The Regional Organization for the
Conservation of the Environment of
the Red Sea and Gulf of Aden

(PERSGA)

Sanganeb Marine National Park

Site-Specific Master Plan with Management Guidelines

DRAFT

16-05-2004

PERSGA
May 2004

PERSGA - 'The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden' is an intergovernmental authority dedicated to the conservation of the coastal and marine environments in the region and the wise use of their natural resources.

The Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (Jeddah Convention) 1982 provides the legal foundation for PERSGA. The Secretariat of the Organization was formally established in Jeddah following the Cairo Declaration of September 1995. The PERSGA member states are Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan, and Yemen.

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This document was prepared by Dr. Simon Wilson under contract to PERSGA with the cooperation of the Wildlife Conservation Administration (Sudan). The work was carried out through the Marine Protected Areas component of the Strategic Action Programme for the Red Sea and Gulf of Aden executed by PERSGA and implemented by the GEF partners (UNDP, UNEP and the World Bank) with supplementary funding from the Islamic Development Bank.

This publication may be cited as:
PERSGA/GEF. 2004. Sanganeb Marine National Park Site-Specific Master Plan with Management Guidelines. PERSGA, Jeddah.

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Abbreviations and Acronyms

CBD	Convention on Biological Diversity
CD-ROM	Compact Disc - Read Only Memory
CITES	Convention on the International Trade in Endangered Species
CoTS	Crown-of-Thorns Starfish
DMPA	Dungonab Bay Marine Protected Area
EEZ	Exclusive Economic Zone
FIELD	Foundation for International Environmental Law and Development
GCRMN	Global Coral Reef Monitoring Network
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HCENR	Higher Council for Environment and Natural Resources
IMO	International Maritime Organisation
IOPC	International Oil Pollution Compensation
ITOPF	International Tanker Owners' Pollution Federation
IUCN	International Union for the Conservation of Nature
MARPOL	International Convention on Marine Pollution
MEPS	Marine Environmental Protection Society
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MSC	Monitoring, Surveillance and Control
NGO	Non-Governmental Organisation
NOSCP	National Oil Spill Contingency Plan
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation
PERSGA	Programme for the Environment for the Red Sea and Gulf of Aden
RIB	Rigid Inflatable Boat
SCUBA	Self-contained Underwater Breathing Apparatus
SECS	Society for the Environment and Conservation in Sudan
SMCC	Sudan Marine Conservation Committee
SNP	Sanganeb Marine National Park
SPC	Sea Ports Corporation
TBT	Tri-butyl Tin
UK	United Kingdom
UNEP	United Nations Environment Programme
UNESCO	United Nations Education, Scientific and Cultural Organisation
USA	United States of America
VHF	Very High Frequency

Acknowledgements

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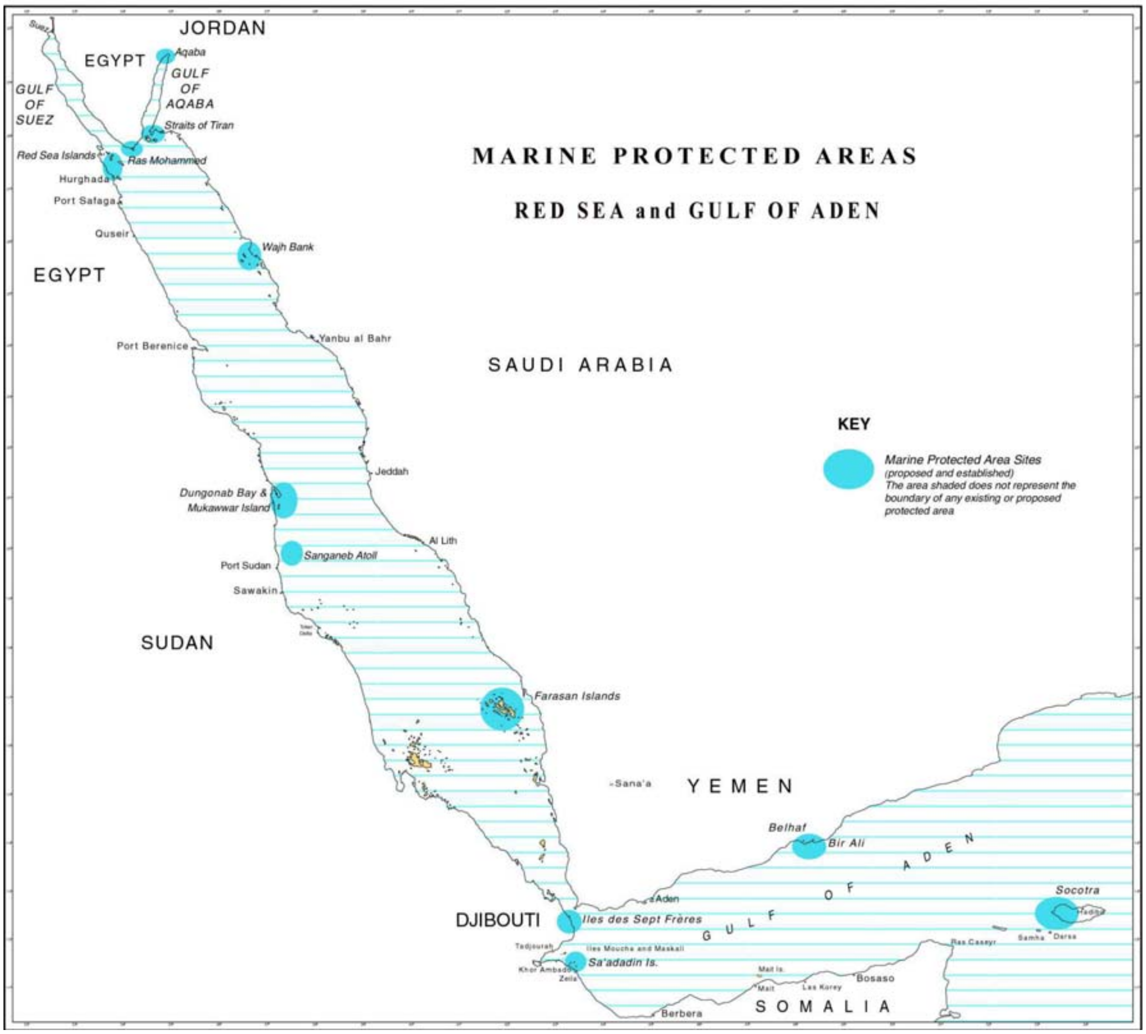


Key areas selected to create a regional network of marine protected areas in the Red Sea and Gulf of Aden.

EXECUTIVE SUMMARY

This management plan is a business plan. The single most important philosophy incorporated into this plan is that without sustainable funding there can be no effective conservation at Sanganeb Marine National Park (SNP), and the most important source of income for the Park[1] is derived from its visitors. Therefore it is true to say that without recreational use of the Park, there can be no active conservation of its natural resources.

The overall approach to the development of SNP, as presented here, conforms to the IUCN's vision of a Category II Protected Area (ANON 1994):

Category II: ***National Park: protected area managed mainly for ecosystem protection and recreation*** – natural area of land and/or sea designated to: (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area, and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

SNP is designed to protect a unique geological structure, the only widely recognised atoll in the Red Sea, along with its pristine living reef and populations of associated fauna including commercially important fish stocks. The reef is located in the central Red Sea away from many human impacts and close to the Red Sea's centre of biodiversity. The atoll is entirely submerged, and the only part of SNP to occur above the sea's surface is the magnificent Sanganeb lighthouse and the few buildings that surround it. These features, along with its growing reputation as one of the best dive sites in the world, make SNP an excellent candidate for protection. This is largely because its potential for recreation and its conservation value are both very strong and compatible.

The plan presented here is almost entirely focused on what occurs within its boundaries, but it must be recognised that SNP must also fit into a wider context, a context that treats the entire Sudanese coast, indeed the entire Red Sea as a whole, integrated system. Although it has been written to integrate with a regional plan (PERSGA Master Plan for the Regional Network of MPAs) and two national plans (Biodiversity and Oil Spills), there are numerous other roles in which it may play a significant role, notably plans to manage marine fisheries, tourism, mineral exploration, security and defence.

[1] Park, capital 'P', refers in this document to Sanganeb Marine National Park.

1 OBJECTIVES, GOALS, STRATEGIES AND POLICIES

The immediate objectives of this Site-Specific Master Plan are as follows:

- To manage SNP sustainably,
- To maintain species diversity, conserve habitats and the human built environment within SNP,
- 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 SNP management,
- To provide for the sustainable use of living marine resources, and
- To contribute to the effective operation of a network of MPAs throughout the Red Sea and Gulf of Aden.

These underpin the goals of this Master Plan, which in turn form the platform for the development of the Park's policy and strategies as given in Table 1. The Management Plan presented in Section 4 is in line with the policies and strategies, and once implemented will result in progress toward reaching the goals.

Table 1: Objectives, goals, strategies and policies of the SNP Site-Specific Master Plan

OBJECTIVES	GOALS	STRATEGIES AND POLICIES
1. To sustainably manage SNP	To secure sufficient, sustainable and flexible sources of financing To ensure that the carrying capacity of SNP is reached but not exceeded To respond appropriately to human induced changes detected in the environment and user profile To include the local community in all aspects of Park management as far as possible To reciprocate in sharing management experiences with other MPAs, and to learn from them To manage the conflicts between non-extractive use and conservation by implementing a zoning plan To maintain SNP infrastructure at a level that is necessary and sufficient for effective management. To ensure that SNP has the necessary legal basis for its operation	SNP will strive to become self-financing as far as possible using income from visitors and other non-extractive uses. Each year the Park's books will be audited and balanced. SNP's income will be ring-fenced for use in implementing the management plan, and will not be pooled in the federal budget. This will require establishing a proper legal system for SNP such as a trust fund. The number of tourists using SNP will not exceed the carrying capacity. Critical aspects of the Park's functioning and status of its natural resources and environment will be surveyed and monitored and the results fed back into the planning process. Visitors and tour operators will be encouraged to be self-policing and self-monitoring. Every second year the SNP management plan will be revised to incorporate the lessons learnt from the previous year and from scientific monitoring. The local community shall be invited to participate in business opportunities that SNP creates, become involved on the SNP committee and offer creative feedback to management at all levels. Visitors to the Park will be encouraged to report their observations and share their photographs. The Park's management will participate in regional and international discussions, conferences and workshops on MPA management. SNP's zoning plan will be implemented and periodically assessed and updated as necessary. Mooring buoys and anchorage areas will be installed and designated to protect coral from anchor damage. A buffer zone will be legally established to control remote impacts. SNP's equipment and infrastructure will be maintained at an appropriate level with care given to ensuring that their running and maintenance costs do not escalate beyond what is affordable and necessary. SNP will seek professional legal advice with regard to its legal standing and liabilities and where necessary take action to minimise its risks. SNP will agree to a memorandum of understanding with the Sea Ports Corporation (SPC) over the use of the lighthouse and associated buildings.

2. To maintain species diversity, retain habitats and the human built environment within SNP	To protect the habitats and ecological processes that sustain living marine resources at all stages of their life cycle To enforce a no fishing regulation within the Park (except from the jetty with hook and line) To protect and conserve the lighthouse and wrecks in SNP To consider the risks and threats that SNP faces from external forces, and to be prepared for all possible incidents	Viable populations of key species within the Park including bumphead parrotfish, Napoleon wrasse, spotted coral grouper, sea cucumbers and *Trochus* will be sustained, protected and encouraged. The mating, spawning and nursery areas of other important species including sharks, billfish and dolphins will be protected in special areas. SNP will draw up legally binding regulations concerning fishing and other issues, and these will be rigorously enforced. The lighthouse and wrecks will be cleaned, maintained and protected in co-ordination with SPC. SNP will prepare contingency plans that cover the incidents of CoTS outbreaks, oil spills, ship groundings etc. and co-ordinate with the navy and coastguard on matters of national security.
3. To promote sustainable tourism in SNP	To ensure that visitors do not directly or indirectly damage the natural and built resources within SNP To ensure that visitors and Park management behave responsibly and with respect to the natural environment and culture in which SNP is located To ensure that future tourism developments are undertaken in a sustainable way, and subjected to rigorous environmental and social impact assessment prior to implementation To become recognised as one of the world's premiere safe, dive sites To make SNP more attractive to non-diving visitors	Friendly but firm rangers will patrol SNP to inform visitors and protect the environment. A waste management plan will be drawn up and implemented, and the toilet facilities upgraded. Codes of conduct will be formulated and disseminated to SNP users to minimise their impact on the natural resources within the Park (codes for tour operators, diving, cetacean watching, etc.). The relationship between SNP and its visitors will continue after the visitor has left SNP to encourage return visits. This will be achieved by establishing a membership organisation, Friends of Sanganeb, which will distribute new information about the Park by e-mail. All future developments within SNP will be subject to impact studies. SNP will be promoted as a 'must see' location for international tourists visiting Sudan, and will also offer a rich and inspiring experience to non-diving national and international visitors. SNP will work with dive operators to develop an emergency response for divers and fishermen lost at sea. SNP will be promoted as a world class dive site to attract the required numbers of diving tourists. Visitor numbers, profiles and activities will be monitored and the results will feedback into the management planning process.

		SNP's aesthetic values will be protected. SNP will consider the development of more walkways and rest areas, and rehabilitation of the existing rest area (on the northern jetty) to increase the number of non-diving day-trippers that the Park can accommodate. A safe area will be designated for swimming and snorkelling. Park entrance fees will be in line with comparable sites elsewhere in the Red Sea and the world.
4. To educate and inspire	To be recognised as a prime site for school and university field trips for students to learn about the marine environment and its conservation To develop public education and awareness programmes that disseminate information and encourage active participation in the global conservation movement To develop a public awareness plan and communication policy that meets the needs of SNP, and reaches its major stakeholders To develop a visitor centre at SNP	SNP will accommodate and welcome school and university field trips. SNP will become a model MPA where it will be possible to test theories about the way MPAs function and conserve the environment. A range of information in a variety of media will be developed and presented imaginatively to visitors and the general public. SNP's research requirements will be advertised to encourage collaboration with Universities in Sudan and from around the world. SNP will develop a public awareness plan and communications policy that incorporates feedback from stakeholders. Services offering tours of the reef with glass-bottomed boat will be encouraged from the private sector to allow young children and non-swimmers to view the reef. SNP will develop a visitor centre in an imaginative and creative way that is designed to inspire and educate visitors, and a kiosk to inform the public about the Park.
5. To contribute to the development of a national capacity to plan and manage MPAs	To train Sudanese staff in MPA management and planning To procure equipment necessary to implement the management plan To work with other Sudanese MPAs to mutually benefit from shared experiences To encourage links with other MPAs in the region and globally in order to exchange views on best management practices	SNP will recruit, develop terms of reference, work plans, train its staff to appropriate international standards and offer training opportunities for staff from other MPAs in the region. Information regarding training opportunities will be gathered for use in cost planning. SNP will economically procure the necessary equipment and technical references from appropriate sources. SNP will be fully integrated into a national network of protected areas to maximise the possible synergy available including training opportunities and management lessons. SNP will actively participate in international discussions relating to MPA management in the region and globally.

		SNP will allocate budget, if available, for training, exercises, workshops and capacity building. SNP will encourage the Wildlife Conservation Administration to hold a regular workshop for all Sudanese protected areas staff to share their experiences.
6. To involve local communities as partners and stakeholders in SNP	To ensure that the local community participates in the success of SNP To ensure that the local community benefits economically from SNP through partnerships, participatory co-management and employment	The SNP committee will include representatives from all the major stakeholders and user groups. SNP management will be receptive to and consider suggestions offered by the local community. SNP will ensure that local businesses are given fair and equitable opportunities to participate in the business activities associated with the tourism industry.
7. To provide for the sustainable use of living marine resources	To protect and enhance the indirect fishery potential of the Park through replenishment of depleted areas outside the Park, and if necessary rehabilitation of viable populations of species within the Park To be used as a site for bio-prospecting for medicines and other compounds that might benefit mankind	SNP will draw up, disseminate and enforce regulations controlling all fishing within the Park boundaries. No poaching of marine products or any form of illegal fishing will occur within the Park boundary, including the buffer zone. SNP may serve as a platform for fisheries monitoring surveillance and control of Sudan's Exclusive Economic Zone. The status of various populations of commercially important species will be assessed and if necessary enhanced to ensure SNP maintains viable and protected populations. Where necessary, SNP will encourage research on the aquaculture potential of species found within the Park. Fish spawning and shark breeding areas will be fully protected in strict Nature Sanctuaries. There will be no fishing within SNP, except by hook and line from the jetty. There will be no collection of invertebrates whatsoever, except for research purposes. SNP will encourage research into the connectivity of the reef to the wider marine environment to understand the ecological links it has outside the Park. SNP will assist in drawing up a bio-prospecting contract and actively promote SNP as a site for bio-prospecting. SNP will encourage the necessary background research to promote the Park as a good bio-prospecting site.

8. To contribute to the effective operation of a network of MPAs throughout the Red Sea and Gulf of Aden	To effectively protect a set of habitats that are representative of the Red Sea To be a high profile MPA in the Red Sea that draws attention to conservation efforts being made in the region	SNP will be managed sustainably according to best management practices and current thinking. SNP will strive to attain the status of UNESCO World Heritage Site and will develop its own identity as a site within the network.

1.1 MANAGEMENT POLICY

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

1. Sustainable funding based on business principles

In order to meet its goals, SNP must adopt a policy that is consistent with modern business practice. Visitors are the Park's customers on which its conservation success depends. The visitor should get a sense that SNP offers value for money, that its budget is well spent, and that it is run efficiently. The Park must also actively and imaginatively promote itself through a range of different media that appeal to its main users, and the user base must be expanded to include non-divers. This requires the clear dissemination of useful information before, during and after a visit to the Park both in SNP's role as a recreational area and as a site for education and learning.

2. Flexibility and feedback to improve plans

This plan is intended to be flexible, and not simply a formula that is applied to achieve the desired result. Incorporated into the planning process are channels that allow different user groups to communicate their views, and in this way it is hoped that the end result reflects the vision of the users. However, the overall management of the Park is the responsibility of the Park Manager. Every second year amendments and alterations will be made to the existing plan that take into account the new situation as it changes, whether that be changes in the numbers and types of visitors, or the results of the scientific monitoring programme.

3. Friendly, efficient and economical

The way in which the Park staff interacts with visitors should also be governed by policy. Park staff must see each encounter with visitors as an opportunity to make a friend, inform, or educate. This will produce a positive experience for the visitor, which in turn results in a sense of involvement in the future of the Park. This policy is aimed at increasing the likelihood of SNP being recommended by word of mouth, the most efficient way of increasing the reputation of a MPA and increasing the number of visitors it attracts each year.

4. Phased approach to learn from new experiences

It is necessary to start at the beginning by getting the essential foundations in place before further development of the Park's capacity can be achieved. The approach to implementing this plan is to be phased in line with income and experience available to the Park Manager.

- Phase I – Getting started (one year duration)
- Phase II – Capacity building and promotion (two year duration)
- Phase III – Self-sustaining management (five year duration)
- Phase IV – Expansion of the Park into a co-ordinated national and international network.

The expected income due in Phase I (year one) amounts to US$12,000, while that at the end of Phase III should be in excess of US$80,000. In order to move from one phase to the next visitor numbers must increase and the capacity of the Park's staff must be strengthened through international (e.g. voluntary) technical assistance, international and national exchange programmes, and formal training workshops.

5. Communication

Clear and timely communication is a vital ingredient to the success of the Master Plan. It is one of the Park's goals to develop a comprehensive public awareness and education plan that includes educational talks and visits by school groups, information leaflets, books, a website, interactive CD-ROM, and the provision of a visitor centre and glass-bottomed boat to maximise the educational potential of a visit to SNP. Each of these elements requires information to pass from the Park to the visitor, which is why clear communication is essential.

1.2 DEFINITIONS

Master Plan

The Master Plan (or Site-Specific Master Plan) is a framework that defines the overall objectives that govern the management of the Park: objectives that will not change as the environment responds to the intervention given in the management plan. These objectives are the ultimate targets that the Park should continue to strive for even once all the goals have been met. Therefore the Master Plan encapsulates the very purpose for which the SNP has been brought into existence.

Management Plan

The Management Plan, as presented in Section 4 of this document, is a plan of action based on the existing condition of the site that follows the strategies and policies necessary for achieving the goals of the Master Plan. The Management Plan will therefore change as actions are successfully implemented and the environmental context of the Park changes (i.e. as capacity develops, equipment is procured, visitor numbers rise and sustainable financing is made available). The Management Plan must be updated every two years to reflect the positive and negative changes that the Park experiences, as well as the feedback from its stakeholders and users. The Management Plan is therefore a set of instructions that move the Park towards meeting the goals that lie on the path towards the overall objectives.

Zones

The zones given in the zoning plan have names that reflect their objectives, and these need to be defined clearly at an early stage so that the reader can understand exactly the function of each.

Buffer zone

The 'buffer zone' is an area surrounding the Park that is necessary to control human activities that might impact on the Park either directly or indirectly. These activities include shipping, mineral prospecting and exploitation, industrial fishing, military exercises and any other activity that might negatively impact on the marine environment in such a way that the causal agent (e.g. spilt oil, turbidity, sediments rich in heavy metals, drifting nets and noise) may be carried inside the Park's boundary. The buffer zone extends 5km from the boundary of the 'core zone' in all directions.

Core zone

The 'core zone' is a multi-use area that allows the dual functions of SNP, conservation and recreation, to achieve their full combined potential. It is vital to realise that both of these objectives are mutually interdependent: without the conservation of habitats and natural resources the attraction of SNP to tourists is diminished, and without recreational use of the Park there would be insufficient funds to conserve the area for future generations. This may appear to lead to conflicts of interest if only one half of the goal is considered, but this plan has been designed with both objectives taken together. All activities in the core zone are controlled, while some activities are banned altogether. Diving, snorkelling and yachting will be the main activities taking place in the core zone, while mooring and anchoring will be restricted to certain points and areas.

Nature Sanctuary

Nature Sanctuaries are areas where no human activity is permitted, with the exception of research. The rationale for fully protecting areas is to preserve the resources within them in their original, natural, undisturbed state. It is only against such pristine areas that the influence of human activities can be measured. Strict Nature Sanctuaries will protect about 30% of the total reef area.

2. DESCRIPTION OF THE AREA

The Red Sea contains some of the world's finest coral reefs. Within the central Red Sea, including the entire Sudanese coastline and a large section of the Saudi Arabian coastline, conditions are optimal for coral growth and reef development, and the diversity of reef organisms is greatest. Sanganeb Atoll therefore lies at or close to the centre of marine biodiversity in the Red Sea.

In addition to their unique geological structure, the reefs at Sanganeb Marine National Park (SNP) are unusual in that they are in excellent condition, have a high species richness with a large number of flagship species (e.g. large fish and sharks), are not immediately threatened by human activity and have good potential for non-extractive development compatible with the conservation aims of the Park (e.g. tourism and bio-prospecting). Having no resident population and not being an important traditional fishing ground also adds to SNP being a strong candidate for effective management.

