is distinctive and unique because of its high number of species, diverse number of habitats, high endemism, and remoteness. They are located in the North-Western Indo-Pacific biogeographic region that contains no World Heritage Site.

Criterion ix: Be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals:

The combination of optimal temperature, visibility and salinity conditions creates an environment of exceptional regional and global coral growth and reef development within the nominated site. Sanganeb Atoll is characterized by 13 different bio-physiographic reef zones, each providing typical coral reef assemblages. Due to these conditions, the number of coral species observed in the Sudanese Red Sea is greater than either the northern or the southern Red Sea. Such habitats in the Red Sea contain a high percentage of endemic species (Sheppard *et al* 1992) and it is logical that the nominated property will support a unique and higher, on average, subset of the endemics available in the Red Sea.

Furthermore, SMNP serves as an important larvae export area, acting as a source of recruits

for all species of plants and animals present in and around the reef, including invertebrates and fish species. SMNP also hosts important spawning sites for the key fishery species.

The highly unusual salinity and temperature ranges found within Dungonab Bay have given rise to nature and ecology unique to the Red Sea Region and perhaps the entire world. These unusual conditions further help the Bay act as an important refuge for coral communities against the impact of climate-change induced coral bleaching. DMNP's unique 'biogeographically displaced' species (representative of both northern and southern Red Sea species groups) encompass a variety of fish and coral communities more usually separated by several hundred kilometers.

Criterion x: Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value form the point of view of science or conservation:

The Sudanese coast lies at the centre of biodiversity in the Red Sea and boasts high levels of endemism in fish and invertebrate species. The wide range of habitats present in both sites will help ensure long-term protection of viable populations of important plant and animal species essential to the sustained health of biodiversity, making these Parks critical areas from global conservation and scientific research standpoints.

Sanganeb Atoll serves as a biodiversity 'hotspot' lying at or close to the centre of marine biodiversity in the Red Sea and boasting hard and soft coral fauna that is amongst the richest in the Region. Thriving on this rich reef ecosystem, over 300 fish species (including pelagic) inhabit SMNP and hosts significant populations of globally-important and endangered species, including: sharks, cetaceans, Napoleon Wrasse, grouper, and marine turtles. SMNP also acts as an important spawning ground for key fishery species as well as a larvae export area.

DMNP's key role for biodiversity conservation rests mainly with: (a) the varied and diverse fish and invertebrate communities it contains; (b) the optimal conditions of Dungonab Bay for coral reef resilience in the face of climate change; (c) the dependence of the threatened/endangered flagship species (including a globally-significant dugong population, at least three species of marine turtle and an abundance of key predators such as sharks) on the Park's ecosystem services and habitats (including some of the most expansive Regional seagrass beds representing at least 9 of the 10 Regional species and extensive beaches allowing large-scale turtle nesting); (d)the

seasonal aggregations of whale sharks and manta rays to DMNP are unique to the entire Western Indian Ocean region; (e) the entire Park has been internationally-recognized as an Important Bird Area (IBA) for both resident and migratory birds.

3.1. c. Statement of Integrity:

The property is an outstanding marine ecosystem that sustains intact ecological setup and interacting biological processes which in need of long-term conservation support for its unique diversity and endemism. It covers both shallow habitats and reef formations and deep-sea areas that are ecologically interacting by natural exchange.

The semi-enclosed nature of the Red Sea has buffered the drastic effects that would have impacted on the area by high waves, strong currents, tsunami and other natural phenomena such as earth quakes and volcanoes.

The relatively calm conditions in the area and the crystal clear waters have gracefully shown the colorful and beautiful life of the coral reefs.

The occurrence of seagrass beds, mangrove forests and sand beaches has regulated nutrient and sediment input into these reef complexes.

The property size is appropriate to contain the different features which sustain the intactness and the long-term conservation of its biodiversity. In fact the same proposed site was included when a property was nominated for Ramsar site in 2003 (Appendix 4 and 5).

Sanganeb atoll is rather remote from land-based activities and the traditional artisanal fishing around it is under the control of fisheries Administration. Illegal fishing from visiting fishing fleets has little impact because of the expensive journeys to the site. Wildlife Administration and coast guards patrol the area regularly.

Dungonab Bay marine waters are protected by Wildlife Administration and Fisheries regulations. If these regulations are not promptly enforced, Dungonab Bay is likely to suffer negative impacts on the biota from the two villages at the coast, from major land use changes, salt pans production and oyster (+ pearl) farming. Species which are likely to be affected are coral and fish species, turtles, manta rays, sharks, dolphins, dugongs, and birds.

Although the whole coastline of the property is subject to negative impacts from future developmental activities, the property has not shown any invasive or non-resident species as yet. However, with the increasing oil shipping tankers at the Sudanese coast, caution must be taken to monitor any effect from ballast water of these tankers. Projects have already started to assess this effect and to follow any algal blooms around oil terminals, including PERSGA/IMO project on Ballast water management and UNESCO Chair project on the effect of Ballast water on fauna and flora.

3.1. e. Protection and managements requirements

Through the Comprehensive National Strategy, Sudan has committed to sustainable use of resources and pursuit to protect the environment.

The relevant enabling legislation for Sudan and the Red Sea State that relate to coral reef, fishing, maritime, pollution, parks, coastal zone and public health, are in place as a priority requirement for protection and management. These national legislations include the Wildlife Protection Act, (1936); the Sudanese Fishery Ordinances and Regulations prohibiting over-fishing, dumping of refuse, including oil, into the sea and the collection of corals, shells and aquarium fish (These date back to 1937 and were amended in 1975 and 1978). National Parks, Sanctuaries and Reserves Regulation, (1939); Harbors and Shipping Ordinance of 1961; The Terrestrial Waters and Continental Shelf Act, (1970); General Regulations and Control of Merchant Shipping Act, (1971); the Wildlife Conservation and National Park Act, (1987); A Federal Environmental Law (2001), and State Environmental Law (2006). In 2008 a Red Sea Fisheries law was adopted and a Federal Environmental Law was updated in 2010.

Implementation of the regional and international conventions and protocols is also a requirement, which Sudan has signed and ratified. SMNP and DMNP fall under the Game Protection and the Federal Parks Act (1986) administered by (WCGA). Fisheries (both Research and Administration), Coast Guards, National Security, Local Government and NGO_s are all committed to enforce the conservation laws and regulations. In the year 2004, PERSGA has formulated a Specific Master Plan for SMNP, followed that by a Management Plan for DMNP and currently the management is following these plans. However, a common Management Plan for the property is inevitable. This requirement is to meet the potential threats arising from major marine and land use changes that might negatively challenge the integrity of the property.

Currently, the majority of the Sudan Red Sea coastline is very low in pollutant loadings given the relatively low levels of coastal development; nevertheless, effective monitoring should be undertaken in DMNP as well as SMNP. Additionally long-term research should be carried out at the two Parks.

Targeted communication and outreach efforts within Sudan (both nationally and within the Red Sea State) should be strengthened.The current specific management plans for both Parks should be systematically revisited and updated based on recent changes, vetted and used with members (i.e. focal points and agencies) and especially discussed in detail with local stakeholders to examine which recommendations will be practical and accepted to implement.

A series of exchanges between MPA counterparts from one PERSGA member country to another should be developed including lessons that one jurisdiction can present to another. Strengths can be shared and weaknesses can be examined for possible ways in which they may be improved based on exchange of information and knowledge.

Local communities and stakeholder should be assisted to define standards for environmental quality. These standards should be required to a) protect those ecosystem services that support human need and well being, b) provide tangible benefits to local stakeholders and c) maintain environmental quality so that such benefits are sustained over time. An example of such activities is planned within the joint project between PERSGA and the World Bank to be implemented in DMNP under the title: "Red Sea and Gulf of Aden Strategic Ecosystem Management".

Both social and economic monitoring should be developed to determine the nature and distribution of benefits tied to marine resources coming from MPAs.

Routine follow-up monitoring from selected trainings (i.e. through the PERSGA Annual Training Programme) should be performed immediately following the training program, to examine how the skills learned are being used within Sudan.

It is important to monitor the impacts of tourism on ecosystems and on local communities given that expanding tourism can exact social and environmental costs if growth is too fast or goes beyond crucial thresholds.

