PERSGA - SAP

A Regional Network of Marine Protected Areas

Survey design for
Proposed Marine Protected Areas

Isles des Sept Frères & Ras Siyyan, *Djibouti*

Aibat & Saad ed Din, *NW Somalia*

Mukkawar (Magarsam) Island and Dungonab Bay, *Sudan*

Bir Ali - Belhaf, *Yemen*

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SUMMARY

Surveys of proposed Marine Protected Areas (MPAs) in the Red Sea and Gulf of Aden region will include both Biological and Resource Use (Socio-Economic and Fisheries) components. These surveys will provide information for the development of Site-specific Master Plans and Management Plans. The information requirements for the development of those plans are described in the Draft '*Red Sea and Gulf of Aden Regional Network of Marine Protected Areas, Regional Master Plan*' (PERSGA 2001).

A hierarchical approach will be adopted to the spatial design of biological surveys for MPAs. Large survey areas (such as those for the MPAs in Djibouti, NW Somalia, Sudan and Yemen, proposed as part of the Regional Network) will be divided into sectors and sub-sectors. Smaller survey areas may only be divided into sectors, and very small survey areas, of just a few square kilometres or less, may not need to be subdivided at all.

Methods for biological surveys will be based upon those described in the Standard Survey Methods Manual, produced under the Habitats and Biodiversity Component of the PERSGA Strategic Action Programme (SAP). The basis for these surveys will be Rapid Assessment methods, providing an overall assessment of the nature and condition of each site, including habitats, species and human impacts. At a subset of survey sites more detailed assessments of the diversity and community structure of key indicator groups, including corals, fishes, mangroves and seagrasses, will be carried out in addition to Rapid Assessment.

Sites of critical ecological importance, including nesting, spawning, roosting, nursery, feeding, and other aggregation sites, will be identified and surveyed. Species of particular importance included in the biological surveys include dugong, turtles, cetaceans and birds.

Resource-use surveys (including both socio-economic surveys and fisheries surveys) will survey both the proposed MPA *and* adjacent areas of land and sea. This is necessary because human activites outside the boundaries of proposed MPAs, both in the sea and in coastal areas (including watersheds), may directly affect decisions made in both the design and management of any MPA.

Fisheries surveys will examine all extractive uses of living marine resoures including finfish, elasmobranchs and invertebrates. Socio-economic and fisheries surveys for the Regional Network of MPAs will be designed by regional experts, who will carry out the surveys in the field, and train national specialists in those methods, in each of the survey countries.

Production of images and unsupervised classifications of survey areas using Geographical Information Systems (GIS) and remote sensing prior to the start of the field surveys will be essential for the surveys of the proposed Regional Network of MPAs. It is recognised that such techniques will not always be available for all MPA surveys in the region, but they should be incorporated within survey programmes whenever possible. In particular, GIS techniques will be crucial for successful surveying and habitat mapping of very large areas. Accurate georeferencing of survey sites is essential, and use of hand-held GPS units by all survey teams will be standard procedure for MPA surveys in the region.

The four proposed MPAs to be surveyed for the Regional Network are all large (up to 300 km^2 or larger), and all are home to a wide range of important habitat types and species. Amongst others these include coral communities, seagrasses, mangroves, turtle and bird nesting sites and fisheries resources. This combination of biodiversity and fisheries resources within the proposed MPAs emphasises the high degree of convergence between the MPA component, other components of the SAP, and other initiatives in the region.

The interests of the MPA component of the SAP overlap considerably with those of the Habitats and Biodiversity component and with the Living Marine Resources component. In Yemen there is further important convergence of the MPA component with the GEF ICZM project in Hadramaut & Shabwa Provinces. The GEF ICZM project includes the entire area of the proposed MPA at Bir Ali - Belhaf.

The Survey team will consist of three groups:

- Survey Team Leaders (Survey Leader and Assistant Survey Leader)
- Regional team members
- National team members

The Survey Leaders will be members of the Biological Survey team. Regional team members will consist of two further biological surveyors, the socio-economist and the fisheries surveyor. The Regional Team will subsequently form the core of a regional MPA survey team able to design, carry out and interpret surveys for MPA projects throughout the region, as well as train other workers to the same standard. National team members will include one biological surveyor, one fisheries surveyor and one socio-economist. Team Leaders and Regional team members will take part in surveys of all four of the proposed MPAs. National team members will participate only in the surveys in their own countries.

The Team Leaders and Regional team members will be qualified and trained specialists in the relevant fields. National team members will be qualified individuals who will gain considerable further training and extensive experience from their involvement in the surveys, and will subsequently be able to carry out similar work within their own countries for the continued development of National Networks of MPAs.

Equipment required for the surveys will include transport (Boats, and 4x4 vehicles) all necessary boat and diving equipment (including communications equipment: two-way radios for boats and vehicles and, for emergencies, a mobile phone), camping equipment, scientific equipment (including stationery, cameras and film, quadrats, tape measures, sampling and sample storage equipment, etc). Boats, vehicles and some diving equipment (tanks, weights and compressor) will be imported to the survey countries permanently. Other equipment, such as ‘personal’ diving gear (regulators, masks, fins, wet suits, BCDs, etc) will be retained by each surveyor for use in all four surveys.

Effective logistical support for the survey teams will be essential while in the field. Issues of supply, re-supply and communication will be resolved prior to the start of the surveys and will require considerable active participation of the NPCs and MPA Working Group Members in each country. A National Survey Co-ordinator will be appointed to act as a central contact and logistical support point in each country, and to undertake organisational work including arrangement of all permits, clearance of imported equipment through customs, etc. Of particular importance will be ensuring adequate supplies of food, water and fuel, and the early acquisition of all permits necessary for travel, diving, photography, sample collection and export. Safety will be of paramount importance throughout the surveys. All surveyors involved in biological surveys will be strong swimmers and qualified SCUBA divers.

Survey data will all be recorded on standardised recording sheets, and will always be backed up in either hard or soft copy within a few days of collection. During or after completion of surveys, the data will be entered into databases (to be designed under the Habitats and Biodiversity Component), or into database - compatible spreadsheets, for analysis, and for incorporation into the final products of the GIS and remote sensing aspect of the project.

Final outputs from the survey programmes will consist of:

- Reports detailing the results of each survey, and providing maps of habitat and biodiversity distributions within each survey area
- GIS output, in the form of habitat, resource use and conflict maps
- Soft copies of raw data in a standardised format (either in databases if they are available, or in compatible spreadsheets)

Those reports and databases will provide information on which to base the development of site-specific master plans and management plans for each MPA.

PART 1. INTRODUCTION AND OBJECTIVES

1.1. INTRODUCTION

The Red Sea and Gulf of Aden contain some of the world's most diverse and varied tropical marine habitats and communities. The combination of high levels of diversity, biogeographic complexity, and high levels of endemism found in these bodies of water make the Red Sea and Gulf of Aden a region of global importance for marine biodiversity conservation (Chiffings 1995, PERSGA 2001).

The primary goal of the Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) is the conservation of the environment, and consequently conservation of the biological diversity, of this unique region. The PERSGA Strategic Action Programme (SAP) supports and facilitates that goal. The SAP includes several components, one of which (Component 5) is *Development of a Regional Network of Marine Protected Areas*.

Component 5 includes the development of a Regional Master Plan for Marine Protected Areas (MPAs), and the development of a network of MPAs throughout the region (PERSGA 2001).

Four MPAs of regional or global importance in the Red Sea and Gulf of Aden have been proposed to complement the MPAs already existing in the region. The survey, design and implementation of those four MPAs will be carried out as part of Component 5 of the SAP.

The four proposed MPAs are:

- Isles Sept Frères and Ras Siyyan, Djibouti
- Saad ed Din and Aibat, NW Somalia
- Dungonab Bay & Mukkawar (Magarsam) Island, Sudan
- Bir Ali - Belhaf, Yemen

A summary of the current status of the four proposed MPAs is presented in Table 1 (below).

This report provides a design for surveys of marine and coastal habitats, species and resource uses in these four MPAs. It is envisaged that the Regional Network will be supplemented and complemented by development of National Networks of MPAs in the countries of the region. This report will ultimately provide a template for surveys in other proposed Marine Protected Areas throughout the Red Sea and Gulf of Aden (RSGA) region.

The refinement of the survey designs presented in this report will be a continuous process, from the present time (April 2001) until implementation of the surveys in 2002.

Table 1. Summarised details of the four proposed MPAs

Country	Protected Area	Size	Major Habitats and Regional Significance	Impacts and Conflicts	Management/ Projects	Priority
Djibouti	Isles Sept Frères & Ras Siyyan	Undefined	High aspect islands and adjacent coast, including bays and mangroves; diverse corals and reef fish at Bab-al-Mandab.	Recreation/tourism Fishing	None	Regional
NW Somalia	Saad ed Din & Aibat	c. 300 km^2	Low - lying mangrove islands, with largest coral reefs and mangroves in the GoA; bird and turtle nesting sites, dugong.	Coral and egg collection Fishing pressure	None	Global
Sudan	Mukkawar Island and Dungonab Bay	>300 km^2	Coral reefs, whale sharks, manta ray aggregations, bird nesting sites, turtle nesting sites, dugong, oyster beds.	Shark fisheries Oyster culture *Trochus* fishery Beche-de-mer fishery	None	Regional
Yemen	Bir Ali and Belhaf Area	Undefined	High aspect coast and islands with sandy beaches; extensive coral communities, unique fish communities; crater with mangroves; bird and turtle nesting, cetaceans.	Tourism development Fisheries Proposed oil terminal	None yet (but GEF ICZM project will soon be implemented)	Regional or Global

1. 2. THE OBJECTIVES OF THE SURVEYS

One of six stated objectives of Component 5 of the SAP is development of '*a site-specific master-plan, which is a long-term policy document and includes the management plan* [....] *for each MPA.*" (PERSGA 1999). Development of those site-specific master-plans will be carried out using information provided by biological and resource-use surveys of each area.

Management Objectives of the Regional Network of MPAs

The objectives of the Regional Network of MPAs, defined in the Regional Master Plan (PERSGA 2001), are:

- To develop regional capacity in all aspects of MPA planning and management
- To provide for the sustainable use of living marine resources
- To support local and national economic and social development
- To involve local communities and stakeholders as partners in MPA management
- To conserve representative and prime examples of the biodiversity of the Red Sea and Gulf of Aden
- To conduct research and monitoring programmes for the benefit of MPA management
- To enhance public awareness for the marine resources and biodiversity of the Red Sea and Gulf of Aden and the principles of sustainable use
- To protect the unique cultural heritage of the marine and coastal environments of the Red Sea ad Gulf of Aden
- To implement the regional legal framework for protected areas and biodiversity

Objectives of the Biological and Resource-use Surveys

The surveys described in this Survey Design will provide biological and resource-use information to inform the development of site-specific Management Plans, to enable the MPAs to achieve the objectives defined above.

Within the constraints imposed by time and other available resources, that information (from PERSGA, 2001) will include:

1. *Bio-physical Information*
   - Types, and extent, of ecosystems and habitats occurring within the MPA, including open water, coral reefs, other subtidal habitats, beaches, rocky shores, sabkah, mangrove, seagrass, intertidal, saltmarsh, wetland
   - The flora and fauna of each of these habitats
   - The structure and extent of coral communities and other benthic communities
   - The composition of fish assemblages associated with the coral communities and other benthic communities
   - Areas that are unusually rich in biodiversity within the boundaries of the MPA, i.e. areas with a high diversity and richness of a particular group; areas with a high diversity and richness of several groups

- Areas used by fishes for spawning, and as juvenile nursery areas
- The distribution of sea turtles, dugong, other marine mammals, and of habitats used by these groups
- Seabirds, and the areas used by them for feeding and nesting

2. *Resource Use Information*

- The types of uses made of the living marine resources occurring in the area, the locations where these uses occur, and the intensity of use in each of these locations
- Species caught by fishermen, and any seasonal patterns in species targeted
- Historical records of catch and effort for species caught
- The types of fishing equipment used by fishermen
- The locations of fishing camps
- Seasonal patterns in the use of living marine resources
- Areas important for recreation and tourism, and the levels of usage
- Areas important for research and education
- Use of the area for navigation, shipping (including anchorages and ports), defence
- Areas with traditional and cultural significance

3. *Socio-Economic Information*

- Locations of towns, settlements, and their populations, within the MPA or adjacent to the MPA
- Numbers of people engaged in each of the resource usages, and whether they work seasonally or full-time in these activities
- The economic significance of the area for each of the uses
- The income derived by users of resources within the MPA
- Population growth rates and levels of education
- The use of customary or traditional management practices
- The role of local *sheikhs* in the local community and in resource usage
- The presence of other significant individuals (such as chief fishermen)

Biological Surveys will be used to gather bio-physical information, in combination with the use of Geographical Information Systems (GIS) and remote sensing techniques.

Socio-Economic Surveys and Fisheries Surveys, together termed Resource Use Surveys in this report, will be used to gather socio-economic and resource use information.

Already extant information

Varying amounts of information about habitats, species and/or resource uses already exist for each of the survey areas. That existing information is very sparse for survey areas in Djibouti, NW Somalia and Sudan. Some more detail is known of the Bir Ali - Belhaf area, which was included in several surveys in the mid to late 1990s (Huntington & Wilson 1995, Watt 1996, Kemp 2000, Kemp & Benzoni 2000, DeVantier & Hariri in press). Kemp (1998), provides a broad overview of marine and coastal habitats, species and biodiversity in the Bir Ali - Belhaf area, with particular reference to conservation and MPA design.

Extant information about Isles des Sept Frères (Djibouti) and Saad ed Din - Aibat (NW Somalia) is based principally upon rapid surveys carried out in the late 1990s (McClanahan & Obura 1997, PERSGA 1998b, Ahmed *et al*. 2000, Ali *et al*. 2000). No systematic survey of the

Dungonab - Mukkawar area (Sudan) has been carried out to date, although studies of specific resource uses, particularly *Trochus* fisheries, were carried out there in the late 1990s (Mohammed Eltayeb, personal communication, October 2000). The proposed surveys will fill gaps in the available information. In all cases this will require extensive surveys of habitats, species and resource uses.

The Bir Ali - Belhaf area was heavily impacted by coral bleaching in mid 1998. DeVantier & Hariri (in press) assessed the impact of this bleaching event on corals at several sites. The severity of the bleaching event means that previous subtidal habitat and species surveys, while providing valuable baseline information, need to be comprehensively updated.

Physical information about the survey areas (bathymetry, etc.) is included in navigation charts of the region. Navigation charts are of very variable usefulness to the surveys. Those which include the Bir Ali - Belhaf area cover the entire Gulf of Aden and so lack any very useful detail. Those for Sudan and Saad ed Din / Aibat include enough information to be useful throughout all or most of the field surveys (detailed charts cover only part of the Sudan survey area). A detailed chart of Isles des Sept Frères will provide extensive useful information about the physical characteristics of the Djibouti survey area.

Relevant navigation charts are itemised in detail in Section 3.1, '*Site Specific Survey Details*' and Section 3.2.4 '*Navigation charts*'.

A SECONDARY OBJECTIVE

As a secondary objective, this programme of surveys will provide a model to be adapted and used for MPA survey and design programmes at a national level throughout the PERSGA region.

PART 2. SURVEY DESIGN

2.1. SPATIAL DESIGN OF MPA SURVEYS

Key Points

- Survey areas for proposed MPAs in the RSGA region will vary considerably in size from very small (perhaps less than 1 km^2) to very large (several hundred square kilometres). Those proposed for the Regional Network in Djibouti, NW Somalia, Sudan and Yemen are all large.
- Survey areas for MPAs throughout the RSGA region are likely to include a wide range of habitats, biological communities, human impacts and socio-economic activities.
- A hierarchical survey design has been adopted, providing a spatial structure for MPA surveys. For large survey areas (such as those in Djibouti, NW Somalia, Sudan and Yemen) each survey area will be divided into sectors, and sectors will be further divided into sub-sectors. For smaller survey areas there may be no requirement for the use of sub-sectors.
- Within and between sub-sectors (or sectors, in smaller survey areas), sites will be selected to be as representative as possible of the full range of biotopes present.
- In addition to sites selected using the hierarchical design there will be a number of 'self-selecting' survey sites, where important habitats, communities, or phenomena occur. Such sites will include, for instance, feeding, breeding and other aggregation areas for birds, turtles, etc.
- For surveys of large areas, and when time and other resources for field survey work are limited, the use of GIS and remote sensing techniques can be crucial for design, conduct and interpretation of habitat surveys (PERSGA 2001). Such methods will be less crucial for surveys of smaller areas than for those in large areas. It should be recognised that GIS and remote-sensing analysis will not always be available, but that it is desirable to make use of these techniques for all MPA surveys whenever possible.

Introduction

Surveys will be structured to maximise survey coverage within the limits of available resources, and to provide a balanced combination of information about broad habitats and resource uses. More detailed species and biodiversity information will be collected for selected groups.

2.1.1. Hierarchical survey design

An hierarchical approach to the design of MPA surveys will be adopted. Each survey area will be divided into sectors, which will then be further divided into sub-sectors. Within sub-sectors the distribution of survey sites will be designed to provide an optimal assessment of the nature and condition of a representative range of communities from the principal habitats or biotopes present. These surveys are baseline surveys, providing information about species, habitats and resource uses in the survey areas within a single, relatively short period of time.

Appendix 3 provides additional criteria to be applied to the selection of sites for these baseline surveys, contrasting them with criteria for selection of monitoring surveys (which provide information about changes in an area over time). That list will be used as an additional guide to survey site selection.

Sectors

So far as possible and practical, surveys of one sector will be completed before surveys of the next sector begin. The boundaries of the survey sectors will be decided on the basis of a combination of:

- Physical and biological features and characteristics
- Logistical convenience and practicality for the survey phase

Sectors will provide a coarse-scale breakdown of areas which may differ from each other, such as inshore and offshore reef areas.

A flexible approach will be maintained, allowing the boundaries of sectors to be altered if necessary. Changes will only be made if exceptional circumstances demand it.

The sectors for each survey area in Djibouti, NW Somalia, Sudan and Yemen are provisionally designated as outlined in Section 3.1. '*Site Specific Survey Details*', below (indicative only at this stage, pending finalisation when remotely sensed images & GIS data are available).

Sub-sectors

In cases where the area to be surveyed is very large, each sector will be further divided into sub-sectors. Sub-sectors will correspond to self-contained or otherwise distinct physical and biological features of the area, such as single large islands, large bays or reefs. As with sectors, sub-sectors will be selected to represent large-scale units or areas which may differ biologically from other sub-sectors.

Within those constraints, the criteria for delineation of sub-sectors will be largely based on logistical considerations, including timetables for conduct of surveys in each area. Both development of timetables and detailed delineation of sub-sectors will be carried out in 2001 when GIS output is available.

A single large offshore reef such as Turuxaad in NW Somalia or single islands such as Sikha or Hallaniyah in Yemen, or Grand Isle at Sept Frères, may constitute single sub-sectors. In Sudan a sub-sector may be a group of reefs, or the whole of the eastern or western side of the large island of Magarsam, together with its fringing reef. Examples of provisional designations of sub-sectors are provided in sections 3.1.2 - 3.1.5, '*Site Specific Survey Details*'.

Surveys of smaller areas will not require the same degree of heirarchical structuring, and in many cases subdivision of sectors into subsectors may be unnecessary. Very small areas may require no sub-division at all.

There will be a target time for the completion of the survey in each sector and sub-sector, generally of between one and four survey-days, depending upon the size and nature of the particular sub-sector.

2.1.2. The distribution of sites within sub-sectors

Survey sites within sub-sectors will provide replication for each distinct broad-scale habitat type or biotope within the sub-sector.

For instance, in a sub-sector consisting of a single large reef or a group of superficially similar reefs, sites will be chosen to represent different zones such as fore-reef (seaward), back-reef (landward), reef flat and lagoon communities, with replication within those categories. Similarly, on a coast or island with headlands and bays providing a range of differing degrees of exposure, sites will be selected to provide representation of both headlands and bays.

Within all of the identified zones of a sub-sector (e.g. fore-reef, back-reef, headlands, bays) sites will be selected in a random manner.

2.1.3. The distribution of Detailed Survey Sites: Selection from among the Rapid Survey Sites

A Rapid Site Assessment will be carried out at every site. At a sub-set of sites a Detailed Survey will also be carried out, after completion of the Rapid Assessment (see Section 2.2, '*Survey Methods*'). Detailed Surveys will provide more detailed baseline information about the diversity and community structure of selected groups within each survey area at the time of the survey.

Detailed Survey sites will be selected in a random manner from within the identified zones in each sector.

2.1.4. The need for a flexible approach to sectors, sub-sectors, and survey site selection

All aspects of spatial survey design described here are intended to guide the conduct of surveys in the field rather than to be rigidly prescriptive rules. It is important to ensure that the hierarchical approach to site selection is complemented by a flexibility which can cater for the unexpected at all scales, and which will allow departure from standard site selection methods if exceptional sites or situations demand it. All such departures from normal should be complementary to the standardised approach to site-selection, rather than replacing it.

2.1.5. Self-selecting sites

The site-selection methodology and guidelines provided above, are for selection of sites to provide a broad and representative description of widespread habitats, communities and species assemblages within the survey area. These will include intertidal communities, coral and fish communities, etc. (PERSGA 2001, and Section 1.2, above).

There will inevitably be a number of restricted - distribution habitats and communities within the survey areas which should to be included, but because of their very localised nature are unlikely to be selected using the standardised hierarchical approach. These may constitute a considerable proportion of the final total of survey sites and will include:

- Bird aggregation areas (feeding, nesting, roosting, etc.)
- Turtle nesting areas
- Any other areas where clearly defined critical sites or habitats occur, which are relatively limited and localised in extent (including mangroves, seagrasses)

These ‘self-selecting sites’ will constitute a further ‘layer’ to the spatial design of the surveys. These sites will be surveyed using the appropriate specific methods as presented in the Standard Survey Methods (SSM) manual. Given the time constraints placed upon the survey programmes, those methods will provide only rapid assessments, and will be aimed at recording the existence and location of those sites and habitats, with a broad description of their status where appropriate.

2.1.6. Manta-tow surveys

Manta-tows will be an appropriate shallow subtidal survey method in many areas if conditions allow. Use of manta-tows will fall into two categories:

1. Rapid survey of entire areas such as smaller islands or bays up to 1 or 2 km in size, in order to produce maps of the distribution of major types of shallow habitats, and an assessment of the scale and types of impacts or threats.

2. To examine the distribution of broad levels of coral-cover, mortality and threats such as Crown of Thorns starfish (CoTs) by sampling parts of large areas of coral or rocky habitats, such as extensive fringing reefs and larger offshore reefs and islands.

2.1.7. Coastal Areas

Marine Protected Areas do not occur in isolation from the surrounding environment, and MPAs with a coastal component are vulnerable to impacts from incompatible or unsustainable land use practices (PERSGA 2001). Damaging impacts on marine communities caused by shore-based activities are a common reason for failure of both short- and long-term marine conservation programmes. All four of the proposed MPAs included in the survey programme described here have significant areas directly fringing mainland shores, and so this will be an important consideration in the design of Management Plans for these areas.

Marine Protected Areas away from coastal areas, as well as MPAs with a coastal component, are also vulnerable to unsustainable exploitation of marine habitats outside their own boundaries, and to marine pollution events which may originate considerable distances away.

Protection of intertidal and subtidal areas is likely to be wholly or partially ineffective if activities on the adjacent shores are not carefully controlled. Although coastal areas will often lie outside the direct management responsibilities of any MPA, the likelihood of negative impacts can be reduced by co-ordinating activities with relevant agencies (PERSGA 2001). Consideration of coastal areas adjacent to the proposed MPAs will thus be included in the management plans for MPAs. For this reason, although surveys of the habitats and biodiversity of the coastal areas are beyond the scope of these proposed biological surveys, observations of the adjacent coastal lands will be made but throughout the surveys. Those observations will include:

- Major coastal landscapes and drainage features
- The principal uses of these coastal areas, both adjacent to and within the general vicinity of the proposed MPA
- Human uses of the marine environment occurring outside the boundaries of the MPA

2.1.8. Mapping and Geographical Information Systems (GIS)

The use of GIS and remote sensing techniques is a powerful tool aiding in the design, conduct and interpretation of biological and resource use surveys, and for management planning (PERSGA 2001).