Indeed, since at least the early 1980s Sanganeb Atoll has been identified as a potential World Heritage Site, and more recently has been suggested again (PILCHER 2002). Gaining World Heritage Status is a long-term goal of this Master Plan, but it is recognised that the area must be managed effectively before this status can be achieved.

2.1 LOCATION AND SIZE

Sanganeb Atoll is located approximately 30km north-east of Port Sudan at 19º 42'N 37º 26'E (Figure 1). Sanganeb is a small atoll by global standards: its maximum length along the north-south axis is 6.5km, and its maximum width is 1.6km, making it comparable to some of the smaller atolls in the Pacific Ocean. The area of reef flat and shallow fore reef is approximately 2km^2, and the area of enclosed lagoon is approximately 4.6km^2.

The total area enclosed by the present boundaries of SNP is approximately 22km^2. The buffer zone presented in this plan increases the area of SNP to 270km^2.

Box 1: Management issues relating to location, size and topography

While the remote location of Sanganeb Atoll means that it is relatively free of the threats associated with coastal development, it also makes visitor access difficult. Transport costs to and from the Park from Port Sudan must be considered when establishing an appropriate entrance fee, as this is likely to be a significant proportion of the cost for visitors, particularly for day-trippers.

SNP's remoteness also influences the cost and way in which the Park is supplied by and communicates with the mainland. Prevailing sea conditions will influence the movement of visitors within the Park and the choice of vessel and engines used for the patrol vessel, although the lagoon area will remain reasonably calm even if conditions in the open sea are rough. The shape of the atoll is very distinctive and gives a strong identity to SNP. This should be incorporated into the logo for the Park and used in Park-related media.

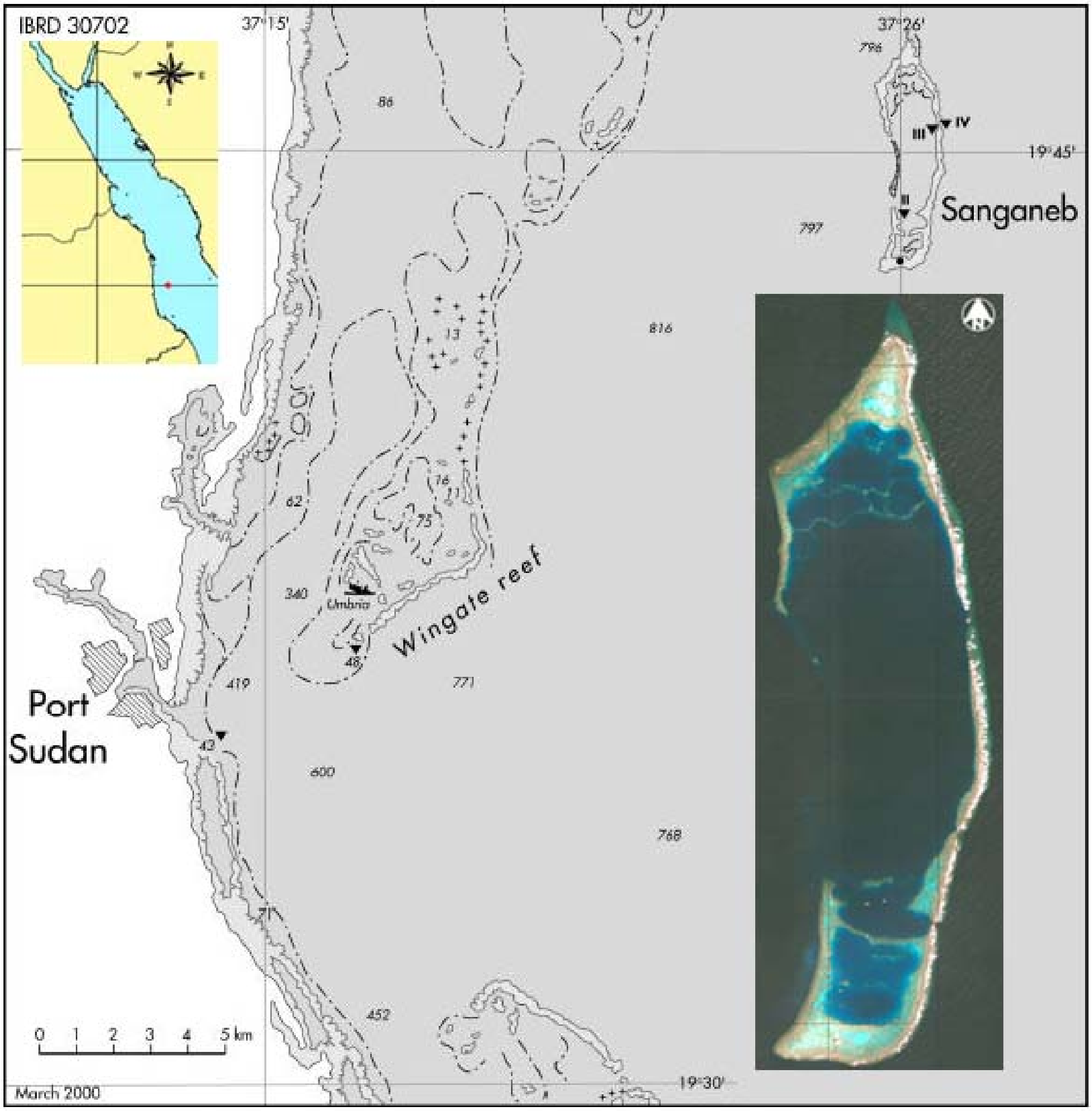


Figure 1: Location map for Sanganeb Marine National Park

2.2 TOPOGRAPHY AND BATHYMETRY

The Red Sea forms part of an extended rift valley caused by the faulting of continental blocks that have sunk as the Arabian Plate moved away from the African plate and towards the Central Asian Plate. This process has resulted in a stepped profile of the continental margin: the shallowest being less than 50m deep and supporting numerous fringing and barrier reefs, deeper shelves of 500-1,000m depth and finally the floor of the Red Sea with its hot brine pools and metalliferous muds at depths approaching 2,000m. Sanganeb Atoll rises from a shelf with its base at about 800m depth. With the exception of the man-made structures built on the reef flat in the south, there is no dry land at Sanganeb.

Box 2: Management issues relating to topography and bathymetry

There are no safe anchorages in the vicinity of SNP in the case of non-routine events, emergencies or severe weather because of the deep water surrounding the atoll. In the event that ships of more than 100t are forced by circumstance to anchor in or near the lagoon, an anchorage area with good holding must be designated to avoid the risk of damaging the surrounding reef.

2.3 GEOLOGY AND SEDIMENTS

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. However, for the purposes of this management plan Sanganeb will be considered as a true atoll, adding to its intrinsic value and uniqueness.

There have been no specific investigations into the sediments of SNP 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.

Box 3: Management issues relating to geology and sediments

Sanganeb is seen as being the only atoll in the Red Sea giving it a distinctive character that sets it apart from other reefs and diving destinations in the region. This aspect should be incorporated into the media and used to promote the attractions of the Park.

Exactly why Sanganeb is the only atoll in the Red Sea raises interesting questions about the formation of atolls in general, and about the geological structure of Sanganeb Atoll in particular. This field offers good potential for academic research within SNP.

Given the on-going possibility for the mining of metalliferous muds from the deeps in the Red Sea it would be prudent to conduct a comprehensive baseline survey of heavy metals in the sediments of SNP in order to establish background concentrations. Included with such analyses should be a study of hydrocarbons in sediments that would serve as a baseline in the event of an oil spill or ship grounding, and to assess the affect of discharging oily bilge water from dive vessels.

2.4 CLIMATE AND OCEANOGRAPHY

Air temperature around Port Sudan varies from a winter minimum of 10–12ºC to a summer maximum of over 40ºC, with average air temperature in May often exceeding 35ºC.

Surface seawater temperatures range between 26.2 and 30.5ºC, while at greater depths (150m) they range from 23.9–25.9ºC. The seawater temperature regime can be categorised as having a low annual variability and a small seasonal temperature range that is optimal for coral growth and reef development.

Sudan lies within the North African desert and semi-desert sub-zone, and there is no regular terrestrial runoff to the sea. The average annual rainfall on the Sudanese coast is about 111mm but it is only after torrential rains, which occur mainly in November and December, that there is some freshwater input to the Red Sea. This means that turbidity, particularly for offshore reefs is very low. Underwater visibility is very good, typically 20-30m, and occasionally reaches more than 40m. Sunlight is able to sustain plants and corals to depths of 70m in some places.

Salinity in the central Red Sea is relatively high (39-41ppt) compared to most of the world's seas and is caused by high evaporation rates and the lack of permanent freshwater input anywhere along the Red Sea. Salinity is kept in equilibrium by the inflow of lower salinity seawater through the Straits of Bab al-Mandab, which connects the Red Sea to the Gulf of Aden and the rest of the Arabian Sea.

From May to October, surface currents flow in a southerly direction, for the rest of the year they flow northwards. The tidal range in the central Red Sea is about 55cm on extreme spring tides, otherwise only about half of this value. There is also an annual tidal cycle caused by differences in pressure between the summer and winter months. In winter months the sea level is about 100cm higher than in the summer.

Box 4: Management issues related to climate and oceanography

The hot, humid and often calm weather during the summer months is not conducive for attracting tourists and consequently the diving season only lasts from September until April. Ultimately, this will limit the number of visitors to SNP. However, the warm weather in winter months is attractive to tourists. The opportunity should be taken to establish a semi-professional weather recording station at SNP to support the interpretation of reef monitoring activities.

The exceptional visibility that SNP enjoys is a critical characteristic that can be used to promote the Park.

There are no data relating to the surface and sub-surface currents around SNP. A study of which factors influence the speed and direction of currents would be useful with regard to identifying areas lying downstream of the reef which receive eggs and larvae exported from Sanganeb reef. In particular, knowledge of currents at the headlands would be useful for research on fish spawning as well as improving diver safety.

In 1998 there was unprecedented coral bleaching in the Indian Ocean and elsewhere, with some reefs in the central Indian Ocean being severely damaged to a depth of 15m. A survey in July 1998 at SNP indicated that bleached corals covered 14% of the substrate. This is in contrast to the level of bleaching on fringing reefs inshore, where 50% mortality of corals was observed in water 0-4m deep. It seems that offshore reefs such as Sanganeb Atoll may be less prone to bleaching than reefs closer to the mainland. Seawater temperatures and the incidence and impact of coral bleaching should be included in the routine ecological monitoring that is conducted at SNP.

2.5 HABITATS

The structure and zonation of Sanganeb reef is typical for the Red Sea and has been reasonably well studied (VINE & VINE 1980; MERGNER & 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 SNP.

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 very silty 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 SNP. 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 lies 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 SNP 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 & VINE (1980) also report 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.

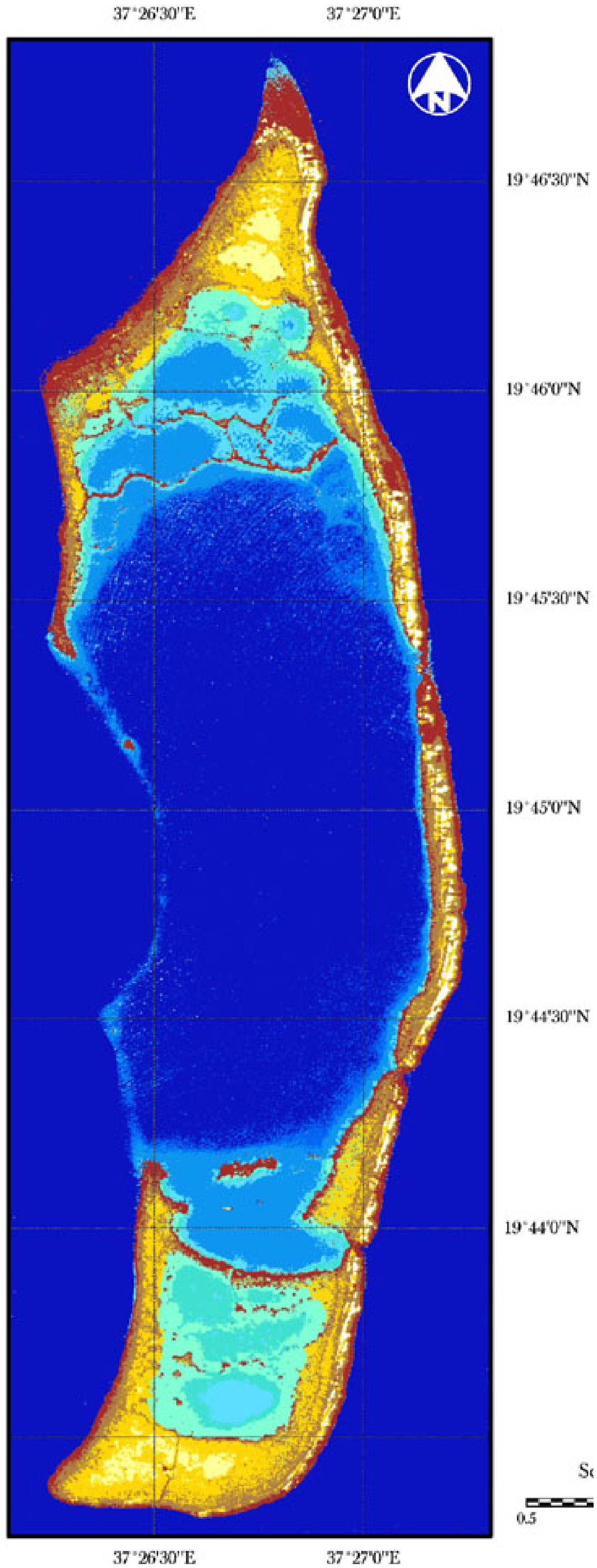
Box 5: Management issues relating to habitats

The zoning plan for SNP must incorporate the different sensitivities and values of the different habitats present in the Park. For example, where tourism activities (e.g. swimming and snorkelling by day-trippers and anchoring) may damage the more fragile branching corals, these activities must be restricted to the less sensitive areas (e.g. the back reef around the lighthouse and designated anchorages within the lagoon).

The distribution of the different habitats will also affect the position of permanent monitoring sites that are to be established. All the major habitat types must be regularly monitored to detect natural and human induced changes.

There is a relative lack of information regarding the ecology of the lagoon and the species which it supports, particularly seagrasses and sailfish. A survey of the area would be desirable for management purposes to fully understand the relationship it has with surrounding habitats, and to ensure that the areas designated for anchoring are not particularly ecologically sensitive or important.

The pinnacle to the north east of Sanganeb may be suitable as a dive site due to the large numbers of pelagic fish that are to be found there. However, it is fully exposed to weather and swell from the north-east that frequently makes diving hazardous. If it is shown that this could be a useful dive site, a mooring buoy should be installed to ensure that the site is as safe as possible.



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 SNP

2.6 FLORA

The algae of SNP have been studied by EL HAG (1994) and a list of species is presented in Appendix 7.4. 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 SNP.

Box 6: Management issues relating to flora

The distribution and abundance of seagrass on the lagoon floor should be investigated in order to manage the potential impacts arising from anchoring.

2.7 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 upwellings 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 SNP (MERGNER & SCHUMACHER 1985). The composition of coral assemblages within SNP and elsewhere in the Sudanese Red Sea are generally well known.

Box 7: Management issues relating to hard and soft corals

That Sanganeb Atoll lies in the biodiversity hotspot of the Red Sea is important for management because it can be used to attract divers and industries interested in bio-prospecting. This aspect should be stressed in the media used to promote SNP as a dive destination.

Sanganeb offers good potential to research coral recruitment and growth rates due to the optimal conditions for coral growth and development. Such research would be useful for Park management (e.g. to predict the recovery of reefs damaged by storms or ship groundings and for comparative studies with reefs in the northern and southern Red Sea).

Commercially-Important Invertebrates

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

Average national exports of kokian for 1980-1997 suggest a harvest of almost 300t/year[2]. 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 SNP.

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, 15t of dried sea cucumber was 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 SNP 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.

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 SNP on these groups.

Box 8: Management issues relating to commercially important invertebrates

As over-fishing of these species continues, the remaining stocks will become increasingly valuable since they are the source of larvae for re-stocking depleted areas. Currently, re-stocking occurs purely as a result of natural processes, but there is considerable potential to accelerate natural recruitment rates using stock management techniques and aquaculture. For this to be possible it is necessary to have access to healthy populations such as those occurring within SNP. There is a need to conduct research to support these fisheries, including research into the reproductive biology and larval ecology of the target species as well as their aquaculture potential.

The population density of bêche-de-mer at SNP is lower than expected for an unexploited population. The stock of commercially important species at SNP should be assessed and if found to be below the carrying capacity of the relevant habitats, re-stocking should be considered by collecting individuals from elsewhere or through replenishment from the PERSGA hatchery project. This will ensure that the population density is sufficient to guarantee fertilisation during spawning, maintaining the resident population as well as exporting larvae to areas downstream. Further research and monitoring may be required to verify the need and value of this approach to restoring populations of sea cucumbers at SNP.

[2] 't' or tonne, equal to 1000kg

SNP must be fully protected from illegal fishing and collecting of these species if the maximum potential benefits are to be realised. This means efficient observations must be made, during the day and night, and an effective enforcement capacity must be developed.

Research on the diversity, distribution and abundance of sponges, nudibranch molluscs and ascidians should be encouraged as these are key target groups for bio-prospecting activities.

Coral Predators

Outbreaks of Crown of Thorns Starfish (CoTS, *Acanthaster planci*) occurred in Sudan in the 1980's and were extensively researched by the Starfish Research Group of Cambridge University. 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 SNP 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.

Box 9: Management issues relating to coral predators

It is important to monitor the levels of coral damage from both human and natural causes, and this includes CoTS and *Drupella*. This is best done regularly (every month) using the manta tow technique to measure the overall density of feeding scars. Transects should also be established to measure the density of juvenile CoTS, with surveys conducted at regular intervals (i.e. every 2 months).

In addition to monitoring the impact of coral predators, a management plan should be developed that outlines the action that must be taken to intervene should an outbreak occur. It will be important to draw on the diving man-power available from the tourist industry to assist in the collection of CoTS, for example. Safe and efficient methods for the collection and disposal of collected animals as well as indicators for success must be described in the plan. The experience gained by the Egyptian Environmental Affairs Agency in the management of CoTS over the past 10 years should be adopted and applied to SNP.

Fish

The coral reef fish fauna of SNP 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 SNP 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 SNP and must be treated accordingly in the Park's management plan. A checklist of coral reef fish is presented in Appendix 7.4, but below is a description of some of the more valuable species, and the management issues associated with them.

Bumphead 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 metre 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 bumphead 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 (Bumphead) wrasse (*Cheilinus undulatus*)

The bumphead 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 metres 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 SNP 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 SNP is not known, but is likely to be relatively healthy because of the low fishing pressure, and should therefore be totally protected.

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 & 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 163t in 1990/91 to 26t 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.

Box 10: Management issues relating to fish

The monitoring of indicator fish species (e.g. Napoleon wrasse, bumphead parrotfish, grouper and shark species) is a central part of the ecological monitoring requirements of the Park. Whenever possible, research on these and other species should be encouraged, particularly studies of the habitat use of all stages of their life cycle, reproductive ecology and movements.

It is necessary to liaise with the Wrasse and Grouper Specialist Working Group of IUCN's Species Survival Commission to ensure that Sanganeb Atoll is known as a site that supports several species of important fish, including a species that is considered 'vulnerable'. Links should also be established with shark, reef fish and sailfish specialists to inform them about Sanganeb's stocks and encourage dialogue on their status and conservation.

Marine turtles

VINE & 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 SNP 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 SNP, or their use of its habitats. There are no turtle nesting sites within the SNP.

Box 11: Management issues relating to marine turtles

More information is required on the status and movement of marine turtles around SNP, and research on this topic should be encouraged.

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 SNP 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 SNP. 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.

Box 12: Management issues relating to cetaceans

Further investigation is required to establish whether there is potential for commercial whale and dolphin watching in and around SNP. This would certainly be an attraction for sea-sports based tourism, particularly for visitors who do not dive. With whale and dolphin watching as a potential attraction to the Park, it is necessary to develop and enforce guidelines to ensure that it is conducted with the animal’s welfare in mind.

The Park should also protect cetaceans from any impacts that might arise from mineral exploration in Sudan’s offshore waters. One of the most significant environmental impacts arising from seismic surveying is noise pollution that affects cetaceans, while purse-seining and long-lining can result in significant cetacean by-catch. It is therefore necessary to incorporate a buffer zone around the existing SNP boundaries within which certain fishing and industrial activities are prohibited.

There is also a severe lack of knowledge relating to the distribution and abundance of cetaceans in the Red Sea in general and Sudan in particular. Research on the whales and dolphins in the area around Sanganeb Atoll should be encouraged.

2.8 NON-INDIGENOUS SPECIES

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

2.9 RESOURCE USE

The main user groups of SNP are tourists, Sea Ports Corporation (SPC) for the operation of Sanganeb lighthouse, and fishermen, while shipping also has the potential to impact the Park. Each of these is discussed below.

Tourism

Tourism is by far the most important direct use of SNP's resources. Currently the majority of visitors are divers who are attracted by the world class diving that is available at Sanganeb Atoll. However, despite the quality of diving available, SNP only attracted about 800 divers in 2000, an increase from 425 in 1987 which is a very small figure compared to similar sites elsewhere in the world. The underlying reason for such low visitor numbers should be investigated further, but is most likely due to the weak perception of Sudan as a tourist destination, difficulties in obtaining tourist visas, and difficult travel to Port Sudan from overseas.

SNP management should be aware of the factors that lead divers to pursue this activity (from DAVIS & TISDELL 1995), and travel far to access the best dive sites in the world such as Sanganeb Atoll. The following attributes are critical to Sanganeb's image as a world-class diving destination, and must therefore be preserved as important features as SNP develops.

- A desire for a 'wilderness experience',
- An interest in marine life (e.g. sharks, large reef fish and corals),
- Pursuit of hobbies such as underwater photography,
- A general interest in marine ecology,
- An interest in underwater features (e.g. geological formations and ship wrecks),
- The fact that diving is seen as different and special (image),
- To experience the activity in a large or small group (shared experience),
- A desire for adventure with a degree of risk.

All dive tourism at SNP is based on live-aboard yachts and this has advantages and disadvantages from a management perspective. Each yacht is discrete and self-contained in terms of its water and food supply, power generation, and waste-disposal facilities. However, the environmental impacts of yachts must be considered in the management plan, as well as the tourism activities themselves:

- Large yacht anchors damage corals that occur in anchorage areas;
- Live-aboard dive yachts discharge raw sewage directly to the lagoon;
- Oily bilge water is discharged to the lagoon;
- There is potential for small amounts of Tri-butyl Tin (TBT), an extremely powerful anti-fouling agent, to enter the marine environment;
- Hand-lining for food fish is concentrated in the anchorage areas;
- Food waste is discharged into the lagoon, and there is a risk of litter entering the marine environment;
- There is a risk of groundings and small oil spills.

