



PERSGA

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of the Environment of the Red Sea and Gulf of Aden*



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## Survey of Habitats in Djibouti and Plans for their Protection



ALECSO

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

*Survey of Habitats in Djibouti and  
Plans for their Protection*

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**PERSGA - 'The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden' is an intergovernmental organisation dedicated to the conservation of the coastal and marine environments in the region.**

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# *Executive Summary*

## **Introduction**

This document provides a brief and descriptive summary of observations made to investigate the status of reefs and coastal habitats at selected sites in the Republic of Djibouti between 15<sup>th</sup> and 30<sup>th</sup> April 1998. Recommendations for an Environmental Management Plan and visitor management guidelines for key areas are proposed.

The selected sites include: Iles Moucha and Ile Maskali, Khor Ambado and Sable Blanc, Djibouti city reefs, Iles des Sept Frères, Collines de Godoria, Khor Angar, and Ras Siyyan.

## **Methods**

Rapid assessment and mapping of indicators of resource status were undertaken on the coast and in the sea using a combination of quadrat sampling and edge surveys. All assessment sites were geo-referenced for full GIS compatibility. The method used can be repeated in order to produce a robust and detailed dataset that will give valuable information on changes in the status of natural resources.

The Pressure-State-Response model (PSR) was used to identify sampling strategies and to develop management guidelines for the study area. A number of indicator species were selected in order to support the PSR model. In view of the potential for tourism development in the country the PSR model is complemented by

the adoption of the Precautionary Principle approach to sustainable development.

## **Field-work Programme**

A total of 181 geo-referenced locations were surveyed, comprised of 66 beach/shoreline quadrats, two beach/shoreline edge samples, 72 reef assessment quadrats, 34 reef assessment edge samples, seven miscellaneous terrestrial samples. Fifty two turbidity measurements were taken by Secchi disc. One hundred and twelve features were assessed in the coral reef edge swims including the living and non-living substrates, selected fish species and selected indicators of human impact.

Information using the selected indicators was collected in the field using a series of checklists designed to meet the requirements of the survey objectives. All data collected during the survey have been installed on a data management system based on keywords. All data were geographically referenced.

## **Preliminary Conclusions**

The following preliminary conclusions can be drawn from the data with some confidence.

### **Coral Reefs**

Almost all coral reefs at sites visited during this study were in average to good condition,

and reef community structure appeared, in general, to be determined by natural environmental factors, both present and historical, rather than by human pressure. However, signs of visitor pressure (for instance, fishing lines and litter) were observed at most sites and these will increase in the future if left unmanaged. Evidence of coral breakage from small anchors or trampling was found at the resorts of Sable Blanc and Khor Ambado, but this pressure is not severe at present levels.

The site known as the 'Japanese Garden' has the highest live coral cover of the sites visited at Iles des Sept Frères and has not been affected negatively by the Crown of Thorns starfish (COT) outbreak reported previously in the region.

Severely degraded reefs with low living hard coral cover were only observed in one small area at Maskali adjacent to the main beach, but the exact cause of this degradation could not be identified.

COT abundance at the sites visited is high enough to cause concern and must be monitored. However, COT abundance in Djibouti is not currently at 'plague' level, and previously infested sites have recovered well. Most COT were observed at Sable Blanc and reefs of the Iles Moucha reserve. COT abundance at other sites visited was negligible.

Long-Spine Urchins (*Diadema*) are not currently a threat to most of the reefs visited. Most *Diadema* were observed in the vicinity of Djibouti City. Their populations require monitoring.

Fish populations at all reef sites were fairly diverse and indicative of a healthy reef environment. Key groups that are targeted by

fishermen were recorded at most sites. For instance, Snappers (*Lutjanidae*) were found at all sites. The presence of key indicator species such as the Humpheaded Wrasse (*Cheilinus undulatus*) suggests that fishing pressure is moderate to low in the areas surveyed. The grouper genus *Plectropomus* and the Bumphead Parrotfish (*Bolbometapon muricatum*) were not recorded; these could be zoogeographical effects.

Direct evidence of fishing activity (lines and sport fishing by tourists) was observed in the Moucha and Maskali reserve area.

Some reefs in the vicinity of Djibouti City Port are in good health despite the high turbidity and discharge from Wadi Ambouli. The highest live coral cover recorded during the entire survey period was, in fact, in the port area of Djibouti City.

All of the degraded and moderately healthy reefs have the potential for further recovery.

## **Mangroves**

Grazing pressure, wood cutting, disease, and litter were noted in most mangrove stands visited on Iles Moucha and Maskali and on the mainland. These pressures need to be reduced. The site under most pressure from camel grazing and wood cutting was at Ras Siyyan. Substantial evidence of wood cutting was also found in the mangrove stands at Khor Angar and Collines de Godoria.

Natural factors (high winds, restricted water flow, insect infestation, possibly disease, and extreme salinities) have killed parts of the Moucha and Maskali mangrove. Similar effects are apparent in Khor Angar and Collines de Godoria. Anthropogenic influences will be more

destructive when the mangrove system is already under this natural stress.

Abundance and distribution of mangrove in Djibouti is probably restricted by the limited habitat available for mangrove settlement. Seedlings and signs of reproductive regeneration were not common, but this could be a seasonal effect.

### **Beaches and Shoreline**

Turtle nesting occurs on Ile Maskali. Fresh tracks and nests were recorded. Litter is common on the beaches of Moucha/Maskali.