- These methods can provide information on distribution and extent of different broad habitat types *before* the field phase starts, and so during the planning phase can aid decision making about survey design, including the numbers and distributions of field survey sites.
- Development of unsupervised classifications of biotopes prior to the field phase, and ground - truthing of those habitats in the field, can provide maps of the distributions of shallow subtidal biotopes which could not be obtained with the same degree of accuracy through field surveys alone.

GIS and remote sensing methods will be less crucial for surveys of smaller areas than for those in large areas. It is recognised that GIS and remote sensing analysis will not always be available or affordable but, whenever possible, these techniques should be used at all stages of planning, implemention and interpretion of MPA surveys.

2.2. SURVEY METHODS

Key Points

- Survey methods will include a two-tiered system of rapid and detailed site assessments, both intertidally and subtidally.
- Rapid Assessment will be carried out at all survey sites.
- Detailed surveys to provide information on diversity and community structure will be carried out at relatively few sites, constituting a sub-set of the Rapid Assessment sites.
- The survey methods to be used will be selected on the basis of the methods provided in the PERSGA / SAP Standard Survey Methods Manual.

Introduction

Surveys will be based upon a two-tiered approach. A large number of sites will be assessed using rapid assessment methods. A sub-set of those rapid assessment sites will be further characterised by more detailed surveys of selected groups.

The methods used throughout the surveys will be those detailed in the PERSGA Standard Survey Methods (SSM) manual, produced as part of the Habitats and Biodiversity Component of the SAP. This manual is currently in a draft form, and some of the chapters remain to be written, including the Rapid Assessment Methods chapter. Final decisions about the methods to be used for the surveys will be made during 2001.

2.2.1. Rapid Assessment Methods

Surveys will be based primarily upon Rapid Assessment. This allows rapid appraisal and characterisation of a large number of sites, and so will provide a good assessment of large survey areas within the time available (between four and six weeks survey work per area, dependent upon size, accessibility, and other logistical and biological characteristics).

Variations on the basic rapid survey methods will be used in some areas. In areas such as the islands of Sept Frères and parts of Bir Ali-Belhaf the surveys will include the use of manta-tows (included in the Coral Reef Survey Methods chapter of the SSM Manual) if conditions allow, to map the local distribution of broad types of subtidal communities including coral communities, as well as Crown of Thorns, bleaching and other coral mortality. Flexibility will be an inherent part of the survey programmes, and so manta tows may also be used in Sudan, NW Somalia and/or Yemen, if it is decided that the method is appropriate for use in parts of those areas.

2.2.2. Detailed Survey Methods

Detailed surveys of selected groups and communities will be carried out at a sub-set of Rapid Assessment Sites.

Detailed survey methods will follow those laid down in the appropriate chapters of the PERSGA SSM manual, and will fall into two categories:

1. Abundance/community structure surveys

2. Biodiversity surveys

Neither of these categories of survey will utilise very detailed or time-consuming methods. The methods will be selected to provide a basis for comparison of community structure and biodiversity between different sites, biotopes, sub-sectors and sectors of the survey area. These methods will include transects to gather abundance/community structure data, and timed searches for biodiversity assessments.

The groups selected for detailed biological surveys (from PERSGA 2001) *are*:

- *Corals*. Provisional recommended detailed methods: ReefCheck surveys; biodiversity survey (timed search).
- *Reef Fishes*. Provisional recommended detailed methods: Abundance/community structure survey for selected families by underwater visual census (UVC) transects; biodiversity survey (timed search).

These two groups are included for three principal reasons:

- They are important as biodiversity indicator groups
- They are important as indicators of both anthropogenic and natural impacts
- Their taxonomy and biogeographic characteristics are relatively well known in the RSGA region

Two other groups may be included in more detailed assessments. These are:

- Seagrasses
- Mangroves

Both of these latter two groups fall into the 'Self-selecting sites' category (see Section 2.1.5, above).

2.2.3. Rare, Threatened, Vulnerable and Flagship Species

A number of species of regional or global conservation significance are known to occur within the survey areas. These include, in particular:

- Turtles
- Dugong
- Birds
- Cetaceans

There is considerable overlap between MPA survey activities for these groups, and survey programmes to take place under the Habitats and Biodiversity Component (HBC). Turtle surveys are planned for Djibouti, NW Somalia, Sudan and Yemen during 2001, under the Habitats and Biodiversity Component of the SAP.

Close communication and co-operation between the MPA and Habitats and Biodiversity Components will be maintained in order to maximise any added value which can be gained

from these convergences (see Section 3.3, '*Convergence Between the MPA Component of the SAP and Between Other Projects and Initiatives in the Region*').

2.2.4. Commercially important species

Observations of species and species groups which are either known to be exploited locally, or which are known to be particularly sensitive to over-exploitation, will be included in both rapid and detailed survey methods. In particular these include *Trochus, Tridacna, Strombus,* oysters, Beche-de-Mer (Sea Cucumbers), sharks and black coral (*Antipathes* spp).

Commercially important reef fish such as groupers, snappers and emperors will be included in the reef fish categories of the rapid assessment methods, and within the reef fish detailed survey methods. These surveys will contribute to the fisheries assessment.

Each survey will be accompanied by a fisheries specialist and a socio-economic specialist (*see Section* 3.4).

2.2.5. Critical Sites (Sites of Ecologically Important Phenomena)

Critical sites are here defined as being specific locations which are of particular or unusual importance for ecological or biological processes such as feeding, roosting or breeding. These include but are not restricted to: nursery areas; turtle nesting beaches; dugong feeding and aggregation areas; bird roosting, nesting and feeding areas; important fish spawning sites.

Close co-ordination between the biological surveys and the socio-economic and fisheries surveys will be an important aspect of the surveys of critical sites. This is because:

1. Critical sites may be transient (e.g. seasonal nesting or feeding) and so may not be observable during the survey period. In this case the knowledge of the local communities will be the only way to identify these sites (which may require further investigation later, during the season that become important).
2. Critical sites may be very limited in area, and so may be missed by the surveys unless identified through the knowledge of local communities.
3. Critical sites may be deliberately targeted for exploitation by local communities, and this information must be gathered effectively to enable management decisions, and relevant consultations with stakeholders, to be undertaken effectively during the development of site-specific management plans.

2.2.6. Photography

Photography will be routinely used to provide a descriptive record of subtidal and intertidal sites, habitats and species. Photography will be used to record:

- Human impacts (pollution, damage to corals, mangroves, etc)
- Important sites and species
- 'Typical' sites
- Important landmarks

Details of photographs taken must be recorded. Standard photographic record sheets will be used which will document:

- Time and date
- Film roll and exposure number
- Photographer
- Location (lat./long.)
- Location (description)
- Cross-reference to relevant survey sheets
- Further descriptive notes

2.2.7. Resource Use Surveys

Resource Use Surveys include socio-economic surveys and fisheries surveys. Two different but complementary approaches will be taken to Resource Use Surveys. These will be

(1) Targeted studies including stakeholder interviews and fisheries surveys

(2) Direct observation of human activities and impacts, carried out as an integral part of the biological field surveys

A **Socio-economic Specialist** will be identified, to design and carry out the socio-economic surveys in all four of the survey areas. This specialist will assist with identifying and training socio-economists to be a part of each National Team. These national team members will assist the socio-economic specialist in carrying out the field surveys. The socio-economic and biological field phases should be carried out at the same time to allow for communication and feedback between the two aspects of the survey to be most effective.

A **Fisheries Specialist** will be identified to design and carry out the fisheries surveys in all four of the survey areas. The fisheries specialist will assist with identifying and training fisheries experts to be a part of each National Team. These national team members will assist the fisheries specialist in carrying out the field surveys. The fisheries and biological field phases should be carried out at the same time so that communication and feedback between the two aspects of the survey can be more effective.

2.2.8. Biogeographic variation in the Red Sea and Gulf of Aden: relevance to MPA survey programmes

The Red Sea and Gulf of Aden region is one of the most biogeographically variable parts of the Indo-Pacific, a characteristic which contributes to the global importance of the region for marine biodiversity conservation.

This biogeographic variability is more pronounced for some groups (such as fishes and corals) than for others (such as mangroves and seagrasses).

Biogeographic variation will be taken into account during both the training of surveyors and the execution of surveys. This is particularly true for biodiversity work, where species identification will be an issue. Consequently:

1. Standardised species lists (such as may be produced for standardised biodiversity survey record sheets) for one part of the region may be inappropriate for use in any other part.

2. Surveyors will need to be aware of the probable differences in species composition they will encounter in different parts of the region.

PERSGA is addressing this problem by developing a regional guide which should fulfil the requirements for ID guides throughout the region. Until that guide is completed, collections of ID guides, rather than single volumes, will be required for use during survey programmes which include more than one area of the Red Sea and Gulf of Aden. The problem is particularly acute in the Gulf of Aden where Red Sea, Omani and Indian Ocean species assemblages mingle. Until an appropriate guide is available, surveys in this area will need Red Sea, Oman and Indian Ocean ID guides.

2.4. DATA RECORDING, DATA BACK-UP AND DATABASES

2.4.1. Data recording

Standardised survey data sheets

Standard survey sheets will be used for data recording on-site throughout the surveys. The format of the standard survey sheets will be based upon those provided in the relevant chapters of the PERSGA SSM Manual. The standard survey data recording sheets which are essential for the MPA survey are:

- General site description / location sheet (from the draft *Subtidal Survey Methods* chapter)
- Rapid Assessment sheet
- Coral community assessment sheets (relatively rapid methods) from the SSM corals chapter
- Fish abundance and diversity assessment sheets (relatively rapid methods) from the SSM fish chapter

Further standard sheets which may be useful for the surveys but which, given the extensive use of rapid survey methods, may not be essential include:

- Intertidal and supra-littoral survey data sheets* (relatively rapid methods)
- Mangrove survey data sheets* (relatively rapid methods)
- Megafauna (turtles, dugong, cetaceans, etc.) and bird record sheets

Survey data sheets will be prepared prior to the start of the surveys. All subtidal data sheets will be printed or photocopied onto waterproof paper, with an equal number produced on ordinary paper for production of back-up copies in the field.

* The necessity or otherwise of these standard data sheets will be determined when final decisions about survey methods to be used are made.

2.4.2. Geo-referencing

The locations of all observations made during the survey phase will be geo-referenced using hand-held Global Positioning Systems (GPS)

This requirement includes:

- The location of all rapid and detailed survey sites
- All other sites and observations such as turtle or bird nesting areas
- Any other aggregation sites
- All incidental observations of megafauna
- Sites of human habitation, human impacts and resource uses
- Conspicuous landmarks

To achieve this all survey parties will have a GPS with them at all times. The availability of multiple GIS's will enable more than one survey party to work at the same time (e.g. a subtidal group and an intertidal group).

The map datum (reference spheroid)

The map datum (reference spheroid) used will be standardised throughout the surveys as the *Universal Spheroid WGS84*. All locations will be recorded as DD/MM/SS.S.

2.4.3. Data storage and back-up

Regular backing-up of field data is essential. Data should be backed up as frequently as possible, by the copying of field data sheets onto 'dry' copies of the same sheets (in the case of sheets used for underwater surveys, the 'wet' copy will be on waterproof paper, and the 'dry' copy on normal paper. For other survey sheets both will be on ordinary paper).

While in the field data back-up will often only be possible as hand-written copies.

Basic quality - control measures will be enforced to ensure that data is being accurately transferred to back-up sheets. Further back-ups can be created by photo-copying later, avoiding problems with quality-control.

Entry of data into spreadsheet or database programmes will be carried out as far as possible *during* surveys, dependent upon the computer facilities available.

2.4.4. Databases.

Suitable databases, designed specifically for the storage of the survey data, will ideally be available by the time the surveys are carried out. The development of databases is included in the objectives of the Habitats and Biodiversity Component of the SAP, as part of the development of Standardised Survey Methods for the region. Such databases will not be developed until the methods in the SSM Manual are finalised, and will be based upon those methods.

Co-ordination between SAP Components will be necessary for database design and development. The database components of the MPA Component, and the Habitat and Biodiversity Component of the SAP, should be closely linked from their earliest stages. This linkage should probably extend to their using the same database system, developed by a single database design specialist or team.

If suitable databases are not ready by the time of the survey, then survey data will be entered into those databases as soon as they are ready. In this case data will be stored in both hard copy, and in soft copy (for instance, in compatible spreadsheets such as Microsoft Excel, which will allow data analysis for the MPA survey reports and management plan development, prior to utilisation of the databases) until the databases are available.

PART 3. SURVEYS FOR THE REGIONAL NETWORK OF MARINE PROTECTED AREAS IN DJIBOUTI, NW SOMALIA, SUDAN AND YEMEN

Biological and Resource Use Surveys of the four proposed MPAs in Djibouti, NW Somalia, Sudan and Yemen, which will form part of the Regional Network of MPAs, will be carried out following the survey design outlined above. This section provides site - specific details of survey design for these four areas.

3.1. SITE-SPECIFIC SURVEY DETAILS

3.1.1. Summary of survey locations

The areas to be surveyed are all large, and are all remote from well developed infrastructure.

- ***Djibouti*** (*Sept Frères and Ras Siyyan*). This survey area covers approximately 30 km of coastline (straight - line distance) with islands up to 15 km offshore. The area is 100 km north of Djibouti city by sea, and is located in the Bab-al-Mandab. Because of uncleared minefields this area is currently (March 2001) only accessible from Djibouti city by boat.
- ***NW Somalia*** (*Saad ed Din and Aibat*). This survey area lies in the western Gulf of Aden (north-west Somalia), and covers approximately 30 km of mainland coastline (straight - line distance). Islands and reefs included in the survey extend more than 15 km offshore. Some offshore sites (e.g. Siigaale reef and the Filfil reef complex) lie approximatly 10 to 12 km offshore, and 15 - 20 km east of the eastern edge of the survey area on the mainland. The small town of Zeila, approximately 40 km east of Djibouti, which is the local centre of population, and hence of locally - based resource users. Zeila town is not included in the habitat and species surveys, but will be of central importance for resource use surveys, and for the eventual development of a management plan for the area.
- ***Sudan*** (*Dungonab and Mukkawar* (*Magarsam*) *Island*). This survey area lies in the northern central Red Sea, extending between 130 km and 200 km north of Port Sudan. It includes 220 km of coral reef-fringed coastline (straight-line distance approximately 70 km) and extends to include numerous reefs and islands between 1 km and 20 km offshore.
- ***Yemen*** (*Bir Ali - Belhaf*). This survey area lies in the north-eastern Gulf of Aden about 80 km west of al-Mukalla, and covers approximately 40 km of mainland coast. Most work in the Bir Ali area will be close inshore (<2 km) with the exception of one small island about 10 km offshore.

3.1.2. DJIBOUTI

Refer to Appendix 1 for general and specific comments about Djibouti, the survey area, and an account of the reconnaissance visit made to Djibouti and Sept Frères in October - November 2000.

Ras Siyyan, Isles des Sept Frères

3.1.2.i. *Location & extent of the survey area*

Name of MPA: Isles Sept Frères & Ras Siyyan

Proposed size: Not yet defined

Survey Area:

- Mainland coast, lagoons, bays and reefs from approximately 12°32' N (in the area of the shipwreck and small island to the north - west of Ras Siyyan) southwards to Khor Angar (approximately 12°19' N).

- All of the mangrove and fringing reef areas at Khor Angar will be surveyed.

- All offshore islands, reefs, shoals and shallows between those two latitudes (12°32' N and 12°19' N) will also be surveyed.

This survey area includes approximately 30 km of mainland coast. Shoals, reefs and islands extend to approximately 15 km offshore (Fig. 2). There are six main islands, none of which is larger than one or two kilometres in length, and at least one very small rocky outcrop. There are also an as yet unknown number of shallow rocky reefs in the area. All or most of these will be revealed by remote-sensing and GIS work prior to the start of the surveys.

Commercially available marine maps and charts of the area include:

British: (Admiralty)
6 (**poor**. Covers whole Gulf of Aden)
#3661 (**partial**)
#143 (**partial**)
#1925 (**partial**)

French: (Service Hydrographique et Océanographique de la marine)
#6987 (**poor**: covers entire Gulf of Aden)
#6893 (**poor**: covers entire Bab al Mandab area)
#6326 (**excellent**: covers survey area at large scale and in some detail).

3.1.2.ii. *Djibouti overview*

An overview of the state of the marine environment in Djibouti, with particular reference to coral reefs, is provided in Ahmed *et al*. (2001).

Djibouti lies in a hot semi-arid zone, where the Indian Ocean monsoon is a major influence on climate. Air temperatures are in the region of 25°C in the winter, and 35 - 40°C with high humidity in summer. Water temperatures are in the region of 25 - 29°C throughout the year.

During the south-west or summer monsoon (approximately June to September) winds blow from west to east through the Gulf of Aden, and in the north-east or winter monsoon (approximately October - May) they blow from east to west, from the Gulf of Aden into the Red Sea. The funnelling effect of the Bab-al-Mandab means that these winds can be very powerful in the area, and high winds are likely to be a limiting factor for surveys.

The Gulf of Aden lies at the confluence of three very distinct biogeographic areas: the Red Sea, the western Arabian Sea, and the Indian Ocean. Partly as a result of this the area has a very high diversity of marine species, and very unusual species assemblages.

The influence of the Arabian Sea upwelling in Oman, eastern Yemen and Somalia to the east of Djibouti means that marine communities and biotopes here are unusual. Djibouti has many well developed and extensive coral reefs, but a mixture of rocky reefs, non-reefal coral communities and true coral reefs all occur in close proximity in the region. In some areas macroalgal communities and kelp forests may be seasonally dominant (as occurs in southern Oman and at Socotra), although this is not yet confirmed.

3.1.2.iii. *Description of the survey area*

The survey area lies in the north of Djibouti, in the narrow strait of Bab-al-Mandab, which links the Red Sea to the Gulf of Aden and the rest of the Indo-Pacific.

A number of marine surveys have been carried out in the area recently, including those of PERSGA (1998), Obura (1998) and Obura & Djama (2000). Together with the reconnaissance visit of October - November 2000, these provide a good preliminary description of many of the features of the area.

Shallow subtidal hard-substrate habitats in the survey area are largely dominated by coral communities, some of which form well developed coral reefs, and many of which have very high coverage of living coral. Diverse and extensive non-reefal coral communities are very common at the islands, although coral reef structures are probably rare at these sites. In contrast, well developed coral reef structures are extensive along the mainland shore, where fringing reefs dominate. These fringing reefs can be very wide, and in places appear to have extensive back-reef and lagoon areas behind them. Very extensive areas of coral occur in shallow water in Ras Siyyan bay.

In October / November 2000 the coral communities of the area were generally in very good condition, with little or no extensive mortality. These corals appear to have escaped the effects of the 1998 coral bleaching event almost unscathed. Crown-of-Thorns starfish (CoTs) have not been reported to be a problem here recently, but large numbers of CoTs and feeding scars were seen at Isle de Sud in late 2000, and CoTs assessment will be important in the MPA surveys.

Rocky (non-coral) reefs and habitats are known to occur at the islands, often with high coverage of soft corals and other invertebrate animals. The extent and importance of seasonal macroalgal communities in the survey area is as yet unknown.

Two significant areas of mangroves are known to occur in the survey area, at Ras Siyyan.

Important species

Turtles. Turtles are known to nest in the area, but their numbers, and the distribution of nesting sites, are not yet known. The identity of the main nesting species is not yet known. One possibly important turtle nesting site has been identified at a beach on the north-eastern side of Grand Isle (Waypoint 7FR-2, see Appendix 2). Anecdotal accounts suggest that turtles also nest on mainland beaches, and on other islands of the Sept Frères group. Both Hawksbill turtles and Green turtles occur in the area, and turtles appear to be common inside Ras Siyyan bay.

Dugong. Dugong are not known to occur in the area although this needs to be investigated further.

Birds. Birds are a very important feature of the area, and large numbers of roosting and nesting birds occur on islands inaccessible to people, such as Isle Double. Ospreys nest on several of the islands including Grand Isle. The area is also an important feeding and resting area for migratory birds.

Cetaceans. Cetaceans are known to occur in the area, although the species, and their local abundance, are unknown.

Human impacts and other features.

Human impacts and levels of activity at the islands during the most recent visit in late 2000 were extremely low, and virtually all habitats appeared to be in an almost pristine condition.

The only appreciable impacts were from tourism (low impact, and localised, but with great potential to cause considerable damage very quickly). An important aspect of the tourism is that it almost certainly includes extensive illegal spear-fishing in the area. A now deserted tourist village / camp is located at Ras Siyyan.

A shark fishery in the area is apparently carried out exclusively by non-Djiboutians. The impact of the shark fishery locally is not yet known, and an assessment of this activity should be a priority for the fisheries element of the surveys.

3.1.2.iv. *Spatial survey design*

Details of spatial design described here are intended to guide the conduct of the surveys in the field rather than to be rigidly prescriptive rules. An ability to be flexible when necessary will be expected, and the Survey Supervisors will have the leeway to alter the locations and boundaries of these provisional sub-sectors, and even of sectors, if specific circumstances demand it.

Sectors

Sector 1. The northern mainland coast and fringing reefs, from the northern edge of the survey area to the northern end of the Ras Siyyan peninsula, and including all of Ras Siyyan bay.

Sector 2. The southern mainland coast and fringing reefs, from the northern end of the Ras Siyyan peninsula, to the southern edge of the survey area south of Khor Angar.

Sector 3. All offshore islands, reefs and shoals.

Sub-sectors (provisional)

Sub-sectors will only be finalised once GIS imagery is available, and will remain flexible throughout the survey period. Provisionally, sub - sectors are:

- Each island will constitute one sub-sector. Submerged reefs and rocks close to any island will be included within the same sub-sector as the island.
- The mainland coast will be sub-divided into areas of distinctively similar features/habitats. For instance, Ras Siyyan Bay including the mangroves will probably constitute one sub-sector. Linear areas of coast with fringing reef and lagoon will probably be single sub-sectors, unless very large, when they may be sub-divided into two or more areas of roughly equal size. The mangroves and khor/mersa at Khor Angar will probably also constitute a single sub-sector.

Methods

The survey methods to be used are outlined in Section 2.2. The Sept Frères survey area (both the islands and the mainland fringing reefs) are particularly suited to survey using manta-tow techniques to map the distribution of major habitat types and benthic communities. If local conditions allow, shallow subtidal habitats at all the islands will be surveyed using manta-tow methods, in addition to other rapid and detailed methods. Parts of the fringing reefs will be sampled using manta - tow methods.

Other considerations

- Fisheries and tourism impacts throughout the survey area do not appear to be generated locally, but from neighbouring countries (the shark fishery), from Djibouti city (tourism and possibly some artisanal reef fishery) and from Tadjourah and Obock (artisanal reef fishery). Khor Angar village, the only village in the survey area, may not engage in any fisheries activities; this will have to be confirmed during the survey.
- Tourism to the area is apparently organised through groups using tour operators and other organisations in Djibouti city. It also takes place though informal hire of unofficial tourist boats (local fishing boats) from Djibouti city, Tadjourah and other areas, particularly by members of the expatriate community. The Resource Use surveys

will have to take this into account, and include work in Djibouti city, Tadjourah, Obock and possibly other areas in their survey plans.