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3.2. Comparative Analysis

The nominated property is located in the Far Western Indo-Pacific biogeographic region, at the northern part of the Red Sea. The semi- enclosed Red Sea is an embryonic sea which is expanding as a result of the tectonic movement. Although its water, fauna and flora are from an Indian Ocean origin, yet it-due to its semi-enclosed nature-has developed a unique and different ecosystems and species not found elsewhere. However, out of the 188 natural properties in the World Heritage List no Red Sea natural property appears and has been identified as a gap by the IUCN Glad.(Gladstone, 2008). The central Red Sea, of which the Sudanese coast is a major part, presents areas which meet the UNESCO World Heritage Global Strategy as one of the priorities nominated for inscription in the list. The present nominated property is discussed as a perfect example of a site that would meet with this strategy.

In this section, the nominated serial site is compared with 14 global sites of similar values. The similar features of these global sites are summarized and tabulated in Table 5 against those of the nominated property. Unlike the compared sites, the nominated property is located in northern part of the Western Indo-Pacific biogeographic region and in a highly endemized sea that currently contains no World Heritage sites that may represent the biogeography of this part of the world.

The most common feature to these global sites is the occurrence of coral communities with variations in biodiversity, health status, and degree of endemism, intactness and resilience. Compared to these global sites, the nominated property may be unique due to the small size (765300h), similar to Coiba of Panama (270125h), Socotra of Yemen (410460 h) and Sian Ka'an of Mexico (528000h).But this small size displays shallow habitats, reef formation and deep-sea areas (up to 2000m) including the only atoll formation with associated fauna and flora. Coiba National Park and its special marine zone contain Coiba Island and 38 small islands forming the only group of inshore islands within the Gulf of Chiriqui in the Tropical Eastern Pacific. This arrangement is similar to Mukkawar Island and the smaller islands and islets in Dungonab Bay in the Red Sea. Sian Ka'an in the tropical Northwestern Atlantic Region contains a marine section intersected by a barrier reef and having mangroves and marches but no atoll formation. Other Tropical Eastern Pacific sites, comparable to the nominated site, are Cocos of Costa Rica and Malpelo of Colombia. Unlike the nominated site, both sites are offshore sites.Cocos is a small

oceanic island with a tropical rainforest located 550 km from the mainland. Malpelo is 506 km off the coast of Colombia and its marine surroundings is famous for diving, similar to Sanganeb Atoll.

In the Western Indo-Pacific Region, the nearest natural properties to the Red Sea are Socotra Archipelago and Aldabra Atoll. Socotra mixed property is composed of 4 islands and 2 rocky islets near the Gulf of Aden in the northwest Indian Ocean. Although it is rich in marine fauna and flora, similar in area to the nominated property, the marine area is only 30% and it is managed for its outstanding terrestrial conservation value. The Aldabra Atoll of Seychelles (35000h) with 41% marine area is mostly shallow water habitat compared to the shallow and deep water habitats in the nominated property.

In addition to Socotra Archipelago, five sites are compared to the present property: Three from the Indo-Pacific region, one from the west Atlantic-Caribbean, and one from the Pacific region. They are chosen for the comparative analysis because they contain similar habitats like those shown in Table 6. The nominated property is different from these tropical World Heritage Sites by having a mid-sea coral reef habitat in a small semi-enclosed sea. Large barrier reef systems such as the Great Barrier Reef, Belize Barrier Reef or the New Caledonia Barrier Reef are all located on shallow continental or sub-continental shelves, while the nominated property presents remote fringing reefs associated with an atoll. Table 6 shows that the present property contains all the habitats compared to the other sites. These structurally diverse habitats in the nominated property, containing a high percentage of endemic (globally unique) species and threatened species, give the nominated property a strong call for nomination as the first natural site in the most northerly located coral reefs in the world (23.5 N, Tropic of Cancer).

Table 5: Some features of 14 global and regional sites compared to the nominated property.

Property State Party	Total area (ha) and % marine	Natural World Heritage Criteria	Marine realm/province (Spalding et al.2007	Coral Species	Fish species	Marine Mammal Species	Bird species	Notes and Geographic Context
SMNP and DMNP	765300 87%	vii-ix - x	WI-P/Red Sea and Gulf of Aden	260	300	11	20	Submerged fringing reef Only Atoll in the Red Sea. Largest Bay inSudan, Red Sea.
PIPA, Kiribati	40,825.000 (100%)	vii,ix, x	Eastern Indo-Pacific/Central Polynesia	200	518	18		Largest MPA in the world; atolls in deep sea. Demonstrated coral reef resilience to bleaching.
PMNM, USA	36,207.499 (100%)	viii, ix, x	Eastern Indo-Pacific/Hawaii	57 24-42% endemic (Friedlander et al. 2009)	250 20-62% endemic (Friedlander et al. 2009)	20	72 including 4 threatened endemic land birds (3 CR, 1 VU)	2nd largest MPA in the world; oceanic islands over volcanic hotspot
Great Barrier Reef Australia	34,870.000 (95%)	vii,viii,ix,x	Central Indo Pacific/Northeast Australian Shelf	400	1500		242	Largest World Heritage property; largest barrier reef in the world continental shelf
Shark Bay Australia	2,200.902 (31%)	vii,viii,ix,x	Temperate Australasia/West Central Australian Shelf	95	323	6	230	Continental shelf
Belize Barrier Reef, Belize	96,300 (50%)	vii,ix,x	Tropical Atlantic/Tropical Northwestern Atlantic	100	500		187	World Heritage in Danger,2nd largest barrier reef in the world; continental shelf
Malpelo, Colombia	857,500 (100%)	vii, ix	Tropical Eastern Pacific/Tropical East Pacific		394	17	61	Oceanic island
Cocos, Costa Rica	199,790 (97%)	ix, x	tropical Eastern Pacific/Tropical East Pacific	32	300	10	95	Oceanic island
Galapagos Islands, Ecuador	14,066,514 (95%)	vii,viii, ix, x	Tropical Eastern Pacific/Galapagos	120	460	24	150	World Heritage in Danger, oceanic islands over volcanic hotspot
New Caledonia, France	1,574,300	vii, ix, x	Central Indo-Pacific/Tropical Southwestern Pacific 510	1695		105	Continental shelf	Tropical ocean archipelago – lagoons
Sian Ka'an, Mexico	528,000 (23%)	vii, x	Tropical Atlantic/Tropical Northwestern Atlantic	83	175		339	Continental shelf
Coiba, Panama	270,125 (50%)	ix, x	Tropical Eastern Pacific/Tropical East Pacific	58	760	19	147	Continental shelf
Tubbataha Philippines	130,028 (100%)	vii, ix, x	Central Indo-Pacific/Western Coral Triangle	374	479	11	99	Atoll in deep sea
Aldabra, Seychelles	35,000 (41%)	vii, ix, x	western Indo-Pacific/Western Indian Ocean	210	287		65	Atoll
Socotra, Yemen	410,460 (32%)	X	Western Indo-Pacific/Red Sea and Gulf of Aden	283	730		192	Continental Shelf

Table 6: Occurrence of Habitats in 6 World Heritage Properties and in Sanganeb Marine National Park and Dungonab Bay – Mukkawar Island Marine National Park

	Reef	Atoll/ Atoll-like	Lagoon	Island/ Islet	Sand Flats/ Sand Cays	Seagrass	Mangrove
Soctra Archipelgo	*			*			*
Great Barrier Reef	*	*	*	*	*	*	
Lagoons of New Caledonia	*	*	*	*		*	*
Tubbataha Reef	*	*	*	*		*	
Belize Barrier Reef	*	*	*	*	*	*	*
Papahanaumokuakea	*	*	*	*			
Sanganeb-Dungonab-Mukkawar	*	*	*	*	*	*	*

Area and Origin

Very few atolls (4) out of more than 400 atolls and reef islets in the world have been inscribed as World Heritage, and most of them are raised atolls. Sanganeb atoll of the present nominated property is totally submerged sea mount rising up 800m from the continental shelf.

Nevertheless, of the ten tropical and subtropical archipelagos in the Indian Ocean, only two (Chagos and Mascavene archipelagos) were formed from seismic activity associated with the mid-ocean ridge or by deep-sea trench subduction zones. In the case of the present property, the geological process of rifting has created a stepped profile to the continental margin either side of the Red Sea.

Other marine sites as World Heritage properties that are comparable to the present site are the Tubbataha Reef, Great Barrier Reef of Australia, the lagoons of New Caledonia and the Belize Barrier Reef. However, these sites are large open continental areas.

The natural property in danger, Belize Barrier Reef Reserve System (96300h) is a trans-boundary serial property and the largest barrier reef in the northern hemisphere. The serial sites of Lagoons of New Caledonia are one of the three most extensive reef systems in the world. The three-atoll reef and extensive reef flats of Tubbataha Reef Natural Park extend to 130028h. The Great Barrier Reef (34870000h) contains the world's largest collection of coral reefs. Socotra Archipelago extends to 410460h.The present serial site has a total area of 765300h.