### **Environmental Management Plan**

An Environmental Management Plan (EMP) was proposed during a workshop with the relevant in-country representatives. The proposal achieved widespread support and consensus. The plan calls for the establishment of a single authority responsible for the sustainable development of those areas designated to be environmentally sensitive. It was suggested that the authority be known as the Djibouti Biodiversity Protectorates Authority (DBPA). The EMP specifies that the operation of the Authority and the management of the areas should be guided by the Convention on Biological Diversity and should aim to direct part of the wealth generated from the areas into effective environmental conservation management.

Additional environmental conservation is suggested for three areas considered to be under particular threat from the immediate impact of tourism. Specific visitor management guidelines have been developed for these areas, focussing on the environmental pressures and the responses of management to those pressures. These areas are:

- Iles Moucha and Ile Maskali,
- Khor Ambado,
- Reefs of Djibouti City.



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# *Résumé des études de terrain et observations à Djibouti*

## **Introduction**

Ce document nous donne un bref résumé des observations faites par deux consultants internationaux contracté par le PERSGA et quatre cadres djiboutiens pour établir le statut des récifs coralliens et des habitats côtiers et marins dans quelques sites sélectionnés en République de Djibouti.

## **Methode**

L'équipe a utilisé une méthodologie scientifique qui consiste à réaliser des quadrants à l'intérieur desquels la faune marine est échantillonnée. De plus une évaluation de la couverture des récifs coralliens a été faite dans chaque quadrant pour un diagnostic rapide et pour répertorier les indicateurs du statut des ressources biologiques. Les positions en latitude et longitude de tous les sites ont été répertoriés en utilisant le Geographical Positioning System (GPS). Cette méthode si elle est répétée dans le temps avec intensité produira une base de donnée détaillée et robuste. Aussi, ces données peuvent produire des séries valables d'information qui seront utilisés pour suivre les changements du statut des habitats marins au cours du temps. Des détails complémentaires de cette méthode seront présentés dans le rapport final.

## **Programme des Etudes de Terrain**

Le tableau 1 montre le programme détaillée des sites visités durant l'étude sur le terrain. Les habitats clés (mangroves, plages, récifs coralliens) diagnostiquées à chaque site figurent dans celui-ci. Au total, dix jours ont été passés sur le terrain. Le tableau 2 indique le nombre d'études réalisées dans chaque type d'habitat clé.

## **Conclusions Preliminaires**

Les conclusions préliminaires suivantes peuvent être faites à partir des observations avec un certain degré de confiance:

### **Les Récifs coralliens**

Le statut de presque tous les récifs coralliens visités varient entre une condition moyenne à bonne. Le tableau 3 indique le nombre des études des récifs du tombant pour chaque catégorie de coraux vivants. La communauté des espèces vivants dans les récifs apparaissait en général influencée par des facteurs environnementaux actuels et historiques et non par des facteurs liés à la pression humaine. Cependant, il y a des indications d'une pression exercée par les visiteurs (filets et lignes de pêche, poubelle) observées dans la plupart des sites et ceux-ci deviendront importants dans un futur proche s'il y a une absence d'une gestion des habitats marins. Des preuves de coraux endommagés par des ancres de petites tailles et par le passage fréquent des visiteurs ont été trouvés dans les plages de Sable Blanc et Khor

Date	Lien	Ressource Diagnostique
19/04/98	Prés de Djibouti Ville	B
20/04/98	Khor Ambado	CR, B
21/04/98	Ile Maskali	CR, B, M
22/04/98	Iles Moucha	CR, B, M
23/04/98	Iles Moucha	CR, M
24/04/98	Khor Angar, Collines de Godoria	CR, M; CR, M
25/04/98	Les Sept Frères et Ras Siyyan	CR; M
26/04/98	Sable Blanc	CR, B
27/04/98	Iles Moucha	CR
28/04/98	Prés de Djibouti Ville	CR

**Tableau 1: Le Programme de Travail du PERSGA**

**B - Les plages**

**CR - Les récif coralliens**

**M - Les mangroves**

Ressource	Nombre de Sites
Les plages	11
Les récif coralliens	Etudes périphériques: 34 Quadrants: 73
Les mangroves	56

**Tableau 2: Nombre de sites étudiés en République de Djibouti par type d'habitat clé**

Couverture des coraux vivants et durs (en %)	Nombre d'études des coraux périphériques
<10	3
10-19	1
20-29	6
30-39	7
40-49	8
>50	9

**Tableau 3: Nombre d'études des récifs coralliens et leurs pourcentages de couverture dans les différents sites**

Ambado, mais cette pression n'est pas sévère actuellement.

La zone des récifs des îles des Sept Frères appelé localement 'le Jardin Japonais' a le taux le plus élevé de coraux vivants de toutes les îles des Sept Frères. Elle n'a pas été affectée de façon irréversible par l'épidémie de l'étoile de mer prédatrice, *Acanthaster planci* (COT), dont on a fait état dans des rapports précédents concernant Djibouti.

Des coraux sévèrement dégradés ont été observés dans une petite zone à l'île Maskali opposée à la plage principale. Les causes exactes de cette dégradation n'ont pas été identifiées.

L'abondance de COT est élevée à un point tel qu'elle présente un danger pour les coraux, mais elle n'a pas atteint le stade de l'épidémie. La majorité des COT ont été trouvées à Sable Blanc et au parc territorial de Moucha. Dix huit sur trente quatre échantillons pour lesquels COT était recherchée les contenaient. Cinq de ces mêmes échantillons contenaient plus de dix COT.

Les oursins du genre *Diadème* ne sont pas à l'heure actuelle une menace pour la plupart des récifs visités. Le nombre le plus élevé d'oursins ont été trouvés dans les récifs situés aux abords de Djibouti et cela nécessite une surveillance.