Each of these issues can be managed by developing a set of best operating practices for dive operators that includes the management of the live-aboard dive vessels. These best practices, in combination with other management actions, must address each of the above points. For example, dive vessels must install wastewater tanks for sewage and grey water that must be used while at anchor at SNP, the contents of which can be discharged to sea once the vessel leaves the SNP buffer zone. A minimum level of maintenance is required for vessels operating in SNP, particularly with regard to bilges, and these should be subject to inspections by Park rangers. If necessary the quality of bilge water being discharged should be visually inspected to check for oil, bearing in mind that the oily fraction is mostly discharged when the bilges are almost empty. The use of TBT has now been banned by IMO, and alternatives are available on the market. Dive vessels regularly visiting SNP should adopt these alternative anti-fouling paints and all vessels should avoid scraping their hulls while at anchor in SNP. The installation of mooring buoys and adherence to an anchoring protocol if these are not available, would significantly reduce the level of anchor damage arising from yachts.

Diving generally has a low environmental impact, but damage can be caused to the reef particularly by inexperienced divers who are not aware of how to behave on coral reefs. Damage is most often caused by divers breaking corals by touching them with either gloved hands or fins, particularly when taking underwater photographs (HARRIOTT et al. 1997). There is a general consensus amongst MPA managers, based on research, that each dive site can support about 5,000 dives per year without sustaining any noticeable damage.

The only tourist figures available to date are those compiled by AL-RAHMAN (2001) which show that the number of divers at SNP has risen from 425 in 1987 to 778 in 2000, i.e. approximately a third of the Park's carrying capacity of divers, indicating that there is scope to increase the number of visitors by about 1,800. There is a strong seasonal pattern to the number of visitors with a peak in February and March, and zero visitors over the summer months due to the uncomfortably hot weather. It should be noted that these numbers (Table 2) are for tourists arriving in Sudan by air and therefore do not include those arriving by ship (e.g. from Egypt or Saudi Arabia).

Table 2: Visitor numbers to SNP (1987-2000); data from AL-RAHMAN (2001)

	1987	**1995**	**1999**	**2000**	**Average**	**Standard Deviation**
January	28	51	47	65	47.75	15.26
February	89	117	121	138	116.25	20.32
March	112	96	103	184	123.75	40.70
April	62	60	93	90	76.25	17.67
May						
June						
July						
August						
September		46	51	47	48.00	2.65
October	39	65	66	83	63.25	18.15
November	54	78	85	112	82.25	23.87
December	41	53	49	59	50.50	7.55
TOTAL	**425**	**566**	**615**	**778**		

Divers are the main user group at SNP and as such are the largest potential source of income for the Park. The Park's policy towards them is that they are the 'customer' and should be made to feel that they are receiving good value for money when they pay the fees and licences. This must be achieved by providing attractive, accurate and clear information about the resources in the Park and the way in which they are managed, particularly from a conservation point of view. Without diving visitors to SNP, there would be insufficient funds for its conservation.

The number of live-aboard dive vessels, known in Arabic as yachts, operating out of Port Sudan has remained stable since 2000 at 13-14, although there are also live-aboard dive yachts operating from Egypt that visit Sudanese reefs including Sanganeb Atoll. A typical diving excursion lasts for 6 days and will spend time at Wingate Reef, Sanganeb Atoll and Shaab Rumi before returning to Port Sudan. Dive tourism in Sudan is set to increase as new international flights are scheduled for Port Sudan and tourist visas become easier to obtain. Once these basic elements are in place Sudan is well positioned to start acquiring a market share of the Red Sea diving sector that Egypt currently enjoys.

Another tourist group that may visit SNP in the future includes the day-trippers. Provision has been made in this plan to attract more day-trippers than is currently the case. The main environmental impacts likely from this group are related to the waste that they generate, and the damage they may cause to coral as they swim and snorkel. Solid waste can only be controlled through increasing awareness about the sensitivity of the Park and through the provision of adequate rubbish bins. These must be emptied regularly and the waste disposed of according to a waste management plan to be developed for the Park. Human waste will be discharged to sea from the toilets. Impacts from swimming and snorkelling (e.g. trampling and collecting marine curios) are best managed through the zoning plan, as described in Section 3.3.

Box 13: Management issues relating to tourism

Diving visitors are the largest potential source of income for SNP. Revenue might be raised through Park entrance fees, diving, photographic and fishing licences. This cost burden must be managed extremely tactfully, and licence fees must be set in consultation with dive/tour operators to be acceptable. The diving community should be seen as the customer base, and should be managed in such a way that they feel that the price they pay to visit and dive in SNP is good value.

Diver impacts can be reduced through i) designating dive sites that are then the focus of diving activity, ii) developing a set of diver best practices, and iii) ensuring that these best practices are communicated by dive-masters during a briefing before divers enter the water.

Pollution from dive vessels (e.g. oily bilge water, litter, sewage and food wastes) is a potential source of impact to the lagoon area because vessels are concentrated into anchorage sites and around mooring points. These need to be controlled before the number of yachts visiting SNP increases and is best done through the development, dissemination and enforcement of a set of best practices for dive tour operators. Anchor damage from yachts can be minimised with the installation of mooring buoys. If the need to anchor arises (e.g. if all mooring points are occupied or in the case of engine failure), then anchoring should be within designated areas and the rate at which the anchor is released should be limited to avoid heavy impact to the seabed.

Since dive tours are timed to coincide with regular flights from Port Sudan, all yachts tend to have a similar schedule and are generally in port on the same day, and tend not to operate during the summer months. The potential role that yachts have in discouraging illegal fishing activities on the reefs is somewhat compromised by these limitations. However, it does also present an opportunity to educate tour operators and dive masters, and diving tourists simultaneously.

Although largely a concern for the operator, diving safety is also an issue for SNP and full co-operation must be extended to the dive operators in developing contingency plans in the case of diver related emergencies (e.g. incidents of decompression sickness, divers lost at sea and shark attack).

Impacts from day-trippers mostly relate to waste management (litter and sewage), and from the possible damage to the reef from careless swimming and snorkelling. These should be addressed by the development of a waste management plan and by the designation of a swimming and snorkelling zone.

Lighthouse and Shipwrecks

The lighthouse at Sanganeb Atoll is a historic building and is an important part of Sudan's maritime heritage (Figure 3). 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.

Figure 3: View of Sanganeb lighthouse from the northern jetty

The lighthouse accommodates up to six staff from the Sea Ports Corporation that operate and maintain the building. There are four rooms, a kitchen and mess room, a generator room, a general room that has been allocated to the Red Sea University for research, a storeroom, shaded area and two toilets. Freshwater and provisions are brought by ship from Port Sudan, and most solid waste are disposed of in a burn pit. The toilets drain directly into the sea.

The lighthouse is a major feature of SNP with considerable potential for further development as a Park asset (e.g. as part of the visitor centre, lookout point and feature of interest). As a historic building that adds considerably to the attraction of SNP, it should be managed and maintained accordingly. Some minor repairs to the lighthouse and surrounding buildings are required as well as other measures to improve the overall appearance of the site.

Two significant shipwrecks are present within SNP. 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.

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. Archaeological exploration should be included amongst the potential commercial activities that require a contract to ensure equitable benefit sharing between the organisation conducting the research and SNP.

Box 14: Management issues relating to the lighthouse and shipwrecks

The best location for the visitor centre at SNP is in the room currently designated for use by the Red Sea University for research. The centre must still function as a base for research and these two functions are not incompatible because many resources might be used for both purposes (e.g. computer, projector, posters, biological samples and collections). More space for storage of chairs and scientific equipment could be made available with more efficient use of the existing lighthouse storeroom.

Engineers from the civil works department of SPC should survey the buildings and jetty in order to identify areas requiring maintenance, cleaning or modification. Of particular focus should be the iron spiral staircase leading to the light room and the safety of the walkway surrounding the light. If visitors are to walk to the top of the lighthouse, there must be a clear indication that they do this at their own risk and that SNP bears no liability for their safety. A lawyer must be consulted to ensure that all the necessary legal measures are in place to redeem SNP of any liability in this regard.

Details and images of Sanganeb lighthouse should be included in SNP's website for general information but also because there are lighthouse enthusiasts with particular interest in its history, form and operation.

A thorough cleaning of the entire lighthouse complex is required. This should focus on removing accumulated solid waste (e.g. burn pit, scrap aluminium and material in storeroom), as well as cleaning and renovating (e.g. painting) the accommodation block, toilets and other rooms in the lighthouse.

Although the current arrangement of the toilets is far from ideal, it is not a priority to upgrade the facilities at this stage. The first step for improvement would be the installation of a macerator and discharge pipe to the edge of the lagoon to ensure that solids were sufficiently small to be broken down quickly and taken on the currents away from the reef. With the existing arrangement there is a small risk that discharged toilet wastes may enter the area designated as a swimming/snorkelling area.

Information should be gathered about the shipwrecks at Sanganeb, particularly the 'White Elephant'. These wrecks are features of interest and should be presented to Park visitors, particularly the divers.

Navigation and Shipping

Port Sudan is Sudan's largest port and accounts for the bulk of the country's import and export trade with about 1,000 ship calls per annum. Port Sudan also handles a considerable amount of trade from other countries in the interior of north-east Africa including Ethiopia, the Central African Republic and Chad. The approaches to Port Sudan from the northern Red Sea shipping lanes pass south of SNP. Some coastal vessels (less than 1,000t), however, pass between the mainland reefs and SNP in order to advance north more rapidly than is possible by following the main shipping lane (see Figure 4).

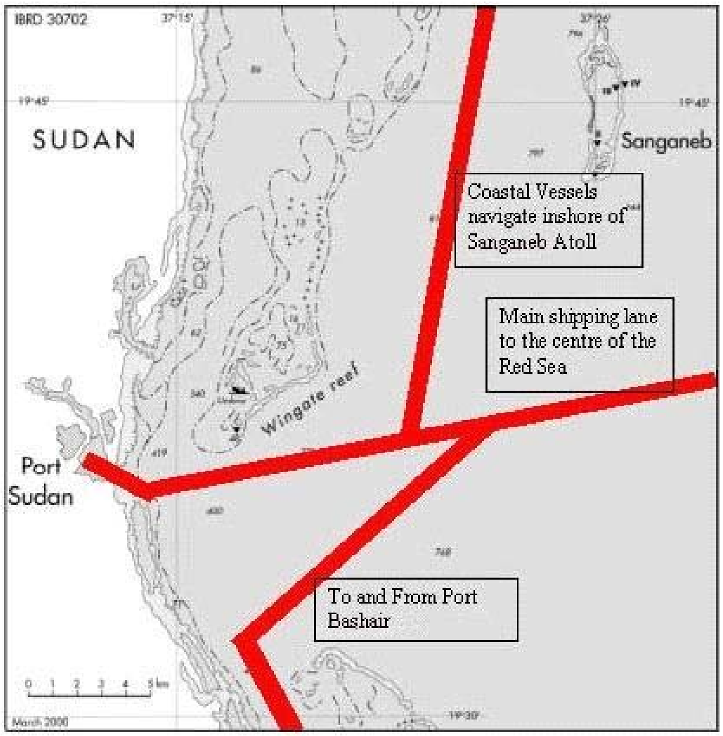


Figure 4: Approximate positions of the main shipping lanes on approaches to Port Sudan and Port Bashair. Ships pass within 5 nautical miles of SNP.

Navigational aids in and around the Sudanese mainland are considered to be adequate (PERSGA/UNEP 2003). However, navigation in reef areas is inherently risky, particularly in the event of engine failure. Combined with heavy maritime traffic and limited navigational devices, there is a constant risk of ship collisions and groundings. This risk is highest near the ports of Port Sudan, Suakin and Bashair (Bashayer), all of which have been identified as being exposed to a higher risk due to the close proximity of large reef complexes. Vessel sewage and ship discharges of solid waste pose additional threats because without waste reception facilities at the ports, ships are forced to dispose of their waste directly to the sea.

Sudan is not party to any of the international conventions relating to oil spill response (e.g. MARPOL, OPRC 90, or the FUND) largely because of the lack of oil reception facilities at Port Sudan. Sudan is however a signatory to the Protocol Concerning Regional Co-operation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1984), which means that it can draw on the resources and expertise in the countries boarding the Red Sea to combat oil spills. A National Oil Spill Contingency Plan for Sudan (PERSGA/UNEP 2003) has recently been published and serves as a framework for the development of site-specific spill contingency plans.

There is very little oil containment or clean-up equipment in Port Sudan or Port Bashair. Given this situation, the International Tankers Owners Pollution Federation (ITOPF 2000) advise that it seems likely that Sudan would call on assistance from international organisations in the event of a significant Tier II or Tier III spill. The recent development of an oil pipeline leading to a new refinery and export terminal at Port Bashair, 24km south of Port Sudan, has resulted in an increase in oil-laden ship traffic in Sudanese coastal waters. It is understood that Port Bashair is equipped with 500m of boom, one skimmer and 2 tugs with a capacity to hold spilt oil (enough to cope with a Tier 1 oil spill). In addition to the threat from the import and export of oil, there is also a risk of groundings and collisions from container traffic that may result in the loss of bunker fuel and lube oils to the marine environment. The National Oil Spill Contingency Plan (NOSCP) also recognises that a ship collision in the south-bound shipping lane in the Red Sea is likely to result in oil being transported shoreward towards the Sudanese mainland. Although there has never been a large oil spill in Sudanese waters (SPC pers. comm.), the risk is ever present and, with the development of the oil export industry and expansion of Port Sudan, is now increasing.

Box 15: Management issues relating to navigation and shipping

There is a moderately low risk of ship groundings at SNP due to the relative proximity of the shipping lane that serves both Port Sudan and Port Bashair. Although the risk is low, the consequences of grounding could be severe. Not only would the physical fabric of the reef be damaged but there would also be a high risk of pollution from the vessel's bunker fuel and/or cargo. A ship grounding contingency plan should be developed to ensure that there is sufficient pre-grounding data on which to base a compensation claim from the vessel's insurers, and that all the necessary procedures are followed to validate the claim. To this end the IOPC Fund Claims Manual should be obtained and integrated into the Park's management plan to give the highest chance of a successful claim in the event of a spill. The lessons learnt at Ras Mohammed in terms of successful claims for compensation following ship groundings should also be given careful consideration during the formulation of a grounding contingency plan. Particularly important in making a claim is good information relating to the wider distribution of the damaged resource.

The size of the buffer zone around the Park must take into consideration the risk from shipping (e.g. ship groundings, discharge of oily wastes and disposal of solid wastes).

Observations of major pollution originating from shipping (e.g. solid wastes including garbage) should be reported to the Sea Port Authority, particularly if there is evidence of the identity of the vessel from which it came.

All existing signs and marker posts within SNP should be installed with radar reflectors to ensure that the position of the reef is detected by passing vessels.

Fishing

Fishing within the Park

Fishing pressure within the Park boundaries is low. There is some hand-lining for grouper and snapper from the lighthouse jetty and from dive vessels while at anchor, and the catch is for consumption by SPC staff and tourists respectively. There are anecdotal reports of collecting bêche-de-mer from the reef flats during the summer months when there are no dive vessels at Sanganeb. There are also reports of artisanal fishermen targeting grouper as they form spawning aggregations in May, June and July.

It should be noted that information about the timing and location of fish spawning aggregations should be kept as secret as possible and should not be published. Information of this sort can be used by unscrupulous businessmen to over-exploit fisheries resources. Care should therefore be exercised in disseminating the results of research in this regard.

Fishing around the Park

In artisanal fisheries on the Sudanese Red Sea coast, the following ten taxa account for 60-70 % of the catches: gushar *(Epinephelus* spp. i.e. groupers), bohar *(Lutjanus boha*r i.e. red snapper), asmoot *(Lutjanus gibbu*s i.e. humpback red snapper) shaoor *(Lethrinus* spp., i.e. emperors), bayad (Carangidae i.e. jacks), najil *(Plectropomus maculatus* i.e. spotted coral grouper), farisi *(Aprion* sp. i.e. jobfish), abu garin *(Naso unicorni*s i.e. bluespine unicornfish), arabi *(Valamugil sehel*i i.e. bluespot mullet) and sharks (mainly Carcharhinidae and Sphyrnidae). These are largely caught inshore from locally made wooden boats using either hand-lines (for the carnivorous species) or gillnets (for the herbivorous species like mullet and unicornfish, and sharks). The best fishing is to be found on the inshore sides of the offshore reefs but few artisanal fishermen venture out as far as SNP.

Shark catches, which presently represent a small sector of the artisanal fishery, decreased from 90t in 1982 to 13t in 1992. No figures are available for catches by foreign vessels. At present shark resources are being depleted and catches by local fishermen are declining rapidly due to large-scale shark fisheries by foreign vessels from the Arabian Region for the East-Asian shark fin market. A portion of these fishermen operate with licences issued several years ago, but many fish illegally.

Sharks are caught by hook and line, bottom set long-lines, and drift nets. If such nets drift on to a reef they are extremely damaging to coral and associated marine life. Generally, sharks are ‘finned’, that is, their fins are removed and retained while the rest of the carcass is discarded to sea. In addition to the target species, shark fisheries particularly those using nets catch a high proportion of by-catch, including turtles, dolphins and fin-fish that are often discarded dead.

From an ecological point of view, the capture of apex predators and the accidental mortalities that are associated with the trade may irreversibly alter the balance of reef or open water ecosystems. From a dive tourism point of view, large sharks are a major factor in determining the quality of a dive site amongst the international diving community, as a recent study on the economics of shark fishing in the Maldives has shown (ANDERSON & AHMED 1993).

There is commercial potential for purse-seine fisheries in Sudanese waters, and it is possible that these will be opened up to foreign vessels in the near future. This suggests that there may be increasing fishing pressure in the waters around SNP, and management should be aware of its potential impacts (particularly to small cetaceans) in order that sufficient enforcement is applied to prevent such industrial fishing from occurring in the buffer zone. Particular care must be taken to ensure that vessels comply with fishing licence conditions.

Illegal fishing around the Park

There are numerous reports of illegal fishing taking place in Sudanese waters, particularly by trawlers, and long-liners targeting shark. In Sudan, enforcement of marine and fisheries laws is the responsibility of the Ministry of Defence and is implemented by naval vessels, but in the past 10-15 years the number of patrols has decreased and reports of poaching have increased.

Box 16: Management issues relating to fishing

Hand-lining is to be permitted from the jetty only. The lighthouse's staff have always fished from here, and it is seen as a necessity for them to supplement their diet. The impact on SNP's fish population of hand lining within this small area is considered to be insignificant, although certain species (e.g. najil and Napoleon wrasse) should be returned if caught. Visitors to the Park may also fish from the southern end of the jetty after purchasing a fishing licence from the Park authorities.

The presence of rangers is required all year round to ensure that fishing and collecting is properly controlled outside the main tourist seasons. This is particularly important during times when groupers are spawning.

Since sharks are wide ranging species, all shark fishing in Sudanese waters has a potential impact on the Park. It should be the general policy of the Park to oppose shark fishing, and all illegal fishing activity should be carefully monitored and prevented in the Park and its surrounding buffer zone. Research in the Maldive Islands has shown that shark fishing yields only a small percentage of the potential economic benefit compared to that derived from dive related tourism. Similarly, the impact from long-lining and purse seining on wildlife species (birds, turtles, cetaceans) can be very significant, and these forms of industrial fishing must be prevented within the Park and its buffer zone.

3. GENERAL POLICIES AND STRATEGIES

The overall approach to the development of Sanganeb Atoll presented here conforms to the IUCN's vision of a Category II Protected Area (ANON 1994):

Category II: ***National Park: protected area managed mainly for ecosystem protection and recreation*** – natural area of land and/or sea designated to: (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area, and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

In the sections that follow, general policies are given for various themes relating to the function of the Park. As given in the executive summary, the objectives of the management policies at SNP are as follows, in order of priority:

1. To manage SNP sustainably,
2. To maintain species diversity, and conserve habitats and the human built environment within SNP,
3. To promote sustainable tourism in SNP,
4. To educate and inspire,
5. To contribute significantly to the development of a national capacity to plan and manage MPAs,
6. To involve local communities and stakeholders as partners in SNP,
7. To provide for the sustainable use of living marine resources, and
8. To contribute to the effective operation of a network of MPAs through out the Red Sea and Gulf of Aden.

This plan should be viewed as an evolving document and not as a definitive and rigid dictate. Built into the management plan itself is a review cycle that allows for new information to be incorporated every two years. Such new information may arise from research and monitoring conducted within the Park itself, from developments in the understanding of the marine environment or behaviour of user groups, or from best management practices and current thinking in MPA management elsewhere in the world.

3.1 BIODIVERSITY

Sudan signed the Convention on Biological Diversity (CBD) on 9th June 1992 and became a party on 30th October 1995. Since then the Higher Council for Environment and Natural Resources (HCENR) has developed a National Biodiversity Strategies and Action Plan as part of its commitment to the Secretariat of the CBD. This document provides a framework for the development of policies relating to the use of biodiversity in Sudan, and where possible these have been incorporated in this management plan.

Export of Larvae

The overall policy towards the use of biodiversity within the Park is primarily one of conservation and protection, and secondly one of non-extractive use. To preserve an entire reef system intact will result in any excess gametes and larvae being exported to reef areas downstream of SNP, as well as providing a continuing supply for the source reef. This is true for all species of plants and animals present in and around the reef, including invertebrates and fish species. With proper protection, SNP may act as a source of recruits for the surrounding fish stocks and coral reefs that are open to extractive exploitation, an assertion that must be tested through proper research. This export of larvae is an ecological service that will not generate revenue for the Park, but it is hoped that it does and will continue to provide a real benefit, commercial and otherwise, to the surrounding areas.

Use of Biodiversity for Medical Research

Benthic organisms, particularly those living under conditions in which competition for space is paramount such as coral reefs, have evolved metabolic pathways to synthesise compounds that interfere with cell function. These are used as chemical defences, either to deter grazing or to defend their tissues from being overgrown by neighbouring organisms. The diversity of such bioactive compounds is proportional to the species richness in an area and this diversity is a resource which medical research uses to prospect for a wide range of novel pharmaceuticals. Access and benefit sharing by the growing industry of bio-prospecting is controlled under the Convention on Biological Diversity (CBD).

A typical bio-prospecting campaign will start with a collection of about 10g (wet weight) of a very wide variety of organisms that will be screened for the biological activity of interest (e.g. anti-biotic and anti-cancer properties). If the initial screening indicates any of the desirable characteristics, then up to about 100g more biological material will need to be collected. From this the active molecule is extracted and its structure determined if possible. Depending on the nature of the active compound, its genes may be identified and could then be used to genetically engineer bacteria to secrete the compound to produce sufficient quantities for commercial production. The life cycle from initial screening to commercial production is generally 10-15 years and requires tens of millions of dollars of investment in research and development.