Shark Bay of Western Australia with its islands resembles Dungonab Bay with its islands. Seagrass beds, occurrence of endangered species and terrestrial landscape are common features for both sites. However, Shark Bay itself is a large shallow area (2197300h) with an average depth of 9m, while Dungonab Bay is 15.9m in depth in most of its area (Farah 1982).

In contrast to the nominated property, the Phoenix Island group is the largest Marine Protected Area in the World which contains mid-ocean coral archipelago ecosystems and 14 underwater sea mounts of volcanic origin in the southern Pacific Ocean. The area is vast (40825000 h) and the water depth reach 6147m. Unlike the nominated property, the area is under the effects of ocean currents.

Galapagos Islands are some 1000 km from the South America coast and in complete isolation. These 19 large volcanic islands are located at the confluence of three ocean currents and upwelling phenomenon. The nominated property is under no such impact. In fact, the outstanding terrestrial fauna and flora of Galapagos-with high endemism-overshadow the highly varied marine fauna.

In the Pacific region, the vast area (36207499h) of Papahanaumokuakea marine National Monument geological origin resembles that of the Red Sea and deserves comparison with the present property. This is mainly because Papahanaumokuakea shares with the Red Sea, the feature of having significant concentrations of locally endemic species. Table 7 shows some similarities between it and the present property.

Table 7: Comparison of some features between Papahanaumokuakea Marine National Monument (PAPMNM) and Sanganeb Marine National Park-Dungonab Bay-Mukkawar Island Marine National Park (SMNP)-(DMNP).

*** Area:**

Papahanaumokuakea	36,207,499ha
SMNP-DMNP	765300 ha

*** Location:**

Papahanaumokuakea	N 25° 20’ 56.652”
	W170° 8’ 44.952”
SMNP – DMNP	N 20°56’7895”
	E 37°36’7789”

* **Abundant large Predatory fishes:**

Papahanaumokuakea	Sharks, Giant Trivially, Groupers.
SMNP – DMNP	Sharks, Rays, Wrasse, Parrot fish, Groupers.

***Reptiles:**

Papahahaumokuakea	Green turtle – 450 nesting sites.
SMNP – DMNP	3 turtle species– Many nesting sites.

* **Birds:**

Papahanumokuakea	5.5 million resting annually.
	14 million rely on tiny islets chain.
SMNP – DMNP	(20 + 6) recorded species. IBA

* **Marine Mammals:**

* Papahanaumokuakea	Monk seal (endangered)
SMNP – DMNP	Dolphins, Dugong.

Biodiversity and Endemism

The Red Sea appears to contain the richest diversity of coral west of India, and in part this is due to biogeographical reasons whereby the Red Sea acts as a trap of larvae which flow with the winter currents through Bab-el-Mandeb (Sheppard et al 1992). Several of the above species are endemic to the Red Sea, suggesting speciation since the Holocene transgression, and several common species show different morphological ranges, suggesting effects of prolonged isolation.

The Indo-Pacific region harbors a wealth of coral formations. The Great Barrier Reef contains the world's largest collection of coral reefs (400 sp.) (Bennett,1971).The Lagoons of New Caledonia, although they surpass the Great Barrier Reef in coral and fish diversity, they contain 320 sp. of scleritian corals (Chevalier,1973).Tubbataha Reef extensive reef flats and perpendicular walls have over 374 coral species. Socotra Archipelago contained 253 species of reef-building corals.Belize Barrier Reef showed only 65 scleritian corals and 45 hydroides. Papahanaumokuakea Marine National Monument has 57 stony corals (+28) of which 40 % are endemic. In the present property, recent surveys have recorded 126 Cnidarian species from Sanganeb Atoll.

In these properties the fish diversity is notably high within the reefs. 1500 fish species in the Great Barrier Reef (Randall, J.E.*et al*1971), over 500 in Belize Barrier Reef and 479 in Tubbataha Reef are good examples. Socotra Archipelago showed 730 species of coastal fishes. However, the lower numbers of fish species in Papahanaumokuakea Marine National Monument (250 sp.) and in SMNP and DMNP (300 sp.) have shown remarkable percentages of endemism (23 and 17 % respectively).These high level of endemism, when compared to 1% in the Great Barrier Reef, recommend the present property for international efforts of conservation of its biodiversity. Papahanaumokuakea and Red Sea areas like the present property are considered "hotspots" for reef fish endemism (Allen, 2007).

Comparisons for invertebrates are rather difficult. This is because of the few available literature and the scattered areas of research. In Papahanaumokuakea echinoderms total up to 26 species, while in New Caledonia the number is 43.In the Red Sea, there are 170 recorded echinoderm species, of which 5.3% is endemic. In a recent study, 47 epibenthic macoinverebrates species were recorded from DMNP seagrass meadows of which 37% were echinoderms (Gaiballa 2013).

The Great Barrier Reef support 500 of marine algae, while New Caledonia contains 336 species. In the Red Sea about 500 species of benthic algae have been recorded (Chiffings 1 995).In Sanganeb Atoll, 91 species were recorded (Krupp *et al* 1 994).However, low numbers of sea urchins were noticed in Sanganeb deep waters reefs (Schuhmacher *et al* 1995). The same authors did, however, note that Diadema is abundant in the northern Red Sea where it played a major role in controlling reef development; being grazer that control the growth of algae. The low number on the great majority of the Red Sea reefs is confirmed by data collected by the Reef Check Program (Hodgson and Liebeler *2002*), which recorded a significant fall in abundance of Diadema on coral reefs of Indo-Pacific , including the Red Sea , between 1998 and 2001.

Intactness and resilience

All the compared sites in this comparative analysis are open high-sea areas which are subject to a multitude of effects. These effects include, high waves, strong currents (cold and warm) modernized extensive fishing fleets, tsunami and global climate change. Legislations and regulations can do nothing to these effects, but to wait for mitigations.

The present property is partially protected by the semi-enclosed nature of the Red Sea, the widely distributed barrier reefs, and currents driven mainly by monsoon winds and by changes in water density caused by temperature and salinity differences. In other areas the currents for example in the lagoon of New Caledonia are both warm and cold strong currents.

In Belize Barrier Reef, the coastal lagoons are affected by the estuaries and input of fresh water and consequent turbidity. In the present property, the lack of terrestrial fresh water runoff, combined with relatively low productivity, gives rise to low levels of turbidity and visibility can reach 70m (PERSGA 2001).

These conditions in the Red Sea have created complex patterns of species distribution and that areas separated by relatively short distances of one or two hundred kilometers can be home to markedly different species assemblages, and is well illustrated by the fish communities found there (Roberts *et al* 1992, Sheppard *et al* 1992, Kemp 1998.) In contrast to these conditions, the majority of species in the compared sites are widespread throughout the region concerned; due to their planktonic mode of larval dispersal by the dynamic transport conditions.

The present property holds much promise from a scientific perspective, as areas like Dungonab Bay showed remarkable resilience in the face of the 1998 global coral bleaching event (Equipe Cousteau, 2008).The area could therefore provide valuable insights into optimal conditions that may resist climate-change-induced bleaching impacts.

3.3. Proposed Statement of Outstanding Universal Value

An expanse of coastline, containing two protected areas and encompassing very significant formations of an atoll and a large bay that contains islands, several small islets and some of the most northerly coral reefs in the world associated with species (including seagrass and mangroves) at the limits of their global range, evolutionary expansion, and thus are important from a scientific and conservation perspective. The two protected areas are naturally, geologically and ecologically connected and functionally linked by open flow and exchange.

The only atoll in the Red Sea, Sanganeb atoll is a submerged and over hanged predator dominated coral reef ecosystem of 13 different bio-physiographic reef zones, each providing typical coral reef assemblages. It supports a wealth of marine life and breathtaking underwater vistas, hosting at least 361 fish species with numerous endemic and rare species. Besides being a nurseries and spawning areas for key fishery species, it also hosts resident populations of dolphins, sharks and marine turtles, which also use the atoll as a resting, breeding and feeding area. .

Dungonab Bay, engulfing Mukkawar Island and other islands, contains an array of habitat types, including extensive coral reef complexes, mangroves, seagrasses and intertidal and mudflat areas which all enable the survival (Breeding, feeding and resting) of even endangered dugong, sharks, manta rays, dolphins and migratory birds. The Bay exhibits overlying fossil reef, sometimes up to 150m high, and contains fish and coral communities more usually separated by several hundred kilometers.

Criterion (vii)

Sanganeb Atoll is the only atoll in the Red Sea rising up 800m exhibiting spectacular colorful diversity of coral, fish and invertebrates that rendered it a Mecca to divers and photographers of the world due to the clarity of the water.