Les populations de poissons dans tous les récifs sont d'une diversité modérée et indiquent des récifs en bonne santé. Des groupes cibles de poissons recherchés par les pêcheurs ont été trouvés dans la plupart des sites. Par exemple, les poissons de la famille des Vivaneaux (*Lutjanidae*) sont présents dans tous les sites. La présence d'indicateurs clés tel que le poisson Napoléon (*Cheilinus undulatus*) suggère que l'effort de pêche est d'un niveau bas à modéré

dans les zones visités. Le genre du Mérou *Plectropomus* et celui du poisson Perroquet *Bolbometapon muricatum* n'ont pas été trouvés dans les zones étudiées. Les causes de l'absence de ces deux groupes peuvent être naturels, mais ceci nécessite des études plus détaillées.

Des preuves évidentes d'une pêche (par exemple, lignes de pêche, pêche sportive par les touristes) ont été observés dans la réserve de Maskali et à Moucha.

Certains coraux proches du port de Djibouti sont en bonne santé malgré la turbidité élevée et le flux d'eau douce provenant de l'oued d'Ambouli. Le récif avec le taux le plus élevé de coraux vivants était observé dans cette zone.

## Mangroves

La pression liée au pâturage des dromadaires, la coupe du bois, la maladie, et les déchets ont été notés dans la majorité des mangroves visitées à Moucha, Maskali, et sur la côte nord. Ces pressions doivent être réduites. Le site avec la plus forte pression était celui de Ras Siyyan, et il y avait une intense coupe de bois à Khor Angar et Godoria.

Les facteurs naturels (vents forts, flux d'eau réduit, épidémie d'insectes, maladie, salinité élevée) ont détérioré des parties des mangroves de Moucha et Maskali. Des effets similaires existent à Khor Angar et Godoria. Les influences humaines peuvent être plus destructrices quand les mangroves subissent déjà une pression naturelle.

L'abondance et la distribution des mangroves à Djibouti est probablement tributaire des habitats limités disponibles pour leur prolifération.

Les jeunes plants de mangrove et les signes d'une reproduction étaient négligeables dans tous les sites probablement parce que ce n'est pas la bonne saison mais les fleurs étaient présentes.

## **Plages**

Les lieux de ponte des tortues sont localisés dans l'île de Maskali. Des traces récentes de leur passage ainsi que les sites contenant leurs oeufs ont été observés.

Les déchets sont très abondants dans les îles Moucha et Maskali.

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# *Introduction*

## **General**

The most recent analysis of the current state of the Red Sea and Gulf of Aden was undertaken as part of the Strategic Action Programme (SAP) for the Red Sea and Gulf of Aden (AHMED *ET AL.*, 1997). Co-ordinated in the region by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), the SAP was funded by the Global Environment Facility (GEF) and the governments of countries in the region. The objectives of the SAP were to evaluate current issues and resources in marine and coastal environments and to develop a programme of regional actions designed to address the issues over the next decade. Djibouti is a recent signatory to the PERSGA regional programme and is now committed to meeting these objectives. As part of the work programme for 1997-1998 PERSGA identified the need for surveys of natural coastal and marine habitats at specified locations in Djibouti and the development of visitor and tourist management guidelines for their protection.

The coastline of the Republic of Djibouti extends for approximately 370 km; a third of this faces the narrow straits of the Bab el Mandeb. The remainder of the coastline lies along the Gulf of Tadjoura between Obock in the north and the main port of Djibouti to the south. Coral reefs, mangrove, and seagrass habitats all occur but they have been reported as generally under-developed in comparison with other locations in the Red Sea and Gulf of Aden (UNEP/IUCN/WCMC, 1988).

UNEP/IUCN/WCMC (1988) provides a cursory review of information on the coral reefs of the Republic of Djibouti. There are some early, detailed accounts of the reefs in the region from GRAVIER, (1910a,b,c, 1911) cited in UNEP/IUCN/WCMC (1988). Observations made recently, in association with studies on the fish trade (BARRATT and MEDLEY, 1998, 1990), indicate that reef health is poorest near Djibouti City and best on the northern coast of the Gulf of Tadjoura and into the Bab el Mandeb. The early reports of GRAVIER had described Djiboutian reefs as flourishing, and anthropogenic pressures (UNEP/IUCN, 1988) and Crown of Thorns outbreaks (PICHON, 1990) have since been stipulated as the most likely causes of the significant reduction in the reef quality. The draft PERSGA Strategic Action Programme Document (PERSGA, 1997a) and Country Report for the Republic of Djibouti are the most recent attempts to collate the available information on local coral reef status (PERSGA, 1997b).

Natural factors have historically limited the development of mangroves and seagrass beds along the coast (SHEPPARD *ET AL.*, 1992). Where they do occur, and especially on the mainland, mangroves have been reported as being under intense pressure from a variety of anthropogenic activities as specified in the Country Report for the Republic of Djibouti (PERSGA, 1997b). The alarming and increasing degradation rate of coastal habitats - especially coral reefs - is highlighted in these reports, although no quantitative data are provided. As anticipated, human-induced pressure is reported as at its greatest in the vicinity of the capital city.

## **Background**

The Work Programme approved by the PERSGA Council of Ministers in October 1996 identified the need for a survey of habitats in Djibouti and recommendations for management actions to address current issues affecting the marine and coastal environments and associated resources. To fulfil these objectives a Pressure-State-Response (PSR) approach (see Methods) was adopted to identify strategies and introduce effective management to the study areas.