- Marine curios including corals and shells, and turtle products such as meat, shells and stuffed turtles are widely and openly sold in Djibouti. The sources of these items is not known, and may be Djiboutian or Somali waters, or both. The socio-economic surveys will have to include investigation of this aspect of marine resource use.
- Anchor damage to corals, by either fishing boats or tourist boats, has been noted in the area in the past, particularly at Rhounda Dabali (12°28.076'N, 43°23.162'E) in the survey area (PERSGA 1998).
- The only apparent exception to this lack of locally-generated impact is anthropogenic impact upon the mangroves at Ras Siyyan Bay. These mangroves may be cut for camel fodder, and camels may be encouraged or allowed to graze the trees directly.

3.1.2.v. *Timing and duration of surveys*

Timing. Local dive operators and divers were extensively consulted about seasonality and weather conditions in the survey area. The most important features of seasonality in the survey area are high winds and high temperatures, both of which occur in summer. In-water work in particular, and survey work in general, is likely to be difficult or impossible during the period May/June to September.

Very high winds occur in the Bab-al-Mandab area earlier in the year, sometimes as early as March or April.

The best periods for survey work in the Bab-al-Mandab / Sept Frères region has been identified as being October - March.

Duration. The duration of the survey phase at Sept Frères / Ras Siyyan will be approximately 4 weeks. Ten to fourteen days of this will be aboard a live-aboard dive boat.

3.1.2.vi. *Logistics*

- The Sept Frères area is 100 km from Djibouti city by sea, and is remote from all infrastructure. There are no towns and no paved roads in or near the survey area, although there is a small village at Khor Angar, and another one to the north of the survey area. Visits to these villages were not possible during the reconnaissance trip, but it is unlikely that any supplies or infrastructure will be available in them.
- Access to the area by land is currently not possible due to the danger of mines in the Tadjourah and Obock areas. Occasional fighting also still occurs in these areas, although apparently not in the survey area, which is currently secure. Because of the security situation, security clearance will have to be obtained from UNDP Djibouti before the surveys start.
- All food, water, fuel, oil and equipment will have to be transported to the area from Djibouti city, although some re-supply of basic essentials such as water, fuel and fresh food, may be possible from either Tadjourah or Obock.
- The eastern side of Ras Siyyan bay, near to the abandoned tourist village, is the most suitable mainland site in the area for a base-camp during the surveys. This also appears

to provide the safest anchorage in the area. A channel allowing access through the fringing reef was identified here during the reconnaissance visit.

- ***Safety*.** Very strong currents are prevalent in the Sept Frères area, and will be the most important safety concern during the surveys. It will probably be necessary for all dive pairs to routinely use a Surface Marker Buoy (SMB) when diving, and some sites or areas may be impossible to survey using any detailed methods because of the currents.
- Outside Ras Siyyan bay access to much of the mainland, and to reef flats, lagoons, mangroves, etc, is difficult (and in many places impossible at all except the highest tides, or in the presence of a swell) due to the presence of a very shallow reef crest. For this reason travel by vehicle for much of the mainland survey will be preferred, if it is possible to get a vehicle or vehicles to the survey area.

3.1.2.vii. *Further tasks and information gathering*

***Permits*.** All permits needed for the surveys should be obtained in advance of the arrival of the survey team. These include any permits which may be necessary for travel by land and sea to and within the survey areas, diving, photography, and collection and export of marine biological specimens.

The need for permits for use of a live-aboard dive boat for the surveys will have to be investigated immediately, as the need for, and type of, such permits will have a bearing on the hire of such a boat.

Appendix 5 provides a preliminary list of outstanding tasks for the planning and implementation of the MPA surveys.

3.1.3. NORTH WEST SOMALIA

Refer to Appendix 1 for general and specific comments about NW Somalia and the survey area, and an account of the reconnaissance visit made to Hargeisa and Zeila District in March - April 2001.

Mangroves at Saad ed Din

3.1.3.i. *Location & extent of the survey area*

Name: Saad ed Din and Aibat

Proposed size: circa 300 km^2

Survey area: - Mainland coast from approximately Ras Gamurlah (c. 11° 29.5'N, 43° 17'E), to Zeila (c. 11° 21'N, 43° 28'E).

- All reefs, islands and shallows including Saad ed Din, Ceebad, Siigaale Shoal, Shaab Filfil & Shaab Turuxaad.

This is a total of approximately 30 km of mainland coast, with islands and shoals extending to approximately 12 km offshore. Offshore survey areas extend 10 - 15 km further east than mainland survey areas.

Commercially available marine maps and charts of the area include:

British: (Admiralty)
#253 (**poor**: covers whole Bab al Mandab region)
#6 (**poor**: covers entire Gulf of Aden)

French: (Service Hydrographique et Océanographique de la marine)
#6987 (**poor**: covers entire Gulf of Aden)
#6894 (**good**: covers Gulf of Tadjourah and Zeila District).

3.1.3.ii. *North-western Somalia overview*

A broad overview of the state of the marine environment in Somalia, with particular reference to coral reefs, is provided in Ali *et al*. (2001).

The survey area lies in the western Gulf of Aden, close to the entrance of the Red Sea at the Bab-al-Mandab. The Gulf of Aden lies at the confluence of three very distinct biogeographic areas: the Red Sea, the western Arabian Sea, and the Indian Ocean. Partly as a result of this the area has a very high diversity of marine species, and very unusual species assemblages. The biogeographic status of subtidal communities in the survey area is probably very similar to those of Sept Frères, although this remains to be confirmed, and there may be important differences for both biogeographic and ecological reasons.

The climate of north-western Somalia is similar to that of Djibouti and the Sept Frères / Ras Siyyan survey area (see Section 3.1.2.and Appendix 1). The coast of the region is generally shallow and exposed, with extensive sandy beaches and often very extensive intertidal areas. The continental shelf in NW Somalia rarely exceeds 15 km, except in the survey area around Zeila and Saad ed Din where it is over 20 km in width.

The influence of the Arabian Sea upwelling in eastern Yemen and eastern Somalia, to the east of the survey area, is another factor which may give rise to unusual marine communities here, with a mixture of rocky reefs, non-reefal coral communities and true coral reefs likely to occur in close proximity. In some areas macroalgal communities and kelp forests may be seasonally dominant (as occurs in Oman and at Socotra), although this is not yet confirmed.

A number of important marine and coastal biological surveys have been carried out in NW Somalia over the past four years. Two of these, both carried out under the auspices of the IUCN (McClanahan & Obura 1997, Schleyer & Baldwin 1999) provided considerable detail of various aspects of the coastal biology. Schleyer and Baldwin (1999) worked away from the survey area to the east of Berbera, but McClanahan & Obura (1997) carried out a rapid assessment of habitats, species and threats within the Saad ed Din and Aibat survey area.

In spite of these surveys, the northern coast of Somalia is still probably the least well known in the entire Indian Ocean region.

3.1.3.iii. *Description of the survey area*

The survey area lies in the far western part of Somalia, and extends along the mainland coast from south-east of the small town of Zeila (or Seylac) to the border between Somalia and Djibouti, and offshore to include several islands, reefs and reef complexes.

Saad ed Din and Aibat are the two principal islands in the area: Saad ed Din is a raised fossil reef, while Aibat is a sandy island. Each of these islands has very extensive coral reefs. Offshore, the western edge of the survey area lies just to the west of Turaltat Reef, and the eastern edge lies to the east of Filfil and Siigaale reefs.

Major non-emergent reefs such as Siigaale and Filfil will be included in the survey area, but extend considerably further east than the mainland survey areas. These eastern areas may also include a number of smaller uncharted reefs. This will become clear from satellite imagery and GIS output.

Very extensive areas of shallows occur between the islands and reefs throughout the survey area. The extent of coral and other fragile benthic communities in these shallow areas is currently entirely unknown, although initial observations by McClanahan and Obura (1997) suggest that these areas are mostly composed of sand. GIS output will be of central importance to surveys.

McClanahan & Obura (1997) provide a description of the habitats, species, and human resource uses and impacts in the area on the basis of a rapid survey carried out in early 1997. Important habitats include coral communities (including some extremely extensive coal reefs), sandy and other soft subtidal substrates, very extensive areas of mangroves (particularly on Saad ed Din island), very extensive intertidal areas, and extensive sandy beaches. The coral-associated fish communities in the survey area are apparently highly diverse. Subtidal and intertidal habitats and communities are very variable, depending upon whether they are in sheltered (landward) or exposed (seaward) positions.

Important species

Turtles. Turtles were abundant, and important turtle nesting sites widespread, in the survey area in early 1997. Nesting beaches occur on both the mainland shore and on the islands of Saad ed Din and Aibaat. Saad ed Din was identified in 1997 as being one of the most important Loggerhead nesting sites in the western Indian Ocean region. Remains of numerous very recently butchered turtles were consipicuous and abundant during the reconnaissance visit in March - April 2001.

Dugong. Dugong are known to occur in the area, but their abundance and distribution here is currently unknown.

Birds. Abundant and diverse assemblages of birds, including flagship species such as the Goliath Heron, occur throughout the survey area. The islands may be regionally important nesting and roosting areas for a number of species.

Cetaceans. Ceatceans, particularly dolphins, are very common in the survey area. At least two species (bottlenose dolphins and common dolphins) were observed during the 2001 reconnaissance.

Regionally important areas of mangroves (which here include *Rhizophora mucronata*) also occur in the survey area.

Human impacts and other features

Human impacts and socio-economic activity in the survey area were generally at a very low level in 1997 when McClanahan & Obura carried out their survey. The reconnaissance visit to the area by the MPA - LS and the consultant in March - April 2001 confirmed that this situation remains largely unchanged. The likely imminent return of approximately 20,000 refugees from Djibouti to the Zeila District means however that this may not be the case for much longer (see Appendix 1).

Harvesting of turtle eggs, and turtles for meat, is widespread throughout the survey area, and assessment of the extent and importance of these activities will be an important component of the socio-economic surveys. Other locally important extractive resource uses include a Beche-de-Mer (sea cucumber) fishery, a lobster fishery, collection of mangrove crabs (*Scylla serrata*), and a shark fishery. This latter fishery is apparently carried out by non- nationals (as is also the case in the Djibouti survey area).

Marine curios including corals, shells, and stuffed turtles, and other turtle products such as meat and shells, are widely and openly sold in Djibouti and the source of these items may be from Somali waters. The socio-economic surveys in Somalia should include investigation of this aspect of marine resource use. This will include consultations with socio-economic and fisheries workers from the Djibouti survey, who will by that time already have assessed the sources of materials for the marine curio and turtle meat trades in Djibouti.

3.1.3.iv. *General survey design*

Details of aspects of spatial design described here are intended to guide the conduct of the surveys in the field rather than to be rigidly prescriptive rules. An ability to be flexible will be expected, and the Survey Supervisors will have the leeway to alter the locations and boundaries of these provisional sub-sectors, and of sectors, if circumstances demand it.

In particular, the designation of the main sectors may change considerably after the reconnaissance visit. The designation of the mainland coast as one Sector is based on the assumption that it will be surveyed largely by vehicle. If however parts of this area have to be surveyed by boat, then for logistical reasons the mainland coast may be split up, and some parts included in sectors with islands and offshore reefs.

Sectors

Sector 1. The mainland coast and reefs, from Ras Gumarlah to south of Zeila.

Sector 2. Offshore islands and reefs from and including both eastern and western sides of Shaab Turuxaad, to and including Aibet and Saad ed Din.

Sector 3. The Filfil / Sigaale reef group, and all reefs and shoals between that group and Saad ed Din / Aibat.

Sector 4. The Banka Arab (provisionally).

***Sub-sectors* (*provisional*)**

Sub-sectors will only be finalised once GIS imagery is available, and will remain flexible throughout the survey period.

- Islands (Saad ed Din and Aibat) and each large reef (Turuxaad, Siigaale, Filfil) will each constitute one sub-sector. Smaller submerged reefs and rocks close to any of these reefs and islands will be included within the same sub-sector.
- The mainland coast will be sub-divided into three or four areas of approximately equal extent.

Method.

The survey methods to be used are outlined in Section 4, but final decisions on the exact methods to be used will be made when the Draft Standard Survey Methods Manual is available, in the first half of 2001.

Parts of the NW Somalia survey area (the islands) are particularly suited to manta-tow techniques. If conditions allow, shallow subtidal habitats at all the islands will be surveyed using manta-tow methods, in addition to other rapid and detailed methods.

3.1.3.v *Timing and duration of surveys*

***Timing*.** Djiboutian dive operators and divers were extensively consulted about seasonality and weather conditions in the region (see Appendix 1). The most important features are high winds and high temperatures, both of which occur in summer. In-water work in particular, and survey work in general, is likely to be difficult or impossible during the period May/June to September.

The best periods for survey work in the area has been provisionally identified as being October - March. During the reconnaissance visit by the Lead Specialist and consultant in March - April 2001 this was confirmed, with the best period probably being February - April.

***Duration*.** The duration of the survey phase will be approximately 5 to 6 weeks. Ten to fourteen days of this will be aboard a live-aboard dive boat, which will be used to survey the most exposed offshore areas including Filfil and Sigaale reefs, and probably other areas such as the seaward side of Aibat reef.

3.1.3.vi. *Logistics*

- By land the survey area is only accessible via unpaved road from Hargeisa, Berbera or Djibouti.
  1) *Hargeisa - Zeila*. The journey Hargeisa - Zeila is approximately 250 km, and takes 12 hours or more by 4-wheel drive vehicle in the dry season. In the wet seasons the road is likely to be impassable for several days at a time.
  2) *Berbera - Zeila*. The distance Zeila - Berbera is between 180 and 200 km by road. It was not possible in the time available to fully assess road links between Zeila and Berbera first hand, but approximately 80 km of the Zeila - Berbera road, which runs along the coastal plain, was travelled on the return journey to Hargeisa. This road was at least as difficult to travel as the Hargeisa - Zeila road, and accounts from people consulted in Zeila suggested that the duration of the journey Zeila - Berbera is likely to take as long as, or longer then, the journey Zeila - Hargeisa.
  3) *Djibouti - Zeila*. The 28 km journey from Zeila to the Djibouti border at Loyado takes approximately 1 hour. From the border to Djibouti city is approximately a further 12 to 15 km. The time taken for this journey will be considerably shorter if the road is improved. The Port authorities at Berbera have a motor grader which they agreed to send to Zeila to grade the Loyado - Zeila road.

N.B. The border between Djibouti and NW Somalia was closed for political reasons, both by land and sea, in April 2001. There is little prospect of this border re-opening in the near future, although this situation may have chagned by the time the surveys are carried out in early 2002.

This situation should be closely monitored by the NW Somalia and Djiboutian NPCs. Arrangements to import equipment to NW Somalia by sea via Berbera, and for re-supply of the survey team by land or sea from Berbera, rather than Djibouti, should be initiated in case the border remains closed. This may add considerably to the logistical problems faced by the survey team and their logistical support in NW Somalia, but these problems should not adversely affect the surveys at all, if measures are put in place early enough.

- The possibility of importation of equipment for the MPA project and survey from Djibouti by sea should be fully investigated.
- As stated above, import and resupply from Berbera should be fully investigated, in case the Somali / Djibouti border remains closed. Plans should be made to use this route well in advance, because of the additional logistical difficulty involved. If the situation on the Djibouti / NW Somalia border changes before the surveys it will be easier to change from using Berbera to using Djibouti, than *vice versa*.
- Access to much of the mainland coast in the survey area is likely to be problematic. Much of the coast is difficult to access by land due to the lack of roads and the presence of

minefields, and difficult to access by sea due to the presence of extremely wide intertidal areas.

- Travelling by boat, anywhere within the survey area is accessible within 1.5 hours from Zeila in calm weather. This time is likely to be doubled (or more) during periods of high winds or swells.
- An uncleared minefield is believed to exist in the area between Toqoshi village and the sea. The size of this minefield and other details are currently unknown. This situation should be monitored by the PERSGA NPC, and the MPA Working Group Member. Unless further detailed information is forth-coming this area will be entirely excluded from the surveys.
- *Rains*. There are two rainy seasons in NW Somalia, smaller rains in approximately April / May, and heavier rains in late summer (approximately September / October). In the Zeila district there has been little or no rain for three years (and water is consequently in short supply there). Rains are unlikely to seriously affect fieldwork directly within the survey area, but flooding of watercourses without bridges may seriously hamper land - based travel between the survey area and Hargeisa, Berbera and Djibouti.
- *Winds*. According to local fishermen the area is dominated by strong winds for large parts of the year. These may be strong enough to hamper or stop work from boats at exposed sites such as Filfil and other offshore reef areas. December - January is apparently often dominated by strong winds, and the period February - April is likely to be the best time to carry out surveys.
- *Fuel* is available in the survey area, but in limited amounts, and special arrangements will have to be made to import fuel to Zeila specifically for the survey boats and vehicles. Two-stroke oil, necessary for outboard motors, is not available (local boats use ordinary motor oil, which significantly reduces the efficiency and life span of the engines), and so this will have to be specially imported to the area.
- *Water*. The lack of rains in the Zeila area in the past three years means that water is in short supply in the survey area. Wells supplying water to Zeila are located in the village of Toqoshi, approximately 8 km west of Zeila. Currently the water supply is adequate for the purposes of the survey, but this situation will have to be reassessed closer to the time of the survey, and if necessary arrangements will have to be made to import drinking water from outside the survey area.

3.1.3.vii. *Further tasks and information gathering*

***Permits*.** All permits needed for the surveys should be obtained in advance of the arrival of the survey team. These include any permits which may be necessary for travel, diving, photography, collection and export of marine biological specimens.

The need for permits for use of a live-aboard dive boat for the surveys will have to be investigated very soon, as the need for and type of such permits will have a direct bearing on the hire of such a boat.

NB: *Check* 1) *A possible military exclusion area just to the west of here in Djiboutian waters, and* 2) *the location of the Djibouti/Somalia international boundary offshore. The French and Djiboutian military authorities may have to be informed of our activities in advance* (See Appendix 5).

Appendix 5 provides a preliminary list of outstanding tasks for the planning and implementation of the MPA surveys.

3.1.4. SUDAN

Refer to Appendix 1 for general and specific comments about Sudan and the survey area, and an account of the reconnaissance visit made to Sudan, and to the Dungonab-Mohammed Qol survey area in October - November 2000.

Dugong skin, Dungonab Bay, Sudan

3.1.4.i. *Location & extent of the survey area*

Name: Mukkawar (Magarsam) Island and Dungonab Bay

Proposed size: > 300 km^2

Survey area:

- Mainland coast from Khor Shanaab at 21° 20'N (north of Dungonab village) southwards to c.20° 45'N (southern-most area of mangroves, approximately level with the southern end of Mukkawar island)
- Dungonab Bay
- All shallows, reefs and islands between 21° 20'N and 20° 45'N

This is a total length of mainland shore of approximately 200 km, although the straight-line distance is approximately 70 km. Approximately 100 km of that shoreline is within Dungonab Bay. The largest island is Mukkawar (local name Magarsam), with a total coastline of approximately 30 km (Fig. 4). Islands and reefs extend to approximately 20 km east of Magarsam. All other islands are smaller than Magarsam, although some reefs and reef complexes are comparable in extent to that island.

Commercially available marine maps and charts of the area include:

British: (Admiralty)
#3722 (**good, but partial.** Only covers the southern and western part of the curvey area)
#138 (**poor**: covers entire central Red Sea)

French: (Service Hydrographique et Océanographique de la Marine)
#7112 (**poor**: covers entire central Red Sea)

3.1.4.ii. *Sudan coast overview*

An overview of the state of the marine environment in Sudan, with particular reference to coral reefs, is provided in Abdellatif *et al*. (2001).

The Sudanese coast occupies the central area of the western (African) shore of the Red Sea. The marine communities of this area are characteristically dominated by Red Sea species assemblages, and the major subtidal hard-substrate habitats are well developed coral reefs,

both fringing the shores of mainland and islands, and forming patch reefs. In many areas of Sudan a well-developed offshore barrier reef complex exists, between 1 and 20 km from shore, with a steep drop-off to several hundred metres on the seaward side of this barrier reef. The reefs of the Sudan are among the most diverse and spectacular of the entire Red Sea, and by extension of the entire Arabian and north-western Indian Ocean region.

Terrestrially, Sudan lies within the semi-desert and desert zone of north Africa, and the coastal plain is very dry, with only occasional fresh-water run-off into the sea during the rainy season in November - December. Unlike most of the Gulf of Aden region where the other three survey areas are located, clarity is generally very high in Sudanese waters. Water temperatures range from approximately 26ºC to 31ºC.

Prevailing currents vary seasonally, flowing from north to south in summer (approximately May - October), and reversing during the winter (November - April).

Many areas of inshore Sudanese coral reefs to the south of Port Sudan appear to have suffered extensively during the temperature-related coral bleaching event of 1998, with widespread mortality. Anecdotal accounts suggest that the mortality may have been much less pronounced to the north of Port Sudan (in the survey area) and on the offshore barrier reef.

3.1.4.iii. *Description of the survey area*

The survey area covers a straight-line distance along the coast of approximately 70 km, starting at the southern edge of the survey area which lies 125 km north of Port Sudan (straight-line distance. The distance by road is nearer to 175 km). The complex coastline, which includes the very large bay at Dungonab, together with the large island of Magarsam, means that the total length of coastline in the survey area exceeds 200 km. In addition to Magarsam Island, there are numerous small islands at the southern end of Dungonab Bay, and to the south of the Bay towards Magarsam.

Dungonab Bay itself is approximately 13 km across at its southern end, and extends 27 km from north to south. The entire bay is shallow, although the bay does not appear to have ever been fully surveyed, and bathymetry is not shown on navigation charts. Although the bay appears to consist almost entirely of sandy substrates, fringing reefs occur around the edges of the bay, and there may be scattered patch reefs within the bay. GIS outputs produced using remotely sensed images will be extremely useful for identifying and mapping the distribution of habitats inside this very extensive shallow area.

The survey area outside Dungonab Bay is heavily dominated by well developed coral reefs fringing both mainland and islands, and by very extensive offshore patch reefs and barrier reefs extending to approximately 20 km from shore.

Mangroves, apparently entirely *Avicennia marina*, occur at several locations in the survey area. The most significant are probably those at the southern edge of the survey, but others occur at Khor Shanaab at the northern edge, and there appears to be some regeneration or colonisation of mangroves in a shallow lagoon or Mersa to the north of Dungonab village.

Important species

- A wide range of important species occur in the survey area. These include but may not be limited to: dugong; turtles; birds; manta rays; whale sharks.

- *Dugong*. Dugong occur throughout the survey area, especially in Dungonab Bay and inside various marsas including that at Khor Shanaab. Dugongs are frequently drowned in fishing nets, and the fishers of Mohammed Qol stated that their numbers are declining. Their meat is prized, and although there is no targeted fishery for them, those caught accidentally are eaten.
- *Turtles*. Turtles apparently nest throughout the area, especially on the islands, but possibly also on a number of mainland beaches including those on the western side of Dungonab peninsula. Magarsam Island was repeatedly identified as the most important turtle-nesting site in the area. Turtle eggs may be collected for consumption, and birds eggs are definitely collected, although the extent and impact of this egg collection remains unknown.
- *Birds*. Bird nesting is very important on the islands of the area, although main nesting seasons have not yet been determined.
- Large aggregations of manta rays (*Manta birostris*) occur in the survey are from approximately April/May until October/November, mostly outside the bay in the area bounded by the mouth of the Bay, Magarsam Island, and the mainland coast.
- *Cetaceans*. Small cetaceans are common in the area, although the identity of species occurring here is not yet known.

Human impacts and other features

Human impacts in the area are probably currently at quite low levels overall, and are entirely related to three activities: Artisanal fisheries; culture of oysters, and tourism.

Tourism. Tourism is currently at very low levels, and is entirely restricted to dive tourism on board boats visiting from Port Sudan. These boats only visit the reefs offshore.

Pearl aquaculture. There are two oyster culture projects in the area, both based in or near to Dungonab village. Both use the shallow waters of Dungonab Bay for the culture sites. These two projects are a government-run community project with a base camp at Dungonab, and a commercial oyster farm based just south of Dungonab (Waypoint 'Oyster', see Appendix 2). This commercial venture has a lease over a large part (almost half) of the bay, extending for a radius of 4 miles around the island of Umm al Sheikh.