Dungonab Bay contains diverse pristine habitats including colorful coral reef communities and marine species, some completely unique to Sudan's marine ecosystem.

The naturalness and the esthetic features gave the property an increasing interest both regionally and internationally.

Criterion (ix)

The exceptional environmental conditions of the property provided coral growth and reef development in the Sudanese Red Sea with numbers of coral species higher than either the northern or the southern Red Sea. . Such habitats in the Red Sea contain a high percentage of endemic species (Sheppard *et al* 1992) and it is logical that the property will support a unique and higher, on average, subset of the endemics available in the Red Sea.

The property serves as an important larvae export area and host important spawning sites for key fishery species. The property encompasses a variety of fish and coral communities more usually separated by several hundred kilometers

Criterion (x)

The property diverse habitats host significant populations of globally-important and endangered species, including sharks, manta rays, dugong, dolphins, napoleon wrasse, groupers and marine turtles. The property is home to whale sharks, and the largest aggregations of manta rays in the Red Sea .The property have been internationally-recognized as an Important Bird Area (IBA) for both resident and migratory birds.

Statement of Integrity

The intactness of the ecological setup of the property with its rich biological diversity and endemism, deserve long-term conservation support. The complex assemblage of the most northerly located coral reefs in the world, together with the high endemism, represents the features of a whole ecologically sustainable area. The occurrence of seagrass beds, mangrove forests and sand beaches has regulated nutrient and sediment input into these reef complexes. The area of the property is adequate enough to represent all these features and processes, if soundly protected from any adverse impact.

Sanganeb Atoll remoteness has partially restored its integrity being the only unique atoll in the Red Sea. Dungonab Bay marine waters are protected by Wildlife Administration and Fisheries regulations. If these regulations are not promptly enforced, Dungonab Bay is likely to suffer negative impacts on the biota from the two villages at the coast. Species which are likely to be affected are coral and fish species, turtles, manta rays, sharks, dolphins, dugongs, and birds.

Although the whole coastline of the property is subject to negative impacts from future developmental activities, the property has not shown any invasive or non-resident species as yet.

However, with the increasing oil shipping tankers at the Sudanese coast, caution must be taken to monitor any effect from ballast water of these tankers.

Requirements for protection and management

There is a demonstrable commitment from the Government of Sudan towards the protection and conservation of the resource in the coastal waters. Several laws and regulations are in force and Sudan has signed and abides to regional and international protocols and conventions. The proposed site is protected by defined state and federal laws and administered by Wildlife Conservation General Administration (WCGA) and supported by an increasing awareness of the stakeholders. There are two separate Management Plans for the two components, but WCGA is aware of that the serial site will have a common management plan, if inscribed in the World Heritage List. . PERSGA (as it is currently updating DMNP Management Plan) has offered in December 2015 to support producing a common integrated management plan for the property.

4. STATE OF CONSERVATION AND FACTORS AFFECTING THE PROPERTY

4. a. PRESENT STATE OF CONSERVATION

SMNP

SMNP has been the focus of various conservation efforts since the seventies as its reefs are among the most beautiful of the world, a fact agreed between scientists, divers, and underwater photographers. The driving force in reef conservation has been, during the seventies and eighties, the Sudan Marine Conservation Committee (SMCC) which is composed mainly of representatives of government departments concerned with the sea such as Sea Ports Corporation, Fisheries Department, Government of the Red Sea Province, Navy, Tourist Corporation, Fisheries Research Centre, Suakin Marine Biological Laboratory (University of Khartoum) and the Institute of Oceanography (presently the Institute of Marine Research, Red Sea University). The activities of conservation covered a broad spectrum ranging from legal protection to public education, from marine recreation to environmental monitoring and scientific research.

Information and public education

It is well known that marine conservation requires intensive information and public education material. Thus, leaflets were printed and distributed by the SMCC to tourists and visiting yachtsmen. Divers and boat owners were informed by wooden notice boards placed at various landing sites.

Public education focused on various spectrums of people in Port Sudan area using slide and movie shows. The equipment and materials to show were provided by IUCN/WWF for this purpose. The target sector of community included school boys, fishers, government officials, Navy and custom officers, and even sport clubs. The films and slides were oriented towards the beauty of reefs in general and SMNP in particular and the need for their conservation.

The idea of public aquarium, as a mean of education by direct observation, has been pursued for a number of years. Although the Commissioner of the Red Sea Province (now the Red Sea State) has taken the initiative of having a building for the public aquarium, the original plan was based on little experience which hindered the operation of the aquarium. However, an alternative to a large public aquarium was small aquaria in schools and clubs.

These conservational efforts were supplemented by additional leaflets, exhibition, newspaper and magazine articles and postcards which reached wider audiences. The postcards were donated by

the famous photographer Leni Riefenstahl with captions concentrating on the beauty of corals and coral community and the need for their conservation. Such efforts were made bearing in mind the recreational potential of Sanganeb reefs which are so well known all over Europe where every diver dreams of diving on Sanganeb Atoll.

Steps in establishing the property

Sanganeb reef has been proposed for years by many individuals inside and outside the Sudan to be a marine national park. Substantial support was made in this direction by WWF/IUCN through the project No. 1259: "Establishment and development of a proposed Sanganeb Marine National Park" with the aim of protecting and conserving the marine habitat, mainly coral reefs, promoting public awareness, scientific research and offering recreational facilities. H.R.H. the Duke of Edinburgh paid a visit to Sanganeb in March 1982 in the framework of this WWF/IUCN project.

Plate 19: The visit of H.R.H. the Duke of Edinburgh to SMNP in 1982

Such combined efforts for the conservation of Sanganeb reef lead to its declaration by the Government of Sudan as the country's first marine National Park in 1991. A Draft Management Plan for SMNP was developed (Appendix 6) as part of the PERSGA Marine Protected Area-Strategic Action Programme (MPASAP), funded by the Global Environment Facility (PERSGA / GEF, 2004).

Sanganeb atoll is one of the most unique reef structures in the Sudanese Red Sea (Krupp 1990), who's steep slopes rise from a sea-floor of more than 800 m. Sanganeb has yielded a wealth of information on Sudan's marine habitat, and is the center of much of the country's research into coral reef ecosystems. The remoteness of SMNP, situated in the Red Sea at about 30 km north east Port Sudan city away from any population pressure, has ensured that human-based impacts have been relatively few, and the biological resources of this property is well preserved.

Plate 20: An aerial photo of the Lighthouse in Sanganeb atoll

Plate 21: The southern jetty in Sanganeb atoll

Plate22: Sanganeb atoll showing the northern jetty leading to the lagoon

Plate23: Scorpion fish common on the reef flat at the southern jetty

DMNP

Dungonab Bay and Mukkawar Island National Park is situated 125 km north of Port Sudan. It includes within its boundaries a highly diverse complex of coral reefs, mangroves, seagrass beds, beaches, and intertidal areas. Nevertheless it did not receive the conservational efforts made for SMNP because of its very low inhabitants mainly fishers. Moreover, these inhabitants have historically low levels of marine resource exploitation and fish consumption is still low.

Apart from the work of Crossland, the area attracted several scientists including Sudanese and foreigners. The coral communities at a number of sites inside and outside the bay are described by Vine and Vine (1980). The survey carried out by PERSGA in Dungonab Bay and Mukkawar Island focused on resource assessments and mapping of the biodiversity and health of ecosystems, with greatest emphasis on coral reef habitats. The results of this survey were used as the informational base in the development of the first Draft Management Plan prepared by PERSGA. These surveys also found differences between the extent of bleaching-related mortality (a result of the 1998 global coral bleaching event), inside and outside the bay, which suggest that the area may act as an important refuge for corals during regional or global coral bleaching events.

The area has also long been known to be of particular significance for birds (Moore and Balzarotti, 1983, Fishpool and Evans, 2001), and is designated an Important Bird Area of internationally a high conservation priority for birds (Fishpool and Evans, 2001).

However, Sudan has great potential for the development of sustainable high value marine tourism, particularly SCUBA diving, and is world-renowned among sport divers for the quality and condition of its unspoiled and spectacular coral reefs.

Increasing importance is expected to be placed on exploitation of marine resources in the future, including oil exploration, shrimp farming, tourism and fisheries. All of these activities can be expected to have serious deleterious impacts on the marine and coastal environment and biodiversity if management mechanisms for sustainability are not put in place.