The scope of work undertaken included:

- an assessment of the status of habitats, range of visitor activities, and impacts of these activities (identification of pressure and assessment of state) at Iles Moucha and Ile Maskali, Khor Ambado and Sable Blanc, the reefs off Djibouti city, Iles des Sept Frères, Collines de Godoria, Khor Angar, and Ras Siyyan;
- the development of specific visitor management guidelines for the conservation and sustainable use of Iles Moucha and Ile Maskali, Khor Ambado and the reefs offshore from Djibouti city (response);
- a one-day workshop to present the study results and draft recommendations for an Environmental Management Plan (EMP).

## **Project Goal**

To strengthen the capacity of the government of Djibouti to undertake sustainable management of resources while conserving coastal and marine biodiversity.

## **Project Strategy**

The fieldwork was carried out between 15<sup>th</sup> and 30<sup>th</sup> April 1998. A recent appraisal of the methods described can be found in the programme report for the Asian Development Bank funded 'Indonesian Marine Resources Evaluation Programme', 1995-1997. A general review of the coastal resources at each site visited during the study is given.

The Environmental Management Plan (EMP) was presented by the Djiboutian counterparts at a Workshop held in the Palais du Peuple, Djibouti City on April 30, 1998. A project proposal, based upon the logical framework model, has been prepared for implementation of the EMP (Appendix 1). The need for significant financial investment into visitor management and conservation of marine resources on the Djiboutian coast cannot be over-emphasised. Specific management guidelines for key areas are presented in the final section.

# Methods

## The Pressure-State-Response Model

### General

This model was developed by the Organisation for Economic Co-operation and Development (OECD) in 1993, and has been further refined by the Environmental Protection Agency (1994), UNEP (SWART *ET AL.*, 1995), and the European Environment Agency (WIERINGA, 1996). The validity of the model in the coastal context has been demonstrated by OLSEN *ET AL.*, (1997). Figure 1 depicts the basic structure of the model. There are three types of indicators distinguished in the model.

The definitions of the indicators, as applied in the present Technical Paper, are as follows:

- **pressure** indicators quantify the stresses in the form of direct pressures, such as fishing, trampling, grazing, diver damage, wood cutting etc. (the human activities and economic sectors which produce the pressures are referred to in the model as **driving forces**);
- **state** indicators describe the environmental conditions of the water, coastline, and reef systems, and the quality and quantity of specific natural resources; and
- **response** indicators describe the actions taken to improve the quality of the environment. Due to the need to enhance administrative capacity and environmental management in Djibouti, the Environmental Management Plan (EMP) presented is focused primarily upon response indicators.

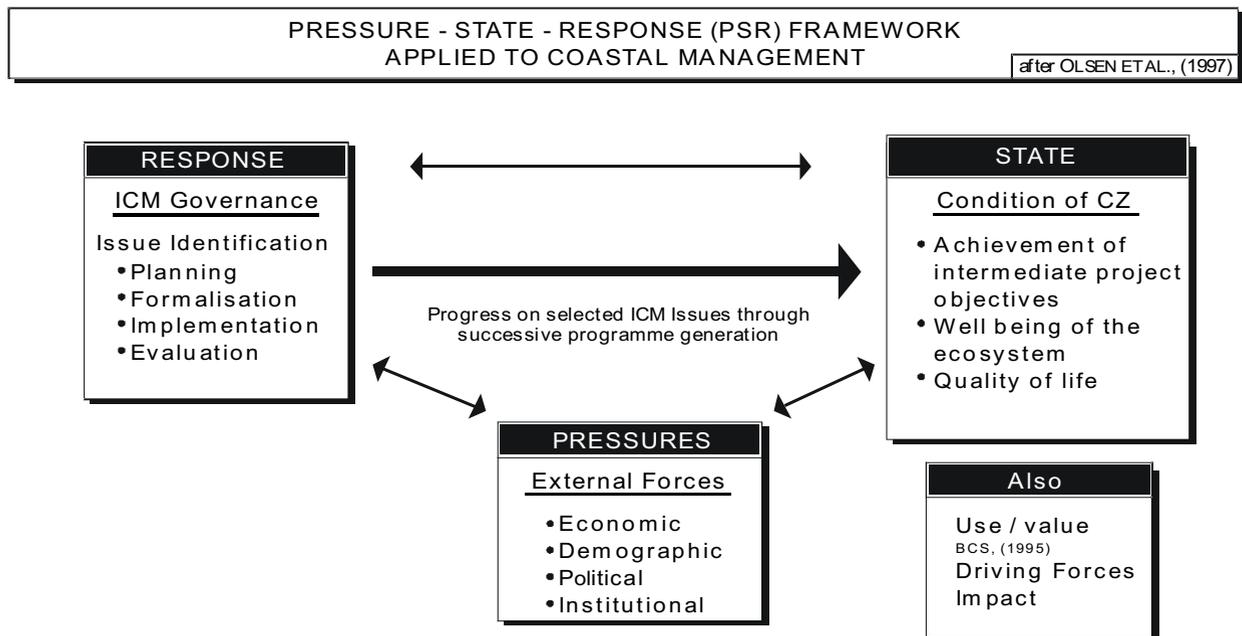


Figure 1: The Pressure-State-Response Model

Environmental indicators selected during the study were incorporated and structured into the framework of the Pressure-State-Response (PSR) model. The fieldwork undertaken relates the framework of the PSR model to the EMP, developed to enhance the management of visitor activities to coastal sites.