Artisanal fisheries. Artisanal fisheries include Beche-de-Mer, *Trochus* and oysters as cash harvests, and finfish as a subsistence harvest. The finfish fishery would possibly be much larger if cold-storage facilities were available. Lack of such facilities at the moment precludes the development of an external market for locally caught fish.

Industrial / commercial fisheries. Commercial trawling, including demersal trawling, and a long-lining fishery have both occurred throughout the area in the past, but these activities are, at least for the present, no longer an immediate threat.

3.1.4.iv. *General survey design*

Details of aspects of spatial design described here are intended to guide the conduct of the surveys in the field rather than to be rigidly prescriptive rules. An ability to be flexible will be expected, and the Survey Supervisors will have the leeway to alter the locations and boundaries of these provisional sub-sectors, and even of sectors, if specific circumstances demand it.

Sectors

Sector 1. Mainland coast and reefs from Khor Shanaab (the northern edge of the survey area, near to Waypoint SUD-02: see Appendix 2) to the southern end of Dungonab peninsula.

Sector 2. Dungonab Bay (all coasts, islands, reefs and subtidal areas inside the bay, north of a line drawn directly westwards from the southern point of Dungonab peninsula to the mainland shore).

Sector 3. The mainland coast and reefs from the southern end of Sector 2 to the southern edge of the survey area, south of the southern mangroves (At or near to Waypoint S-MGR2: see Appendix 2).

Sector 4. Mukkawar (Magarsam) Island, and all islands and reefs between Mukkawar and the mainland to the west, and all islands and reefs between Mukkawar and Dungonab Bay to the north..

Sector 5. All reefs and islands west of the mainland survey areas and Magarsam (Magarsam) Island.

***Sub-sectors* (*examples only at this stage*)**

Sub-sectors will be designated on the basis of Remotely sensed images and GIS outputs. Examples include:

- Khor Shanaab
- The linear fringing reef from Khor Shanaab to the Dungonab peninsula (probably divided into two sub-sectors of approximately equal size)
- Magarsam island and fringing reefs
- The coastal and inshore areas of Dungonab Bay divided into two sub-sectors, with the bulk of the waters of the bay constituting a third sub-sector

Methods

The survey methods to be used are outlined in Section 4, but final decisions on the exact methods to be used will be made when the Draft Standard Survey Methods Manual is available, in the first half of 2001.

If conditions allow, more extensive areas of shallow subtidal habitats will be sampled using manta-tow methods, in addition to other rapid and detailed methods.

3.1.4.v. *Timing and duration of surveys*

***Timing*.** The rainy season starts in October, peaks in November/December, and continues through to Dec/Jan. During the rains the coast road to Dungonab is usually closed, and access to the survey area at this time is by the inland road. Access to areas of the coastal plain, including travel within the survey area, is difficult during the rainy season.

The windy season is from approximately October/November to April/May. This wind started a couple of days before the Reconnaissance visit, and precluded visits to Magarsam/Mukawwar or any of the offshore reefs and islands.

Taking these seasonal factors into account, surveys should take place in either May/June, before the weather is too hot but after the windy season is over, or in September/October before the wind and rains start.

Duration. The size of the area to be surveyed, and the fact that so much of the area is a considerable distance offshore, means that the surveys will take approximately 6 weeks. A detailed schedule for the surveys will be drawn up using the outputs from GIS and remotely sensed imagery. Surveys of the offshore reefs and islands will require hire of a live-aboard dive boat (10 - 14 days).

3.1.4.vi. *Logistics*

- *Accommodation*. The ACORD camp at Mohammed Qol will, if available, provide an excellent base-camp for the survey.
- *Accessibility*. By land the survey area is only accessible via unpaved road from Port Sudan, a road distance of approximately 175 km. This generally takes six to seven hours, and in the rainy season may take considerably longer.
- *Fuel*. Fuel and oil are not commercially available in the survey area, and will have to be transported to the survey area from Port Sudan. Two-stroke oil, necessary for most outboard motors, could not be found in Port Sudan. Provision of 2-strike oil should be arranged well in advance, to allow it to be brought in from elsewhere if it cannot be purchased in Port Sudan.
- *Water*. Wells in the survey area are brackish. It may be possible to get fresh water for washing, etc. from these wells, but probably not in any real quantity, and this should not be relied upon. It should be assumed that fresh water would have to be transported from outside the survey area.
- *Rains*. The rainy season starts in October, peaks in November/December, and continues through to Dec/Jan. During the rains the coast road to Dungonab is usually closed, and access to the survey area at this time is by the inland road. Access to areas of the coastal plain, including travel within the survey area, is difficult during the rainy season.
- *Winds*. The windy season is from approximately October/November to April/May. This wind started a couple of days before our visit, and prevented us from visiting Magarsam/Mukawwar or any of the offshore reefs and islands.
- *Travel permits* are needed for travel in the area, both on land, and at sea. Both types of permit will be needed in order to work in the Dungonab/Mohammed Qol/Magarsam area.

3.1.4.vii. Aerial surveys

Marine mega-fauna including dugong, manta rays and whale sharks are an important aspect of biodiversity within the proposed MPA at Dungonab / Mukkawar, being one of the reasons for the proposal of an MPA in this area. Because of their importance here, the distribution and

abundance of dugong, manta rays, etc. will *if logistically possible* be assessed by aerial survey, in addition to the recording of all observations of such mega-fauna made during the coastal and subtidal surveys.

An aerial survey will enable a more complete assessment of the status and distribution of these important groups (and especially of dugong) throughout the survey area. Dugong in particular are a globally threatened species, and detailed plans for their conservation and management within the MPA will be included in the Management Plan developed on the basis of the surveys. It is thus particularly important to accurately identify areas in which dugong occur, and to acquire information on their abundances in different areas.

The logistical feasibility and costs of this aerial survey in Sudan will be assessed by the Sudan NPC and MPA Working Groups Member, in consultation with the Lead Specialist, prior to the commencement of the field surveys. If such a survey is feasible then suitable aircraft will be identified, and all permits, permissions etc. obtained, prior to the start of surveys.

3.1.4.viii. *Further tasks and information gathering*

***Permits*.** All permits needed for the surveys should be obtained in advance of the arrival of the survey team. These include any permits which may be necessary for travel, diving, photography, collection and export of marine biological specimens.

Travel permits are needed for travel in the area, both on land, and at sea. Both types of permit will be needed in order to work in the Dungonab/Mohammed Qol/Magarsam area.

The need for permits for use of a live-aboard dive boat for the surveys will have to be investigated very soon, as the need for, and type of, such permits will have a bearing on the hire of such a boat.

Appendix 5 provides a preliminary list of further outstanding tasks for the planning and implementation of the MPA surveys: In Sudan these include but are not limited to: arrangement of accommodation at Mohammed Qol and Dungonab; arrangements for hire of a live - aboard dive vessel for ten days to two weeks; investigation of costs and feasibility of carrying out an aerial survey of the area; arrangements for importation of survey equipment (some permanent, some temporary).

YEMEN

Bir Ali - Belhaf, Yemen

No reconnaissance visit to the Bir Ali - Belhaf survey area by the MPA - LS and the consultant has taken place during the MPA survey planning phase, or is currently planned to take place. Although this may change, both the MPA - LS and the consultant are already broadly familiar with the area. Details of logistical considerations including up to date accounts of facilities available at Bir Ali, and aspects of supply and re-supply, will need to be determined by the Yemen NPC, MPA Working Group member, and / or the MPA Surveys National Counterpart well in advance of the survey.

3.1.5.i. *Location & extent of the survey area*

Name of MPA: Bir Ali - Belhaf

Proposed size: Not yet defined

Survey area:

- Mainland coast and all islands, rocky and coral reefs, and shallow sediment areas between Belhaf (c. 48° 10’ E) and Ras Majdahah (c. 48° 30’ E).
- All islands and reefs between those two longitudes, including Sikha, Hallaniyah, Ghaddarayn and Barrakah Islands.
- Bir Ali Bay (this bay is very shallow, with a maximum depth of approximately 11 - 12 metres).
- Volcanic crater (assessment of mangroves and mangrove fauna, possibly including some specimen collection).
- Rapid characterisation of coast and habitats 5 - 10 km eastwards from Ras Madrakah, as potential buffer zone. This survey is to take a maximum of 1 - 2 days, unless important areas are discovered, in which case these may be surveyed in more detail, time permitting.

This represents a total length of coastline of approximately 40 km (not including the area to the east of Ras Madrakah), although the straight-line distance is considerably less. Only one island, Sikha, is more than one kilometre offshore.

Commercially available marine maps and charts of the area include:

British: (Admiralty)
#6 (**poor**: covers entire Gulf of Aden)

French: (Service Hydrographique et Océanographique de la Marine)
#6987 (**poor**: covers entire Gulf of Aden)

None of these commercial navigation charts are sufficiently detailed to be of very much use during the surveys. However, at least one should be purchased in case of need in the field. The British Admiralty chart is marginally more detailed than the French one, and it is recommended that this one be purchased.

3.1.5.ii. *Yemen: Gulf of Aden mainland overview*

An overview of the state of the marine environment in Yemen, with particular reference to coral reefs, is provided in Haddad *et al*. (2001).

The Gulf of Aden is dominated by the northern Indian Ocean monsoons, with prevailing currents flowing from south-west to north-east during the summer monsoon, and reversing during the winter monsoon. During the south-west monsoon a coastal upwelling of cold nutrient-rich water is a dominant influence in Oman and eastern Yemen, and this upwelling extends westwards from the Arabian Sea coast into the eastern Gulf of Aden.

3.1.5.iii. *Description of the survey area*

Since 1995 a number of marine biological surveys have been carried out in the survey area (Huntington & Wilson 1995, Watt 1996, Kemp 1998, 2000, Kemp & Benzoni 2000; DeVantier & Hariri in press). The bulk of this work was carried out prior to the major coral bleaching event of 1998, which had a serious impact upon the corals of the Bir Ali-Belhaf area (DeVantier & Hariri in press).

The survey area lies approximately 100 km west of al-Mukalla, and consists of extensive rocky headlands interspersed with sandy bays. The main survey area is bounded at the eastern end by the high headland of Ras Majdahah and the island of Barrakah, and at the western end by the low rocky headland of Belhaf. Rocky islands are found between 200 metres and 10 km offshore, and in addition to Barrakah and Sikha include Ghaddarayn and Hallaniyah. The seaward edge of the survey area is marked by the southern side of Sikha Island, approximately 10 km offshore.

The geology of the area gives rise to an inshore marine environment which is dominated by shallow rocky slopes providing hard substrates for the settlement and growth of hard and soft corals and other invertebrate animals, and marine algae. Inshore the waters of the area are generally very shallow, with rocky substrates usually only extending to a depth of between 4 and 15 metres before reaching an almost level sand or gravel sea floor. In all sheltered or moderately sheltered shallow parts of the survey area hard substrates are colonised by corals, often at high levels of cover, although coral reef structures are rare in the area. With the exception of Sikha Island, coral-rich areas are probably almost entirely restricted to depths shallower than 15 metres (although this is not confirmed, and deeper areas, and areas further offshore, need to be investigated).

The coastal landscapes are dominated by volcanic hills and extinct volcanoes, including two large flooded volcanic craters immediately east of Bir Ali. One of these two volcanic craters is of global interest due to the unique isolated stand of mangroves found inside it.

Important species

- *Turtles*. Turtles probably nest in the area, particularly along the sandy shores to the east of Ras Majdahah, which will be rapidly surveyed. They may also nest within the survey area at Hallaniyah Island and other locations. Green turtles have occasionally been observed in the water in the survey area. A single drowned Hawksbill was recorded in an abandoned fishing net in early 1998.
- *Dugong*. Dugong are not known to occur in the area, and known seagrass beds here are very sparse. Cetaceans are common, and several species have been observed in the area including bottlenose, common and humpbacked dolphins.
- *Birds*. The area appears to include important feeding and roosting areas for birds, particularly the Socotra Cormorant. Extremely large aggregations of this species have been observed both inside Bir Ali bay, and in the area of Hallaniyah Island.
- *Cetaceans*. Dolphins have been observed throughout the survey area. Species known to occur here include comon dolphins, bottlenose dolphins and probably Indo-Pacific humpback dolphins.

Human impacts and other features

Levels of human impact were extensive but low-intensity throughout the survey area during the 1998 surveys. Impacts were obvious in many areas, but were not particularly serious or threatening. The main activities are fishing (both artisanal from Bir Ali village, and commercial from foreign trawlers), and activities directly related to habitation at Bir Ali village. Some occasional sport-diving probably occurs in the area. The only significant settlement in the area is Bir Ali village, although there are several other small settlements along the coast in the area. Raw sewage enters the bay from this village, along with considerable amounts of litter and other refuse. The other major human feature of the area is the main Aden to al-Mukalla road, which runs within one or two kilometres of the shore throughout all or most of the survey area.

The major embayment of the area is the bay at Bir Ali itself, which serves as an anchorage for the fishing boats based at Bir Ali, and for visiting small vessels including trading dhows and sailing yachts. Anchorages which are similarly used are found at Ras Majdahah and at Belhaf, and to a lesser extent at Sikha.

Some moderately serious anchor and boat damage to corals was observed in some areas at Sikha and other locations in 1998, and lost or discarded fishing nets were causing damage to corals, and continuing to ghost-fish in some areas in 1998 (including capturing and drowning turtles at Sikha).

3.1.5.iii. *General survey design*

Details of aspects of spatial design described here are intended to guide the conduct of the surveys in the field rather than to be rigidly prescriptive rules. An ability to be flexible will be expected, and the Survey Supervisors will have the leeway to alter the locations and boundaries of these provisional sub-sectors, and even of sectors, if specific circumstances demand it.

The area suffered badly during the global coral bleaching event of mid to late 1998 (DeVantier & Hariri, in press). Assessment of the extent and severity of this impact will be an important aspect of the MPA survey. For this reason some re-visiting of previously surveyed sites will be incorporated into the new survey (see '*Sub-sectors*', below).

The hill of Qana on the western edge of Bir Ali bay is of at least regional historical and cultural importance. Information about the extent of the subtidal archaeological sites should be gathered, to enable inclusion of historical and archaeological features in the management plan.

Sectors

Sector 1. The mainland coast and reefs from just to the west of the Belhaf headland (or to the eastern edge of the new Total Oil terminal development, whichever is encountered first), to the eastern side of Qana at the entrance to Bir Ali Bay. This sector will also include Hallaniyah Island, and the waters around Hallaniyah and between Hallaniyah and the mainland.

Sector 2. Bir Ali bay, reef, and the mainland coast (including the mangrove crater) to Ras Madrakah. This sector will include Ghaddarayn Island, some extensive shallow reefs and coral communities close to Ghaddarayn, Barrakah Island, and the Madrakah anchorage bay.

Sector 3. Sikha Island.

Sector 4. The coastal and inshore areas for 5 - 10km east of Ras Majdahah (Rapid Assessment only).

***Sub-sectors* (*provisional guidelines only at this stage*)**

Sub-sectors will be:

1, 2 & 3. Sikha (north bay, south bay, other areas)
4. Hallaniyah
5. Ghaddarayn, including the semi-emergent rocky reef to the ENE of the island
6. Bir Ali bay including the reef across the entrance
7 & 8. The coast from Bir Ali to Belhaf (two sub-sectors of approximately equal extent)
9. The coast from Bir Ali bay to Ras Majdahah
10. The coast to the east of Ras Majdahah
11. The mangrove crater

These sub-sectors are very variable in extent; some, such as those at Sikha, Hallaniyah or the volcanic crater will probably only take one or two days of survey, others such as the coast from Bir Ali to Belhaf may take 3 or 4 days.

Five or six of these sub-sectors will include assessment of bleaching impacts, utilising data on corals and fishes gathered during surveys in 1998. Those sub-sectors are 1, 2, 3, 4, 6 and 8 (the sub-sector including Belhaf headland).

Methods

The survey methods to be used are outlined in Section 4, but final decisions on the exact methods to be used will be made when the Draft Standard Survey Methods Manual is available.

If conditions allow, shallow subtidal habitats at Sikha and other suitable sites (to be selected during the survey) will be sampled using manta-tow methods, in addition to other rapid and detailed methods.

3.1.5.v. *Timing and duration of surveys*

Timing. The most important features of seasonality in the survey area are high winds, cold water and poor visibility due to the summer monsoon, and high winds during the winter monsoon. In-water work in particular, and survey work in general, is likely to be difficult or impossible during the period May/June to September.

The best period for survey work in the Bir Ali area has been provisionally identified as being January - April.

Duration. The duration of the survey phase at Bir Ali - Belhaf will be approximately 4 weeks.

3.1.5.vi. *Logistics*

- The Bir Ali area is located approximately 100 km from al-Mukalla, and is easily accessible from both al-Mukalla and Aden via the main coast road, which passes close to the survey area. Basic supplies can be obtained in Bir Ali village, but occasional re-supply from al-Mukalla will also be necessary (once or twice weekly).
- The most suitable location for a camp site has been provisionally identified as being close to the foot of Qana hill, near to the archaeological site. This is open to discussion and may be subject to alteration if necessary.
- Some of the inshore work will be possible from 4x4 vehicles, although a boat or boats will be needed for the islands, for most of Bir Ali bay, for all of the coastal area from Bir Ali to Belhaf, and for headland areas including the volcanoes and Ras Majdahah.
- It will be necessary to clarify where fuel, 2-stroke oil and drinking water can be obtained for the survey. In particular, 2-stroke oil was very difficult to find in al-Mukalla in 1998, and may have to be brought from Aden.

3.1.5.vii. *Further tasks and information gathering*

Permits. All permits needed for the surveys should be obtained in advance of the arrival of the survey team. These include any permits which may be necessary for diving, photography, collection and export of marine biological specimens. There are currently no plans to use a live-aboard dive boat in the Yemen survey area.

In particular, the need for permission to camp at or near the archaeological site at Qana should be investigated, and permission obtained well in advance of the arrival of the survey team.

Appendix 5 provides a preliminary list of outstanding tasks for the planning and implementation of the MPA surveys.

3.2. MAPPING & GIS REQUIREMENTS FOR THE SURVEYS IN DJIBOUTI, NW SOMALIA, SUDAN AND YEMEN

Key Points

- GIS analysis and satellite imagery will be of central importance to the design and execution of the MPA survey phases.
- GIS output, including preliminary maps and unsupervised classifications, should be ready for incorporation into the planning and execution of the survey programme before the field surveys start.
- Technical GIS expertise and input should be sought and utilised throughout all stages of the GIS and remote-sensing part of the programme, from image purchase onwards.
- A timetable for procurement of GIS andf remote sensing expertise and images, and production of outputs, is provided.

3.2.1. Purchase of satellite images

Satellite images of all four survey areas should be purchased as soon as possible, in consultation with the institution and/or consultants who will be identified to carry out the analysis of the images. The possibility of sharing the costs of image purchase, GIS activities, and consequent costs with other Components of the SAP (such as the Habitats and Biodiversity Component which has a probable interest in using such images) should be explored.

3.2.2. Areas to be covered by the satellite images

The areas covered by the images should, at the minimum, include the entire area of each of the surveys, as described in Sections 3.1.2 - 3.1.5. The purchase of images covering larger areas than this, and so providing additional information about the boundary areas, and allowing for extension of the survey areas if the need arises, should be considered.

The minimum areas to be covered by the images are described in Table 2. Practical and technical aspects of these requirements should be discussed with the institution and/or consultants identified to carry out the work, prior to purchase of images.

3.2.3. Timeframe for acquisition of satellite imagery, and products required prior to the survey phase

The institution and GIS consultant to carry out the GIS and satellite image work should be identified and engaged as soon as possible. This must be done soon enough to allow the production of preliminary unsupervised maps of all survey areas, based on the satellite images. Those maps will be sued in two ways:

1. They will be essential for final detailed planning of the surveys and

2. They will be used extensively during the surveys as practical aids (i.e. maps).

Discussions and consultations should be carried out with the GIS consultant(s) to determine the most productive approach to using those preliminary maps (e.g. would production of unsupervised classifications for ground-truthing during the surveys be possible, and would

adoption of such an approach be a productive use of effort both before and during the surveys).

Table 2. Timetable for GIS work

	Description	Target date:	Action by:
1	Identification of GIS consultant. Issue of contract.	End of June 2001	LS, Survey Consultant
2	Purchase of images.	July - August 2001	GIS Consultant, LS
3	Preliminary output (all survey areas). Input to survey plans.	September 2001	GIS Consultant, LS, Survey Consultant
4	Final images & unsupervised classifications (Djibouti, NW Somalia, Yemen). Input to survey plans.	October 2001	GIS Consultant
5	Final images & unsupervised classifications (Sudan). Input to survey plans.	March - May 2002	GIS Consultant
6	Production of final images, maps and classifications for Management plans.	July 2002	GIS Consultant, Survey Consultant & team
7	Incorporation of GIS in MPA Survey Guide.	December 2002	GIS Consultant, Survey Consultant, LS

(LS = Lead Specialist)

N.B. This timetable will be discussed with the GIS Consultant, and may be modified.

Table 3. Satellite images for MPA surveys: Minimum area to be covered (provisional, pending consultation with the GIS specialist)

Country	MPA Name	Boundary	Latitude or Longitude
Djibouti	Sept Frères & Ras Siyyan*	North	12°32'N
		South	12°24'N
		East	43° 29'E
		West	43° 14'E
Somalia	Saad ed Din	North	11° 40'N
		South	11° 17'N
		East	43° 44'E
		West	43° 16'E
Sudan	Dungonab & Mukkawar	North	21° 26'N
		South	20° 36'N
		East	36° 33'E **
		West	36° 57'E
Yemen	Bir Ali - Belhaf	North	14° 04'N
		South	13° 50'N **
		East	48° 34'E
		West	48° 08'E

N.B. All of these latitudes and longitudes are provisional, and may be subject to change after discussions with the GIS specialist. In particular, those marked with asterisks (*) need further checking.

* This may ultimately be part of a a trans - boundary network of MPAs covering the both sides of the Bab al Mandab including Perim and the mainland shore of Yemen (see section **3.2**, above). Consequently it may be worth purchasing images for this entire Bab al Mandab area.

** These need confirmation. They are offshore distances, and the area of coverage and level of detail on maps and charts immediately available may not be high enough to be sure that all offshore reefs and shoals are included. For this reason these two distances may be over-estimated, but may equally be insufficient to include all offshore features.

3.2.4. Navigation charts

Navigation charts, in particular British Admiralty charts and French Hydrographic Office charts, for all of the survey areas should be purchased in advance of the survey phase. Those charts will be utilised alongside remotely sensed images during the detailed planning stages, and during the survey implementation stages.

Lists of British Admiralty charts and French Hydrographic charts available for each survey area are provided in Sections 8.1. - 8.4. (above).

Table 4. Navigation Charts to be purchased prior to the Field Surveys

Survey Region	*Publishing Authority*	*Chart number*
Sept Frères *	Service Hydrographique et Océanographique de la Marine, Paris.	6326 6893
	British Admiralty, London	3661 143 1925
Saad ed Din & Aibat	Service Hydrographique et Océanographique de la Marine, Paris	6894
Dungonab Bay & Magarsam	British Admiralty, London	3722 138
	Service Hydrographique et Océanographique de la Marine, Paris	7112
Bir Ali - Belhaf	British Admiralty, London	6

* Purchase of charts covering the entire Bab al Mandab is recommended, both to provide a broader picture of the important context of this proposed MPA, and because of the possibility that surveys will be conducted at Perim and on the Yemen mainland coast as well.

3.3. CONVERGENCE BETWEEN THE MPA COMPONENT OF THE SAP AND BETWEEN OTHER PROJECTS AND INITIATIVES IN THE REGION

There is considerable overlap and convergence between the Marine Protected Areas Component and other Components of the SAP, and with other initiatives in the region.