Following the history of Dungonab Bay, the scientific work carried out in the area and the biological and ecological surveys carried out in 2002 by PERSGA, Dungonab Bay and Mukkawar Island National Park was declared by the Government of Sudan in 2004

Legal aspects

Regional and international conventions

Sudan is a Party to the following Regional and International conventions:

- *The Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (Jeddah Convention), 1982*, signed and ratified in response to the concern of the coastal and marine resources of the region. Sudan became a Party to the Convention on 5 June 1984. In accordance with the Articles of this Convention, the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) was formally announced in 1995, with its headquarters in Jeddah, to act as the Secretariat of the Jeddah Convention.
- *The Protocol concerning Regional Co-operation in Combating Pollution by Oil and other Harmful Substance in Cases of Emergency, 1982.* Sudan became a Party to the Protocol, 5 June 1984. The objective of the Protocol is to enhance measures for responding to pollution emergencies on a national and regional basis. The contracting Parties undertake to cooperate in undertaking measures to protect the coastline (and related interests of Parties) from pollution arising from oil or other harmful substances in the marine environment as a result of marine emergencies (Article II).Cooperation is facilitated through the establishment of a Marine Emergency Mutual Aid Centre (Article III). The Parties further undertake to cooperate under the Protocol by exchanging relevant information (Articles V, VI, VII and VIII).
- *Protocol Concerning the Conservation of Biological Diversity and the Establishment of network of Protected Areas in the Red Sea and Gulf of Aden, 2007.*
- *Protocol concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden, 2007.*
- *Protocol concerning Technical Cooperation in Transboundary Transfer of Equipment, Experts and Technicians in cases of Emergencies, 2009.*
- *Convention for Biological Diversity (CBD), 1992:* Sudan became a Party to the Convention on 30 October 1995.
- *Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973:* Sudan became a Party to the Convention on 26 October 1982.

- *United Nations Convention for the Law of the Seas (UNCLOS), 1982:* Sudan became a Party to the Convention UNCLOS, 23 January 1985.
- *African Convention on the Conservation of Nature and Natural Resources, 1968:* Sudan became a Party to the Convention on 21 October 1973.

Sudan has already started the procedure for accession to the International Convention for the Prevention of Pollution from Ships (MARPOL), as well as related conventions such as: The International Convention on Oil Pollution Preparedness, Response and Co-operation (1990); the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (1969); the Civil Liability Convention (1969); the International Oil Pollution Compensation

National legislation

Several national legislative frameworks are in place that relates to coral reefs:

- *Sudanese Fishery Ordinances and Regulations:* Dates back to 1937 and was amended in 1975 and 1978. Prohibits overfishing, dumping of refuse, including oil, into the sea and the collection of corals, shells and aquarium fish.
- *Environmental Health Act:* Established in of 1975. Prohibits the dumping into the sea of any item that is harmful to humans or animals.
- *Marine Fisheries Ordinance:* gives police, customs officers, and local authorities the right to board and search a vessel, and detain any craft accused of violating the above regulations.
- *Maritime Law:* Drafted by the Maritime Administration and approved in 2011.
- *Comprehensive National Strategy:* Through this, Sudan has committed to the pursuit of sustainable development and environmentally sound resource management.

The Red Sea State Environment Protection Act (2006) addresses environment, pollution, fisheries, marine parks, the coastal zone and the coastal environment. Its objectives are: *"protection of the purity and natural equilibrium and conservation of the environment and the social and cultural systems thereof, to achieve safety and sustainable development for the benefit of generations; promotion of the environment for sustainable development; linking development and the environment and spreading awareness; and ascertaining and activating the role of the competent authority and its delegates and preventing laxity and short comings of performance".*

Regional and national action plans

PERSGA has taken several steps to conserve coral reefs, mangroves, seabirds and marine turtles in the Red Sea and Gulf of Aden region. Surveys were then conducted to determine the status of habitats and species within the region resulting in the development of country status reports. This step was followed by the development of Regional Action Plans (RAPs) for conservation of those key habitats and species. However, it was necessary to develop National Action Plans (NAPs) for the conservation of those habitats and species by the PERSGA countries, in the light of the RAPs, as a fundamental and harmonizing step; the NAPs also facilitate implementation of the actions at the national level. Accordingly Sudan has formulated the NAPs for the conservation of its key habitats and species. The Implementation of the NAPs will occur through integrated networks of national and local working groups, government departments, agencies and personnel, non-governmental organizations and other stakeholders.

Sudan has also prepared the following national action plans:

- *National Oil Spill Contingency Plan for Sudan.*
- *National Integrated Coastal Zone Management*
- *National Plan of Action for the Protection of the Marine Environment from Land based Activities.*

Threats to the property

- Anchor damage, resulting from careless anchoring within coral areas.
- Human activities have until very recently been at low levels within the Parks. Consequently coral bleaching is considered to be the single most significant impact on the corals of the Parks in recent years.
- In July 1998, a survey on the western side of Sanganeb atoll indicated that reefs were relatively healthy, supporting a diverse fish population, and bleached corals covered 14 % of the substrate (Nasr and Al-Sheikh 2000).
- Coral predators such as the Crown of Thorns starfish *(Acanthaster plancii)* and Drupella, a small gastropod snail, were present in high abundances at some sites. Although Drupella was present in relatively high abundances it appears to be a perennial and natural phenomenon in some parts of the Red Sea. The Crown of Thorns is a potentially serious threat, especially to the relatively small and isolated but very important and valuable coral communities inside Dungonab Bay.

Species trends

Coral reefs: species lists for Sanganeb (Schroeder and Scheer 1981) are available. Coral reefs in DMNP were assessed in 2002. Major differences in the health of coral communities were present between parts of the MPA. The coverage of living coral was generally greatest within Dungonab Bay. The greater coverage of dead coral outside Dungonab Bay was attributed to the effects of the 1998 coral bleaching event. Corals within Dungonab Bay may be pre-adapted to greater ranges in sea surface temperature because of the semi-enclosed nature of the bay. Additionally, it is possible that Dungonab Bay may not have experienced the elevated sea surface temperatures because it is somewhat isolated from the main body of the Red Sea, unlike coastal areas of the MPA (PERSGA/GEF 2004).

Algae: In SMNP a total of 60 genera and species of benthic small filamentous algae and macroalgae were encountered. They comprise 25 *Rhodophyta* (red algae), 16 *Chlorophyta* (green algae), 12 *Phaeophyta* (brown algae) and 7 *Cyanophyta* (blue-green algae).

Reef Fishes: In SMNP 251 fish species have been recorded; many of them are recorded for the first time from Sanganeb, others are new records for the central Red Sea on the whole (Krupp *et al,* 1993). Altogether, 121 fish species were recorded at 8 transects. The most common species, *Pseudanthias squamipinnis,* accounted for 44% of all individuals, followed by *Chromis dimidiate* with 19%. The eight most common species made up for 80% of all individuals. Most other species occurred in relatively low numbers: 94% of all individuals belong to 31 species while the remaining 90 species accounted for only 6% of all individuals (Krupp *et al,* 1993).

There were marked differences in species composition and numbers of individuals between the various transects. The number of species ranged between 36 and 56 (mean 44.4), the number of individuals was between 200 and 1665 (mean 866) (Krupp *et al,* 1993).

At the six transects where counts were taken in spring 1991 and autumn 1992 there were shifts in the numbers of species at each individual transect, but the average number remained the same (mean 44.2 in both years). The number of individuals at the two lagoons transects increased from a total count of 520 in 1991 to 815 in 1992. At all outer reef transects, however, it sharply decreased from a total 5274 in 1991 to 3486 in 1992. Looking at individual species there was a remarkable decrease in the number of *Pseudanthias squamipinnis, Pseudochromis fridamani* and *Ctenochaetus striatus,* while an increase was recorded e.g. in the numbers of *Cephalopholis hemistiktos, Amblyglyphidodon leucogaster, Chromis dimidiatus* and *Thalassoma kleunzingeri* (Krupp *et al,* 1993).

Plate 24: Corals and coral fishes

Marine mammals:

Dugongs do occur in Dungonab Bay/Mukkawar Island. The population there may be the most important remaining on the coast of Africa (PERSGA, 2006). However, numbers have declined sharply in recent years. The cause is most likely accidental capture in fixed Fishing nets.

Dolphins: Dolphins are reported and observed to occur around SMNP and DMNP (PERSGA/GEF 2004f).

Plate 25: *Dugong dugong* feeding on seagrass

Plate 26: Dolphins swimming in front of the tug boat at Sanganeb.

Whale sharks and Manta rays: Mukkawar Island and Dungonab Bay are home to whale sharks, and the largest aggregations of manta rays in the Red Sea (PERSGA, 2006).