The fieldwork component concentrates on *pressure* and *state* assessment. Features of the environment (for instance, species, life forms, and anthropogenic disturbances) were selected to serve as indicators of pressure on resources and their status. The EMP, however, addresses the actions required (*responses*) in order to ensure the sustainable utilisation of environmental resources in the study region. Capacity building is critical in order to ensure that the PSR model operates in the future (in its capacity to assess pressures, determine state, and provide responses).

### **Justification of Chosen Indicators in the Light of the PSR Model**

The following paragraphs offer a general explanation of the method by which features of the environment were categorised as either 'pressure' or 'state' indicators in order to assess the resources of the field study areas.

#### ***PRESSURE: Groups and Species Indicative of Pressure on the Reef System***

An estimation of the degree of anthropogenic stress that a marine community is under can be obtained by examination of a set of features which are indicative of that pressure. Pressure indicators included evidence of discarded or lost fishing line, nets, and traps. Anchor damage (only noted as present or absent in this study) to corals is a pressure indicator, as is grazing in mangrove stands. In addition, any other solid waste such as discarded rubbish

provides an indication of frequent use or accessibility to the reef system and mangroves.

Fishermen often target certain species, and the abundance of these selected species is a measure of the degree of fishing pressure. Target groups include the snappers (*Lutjanidae*), grunts (*Haemulidae*), wrasse (*Labridae*) and groupers (*Serranidae*). The humpheaded wrasse, *Cheilinus undulatus*, is also a prime food-fish subject to overfishing and included in this survey. The bumphead parrotfish, *Bolbometopon muricatum*, is a large, shy species potentially attaining lengths of up to 130 cm and can occur in groups. The value of noting the abundance of *B. muricatum* as an indicator of fishing pressure is a matter of debate, but the presence of shoals of this fish may indicate low fishing activity (LIESKE and MYERS, 1994), particularly spearfishing (J. KEMP, pers. comm.). It was also selected because of the damage that it can inflict on hermatypic corals which may, in certain circumstances, resemble anchor damage.

Many benthic fauna are subject to fishing and collection pressure. Such benthic fauna include top-shells, sea cucumbers, giant clams and lobsters. Of these, top-shells and lobsters are cryptic and nocturnal respectively. Their value as fisheries resources is high, hence their inclusion in this survey. Additional organisms might be included as indicators of the curio trade<sup>1</sup>.

Larger species such as shark and turtle are included in a survey of this nature as both are under increasing pressure from fishing and because of their importance as tourist attractions. These species have low reproductive capacities so population recoveries following impacts are slow. Turtles are internationally recognised as vulnerable fauna and are known to

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<sup>1</sup> A fairly extensive curio trade is reported in the Djibouti Country Report for the SAP. However, limited evidence was observed other than 'roadside' trade with French nationals on their way to and from the yacht club and recreational beaches.

nest in Djibouti (PERSGA, 1997b). Their inclusion as pressure indicators is justified on these grounds.

### ***STATE: Groups or Species Indicative of the State of the Reef System***

Some species, although not directly or significantly influenced by anthropogenic activity, are believed to provide a general indication of the *state*, or “health”, of a reef system. Many of the indicator species included in the checklists of the present Technical Paper are associated closely with the reef substrate. These include butterflyfish, angelfish and some triggerfish. Of these three examples, butterflyfish are highly territorial and obligate corallivores. They are also important aquarium fish and are highly conspicuous. Angelfish and some triggerfish are also territorial. Monitoring of these species indirectly monitors for subtle or sub-lethal change to the benthic reef community. (For a discussion on the choice of indicator species see AIMS (1997) and DAWSON SHEPHERD *ET AL.*, (1992)).

Of the benthic fauna, anemones are considered indicative of healthy hard coralline communities. In such locations, algal communities would be expected to be limited and water clarity good. Sea urchins are similarly linked to the state of the environment. The density of the long-spined urchin, *Diadema*, has been shown to exhibit a negative relationship with algal turf cover in the Gulf of Aqaba (BENAYAHU and LOYA, 1977a), but the precise relationship between urchin density and algal coverage is not certain (GOREAU, pers. comm.). Urchins are bioeroders and in high numbers can contribute significantly to the destruction of reef substrate. The Crown of Thorns starfish, *Acanthaster planci*, is historically known to have been a problem in some areas of the Red Sea and also in Djibouti (PICHON, 1990). The potential of this creature to cause widespread devastation to a reef system means that abundance measures for this species should be

included. Crown of Thorns starfish and long spine sea urchin (*Diadema*) numbers are considered to be important indicators of reef health and the latter is possibly indicative of human impact, specifically hydrocarbons and faecal indicators. Additionally, slate pencil urchins (*Heterocentrotus mammillatus*) are extremely abundant elsewhere in the Red Sea and their numbers are potentially indicative of the degree of bioerosion taking place in a reef system.

### **The Precautionary Principle**

In light of the many different visitor activities undertaken at the field study sites and in view of the status of the marine environment, the Precautionary Principle has been adopted in support of the Pressure-State-Response model.

The Precautionary Principle is a management strategy that allows for events that may occur in the future and that may be environmentally damaging. In many ways it is a predictive, rather than a responsive approach, which assumes a worst-case scenario even without full scientific justification, and mitigates accordingly. The Precautionary Principle is embodied in the agreements of the Earth Summit and inherent in the environmental strategy for the 21<sup>st</sup> century, ‘Agenda 21’. Therefore, all governments who are signatories to the Convention on Biological Diversity (CBD) have endorsed the Precautionary Principle.

## The Database System

All data collected have been stored in a data management system (DMS). It is fully Geographic Information System (GIS) compatible and provides a framework for storing and building-up an appropriate data set for management purposes.