- Two areas of convergence are of direct relevance to the MPA Component, and particularly to the survey phase: The Habitats and Biodiversity Component and the Living Marine Resources Component.
- The GEF Bir Ali - Burum Pilot ICZM project has considerable overlap with the Bir Ali - Belhaf MPA project of the MPA Component of the SAP. Discussions between Lead Specialists of these components and of the MPA component were held in late 2000.
- A further important issue is that of trans - boundary co-operation between PERSGA member states, with reference to the MPA programme. This issue is of particular importance, and provides significant opportunities, in the Bab al Mandab region.

3.3.1 Convergence between the Marine Protected Area Component and the Habitats and Biodiversity Component of the SAP

Co-operation between these two components of the SAP was discussed by the Component Lead Specialists in November 2000, particularly with reference to the survey phases of both components. It was agreed that there is considerable overlap in objectives and methods, and that close communication and co-operation should be maintained between the two components. Co-operation between these two Components may result in the gaining of considerable added value for the SAP.

Initial agreement was reached that surveys of turtles, planned for Djibouti, NW Somalia, Sudan and Yemen under the HBC component over the next twelve months (before the MPA surveys take place) will endeavour to carry out comprehensive surveys of the areas of the four proposed MPAs. To facilitate this the HBC Lead Specialist was provided with details of the currently planned boundaries of the four survey areas.

This agreement requires further discussion and consultation.

In addition to turtle surveys, obvious target groups for both components include birds, dugong, mangroves, corals and fishes. Ways in which these convergences can be exploited should be further investigated.

3.3.2. Convergence between the Marine Protected Area Component and the Living Marine Resources Component of the SAP

Co-operation between the MPA and Living Marine Resources Components of the SAP was discussed by the Lead Specialists in November 2000. It was agreed that there is considerable overlap between the scope of the two Components, and that communication should be maintained. No firm agreements were reached for collaboration in the survey phase of the MPA programme, but it was emphasised that no-take zones within MPAs would probably form an important part of the Living Marine Resources management programme.

Further consultation is required to investigate how the survey phases of the two components can best benefit each other.

3.3.3. Convergence between the PERSGA MPA project at Bir Ali-Belhaf, and the Global Environment Facility (GEF) ICZM Pilot Project at Bir Ali-Burum

The high degree of overlap between these two projects (SAP & GEF) is very clear. Close communication between the two programmes should be developed and maintained. The MPA Lead Specialist initiated direct contact and discussions with the CZM programme in March 2001. At those meetings preliminary agreement was reached on communication and co-operation between the two projects.

3.3.4. An important opportunity for trans - boundary co-operation, through development of an MPA network in the Bab al Mandab.

A major management issue for any MPA or fisheries management programme in the Bab al Mandab area is trans-boundary fisheries, particularly for shark, but also for lobster and finfish.

During the reconnaissance phase of the preparation of this report the creation of a trans - boundary system of MPAs, across the strait, was proposed (see Appendix 1). Trans - boundary co-operation for the development of management activities in the Bab al Mandab area, through the Regional Network of Marine Protected Areas within the SAP, provides an opportunity to effectively address issues which will benefit both Djibouti and Yemen, and which will be more difficult to address outside the structure of the MPA network.

The prospect of including Perim island and adjacent areas of the Yemen mainland coast within the PERSGA Regional Network of MPAs, and the MPA survey programme, should be addressed as a matter of urgency.

3.4. THE SURVEY TEAM

3.4.1. Personnel

The survey team will consist of three components. These will be:

1. *Survey Team Leaders*:

- Survey Leader
- Assistant Survey Leader

2. *Regional team members*

- Socio -economic Surveyor
- Fisheries Surveyor
- Two biological surveyors

3. *National team members*

There will be a minimum of three national team members. One each to assist with the Biological survey, the Socio-economic survey and the Fisheries survey.

4. *Additional workers*

Additional members of th survey teams will include:

- Boat handler (locally or nationally recruited)
- Cook / camp guard (locally recruited)

The Team Leaders and the regional team members will be closely involved in all four of the surveys. The national members of the survey team will be involved in the surveys of the proposed MPA's in their own countries. There will thus be four different sets of 'national' team members, from Djibouti, Somalia, Sudan and Yemen.

Various selection criteria for the various Survey Team members are outlined throughout Section 3.4.1. Some team members selected may not fulfil all of the requirements at the time of selection, and all or most will require futher training and practice in the specific survey methods to be used during the surveys. The following section (3.4.2) provides details of further training which will be provided to survey team members as necessary.

3.4.1.i. Survey Leaders

Biological Survey. The Survey Leader and the Assistant Survey Leader will both be biological surveyors. Before, during and after the Field Phase the Team Leader and Assistant Team Leader will work together closely on all aspects of survey preparation, execution and data analysis / reporting.

In order to ensure that this requirement for two biological survey Team Leaders in the field is fulfilled, a back-up Assistant Team Leader will be identified in the pre-survey period, to be available to stand in for either of the other Team Leaders if the need arises.

The Survey Leader has already been provisionally identified. The Assistant Survey Leader (and back - up) will be recruited from within the PERSGA region,and will be identified as

soon as is practical, in order to allow them to be fully familiarised with the MPA programme. They will be involved in as much of the survey preparation as possible, including selection of Regional and National survey teams.

Selection criteria: The Survey Leaders should be marine biologists trained to post-graduate level, and with at least five years post-graduate research and survey experience, including experience in the Arabian region. A broad familiarity with Arabian marine ecology is essential. Specific experience required will be marine survey and biodiversity work, and conservation work in general, or MPA work in particular.

3.4.1.ii. Regional team members

Four additional members of the survey team, recruited at a regional level, will be involved in all four of the survey areas. Together with the Survey Leaders these team members will form the core of the survey team.

Regional team members will include:

- **Two** marine biologists, who together with the two Survey Leaders will carry out the biological surveys. One of the two regional marine biology specialists should have coral ecology and identification expertise. The other will should have experience and expertise in identification and visual census of fishes.
- **One** Socio-economic Surveyor to design and carry out the socio-economic surveys.
- **One** Fisheries Surveyor to design and carry out the fisheries surveys.

Regional team members will be selected from the PERSGA countries, and will contribute broadly to the surveys. Involvement of these surveyors in all four surveys will:

- Ensure continuity of personnel during the MPA survey programme, benefiting the MPA surveys.
- Maximise the training and experience gained by the members of the Regional Team, benefiting the training objectives of the survey programme. Following the survey programme this Regional Team will provide the basis for a regional training and survey resource.

The regional members of the survey team should have contracts with PERSGA dedicating them to the survey programme for an extended period (up to several months), extending either side of the surveys themselves.

3.4.1.iii. National Team Members

Each survey will be accompanied by three or four National team members. The National team members will include:

- **An Assistant Socio-economist**, to assist with and gain experience during the socio-economic surveys.

- **An Assistant fisheries surveyor** to assist with and gain experience during the fisheries survey.

- **An Assistant biologist** to assist with ane gain experience during the biological surveys. Although these biologists need not be trained and competent divers, they will have to be competent swimmers and snorkellers in order to effectively carry out shallow subtidal work for Rapid Assessment surveys. Ideally they will be trained in SCUBA diving before the surveys begin so that they can if necessary assist with diving work. However, they will not be expected or required to routinely carry out diving work.

- **Logistical support**. This will provisionally consist principally of a dedicated and trained boat-handler.

The national team members will be selected from among individuals identified by the Country Representatives of the MPA Working Group of the SAP, and / or from trainees attending Survey Methods training courses under the Habitats and Biodiversity Component of the SAP. The national survey team members should have contracts with PERSGA dedicating them to the survey programme for an extended period of up three months, extending either side of the surveys themselves. These National Team members will then be involved with logistical preparations in their countries for the arrival of the main survey team.

Minimum diving qualifications and experience for team members involved in diving work

All survey team members involved in diving work must be competent swimmers, snorkellers and divers (minimum requirement PADI Advanced Diver). The Survey Leader and the Assistant Survey Leader must have >200 dives completed, and have experience of leading groups of divers on biological survey work in the Arabian region.

3.4.1.iv. Selection of Regional and National Team Members

Regional and National Team members will be selected from those whose CVs have been gathered by NPCs and MPA Working Group Members in the PERSGA region.

***Specific selection criteria*:** At all stages of the selection process, selection criteria will include but will not be limited to:

- Scientific qualifications
- Practical experience and training (Field skills and particularly, in the case of the biologists, diving experience)
- Biological survey and research experience and training.

- *Back-up personnel* should be identified, in case of unavoidable absence of any team members from any survey.
- *Preliminary selection of National and Regional candidates for the survey teams, from among the CVs provided by NPCs and Working Group members,* will be carried out by the MPA Lead Specialist and Survey Leaders. Where possible this will also include consultation with survey methods trainers.

- *Final selection* will take place during and after a pre-survey training and evaluation course to be held during summer 2001. This training course will concentrate on the Rapid Assessment and specific detailed survey methods to be used during the surveys.

***General selection criteria*:** The ability to work well as a team in difficult circumstances will be very important. The surveys will require team members who are able to work well with others in the field, are capable of hard work in conditions of relative discomfort, and are capable of maintaining high standards of work in such conditions over periods of several weeks. These are qualities which cannot be assessed on the basis of technical or scientific qualifications.

Even experienced and technically competent people will ***not*** be suitable for inclusion in the surveys if they will not be able to work well as part of the team.

Use of a training and selection course to finalise selection of Team members will enable the Survey Leaders and Lead Specialist to evaluate these more general characteristics of candidates. Specifically:

1. It will provide a period prior to the surveys in which strengths and weaknesses in the team members will be identified, and steps taken to address and remedy any weaknesses found at a time when interference with the effectiveness of the surveys themselves will be minimal.
2. It will enable the survey supervisors to establish and assess roles for the Team members, and for the teams to establish themselves as efficient working units.
3. It will fully familiarise the Team members with the equipment and methods to be used, and particularly with the logistical considerations and constraints for the surveys.

Aden - Ras Imran and/or al Mukalla - Bir Ali have been provisionally identified as the most appropriate locations for this training and selection exercise.

If this exercise takes place during the summer months (*June - September*), when diving is difficult in the Gulf of Aden, the course will be moved to a more suitable location such as Egypt (Ras Mohammed / Sinai, utilising the EEAA Training Centre) or Saudi Arabia (Farasan, utilising the NCWCD Training Centre).

3.4.2. Training

Once potential team members have been identified, they will take part in training courses as necessary to bring them up to the required levels of qualification and experience for all aspects of the field work, both practical (diving, boat handling, compressor operation, etc) and scientific (survey skills).

N.B. *The training component will require close co-operation and communication between the MPA Component of the SAP, and the Habitats and Biodiversity Component.*

There will be a number of minimal requirements the survey team should fulfil before the start of the surveys, provisionally timetabled to begin at the start of 2002. These requirements are:

1. For those who will be involved in subtidal work: Competence and confidence when swimming, snorkelling and diving. All team members should be able to carry out survey tasks in the water comfortably and safely.

2. For all survey team members: Familiarity with the survey methods they will be participating in.
3. For all survey team members: A basic understanding of and familiarity with practical field skills including compressor operation and maintenance, and basic boat-handling skills.

The need for these requirements will be addressed in two ways:

- Through selection of survey team members (see above), including participation in a seven to ten day MPA survey training and assessment period during the summer of 2002.
- Through training courses for survey methods, diving and selected logistical capabilities (e.g. compressor operation and maintenance, other equipment maintenance) after selection.

Survey skills training

All survey team members will be trained in relevant biological survey skills prior to the start of the surveys. All biological survey team members should be trained in all aspects of Rapid Assessment surveys.

Training of surveyors has already started, under the Habitats and Biodiversity Programme which has already conducted coral reef survey training courses and is also carrying out training in turtle survey methods, amongst others.

As with many other aspects of the MPA survey programme, close co-operation between the MPA Component and the Habitats and Biodiversity Programme will be required for all aspects of survey team selection and training.

Dive training

A minimum standard of competence will be required for any surveyors taking part in dive and snorkel work for the surveys. That competence will come from formal dive training (to a minimum of PADI Advanced Diver standard), from experience gained subsequent to training, and from the natural aptitude of individuals for diving and swimming.

There are two reasons for this requirement for a minimum standard:

1. ***The over-riding consideration for work throughout the surveys will be safety***. More training, experience and aptitude for diving among the survey team members will ensure safer diving.

2. In order to work effectively and productively under water it is necessary to be comfortable and confident when in the water.

The time available to carry out the surveys in the field is short, and so it is essential that all survey team members are trained and competent *before* the surveys start. There will be insufficient time to bring team members up to speed during the surveys, without risking seriously compromising the quality of the survey work.

Boat handling

A trained boat-handler will be required for the surveys. The boat-handler(s) should be experienced, or receive training in, working with divers. They should also be competent in basic outboard motor maintenance and repair, and will be responsible for maintenance of the survey boats and engines.

Boat-handling will be a dedicated job carried out by a non-surveyor. The possibility of employing an experienced local boat-handler for the duration of the surveys should be investigated for each country.

Other team members will only be allowed to handle either of the boats (the main survey boat and the small inflatable) after they have been cleared to do so by one of the Two Biological Survey Team Leaders.

Training of compressor operators, and designation of equipment officers:

Compressor operators. A minimum of two members of the survey team should be fully trained in compressor operation and maintenance before the start of the surveys.

Equipment officers. Each member of the survey team will be responsible for their own equipment throughout the period of the surveys. One Equipment Officer will also be designated for the survey team for the survey period.

Because all major items of equipment such as compressors, boats and vehicles will be provided to each country before the surveys start, and will remain in each country after the surveys are completed, each country will designate one person to be that nations PERSGA MPA Equipment Officer.

That Equipment Officer may be the same individual as the National Survey Co-ordinator and / or the MPA Working Group Member, and will be responsible for organising the storage and maintenance of all equipment. As such this will have to be an individual who is local to the survey area. For instance, in Sudan this will have to be a person who lives on the coast, preferably in Port Sudan.

Each national Equipment Officer should be provided with training in basic maintenance of regulators, BCDs, compressors, boat engines, etc.

3.4.3. Logistical support: National Survey Co-ordinators

An essential part of the project will be the provision of logistical support in-country before, during and after the surveys, by personnel who may not take part directly in the surveys themselves. In addition to the national Equipment Officers (see 3.4.2., above), support from the National Programme Co-ordinators, MPA Working Group members and particularly from National Survey Co-ordinators will be essential.

National Survey Co-ordinators. In each country the MPA programme will employ one person, a National Survey Co-ordinator, to work on logistical support for the surveys before and during the surveys. This person will be the central co-ordination and contact point for the surveys. In close co-operation with the NPC and MPA Working Group member in each country, this person will prepare the on-the-ground logistical support for the surveys, from selection and hire of accommodation, equipment storage and transport to the survey area, and organisation of supply and re-supply for the survey teams.

Areas of responsibility for the NPC, MPA Working Group member, and National Survey Co-ordinator for the surveys will have to be clearly defined. This definition of areas of responsibility, and TORs for the National Survey Co-ordinator, will be developed by the Lead Specialist, with input from the Consultant/Survey Leaders.

3.5. LOGISTICS & SAFETY

This section provides a preliminary outline of logistical and safety considerations relevant to the MPA surveys.

All survey areas are relatively remote, and provision will have to be made for all aspects of transport, supply and re-supply for the survey team, for periods of four to six weeks.

3.5.1. Logistics

***Accommodation*.** In two of the four survey areas (Sept Frères , and Bir Ali/Belhaf) camping will be the only available accommodation.

In Sudan the use or hire of the ACORD camp at Mohammed Qol, and the oyster project camp at Dungonab village, will be investigated as these are the preferred accommodation sites here. This should be fully investigated and confirmed by the NPC and MPA Working Group Member (or National Survey Co-ordinator, when appointed) as soon as possible Some camping may nevertheless be carried out in Sudan.

In NW Somalia it should be possible to hire part of the COOPI Artisanal Fisheries Project building in Zeila for use as a base-camp. This should be fully investigated and confirmed by the NPC and MPA Working Group Member as soon as possible.

Transport. Transport by land to and within the survey areas will be by 4 x 4 vehicle (with the possible exception of Isles des Sept Frères, where mines *en route* may prevent the transport of vehicles overland to the survey area. The survey area itself is free of mines). Each survey will require the use of **two** (and at times perhaps three) vehicles throughout its duration. This is for three reasons:

1. The number of surveyors and amount of equipment to be routinely transported during shore based surveys.
2. Different survey groups (Biological, Resource Use) will need to work in different areas at the same time.
3. A second vehicle will be required as a back - up throughout the surveys, for safety reasons.

Transport by boat within the survey areas will use the boat procured by the MPA Component for the Park in each country. A seoncd, smaller, boat will also be used. That second boat will be a small inflatable which can be transported by 4 x 4 throughout the survey area and assembled easily and quickly on the beach. This boat will be both a back - up boat for safety purposes, and will enable acess to shallows, lagoons, etc not accessible directly from the sea by the larger boat.

A live - aboard dive boat will be used for all surveys of offshore reefs. This will be essential for the survey in Sudan, which will require at lest two weeks of work based on a live - aboard. This is not so essential for the surveys in Djibouti and NW Somalia, although it is still highly desirable. Live - aboard based work is not necessary in Yemen.

***Re-supply*.** Regular re-supply of the survey teams will be needed, especially for fuel and 2-stroke oil, fresh water and fresh food. In general, food should consist of canned goods and dried goods that will last a long time, with fresh vegetables being restricted to onions, garlic,

cabbages, peppers, carrots, potatoes and others which keep for longer periods without refrigeration. Fresh fruit such as grapefruit, oranges and apples also keep well.

Provision will be made for regular re-supply of fuel, food and water by making prior arrangements with staff or other persons at the nearest urban areas, or by some of the team members. In cases where prior arrangements are made for re-supply, care should be taken to allow for delays due to weather, transport availability and third-party logistical arrangements.

In Djibouti it may be necessary for all re-supply to be carried out to the survey area by boat, due to potential security problems for re-supply by land (mines). The security situation in Djibouti will be monitored, and if the situation changes then re-supply will if at all possible be by road.

In Somalia, re-supply of fuel will ideally be arranged from Djibouti. At the present time (April 2001) the border between Djibouti and NW Somalia is closed both by land and by sea. There is little prospect of this situation changing before the survey period, but this will have to be cntinually re-assessed. If re-supply from Djibouti is not possible arrangements for regular resupply from Berbera will have to be in place before the arrival of the survey team.

3.5.2. Safety

Safety will be a consideration of over-riding importance throughout the survey phase. This applies to all aspects of the work, but it is particularly important in relation to two activities: use of boats, and diving. Both of these will be addressed through training of surveyors, and through adoption of safe working practices when in the field.

***Communication*.** Ways to maintain regular communication between the survey teams and support personnel will be investigated.

A mobile telephone should be supplied to the Survey Leader, for use in emergencies only. In case of emergency this should allow direct communication with the NPC in each country, and ideally with the PERSGA offices in Jeddah, as well as with other authorities in the survey countries.

Two-way radios will be provided for communication between different components of the survey team in the field (a radio on the survey boat, and two hand-held radios).

***Safe diving practices* (Indicative only: for discussion)**

The remoteness of the survey areas from recompression facilities means that even greater anti-DCS precautions than normal will be standard during the surveys. These will include:

- No-one with less than 100 dives *or* with qualifications lower than PADI Advanced Diver and Rescue Diver, or equivalent, is to dive deeper than 20 metres, under any circumstances.

- Dives deeper than 20 metres will not be carried out by anyone as a matter of routine.

- A maximum three dives will be allowed per diver per day.

- A maximum of four consecutive days of diving without a break will be allowed for any diver.

- Precautionary ‘safety’ stops will be completed for 2 minutes at 3 metres depth, on every dive deeper than 8 metres.

- Decompression diving will be ruled out in all circumstances.
- All divers are to use dive computers for all dives.
- Each pair of divers will use a Surface Marker Buoy (SMB) when diving with boat cover.

All divers should have completed the PADI Advanced Open Water Diver course, or equivalent, before taking part in the surveys.

Otherwise, safety considerations will follow standard diving practice.

Recompression facilities. The only recompression chamber currently known to be in the survey region is located in Jeddah. There are no recompression facilities in Sudan, Djibouti or Somalia. There may be facilities in Yemen, in Aden and/or at the oil terminal north of Hoddeidah. This needs to be confirmed. The oil terminal construction site at Belhaf is likely to be equipped for divers, and this may include recompression facilities.

Although recompression facilities may exist at Salalah in Dhofar, southern Oman, this is probably too far from any of the survey areas to be of any use in emergencies. Nevertheless this possibility should be investigated.

The exact locations, contact details, status and accessibility of the recompression chambers should be determined in advance of the survey phase. The possible existence of recompression facilities in Yemen and Oman should be confirmed, and exact locations, contact details, status and accessibility determined.

Medical and First Aid. A good and comprehensive first aid kit, including a supply of clean hypodermic needles and syringes, should be provided for the survey team in each country, with two smaller kits to be provided to accompany boats or vehicles away from the main survey party.

An emergency evacuation plan must be developed for each survey, to be put into action in case of the need for evacuation of any team member to hospital.

N.B. The survey team in each country MUST be supplied with an oxygen kit for decompression emergencies. This may require considerable advance organisation for imprtation and permitting purposes.

Insurance. Good comprehensive insurance must be provided for all or by all participants in the surveys. This must include medical and accident insurance, emergency evacuation cover, and third-party liability cover.

3.5.3. Equipment

Appendix 4 provides preliminary equipment lists for the surveys. Continued development and refinement of these lists will be an on-going exercise throughout the preparation for the survey phase.

3.6. DRAFT TIME-TABLE

On the basis of discussions with the MPA Lead Specialist and the Chief Technical Advisor, a broad-scale timetable has been drawn up, and is presented here. This timetable is preliminary, and in this draft of the report is indicative only. Further alterations to this timetable, and development of detailed log-frames for both the preparation and the implementation phases of the MPA survey programme will be developed during the first half of 2001.

Weather. Planning of the surveys must include a margin to allow for missed survey days because of bad weather. A margin of one lost day in every four or five (i.e. three or fours days work followed by one day lost) should be allowed.

Table 3. Draft Timetable for Biological and Resource Use Surveys

Survey area	Approximate duration	Proposed survey period
Belhaf and Bir Ali Area.	4 weeks	January - February 2002
Isles Sept Frères & Ras Siyyan	4 weeks	February - March 2002
Saad ed Din and Aibat Islands, Saba Wanak.	4 - 6 weeks	March - April 2002
Mukkawar Island and Dungonab Bay.	6 weeks	September - October 2002

3.7. OUTPUTS & DATA ANALYSIS (indicative only at this stage)

Guidelines for methods and techniques of data analysis will be presented in the PERSGA SSM Manual, and analyses of the survey data gathered during the MPA surveys will utilise the appropriate data analysis methods as presented in that Manual. For the purposes of the MPA surveys those analysis methods will be largely descriptive, and will make extensive use of multi-variate methods.

Outputs will include:

- ***A database, or databases*** including all raw biological and resource use data, quantitative and qualitative, gathered during the resource use surveys. Development of the database design will be carried out as part of the Habitats and Biodiversity Component, within the Standard Survey Methods programme. This will require close communication between the HBC Component and the MPA Component.
- ***Presentation of analyses of the raw data***, in the form of written reports, including the distribution of diversity and species composition within each survey area, habitat/community types (biotopes) and resource uses. Analytical methods used will include both basic descriptive statistical analyses and multi-variate analyses.
- ***GIS - derived maps***, based on remotely sensed images, and utilising ground - truthing using data from the habitat and resource use surveys. This will provide an area-wide analysis of the distribution of habitats, species, biodiversity, important sites and resource uses. These maps will be incorporated into final survey reports, but will also be important management tools in their own right.