Regionally important populations of sharks are known to occupy the waters off the coast of Sudan, and are a very important attraction for the marine tourism trade. Hammerhead sharks are known to occur around Sanganeb Atoll and around many of the reefs of Dungonab Park in winter, but very few were observed during the recent survey.

Seabirds: Mukkawar Island and Dungonab Bay support breeding colonies of osprey, sooty falcon, sooty gull, white-eyed gull, bridled tern, white-cheeked tern and crab plover. The following are recorded species: *Sterna bengalensis, Sterna repressa, Sterna anaethetus, Larus hemprichii and Larus leucophthalmus.*

A total of 20 bird species were observed in the DMNP of which two, the bridled tern and the Crab Plover, were nesting in significant numbers.

Six bird species were recorded at Sanganeb, including the regional endemic species *Larus leucophthalmus* in bre eding plumage. This relatively low diversity is unsurprising given the fact that Sanganeb is over 20km offshore, and has no emergent land except for the lighthouse and its associated piers.

Decapod Crustacea: In SMNP a total of approximately 6300 decapod Crustacea from 128 samples were collected; the preliminary species list consists of 51 species from 14 families. Former investigations indicated that all species of the genus *Trapezia* are obligate coral symbionts and confined to living colonies of branching corals. However, recent studies showed that a few specimens of each *Trapezia cymodoce, Trapezia ferruginea, Trapezia guttata, Trapezia tigrina, and Trapezia cavimana,* are found in dead coral colonies.

Polychaete fauna: A total of 630 polychaetes from 28 samples taken from 4 localities on Sanganeb Atoll were identified. They represent 23 families, comprising 57 genera. Among these, 17 species and 6 genera were recorded for the first time in the Red Sea (Table 8).

Table 8. The most abundant species of polychaetes at Sanganeb Atoll

Species	**Total number of specimens**
Pista cf. unibranchia	148
Eunice antennata	29
Eunice siciliensis	28
Cirriformia filigera	25
Loimia medusa	24
Haplosyllis spongicola	22
Lumbrineris sp.	19
Ceratonereis mirabilis	19
Cirrophorus sp.	17
Phyllodoce madeirensis	14

Turtles: A significant part of the very important turtle nesting beaches on the eastern side of Mukkawar Island were surveyed, revealing high levels of nesting activity. The entire Dungonab – Mukkawar area, but particularly the islands and the peninsula, constitutes a regionally important turtle nesting area. All species of marine turtle are globally endangered and are CITES listed.

4. b. Factors affecting the property

(i) **Development Pressures(e.g., encroachment,adaptation,agriculture,mining**)

The factors which are likely to affect or threaten the Outstanding Universal Value of the property stem mainly from future developmental activities which are expected to have negative impacts on the marine habitats, fauna and flora. The present traditional pattern of use of the property, including artisanal fisheries, natural oyster culture and salt production, is in the minimal stage.

The construction of the paved road parallel to the coastline of the property has already altered the pattern of water movement at the coastal plain and the impoundment has decreased the freshwater input to the mersas and mangroves.

A power plant is suggested to be built in mersa Arakyai.But the project idea is opposed by NGOs, the state Ministry of Environment and Tourism and academia, unless favorable EIA and safety measures are reached. The project, if passed by the state legislative council, will affect the water temperature; destroy the immediate habitats and the coral reef facing the mersa.

Intended projects along the coastline of the property for shrimp and fish culture are on line and their effects on the neighboring waters are to be faced.

(ii) **Environmental pressures(e.g.,pollution, climate change, desertification)**

Although the whole coastline of the property is subject to potential negative impacts from future developmental activities, the property has not shown any invasive or non-resident species as yet. However, with the increasing oil shipping tankers at the Sudanese coast, caution must be taken to monitor any effect from ballast water of these tankers.

Mukkawar Island is a target for large-scale tourism investments which threaten the integrity and the carrying capacity of the property. Inscription of the property in WH List will deter any drastic activity inside the property.

(iii) **Natural disasters and risk preparedness(earthquakes, floods, fires, etc.)**

The property lies in an area which has no known volcanic or earthquakes activity and also safe from tsunami or large floods.

(iv) **Responsible visitation at World Heritage sites**

The property can absorb the current number of visitors without any adverse effects.The majority of the visitors to Sanganeb are dedicated tourists, divers, photographers and researchers who are the most aware of the importance of protecting this ecosystem. Regular collection of garbage and refuse is maintained and shipped to the mainland. The effect of anchorage on the coral reef is likely to increase if the boats and yachts do not follow the posted anchorage guidelines.

Visitation to DMNP is in the small scale at the moment and the effects are minimal. There are no figures to postulate from the future number of visitors, but WCGA has to prepare for such an increase of visitation by improving the present controlled capacity, facilities, infrastructure and amenities.

(v) **Number of inhabitants within the property and the buffer zone**

There are two major villages in the buffer zone of DMNP; Dungonab and Mohamed Qol .A small temporary camping site (Shuma)for moving nomads lies north of Dungonab village. The commissioner's office of the Directorate released in 2013 that the inhabitants of both villages are slightly over 8000. Thus a good estimate for the whole property inhabitants will not exceed 10,000.

5. Protection and Management of the property

5. a. Ownership

Both Sanganeb Marine National Park (SMNP) and Dungonab Bay/Mukkawar Island Marine National Park (DMNP) are owned by the Federal Government of Sudan. The Government owns the land and delegates the different states for land uses. The Federal Government has the constitutional right to allocate and designate National Parks in Sudan.

The first park, established in 1990, was Sanganeb Atoll Marine National Park (SMNP). This Park encompasses the remote offshore reef of Sanganeb, 30 km to the north-east of Port Sudan. More recently, the Government made a further commitment to sustainably managing their marine resources through establishing the second park, the Dungonab Bay and Mukkawar Island National Park (DMNP). This Park encompasses a section of mainland coast and offshore islands, approximately 125 km north of Port Sudan. It was declared by the Government of Sudan in 2004, following biological and ecological surveys carried out in 2002 with the support of PERSGA and the Sudanese Wildlife Conservation General Administration (WCGA).

5. b. Protective designation

Legislation relevant to the management of DMNP is administered by both the Federal Department of Wildlife Conservation General Administration (WCGA) (which sits within the Ministry of Tourism and Wildlife) as well as the State Ministry of Agriculture, Animal Wealth and Natural Resources. At the Federal level, WCGA is responsible for the administration and management of Sudan's National Parks and for the protection of wildlife throughout the country through the Game Protection and the Federal Parks Act (1986). At the State level, the Ministry of Agriculture, Animal Wealth and Natural Resources is responsible for all environmental matters in the Red Sea State, through its Environmental Protection Act (2006) and Fisheries legislation (Marine Fisheries Ordinance 1937; Regulations amendment 1975).

DMNP falls under the Game Protection and the Federal Parks Act (1986) which has the following objectives:

- The protection of wildlife and the conservation of the Federal Parks and the game areas.
- The optimum utilization and development of the wildlife resources.
- The implementation of the international Convention on International Trade in Endangered Species of wild fauna and flora (1973).
- The provision of information on wildlife resources, their distribution inside and outside Sudan,

and the encouragement of scientific research on wildlife and their reservations.

- Preserving the natural beauty of some of these areas, or those with special importance; as far as their natural components are concerned.

State legislation

Extraction of fish and other marine resources is regulated under the State Marine Fisheries Ordinance (1937) and Amendment (1975).

The Red Sea State Environment Protection Act (2006) addresses environment, pollution, fisheries, marine parks, the coastal zone and the coastal environment. Its objectives are:

"protection of the purity and natural equilibrium and conservation of the environment and the social and cultural systems thereof, to achieve safety and sustainable development for the benefit of generations; promotion of the environment for sustainable development; linking development and the environment and spreading awareness; and ascertaining and activating the role of the competent authority and its delegates and preventing laxity and short comings of performance". The Act specifies the establishment of the "Environment and Natural Resources Supreme Council" and makes provisions for competent authorities to be delegated to conduct environmental protection on behalf of the Council, namely other ministries and national societies.

Both SMNP (1990) and DMNP (2004) are declared as MPAs by Presidential Decrees and buffer zones were drawn to further protect their boundaries. The 5km buffer zone around Sanganeb Atoll will include the pelagic and deep water areas which are integral part of the Atoll.

5. c. Means of implementing protective measures

The Wildlife Conservation General Administration (WCGA) through its rangers and available equipment is currently managing the property, but with limited facilities. Regulations of Fisheries Administration are enforced and other security departments complement the implementation.