### Keyword Combinations and the Glossary ID

Keywords are combined into sets; a set of combined keywords includes:

- a keyword defining **the feature** to be assessed (e.g. sand, mud, *Avicennia marina*, halophyte, pH, salinity, giant clams, turbidity, litter, etc..),
- a keyword defining which **sub-sampling method** was utilised (e.g. refractometer, Secchi disk, visual assessment, pH probe, tape measure, etc..),
- a keyword defining which **sub-sub-**

**sampling method** was utilised, thus allowing the environmental scientist to sub-divide and refine the method if necessary,

- a keyword defining what **element** of the feature was examined (e.g. length, width, percentage cover, count, presence or absence, etc..), and
- a keyword defining what **units** of assessment were applied (e.g. degrees Celsius, metres, ppt, pH units, inches, etc..).

Each set of combined keywords is identified by a unique number code, and this is called the Glossary ID (G-ID). For example, the G-ID for *Avicennia marina* that has been visually assessed in terms of its percentage cover is 563. Similarly, the G-ID for *Rhizophora mucronata* that has been visually assessed in terms of its percentage cover is 657. Other G-IDs are presented on the survey checklists (Figures 3, 4 and 5) and are accompanied, for reference purposes only, by the English or scientific name of the feature.

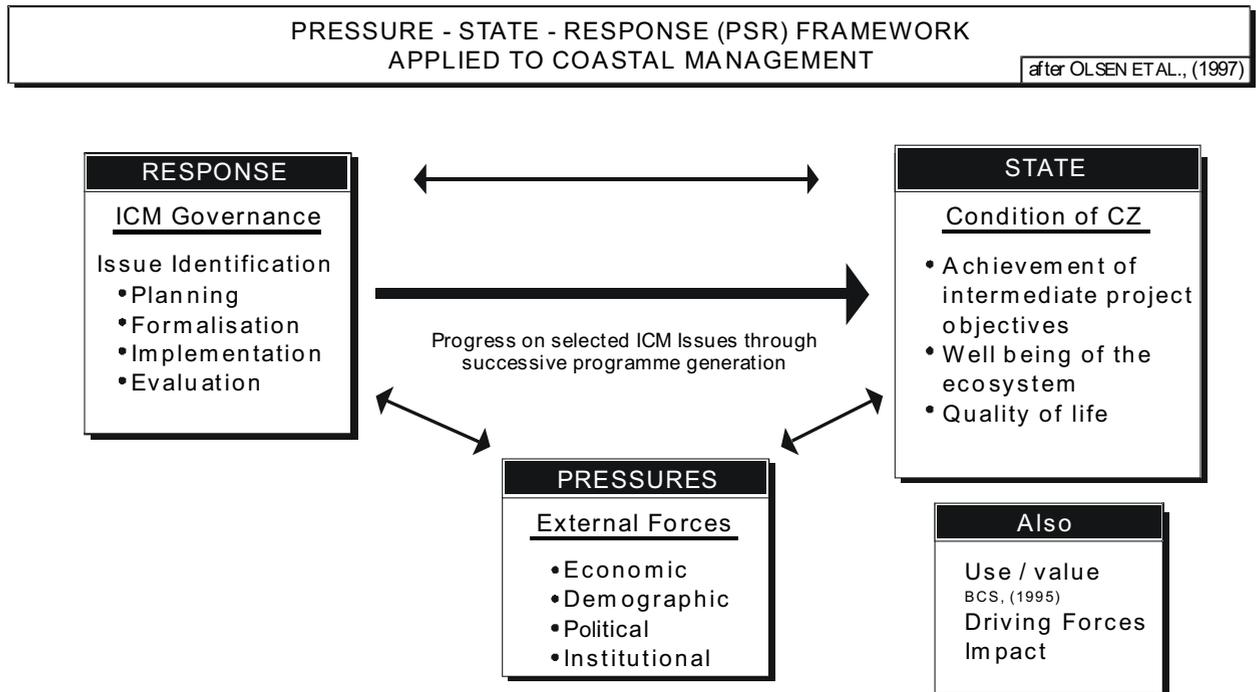


Figure 2: The structure of the Data Management System



## Survey Checklists

A list of keyword combinations makes up a field checklist. This list determines what features of the environment will be assessed and how. There could be many records on a checklist - this makes the survey complex - or there could be very few records on a checklist (for instance, just Crown of Thorns (COT) and *Diadema* during a Manta Tow survey [AIMS, 1997]). However, all checklists are designed to meet the requirements of the survey objectives, and each item added to the checklist should be justified during any survey design process or pilot study.

The length of the checklist and the items and features that are added to it are determined by the nature of the survey, logistical constraints placed on the work, the nature of the environment, and personal knowledge of the study area. Other factors will also influence checklist design, but the main principle is that a well-designed checklist can provide a robust and standardised form to encourage disciplined field-data collection. Items included in a checklist should be environmental indicators of either pressure, state, or response.

Any single checklist can be printed off separately and used in conjunction with a blank universal field survey datasheet (Figure 3) or incorporated into the design of a field survey datasheet. Figures 4, 5, and 6 illustrate the field datasheets utilised for Beach/Shoreline Observations, Benthic or Sessile Features on reef edge swims, and Mobile Features on reef edge swims respectively.

At each sample site the many features on the checklist are worked through systematically (note: there is a one to many relationship between sample site and checklist records), and each feature is assessed in turn according to the overall method being applied.

## Filling in the Field Datasheets

The field datasheets with incorporated checklists are self explanatory. Terms appearing on the sheets that may require clarification are defined in the glossary (Appendix 4).