The strategy with regard to bio-prospecting at SNP should be one of active promotion as it carries the potential to bring sustainable funding to the Park as well as other tangible benefits including capacity building and taxonomic research. Care must be taken to ensure that these benefits are indeed derived from opening SNP to bio-prospecting organisations. It is therefore imperative that the proper legal framework is agreed and in place before any biological material is removed from the Park. More information and advice regarding the development of proper procedures to control bio-prospecting is available from IUCN, the Secretariat of the CBD and NGOs such as the Foundation for International Environmental Law and Development (FIELD, based in London, UK). Bio-prospecting is conducted by many of the large pharmaceutical companies (e.g. Bayer, Welcome Foundation and Novartis), specialist medical research companies (e.g. Pharmamar SA), and national medical research institutes (e.g. The Cancer Research Institute in USA), national university departments e.g. Harbour Branch Oceanographic Institute in USA, and the University of Delft in Holland).

3.2 RESOURCE USE

Tourism

Research in the Red Sea and Caribbean suggests that reefs can support between 5,000-6,000 dives per site per year, and that greater use causes a rapid rise in diver damage (HAWKINS & ROBERTS 1997). For the purposes of SNP, the figure for the maximum number of dives at a single dive site has been set at 5,000. Given that there are four major dive sites at SNP, this indicates that a total of 20,000 dives per year can be sustained at SNP. Assuming that each diver dives approximately four times per day and stays 2 days, the estimated annual carrying capacity for divers within SNP is 2,500.

A Park entrance fee of US$5 per person per day is consistent with Park entrance fees throughout Sudan and in line with international standards. A further US$5 diving licence fee per visit is recommended, but before implementation this should be discussed with tour operators and if necessary introduced over a period of 12 months. This additional income is essential for the Park to be self-financing in the long term. Critical to achieving self-financing of SNP and other National Parks in Sudan, is that income from the Park must be 'ring-fenced' such that it is all made available for the management of the Park, and not pooled into the federal, state or Wildlife Department budgets. It is therefore important to establish a proper legal system for SNP to accept and disburse its own income, and this may require setting up a special financial instrument such as a trust fund so that SNP can manage its own finances.

The strategy to ensure adequate numbers of visitors to SNP is to promote the Park's attractions by disseminating information about its resources through a number of channels that are appropriate for the international diving community (e.g. website, CD-ROM, and information leaflet). Tourist numbers must be monitored to ensure that the optimum number (i.e. carrying capacity) visit SNP, and that this number is not exceeded. Should it be necessary, visitor numbers can be limited by increasing licence fees (i.e. through economic means), but this should be done with great care and in consultation with tour operators.

The impact of tourism must be carefully monitored and managed through a range of measures that are aimed directly at visitors and tour operators. Measures include the use of mooring points, best diving practices and best operator practices.

Visitors are a good source of information to improve the management of the Park; their perception of the management is valuable. Visitors can also provide useful biological observations. Feedback from visitors to management should be encouraged by providing channels through which photographs, observations and recommendations can be made available. The relationship with visitors should start before their visit to the Park via the SNP website and should continue afterwards through the 'Friends of Sanganeb', and the circulation of an annual newsletter etc.

Tour operators should be encouraged to be self-policing and self-reporting. Good relations should be maintained with operators since they are currently the only means by which visitors are brought to the Park. A large number of activities that are in SNP interests are also in the interests of tour operators (e.g. promotion of the Park, dissemination of information, conservation of the reef and maintenance of the moorings) and a sense of partnership and ownership should be encouraged.

Fishing

The policy of SNP towards fishing is that it should manage its living marine resources to protect and enhance the indirect benefits to fisheries through the export of larvae and the overflow of adults. Reef fish are recognised as one of the Park's key natural resources that require protection, and it is the larger species (groupers, sharks, wrasse and parrotfish etc.) that are particularly attractive to divers. By protecting these species, divers are attracted to SNP and in turn generate the necessary income to provide full protection to all other natural resources in the Park.

In order to achieve this objective there should be no fishing whatsoever inside the Park, except for hand-lining or rod fishing from the southern lighthouse jetty. This definition of fishing includes all collecting of invertebrates for commercial, subsistence or recreational use. There will be absolutely no fishing from dive tenders, yachts or other vessels, spear-fishing, or collecting of any invertebrate, or part of invertebrate, dead or alive. Fishing and sample collecting for research purposes is subject to approval by the SNP Management Committee.

The no-fishing regulation will be enforced through regular lookouts and patrols by Park staff. Of particular importance is enforcement during the spawning seasons of the main commercially important reef fish (e.g. groupers and wrasse). However, perhaps the most effective way of implementing the no fishing policy will be by winning the co-operation of the dive operators who will then become self-policing. This is possible because reef fish are a significant resource that attract divers to SNP, so it is in the dive operators' interests to protect them.

Later in the development of Sudan's network of marine protected areas SNP could have a key role in fisheries monitoring, surveillance and control (MSC). Rangers and the network of dive vessels that associate with SNP could provide valuable feedback to the Sudanese navy to identify and report illegal fishing activities.

3.3 ZONING PLAN

The objectives of the SNP zoning plan are:

- Conservation of Sanganeb Atoll and its natural resources,
- Regulation of the use of SNP to protect the atoll while allowing reasonable multiple uses of SNP,
- Regulation of activities that exploit the resources of SNP to minimise the effect on the Park,
- Reservation of some areas of SNP for the appreciation and enjoyment of the public, and
- Preservation of some areas of Sanganeb Atoll in its undisturbed natural state except for the purposes of scientific research.

The Wildlife Conservation Administration is the government agency with responsibility to ensure that the boundaries and regulations for each of the areas within the zone are incorporated into the amendment of the ministerial decree that originally established Sanganeb as a National Park.

The zoning plan is central to achieving SNP's management policy. SNP's core zone allows the dual functions of the Park, conservation and recreation, to both achieve their full potential. It is vital that management realises that both of these objectives are mutually interdependent: without the conservation of habitats and natural resources the attraction of SNP is diminished, and without recreational use of the Park there would be insufficient funds to conserve the area for future generations.

The zoning plan for SNP is very simple because of the Park's small area and limited number of user groups. The basic concept is that the area designated in 1990 represents the core zone within which there are five strict Nature Sanctuaries, and other areas designated for specific activities e.g. anchoring areas, swimming and snorkelling areas and dive sites. Surrounding the core zone is a buffer zone that extends 5km either side (designed to control remote sources of impact) that may in the future be contiguous with the buffer zones of other nearby protected areas (e.g. Shaab Rumi).

Buffer Zone

The existing boundaries of SNP enclose an area of about 22km^2 (a rectangular block of 7.3km by 3.2km around Sanganeb Atoll) and run within 1km of the edge of the reef. Around this core zone, a buffer zone is to be established that extends the protection afforded to the Park to a minimum distance of 6,000m from the reef edge. This will be achieved by setting boundary lines that are 5km away from and run parallel to the core zone boundary lines, as shown in Figure 5.

In order that the buffer zone does not inhibit the passage of vessels through the shipping lane shoreward of SNP, an area should be designated within the buffer zone as a shipping lane. Ships using this lane must be informed of its status and the restrictions on waste disposal that operate within it, both through notices to mariners and via information given on admiralty charts and in the Red Sea Pilot.

Core Zone

It has been recognised that SNP is already known amongst the international diving community, and that easy access to the underwater environment is essential to the success of the Park. Diving and snorkelling are activities that must be actively encouraged throughout the Park, although these activities must be properly controlled to avoid unnecessary damage to the reef. Within the core zone diving and snorkelling are permitted (except at certain times of year to be determined when fish are spawning), although it is desirable to focus these activities in designated areas (see Figure 6).

Dive Sites

Divers have access to all parts of the Park for most of the year, with the exception of those areas and seasons in which fish spawning occurs. However, there are preferred dive sites that are most frequently used and these are marked on the zoning plan. Diving activity will be focused here, partly because these areas are where the best diving is to be found, and partly because mooring buoys for dive tenders are to be located here. Any diver impacts will be focused in these areas. Each dive site has an estimated carrying capacity of about 5,000 dives per year, so the number of dive sites ultimately determines the diver carrying capacity of the Park. Other sites, particularly the pinnacle to the north of the atoll, should be investigated as potential dive sites by dive operators and then proposed to Park management.

As yet these sites do not have official names by which Park management and visitors can refer to them and these should be established in consultation with dive operators. Unofficial or altogether new names may be adopted by the Park's management committee.

Swimming and Snorkelling Area

A swimming and snorkelling area has been designated in the back reef area adjacent to the lighthouse. This is primarily designed to cater for day-trippers visiting the lighthouse and rest areas at SNP. Unlike divers, swimmers and snorkellers are generally less well informed about proper behaviour to prevent damage to corals (e.g. trampling and breaking corals). This area is also close to the lighthouse for easy access to the water and to the amenity facilities available. Being on the south west of the atoll, it will be sheltered during much of the year and so provides the safest swimming and snorkelling opportunities. The area should be marked with a series of discrete marker floats (green or blue in colour), anchored at the limits of the zone.

Mooring Buoys and Anchoring

The objective of the anchoring and mooring strategy is to prevent anchor damage from two main sources: live-aboard vessels and dive tenders.

Currently live-aboard vessels anchor in three main areas in the northern lagoon depending on the number of other vessels anchored and the prevailing weather conditions. Mooring buoys are required in these areas to prevent further damage to corals and ensure safe anchoring. Additionally, moorings for small vessels (e.g. dive tenders) should be installed at the main dive sites to prevent anchor damage to corals and improve diver safety. To minimise the impact of installing mooring blocks, these smaller moorings are to be designed to carry up to three small tenders moored simultaneously. The locations of the mooring buoys are as follows:

1. N19.73416 E037.44623 (two at this site for vessels up to 100t, separated by 50m)
2. N19.76125 E037.44945 (one at this site for vessels up to 100t)
3. N19.72301 E037.43700 (one at this site for up to three dive tenders)
4. N19.73006 E037.44297 (one at this site for small boats up to 10t)
5. N19.76125 E037.44945 (one more at this site for vessels up to 100t, separated by 50m from the other buoy)

Nature Sanctuaries

The five Nature Sanctuaries have been strategically placed around the atoll to encompass a high proportion of representative habitats (back reef, reef flat, and reef slope). These are situated on both the more exposed eastern side of the atoll as well as the more sheltered western side. This design allows the comparison between north and south, exposed and sheltered sections of the reef, as well as comparisons with areas receiving greater user-pressure. Nature sanctuaries are to be marked at each end by a pole erected on the reef flat, and a description of their position, resources and user restrictions shall be given in the printed literature distributed to Park visitors.

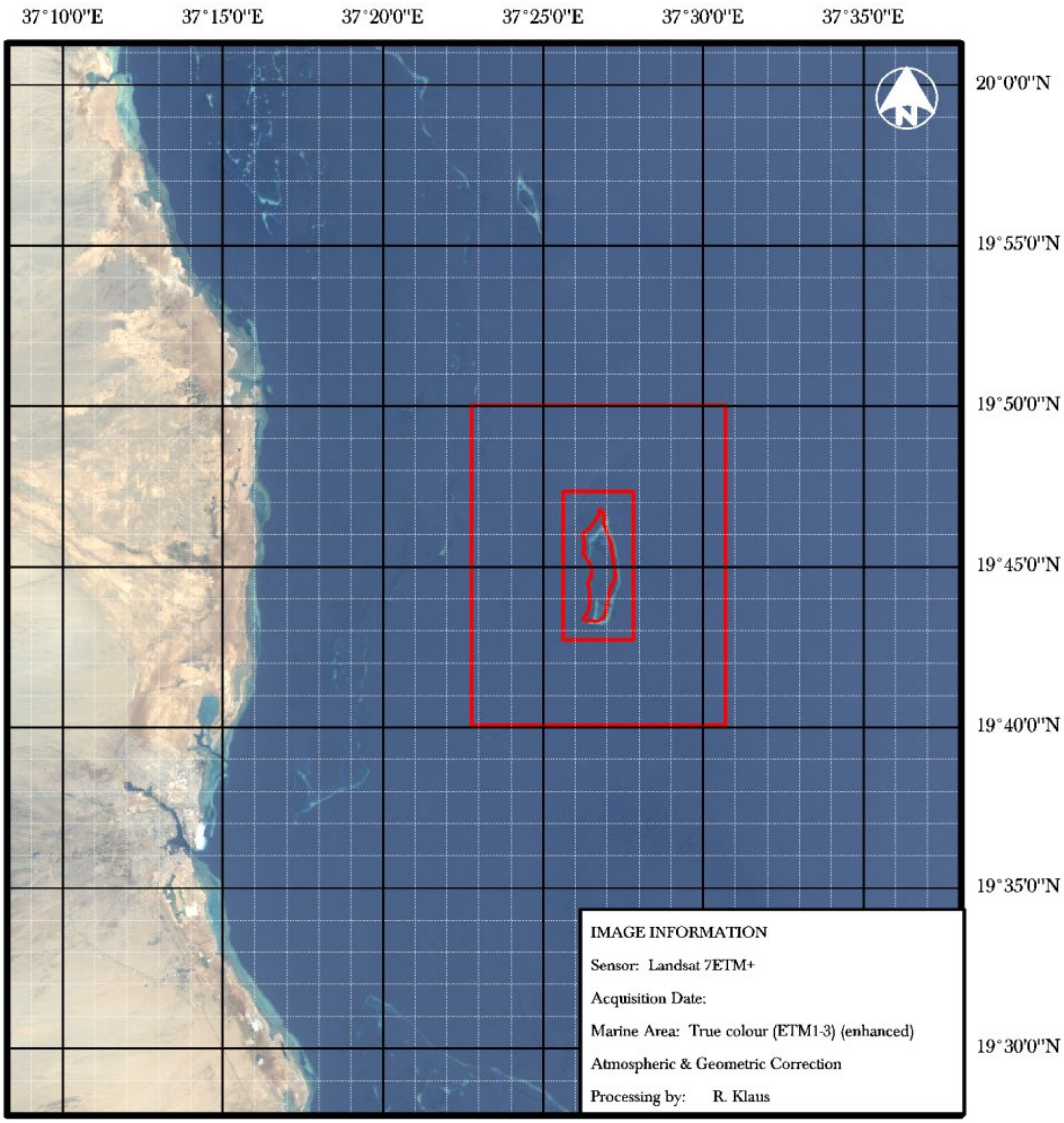
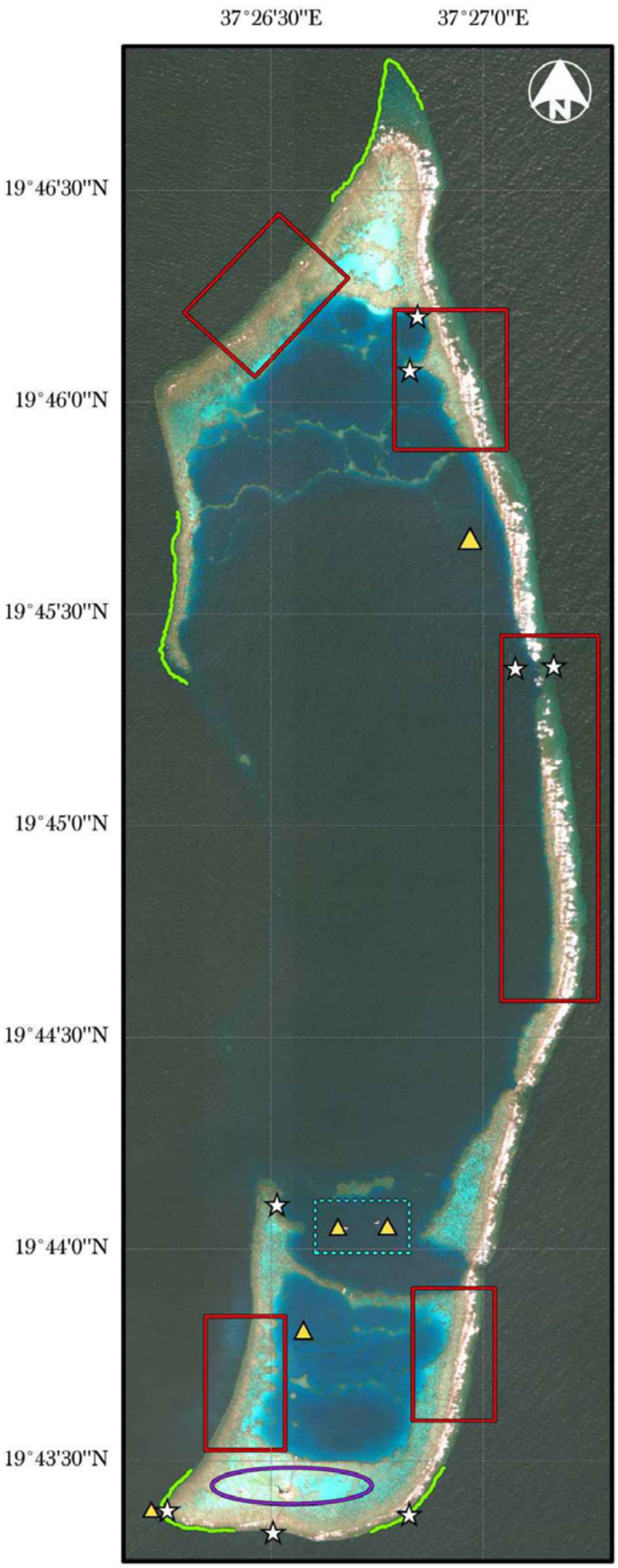


Figure 5. Location and extent of the buffer zone around SNP. The buffer zone extends 5km on each side of the core zone and is designed to control potential sources of impacts that originate from a distance e.g. shipping, fishing and mineral exploration and exploitation.

Enforcement of restrictions operating in these Nature Sanctuaries should be rigorous, with clear and easily enforceable, escalating deterrent penalties for infringements. These should start with verbal warnings, escalate to written warnings, and then prosecutions or direct fines – to be payable within a strict time limit. Written warnings may be prepared in advance on standard forms, with only dates, locations, ranger's name, and boat or skipper names/numbers to be inserted while in the field.



KEY

Red squares: Nature Sanctuaries

Green lines: Dive sites

White stars: Monitoring sites

Yellow triangles: Mooring buoys

Blue dashed square: Anchoring area

Purple oval: Swimming and snorkelling area

[Sensor: Digital Globe Quickbird; date: 18-11-2002. Marine area: true colour (ETM1-3) (1m). Atmospheric and geometric correction processing by R. Klaus.]

Figure 6: Zoning plan for SNP's core zone and Nature Sanctuaries

Monitoring Sites

Monitoring stations for different natural resources must be established wherever possible in locations where existing baseline information exists as well as in the strict Nature Sanctuaries that will serve as baseline areas. Monitoring transects have already been established over the years by the former Institute of Oceanography and the Senckenberg Research Institute (KRUPP et al. 1994), particularly for reef fish, corals, algae, polychaetes and crabs. These must be supplemented with new monitoring sites to reflect the new management objectives.

Monitoring stations should be permanently marked to ensure that data is collected from the same station on each occasion. It is also important to establish the degree of variability in the data arising from: different observers, laying transects at different times of day, and at different times of year.

Since the precise protocol can have a bearing on the results, it is vital that a monitoring manual be written that gives precise details of the methods, locations of sampling stations, treatment of data and interpretation. The monitoring and surveying methods should be based on the PERSGA's Standard Survey Methods (PERSGA/GEF in prep.).

ZONES

Zone	Sub-Zone	Main Purpose (to be actively encouraged)	Prohibited Activities
Buffer zone		• The protection of the core zone from remote impacts that might affect the functioning of the Park such as shipping, oil spills, all fishing activity, mineral exploration and exploitation	• Passage of commercial shipping • Discharge of any wastes • Mineral exploration and exploitation • All forms of fishing and collecting • Military exercises
	Shipping lane	• To allow the passage of vessels transiting through the inshore shipping lane	• As for buffer zone, except the passage of shipping
Core zone		• Conservation of marine natural resources • Appropriate recreation activities	• All forms of fishing and collecting, except for bio-prospecting and scientific research • The use of jet-skis and other noisy and/or fast moving craft • Anchoring or poling of vessels • All construction of non-critical infrastructure • NB access restrictions may be imposed during critical seasons (e.g. fish spawning)
	Swimming and snorkelling Area	• Swimming and snorkelling	• As for core zone, except construction and then only if it is absolutely necessary for the sustainable management of SNP
	Dive sites	• Diving and snorkelling	• As for core zone
	Mooring and anchorage areas	• Vessel mooring (and anchoring under certain conditions)	• As for core zone, except anchoring vessels
Nature Sanctuary		• Preservation of habitats and marine natural resources • Scientific research and monitoring	• All activities except in emergencies

3.4 CULTURAL HERITAGE

The Lighthouse

The lighthouse is both a significant historic building and a striking landmark, and both attributes are attractive features of SNP. While the Sea Ports Corporation (SPC) owns and maintains the buildings, it is in the interests of SNP management to be consulted about decisions regarding its upkeep, operation and appearance. A good working relationship must be established and maintained between SNP management, SPC and the Red Sea University to ensure that the current harmonious situation continues.

The wrecks in SNP, both those that are known and those that may remain buried in the lagoon, are also a significant element in the cultural heritage of the Park. It is known that the Red Sea has been an important navigation route for many centuries, and given that Sanganeb Atoll has a shape that would provide safe anchorage during a storm, it is possible that historic wrecks may have foundered on the reef over the passing millennia. Marine archaeology is in its infancy in Sudan, but is likely to be a fruitful activity at sites such as Sanganeb and should be encouraged.

3.5 CAPACITY BUILDING AND TECHNOLOGY TRANSFER

Given that SNP is the first marine protected area in Sudan it will be extremely important that technical assistance is available for Phase I of its management in order to develop capacity amongst Wildlife Department staff to continue the task into the future. Capacity building is one of the key objectives of this management plan, and as that SNP is the first MPA in Sudan, it should take this task very seriously. The importance of SNP cannot be over-emphasised: not only is it critical for the conservation of Sudan’s unique marine natural heritage but it also forms part of a regional network of MPAs which is designed to conserve biodiversity throughout the Red Sea and Gulf of Aden. Effective management of SNP can only be achieved through developing a national capacity for MPA management.

The best approach in this regard will be to recruit a marine Park Manager or Assistant Manager who can train a counterpart in the skills needed to manage the Park in a sustained manner. Since this job has both a training element and a park management element it will be important that the selected candidate has teaching skills as well as practical fieldwork skills, particularly in a MPA context.

It will also be necessary to train the Park’s rangers in a range of skills including small boat handling, the English language, public relations, tour guiding, teaching, search and rescue, and fisheries monitoring, surveillance and control. For this it will be necessary to employ a well-qualified and appropriately experienced trainer to develop capacity through on-the-job training. During Phase I and possibly Phase II, this position could be held by a suitably qualified international expert, or volunteer, with experience of marine resource management in protected areas. This technical trainer could be a shared between SNP and the Dungonab Bay – Mukawwar Island protected area.

Once there is sufficient capability amongst the Park staff to manage the Park effectively, investment in developing their skills must continue through workshops and specialist training courses overseas. These must be spread equally amongst all Park staff, including the administrator, and can be used by the Park Manager as incentives to reward good performance.