The Red Sea State established a committee for developing strategic program for protection of Red Sea coastal environment by a ministerial decree No 5 in 2014 , including the membership of several related authorities such as Directorate of Environment and Tourism, Red Sea University, Fisheries Research Center, Faculty of Marine Science, Wildlife Administration, Coastal Fisheries Administration, Marine Environment Protection Administration, representative of Mohamed Goal Locality, Maritime Security, representative of Dungonab Local Community and representative of Mohamed Goal Local Community. The committee has

the mandate of enforcing the regulations of Environment, Fisheries, Wildlife and other related departments. There is full cooperation between all the above mentioned institutions.
Community participation has been taken into account by PERSGA in the management of DMNP through a PERSGA/World Bank project to be implemented in 2012.
WCGA proposed a Management framework for Community Participation to enforce the coordination between WCGA, Wildlife Department in the Red Sea, the Tourism Private Sector, the NGOs and the local communities in the property.

Plate27: Fishers community at DMNP.

5. d. Existing Plans related to municipality and region

There are no existing plans related to municipal management of the property. In June 2011the state Ministry of Environment, Tourism and Wildlife endorsed a five-year (2012-2016) Strategic Plan for Tourism Sector in the State (In Arabic). Among the tourism projects of the plan, is nominating the property for inscription in the WHL

Cousteau Organization is willing to develop a partnership with WCGA for developing Ecotourism Strategy for the property. As being stated under the factors that might affect the property, the development activities as related to ecotourism will be undertaken within the strategy to have no negative impacts on the marine habitats, fauna and flora and to be non-consumptive and non-extractive.

The future number of visitors might increase. Therefore WCGA has to prepare for such an increase of visitation by improving the present facilities, infrastructure and amenities. The tourist lodges would include simple design, The business contractors should construct and operate low-impact facilities in such lodges.

The private tourism industry would generate financial benefits for both local people and private companies. The tourism companies should recognize the rights and spiritual beliefs of the Indigenous communities in Dungonab and Mohamed Gol villages and work in partnership with them to create empowerment.

The ecotourism strategy will aim to minimize physical, social, behavioral, and psychological impacts. As stated before the property can absorb the current number of visitors without any adverse effects. But the visitors are expected to increase especially at Mukkawar Island as it is a target for large-scale tourism investments which might threaten the integrity and the carrying capacity of the property.

But the strategy will build environmental and cultural awareness, and respect of the visitors to the OUV of the property. The awareness program will include positive experiences for both visitors and hosts and the divers, photographers and researchers who are the most aware of the importance of protecting this ecosystem.

5. e. Property Management Plan

(1) Sanganeb Marine National Park Site-Specific Master Plan with Management Guidelines

DRAFT 16-05-2004 PERSGA
Appendix 6

(2) Dungonab Bay–Mukkawar Island Proposed Marine Protected Area Site-Specific Master Plan with Management Guidelines

Draft 28 June 2004 PERSGA
Appendix 7

Sanganeb Atoll has attracted the attention of scientists inside and outside the Sudan. IUCN supported a feasibility study for Sanganeb Marine National Park by an international consultant. Unfortunately the consultant was not able to complete and submit his final report. PERSGA supported the Park by preparing a Site-Specific Master Plan in 2004 (Appendix 6).The immediate objectives of this Plan are as follows:

- To manage SMNP sustainably,
- To maintain species diversity, conserve habitats and the human built environment within SMNP,
- To promote sustainable tourism in SNP,
- To educate and inspire,
- To contribute significantly to the development of a national capacity to plan and manage MPAs,
- To involve local communities and stakeholders as partners in SMNP management,
- To provide for the sustainable use of living marine resources.

The way the Master Plan is implemented is governed by a management policy based on five principles:

1. Sustainable funding based on business principles;
2. Flexibility and feedback to improve plans;
3. Friendly, efficient and economical;
4. Phased approach to learn from new experiences;
5. Communication.

DMNP

Following a comprehensive biological survey PERSGA has also prepared a management plan for DMNP which was updated by the African Park Foundation.The objectives and the bases of policy are similar to SMNP management plan (Appendix 7).

The WCGA has started steps to prepare an Integrated Management Plan for the property. The Plan will be comprehensive , participatory and with a clear framework of approved policy (Appendix 13).

5. f. Source and level of finance

The Federal Ministry of Finance supports WCGA by an annual budget for currently running the property. However, extra-budgetary resources are always obtained to improve the infrastructure and monitoring.

5. g. Sources of expertise and training in conservation and management techniques

PERSGA has an annual training programme including courses in MPA management where rangers from WCGA participate. This is in addition to the periodic training opportunities held locally (Plate 28), (Appendex 13)

5. h. Visitor facilities and infrastructure

There are regular trips for Sea Port Corporation tug boat to Sanganeb whereby visitors from Port Sudan visit the property. However, tourists visit the property in their own yachts. Few boats enter Dungonab Bay and visitors reach it by paved road. Generally, the facilities and infrastructure are poor and need more support in the future (Refere to 5 c)

5. I. Policies and programmes related to the presentation and promotion of the property

These policies and programmes are included in the Management Plans of SMNP and DMNP. Recently, a Memorandum of Understanding was signed by WCGA, Cousteau Organization and Red Sea state for research and monitoring flag-ship species (Sharks and Manta Rays).

PERSGA Marine Protected Area-Strategic Action Programme (MPASAP), funded by the Global Environment Facility (PERSGA / GEF, 2004), creating a regional network of marine protected areas in the Red Sea and Gulf of Aden including SMNP and DMNP, is related to the presentation and promotion of the property.

5. j. Staffing levels and expertise (professional, technical, maintenance)

WCGA has recruited 35 rangers for both SMNP and DMNP (2015). Moreover, 7 marine biology graduates have been trained as park wardens and appointed in July 2012 (Appendix 13). This relates specifically to the technical and maintenance staffing capacity and levels of experience.

6. Monitoring

6. a. Key indicators for measuring state of conservation

The key indicators for measuring the state of conservation of the property are mainly ecological and partially socio-economic. The major ecological indicator is to measure and monitor biodiversity periodically. However, variability of oceanographic properties can be good indicators of any changes within the ecosystem. Temperature, salinity, eh Redox are good examples.

The abundance and distribution of the key fishery species will indicate the level of stability of the oceanographic condition and the health of the ecosystem. Fisheries statistics from the Fisheries Administration could also be an indicator for measuring the state of conservation.

Currently a project titled "Marine Fisheries Development Strategy in the Red Sea State of Sudan" supported by UNIDO (2013) is carried out. The objectives of the project are to analyse the Red Sea State fisheries sector and identify the development drivers based on which a long term development strategy could be built.

The ratio of occurrence of some species to each other is another indicator to the equilibrium of the state of conservation e.g. nematode/copepod ratio is an index to the health of the area and to the stress of pollutants.

The SMNP light house building contains a small room laboratory for Red Sea University researchers. There are two research stations in DMNP- Fisheries Research Station and Red Sea University station- and their continuous research on these indicators contribute substantially to the knowledge of the state of biodiversity.

Habitat alteration and degradation is another key indicator for measuring the state of conservation especially resulting from natural disasters. Wildlife Authority (WCGA) monitors on regular bases these habitats.

As for socio-economic indicators, especially in DMNP, the total economic value in the area is a reflection of the state of conservation. Public health and safety together with cultural integrity of the community are good indicators for a sound state of conservation.

Table 9 indicates the possible key indicators for measuring the state of conservation of the property.

Table 9: Key indicators for measuring state of conservation of the property.

Indicator	**Periodicity**	**Location of Records**
Oceanographic variables e.g. Temperature, salinity eh Redox….	Monthly	* Fisheries Research Centre (Dungonab Station). * Red Sea University: (i) Dungonab Station (ii) Sanganeb Laboratory.
Coral Percentage Cover % by(underwater photography)	Every 4 months	Same as above
Commercial fish stock	Monthly	Fisheries Administration Statistics Department (Port Sudan)
Public health Statistic	Monthly	State Ministry of Health(Port Sudan)

6. b. Administrative arrangements for monitoring property

The administrative arrangements for monitoring property are a collective responsibility of the following:

- The Wildlife Conservation General Administration (WCGA), Red Sea state, Port Sudan.
- The Fisheries Administration, Red Sea state, Port Sudan.
- The State Ministry of Environment and Tourism.
- Research institutions and universities :
- Fisheries Research Center (Port Sudan), Dungonab station.
- Red Sea University Marine Station, Dungonab.
- Local government and local community committee.

WCGA will collect data from all and assign researchers, officers and rangers to implement monitoring.