When recording data on the Beach/Shoreline Field Datasheet, and also the Universal Blank Field Datasheet, it is important to understand how to use the SS and SSS columns in order to record multiple parameters about a particular feature. The following example aims to clarify the use of these columns when recording data. Figure 7 shows a completed datasheet with data based upon the following example:-

Suppose the objective of an observation was to note the percentage cover of *Avicennia marina* and also to give an indication of the average height of the trees. For the purposes of this example, let us assume that *A. marina* covers 40% of the quadrat and that the estimated average height of the trees is 1.5 m. The G-ID for *A. marina* (563) should be recorded in the G-ID column of the field datasheet; the feature name (i.e. *A. marina*) should be recorded in the Feature column; and then the percentage cover (i.e. 40%) should be noted in the Value column. On the next line, the G-ID for height in meters (24) is placed in the G-ID column, the feature name (i.e. height) in the Feature column, and the estimated height (i.e. 1.5 m) in the Value column. In order to link the two observations together, a number (for instance, one) is entered into the SS column for both height and *A. marina*. So, the SS for G-ID 563 is one and the SS for G-ID 24 is one also. This tells us that the height assessment refers to *A. marina* and not to any other feature within the quadrat (for instance, *Rhizophora mucronata*) for which average height was also assessed. The number can be any number, but must be unique to the combination of observations.

<b>SAMPLE ID</b>		<b>NO. OF SHEETS</b>		<b>Shoreline/Beach Intertidal Field Datasheet</b>							
<b>S-METHOD</b>		<b>COLLECTOR</b>		<b>REGION</b>							
				<b>PLACE NAME</b>							
				<b>PLACE SOURCE</b>							
<b>DATE(START)</b>		<b>DATE(FINISH)</b>		<b>Sheet Check</b>		<b>Check date</b>					
<b>START UTC</b>		<b>FINISH UTC</b>		<b>Data Entry</b>		<b>Entry Date</b>					
<b>SAMPLE NOTES</b>											
continue overleaf →											
<b>GEOREFERENCES</b>											
<b>G-Code</b>	<b>GeoPS</b>	<b>S-Code</b>	<b>Spheroid</b>	<b>N/S</b>	<b>E/W</b>	<b>Zone</b>	<b>Latitude/UTM-Northing</b>	<b>Longitude/UTM Easting</b>			
<b>G-ID</b>	<b>Checklist</b>	<b>G-ID</b>	<b>Feature</b>	<b>SS</b>	<b>SSS</b>	<b>Value</b>	<b>G-ID</b>	<b>Feature</b>	<b>SS</b>	<b>SSS</b>	<b>Value</b>
537	Agriculture										
403	Algal turf										
154	Algal assemblage										
563	Avicennia marina										
545	Beach										
617	Bridge										
558	Building										
552	Calcareous										
85	Channel										
634	Culvert										
27	Depth										
39	Direction										
559	Dirt road										
535	Domestic										
534	Fisheries										
573	Fishing Line										
576	Fishing net										
577	Fishing trap										
335	Gravel										
562	Halophyte										
24	Height										
546	Intertidal										
542	Liquid waste										
633	Mud										
572	Other wetland										
49	Photograph										
105	Rock										
33	Salinity										
93	Sand										
121	Seagrass										
90	Silt										
554	Solid jetty										
543	Solid waste										
560	Tarmac road										
318	Temperature										
553	Terrestrial										
35	Turbidity										
579	Vessel										
11	Width										

Figure 4: An example of a Shoreline and Beach Intertidal Field Survey Datasheet

Figure 7 indicates how the same methodology as described in the above paragraph can be applied to indicate the average height of *Rhizophora mucronata* in the same quadrat, the coverage of halophyte, and the direction and frame number of four photographs taken from within the quadrat.

## The Field Survey

### The Scope of the Survey

The Country Report for the Republic of Djibouti and previous experience of the Arabian region were used to develop preliminary checklists, which were then refined as the survey progressed.

### General survey strategy

The study objectives required a rapid, broadly based assessment of the status of a wide variety of environmental features and also an investigation into the many different stress factors acting upon these features. Therefore, a relatively large number of features were assessed at the specific sites illustrated in Map 1. An alternative strategy, mapping the distribution of a more limited number of features over a wider area, was not considered suitable.

### Study locations

Sample sites were assessed at eight distinct locations (Map 1). The following figures display the exact position of the sample sites at each location. All maps can be found in Appendix 2.

- Iles Moucha and Ile Maskali (Map 2)
- Khor Ambado (Map 3)
- Djibouti City (Map 4)

- Sable Blanc (Map 5)
- Collines de Godoria (Map 6)
- Khor Angar (Map 7)
- Iles des Sept Frères (Map 7)
- Ras Siyyan (Map 7)

In total, 181 sample points were geo-referenced.

### Geo-referencing the Sample Sites

In most cases the geo-references of each feature were recorded as Universal Transverse Mercator (UTM) co-ordinates from a hand-held Global Positioning System (GPS). The reference spheroid adopted was the universal spheroid, WGS84, and the GPS systems were initialised using Djibouti City as the positioning datum. The sample site geo-references were collected as Latitude and Longitude. Geo-references were collected and stored in the DMS in decimal format to three decimal places (i.e. DD.MM.MMM where D represents degrees and M represents minutes). See website at <http://www.cellspark.com/UTM.html> for free conversion between UTM and Latitude & Longitude data.