Perhaps the most useful means of developing capacity is through exchange programmes with other protected areas in the region, including the proposed Dungonab Bay and Mukawwar Island protected area. Of particular value will be collaborative work conducted with Ras Mohammed National Park and the Gulf of Aqaba Protectorates in Egypt, as these organisations have developed significant experience in the field of MPA management in the region. Links should also be developed and maintained with MPAs throughout the region, including MPAs being established through the PERSGA/SAP initiative (such as Bir Ali in Yemen and Isle des Sept Frères in Djibouti). This will simultaneously allow the less experienced staff to gain valuable exposure to the more established Parks and Park staff in the region, as well as bringing more experienced overseas Park staff to SNP.

3.6 COMMUNITY CONSULTATION AND PARTICIPATION

Since there are no inhabitants within or around SNP, there is a reduced requirement for extensive community consultation. Similarly, SNP lies too far offshore for most artisanal fishermen so it is not considered an important fishing ground by them. Indeed, the fact that Sanganeb Atoll has been protected for more than 10 years and is still in excellent condition suggests that its status has largely been accepted by the local user-groups. Nevertheless, implementing a more rigorous management regime will require clear communication with those groups with a stake in the Park. The most important of these are:

- Local and national politicians,
- The Sea Ports Corporation,
- Environmental non-governmental organisations (e.g. Sudan Marine Conservation Committee (SMCC), Marine Environmental Protection Society (MEPS) and Society for the Environment and Conservation in Sudan (SECS),
- Fishermen (through the Port Sudan Fishery Co-operative),
- Local community,
- The Red Sea University,
- Visitors (past and future),
- Dive tour operators, and
- The general public.

Stakeholder participation will largely be achieved by including representatives from the major user groups on the Park’s management committee. Regular meetings and consultations will help to ensure that stakeholders develop a sense of participation in the Park’s management, which must be a co-operative activity.

Communication with visitors to the Park will be through numerous channels including Park staff (telephone enquiries and rangers), tour operators (introductory talk given on arrival at the Park), printed media (information leaflets and booklets), and electronic media (CD-ROM and website). Communication with visitors after they have left the Park should also occur, encouraging feedback and participation in the Park’s management via a ‘Friends of Sanganeb’ society.

3.7 RESEARCH AND MONITORING

The purpose of conducting research and monitoring is principally to supply the Park's management with the necessary information to improve, update and review the management plan. Any research that contributes to this purpose should be considered as beneficial to the Park and should therefore be seen in a positive light.

There are a large number of fields of research that could contribute data useful for the management of SNP. However, since there is no plan to develop a research capacity amongst the Park staff the policy to be adopted is one in which research will be conducted by outside organisations under the control of the Park management. Key to conducting useful research in the Park will be the active participation of the Faculty of Marine Science and the Institute of Marine Research of the Red Sea University. Applications to conduct research should be co-ordinated by the Park Manager and appraised by the Scientific Officer of the Park's management committee.

The strategy for research activities is more reactive than proactive, but research in some field is to be actively encouraged. The Park should publish its research requirements on the website, and provide detailed information regarding the means by which research groups can apply for permission to conduct research in the Park.

There are four main themes to the research strategy at SNP:

- To collect **baseline data** on SNP's marine environment and ecology. This includes: studies on the geology and sediments of the atoll; surveys of currents and seawater temperatures within and around SNP; the distribution of seagrasses in the lagoons; research on any biological element associated with the Park especially the corals, fish, sponges, nudibranchs, ascidians, reptiles, and cetaceans; and the marine archaeological resources of the Atoll's lagoon and reef slopes. The survey methods used should be taken from the PERSGA Standard Survey Methods Manual, and where this is inappropriate strong justification should be given when presenting the research proposal to the committee.
- To investigate opportunities to **enhance ecological benefits** arising from the Park. This includes studies to help understand how and where gametes and larvae exported from the Park benefit areas outside the Park boundaries; the applied ecology of commercially important invertebrates; the fish fauna and especially the reproductive ecology and seasonal movements of the bumphead parrotfish, Napoleon wrasse, groupers, sailfish, and sharks. Again, survey methods as described in the PERSGA Standard Survey Manual should be used wherever possible.
- To investigate **resource use** and users. This should include a survey of the lagoon to identify an area suitable for a large vessel to anchor in the case of an emergency; diver perceptions and Park visitor feedback regarding management; the effectiveness of different media in promoting SNP; and best management practices in marine protected areas around the world.
- **Other research** which would include any unsolicited research proposals from organisations.

The initial strategy relating to monitoring of the Park's resources is to delegate this to the Red Sea University's Faculty of Marine Science during Phases I and II. This reduces the technical capability required of the Park rangers, and so reduces the investment required for their training. Some funds raised by the Park should be made available to implement the monitoring programme. Park staff may eventually conduct all monitoring of the Park's users and resources. Monitoring of visitor numbers and acquiring their feedback is best done by tour operators who will require some instruction and appropriate information (e.g. questionnaires and visitor data sheets).

Similarly, the monitoring strategy at SNP is designed to track disturbances and recovery of natural resources within the Park that are caused by both natural events and human activities. The following themes are included in the monitoring strategy:

- The **status of the natural resources**, e.g. coral reef health (live coral cover etc.), numbers, distribution and spawning behaviour of indicator fish species, seawater temperatures, weather and sea conditions;
- The **level of resource use**, this will include a daily inventory of the number of vessels in the Park, individual visitor numbers, the number of visitor-days, the number of dives conducted and the sites where they occurred, observations of fishing outside the buffer zone, the number of visitors to the visitor centre and using the Park's infrastructure;
- Impacts of **resource use and natural stressors** on the resource base, e.g. a periodic inventory of litter in the Park, CoTS feeding scars and coral bleaching;
- Feedback on the **effectiveness of Park management** which will involve circulating a questionnaire to Park visitors that enables them to provide information that will guide future improvements to the service that the Park offers. Important areas in which such feedback will be required include: how the visitor first heard about SNP, any problems with travel arrangements in getting to the Park, the effectiveness of Park staff, the acceptability of the Park entrance fee, the quality of the resources within SNP, and suggestions on how to improve the overall management of the Park.

Marine protected areas around the world conduct research and monitoring programmes of this sort and provide a valuable pool of information and guidance on their methods and results. For example, Komodo National Park (Indonesia) publishes monitoring reports on spawning and aggregations of groupers (Serranidae) and Napoleon wrasse (Labridae) in their park on the internet. Maximum use should be made of these sources of information.

3.8 PUBLIC AWARENESS AND EDUCATION

In order to develop a communication strategy it is important to first identify the specific target groups to whom information needs to be conveyed. Each group requires different information and will be responsive to different styles and modes of communication. In the case of SNP the main target groups are:

- Political decision makers in Sudan and internationally,
- Other Sudanese government agencies,
- Sudanese school children between the ages of 8-18 years,
- University students from Sudan and other countries aged 18-21 years,
- International diving community,

- Other tourist groups from Sudan, the Arabian region and elsewhere,
- International funding agencies and conservation NGOs,
- The managers of other marine protected areas around the world,
- The artisanal and industrial fishing communities operating around SNP.

The objectives of a communication policy are to provide information that supports the concept of conservation of natural resources and, in particular, those of SNP. This should include details the Park's regulations and underlying scientific and moral rationale.

The most important educational tool will be a visitor centre to be housed in the Red Sea University's facility adjacent to the lighthouse. The displays should be a combination of posters with colourful images of marine life and bilingual (Arabic and English) text, specimens of marine organisms that can be handled by the public (e.g. coral skeletons, shells, bones of turtles and cetaceans), a three dimensional model of Sanganeb Atoll etc. There should also be a slide projector and a collection of high quality slides that can be used to illustrate talks on coral reef ecology and SNP, and development of an interactive CD-ROM explaining the science behind marine conservation in general and at SNP in particular. The content of these displays should appeal to a wide range of ages, cultural backgrounds and intellect.

An interactive CD-ROM should be developed that describes the natural resources and the management philosophy of SNP for use in education and for promoting the Park. It should be produced in English and Arabic, and should contain high quality images, video footage, satellite imagery and other media to appeal to school children, university students and the international diving community. This can be used as a vehicle to carry details of how to make bookings with the dive operators, local hotels and airlines serving Port Sudan giving the CD-ROM the potential for its production to be sponsored by dive operators, hotels and airlines. Such a multi-media tool will be a useful asset to those wishing to promote Sudan as a tourist destination at international exhibitions such as the Sudanese Tourism Department and its Embassies and specialist travel agents (exotic destinations). It should also have links to the SNP website and carry details of how to join the 'Friends of Sanganeb' society. Once written, this kind of material is very cheap to mass produce and can be sold through appropriate channels such as the visitor centre.

The 'Friends of Sanganeb' society should be registered as a NGO in Sudan. Its main objective should be the promotion of and dissemination of information about SNP, particularly amongst those visitors that feel that they can make a contribution to the management of SNP either in a professional capacity or through charitable donations. A small subscription fee should be charged to cover the costs of producing and distributing an electronic newsletter once a year. By encouraging regular contact with those who would like to contribute, it will be possible to establish a coherent body of interested people to assist with promotion of SNP at the least, and a sustainable source of funding at best.

A website describing SNP should also be developed, as this is one of the most efficient and modern means of presenting information to the international community. However, it is only effective at reaching a subset of the required target groups and will not be particularly effective at reaching Sudanese school children, for example. The site should initially be produced in the English language, but should be translated into Arabic soon after its content has been agreed. Thereafter, it should be translated into more European languages to reflect the blend of nationalities visiting the Park (e.g. Italian and German).

Perhaps the most important mode of communicating with the Park's visitors will be through the use of printed material in the form of a leaflet and booklet. As a minimum, the leaflet will contain a description of the Park's boundaries, the significance of SNP and its unique features, the Parks regulations and the penalties for their transgression. The leaflet should also inform its recipient that more information is available in a supporting booklet that describes both SNP and the Dungonab Bay and Mukawwar Island protected area. This booklet should provide a comprehensive level of detail about the Park's natural and cultural resources, and management strategy both of which should be well illustrated with colourful images taken at the Park. The style and quality in which it is produced should be that of a memento and it should be priced accordingly.

Opportunities for educating school children at SNP will be maximised through the use of a glass-bottomed boat through which children are able to view the reef without actually getting into the sea. While this would be beneficial to meeting the Park's objectives as a site for education, the Park should not own the vessel but should solicit proposals from the business community to provide tours to and around the Park as a service. Park entrance fees for school trips should be reduced or waived at the discretion of the Park Manager.

The development of a formal and comprehensive public awareness plan should be considered both for SNP specifically, and also more generally under the combined auspices of SNP, Dungonab Bay and Mukawwar Island protected area. This Plan should be prepared by an international expert, and will identify additional routes for awareness raising activities outside the MPAs locally, nationally and internationally including, for example, airport and hotel displays, posters and leaflets for wide distribution in the coastal areas of Sudan and in Khartoum, interactions with local, national and international media. It will also identify key partners (such as hotels and schools), develop a schedule for implementation and identify likely sources of funding.

3.9 INFRASTRUCTURE

The policy with regard to Park infrastructure is that it should be necessary and sufficient for the effective management and administration of the Park. This is because infrastructure is generally a liability in that it requires funds to maintain and replace, as opposed to an asset that generates income. However, in the case of SNP, all the buildings within the Park (the lighthouse and associated buildings, jetties, wharf, etc.) are owned by the Sea Port Corporation and not by the government. SPC therefore have responsibility for bearing the cost of the buildings' upkeep, but the Park may need to maintain higher standards than SPC are willing to maintain. The present arrangement has the potential to result in ownership and development conflicts because SNP's management cannot dictate the buildings' use or their level of upkeep. To avoid potential conflicts, a memorandum of understanding should be drawn up and agreed between the SNP management and SPC so that the expectations and responsibilities of each party are clearly discussed, agreed and put in writing.

Figure 7: 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 aluminium recovered from the wreck of the White Elephant is scattered behind the storeroom.

Visitor Centre

The best location for a visitor centre at SNP is in the space that has already been allocated to The Red Sea University for its use as a research facility (see Figure 7 for its location). Again, there should be a transparent and clear agreement between SPC, the University and SNP for the use of this room, and this should take the form of a memorandum of understanding. The visitor centre should offer a range of items for sale, including books about Red Sea marine life and the life in the Park, post cards and other souvenir items with the Park's logo (e.g. coffee cups, T-shirts, mask straps and baseball caps).

Office in Port Sudan

The two marine parks (at Sanganeb and Dungonab) should maintain an office in Port Sudan as an administrative centre and as an information centre for prospective visitors. This office should be equipped with a computer and printer for use by SNP's Park Manager and the Park Administrator. SNP should also keep a computer and printer in the visitor centre to help with record keeping at the Park itself (input of monitoring data etc.). The telephone number of the Park's office should be disseminated widely, as this is the main channel through which visitors will acquire basic information.

In the future, the Park should consider opening a small kiosk at the visitors' point of departure in Port Sudan that can provide relevant information (leaflets and booklets). This kiosk might only be manned for one day a week (e.g. by the Administrator on Saturdays when dive tourists board their live-aboard dive vessel for the week), and when unmanned could present information about the Park (e.g. posters and leaflets) to the general public and visitors travelling independently to the Park. The aim of the kiosk would be to provide information to divers who are visiting the Park but who will not have had the opportunity to visit the Park office in Port Sudan.

Patrol Vessel

The initial strategy with regard to a Park patrol vessel is that this should be a 4m inflatable boat with a 25hp outboard capable of navigating in the lagoon during most sea conditions and outside the reef when conditions are sufficiently calm. An inflatable is adequate to make visits to the dive vessels anchored in the lagoon, and to transport a pair of divers and their equipment to monitoring sites. This craft is ideal to develop small-boat handling experience amongst Park rangers, is easy to launch and recover, consumes very little fuel and is sufficient to start the task of managing the Park. Transport for Park staff to and from Port Sudan will have to be co-ordinated with SPC, the port police or the navy, and it is therefore critical that an agreement is reached between SNP and these authorities to provide this service as required.

Once the Park becomes more established and visitor numbers increase to above 2,000 per year, then funds should be invested in a 6m rigid inflatable boat (RIB) with twin 40hp that will be capable of patrolling outside the lagoon in most conditions, and making routine journeys to Port Sudan. However, such a vessel requires a more substantial budget to purchase, maintain and operate than currently available. In order to recover costs, it may be necessary to hire the RIB to tourists or researchers periodically, as long as this does not lead to any reduction in the ability of the Park to implement its management responsibilities.

A larger, more seaworthy vessel will be a useful asset for the Wildlife Conservation Administration to own and operate once a MPA network is established. This vessel could take on the role of supplying SNP with materials, providing transport for Park staff and operating as a passenger ferry to and from SNP on a part time basis during peak season. It could also have a wider role to play in fisheries enforcement, which could generate income for its operation and maintenance through the shared collection of fines. In considering the potential use of such infrastructure, consideration must be given to ways in which they can generate sufficient revenue to cover their costs, including depreciation. A feasibility study of the Wildlife Conservation Administration operating a larger vessel should be conducted at the appropriate phase of the future MPA network's development.

Communications

Communication between the Park's office in Port Sudan, the office at the Park and the patrol vessel must be efficient. This is best achieved by installing an external GSM aerial on the lighthouse in order to obtain a mobile phone signal that will allow communications between the offices. Communication with the patrol boat and the Park office at the lighthouse can be achieved with marine VHF radios.

Recreational Facilities

There is a lack of recreation facilities for large groups of visitors who might be interested in spending the day at SNP but who are not divers. Targeting a relatively small percentage of foreign tourists and divers would deprive the majority of Sudanese people, as well as a large proportion of foreign tourists, the opportunity to visit and enjoy the aesthetic and recreational value of SNP. To focus solely on foreign tourists as the main source of income for the Park renders it susceptible to the rise and fall of foreign tourism, and therefore it could be severely threatened by unpredictable downturns in the tourism industry. It is therefore essential that SNP can offer something to a wider group of visitors than just foreign divers. For this reason it is very important that SNP develops a more diverse set of recreational facilities other than just dive sites and a visitor centre. In justifying such development it is important to stress that entrance fees from visitors represent the single most important revenue stream for the Park without which it would cease to be able to provide any effective level of protection and management.

Rest Areas

The concept proposed is to construct a series of shaded platforms that are raised above sea level on concrete stilts, and which have easy access to the swimming/snorkelling zone via small floating pontoons. The floors of such platforms should be made of wood rather than concrete, and should support a simple structure of date palm fronds, jareed, and wood that provides shade from the sun and a good degree of privacy. Some of the platforms should be exposed to the sun for use by sunbathers.

The number of platforms to be built will depend on the budget and the available space, but could eventually be up to ten. The design of each unit should be similar, but not necessarily identical, and each could incorporate unique features (different sizes to accommodate different sized groups, litter bin, hammock fixtures, barbeque facilities, picnic tables, light fittings for visitors camping overnight, a simple shower for rinsing, life-ring and rope and a sand bucket for extinguishing fires etc.). They should be located on either side of the jetties leading to the lighthouse, and access to them should be via a short boardwalk leading from the jetty. The northern jetty corridor, which is approximately 170m long, offers more space because the cover of live coral here is lower than on the southern jetty corridor.

It will be extremely important to ensure that their design is sympathetic to the surrounding environment and uses natural and local construction materials wherever possible. Such a development could be the focus of a grant or commercial sponsorship since it is a significant legacy that would help to generate sustainable income for the Park into the future.

It is also essential that this development be subjected to a rigorous environmental impact assessment. It is to minimise the impact to the reef that such structures should be raised platforms and not solid structures, and that they use natural materials. The precise location of each platform should be carefully selected to minimise damage to corals from both construction and the shading effect of the platform and pontoon. The design must take into consideration the maximum possible sea level (i.e. winter, highest astronomical tide with a storm surge).

The income from these facilities would contribute significantly to the overall income of the Park, while the costs of construction would be relatively small. Assuming ten platforms are built, and an occupancy rate of 20% for groups of 5 people on average, these platforms could generate US$18,000 per year in entrance fees alone. An additional fee of US$5 per platform per day could be levied, generating an additional US$3,600 per year. The costs of design and construction are estimated at approximately US$6,000-8,000 per platform, depending on the level of assistance available from SPC.

Beach

The existing small area of reclaimed land along the northern jetty, shown in Figure 8, must also be considered for development into a more appropriate recreational facility. This area should be used to create a small beach with easy access to the swimming/snorkelling area. Beach sand should be used to fill this area up to the level of the top of the retaining wall and coarse gravel used to cover the rubble lying under the walkway from the jetty. Care must be exercised in selecting suitable beach material since it must be of similar grain size (with a negligible fraction of fine sediment) and colour to the sand on the reef flat. Coarse gravel has the advantage that it is less likely to be washed away, yet sand will make access to the water easier and more comfortable in bare feet. Since the quantity of sand required is so little, this might be sourced from the reef flat in the vicinity as it will not contain fine sediment and will be aesthetically acceptable. Washed, well-sorted gravel should be sourced from the mainland.

3.10 DEFENCE AND SECURITY

A number of national defence issues arise when considering SNP and its position in the Sudanese Exclusive Economic Zone (EEZ). Its position is strategically important in terms of Sudan's claim over its EEZ as well as from a military point of view, although the latter's significance is low because of the continuing good relations which Sudan enjoys with its immediate neighbours. As an outpost, SNP has a useful role to play in monitoring ship movements (including those of fishing vessels), an opportunity that has not yet been capitalised on by the relevant authorities but which still holds considerable potential.

The policy of SNP towards national defence issues is that such activities should be supported wherever there is no risk of damage being caused to the Park and its resources. Wherever a risk or potential risk is identified, this should be assessed and analysed so that recommendations on alternative courses of action might be made to the relevant authorities. It is always in the Park's interests to maintain good relations with all stakeholders.

SNP management must also be mindful of the potential security issues facing foreign tourists and in particular private yachts in the southern Red Sea and Gulf of Aden. Piracy and kidnapping have taken place in the Gulf of Aden and it is possible that this could extend into the Red Sea in future years.

3.11 OIL SPILL CONTINGENCY PLAN

SNP lies approximately five nautical miles to the north of the main approaches from the northern Red Sea and the Suez Canal to Port Sudan and Port Bashair.

This plan's strategy with regard to oil spills is to develop a site-specific oil spill contingency plan for SNP that must be integrated into the National Oil Spill Contingency Plan (NOSCP). SNP has been recognised in the NOSCP as a sensitive area with high priority for protection. It is likely that any spill occurring at SNP would be a Tier II incident since it would require the co-ordination of more than one organisation and is most likely to result from a ship collision or grounding. The NOSCP suggests that grounding on a reef (i.e. resulting in a Tier II or Tier III spill) is most likely to involve an oil-laden tanker, in which case a minimum of 700t of oil may be spilt.

Figure 8: The existing small, reclaimed area along the northern jetty offers a good opportunity to increase the beach area available for day-trippers.

It is important to note that, because there is a one-metre seasonal tide in the Red Sea, the sensitivity of coral reefs, particularly the reef flat, also varies seasonally. In the summer months, floating oil is more likely to come into contact with and therefore adhere to drying rocks and banks of coral rubble than in the winter months.

Particularly important will be a thorough assessment of: the conditions under which dispersants may be used; the implications of an oil spill during different seasons and sea conditions; the fate of spills of oil of different hydrocarbon composition; and reporting procedures. The placement of booms at the lagoon entrance also needs careful consideration. Studies of water currents are required to assess whether booms could be effectively deployed there, and if it is found that they can, consideration should be given to installing permanent mooring buoys that will serve both as a point of attachment for the boom(s) in the event of a spill and for use by small dive tenders at other times. The impact of deploying booms on the reef flat should also be considered as an option for preventing oil from crossing the reef, particularly in areas where the reef flat is narrower or deeper than elsewhere.

The monitoring and research plan presented here incorporates activities that will be useful to assess the impact and recovery of resources following a spill, which is an essential element in claiming compensation for damages from the ship's insurers.

3.12 SUSTAINABLE FINANCING AND STAFFING

It should be recognised that adequate sustainable financing is the single most important factor in the success or otherwise of a protected area and the amount of management effort that is spent on securing such financing should reflect this fact. Before being able to rely on sustainable sources of funding it will be necessary to develop the capacity of the Park to generate sufficient income to provide for its own management needs. In order to do this it is necessary to invest capital in the Park's facilities, infrastructure and marketing material. It is therefore extremely important that Park management realises that SNP must be thought of and managed as if it were a business venture, whose success depends on generating income from its users.

The advantage of SNP is that it covers a small area but has the potential to attract a large number of fee paying visitors: such parks are more likely to meet their income requirements through revenue generated by visitors. However, given that the estimated diver carrying capacity of the Park is estimated at 2,500 per year, and with an entrance fee of US$5 per day and an average stay of 2 days per diver, the maximum revenue from Park entrance fees from divers is US$25,000.