These outputs will be presented, integrated and discussed in Site-specific survey reports.

4. LITERATURE CITED & ABBREVIATIONS USED

4.1. LITERATURE CITED

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4.2. . ABBREVIATIONS USED

BCD	Buoyancy Control Device
CoTs	Crown of Thorns starfish (*Acanthaster plancii*)
COOPI	Cooperazione Internatzionale, NW Somalia.
EEAA	Egyptian Environmental Affairs Agency
GEF	Global Environment Facility
GIS	Geographical Information System
GPS	Global Positioning System
HBC	Habitats and Biodiversity Component of the PERSGA SAP
ICZM	Integrated Coastal Zone Management
IUCN	World Conservation Union (International Union for the Conservation of Nature)
IUCN-EARO	IUCN East Africa Regional Office, Nairobi.
Lat / long	Latitude and Longitude
LMR	Living Marine Resources Component of the PERSGA SAP
LS	Lead Specialist (of PERSGA SAP Component)
MPA	Marine Protected Area
NCWCD	National Commission for Wildlife Conservation and Development (Saudi Arabia)
NPC	National Programme Co-ordinator.
PADI	Professional Association of Diving Instructors.
PERSGA	Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden.
RSGA	Red Sea and Gulf of Aden.
SAP	Strategic Action Programme of PERSGA
SC	National Survey Co-ordinator.
SCUBA	Self Contained Underwater Breathing Apparatus
SMB	Surface Marker Buoy
SSM	Standard Survey Methods`
UVC`	Underwater Visual Census

APPENDIX 1

Field trip reports

Dungonab Bay and Mukkawar Island, Sudan &
Isles Sept Freres and Ras Siyyan, Djibouti
(October - November 2000)

&

Saad ed Din & Aibat, NW Somalia
(March - April 2001)

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

The Strategic Action Programme (SAP) for the Red Sea and Gulf of Aden

Marine Protected Areas Component

Mission report: MPA survey design project (Sudan field reconnaissance)

Names and Position:
Mohammed Younis, MPA Lead Specialist
Jeremy Kemp, Consultant, MPA survey design project

Period:
20th - 27th October 2000

Area:
Sudan (Khartoum, Port Sudan, Dungonab and Mohammed Qol)

Date of report:
5th November 2000

Objectives:
To carry out a rapid reconnaissance of the area to be surveyed for the Proposed Marine Protected Area at Dungonab Bay and Mukawwar Island, Sudanese Red Sea. The aim of reconnaissance was:

- To carry out a preliminary assessment of logistical requirements for the survey phase, and to identify potential logistical problems.
- To determine the extent of the area to be surveyed.
- To determine the principal habitats and species within the survey area.
- To carry out a very brief preliminary assessment of the principal resource uses and probable threats within the survey area.
- To meet with appropriate persons (administrators and stake-holders) in Khartoum, Port Sudan and the survey area, to inform them of the purpose of our visit and to give them the opportunity to provide input to the MPA project at the earliest stages.

Persons met for Discussions:

Mr Mahgoub Hassan, PERSGA National Programme Co-ordinator, Sudan.
Mr Mohammed Eltayeb, Sudan MPA Working Group member.
Mr. Abdullah Hamed, Deputy Director of Fisheries Administration, Port Sudan.
Dr. Sayed, Dean of the Faculty of Marine Science, University of the Red Sea, Port Sudan.
Captain A. Halim, Dive tourism operator, Port Sudan.
Mr Andrea Bari, Farm Manager, Dungonab Oyster Farm.

Mr Ahmed Adam Tamiem, ACORD Red Sea Hills Programme, Port Sudan - Diem Medina. *Dr Nadir Mohamed Awad*, Secretary General, Higher Council for Environment & Natural Resources (HCENR), Khartoum.
Brig. Hago M. Elhassan, Head of Wildlife Conservation, Khartoum.

Activities

- *20th October, Travel from Jeddah to Port Sudan*. The MPA Lead Specialist (MY) and the consultant (JK) travelled from Jeddah to Khartoum where they met with the Sudan NPC, Mahgoub Hassan. From Khartoum MY, JK and the NPC travelled to Port Sudan.

- *21st October, Port Sudan*. Meetings in Port Sudan included: Mr. Abdullah Hamed (Deputy Director of Fisheries Administration) and Dr. Sayed (Dean of the Faculty of Marine Science, URS), Mr Mohammed Eltayeb (the Sudan MPA Working Group member) and Mr Mohammed Abdul Rahim (of the Research Centre of the Fisheries Dept., and the Manager for the Community Oyster Project at Dungonab village).

- *22nd October, Dungonab village*. MY and JK, accompanied by Mr Mohammed Eltayeb and Mr Mohammed Abdul Rahim, travelled to the survey area of Dungonab and Mohammed Qol. A brief preliminary visit was made to Mohammed Qol to arrange boat hire for a visit to Mukkawar (Magarsam) Island on the 23rd October. Dungonab village to the north of Mohammed Qol was then visited, and a meeting held with the village Omda. A brief interview was carried out with the Port Sudan - based fishery coordinator for the Beche-de-Mer fishery at Dungonab village, and a visit made to the Community Oyster Farm project. Visits were made to the northern end of the survey area at Khor Shanaab, north of Dungonab village, and to the coast on the eastern (seaward) side of the Dungonab peninsula. Accommodation for the night was provided at Dungonab Community Oyster Farm.

- *23rd October, Dungonab village and Mohammed Qol*. Bad weather (high winds) prevented the planned visit to Margasam Island and the offshore reefs. Instead several sites on the mainland coast between Dungonab village and Mohammed Qol were visited. A visit was also made to the commercial Oyster Farm just south of Dungonab village (a project completely separate from the Dungonab Community Oyster Farm Project), where a meeting was held with Mr Andrea Bari, the Farm Manager. Later in the afternoon at Mohammed Qol a meeting was held with the Omda and fishermen from the village. In the evening a meeting was held with Mr Ahmed Adam Tamiem of the ACORD Red Sea Hills Project, which carries out socio-economic development activities in both Dungonab village and Mohammed Qol. Overnight accommodation was provided at the ACORD camp, close to Mohammed Qol.

- *24th October, Mohammed Qol*. High winds again prevented a visit to Magarsam and the offshore reefs. Instead marsa sites and important but apparently unrecorded mangrove areas were visited at the southern end of the survey area, along the coast road from Mohammed Qol to Arous. The team returned to Port Sudan in the late afternoon.

- *25th October, Port Sudan*. A meeting was held with Capt. A. Halim, a Dive Tourism operator who runs live-aboard dive boats from Port Sudan to the reefs and islands. MY & JK subsequently returned to Khartoum by air.

- *26th October, Khartoum*. Courtesy visits were made to the Wildlife Service and the Higher Council for Environment & Natural Resources (HCENR).

- *27th October*. Depart from Khartoum for travel to Djibouti.

Results and outcome:

The visit to Sudan was highly productive, providing background information on:

- A broad range of logistical considerations of supply and re-supply, transport and extent of survey area.
- Important biological features of the survey area.
- Centres of population, and the extent and types of resource uses in the area.

General response of stakeholders to the MPA programme.
The response received from all administrators and stakeholders in Khartoum, Port Sudan, Dungonab and Mohammed Qol to the concept of the proposed MPA was strongly positive. The single exception to this was the villagers of Mohammed Qol, who were initially suspicious, but after discussions were far more positive.

Logistics:
- By land the survey area is only accessible via unpaved road from Port Sudan, a road distance of approximately 175 km. This generally takes six to seven hours, and in the rainy season may take considerably longer.
- *Rains*. The rainy season starts in October, peaks in November/December, and continues through to Dec/Jan. During the rains the coast road to Dungonab is usually closed, and access to the survey area at this time is by the inland road. Access to areas of the coastal plain, including travel within the survey area, is difficult during the rainy season.
- *Winds*. The windy season is from approximately October/November to April/May. This wind started a couple of days before our visit, and prevented us from visiting Magarsam/Mukawwar or any of the offshore reefs and islands.
- Travel permits are needed for travel in the area, both on land, and at sea. Both types of permit will be needed in order to work in the Dungonab/Mohammed Qol/Magarsam area.
- Fuel and oil are not commercially available in the survey area, and will have to be transported to the survey area from Port Sudan. Two-stroke oil, necessary for most outboard motors, could not be found in Port Sudan.
- Wells in the survey area are brackish. It may be possible to get fresh water for washing, etc. from these wells, but probably not in any real quantity, and this should not be relied upon. It should be assumed that fresh water would have to be transported from outside the survey area.
- The nearest recompression chamber to the survey area is in Jeddah.

Resource uses in the survey area: Resource uses in the survey area are based upon fisheries and tourism. All or most of the current fisheries activities in the area are carried out by fishers from Mohammed Qol and Dungonab village, and include fisheries for Beche-de-Mer, *Trochus*, *Strombus*, Oysters and finfish. Finfish fisheries are limited by a lack of freezer

facilities and ice, and are probably for subsistence only. Fish are caught by line and by net: trap fisheries do not appear to exist in the area at present.

There are indications that the Beche-de-Mer and *Trochus* fisheries are already over-exploited. Both are cash-fisheries for export from Sudan. Fisheries activities from both of the villages appear to be largely restricted to the sheltered waters of Dungonab Bay, and reefs and islands inshore or close to Magarsam. Each village supports approximately 30 - 40 boats, with 3 - 4 men per boat. The main fishing areas, for all the local fisheries, are Dungonab Bay and the entire area from Dungonab bay to southern Magarsam, although fishing activity anywhere east of Magarsam is uncommon.

Shark fisheries do not appear to occur here at present, although occasional and usually illegal visits by foreign shark fishers have occurred in the past. There is currently no commercial trawl fishery in the area, although there has been in the past.

Oyster Farms: The commercial pearl farm at Dungonab has a lease for the bay, for four miles around Om El Sheikh Island, but currently only a part of this large area is used. The government oyster farm uses several sites inside the bay, which were not visited.

There is still a salt industry on the Dungonab Peninsula (salt pans), which was not visited.

Tourism in the area is currently restricted to live-aboard diving on offshore reefs. There is currently no infrastructure or facilities for land-based tourism inside the survey area, although there are plans to build a tourist village at Marsa Figga, close to Arous approximately 40 km south of the survey area.

Important species:

- Dugongs occur throughout the survey area, especially in Dungonab Bay and inside various marsas including that at Khor Shanaab. Dugongs are drowned in fishing nets quite frequently and the fishers of Mohammed Qol stated that their numbers are declining. Their meat is prized, and although there is no targeted fishery for them, those caught accidentally are eaten.
- Turtles apparently nest throughout the area, especially on the islands, but possibly also on a number of mainland beaches including those on the western side of Dungonab peninsula. Magarsam Island was repeatedly identified as the most important turtle-nesting site in the area. Turtle eggs may be collected for consumption.
- Bird nesting is very important on the islands of the area, although main nesting seasons were not determined. Birds' eggs are collected.
- Both turtles and dolphins are often seen inside Dungonab Bay.
- Manta ray aggregations occur all summer (from April/May to October/November), mostly outside the bay in the area bounded by the mouth of the Bay, Magarsam Island, and the mainland coast, including the channel between Magarsam and the mainland.

Other:

It will be necessary to take differences, and possible antipathy, between the two villages (Dungonab and Mohammed Qol) into account from the earliest stages of the MPA project, including the survey phase. Strenuous efforts must be made, even during the survey phase, to avoid giving any impression that one village is favoured over the other.

The Beche-de-Mer fishers at Dungonab village are supplied with SCUBA equipment by a fisheries company based in Port Sudan (no SCUBA equipment is supplied to the fishers at Mohammed Qol). Without prompting they volunteered information that many shallow areas are now fished out, and they now have to move deeper for economically useful numbers of beche-de-mer. This is a strikingly close parallel to the pattern of extreme over-fishing of beche-de-mer which has occurred throughout some areas of East Africa (which are so severe that there has even been some discussion about proposing beche-de-mer for CITES listing).

Recommendations and follow-up

- *The extent of the survey area*: Areas to be included in the survey include all mainland areas and offshore islands and reefs between Khor Shanaab in the north (21° 50'N) and the mangrove areas south of Mohammed Qol, opposite the southern end of Magarsam Island in the south (20° 45'S). Offshore reefs or islands are important for both fisheries and tourism in the area, and all reefs and islands to the east of the mainland survey area should, as far as possible, be included in the survey.
- The ACORD camp at Mohammed Qol will, if available, provide an excellent base-camp for the survey. This subject was raised in discussions with Mr Ahmed Adam Tamiem of the ACORD Red Sea Hills Programme, and should be followed up with ACORD. The long experience and knowledge of the ACORD project in the two villages may also be invaluable for the resource - use surveys.
- Surveys of the offshore reefs and islands will probably require short-term hire of a live-aboard dive boat (7 - 10 days). The possibility of using one of Capt. Halim's dive boats for the offshore surveys should be investigated.
- Surveys should take place in either May/June, before the weather is too hot but after the windy season is over, or in September/October before the wind and rains start.
- Travel permits should be arranged well in advance of the surveys.
- Provision of 2-strike oil should be arranged well in advance, to allow it to be brought in from elsewhere if it cannot be purchased in Port Sudan.
- Accessibility to the Jeddah recompression chamber in the event of emergency *must* be confirmed, and all necessary precautions taken to ensure that, in the unlikely event that it is needed it will be available. In any event, the remoteness of the recompression facilities means that extreme caution will have to be exercised with all diving.
- Questioning of the SCUBA-using Beche-de-Mer fishermen at Dungonab village revealed that, at least sometimes, they suffer from symptoms resembling Decompression Sickness (DCS). This should be investigated further.
- A person in Sudan, preferably based in Port Sudan, should be assigned to gather already extant biological and socio-economic information related to the survey area. A considerable amount of such information may already exist within various institutions and Government departments.

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

The Strategic Action Programme (SAP) for the Red Sea and Gulf of Aden

Marine Protected Areas Component

Mission report: MPA survey design project (Djibouti field reconnaissance)

Names and Position:
Mohammed Younis, MPA Lead Specialist
Jeremy Kemp, Consultant, MPA survey design project

Period:
27th October 2000 - 1st November 2000

Area:
Djibouti (Djibouti city and Isles des Sept Frères/Ras Siyyan)

Date of report:
5th November 2000

Objectives:
To carry out a rapid reconnaissance of the survey area for the Proposed Marine Protected Area at Isles des Sept Frères and Ras Siyyan, Djibouti. The objectives of the reconnaissance were:

- To carry out a preliminary assessment of logistical requirements for the survey phase, and to identify potential logistical problems.
- To determine the extent of the area to be surveyed.
- To determine the principal habitats and species within the survey area.
- To carry out a brief preliminary assessment of the principal resource uses and threats within the survey area.
- To meet with appropriate persons (Government, administrators and stake-holders) in Djibouti and the survey area, to inform them of the purpose of our visit and to give them the opportunity to provide input to the MPA project at the earliest stages.

Persons met for Discussions:
Mr Mohammed Ali Moumen, PERSGA Focal Point, Djibouti.
Mr Nasser Djama Abdi, PERSGA/SAP National Programme Co-ordinator, Djibouti.
H.E. Mr. Saleban Omar Oudin, Ministre de l'Habitat, de l'Urbanisation, de l'Environnement et de l'Aménagement du Territoire. Djibouti.
Mr. Abubakr Doualé Waïss, Secretary General, Ministère de l'Habitat, de l'Urbanisation, de l'Environnement et de l'Aménagement du Territoire, Djibouti.
Mr Omar Habib, Environment Programme Officer, UNDP Djibouti.
Mrs Afaf Abu-Hasabo, Coordinateur Résident des Activités Opérationelles du Système des Nations Unies et Représentant Résident du PNUD (UNDP). Djibouti.
Mr Christophe Farah, Director, Djibouti News Agency.
Mr Bruno Pardigon, General Manager, Dolphin Excursions (Dive tourism operators), Djibouti.
Mr Hamdi Chaher, Dolphin Excursions (Dive tourism operators), Djibouti.
Mr Alex Hill & Ms Alice Hill, Dive tourism operators and PADI diving instructors affiliated to Dolphin Excursions.

Activities

- *27th October, Travel from Khartoum to Djibouti*. The MPA Lead Specialist (MY) and the consultant (JK) travelled from Khartoum to Djibouti, where they met with the Djibouti NPC, Nasser Djama Abdi (NDA).

- *28th October, Djibouti, and travel to the survey area at the Sept Frères*. Meetings in Djibouti included: Mr Mohammed Ali Moumen (PERSGA Djibouti Focal Point), H. E. Mr Saleban Omar Oudin (Ministre de l'Habitat, de l'Urbanisation, de l'Environnement et de l'Aménagement du Territoire, Djibouti) and Mr Abubakr Doualé Waïss (Secretary General, Ministère de l'Habitat, de l'Urbanisation, de l'Environnement et de l'Aménagement du Territoire, Djibouti). H.E. the Minister raised the subject of a trans-boundary MPA in the Sept Freres area as a way to address important trans-boundary issues. Such an MPA would include Yemeni waters and coastline, so creating a 'Bab-al-Mandab Marine Protected Area'. In the afternoon met with Mr Hamdi Chaher, and Alex and Alice Hill of Dolphin Excursions. MY, JK and NDA travelled with them to Isles Sept Frères by boat.

- *29th October, Grand Isle, Isles des Sept Frères*. Discussions were held with the tour operators from Dolphin excursions, with diving instructors and with divers about the survey area, the proposed MPA, and their observations and concerns about the area. Visits were made to two bays on the island, one of which includes a possibly important turtle-nesting beach. General observations were made of the island, including nesting of birds, use of the island by non-Djiboutian nationals for shark fishing, and other evidence of human utilisation of the island. This largely consists of litter and solid wastes. The French military based in Djibouti city appear to visit the island regularly, largely for recreational purposes, and a military helicopter was seen landing on the island.

- *30th October, Isle de Sud, Tolka, Isle Double and Ras Siyyan*. Visits were made to three further islands in the Sept Frères group, and to Ras Siyyan. Rapid snorkel assessments were carried out at two of the islands (Isle de Sud and Tolka), and on a fringing coral reef at Ras Siyyan. High numbers of Crown of Thorns (CoT) were observed at Isle de Sud. Although this is not yet serious enough to be a cause of major concern, CoT may become a problem here in the next couple of years. Isle Double, where no snorkel assessment was carried out,

is the location of an important bird colony. The strength of the currents in the Sept Frères area was noted. This will be a very important factor for safety during the survey work. Ras Siyyan Bay was visited, and was found to be the location of very extensive coral communities, large numbers of turtles, and mangroves (*Avicennia marina*) fringing several kilometres of shore. This bay is also the most suitable mainland site in the area for a base-camp during the surveys, and provides the safest anchorage in the area. A channel allowing access through the reef was identified here. Returned to Djibouti in the afternoon, passing close to Khor Angar on the way, but the state of the tide did not allow a landing.

- *31st October, Djibouti*. Meetings were held with Mr Omar Habib, of UNDP Djibouti, and with Mr Christophe Farah of the Djibouti News Agency. Mr Habib raised a number of potentially important points including the possibility of support or co-financing from sources such as the French Development Bank. Mr Habib also pointed out that the main threat in many areas is tourism, including collection of souvenirs (coral, shells, etc) and that most such activity is carried out by the expatriate community in Djibouti, who should be specifically targeted in public awareness programmes. A meeting was held with Mr Bruno Pardigon and Mr Hamdi Chaher to discuss logistical and practical factors affecting survey work in the Sept Frères area.

- *1st November, Djibouti, and travel Djibouti - Jeddah*.
  A debriefing meeting was held with Mr Abubakr Doualé Waïss, Secretary General of the Environment Ministry, during which we outlined the results of our visit to Sept Frères. We then met with Mr Ahmed Osman, Director of the Ministry of Maritime Affairs. Agreement was reached in principle that the Ministry's patrol boat would be available for re-supply during the survey phase. A meeting with Mrs. Afaf Abu-Hasabo, the Resident Representative at UNDP Djibouti, took place in the afternoon. At this meeting the security situation in the survey area was discussed, and the need for comprehensive insurance for all workers visiting the area was emphasised. Mines are still a potential hazard for any travel by land to and from the survey area. It was agreed that, unless and until the area is declared safe, travel to and from the survey area would therefore be by boat. Security clearance from UNDP for the survey phase will have to be gained in advance.

Results

The visit to Djibouti was highly productive, providing background information on:

- A broad range of logistical considerations of re-supply, transport and extent of survey area.
- Important biological features of the survey area.
- The extent and types of resource uses in the area.

General response of stakeholders to the MPA programme.
The response received from all administrators and stakeholders in Djibouti to the concept of the proposed MPA was strongly positive. The tourism operators in the area were particularly enthusiastic.

A proposed environmental NGO for Djibouti.
A new environmental NGO is in the process of being established in Djibouti. This NGO will have both terrestrial and marine components, with the marine component being run by two

British diving instructors based in Djibouti (Alex and Alice Hill). This NGO may prove to be a useful resource for the MPA component of the SAP, and other components such as Public Awareness and Participation. Alex and Alice Hill can be contacted through Dolphin Excursions.

Logistics:

- Given the current security situation due to mines, the survey area is only accessible by sea, a distance of approximately 100 km.
- Security clearance will be needed from UNDP before the survey starts.
- Consumables and supplies such as fuel, oil, food and water are not available in the survey area. All supplies will have to be transported to the survey area from Djibouti, or perhaps from Obok.
- The most suitable site for a base camp for the surveys is inside Ras Siyyan bay, at approximately 12° 28' N, 43° 18' E. This also provides a safe anchorage in most weathers.
- Diving and snorkelling throughout much of the survey area is difficult and challenging due to the strength and unpredictability of currents.
- Access to the mainland shore is limited in many places to times of high tide. For this reason travel by vehicle within the mainland part of the survey area for coastal surveys (beaches, lagoons, reef flats, mangroves, etc) will be preferred, if the security situation allows by the time of the survey.
- The nearest recompression chamber to the survey area is in Jeddah.

Resource uses in the survey area: Resource uses in the survey area are based upon tourism and fisheries. The principal fisheries activity in the area appears to be a shark fishery, carried out by non-Djiboutian nationals, apparently operating without permission. The shark fishery apparently uses both lines and nets (two dead manta rays seen on the sea floor in about 5 metres of water at Isle de Sud were recent examples of by-catch from shark nets). A few Djiboutian fishing boats, probably from Obok, were seen south of the survey area, but it was not possible to find out what activities these boats were involved in.

Although it was not possible to visit the village at Khor Angar, discussions with tourist operators, and environmental and fisheries sources in Djibouti, suggested that the people of this village are pastoralists who do not carry out any fishery activities. There may however be some direct impact upon the mangroves of Khor Angar caused by the activities of these villagers, who may cut mangroves on the landward side as camel fodder.

Tourism in the area is currently restricted to occasional visits from live-aboard dive boats from Djibouti, and camping trips to Grand Isle or Tolka. There is currently no infrastructure or facilities for land-based tourism inside the survey area, although there is an abandoned tourist village at Ras Siyyan, which has not been used for several years.

Biology

The observations made during the visit to Isles des Sept Frères and Ras Siyyan supported those made during previous visits by other workers (PERSGA 1998, Obura & Djama 2000) that the marine and coastal habitats of the area are currently in a very good condition and are varied, diverse, and highly deserving of protection within a Marine Protected Areas scheme.

At all sites where in-water assessments were made, the benthic community was dominated by hard corals, generally healthy and often with high levels of cover of living coral. Coral communities fringe most of the shores of the area, both at the islands and the mainland. At

some sites such as inside Ras Siyyan bay, and along the mainland coast south of Ras Siyyan, these corals form extensive coral reefs. The fish communities associated with the coral communities of the area are diverse, and the fishes abundant. The biogeographic nature of the fish assemblages is globally unique, being found only in the area of the Bab-al-Mandab. Isles des Sept Frères and the Ras Siyyan area provides an exceptional opportunity and location at which to manage these unique communities for sustainable use and long-term conservation.