6. c. Results of previous reporting exercises

Results confirming and showing the Outstanding Universal Value of the property are found in:

- Annual reports from the Wildlife Conservation General Administration and Fisheries Administration;
- Research projects carried out by regional and international organizations,
- Research carried out by researchers, university postgraduate students etc. (see appendix 3).

7. Documentation

7. a. PHOTOGRAPHS AND AUDIOVISUAL IMAGE INVENTORY AND AUTHORIZATION FORM

Id. No.	Format(slide/ print/video)	Caption	Date of Photo	Photographer/ Director of the Video	Copyright owner	Contact details of copyright owner	Non exclusive cession of rights
1	Video	The Wonderful Sudanese Red Sea Coast	April 2012	P/Hans Sjoholm D/Dr.Dirar Nasr	Sudan Government (Ministry of Trade)	admin@Sudan-Tourism.Gov.Sd	√
2	Print (containing 44 pictures of the property).	The Wonderful Sudanese Red Sea Coast	April 2012	P/Hans Sjoholm D/Dr.Dirar Nasr	Sudan Government (Ministry of Trade)	admin@Sudan-Tourism.Gov.Sd	√
3	Photo 1	Sanganeb Atoll	April 2012	P/Hans Sjoholm D/Dirar Nasr	Sudan Government (Ministry of Trade)	admin@Sudan-Tourism.Gov.Sd	√
4	Photo 2	Shuab Rumi	April 2012	P/Hans Sjoholm D/Dirar Nasr	Sudan Government (Ministry of Trade)	admin@Sudan-Tourism.Govr.Sd	√
5	JPG file	File/ pictures	Diddrenet dates	PERSGA Photo-library	PERSGA	PERSGA	√

7. b. Texts relating to protective designation

- The two management plans for SMNP and DMNP are attached as Appendix 6 and Appendix7 respectively.
- The Red Sea and Gulf of Aden Network of Marine Protected Areas: Regional Master Plan" – Appendix 8.
- Regional Action Plan for the Conservation of Coral Reefs in the Red Sea and Gulf of Aden – Appendix 9.
- Regional Action Plan for the Conservation of Breeding Seabirds and their habitats in the Red Sea and Gulf of Aden – Appendix 10.
- Regional Action Plan for the Conservation of Mangroves in the Red Sea and Gulf of Aden – Appendix 11.
- Regional Action Plan for the Conservation of Marine Turtles in the Red Sea and Gulf of Aden – Appendix 12.

7. c. Form and date of most recent records

The most recent record is a Ph. D. research work:

Gaiballa,A. K. (2013) Diversity and distribution of seagrass meadows and associated epibenthic macroinvertebrates and fishes in the Sudanese Red Sea coast. Ph. D.thesis University of Khartoum, Sudan. 221pp.

7. d. Address where inventory, records and archives are held

CITES Management Authority

Director / PAs / Directorate

Wildlife Conservation General Administration (WCGA)

Khartoum - Sudan

Tel: ++249 912162768

Tel: ++249 912391671

E. mail: wildlife_sudan33@yahoo.com.

7. e. Bibliography

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8. Contact Information of Responsible Authorities

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Red Sea State, Ministry of Environment and Tourism – Port Sudan- Sudan.

8-d: Official Web address: Not available.

9. **Signature on behalf of the State Party**

On behalf of the state party

General (police) Abdelhafize Osman Eljack

Director / Pas / Directorate

Khartoum – Sudan

January 2016

بسم الله الرحمن الرحيم

جمهورية السودان

Republic of the Sudan

وزارة السـياحة والآثـار والحـياة الـبرية

MINISTRY OF TOURISM ANTIQUITIES, & WILD LIFE

مكتب وزير الدولة

Dear Mr. Secretary General

Sudanese National Commission for UNESCO (SUDNATCOM)

Subject: Declaration of Sanganeb and Dungonab Bay-Mukkawar Island Marine National Parks as UNESCO World Heritage Site

It is with great enthusiasm that the Ministry of Tourism, Antiquities and Wildlife recommends the Sanganeb and Dungonab Bay- Mukkawar Island Marine National Parks be nominated as a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site. The Ministry recognizes the honor of Sanganeb and Dungonab as a serial natural heritage site with an associative natural landscape administered under provisions of the convention concerning the protection of the world Natural Heritage Convention.

On April ١٩٩٠, the Government of Sudan issued Presidential Declaration No. ٦١٦ establishing Sanganeb and on ١٩٩٢ issued Presidential Declaration no… establishing Dungonab Bay- Mukkawar Island Marine National Parks under the authority of Wildlife Act of. 1986.

The serial property nominated here encompasses very significant formations of an atoll and the largest bay in the Sudanese Red Sea, both harbor significant populations of fauna and flora in a stable equilibrium with numerous endemic and endangered species. Sanganeb atoll (٤,٦ km٢) is the only geological structure of its type in the Red Sea. Dungonab Bay (٢٨٤,٥ km٢) contains a diverse structures of coral reefs of the property gave Sudan the distinction of being referred to as "the central Red Sea barrier reef" in the Red Sea coast .

In recognition of the obligation under Article ٤ &٥ of the convention and in coordination with its co-trustees; the State of the Red Sea, the Wildlife Conservation General Administration (WCGA) and the Ministry of Tourism, Heritage and Wildlife take all appropriate measures including legal, scientific, technical administrative necessary for the protection, conservation, and preservation of the outstanding universal value of the site and its resources. This obligation is satisfied through the protective measures taken in the President's declaration, its implemented regulation and the management plan.

The Ministry of Tourism, Antiquities and Wildlife supports the WCGA and National Man and Biosphere (MAB) Committee efforts to nominate Sanganeb and Dungonab Bay-Mukkawar Island Marine National Parks to the UNESCO World Heritage List and offers any needed assistance to ensure the nomination successfully navigates the approval process through Sudan and UNESCO.

Sincerely

06/08/2012

Mr. Eissa Difalla Abdalrazek
State Minister of
Tourism, Antiquities and Wildlife

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WILDLIFE CONSERVATION
GRENRAL ADMINISTRATION
Executive Office

بسم الله الرحمن الرحيم

الإدارة العامة لحماية الحياة البرية

المكتب التنفيذي

Dear Mr. Secretary General
Sudanese National Commission for UNESCO (SUDNATCOM)

Subject: Declaration of Sanganeb and Dungonab Bay-Mukkawar Island Marine National Parks as UNESCO World Heritage Site

The Wildlife Conservation General Administration (WCGA) with the MAB Committee heartily endorses the nomination of Sanganeb and Dungonab Bay- Mukkawar Island Marine National Parks, as a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site. As recognized by many authorizes including the MAB National Committee these marine protected areas, offer a wealth of natural, cultural and historic resources that truly deserve not only national but international acknowledgement

It is an honor for WCGA to support consideration of of Sanganeb and Dungonab as a serial natural heritage site with an associative natural landscape administered under provisions of the convention concerning the protection of the World Natural Heritage Site.

Numerous natural treasures of international significance are found within Sanganeb and Dungonab Bay-Mukkawar Island Marine National Parks, encompasses very significant formations of an atoll which is the only geological structure of its type in the Red Sea, and the largest bay in the Sudanese Red Sea contains a diverse structures of coral reefs that gave Sudan the distinction of being referred to as "the central Red Sea barrier reef" in the Red Sea, both harbor significant populations of fauna and flora in a stable equilibrium with numerous endemic and endangered species.

In recognition of the obligation under Article 4 &5 of the convention and in coordination with its Co-Trustees; the State of the Red Sea, WCGA and the Ministry of Tourism, Antiquities and Wildlife take all appropriate measures including legal, scientific, technical administrative necessary for the protection, conservation, and preservation of the outstanding universal value of the site and its resources. This obligation will continue to be met through the protective measures required by the National Wildlife Protected areas system and by the Presidential Declaration of the two Marine Protected areas within the serial site, its implementing regulations, and its management plan.

Thank you for your efforts to recognize this unique natural treasure. If we can provide any further assistance during the nomination's consideration by Sudan and UNESCO , please contacts Mr. Abdelhafize Osman Al Jack, Director of Protected areas/ WCGA.

Sincerely

لواء شرطة/
سند سليمان بن سليمان

Mr. Sand Bin Sulman

Director of WCGA

Ministry of Tourism, Antiquities and Wildlife

TEL:1832522108 - FAX: 183522109 e- mail .wildlife_sudan33@yahoo.com ت : ١٨٣٥٢٢١٠٨– فاكس: ١٨٣٥٢٢١٠٩

Sudan-Kh - P.O Box:336 السودان- الخرطوم – ص.ب:٣٣٦

Plate 28: WCGA Wardens: On-the-job training workshop