Although the costs of salaries for Park staff will be borne from central government funds, it is felt that a system of incentives is necessary in order to motivate management and ranger staff alike. This will help to ensure that staff, particularly senior staff, are motivated to spend most of their careers working for the Park rather than moving into the private sector after a few years service. Incentives are also necessary to supplement senior management salaries once the ceiling salary level for senior government employees has been reached.

Sustainable sources of income for the Park are:

- Park entrance fees (visitors, vessels),
- Licences (for permission to dive, take photographs, to fish and conduct research),
- Royalties and sales (from the proceeds of successful bio-prospecting research, sales of TV documentaries, books, images, CD-ROMs and other media),
- Central government budget,
- Donations (via 'Friends of Sanganeb').

Sources of non-routine income are:

- Fines from illegal activities including ship groundings, compensation from oil spills etc., and,
- Grants.

The Park's entrance fee of US$5 per day conforms to the national policy on protected area entrance fees and is in line with other similar parks around the world as indicated in Table 3. However, the simple entrance fee is insufficient to generate the necessary income to cover the costs of management at SNP and a more effective strategy for generating revenue must be devised in due course by the Park management.

Table 3: Entrance fees from a selection of marine protected areas offering world class diving

Marine Protected Area	Country	Entrance Fee
Ras Mohammed MPA	Egypt	US$5 per day for foreigners, US$ 1.25 per day for residents
Bunaken MPA	Indonesia	US$6.60 (year pass)
Soufriere MPA	St Lucia, Caribbean	US$4 per day
Saba MPA	Dutch Antilles, Caribbean	US$3 per dive
Bonaire	Dutch Antilles, Caribbean	US$10 per year
All National Parks	Costa Rica	US$6 per day
Half Moon Caye Nat. Monument	Belize	US$5 per day
Exumas Land and Sea Park	Bahamas	US$5 per day
Watamu MPA	Kenya	US$5 per day
Tunku Abdul Rahman MPA	Malaysia	US$1.30 per day
Great Barrier Reef MPA	Australia	US$4 per day

Data taken from LINDBERG & HALPENNY (2001).

Feasibility of SNP being Self-Financing

Starting with the assumption that the long-term management costs of SNP are likely to be in the order of **US$40,000-60,000** (excluding salaries which are to be provided by the government) we can judge the importance of each revenue stream available to the Park.

- Assuming that SNP eventually attracts 2,500 divers and 1,000 day-trippers (i.e. operating at maximum carrying capacity), and that each person pays the full entrance fee of US$5 per day, entrance fees alone will only ever generate about **US$30,000** per year.
- If divers are also charged a US$5 per day diving licence fee, this could generate **US$25,000**
- Assuming that 25% of divers will have photographic equipment, and a photography licence will be set at US$5, this will eventually generate **US$5,000** per year.
- Assuming an average number of 10 divers per yacht, this means that a total of 400 boats will visit SNP. If each is charged an estimated US$20 mooring licence fee, this will generate **US$8,000** per year.
- Assuming sales from the visitor centre generate **US$2,000** profit per year.
- Assuming revenue from research permits amounts to **US$1,000** per year.

Income under these realistic assumptions yields a total income of approximately **US$71,000** suggesting that SNP has the potential to be self-financing, if salaries are excluded from the budget. Capital investments can therefore be made using a combination of surplus income from fees supplemented by funds from grants, royalties and donations.

Securing sustainable funding for SNP should be the Project Manager’s main objective. Guidelines for developing a diversified income stream are given below.

Guidelines for designing revenue generation strategies (taken from GEOGHEGAN 1995)

The experience from MPAs around the world over the past ten years suggests some general guidelines that should be followed in developing revenue generating strategies for protected areas:

1. *Fundraising strategies should begin with the development of a budget for managing the area or system at the desired level*. The aim of the strategy should be to completely cover the management costs based on the budget. It is surprising how often entry fees and other revenue generating mechanisms have been considered or introduced without any regard to actual financial needs.
2. *The preparation of a fundraising strategy should be a consultative process that involves all interested parties, particularly representatives of major user group*s. Consensus among all involved should be reached before any elements of the strategy are implemented. Lack of consultation has created numerous difficulties in implementing fundraising strategies. In the case of the Bonaire Marine Park in the Dutch Antilles, an initial attempt to implement a user fee had to be abandoned because of resistance from the island's dive operators, who were not consulted. A fee system was developed and successfully established several years later with their full participation and co-operation.
3. *A diversified funding base provides greater security and flexibility than reliance on a single source of fundin*g. In particular, strategies that rely heavily on entry fees and other revenues from visitors can be severely threatened by unpredictable downturns in the tourism industry. The most effective revenue generation strategies aim to bring in a surplus in years of high visitation that can cover shortfalls in times of difficulty.
4. *Strategies should aim to reduce, but not eliminate, the level of direct government suppor*t. In most countries it is unrealistic to believe that governments will be able to bear the full costs of protected area management any time in the foreseeable future. It is only through reducing dependence on this inadequate source of support that protected areas can succeed in meeting the costs of proper management. However, complete financial independence from government can result in reduced policy and technical support as well, and should therefore be avoided. Even a small annual financial or in-kind contribution secures the government's stake in the protected area and its management.
5. *Partnerships and co-management agreements can increase management efficiency and reduce costs.* Since the aim of revenue generation is finance management, other approaches that reduce management costs can be as valuable as money. Beneficiaries of protected area management are often willing to contribute time and services or able to carry out management functions at a lower cost than the designated management agency. Arrangements with commercial users to collect fees and maintain records of use are good examples of how partnerships can reduce the financial cost of management without reducing its quality.

4. THE MANAGEMENT PLAN

4.1 RESOURCE MANAGEMENT PLAN

RESOURCE USE		
Issue	**Task**	**Action By**
Lack of procedures for routine observations, visitor control and impacts	Establish a protocol for surveillance and control of visitors in the Park, including the reporting or apprehension of illegal fishing vessels. Ensure a particularly high level of surveillance on days during which live-aboard dive vessels are in Port Sudan. Develop and implement procedure for inspecting level of litter, solid waste and oil etc. within and around SNP. This should be incorporated into the work plan for rangers.	Assistant Park Manager with support from Park rangers
Lack of procedures for non-routine events	Develop a contingency plan in the case of a CoTS outbreak that incorporates success indicators. Guidelines developed by Ras Mohammed National Park should be adopted and applied to SNP. Develop a policy and contingency plan in the case of a ship grounding that incorporates success indicators. Develop a policy and contingency plan in the case of an oil spill that incorporates success indicators, that is compatible with the national oil spill contingency plan. This must be in line with the IOPC Fund's Claim Manual. Encourage dive operators and provide input to developing a contingency plan for a diver lost at sea or other diving related emergency.	Park Manager with support from Assistant Park Manager
Lack of visitors at SNP limits the income available from Park fees	Work with dive operators and other tourism sector stakeholders to promote SNP as one of Sudan's key tourist attractions. Consult with dive operators and diving visitors to establish a reasonable fee that divers are willing to pay in return for the continued conservation of SNP.	Assistant Park Manager

Diver carrying capacity of SNP is uncertain	Investigate the position and status of the pinnacle to the north of Sanganeb Atoll, and establish the potential for installing a mooring buoy at the site. Using the results of the visitor survey and the latest published research findings, refine the estimate for the carrying capacity of dive sites at SNP.	Assistant Park Manager, in co-ordination with dive operators Park Manager
Lack of guidelines for visitor conduct	Develop simple guidelines for divers in consultation with dive operators (e.g. no novice divers and no diving gloves allowed) and ensure that these are communicated to dive groups prior to them entering the water. Develop guidelines for whale, dolphin and turtle watching within SNP in consultation with specialist groups and tour operators. Develop guidance notes for captains of vessels entering SNP, including best operating practices for dive operators, mooring and anchoring protocols.	Assistant Park Manager supervised by Park Manager, with input from specialist interest groups
Lack of clear regulations relating to fishing	Develop a set of legally binding regulations and penalties as a basis for the SNP's fisheries management plan. Ensure that these regulations are enforceable using the resources available, and test them periodically using unannounced field exercises. Ensure that the regulations are very widely disseminated amongst the fishing community and all government departments with an interest in fisheries issues. They should be made available on leaflets in Arabic and English for distribution to any fishing vessel that comes within the SNP buffer zone.	Assistant Park Manager supervised by Park Manager, with input from specialist interest groups
Lack of enforcement of regulations	Encourage dive tour operators to be self-reporting and self-policing. Conduct regular patrols to increase the visibility of Park rangers, and if necessary to inform and enforce visitors and operators of the Park's regulations.	Assistant Park Manager with support from Park rangers

BIODIVERSITY		
Lack of legal framework for bio-prospecting or other research or activities (e.g. filming) with possible commercial benefits	Consult national and legal experts on legal agreements of this sort (e.g. FIELD), and develop a flexible policy and standard contract/memorandum of understanding that must be signed for commercially orientated activities to be conducted within SNP.	Park Manager supported by Administrator
Lack of information about the resource base required to promote SNP as a site for bio-prospecting	Encourage research on the taxonomy and ecology of SNP's natural resources including algae, sponges, molluscs, and ascidians.	Co-ordinated by Park Manager, with support from management committee (Red Sea University representative)
Lack of contact with international organisations involved with marine natural resource management	Establish and maintain contact with the IUCN Wrasse and Grouper Specialist Working Group, and search for other specialist interest groups for SNP's natural resource base (e.g. GCRMN, Reefcheck, IUCN, Billfish and cetaceans).	Assistant Park Manager with support from management committee (Red Sea University representative)
Lack of promotion of SNP as a site for bio-prospecting	Once the necessary legal framework is in place, promote SNP as a bio-prospecting site on the internet (SNP website), direct marketing and industry newsletters etc.	Assistant Park Manager

4.2 ZONING PLAN

Issue	Task	Action By
Implement zoning plan within SNP	Designate and mark safe anchorage in case of emergencies. Designate and mark area around lighthouse jetty for swimming and snorkelling. Designate and mark strict Nature Sanctuaries. Ensure vessels use mooring points. Ensure adherence to SNP's policy relating to fishing.	Park Manager with support from Park rangers
There is currently no legal basis for the buffer zone around SNP	Establish the co-ordinates for the buffer zone. Secure legal basis for buffer zone around SNP, including area designated as a shipping lane. Take steps to ensure Admiralty charts show change of status and restrictions.	Park Manager to co-ordinate with Wildlife Department PERSGA mapping expert
There are no mooring buoys installed at SNP	Design and install mooring buoys at major dive sites and anchorages, and consider the installation of moorings for oil containment booms north and south of the lagoon entrance	Assistant Park Manager to co-ordinate with SPC

4.3 RESEARCH AND MONITORING

Issue	Task	Action By
Lack of formal agreement for conducting research within SNP	Draw up and agree on the terms of a memorandum of understanding between SNP and Red Sea University to conduct research in SNP. Draw up and agree on the terms of a memorandum of understanding between SNP, SPC and Red Sea University for the use of buildings and facilities at the lighthouse (visitor centre and research facilities).	Co-ordinated by Park Manager, with input from legal advisor and Wildlife Conservation Department
Lack of information about the resource base in SNP	Encourage the execution of baseline surveys for sediment characteristics (including hydrocarbon content and composition of heavy metals), speed and direction of currents around SNP (including in open water and at the major points/headlands, and the lagoons' entrances) and the distribution and extent of seagrass assemblages within the lagoon. Encourage research on specific flagship species including sailfish, turtles and cetaceans. Encourage research on the taxonomy and ecology, particularly reproductive ecology, of SNP's natural resources including algae, sponges, coral, molluscs, ascidians, fish, and cetaceans. Encourage research on the ecological connectivity of SNP with other reefs in the area. Encourage research on the natural dynamics of the different coral communities identified within SNP.	Co-ordinated by Park Manager, with support from management committee (Red Sea University representative)
Missed opportunities to support applied research with commercial potential	Encourage non-extractive basic research (excluding grow-out) on the aquaculture potential of natural resources threatened in Sudan that are presently found within SNP, including *Trochus*, *Lambis*, species of sea cucumber, najil and other reef fish.	Co-ordinated by Park Manager, with support from management committee (Red Sea University representative)
Lack of environmental data to support the interpretation of ecological monitoring data	Establish a recording weather station at the lighthouse that records wind speed and direction, air temperature, atmospheric pressure, global radiation and rainfall. Establish a network of seawater temperature monitoring stations using self-contained logging thermistors.	Assistant Park Manager with support from management committee (Red Sea University representative)
Lack of data on abundance of SNP's natural resources	Establish monitoring transects for commercially important invertebrates (*Trochus*, giant clams, *Lambis*, pearl oysters and species of sea cucumber). Establish a protocol and schedule for monitoring coral predators using the manta tow technique as a rapid assessment tool, and supplemented by more detailed survey methods as necessary.	Co-ordinated by Park Manager, with support from management committee (Red Sea University representative)

	Establish a protocol and schedule for monitoring key species of reef fish including bumphead parrotfish, Napoleon wrasse, grouper and shark species. The design should include research on habitat preferences for each group. Reference should be made to the PERSGA Standard Survey Methods.	
Lack of information and guidance relating to monitoring from other MPAs around the world	Conduct internet search for details and reports of other monitoring in MPAs elsewhere, particularly relating to visitor perceptions and feedback. Subscribe to the MPA related Newsletters. Reference should be made to the PERSGA Standard Survey Methods during the design and implementation of all natural resource survey and monitoring tasks.	Assistant Park Manager
Lack of information relating to the population dynamics and distribution of CoTS	Establish monitoring sites around SNP with the aim of monitoring CoTS population levels. The design and selection of survey techniques should be appropriate to the known dynamics of CoTS outbreaks. Reference should be made to the PERSGA Standard Survey Methods.	Assistant Park Manager
Lack of information regarding marine archaeological resources at SNP	Contact specialist marine archaeologist to obtain an opinion as to the potential for historic wrecks at SNP. Encourage marine archaeological research at SNP.	Assistant Park Manager

4.4 PUBLIC AWARENESS

Issue	**Task**	**Action By**
Lack of a public awareness strategy and a communication plan	Develop a strategy for disseminating information about SNP that identifies different user groups and recommends the most efficient media for reaching them.	Park Manager
Lack of information regarding user groups who would benefit from information about SNP	Develop a database of names and addresses of stakeholders, visitors, tour operators, travel agents, hotels, etc.	Assistant Park Manager
Lack of information available for visitors, general public and other user groups	Develop information leaflet describing the resources and importance of SNP. Develop booklet that contains information about SNP and the Dungonab Bay and Mukawwar Island protected area. Develop an interactive CD-ROM that describes SNP's resources, management policy etc. Develop a website for SNP that includes links to 'Friends of Sanganeb', outlines the opportunities for research at the Park particularly bio-prospecting and other non-extractive research. Train tour operators to give an introductory talk to visitors on arrival at SNP. Ensure that travel guides (e.g. Lonely Planet) covering Sudan include descriptions and relevant information for tourists. Ensure that main tourist hotels in Khartoum and Port Sudan have information leaflets and staff at the front desk and are aware of SNP.	Co-ordinated by Park Manager. Must include the Park Manager of Dungonab Bay and Mukawwar Island protected area
Lack of opportunity for interested parties to contribute to the welfare of SNP	Register 'Friends of Sanganeb' as a society/non-governmental organisation in Khartoum. Establish an appropriate subscription and design a newsletter for circulation primarily by e-mail. Facilitate systems for visitors to submit photographs to Park management for their use in promotional material. Design a system to allow comments from Park visitors that can feed back into Park management e.g. suggestion box and feedback form on website.	Park Manager with support from Assistant Park Manager and Administrator

Lack of awareness about SNP and its current state of development	Issue a press release to the Sudanese and international press and specialist press/newsletters announcing the release of the management plan and schedule for its implementation. Ensure that dive operators are informed about the upper limit being set for the carrying capacity of SNP.	Park Manager and Administrator Assistant Park Manager
Lack of facilities and opportunities for school children to visit and benefit from SNP	Solicit interest from the private sector for the provision of tours at SNP from a glass-bottomed boat, and negotiate an appropriate arrangement to facilitate easy access to the Park for school children. Develop visitor centre display materials, talks explaining basic coral reef ecology that are suitable for school children of different ages, as well as the general public.	Park Manager assisted by Administrator Assistant Park Manager
Lack of corporate identity of SNP	Develop logo for Park that uses the distinctive outline and lighthouse of Sanganeb as a feature.	Administrator in co-ordination with Park Manager
Lack of regular communication with other stakeholders	Advise other stakeholder organisations to appoint a member of staff as the point of contact with SNP, and encourage their participation in the SNP Management Committee.	Park Manager
Lack of information about visitor base or their perceptions regarding Park management	Develop questionnaire for Park visitors that acquires information regarding (amongst other topics) nationality of visitors, activities, length of stay, perception of Park management, and acceptability of Park fees.	Park Manager in consultation with staff from Red Sea University
Lack of branded merchandise for sale in visitor centre	Develop a range of branded merchandise incorporating SNP's logo for sale. Set appropriate prices for each item and design eye-catching method of presenting the material.	Assistant Park Manager with support from Administrator

4.5 TRAINING AND CAPACITY BUILDING

Issue	Task	Action By
Currently no staff to implement management plan	Recruit Park Manager, Assistant Park Manager, Administrator and rangers.	Wildlife Department
Lack of capacity within Sudan to manage a marine protected area	Recruit a technical trainer for the Park Manager or Assistant Park Manager.	Wildlife Department/PERSGA
Lack of marine experience amongst Wildlife Department staff	Recruit trainer to develop capacity to operate in a marine environment amongst Park rangers. Training should include use of marine radios, small boat handling and outboard maintenance, public relations, basic reef science, and oil spill containment and clean up. Develop and implement an exchange programme with other Parks in Sudan, the Red Sea and elsewhere. Develop performance criteria to assist in the selection of staff benefiting from exchange programmes and training opportunities.	Park Manager Wildlife Department in consultation with Park Manager Park Manager
Lack of budget for capacity building	Allocate sufficient budget each year for capacity building, workshops and training.	Park Manager
Experience gained at other protected areas within Sudan must be shared	Organise annual workshop or meeting for staff at all levels within the Wildlife Department at which experiences can be shared.	Wildlife Department
Lack of information regarding national or overseas training opportunities and their costs	Establish a database of appropriate organisations in the country (e.g. navy and police) and regions that offer exchange programmes, specialist training programmes, workshops and conferences, and maintain links with them.	Park Manager

Capacity building of the Park staff will be essential in order to make sure that the necessary skills and experience are available for the effective management of the Park. However, until individual staff members have been recruited and their capabilities assessed, it is not possible to provide a detailed schedule for capacity development. Tasks that each staff member are required to carry out are outlined above, and should the assessment show that training is required in certain fields then this should be implemented. In addition to the practical skills necessary, organisational skills, particularly of the Park Manager and Assistant Park Manager, should also be developed.

4.6 OIL SPILL CONTINGENCY PLANNING, DEFENSE AND SECURITY DEFENSE

Issue	Task	Action By
Currently there is no oil spill contingency plan	Develop an oil spill contingency plan that is consistent with the national oil spill contingency plan (NOSCP) and which clearly states the SNP stand on the use of dispersants within the Park at different times of year. Enquire as to the status of the (NOSCP) and track developments towards its implementation. Update the SNP oil spill contingency plan as modifications are made to the NOSCP.	Wildlife Department/PERSGA Natural Resources and Protected Areas Unit, SNP Park Manager
SNP staff are inexperienced in responding to oil spills	Ensure the participation of SNP staff in any oil spill exercises carried out by the relevant authority. Periodically (once a year) conduct exercises to ensure that SNP staff are familiar with the SNP oil spill contingency plan.	To be co-ordinated by Assistant Park Manager
There is no relevant data or equipment on which to base the site specific plan	Conduct surface current measurements across the mouth of the lagoon entrance. Install point of attachment on either end of the lagoon mouth, and consider installing a mooring buoy midway across the entrance. Ensure that the research and monitoring requirements relating to the site specific oil spill plan is included in the research and monitoring plan.	To be co-ordinated by the Park Manager and Red Sea University
No liaison with military or national defence forces	Establish links with the relevant military forces (navy, coastguards, marines and air force etc.) to inform and liaise about military exercises etc.	Park Manager

4.7 INFRASTRUCTURE AND MANAGEMENT STRUCTURE

Issue	Task	Action By
Currently no budget available to implement management	Identify sources of funding to support technical assistance and equipment requirements during Phase I and II of SNP's management. An agreement must be reached with the Wildlife Department whereby all income from SNP is 'ring-fenced' for use only by the Park. This may require establishing a trust fund or other financial instrument.	Wildlife Department/PERSGA Natural Resources and Protected Areas Unit, SNP Park Manager
Currently no framework for updating and reviewing the existing management plan	Update and review this management plan every two years.	Park Manager in consultation and discussion with members of the SNP Committee
Currently no detailed terms of reference/work plans for Park staff	Develop terms of reference for Park Manager, Assistant Park Manager and Administrator. Develop work plan for Park rangers.	Park Manager
Currently no resources to implement management	Procure inflatable boat and 25hp engine, fuel storage and pump system, engine-washing facility at SNP. Procure marine VHF radios (x3 plus shore receiver) and other communication equipment (mobile telephones with extended external aerial). Procure digital camera and binoculars. Procure computers and printers for offices in Port Sudan and SNP, with internet capability (i.e. internet account and e-mail addresses). Procure office furniture for offices in Port Sudan and SNP (filing cabinets, bookcases, table, desks and chairs etc.). This office should be shared with Dungonab Bay and Mukawwar Island protected area. Procure essential technical reference manuals for use by the Park staff including; marine resource monitoring techniques, various IUCN and PERSGA publications and guidebooks for MPA management.	Park Manager and Assistant Park Manager supported by Administrator (in consultation with management of Dungonab Bay and Mukawwar Island protected area where appropriate)