Coral Bleaching. The corals of the Sept Frères area appeared to have escaped recent bleaching events almost unscathed, although some limited coral mortality, which might be attributable to the bleaching event of 1998, was observed at Grand Isle. This mortality was so limited in extent as to be relatively trivial.

Crown of Thorns starfish. Although work carried out in the area in the past three years recorded no evidence of high numbers of CoT, high numbers were observed at Isle de Sud. Although this is not yet serious enough to be a cause of major concern, CoT may become a problem here in the next couple of years.

Important species:

- Turtles apparently nest throughout the area both on the islands and on mainland beaches. The only nesting beach positively identified was that in the bay on the north-eastern side of Grand Isle, at the 'Japanese Gardens' site (12° 28'18"N, 43° 25'51"E).
- Bird nesting is very important on the islands of the area, although main nesting seasons were not determined. At least two pairs of ospreys were nesting on Grand Isle at the time of our visit, and Tropic-birds were also present. Isle Double is a very important bird roosting site for the area.
- Turtles are found around the islands and inside Ras Siyyan bay. Both Green turtles and Hawksbill turtles were observed, although the only site where more than one turtle was seen was among the shallow corals at Ras Siyyan.
- Dolphins (probably Common dolphins and Bottlenose dolphins) and Billfish are often seen in the area. There is a report of a possible sighting of Indo-Pacific humpback dolphins in Ras Siyyan bay.
- Whale sharks are apparently common seasonal visitors to the area.

Recommendations and follow-ups

- *The extent of the survey area*: Areas to be included in the survey include all mainland areas and offshore islands and reefs from north of Ras Siyyan in the north to south of Khor Angar. All of the Sept Frères Islands and reefs are to be included in the survey.
- Surveys should be planned so as to avoid the summer months, particularly from June to September when temperatures are very high and strong winds preclude boat work for much of the time.
- Travel permits / security clearance from UNDP should be arranged well in advance of the surveys.
- Access to the Jeddah recompression chamber in the event of emergency *must* be confirmed, and all necessary precautions taken to ensure that in the unlikely event that it is needed, it will be available. In any event, the remoteness of the recompression facilities means that extreme caution will have to be exercised with all diving.

- The possibility of involving the currently gestating environmental NGO (Alex and Alice Hill: see comments above) in the MPA programme in Djibouti should be seriously considered.
- The possibility of co-funding and/or other forms of support from the French Development Bank should be investigated.
- The lack of development, particularly on any of the islands, is certainly a major factor accounting for the good condition of the area. Any development within the area of the proposed MPA *before* the development of a detailed site-specific management plan may compromise any such plan, and consequently the successful long-term conservation of the area. Any development of any of the islands, no matter how apparently minor, should be discouraged until a management plan for the Marine Protected Area, including guidelines for development activities, is in place. For instance, any efforts to improve access for boats to the camping beaches on Grand Isle will damage or destroy one of the only two true coral reefs seen in the area - a reef that is currently in very good condition. In the absence of a management plan it would also be likely to encourage more frequent visits to the island by both tourists and fishers, and so would increase fishing pressure, littering, spear-fishing and other disturbances.
- A trans-boundary MPA including both Djiboutian and Yemeni waters, as suggested by H. E. Mr Saleban Omar Oudin (Ministre de l'Habitat, de l'Urbanisation, de l'Environnement et de l'Aménagement du Territoire, Djibouti), has been identified as having high potential as a powerful management tool in the area, and should be investigated further.

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

The Strategic Action Programme (SAP) for the Red Sea and Gulf of Aden

Marine Protected Areas Component

Mission report: MPA survey design project (NW Somalia field reconnaissance)

Names and Position:
Mohammed Younis, MPA Lead Specialist
Jeremy Kemp, Consultant, MPA survey design project

Period:
27th March - 5th April 2001

Area:
North - West Somalia (Hargeisa and Zeila)

Date of report:
17th April 2001

Objectives:
To carry out a rapid reconnaissance of the area to be surveyed for the Proposed Marine Protected Area in Zeila District of NW Somalia, at Saad ed Din, Aibat and other islands and reefs. The aim of reconnaissance was:

- To carry out a preliminary assessment of logistical requirements for the survey phase, and to identify potential logistical problems.
- To determine the extent of the area to be surveyed.
- To carry out a preliminary assessment of the principal resource uses and probable threats within the survey area, and in particular to assess any major changes which may have occurred since the production of the habitat and resource use report of IUCN (1997).
- To meet with appropriate persons (administrators and stake-holders) in Hargeisa and the survey area, to inform them of the purpose of our visit and to give them the opportunity to provide input to the MPA project at the earliest stages.

Persons met for Discussions:
Mr Ali Yusuf Ibrahim, PERSGA National Programme Co-ordinator, NW Somalia.
Mr Hussein Haiba Egeh, NW Somalia MPA Working Group member.
Mr. Ahmed Hussein Omane, Minister, Ministry of Fisheries and Coastal Development (Mr Omane is also the PERSGA Focal Point for NW Somalia).
Mr Mohammed Jana Farah, Director General, Ministry of Pastoral Development and Environment, Hargeisa.
Mr Ahmed Deria Elmi, Director, Forestry and Wildlife Department, Ministry of Pastoral Development and Environment, Hargeisa.

Mr Mohammed Ali Hassan, District Commissioner, Zeila District.
Mr Abdullahi Hareed Suldan, Deputy District Commissioner, Zeila District.
Mr Mohammed Hassan Amin, Liaison Officer, Zeila District Commissioners Office.
Mr. Edward Johns, UN Focal Point for Somaliland, UNDP Hargeisa.
Mr. Nick Hilton, Area Programme Co-ordinator, UNDP Somalia, Hargeisa.
Ms Anne Jeupner, External Relations Officer, UNDP Somalia.
Ms Alice Olwalo Litunya, Associate Field Officer, UNHCR Hargeisa.
Mr Mohammed Hussein Yussuf, GIS Manager UNDP/SMAC, Hargeisa.
Mr Mohammed Ibrahim Qalele, Manager, Artisanal Fisheries Centre, Zeila (Ministry of Fisheries).
Mr Bille Hrsi, Deputy Port Manager, Berbera.
Mr Yusuf Abdullahi Noor, COOPI Logistics Officer, Berbera.

Activities

- *26th - 27th March,* Travel of the Lead Specialist from Jeddah to Hargeisa and of the Consultant from the UK to Hargeisa, where they met with the NW Somalia NPC, Ali Yusuf Ibrahim, and the MPA Working Group Member for NW Somalia, Hussein Egeh. An orientation meeting was held on the evening of the 27th.

- *28th March, Hargeisa*. Meetings in Hargeisa included: Mr Ahmed Hussein Omane (Minister for Fisheries and Coastal Development), Mr Mohammed Farah (Director General of the Ministry of Pastoral Development and Environment) and Mr Ahmed Deria Elmi, (Director, Forestry and Wildlife Department, Ministry of Pastoral Development and Environment). Meetings at the UNDP office, Hargeisa, were held with Mr Nick Hilton (Somalia Area Programme Co-ordinator) and Mr Edward Johns (UNDP Focal Point for Somaliland). At the latter meeting, Ms Anne Jeupner, External Relations Officer for UNDP Somalia, was present.

- *29th March, Travel from Hargeisa to Zeila*. The Lead Specialist and the Consultant, accompanied by the PERSGA NPC and Working Group Member, travelled to Zeila by road. The 250 km journey took 13 hours by four wheel drive vehicle, entirely on unpaved roads. On arrival they were met by Mr Mohammed Qalele, Manager of the Zeila Artisanal Fisheries Project. Accommodation was provided in the Fisheries Project buildings.

- *30th March, Aibat and Saad ed Din islands, and Zeila town*. A visit was made to the two principal islands of the proposed MPA (Aibat and Saad ed Din) using a locally hired boat. A turtle nesting beach at Aibat, and the mangrove areas of Saad ed Din were visited. Rapid examinations of several coral and rocky reef sites at both islands, and in shallow waters immediately to the east of Zeila town, were carried out by the Consultant. In the evening a meeting was held with the Zeila District Commissioner, Mr Mohammed Ali Hassan. Also present, in addition to the PERSGA team, were Mr Abdullahi Hareed Suldan (Deputy District Commissioner, Zeila District) and Mr Mohammed Hassan Amin (Liaison Officer, Zeila District Commissioners Office).

- *31st March, Toqoshi / Loyado, and Filfil Reef.* In the morning visits were made to salt works near Toqoshi village, approximately 8 km west of Zeila. Subsequently the NW Somalia / Djibouti border, at Loyado village 28 km west of Zeila, was visited. In the afternoon Filfil Reef was visited, using a locally hired boat. This reef is approximately

16km offshore, and on a good day can be reached in one hour from Zeila. Problems with the boat engine forced an early return to Zeila after only a partial examination of the southern side of the reef.

- *1st April, Travel Zeila - Hargeisa.* A slightly different route from the outward journey was used, to investigate the coast road in the direction of Berbera.

- *2nd April, Hargeisa*. A debriefing meeting was held with Mr Ahmed Hussein Omane, the Minister for Fisheries and Coastal Development. Similar meetings were held with Mr Edward Johns and Mr Nick Hilton, of UNDP Hargeisa. The Lead Specialist departed by air for Berbera in the afternoon.

- *3rd April*. *Hargeisa*: The Lead Specialist met with Mr Yusuf Abdullahi Noor, Logistics Officer for COOPI in Berbera. The Consultant met with Ms Alice Litunya of UNHCR, to find out details of the proposed return of refugees from Djibouti to Zeila District. In the afternoon the Consultant departed from Hargeisa for return to the UK, via Addis Abeba. A meeting was held in Addis with Mr Mohammed Hussein Yusuf, the GIS Manager for UNDP / SMAC in Hargeisa, who was travelling through Addis at the time. The primary aim of this meeting was to clarify the security situation with regard to known minefields in the survey area of Zeila District.
  Berbera: The Lead Specialist met with Mr Yusuf Abdullahi Noor, the Logistics Officer at COOPI (Cooperazione Internatzionale, the organisation which rehabilitated the Artisanal Fisheries Project buildings in Zeila) to discuss logistical considerations for the MPA project. A further discussion about logistical considerations was held with the Deputy Port Manager for Berbera, Mr Bille Hirsi.

- *4th April*. The Lead Specialist met with Mr Bille Hrsi, Deputy Port Manager (Berbera). The Consultant departed Addis Abeba to return to the UK.

- *5th April*. The Lead Specialisat departed Berbera to return to Jeddah.

Results and outcome:

The visit to NW Somalia was highly productive, providing background information on:

- A broad range of logistical considerations of supply, re-supply and transport.
- Important biological features of the survey area, and their current status.
- Centres of population, and the extent and types of resource uses in the area.
- A proposal for the formation of a National Working Group on Legal and Institutional Framework in NW Somalia was presented to the Minister of Fisheries, who agreed and promised to assist.

General response of stakeholders to the MPA programme
The response to the concept of the proposed MPA received from all administrators and stakeholders in Hargeisa and Zeila was strongly positive. It should be noted however that it was not possible to organise a meeting with a wide range of stakeholder representatives in Zeila. Instead a meeting was held with the District Commissioner, Deputy District Commissioner and District Liaison Officer (see above).

Logistics:

- By land the survey area is only accessible via unpaved road from Hargeisa, Berbera or Djibouti.

  1) *Hargeisa - Zeila*. The journey Hargeisa - Zeila is approximately 250 km, and takes 12 hours or more by 4-wheel drive vehicle in the dry season. In the wet seasons the road is likely to be impassable for several days at a time.

  2) *Berbera - Zeila*. The distance Zeila - Berbera is between 180 and 200 km by road. It was not possible in the time available to fully assess road links between Zeila and Berbera first hand, but approximately 80 km of the Zeila - Berbera road, which runs along the coastal plain, was travelled on the return journey to Hargeisa. This road was at least as difficult to travel as the Hargeisa - Zeila road, and accounts from people consulted in Zeila suggested that the duration of the journey Zeila - Berbera is likely to take as long as, or longer then, the journey Zeila - Hargeisa.

  3) *Djibouti - Zeila*. The 28 km journey from Zeila to the Djibouti border at Loyado takes approximately 1 hour. From the border to Djibouti city is approximately a further 12 to 15 km. The time taken for this journey will be considerably shorter if the road is improved. The Port authorities at Berbera have a motor grader which they agreed to send to Zeila to grade the Loyado - Zeila road.
- The possibility of importation of equipment for the MPA project and survey from Djibouti by sea should be fully investigated.
- Access to much of the mainland coast in the survey area is likely to be problematic. Much of the coast is difficult to access by land due to the lack of roads and the presence of minefields, and difficult to access by sea due to the presence of extremely wide intertidal areas.
- Travelling by boat, anywhere within the survey area is accessible within 1.5 hours from Zeila in calm weather. This time is likely to be doubled (or more) during periods of high winds or swells.
- An uncleared minefield is believed to exist in the area between Toqoshi village and the sea. The size of this minefield and other details are currently unknown. This situation should be monitored by the PERSGA NPC, and the MPA Working Group Member. Unless further detailed information is forth-coming this area will be entirely excluded from the surveys.
- *Rains*. There are two rainy seasons in NW Somalia, smaller rains in approximately April / May, and heavier rains in late summer (approximately September / October). In the Zeila district there has been little or no rain for three years (and water is consequently in short supply there). Rains are unlikely to seriously affect fieldwork directly within the survey area, but flooding of watercourses without bridges may seriously hamper land - based travel between the survey area and Hargeisa, Berbera and Djibouti.
- *Winds*. According to local fishermen the area is dominated by strong winds for large parts of the year. These may be strong enough to hamper or stop work from boats at exposed sites such as Filfil and other offshore reef areas. December - January is apparently often dominated by strong winds, and the period February - April is likely to be the best time to carry out surveys.
- *Fuel* is available in the survey area, but in limited amounts, and special arrangements will have to be made to import fuel to Zeila specifically for the survey boats and vehicles. Two-stroke oil, necessary for outboard motors, is not available (local boats use ordinary motor oil, which significantly reduces the efficiency and life span of the engines), and so this will have to be specially imported to the area.

- *Water*. The lack of rains in the Zeila area in the past three years means that water is in short supply in the survey area. Wells supplying water to Zeila are located in the village of Toqoshi, approximately 8 km west of Zeila. Currently the water supply is adequate for the purposes of the survey, but this situation will have to be reassessed closer to the time of the survey, and if necessary arrangements will have to be made to import drinking water from outside the survey area.
- The nearest recompression chamber to the survey area is in Jeddah.

Resource uses in the survey area.

Coastal and Marine resource uses in the survey area appear to be relatively limited at present. They are based largely upon the salt pans at Toqoshi, and to a lesser extent upon fisheries. All or most of the current fisheries activities in the area are carried out by fishers from Djibouti, Toqoshi, Loyado and Yemen rather than from Zeila, and include fisheries for Beche-de-Mer, shark and finfish. The ownership of the Somali / Djiboutian boats used for fisheries is complex, but owners of many of the locally - based boats which fish in the Zeila area are probably Somalis living in Djibouti. These boats fish in both Somali and Djiboutian waters. Finfish are rarely landed in Zeila, generally being exported directly to Djibouti. Many of the small boats based in Zeila are used for the unloading of larger ships, which cannot come inshore to unload directly due to the lack of any loading / unloading facilities (the old jetty at Zeila is in very shalow water [dries at low tide], and is largely collapsed).

Fishing currently occurs throughout the MPA area, including all of the offshore islands and reefs. A number of small fishing camps were observed on both Aibat and Saad ed Din islands. An extremely important fishery occurs at Filfil and Sigaale reefs from May to July each year, when up to 200 boats from Yemen, Djibouti and Somalia congregate to catch kingfish. Accounts from the local fishermen suggested that this may be the location of a spawning aggregation for kingfish. Management of this fishery may be important for sustainability of the kingfish resource over a wide area of the Gulf of Aden, and so further investigation of this should have a very high priority.

Mr Yusuf Abdullahi Noor of COOPI in Berbera believes that the Beche-de-Mer fishery in Zeila District is already over-exploited. This is supported by the almost complete lack of holothurians observed by the Consultant during the reconnaissance, even in areas which appeared to be prime holothurian habitat. Shark fisheries in the area are entirely carried out by Yemenis. There is currently no significant commercial trawl fishery in the area.

The salt industry in the area of Toqoshi village (salt pans) is extremely important for the local economy at the present time. In its present form this industry does not appear to constitute any threat to the integrity of the proposed MPA, but further assessment will need to be carried out, particularly as part of the Socio-economic survey.

Tourism does not currently take place in the area, although there are accounts of illegal visits to the islands for diving and spear - fishing, by members of the expatriate community in Djibouti.

Commercial Fisheries Projects are in the process of being established in the Zeila area. The Artisanal Fisheries Project buildings in Zeila have been rented to a commercial concern (Nasruldin Co) which has installed refrigeration and ice - making equipment. Although no

fishing activity is yet taking place there directly as a result of this facility, it is expected to start in the next few months. This may coincide with the return of refugees to the region (see below), and is in any case likely to stimulate fisheries activities. While in Berbera the Lead Specialist was told that part of Saad ed Din island itself has also been leased to Nasruldin Co by the District Commissioner. This must be further investigated by the PERSGA NPC and MPA Working Group Member, as a matter of some urgency.

Important habitats and species:

In general there appears to have been little change in the status of the area since the survey of 1997 (IUCN 1997). That report, and its conclusions are still for the most part valid. There are some relatively minor exceptions and additions, outlined below.

- In contrast to the account of the earlier survey (IUCN 1997), no reports of dugongs were encountered during the recent reconnaissance, and those fishermen questioned claimed they had not come across them in the area. Seagrasses, which are the principal food source for dugong, appear to be very uncommon in the area.
- The capture and killing of turtles is still an important problem in the area. The very fresh remains (shells, and heads) of at least four recently killed turtles were seen on the beach and in the water around the stone jetty at Zeila town.
- Djiboutian - based boat ownership, Djiboutian landing of Somali - caught fish, and the extensive trade in other marine products between Zeila and Djibouti (IUCN 1997) mean that a significant part of the Socio-economic survey for the MPA will need to, at the very least, liase closely with Djiboutian counterparts, and probably will need to be carried out in Djibouti, in close co-operation with the survey for the Isles des Sept Freres MPA survey.
- The islands of the area are very important for birds, with a lrage and diverse assembalge observed during the reconnaissance, including plovers, two species of booby, Goliath heron and ospreys, amongst many others. The islands are important nesting areas, although main nesting seasons were not determined. Birds' eggs are sometimes collected. The extensive areas of intertidal mudflats along the mainland coast appear to be important bird feeding sites.
- The mangroves of Saad ed Din island are still in exceptionally good condition, and appear to have suffered no significant impacts since the 1997 survey. These are still almost certainly the most important mangroves in the entire Gulf of Aden. Collection of firewood from these mangroves was observed, but only of dead wood, with no cutting of living trees. This does however highlight the potential for damage to these mangroves by wood cutting when refugees return to the area (see below).
- Corals in the area appear to have escaped the impact of the global coral bleaching and mortality event of 1998, which severely impacted the northern and eastern Gulf of Aden. There has been some extensive damage inflicted by Crown of Thorns starfish (CoT) in some areas. On the seaward side of the reef around Aibat Island most *Acropora* corals, and all tabular *Acropora*, were dead (these corals were previously an important part of the reef community). They appear to have suffered this mortality within the last two years. The CoT outbreak appears to have ended for the time being, with only a single starfish being seen by the Consultant.
- Freshly collected corals observed next to a fishing camp on the beach at Aibat indicate that collection of corals does take place here (this was speculated upon, but not confirmed, by the 1997 IUCN survey). Since there are currently no outlets for corals in NW Somalia this coral is almost certainly destined for Djibouti. A number of large *Tridacna* (giant clam)

shells were seen on the beach in the same place. This fishery is definitely a new development since 1997.

Recommendations and follow-up

1. The planned return of refugees from Djibouti to Zeila District.

Approximately 20,000 refugees, currently in Djibouti, are expected to return to Zeila District within the next few months. To start preparations for this, a reconnaissance visit to assess infrastructure (water supplies, health, education) was made to Zeila by UNHCR in November 2000. Alice Litunya, (Field Officer for UNHCR based in Hargeisa) indicated to the consultant that although these 20,000 refugees are to return to the District as a whole, a large proportion are likely to resettle in or near to Zeila town itself. Zeila currently has a population of approximately 2,000, emphasising the scale of the possible resettlement, and potential for resultant environmental impacts. Development of local fisheries is seen as a way to provide these returnees with an income. Both local fisheries resources, and the mangroves on Saad ed Din, are likely to be particularly threatened by this influx of people.

It is strongly recommended *that, in the case of the proposed Saad ed Din MPA in the Zeila area, implementation of on-the-ground management is NOT delayed until after the surveys, but is instead initiated* ***as soon as is practically possible****. The IUCN report of 1997 includes sufficient type and quality of information to form the basis for this level of emergency planning and management. The large numbers of people returning to the district, their need for wood for construction and firewood, and their likely dependence upon marine resources, means that waiting until after the MPA surveys to implement Protected Area management is not a realistic option in this case.*

The possibility of implementing public awareness activities in the Zeila area in the near future was discussed by the Lead Specialist, the Consultant, the NPC and the MPA Working Group Member. It was agreed that this should be followed up by the NPC and Working Group member, in consultation with the Lead Specialist. This activity is all the more important, and urgent, given the refugee situation described above, and could form the basis for developing initial contacts and consultations for early implementation of management measures.

2. Fishing activity carried out by non - nationals in the Zeila area, and the need for investigation of seasonal the Kingfish fishery in the Filfil / Sigaale reef area.

Non - Somali fishers apparently work throughout the entire area of Zeila - Saad ed Din - Filfil throughout the year. This is particularly important during the period May - July, when up to 300 fishing boats from Somalia, Djibouti and especially Yemen assemble to exploit the kingfish aggregation of Filffil and Sigaale reefs. It is strogly recommended that this fishery is fully investigated, in order to assess the nature of the aggregation (is it a spawning aggregation?), and management needs of the fishery.

3. Further recommendations and follow-up.

- *The extent of the survey area*: Areas to be included in the survey include all islands and reefs between Turultaat in the west and the Filfil / Sigaale reef complex in the east. Mainland areas will, as far as possible, be accessed from the shore or from boats.
- The Zeila Artisanal Fisheries Project buildings will, if available, provide an excellent base-camp for the survey. This subject was raised in discussions with Mr Mohammed Ibrahim Qalele, Manager of the Fisheries Project, and should be followed up by the NW Somalia NPC and the MPA Working Group member, to obtain agreement in principle as soon as possible.
- Additional survey of terrestrial fanua and flora should be considered. Many birds, including large birds of prey, and large numbers of gazelle, were observed in the coastal plain in the area of Zeila. The possibility of combining marine, coastal and terrestrial conservation initiatives in the area should be investigated.
- Surveys should ideally take place in March / April.
- All permits should be arranged well in advance of the surveys.
- Provision of 2-strike oil should be arranged well in advance, to allow it to be brought in from elsewhere.
- Accessibility to the Jeddah recompression chamber in the event of emergency *must* be confirmed, and all necessary precautions taken to ensure that, in the unlikely event that it is needed, it will be available. In any event, the remoteness of the recompression facilities means that extreme caution will have to be exercised with all diving.

APPENDIX 2

Field trip waypoints

Sudan & Djibouti, October - November 2000

NW Somalia, March - April 2001

Waypoints from the Reconnaissance Phase of the MPA Survey Design Project. October - November 2000.
Georeferencing was carried out using a hand-held GPS unit (*Magellan e-trex*) All locations are given as DD/MM/SS.S. The map datum (reference spheroid) used was the Universal Spheriod WGS84.