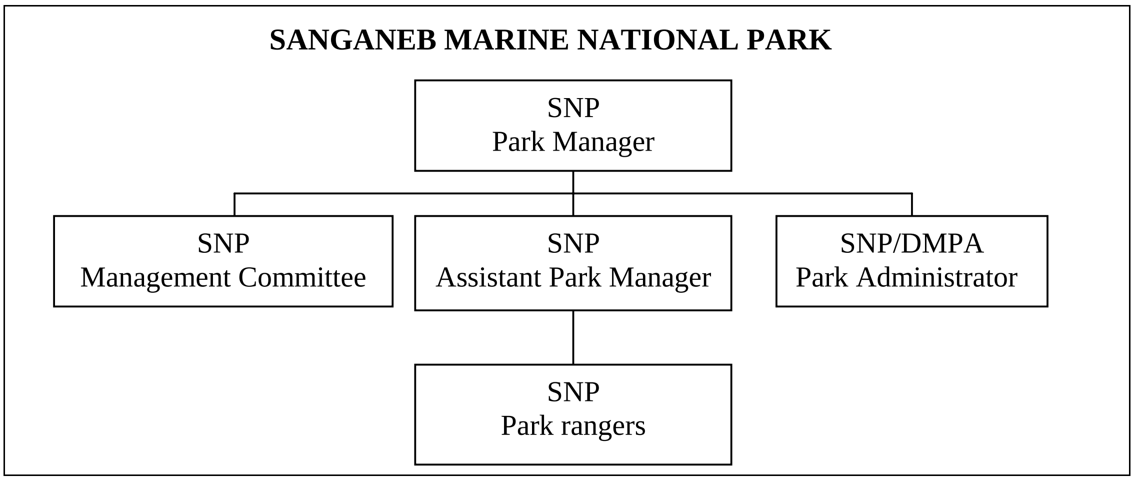
Currently no office space for Park staff	Establish SNP Park office in Port Sudan. Tidy and clean lighthouse area including future visitor centre and store. Seek agreement with SPC for accommodation for 3-4 staff at lighthouse. Confirm arrangements for use of lighthouse buildings as visitor centre. Install office equipment, patrol boat, communications equipment in Port Sudan and visitor centre at SNP, following consultation with SPC and Red Sea University.	Park Manager Assistant Park Manager and rangers with contracted unskilled labour Park Manager Assistant Park Manager All SNP staff
Legal basis of Park regulations and liabilities uncertain (i.e. lack of legal framework)	Consult lawyer with regard to SNP's liabilities in general, and those relating to the structures associated with the lighthouse (e.g. staircase, jetties, moorings and bio-prospecting). Ensure that SNP has the legal right to charge entrance fees, permits and to control the development within its jurisdiction. Agree Park regulations. Setup bank account to accept income from visitor fees and sales. Contract firm of accountants to audit the Park's books. Make enquiries as to UNESCO's criteria for awarding World Heritage Site status and incorporate these criteria into the objectives of the Phase III management plan.	Park Manager supported by the Wildlife Department As above As above Administrator Contract let by Park Manager to local firm of accountants Assistant Park Manager with Park Manager's support
Upgrade infrastructure at SNP	Design and install mooring buoys. Survey lighthouse staircase and jetties for structural integrity and Implement any repairs and maintenance to buildings that are necessary (e.g. painting, replacing broken windows, remove rusted jetty supports from southern jetty corridor). Develop a waste management system for refuse generated by the Park, including the installation of refuse bins at the jetties and offshore disposal site for food wastes. Upgrade toilet facilities at the lighthouse. Conduct annual inspection of all buildings within SNP, and prepare and implement a maintenance schedule for all equipment used by Park staff.	Assistant Park Manager to co-ordinate with SPC As above Park Manager supported by Assistant Park Manager Assistant Park Manager to supervise contractor Assistant Park Manager in consultation with SPC

	Procure RIB with twin 40hp engines. Conduct feasibility study for the operation of a larger sea-going vessel to service a MPA network.	Park Manager Wildlife Conservation Administration
Lack of space on dry land for recreation within SNP	Conduct feasibility study for development of recreational facilities. Design and Construct ‘platforms’ along jetty corridors to provide more recreational opportunities at SNP.	Park Manager to conduct feasibility study, supervise contract for design and construction
SNP management plan requires regular updating	Incorporate new information, government policies, and the results of scientific monitoring and research into the management plan each year.	Park Manager, supported by Assistant Park Manager
Lack of formal agreement between SPC, the University and SNP concerning the use of buildings at the lighthouse and transport of supplies to and from SNP	In consultation with a legal advisor, draw up a MOU for the use of space at the lighthouse, and the regular transport of materials and staff to and from SNP.	Park Manager in consultation with legal advisor

5 PERSONNEL AND FINANCES

5.1 PERSONNEL

The overall management of SNP will be implemented by a park manager and he will be advised and informed by a management committee. The organisational structure of SNP will therefore be as follows:



During Phase I of the management plan, the optimal number of staff for SNP is eight, consisting of:

- A Park Manager,
- An Assistant Park Manager,
- A Park Administrator (possibly to be shared with Dungonab Marine Protected Area initially), and
- Five rangers.

This number makes sufficient manpower available to manage the Park, and builds in the necessary flexibility to accommodate staff training/capacity building, annual and sick leave, as well as promotions or exchanges with other marine protected areas in Sudan (i.e. the Dungonab Bay and Mukawwar Island protected area). Given the remote location of SNP, it is imperative that all staff spend adequate time on the mainland to ensure that staff morale remains high, particularly amongst those staff with families. This has implications for the number of staff required to manage the Park since it will be necessary to rotate the staff at regular intervals. The Park rangers will operate in pairs or small teams of three when at sea and be stationed at the lighthouse, while the others are on the mainland supporting the Park Manager or on leave.

Park Manager

The ideal Park Manager's profile and responsibilities are described in KELLEHER & KENCHINGTON (1992) as:

'An habitual broad perspective style of thinking; an orderly mind which can integrate a large number of factors into an harmonious whole; an ability to communicate lucidly and concisely; an ability to get things done quickly; an ability to resolve conflict; an ability to run a meeting effectively since meetings will be the principal communications and decision-making forum'.

The basic outline for the terms of reference for the Park Manager is as follows:

- To ensure sufficient and sustainable financing for the Park's continued operations;
- To implement and develop the Park's management plan;
- To ensure the effective operation of SNP by co-ordinating and liaising with user groups and stakeholders;
- To train the Assistant Park Manager in all aspects of the Park's operation;
- To be responsible for the overall smooth management of Park staff;
- To liaise with the managers of other MPAs in the regional MPA network throughout the Red Sea and Gulf of Aden region;
- Develop indicators as a means of tracking the effectiveness of the Park's management;
- Design and implement a reporting schedule, delegating reporting responsibilities to the most appropriate staff as necessary;

The requirement for reporting comes from the need to pass information up and down the management hierarchy as well as to maintain an accurate, comprehensive record of the Park's management from year to year.

Three types of reports are necessary:

- Incident Reports: these are written in response to a significant event (e.g. storm, visitor conflict, end of a development project, release of new information relating to SNP and award of funds).
- Quarterly Management Reports: these are produced by the Assistant Park Manager, and approved by the Park Manager summarising the activities and results of monitoring from the three month reporting period.
- Annual Reports: these are produced by the Park Manager and include all data on visitor numbers, the results of all research and monitoring, an outline of the work plan for the following year, and a report on the audited accounts.

Assistant Park Manager

The Assistant Park Manager is responsible for on-the-ground implementation of the management plan and is the Park rangers' operations manager. He will split his time between

Port Sudan and SNP. He should be a graduate in marine science, or have more than 10 years experience of working with the marine environment and managing a small team, and ideally should have some teaching experience and/or experience in the tourism sector.

His main duties are:

- To assist the Park Manager to implement the Park's management plan;
- To train the ranger team in the necessary aspects of MPA management;
- To ensure good relations with tour operators and the other main user groups;
- To assist with group visits (e.g. school tours, guided tours of the lighthouse and visitor centre);
- To co-ordinate implementation of the research and monitoring strategy with staff from the Red Sea University and tour operators.

Park Administrator

The Park Administrator could be a shared post with Dungonab Bay Marine Protected Area, with overall responsibility for supporting the Park Managers in these two areas. This includes general office management, accounting and book keeping, acting as the personal assistant to the Park Managers, organising banking and salaries for Park staff, co-ordinating the maintenance schedules of the Park's resources (boats, and vehicles etc.), co-ordinating the supply of food and water to the Parks, and answering general enquires from the public. A background in office administration with additional experience in graphic design, accounting, law, and information technology would be an advantage.

The administrator's main duties should include:

- Day-to-day management of Park administration;
- Answering telephone enquiries and e-mails from the general public about the Parks;
- Assisting the Park Manager with procurement and contracting requirements;
- Registration of 'Friends of Sanganeb' as a charitable organisation;
- Book-keeping for the Parks and 'Friends of Sanganeb';
- Assisting the Park Manager in organising legal aspects of Park management;
- And assisting the Park Manager in developing a range of SNP branded merchandise.

Rangers

The rangers are the most important implementers of the management plan and the principal point of contact that visitors have with the human element of the Park's management. It is therefore imperative that a ranger can communicate well with the different categories of visitors, from school children to foreign tourists. They should therefore have a background where public relations formed a major part of their work. A ranger should have reasonable English language skills and be comfortable spending many hours at sea in a small boat. His secondary skills should be related to enforcement and surveillance, if possible at sea, and assuring that all Park users abide by the regulations laid down by Park management. Rangers need not have SCUBA diving skills to fulfil their role at SNP, although they should be competent swimmers.

Given the lack of rangers with MPA experience in Sudan, it may be necessary to recruit rangers from the existing stock of terrestrial park managers and train them in the skills necessary to apply their knowledge and expertise in a marine setting. Priority should be given to those who have experience in working with the public in protected areas.

The Park Manager will develop a detailed work plan for the rangers that will include:

- Providing information about SNP to the Park's visitors and tour operators, both verbally and by distributing information leaflets;
- Enforcing the Park's regulations on a day to day basis;
- Assisting with the logistics of monitoring and research being carried out in SNP;
- Making general observations of the ecology around SNP using feedback from Park visitors, direct observations, etc. using GPS where possible.

SNP Management Committee

The SNP management committee will consist of a total of six senior staff drawn from the main stakeholder groups who can support the Park's management. The principle of such a committee is to keep the numbers to a realistic minimum and the quality of inputs to a maximum. The chairman of the committee should rotate yearly amongst the members. Committee meetings should be held at least twice a year, once in August and once in May, before the tourist season starts and again at the end. It is recommended that the following staff sit on the committee:

The **SNP Park Manager**: his role will be to guide meetings and offer his professional expert opinion in order that the committee can jointly decide on the matters under discussion in an informed and intelligent manner. The Park Manager will be responsible for maintaining links with other parks in the region and elsewhere internationally, as well as keeping abreast of the latest thinking and best management practices developing in the sector.

A representative from the **Wildlife Department** Headquarters in Khartoum; his responsibilities will include:

- Liaison with national policy and new national legislation relating to protected areas and management of biodiversity etc.;
- Co-ordination with other protected areas in Sudan including disseminating lessons learnt in other areas such as Dinder National Park;
- Co-ordination with national tourism authority and the relevant airlines to ensure developments in tourism policy and the expansion of the sector are incorporated into the ongoing evolution of this management plan;
- Securing and increasing the allocation of funds to SNP from the central government budget.

Representative from the Sea Ports Corporation; his responsibilities will include:

- Co-ordination with SPC over all issues relating to the installation and maintenance of mooring buoys, the fabric of the lighthouse and associated buildings etc.;
- Co-ordination with SPC over issues relating to oil spill contingency planning and all other pollution arising from shipping;
- Co-ordination with SPC over all issues arising from navigation, including any changes to the use of the lighthouse, installation of radar and beacons in the vicinity of SNP;
- Disseminating relevant information to mariners including notices to mariners, changes to navigation charts etc.;
- Co-ordination with the navy over all issues relating to national security, coast guard activities, fishing surveillance, anti-poaching and smuggling operations.

Representative from **The Red Sea University**; his responsibilities will include:

- Maintaining links with researchers around the world with an interest in Sanganeb Atoll and its ecology;
- Disseminating the results of best practices relating to the ecological management of protected areas to the Park Manager;
- Designing, executing and interpreting (with the Park Manager) the results of scientific monitoring and research conducted at SNP;
- Assisting the Park Manager in applying for international assistance to support SNP's management and operation;
- Co-ordinating all research activities in SNP;
- Co-ordinating with the Department of Fisheries and the Fisheries Research Institute on matters relating to fishing in and around the Park.

A representative from the **Tourism Sector**, preferably a dive tour operator; his responsibilities should be:

- To inform the Park Manager about developments in the dive tourism sector particularly that in Egypt;
- To assist the Wildlife Representative in the task of liaising with the tourism department;
- To maintain links with other dive tour operators using SNP to ensure that feedback is obtained from the users (operators as well as visitors). He will be the main point of contact between the Park and the Park's recreational user base;
- To support the Park Manager on all dive related issues pertaining to the Park;
- To liaise with the SPC representative on matters relating to the moorings within SNP.

A representative from the **Environmental NGO Sector**. His responsibilities will include:

- Liaison with national and international environmental NGOs with an interest in protected areas management and coastal zone management in general;

- To assist the Park Manager and the representative from the Red Sea University in the design and preparation of grant applications in support of the management of SNP;
- To maintain links with the international marine environmental NGO sector (particularly IUCN) and to disseminate information relating to the management of marine protected area and marine natural resources to the management committee;
- To lobby the necessary government departments and ministries to amend their policies in favour of the conservation of marine resources in general, and Sudanese marine protected areas in particular;
- To assist the Park Manager in the management and administration of 'Friends of Sanganeb'.

5.2 FINANCE

The financial scenario presented here is based on several assumptions, including: that the government will pay the salaries of all Park staff for the staffing levels given here; that prices of items obtainable in Sudan are realistic; that there are no costs associated with the provision of office space either in Port Sudan (to be provided by the Wildlife Department) or at SNP (to be provided by SPC); and that the costs of installing mooring buoys has already been accommodated by PERSGA. The figures are also based on assumptions regarding the additional revenue generated by increasing visitor numbers. Overall, these figures should be taken as being indicative, and for use in planning only, rather than firm figures or targets.

Expected Income

Current number of visitors Year 1 (1,000) multiplied by Park entrance and diving licence fees totalling US$10 per visitor: **US$10,000**.

Current number of yachts in Year 1 (100) multiplied by mooring and fishing licence fee totalling US$20 per yacht per visit: **US$2,000**.

Expected Operating Costs during Phase I

The expected operating costs for Phase I are given below. This figure will be need to be adjusted for subsequent years and phases, but can be used as a starting point for planning.

Item	US$	Notes
Fuel and oil for patrol boat and vehicle, maintenance costs	3,500	This item has potential to be reduced through commercial sponsorship by the oil industry
Communications	2,500	Telephone bills, internet and website registration fee
Incentives and bonuses	5,000	
Printing costs for information leaflets	1,000	Per year
Office operating costs (including consumables)	2,000	Paper, batteries and refreshments etc.
Accounting and auditing	1,000	Contracted to local firm
Maintenance of buildings	1,000	Painting and basic maintenance etc.
Reporting costs	1,000	Printing and postage costs
Committee costs (e.g. refreshments and local travel costs)	500	
Annual exchange programme	2,000	Cost of flight and subsistence
Capacity development	3,000	For workshops and training courses etc.
Contingency	3,500	
TOTAL	**25,000**	

Expected Capital Costs

The capital costs for the first three phases are given below. Capital costs required to establish the Park are spread out over the first three phases, while capital costs for improvements to be implemented during Phase IV are not given, as they are too far in the future to be able to estimate accurately.

Phase I		US$
	Costs associated with recruitment of Park staff	500
	Inflatable boat, 25hp engine, fuel cells and jerry cans, washing facilities and equipment (e.g. oars, life jackets, first aid kit and tools)	8,000
	Marine radios	2,000
	Digital camera and binoculars	1,000
	Computers (x2) and printers (x2) for Park offices	2,000
	Office furniture	2,000
	Reference books etc.	1,000
	Labour for cleaning lighthouse and removing solid wastes	500
	Installation of office equipment	300
	Lawyer's fees for advice on liabilities, MOU with SPC etc.	2,000
	Signage and radar reflectors	1,500
	Maintenance of lighthouse buildings, particularly the visitor centre	2,000
	Establish monitoring transects using manta tow board and rope	500
	Development of information leaflet	1,000
	Press release	500
	Develop Park logo	1,000
	TOTAL	**25,800**

Phase II		US$
	Implementation of solid waste management plan	500
	Development of bio-prospecting contract (consulting fees)	5,000
	Weather station	800
	Seawater temperature monitoring system	700
	Development of information booklet	5,000
	Development of interactive CD-ROM	5,000
	Development of website	5,000
	Registration of Friends of Sanganeb as society	500
	Press release	500
	Develop visitor centre	5,000
	Develop range of SNP merchandise and order initial stock	5,000
	TOTAL	**32,000**

Phase III		US$
	RIB with 40 hp engine (x2)	15,000
	Upgrade toilet facilities	5,000
	Feasibility study, design and construction of 'recreational platforms'	25,000
	Press release	500
	Further develop visitor centre	5,000
	TOTAL	**50,500**

Summary

The income expected in Year 1 (Phase I) totals **US$12,000**. As estimated below, the operating costs (excluding salaries or office rent) are **US$ 25,000** per year, leaving a short fall of **US$13,000** that must be met from grants or donations from government or non-governmental sources. This does not include any provision of international technical assistance.

The necessary minimum capital costs for the first three phases (covering an eight year period) are: Phase I **(US$25,800)**, Phase II **(US$32,000)** and Phase III **(US$50,500)**. As it is difficult to predict the numbers of visitors coming to SNP or the effectiveness of the promotion campaign it has not been possible to estimate revenue during Phases II and III. The maximum expected income from visitor fees is **US$71,000** (see section 3.12 on sustainable financing), which suggests that when operating at capacity SNP can become self-financing in the long-term. In the short- and medium-term it is clear that to meet its start-up funding requirements, SNP will need to attract grants from government or non-governmental sources, and this should be the main focus of the Park Manager.

6 IMPLEMENTATION

The implementation of the plan has been organised into four phases, with the greatest emphasis on the early years of implementation. The four phases are:

- Phase I – Getting started (one year duration)
- Phase II – Capacity building and promotion (two year duration)
- Phase III – Self-sustaining management (five year duration)
- Phase IV- Expansion of Park into a co-ordinated national and international network

The first phase is designed to achieve easy and early successes to build confidence and establish a management capacity that makes SNP functional. The second phase is designed to consolidate on the early achievements of the Park through the development of media necessary to promote the Park and through the development of capacity and training. The goal of Phase III is to take SNP into a situation where it has diversified its income generating strategy to such an extent that it becomes self-financing for its operating and capital investment costs. Phase IV should be implemented when this Park and others in Sudan have matured and can be integrated together more closely to form a coherent management unit with a significant role to play in a number of aspects of coastal zone management including fisheries enforcement. Since each phase is further into the future it becomes less possible to write an implementation schedule for each phase, so only details for Phase I are presented here. Implementation schedules for Phases II and III should be developed by the Park Manager after Phase I is complete.

The following table has been compiled from the tasks listed in the management plan. The column entitled ‘Timing’ gives the deadline by which the task should be complete (end of quarter).

IMPLEMENTATION PHASES

Phase I – Getting Started (Year 1) **Issue**	**Task**	**Timing (in Phase I)**	**Estimated Capital Budget**
Currently no budget available to implement management	• Identify sources of funding to support technical assistance and equipment requirements during Phase I and II of SNP's management.	Q1	
Currently no staff to implement management plan	• Recruit Park Manager, Assistant Park Manager, Administrator and rangers.	Q1	US$500
Currently no detailed terms of reference or work plans for Park staff	• Develop terms of reference for Park Manager, Assistant Park Manager and Administrator. • Develop work plan for Park rangers.	Q1	
Currently no resources to implement management	• Procure inflatable boat and 25hp engine, fuel storage and pump system, engine-washing facility at SNP. • Procure marine VHF radios (x3 plus shore receiver) and other communication equipment (e.g. mobile telephones with extended external aerial). • Procure digital camera and binoculars. • Procure computers and printers for offices in Port Sudan and SNP, with internet capability (i.e. internet account and e-mail addresses). • Procure office furniture for offices in Port Sudan and SNP (filing cabinets, bookcases, table, desks and chairs etc.). This office should be shared with Dungonab Bay and Mukawwar Island protected area management. • Procure essential technical reference manuals for use by the Park staff including marine resource monitoring techniques, various IUCN and PERSGA publications and guidebooks for MPA management.	Q1 Q1 Q1 Q1 Q1 Q1	US$8,000 US$2,000 US$1,000 US$2,000 US$2,000 US$1,000
Currently no office space for Park staff	• Tidy and clean lighthouse area including future visitor centre, toilets and store. • Seek agreement with SPC for accommodation of 3-4 staff at lighthouse. • Install office equipment, patrol boat and communications equipment in Port Sudan and at the visitor centre in SNP, following consultation with SPC and the Red Sea University.	Q2 Q1 Q1	US$500 US$300
Legal basis of Park regulations and liabilities uncertain	• Secure legal basis for buffer zone around SNP. • Agree Park regulations. • Set-up bank account to accept income from visitor fees and sales. • Contract firm of accountants to audit the Park's books. • Make enquiries as to UNESCO's criteria for awarding World Heritage Site status and incorporate these criteria into the objectives of the Phase III management plan.	Q3 Q2 Q1 Q3 Q4	US$1,000 per year

Upgrade infrastructure at SNP	• Design and install mooring buoys. • Survey lighthouse staircase and jetties for structural integrity. • Conduct annual inspection of all buildings within SNP, and prepare and implement a maintenance schedule for all equipment used by Park staff.	Q3 Q3 Q4	Cost to be borne by PERSGA/SPC US$1,000 per year
SNP management plan requires regular updating	• Incorporate new information, government policies, and the results of scientific monitoring and research into the management plan each year.	Q4	Printing costs US$1,000
Lack of formal agreement between SPC, the University and SNP concerning the use of buildings at the lighthouse	• In consultation with a legal advisor, draw up a MOU for the use of space at the lighthouse.	Q1	Legal fees US$1,000
Implementation of zoning plan	• Designate area around lighthouse jetty for swimming and snorkelling. • Ensure vessels use mooring points. • Ensure adherence to SNP's policy relating to fishing.	Q2 Q4 Q2	US$500 for mooring buoys and fixings
Lack of procedures for routine observations visitor control and impacts	• Establish a protocol for surveillance and control of visitors in the Park, including the reporting or apprehension of illegal fishing vessels. • Ensure a particularly high level of surveillance on days during which live-aboard dive vessels are in Port Sudan. • Develop and implement procedure for inspecting level of litter, solid waste and oil etc. within SNP. This should be incorporated into the work plan for rangers.	Q2 Q2 Q1	
Lack of procedures for non-routine events	• Encourage dive operators to provide input into developing a contingency plan for a diver lost at sea or other diving-related emergency.	Q2	
Lack of guidelines for visitor conduct	• Develop simple guidelines for divers in consultation with dive operators (e.g. no novice divers and no diving gloves allowed). • Develop guidance notes for captains of vessels entering SNP.	Q2 Q2	
Lack of information concerning the resource base in SNP	• Encourage the collection of baseline survey data for sediment characteristics (including hydrocarbon content and composition of heavy metals), speed and direction of currents around SNP (including in open water and at the major points/headlands) and the distribution and extent of seagrass assemblages within the lagoon. • Encourage research on specific flagship species including sailfish, turtles, cetaceans. • Encourage research on the taxonomy and ecology, particularly reproductive ecology, of SNP's natural resources including algae, sponges, coral, molluscs, ascidians, fish, and cetaceans. • Encourage research on the ecological connectivity of SNP to and with other reefs.	Anytime Anytime Anytime Anytime	

Lack of data on the abundance of SNP's natural resources	• Establish monitoring transects for commercially important invertebrates (*Trochus*, giant clams, *Lambis*, pearl oysters and species of sea cucumber) • Establish a protocol and schedule for monitoring coral predators using the manta tow technique. • Establish a protocol and schedule for monitoring key species of reef fish including bumphead parrotfish, Napoleon wrasse, grouper and shark species.	Q2 Q1 Q1	
Lack of contact with international organisations involved with marine resource management	• Establish and maintain contact with the IUCN Species Survival Commission's Wrasse and Grouper Specialist Working Group, and search for other specialist interest groups for SNP's natural resource base (e.g. GCRMN, Reefcheck, IUCN, billfish and cetaceans).	Q2	
Lack of information and guidance relating to monitoring from other MPAs around the world	• Conduct internet search for details and reports of other monitoring in MPAs elsewhere, particularly relating to visitor perceptions and feedback. • Subscribe to the MPA Newsletter.	Q4	
Lack of information available for visitors, general public and other user groups	• Develop information leaflet describing the resources and importance of SNP. • Develop booklet that contains more information about SNP, and Dungonab Bay and Mukawwar Island protected area. • Develop an interactive CD-ROM that describes SNP's resources and management policy etc. • Develop a website for SNP that includes links to Friends of Sanganeb, outlines the opportunities for research at the Park particularly bio-prospecting and other non-extractive research.	Q2 Q4 Q4 Q4	US$2,000 US$5,000 US$5,000 US$5,000
Lack of awareness about SNP and its current state of development	• Issue a press release to the Sudanese and international press and specialist press/newsletters announcing the release of the management plan and schedule for its implementation. • Ensure that dive operators are informed about the upper limit being set for the carrying capacity of SNP.	Q1 Q1	US$500
Lack of facilities and opportunities for school children to visit and benefit from SNP	• Solicit interest from the private sector for the provision of tours at SNP from a glass-bottomed boat, and negotiate an appropriate arrangement to facilitate easy access to the Park for school children.	Q2	
Lack of corporate identity of SNP	• Develop logo for Park that uses the distinctive outline and lighthouse of Sanganeb as a feature.	Q1	US$1,000
Lack of regular communication with other stakeholders	• Advise other stakeholder organisations to appoint a member of staff as the point of contact with SNP and encourage their participation in the SNP Management Committee.	Q1	US$500
Lack of capacity within Sudan to manage a marine protected area	• Recruit a Park Manager or Assistant Park Manager from overseas.	Q2	US$10,000

Lack of marine experience amongst Wildlife Department staff	• Recruit trainer to develop capacity to operate in a marine environment amongst Park rangers.	Q2	US$5,000
Lack of budget for capacity building	• Allocate sufficient budget each year for capacity building, workshops and training.	Q4	
Lack of implementation plan for Phase II.	• Develop implementation plan for Phase II.	Q4	

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APPENDICES

LEGISLATION AND REGULATIONS

Sudan is party to the following relevant international conventions:

- Convention Concerning the Protection of the World Cultural and Natural Heritage (1974);
- United Nations Convention on the Law of the Sea (signed in 1982);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (ratified in 1982 and entered into force in 1983);
- Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment 1982 ('Jeddah Convention');
- Protocol to the Jeddah Convention Concerning Regional Co-operation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1982);
- Convention on Biological Diversity (signed in 1992, became party to in 1995).

Other conventions and programmes to which Sudan is party include:

- World Heritage Convention;
- African Convention on the Conservation of Nature and Natural Resources;
- UNESCO Man and the Biosphere Programme.

Relevant National Legislation

- Wildlife Protection Act, (1936);
- Sudanese Fishery Ordinances and Regulations: Dates back to 1937 and was amended in 1975 and 1978. Prohibits over-fishing, dumping of refuse, including oil, into the sea and the collection of corals, shells and aquarium fish;
- National Parks, Sanctuaries and Reserves Regulation, (1939);
- Harbours and Shipping Ordinance, (1961);
- Terrestrial Waters and Continental Shelf Act, (1970);
- General Regulations and Control of Merchant Shipping Act, (1971);
- Wildlife Conservation and National Park Act, (1987);

Proposed SNP Regulations

1. Between September and May, SNP will be open to visitors without the need for prior permission but subject to SNP regulations.
2. Staying overnight in SNP is permitted on moored or anchored vessels only, and in places designated by Park management.
3. It is forbidden to stand on, hold, break or collect corals and other attached or free-living marine life.
4. It is forbidden to catch or harm any animal life underwater other than fishes as controlled by specific rules for recreational fishing in SNP.
5. Fishing is permitted from the lighthouse jetty using a hook and line only.
6. It is forbidden to anchor or pole craft or to walk over coral communities and reefs.
7. Littering and discarding of foodstuffs anywhere within the core zone other than in the litter bins provided is prohibited.
8. It is forbidden to possess spear-guns, fish poisons, dead or live turtles, or coral within SNP.
9. It is forbidden to use jet skis and other fast moving or noisy craft in SNP.
10. The building of residences, catering facilities and other shelters or structures whether temporary or permanent shall be restricted to the area around the lighthouse unless by prior written amendment to the management plan by the management committee.
11. The building of piers, groynes, breakwaters, seawalls or other structures in, across or seawards of the reef is prohibited unless by prior written amendment to the management plan by the management committee.
12. The digging, blasting or dredging of channels is forbidden, unless by prior written amendment to the management plan by the management committee following their completion, review and acceptance of appropriate environmental impact assessment studies.

LISTS OF PLANT AND ANIMAL SPECIES

Algae

Chlorophyta	**Phaeophyta**	**Rhodophyta**
Chaetomorpha sp	*Ectocarpus* sp.	*Centroceras* sp.
Cladophora prolifera	*Dictyota dichotoma*	*Digenea simplex*?
Cladophora sp.	*Dictyota* sp. 1	*Spyridia* sp. 1
Microdictyon sp.1	*Dictyota* sp. 2	*Spyridia* sp. 2
Boodlea sp. 1	*Dictyopteris* sp. 1	*Martensia* sp. 1
Boodlea sp. 2	*Dictyopteris* sp. 2	*Dasya* sp.
Cladophoropsis sp.1	*Lobophora variegata*	*Ceramium* sp. 1
Dictyosphaeria cavernosa	*Padina pavonica*	*Ceramium* sp. 2
Bryopsis sp. 1	*Chnoospora* sp.	*Polysiphonia* sp. 1
Bryopsis sp. 2	*Turbinaria elatensis*	*Polysiphonia* sp. 2
Caulerpa serrulata	*Turbinaria decurrens*	*Tolypiocladia* sp.
Halimeda tuna	*Sargassum* sp.	*Herposiphonia* sp.1
Codium sp. 1	*Shacelaria* sp.	*Herposiphonia* sp.2
Codium sp. 2		*Leveillea* sp.
Udotea sp.1	**Cyanophyta**	*Chondria* sp.
Udotea sp.2	*Lyngbya* sp. 1	*Corallina* sp.1
	Lyngbya sp. 2	*Corallina* sp.2
	Microcoleus sp.	*Acanthophora* sp. 1
	Phormidium sp.1	*Laurencia* sp.1
	Phormidium sp.2	*Laurencia* sp.2
	Schizothrix sp. 1	*Laurencia* sp.3
	Schizothrix sp. 2	*Jania rubens*
		Jania sp.
		Lithophyllum sp.

Total number of algae confirmed as occurring at Sanganeb Atoll: 91
Source: KRUPP et al. (1994).

Polychaetes

Paraonidae	**Syllidae**	**Arabellidae**
Cirrophorus sp. 1	*Ehlersia* sp. 1	Drilonereis filum
Cirrophorus sp. 2	*Ehlersia* sp. 2	
Cirrophorus sp. 3	*Ehlersia* sp. 3	**Dorvilleidae**
	Exogone sp.	*Dorvillea* sp. 1
Spionidae	*Haplosyllis spongicola*	*Dorvillea* sp. 2
Prionospio cf *cirrifera*	*Syllis* cf. *amica*	
Pseudopolydora kempi	*Syllis gracilis*	**Terebellidae**
	Trypanosyllis cf *zebra*	*Euploymnia* sp.
Chaetopteridae	*Typosyllis bouvieri*	*Euploymnia nebulosa*
Mesochaetopterus cf *capensis*	*Typosyllis hyalina*	*Loimia medusa*
Mesochaetopterus cf *minutus*	*Typosyllis variegata*	*Lysilla* sp.
Spiochaetopterus bonhourei	*Typosyllis* sp. 1	*Neoamphitrite* cf *grayi*
Spiochaetopterus sp. 1	*Typosyllis* sp. 2	*Streblosoma cespitosa*
	Typosyllis sp. 3	*Streblosoma* sp.
Cirratulidae	*Typosyllis* sp. 4	
Caulleriella sp.	*Typosyllis* sp. 5	**Sabellidae**
Cirratulus africanus	*Typosyllis* sp. 6	*Branchiomma* cf. *nigromaculata*
Cirriformia filigera	*Typosyllis* sp. 7	*Hypsicomus phaeotenia*
Cirriformia sp. 1		*Potamilla reniformis*
Cirriformia tentaculata	**Nereididae**	*Sabella fusca*
Dodecaceria sp. 1	*Ceratonereis mirabilis*	*Sabella* sp.
Dodecaceria sp. 2	*Leonnates jousseaumi*	*Sabellastarte* cf. *sanctijosephi*
	Nereis cf. *caudate*	

Capitellidae *Dasybranchus* sp. *Scyphoproctus* cf *steinitzi* **Maldanidae** *Nicomache* cf. *lumbricus* *Nicomache* **Phyllodocidae** *Eteone* sp. *Phyllodoce madierensis* *Phyllodoce* sp. 1 *Phyllodoce* sp. 2 *Phyllodoce* sp. 3 **Aphroditidae** *Hermonia hystrix* **Polynoidae** *Harmothoe* cf. *aequiseta* *Harmothoe* sp. *Iphione muricata* *Lepidonotus* sp. *Malmgrenia* sp. 1 *Malmgrenia* sp. 2 **Hesionidae** *Gyptis* sp. *Leocrates claparedii*	*Nereis* cf. *falsa* *Nereis falcaria* **Glyceridae** *Glycera tesselata* **Goniadidae** *Goniada* sp. **Amphinomidae** *Chloeia fusca* *Eurythoe complanata* **Euphrosinidae** *Euphrosine foliosa* **Eunicidae** *Eunice* (*Palola*) *siciliensis* *Eunice antennata* *Eunice aphroditois* *Eunice dubitata* *Eunice interrupta* *Eunice marenzelleri* *Eunice perrieri* *Eunice* sp. 1 *Eunice tubicola* *Eunice vittata* *Lysidice* cf. *collaris* *Nematonereis* cf. *Latreilli* *Lumbrineris* sp.	

Total number of polychaetes confirmed as occurring at Sanganeb Atoll: 91. Source: KRUPP et al. (1994).

Fish

Carcharhinidae
Carcharhinus albimarginatus
Carcharhinus amblyrhynchos
Carcharhinus melanopterus
Triaenodon obesus

Sphyrnidae
Sphyrna lewini

Torpedidae
Torpedo sp.

Myliobatidae
Aetobatus narinari

Mobulidae
Manta birostris

Dasyatididae
Taeniura lymma

Synodontidae
Saurida gracilis
Synodus variegatus

Muraenidae
Gymnothorax javanicus
Siderea grisea

Ophichthidae
Callechelys striata

Clupeidae
Spratelloides sp.
Herklotsichthysquadrimaculatus

Belonidae
Tylosurus choram

Hemiramphidae
Hyporhamphus gamberur

Atherinidae
Atherinomorus lacunosus

Syngnathidae
Corythoichthys flavofasciatus
Corythoichthys nigripectus
Corythoichthys schultzi

Ophidiidae
Brotula multibarbata

Antennariidae
Histrio histrio

Lutjanidae
Lutjanus argentimaculatus
Lutjanus caeruleolineatus
Lutjanus kasmira
Lutjanus fulviflamma
Lutjanus gibbus
Lutjanus monostigma
Lutjanus bohar
Macolor niger

Caesionidae
Caesio lunaris
Caesio striatus
Caesio suevicus
Caesio varilineata

Haemulidae
Plectorhynchus gaterinus

Lethrinidae
Lethrinus nebulosus
Monotaxis grandoculis

Nemipteridae
Scolopsis ghanam
Nemipterus sp.

Ephippidae
Platax orbicularis

Kyphosidae
Kyphosus vaigiensis
Kyphosus cinerascens

Monodactylidae
Monodactylus argenteus

Pempheridae
Parapriacanthus guentheri
Pempheris vanicolensis

Bothidae
Bothus pantherinus

Soleidae
Pardachirus marmoratus

Mullidae
Mulloides vanicolensis
Mulloides flavolineatus
Parupeneus cyclostomus
Parupeneus forsskali
Parupeneus macronema

Malacanthidae
Malacanthus latovittatus

Scaridae
Hipposcarus harid
Cetoscarus bicolor
Bolbometopon muricatum
Scarus genazonatus
Scarus sordidus
Scarus gibbus
Scarus ferrugineus
Scarus fuscopurpureus
Scarus niger

Congrogadidae
Haliophis guttatus

Chaetodontidae
Chaetodon auriga
Chaetodon austriacus
Chaetodon fasciatus
Chaetodon lineolatus
Chaetodon melannotus
Chaetodon paucifasciatus
Chaetodon semilarvatus
Chaetodon mesoleucos
Gonochaetodon larvatus
Megaprotodon trifascialis
Heniochus diphreutes
Heniochus intermedius

Pomacanthidae
Pomacanthus imperator
Pomacanthus maculosus
Pomacanthus asfur
Centropyge multispinis
Apolemichthys xanthotis
Pygoplites diacanthus
Genicanthus caudovittatus

Acanthuridae
Acanthurus gahham
Acanthurus nigrofuscus
Acanthurus sohal
Ctenochaetus striatus
Naso hexacanthus
Naso unicornis
Naso brevirostris
Naso lituratus
Zebrasoma veliferum
Zebrasoma xanthurum

Siganidae
Valenciennea sp.

Monacanthidae
Siganus luridus
Siganus stellatus

Holocentridae
Neoniphon sammara
Myripristis murdjan
Sargocentron caudimaculatus
Sargocentron ruber
Sargocentron spinifer

Scorpaenidae
Pterois radiata
Pterois volitans
Pterois sp.
Scorpaenopsis barbatus
Synanceia verrucosa

Platycephalidae
Onigocia oligolepis

Serranidae
Aethaloperca rogaa
Cephalopholis argus
*Cephalopholis hemistikt*os
Cephalopholis miniata
Epinephelus fuscoguttatus
Epinephelus tauvina
Plectropomus areolatus
Plectropomus pessuliferus
Variola louti
Pseudanthias fasciatus
Pseudanthias lunulatus
Pseudanthias squamipinnis
Pseudanthias taeniatus

Grammistidae
Grammistes sexlineatus
Diploprion drachi

Cirrhitidae
Cirrhitichthys oxycephalus
Paracirrhites forsteri
Cirrhitus pinnulatus
Oxycirrhites typus

Pseudochromidae
Pseudochromis flavivertex
Pseudochromis fridmani
Pseudochromis olivaceus
Pseudochromis dixurus
Pseudochromis sp.

Apogonidae
Apogon annularis
Apogon aureus
Apogon exostigma
Apogon cf. *fraenatus*
Apogon cf. *coccineus*
Apogon kallopterus
Apogon leptacanthus
Archamia fucata

Mugiloididae
Parapercis hexophthalma

Echeneidae
Echeneis naucratus

Mugilidae
Crenimugil crenilabis
Oedalechilus labiosus

Sphyraenidae
Sphyraena barracuda
Sphyraena jello
Sphyraena qenie

Pomacentridae
Amblyglyphidodon flavilatus
Amblyglyphidodon leucogaster
Abudefduf vaigiensis
Abudefduf sexfasciatus
Abudefduf sordidus
Amphiprion bicinctus
Chromis caerulea
Chromis dimidiata
Chromis ternatensis
Chromis trialpha
Chromis weberi
Chromis pembae
Chrysiptera unimaculata
Dascyllus aruanus
Dascyllus trimaculatus
Neopomacentrus miryae
Neopomacentrus xanthurus
Paraglyphidodon melas
Plectoglyphidodon lacrymatus
Plectoglyphidodon leucozona
Pomacentrus leptus
Pomacentrus sulfureus
Pomacentrus trichourus
Pomacentrus trilineatus

Labridae
Anampses twistii
Bodianus anthioides
Bodianus axillaris
Bodianus diana
Cheilinus digrammus
Cheilinus fasciatus
Cheilinus lunulatus
Cheilinus mentalis
Cheilinus undulatus
Cheilinus sp.
Coris aygula
Coris africana
Epibulus insidiator
Gomphosus caeruleus
Halichoeres hortulanus
Halichoeres nebulosus

Blenniidae
Cirripectes sp.
Exallias brevis
Ecsenius frontalis
Ecsenius midas
Ecsenius nalolo
Ecsenius cf. *aroni*
Ecsenius gravieri
Meiacanthus nigrolineatus
Plagiotremus tapeinosoma

Gobiidae
Istigobius decoratus
Cryptocentrus lutheri
Cryptocentrus caeruleopunctatus
Ctenogobiops maculosus
Amblyeleotris steinitzi
Asterropterix semipunctatus
Ptereleotris microlepis
Ptereleotris evides
Nemateleotris sp.
Amblygobius albimaculatus
Amblygobius hectori
Gobiodon citrinus
Gobiodon sp.
Eviota sebreei
Bryaninops sp. 1
Bryaninops sp. 2
Bryaninops sp. 3

Balistidae
Balistapus undulatus
Pseudobalistes fuscus
Rhinecanthus assasi
Sufflamen albicaudatus
Odonus niger
Balistoides viridescens
Oxymonacanthus halli

Ostraciidae
Ostracion cyanurus
Ostracion cubicus

Tetraodontidae
Arothron diadematus
Arothron hispidus
Canthigaster margaritata
Canthigaster pygmaea

Diodontidae
Diodon hystrix

Cheilodipterus macrodon	*Halichoeres scapularis*	
Cheilodipterus bipunctatus	*Halichoeres marginatus*	
(*novemstriatus*)	*Hemigymnosus fasciatus*	
Cheilodipterus lineatus	*Hologymnosus annulatus*	
Cheilodipterus quinquelineatus	*Labroides dimidiatus*	
	Larabicus quadrilineatus	
Carangidae	*Pseudocheilinus evanidus*	
Caranx sexfasciatus	*Pseudocheilinus hexataenia*	
Caranx melampygus	*Cirrhilabrus blatteus*	
Caranx cf. *sexfasciatus*	*Pseudodax moluccanus*	
Carangoides bajad	*Thalassoma klunzingeri*	
Carangoides fulvoguttatus	*Thalassoma lunare*	
	Thalassoma purpureum	
	Thalassoma sp.	
	Minilabrus striatus	

Total number of fish confirmed as occurring at Sanganeb Atoll: 250
Source: KRUPP et al. (1994).

HYDROZOA	**Astrocoeniidae**	**Faviidae**
HYDROIDEA	Stylocoeniella armata	*Favia amicorum*
		Favia favus
Milleporidae	**Pocilloporidae**	*Favia laxa*
Millepora dichotoma	*Stylophora pistillata*	*Favia pallida*
Millepora exaesa	*Seriatopora caliendrum*	*Favia rotumana*
Millepora platyphylla	*Seriatopora hystrix*	*Favia speciosa*
	Pocillopora damicornis	*Favia stelligera*
Stylasteridae	*Pocillopora verrucosa*	*Favites complanata*
Distichopora violacea		*Favites flexuosa*
	Acroporidae	*Favites halicora*
ANTHOZOA,	*Astreopora myriophthalma*	*Favites pentagona*
OCTOCORALLIA	*Acropora capillaris*	*Favites rotundata*
	Acropora corymbosa	*Goniastrea edwardsi*
STOLONIFERA	*Acropora cf. haimei*	*Goniastrea pectinata*
	Acropora hemprichi	*Goniastrea retiformis*
Tubiporidae	*Acropora humilis*	*Platygyra daedelea*
Tubipora musica	*Acropora hyacinthus*	*Leptoria phrygia*
	Acropora pharaonis	*Oulophyllia crispa*
ALCYONARIA	*Acropora squarrosa*	*Hydnophora microconus*
Alcyoniidae	*Acropora superba*	*Leptastrea bottae*
Lobophytum pauciflorum	*Acropora variabilis*	*Leptastrea purpurea*
Parerythropodium fulvum	*Acropora sp.*	*Leptastrea transversa*
Sarcophyton ehrenbergi	*Montipora effusa*	*Cyphastrea chalcidium*
Sarcophyton elegans	*Montipora ehrenbergi*	*Cyphastrea microphthalma*
Sinularia candidula	*Montipora granulosa*	*Cyphastrea serailia*
Sinularia dactyloclados	*Montipora meandrina*	*Echinopora gemmacea*
Sinularia flabelliclavata	*Montipora monasteriata*	*Echinopora lamellose*
Sinularia gardineri	*Montipora stilosa*	
Sinularia leptoclados	*Montipora tuberculosa*	**Oculinidae**
Sinularia minima	*Montipora venosa*	*Galaxea astreata*
Sinularia notanda	*Montipora verrucosa*	*Galaxea fascicularis*
Sinularia polydactyla	*Montipora sp.*	
Sinularia querciformis		**Mussidae**
Sinularia schumacheri	**Agariciidae**	*Scolymia vitiensis*
	Pavona clavus	*Lobophyllia corymbosa*
Nephtheidae	*Pavona divaricata*	*Lobophyllia hemprichi*
Nephthea laevis	*Pavona maldivensis*	*Lobophyllia pachysepta*
Dendronephthya hemprichi	*Pavona varians*	*Acanthastrea echinata*

Dendronephthya savignyi *Stereonephthya cundabiluensis* *Lithophyton arboreum* *Paralemnalia eburnea* *Paralemnalia thyrsoides* **Xeniidae** *Xenia macrospiculata* *Xenia umbellata* *Heteroxenia fuscescens* *Athelia fishelsoni* *Athelia glauca* *Sympodium caeruleum* **GORGONARIA** **Gorgonidae** *Clathraria rubrinodis* *Juncella* sp. **ANTHOZOA**, **HEXACORALLIA** **SCLERACTINIA** **Thamnasteriidae** *Psammocora haimeana* *Psammocora nierstraszi*	*Leptoseris mycetoseroides* *Gardineroseris planulata* **Siderasteridae** Coscinarea monile **Fungiidae** *Fungia echinata* *Fungia fungites* *Fungia klunzingeri* *Fungia scutaria* *Herpolitha limax* **Poritidae** *Alveopora daedalea* *Goniopora minor* *Goniopora tenuidens* *Porites echinulata* *Porites lutea* *Porites solida* *Porites (Synarea) undulata* *Porites* sp.	*Symphyllia erythraea* **Pectiniidae** *Mycedium elephantotus* *Echinophyllia aspera* *Oxypora lacera* **ZOANTHARIA** **Zoanthidae** Palythoa tuberculosa **ANTIPATHARIA** **Anthipathidae** *Cirripathes* sp.

Total number of Cnidaria confirmed as occurring at Sanganeb Atoll: 126
Source: MERGNER & SCHUMACHER (1985); VINE & VINE (1980).