1. Sudan

Waypoint name	Lat/long	Description
DNGNEB	21° 06’ 17.3” N 037° 07’ 17.3” E	Dungonab Village: waypoint located in the community oyster farm project compound. This is the landing and processing site for the Beche-de-Mer fishery at this village (which uses SCUBA equpiment).
M-GOL	21° 54’ 20.3” N 037° 09’ 34.8” E	Mohammed Gol village: waypoint located on the southern edge of village.
OYSTER	21° 05’ 19.1” N 037° 07’ 36.0” E	Commercial pearl oyster company compound, just south of Dungonab village.
ACORD	20° 53’ 44.8” N 37° 09’ 08.1” E	ACORD Red Sea Hills project camp, Mohammed Gol village. This would make a good base camp for the survey phase.
SUD-01	21° 15’ 35.7” N 37° 08’ 28.5” E	A site as the seaward side of northern end of Dungonab Bay peninsula. A narrow sandy beach behind a wide (>500m) and deep lagoon behind a very well developed apparently unbrken fringing reef, which appears to be continuous along this whole area of coast. Access to the reef front will have to be by sea. Lots of litter on the shore, but all or most of it appears to have come from the sea. Access to the reef crest, back, lagoon and shore will have to be by road and zodiac.
SUD-02	21° 19’ 59.0” N 37° 01’ 17.1” E	Beach on the southern side of Khor Shanaab.
SUD-03	20° 55’ 56.8” N 37° 08’ 55.1” E	Lagoon north of Dungonab. Almost completely enclosed, very shallow (looks less than one metre) with five or six small *A. marina*. Large quantities of *Halophila* seagrass washed up on the beach.

SUD-04	20° 57’ 11.7” N 37° 08’ 38.7” E	Standard and unremarkable fringing reef flat visited briefly: unable to access reef edge for snorkelling due to low tide, waves and jagged coral. No living coral on ~ 50m wide reef flat, but high cover of diverse small macroalgae.
SUD-05	21° 00’ 38.3” N 37° 06’ 45.8” E	*Trochus* landing site at a beach without any coral reef, at the downwind end of a bay. Three heaps of recently collected (and very smelly) *Trochus*, all very small shells (approx 7cm max size, base to apex).
SUD-06	21° 02’ 16.2” N 37° 05’ 37.6” E	Snorkelled site. Very shallow fringing reef from ~20cm - <2m max depth. Accessible from shore. Turbid site but corals very healthy and diverse, dominated by *Platygyra*, *Porites* and *Acropora*. Dead coral <<5%. Live cover varied from 15% - >50%. Ten minute swim in 2 - 4m visibility. Large *Tridacna* very abundant (never seen so many in such a short swim, anywhere). Fish community good, with abundant and diverse species, large individuals including groupers and sweetlips (31 species positively identified, in short swim in poor visibility).
SUD-07	20° 46’ 54.9” N 37° 10’ 123” E	Large and deep marsa just south of southern mangroves (waypoints S-MGR1 & S-MGR2). Appears to contain extensive fringing reefs in very sheltered locations. Together with the two areas of mangroves this marsa and its reefs should be surveyed, and may mark or be close to the southern edge of any MPA. Possible site for dugong.
S-MGR1	20° 48’ 08.7” N 37° 10’ 03.2” E	First patch of mangroves to the south of Mohammed Gol. Consists of a small patch of large mangroves 50m from silty/mud shore, and a very large number of very small trees over an extensive area of shore and mud to the north, south and shorewards from those. Looks as though this is an area of mangroves in which easily accessible trees were originally cut, and which is now regenerating very extensively.
S-MGR2	20° 45’ 19.3” N 37° 10’ 12.7” E	Second patch of mangroves southwards from Mohammed Gol. Only a couple of km from the first. As with first, there are a few larger trees further from shore, with a much more extensive area of very young trees around them. There is also a slightly separate area of larger trees on the mainland shore.
ARUS	20° 00’ 28.7” N 37° 11’ 19.9” E	Site of an empty and unused tourist village, en route from Port Sudan to Mohammed Gol and Dunganeb area. About 40km north of Port Sudan.
SELAC	20° 27’ 49.4” N 37° 10’ 12.7” E	Site snorkelled on return trip to Port Sudan, although it is outside the area of the proposed survey. This was clearly a very good coral reef until recently (M.Y. last visited it four years ago, when it was apparently healthy) but now is almost entirely dead except for ~ 5% cover of *Platygyra*, *Porites* & *Stylophora*. Possibly badly affected by bleaching in 1998 (which appears to have been the cause) because it is in a sheltered enbayment on southern (downwind) side of a peninsula.

2. Djibouti

Waypoint name	Lat/long	Description
7FR-01	12° 28’ 14.2” N 043° 25’ 43.9” E	Grand Isle: campsite beach, with fringing reef (good condition). No CoTs seen. This site is used by both organised and informal tourist groups. There is some moderately serious but very localised trampling of shallow corals here, and the remains of several large grouper, etc. on the beach from tourist spear-fishing activity. The reef here is very good, but will be rapidly damaged and degraded if use of this camp site increases significantly, or if any on-shore development is carried out. Strenuous efforts were made to dissuade one tourist operator who indicated that he is genuinely eager to use explosives on this reef to improve access to the beach for his boats.
7FR-2	12° 28’ 18.7” N 043° 25’ 51.4” E	Grand Isle: Beach at Japanese Gardens site. Turtle nesting beach with excellent, extensive and very fragile high cover coral communities, with very diverse fish community. One or two CoTs scars seen.
7FR-03	12° 26’ 46.4” N 043° 27’ 05.0” E	Isle de Sud. Non-reefal coral community. Variable but generally high cover (20 - 40%). Dead manta rays here (shark net by-catch). A currently moderate problem with COTs is present at this island, which will need monitoring and thorough assessment during the survey.
7FR-04	12° 27’ 36.4” N 43° 24’ 48.9” E	Tolka. Shallow caves here with rays and sharks. Coral community on rock. Variable cover, but good condition. Only one or two CoTs scars seen. Currents here very strong.
7FR-05	12° 27’ 43.8” N 43° 23’ 13.2” E	Isle Double (Boeing Island). No snorkelling done, but huge # of roosting birds present, of several species.
7FR-6	12° 28’ 40.9” N 43° 18’ 30.3” E	Ras Siyyan Bay. Channel through fringing reef for access to shore on eastern side of bay, close to Ras Siyyan and mangroves. Probable base-camp site.
DJPORT	11° 36’ 02.2” N 43° 08’ 12.9” E	Djibouti Port: Small boat pontoons, refuelling and Club Nautique.

3. NW Somalia

Waypoint name	Lat/long	Description
Zeila	11° 21’ 14.5” N 43° 28’ 12.8” E	Zeila town (Artisanal Fisheries Centre (COOPI). Accommodation during reconnaissance.
Aibat 1	11° 29’ 17.1” N 43° 26’ 47.3” E	Sandy beach at southern point of Aibat Island. Many birds, including Goliath Heron.
Aibat 2	11° 29’ 47.5” N 43° 27’ 08.0” E	Northern end of 1.1 km walk along Aibat beach. One turtle nest, two fishing camps, shark carcasses, collected corals, turtle carcasses en route.
Aibat 3	11° 30’ 44.6” N 43° 27’ 29.3” E	Northern end of Aibat island. Snorkel on patchy coral in turbid water approx 1 - 2 metres in depth.
Filfil 1	11° 23’ 18.2” N 43° 36’ 15.4” E	Rapid look at Reef top at Filfil. NOT a coral reef. In fact a rocky reef or ancient (fossil) coral reef with minimal recent coral growth. This is not a resulto f recent mortailty (at least, not in the past decade or more). Some small areas of healthy coral. Otherwise predominantly algal turf and small macroalgae on flat or nearly flat rocky platforms, with sand patches between. Very reminiscent of parts of Oman.
Filfil 2	11° 23’ 37.5” N 43° 36’ 14.9” E	As Filfil 1
Filfil 3	11° 23’ 30.2” N 43° 36’ 42.9” E	As Filfil 1
Dolphin 1	11° 28’ 25.7” N 43° 27’ 17.9” E	First dolphin sighting (15 - 20 bottlenose).

Dolphin 2	11° 19’ 14.3” N 43° 37’ 27.6” E	Second dolphin sighting (>30 common dolphins)
Hdland	11° 22’ 24.4” N 43° 30’ 23.0” E	Northern point of headland to the north of Zeila town. Useful navigation point.
Rock 1	11° 21’ 35.9” N 43° 31’ 09.4” E	Area of rocks, algae and coral to the East of Zeila town in 2 - 3 m of water. Mostly rocks, with some stressed or dead coral, including some very large *Porites* (>2m diameter). Few fish, but water turbid.
SED 1	11° 25’ 53.6” N 43° 27’ 08.1” E	Mangroves at SW side of Saad ed Din island.
SED 2	11° 25’ 01.6” N 43° 27’ 47.5” E	Mangroves at SE point of Saad ed Din.
Wreck 1	11°.32’.02.0” N 43° 28’ 02.1” E	Wreck just breaking water at the northern edge of Aibat reef. Coral here recently affected by CoTs, which have killed all of the tabular *Acropora* but seem to have spared everything else. Outbreak now apperas to be over (only one CoT seen).
Wreck 2	11° 23’ 10.1” N 43° 30’ 09.2” E	Overturned ship approximately 2 km from Zeila. Useful navigation point.
Well	11° 20’ 56.1” N 43° 24’ 57.1” E	Well near to Toqoshi, where Zeila’s water comes from.
Well 2	11° 26’ 03.4” N 43° 17’ 36.8” E	Well near Djibouti border. Former source of water for Zeila.

Salt	11° 22’ 29.0” N 43° 24’ 30.3” E	Salt ponds to the west of Toqoshi.
Port 1	11° 21’ 31.4” N 43° 28’ 05.5” E	Beach immediately south of zeila, unloading point for ships from Djibouti. Also mooring point for many ‘fishing’ boats.
Port 2	11° 20’ 58.3” N 43° 28’ 55.4” E	Old jetty in Zeila town, very close to COOPI buildings. Very run down and barely usable. Suitable for small boats only, and largely dry at low tide.
Loyado	11° 27’ 25.7” N 43° 15’ 41.1” E	Village at NW Somalia / Djibouti border.
Hargsa	09° 33’ 49.6” N 44° 03’ 27.6” E	Hargeisa.

APPENDIX 3

Summary of criteria for survey site selection
Baseline and Monitoring surveys

Criterion	Baseline surveys	Monitoring surveys
Easy relocation	Not essential.	Essential, although the precision needed will vary for different types of survey [1]
Representativeness	Often not applicable [2].	Important for networks of monitoring sites. What 'representativeness' means in any area or region will usually be decided and defined on the basis of baseline surveys.
Accessibility	Within the constraints of safe practice, an effort should be made to survey the whole range of environmental conditions found within the survey region, including areas which may be too difficult to access regularly and reliably for monitoring programmes (for example, due to distance, or extreme exposure at certain times of year).	An important factor to be taken into account in design of monitoring surveys. Sites should be as accessible as possible, while still achieving the survey requirements of the monitoring programme. Differences in seasonality and exposure should be taken into account, as well as considerations of distance, etc.
Status	Often not applicable [2]	For monitoring programmes it is essential to include a range of sites reflecting the entire range of good, bad and intermediate sites in the area or region [3].

Explanatory Notes:

1. Easy relocation of the site is essential for monitoring sites but is less important for baseline surveys. The precision required for recording of site location will vary even within monitoring surveys. For example, with grab or dredge surveys of soft sediments it may be impossible to provide a location more accurately or precisly than a lat/long from a Global Positioning System (see section 2. 1. iv, *Recording Locations of Survey Sites*). This will usually be adequate for such surveys, but for hard substrate monitoring surveys with transects or quadrats, it may be necessary to physically mark the exact location of the transect or quadrat.

2. It is possible to make some limited *a priori* decisions about the locations of baseline survey site on the basis of assumptions about their likely condition, rather than definite knowledge. For example, some baseline survey sites may be selected because they are expected to be in poor condition due to the known presence of development or pollution (see point 3, below).

Representativeness and condition or status of sites are criteria which cannot usually be applied beyond this level in baseline surveys. This is because defining those terms is part of the aims of those baseline surveys. Which sites are truly 'representative' of an area, and which sites are in good or bad condition, will only become apparent during or after the baseline survey itself. In contrast, both of these criteria are of central importance for the selection of sites for monitoring surveys.

3. Networks of monitoring sites should always include the whole range of good and bad sites. If only good sites are monitored this is likely to bias the results of the monitoring programme: good sites can only get worse!

APPENDIX 4

Preliminary equipment lists

Introduction

The equipment lists presented here are preliminary. Even when finalised they may not be exhaustive. This is for two reasons. Firstly, these lists are primarily intended to provide lists of major items, and items which will need to be purchased and disbursed to the countries in advance of the surveys starting. Secondly, planning for the surveys will be an on-going process from now until (and even during) the implementation phase. Consequently, exhaustive lists of equipment will rapidly become inappropriate and out of date.

Diving equipment

***For each diver*:** Each diver will have one set of dive equipment which they will use throughout the surveys in all four countries. Each diver will be responsible for the care of their own equipment.

1 x	BDC
"	regulator with: - octopus
	- contents gauge
	- compass
"	pair of fins (heel-strap type)
"	mask
"	snorkel
"	wet suit*
"	weight belt (and weights)
"	pair of bootees*
"	whistle attached to BCD
"	dive computer
"	slate for attachment of underwater paper and survey sheets.

* See comments in 'Spares' below, about a range of different sizes for different people.

***For each country*:**

(The equipment is to remain in the respective countries after the survey teams depart).

1 x Portable compressor, *with supply of compressor oil, filters and spares*. N.B. Also requires training of at least two members of the survey team for compressor operation and maintenance (It is suggested that both regional team members be trained). Because the commpressorrs will remian in-country after the surveys, at least one person from each country should be trained in compressor operation and maintenance.

12 x SCUBA tanks (12 L aluminium) per diver (minimum 2 tanks, preferably 3 per survey diver. Minimum total 12 tanks per country).

1 x (If possible) Complete spare set of dive kit (2 spare sets if can budget for it), both as spares in case of equipment failure, and for use of visitors. Definitely require two spare Regulators.

1 x Sea-worthy boat, with outboard engine (s) and comfortable capacity for six dive-kitted people, boat handler, and supplies. Go for basic and reliable, with easy local and regional access to spares and repairs. Would recommend going for Yamaha engines. Avoid unnecessary frills because (1) Frills are more prone to going wrong and (2) when they do go wrong they tend to be more difficult, expensive and time-consuming to fix. Each boat should be fully equipped with anchors, sun-canopy, radio, life-jackets, etc. Extensive discussions about specifications for the main dive boat have already been carried out between MY, JK, FK and others, including dive operators.

1 x Inflatable Zodiac - type boat, large enough for two kitted up divers and a boat - handler, but small enough to be safely and easily deflated, dismantled and carried in or on a 4 x 4 vehicle. A 15 hp engine will be adequate for this boat.

1 x Engine (15 hp) for small inflatables.

2 x Hand-held 2-way radios, in addition to and compatible with the radio on the survey boat.

2 x Hand-held GPS. Two will allow two teams to work separately at the same time.

2 x Surface Marker Buoys (SMBs).

2 x Powerful dive torches.

80 kg Dive weights

Supplies of Spares.

The survey team should be provided with a set of basic spares. These include:

- Spare mask-straps and face masks (including a range of different sizes, for different surveyors).
- Several spare snorkels.
- Spare bootees (including a range of different sizes, for different surveyors).
- Spare weights (not to be transported between countries, but provided from the in-country MPA programme resources) and two or three spare weight - belts.
- Spare fin-straps and strap-clips.
- Sets of basic spares for: regulators, BCDs and compressor (specifically to include spare low- and high-pressure hoses for regulators and BCDs).
- A copious supply of O-rings in various sizes (for tanks, regulators, BCDs).
- A copious supply of of silicone grease (a larger number of small tubes is preferable to a smaller number of large tubes).
- Tool kits for repair and maintenance of boat engines and dive equipment. Dive tool kit specifically to include sets of spanners and allen keys.

Safety and first aid.

- Two or three first aid kits should be provided for each survey. One large and comprehensive kit should be provided for each survey, with one or two smaller kits provided to accompany survey teams who may work separately from the main survey group (for instance, subtidal and intertidal survey teams will on occasion work separately from each other. Each will require a basic first aid kit to be avaliable at all times).
- An oxygen kit for decompression emergencies will be provided for each country.

Scientific. The list of scientific equipment to be used will be drawn up when the methods to be used are finalised. This will include a set of basic equipment such as quadrats, tape-measures, stationery (including prepared standard survey sheets), photographic equipment, collecting equipment (sealable plastic bags, air-tight jars, preservatives, etc), and general equipment such as maps (including GIS output) and marine charts.

Personal. Each member of the survey team will be expected to provide their own basic equipment including bags (for personal kit, dive kit bag, dry-bag, etc.), clothes and wash-kit, and any other personal equipment such as torches.

Camping. Camping equipment will be provided by PERSGA. These surveys will all last from four to six weeks in remote areas. Two of these areas (Bir Ali - Belhaf, and Sept Freres) will be spent camping. Six to eight people will have to be accommodated in tents for weeks at a time. Tents should be spacious enough to accommodate at least two surveyors each, and their equipment, and robust enough to withstand high winds.Larger communal tents will be needed for communal activities such as eating, and for storage and maintenance of equipment, sorting of samples and paperwork, etc.

Provision must be made for cooking, and if possible for refrigeration either with ice in coolboxes or a refrigerator and a small generator. Cooking facilities should include a gas bottle,

stove and attachments, kettle, pots and pans, cooking utensils, plates and crockery, mugs and other assorted items. Mattresses, mosquito nets and sleeping bags should be provided by PERSGA.

Navigation Charts to be purchased prior to the Field Surveys

Survey Region	*Publishing Authority*	*Chart number*
Sept Freres *	Service Hydrographique et Océanographique de la Marine, Paris.	6326 6893
	British Admiralty, London	3661 143 1925
Saad ed Din & Aibat	Service Hydrographique et Océanographique de la Marine, Paris	6894
Dungonab Bay & Magarsam	British Admiralty, London	3722 138
	Service Hydrographique et Océanographique de la Marine, Paris	7112
Bir Ali - Belhaf	British Admiralty, London	6

* Purchase of charts covering the entire Bab al Mandab is recommended, both to provide a broader picture of the important context of this proposed MPA, and because of the possibility that surveys will be conducted at Perim and on the Yemen mainland coast as well.

APPENDIX 5

List of tasks identified
for the MPA survey preparation phase

This list of tasks will need to be continually amended and updated throughout the survey planning and preparation phase.

Key: LS Lead Specialist
NPC National Programme Co-ordinator
SC National Survey Co-ordinator (see Section 3.4.3).

Task #	**Task.**	**Latest date**	Responsible party
1	Identify the consultant to carry out mapping and GIS analysis.	As soon as possible (see Table 2, Section 3.2.3)	LS
2	Acquire satellite imagery for all four proposed MPAs.	As soon as possible (in consultation with the GIS consultant/institution: see Table 2, Section 3.2.3)	GIS specialist, in consultation with LS & Surveys Consultant
3	Identity GIS facilities to be used for mapping and analysis	As soon as possible. (see Table 2, Section 3.2.3)	LS and GIS specialist.
4	Produce of preliminary maps from satellite images	As soon as possible (see Table 2, Section 3.2.3)	GIS specialist
5	Use preliminary GIS output to finalise spatial design of surveys, and to develop detailed survey timetables for all survey areas.	As soon as possible (before October, at the latest)	GIS specialist, Surveys Consultant, LS.
6	Identify and issue contracts to the National MPA Survey Co-ordinators (SCs), to be a central contact and co-ordination point for all in - country arrangements prior to the surveys (These may be the same individuals as the MPA Working Group Members)	Before the end of June 2001	LS, NPC, MPA Working Group Members
7	Formalise role of H & B Component in turtle, bird, etc surveys in MPA ssurvey areas, including the setting of target dates for implementation of surveys of these groups within the proposed MPAs.	Before the end of June 2001	LS
8	Establish an exploratory dialogue re a Trans-boundary MPA at the Bab-al-Mandab. Assess relevance for the MPA survey programme, and management plans.	Before the end of June 2001	LS (and Surveys Consultant?)
9	Develop and maintain a formal framework for communication and collaboration between the MPA and other components of the SAP for the surveys.	Before the end of June 2001	LS
10	Develop and maintain communication between the MPA component of the SAP, and the Bir Ali - Belhaf ICZM project of GEF.	June 2001 (already initiated)	LS
11	Identify all permits necessary for the surveys (e.g. travel, diving, photography, export of specimens, etc).	Before July 2001	SCs
Task #	**Task.**	**Latest completion date**	Responsible party
12	Select exact survey methods to be utilised, on basis of methods in SSM Manual.	July 2001	LS & Surveys Consultant
13	Identify a regional Assistant Survey Leader for the MPA surveys.	July 2001.	LS & Surveys Consultant
14	Select and engage two regional Marine Biodiverity specialists.	August 2001	LS & Surveys Consultant

15	Select and engage Socio - economist and Fisheries experts.	August 2001	LS & Surveys Consultant
16	Identify candidates for National Survey Teams.	August 2001	NPCs/Working Group Members
17	Identify live-aboard survey boats for Sudan, Djibouti, Somalia. 10 days in each place (14 in Sudan). Need information on (a) availability of boats and (b) necessary permits.	August 2001	LS, NPCs & SCs in consultation with Surveys Consultant
18	Establish rules and guidelines for care, servicing and storage of equipment in each country. Identify an equipment officer in each country. Identify storage space in each country and arrange security.	August 2001	LS & Surveys Consultant
19	Acquire survey boats, diving equipment, camping equipment and other survey equipment for all four countries (Also, see Task 29, below).	August 2001.	LS, in consultation with Survey Consultant
20	Train Regional and National surveyors in Rapid Assessment survey methods.	September 2001.	LS., Surveys Consultant & Rapid Assessment consultant
21	Train Regional and National surveyors in Detailed Assessment survey methods.	September 2001.	LS., Surveys Consultant, survey methods consultants
22	Identify and train the national team members to carry out fisheries surveys.	September 2001	Fisheries specialist
23	Identify and train the national team members to carry out socio-economic surveys.	September 2001	Socio-economic specialist
24	Identify recompression facilities in Jeddah, Yemen. Investigate availability, etc.	September 2001	LS
25	Assess feasibility of aerial survey in Sudan: 1. Costs and availability of aircraft. 2. Permits.	September 2001	Sudan NPC & MPA Working Group Member.
26	Buy navigation charts (3 copies of each). See Table 4, Section 3.2.4		LS
27	Gather information re birds in the survey areas, e.g. from BirdLife International, etc. (Also H & B Component)	September 2001	LS & Surveys Consultant
28	Gather archaeological information and opinions re Bir Ali, prior to the surveys.	September 2001	LS & Yemen NPC / Working Group Mamber.
29	Secure all permits necessary for surveys.	September 2001 (initiate this before August 2001)	NPCs and MPA Working Group Mambers

Task #	Task.	Latest completion date	Responsible party
30	Disburse equipment to countries (Requires SCs to obtain importation permits, etc., facilitate passage through customs, and arrange storage, and transport to the survey areas).	October 2001	LS,SCs
31	Investigate/obtain permission for camping near the archaeological site at Bir Ali, if necessary.	Before February 2002	LS & Yemen NPC / Working Group Mamber.
32	Find out about sources of fuel (petrol and 2-stroke oil) and water at Bir Ali.	Before February 2002	SCs.
33	Establish insurance policies for the survey team members (to include 3rd party liability).	Before start of surveys	LS
34	Identify and establish a base-camp for the survey team in each country (not a camp-site).	Before start of surveys	NPCs and MPA Working Group Mambers, consulting with LS & Surveys Consultant.
35	Find out what is available at Tadjourah and Obock in the way of supplies.	Before December 2001	Djibouti SC.