The GPS system used was the Magellan GPS 3000 XL (two individual units were used for back-up). The Magellan model has enhanced capacity for waypoint storage and also numerous features that make it a suitable model for fieldwork. It has the capacity for fixing positions in Latitude & Longitude and UTM. One limiting factor of the GPS-based positioning system is the integral error in the satellite signal (known as Selective Availability) introduced by the US government to maintain a military advantage. The size of the error changes, but the Magellan GPS system can produce an average accuracy of 25 m or better (MAGELLAN SYSTEMS CORPORATION, 1997).

<b>SAMPLE ID</b>		<b>NO. SHEET</b>		<b>Reef (sessile) Datasheet</b>				
<b>S-METHOD</b>				<b>REGION</b>				
<b>COLLECTOR</b>				<b>PLACE NAME</b>				
				<b>PLACE SOURCE</b>				
<b>DATE(START)</b>		<b>DATE(FINISH)</b>		<b>Sheet Check</b>		<b>Check date</b>		
<b>START UTC</b>		<b>FINISH UTC</b>		<b>Data Entry</b>		<b>Entry Date</b>		
<b>SAMPLE NOTES</b>								
continue overleaf →								
<b>GEOREFERENCES</b>								
G-Code	GeoPS	S-Code	Spheroid	N/S	E/W	Zone	Latitude/UTM-Northing	Longitude/UTM Easting
G-ID	Feature	Quadrat 1 : % Cover			G-ID	Feature	Quadrat 2: % Cover	
403	Algal turf				403	Algal turf		
147	Anemones (number)				147	Anemones (number)		
155	Coralline algae				155	Coralline algae		
144	Dead coral				144	Dead coral		
145	Dead coral with algae				145	Dead coral with algae		
335	Gravel				335	Gravel		
123	Living hard coral				123	Living hard coral		
157	Macroalgae				157	Macroalgae		
93	Sand				93	Sand		
159	Sargassum				159	Sargassum		
121	Seagrass				121	Seagrass		
90	Silt				90	Silt		
138	Soft coral				138	Soft coral		
139	Sponges				139	Sponges		
162	Turf algae				162	Turf algae		
49	Photo				49	Photo		
27	Depth (minimum)				27	Depth (minimum)		
27	Depth (maximum)				27	Depth (maximum)		
27	Depth (measurements @)				27	Depth (measurements @)		
33	Salinity				33	Salinity		
318	Temperature				318	Temperature		
34	Turbidity (secchi);35=visual				34	Turbidity (secchi);35=visual		
G-ID	Feature	Number (edge)			G-ID	Feature	% Cover (edge)	
147	Anemones				403	Algal turf		
567	Crown of thorns starfish				155	Coralline algae		
573	Fishing Line				144	Dead coral		
576	Fishing net				145	Dead coral with algae		
577	Fishing trap				335	Gravel		
564	Giant clams				123	Living hard coral		
393	Lobster				157	Macroalgae		
565	Sea cucumber				105	Rock		
330	Sea Urchin (Long spine)				93	Sand		
569	Slate Pencil Urchin				159	Sargassum		
575	Solid waste				121	Seagrass		
566	Top Shell				90	Silt		
					138	Soft coral		
					139	Sponges		
					162	Turf algae		
49	Photo							
27	Depth (minimum)							
27	Depth (maximum)							
34	Turbidity (secchi);35=visual							

Figure 5: An example of a Reef (sessile) Survey Datasheet

To limit the error introduced by this variable, positioning was carried out from known surface features or landmarks (e.g. surface buoys, wrecks, mangrove perimeter, tracks, boulders). For reef assessments the GPS was carried enclosed in two watertight bags (one within the other).

### **Beach/shoreline and Intertidal Survey Procedures**

Ten metre square quadrats were chosen at strategically positioned locations on the coast. Most quadrats were centred on the water's edge. Tidal range is small and, as the time of sampling was noted, the data can be back-calculated to determine the tidal state at the time of sampling.

Geo-references in latitude and longitude were noted for each quadrat. Occasional quadrats were sampled that were not centred on the water's edge, especially when examining the inland edge of mangrove stands. During the study several criteria were used to determine where quadrats were sampled. These criteria included the following:

- Presence of key features or hotspots,
- Indication of impact or pressure on biological resources,
- Proximity of settlement.

Principal checklist features noted in each edge sample and each quadrat sample are listed on the Beach (Intertidal) Survey Datasheet shown in Figure 4. The list of features and G-IDs on the left of the form serve only as a conveniently placed reminder of the features that may be observed within the quadrat. It is also possible to undertake the same work using the universal survey datasheet (Figure 3).

In most shoreline samples photographs were taken in four directions at right angles from the

central point of selected quadrats. The direction of the photograph was determined using a hand-held compass.

### **Sublittoral reef assessment**

In view of the importance of coral reefs in marine-based tourism, most of the work undertaken in the study was conducted on these systems. The protocol for reef assessment is best performed with at least two observers, and is comprised of three steps as follows:

Visual assessment by snorkel of a 10 m by 10 m quadrat centred on the demarcating line between the reef edge and the reef face as shown in Figure 8 (see BEMERT and ORMOND (1981) for definitions of the descriptive terminology and reef zonation). Figure 5 illustrates the field survey datasheet with these features incorporated from the checklist and easily viewable underwater.

Followed by:

A timed 20-minute swim by snorkel along the line of the reef edge, starting at the quadrat, and noting the features within a 10 m wide band transect. Figure 6 illustrates the field survey datasheet with these features incorporated.

Followed by:

An assessment by snorkel of a 10 m by 10 m quadrat at the end of the 20-minute swim also centred on the demarcating line between the reef edge and reef face.

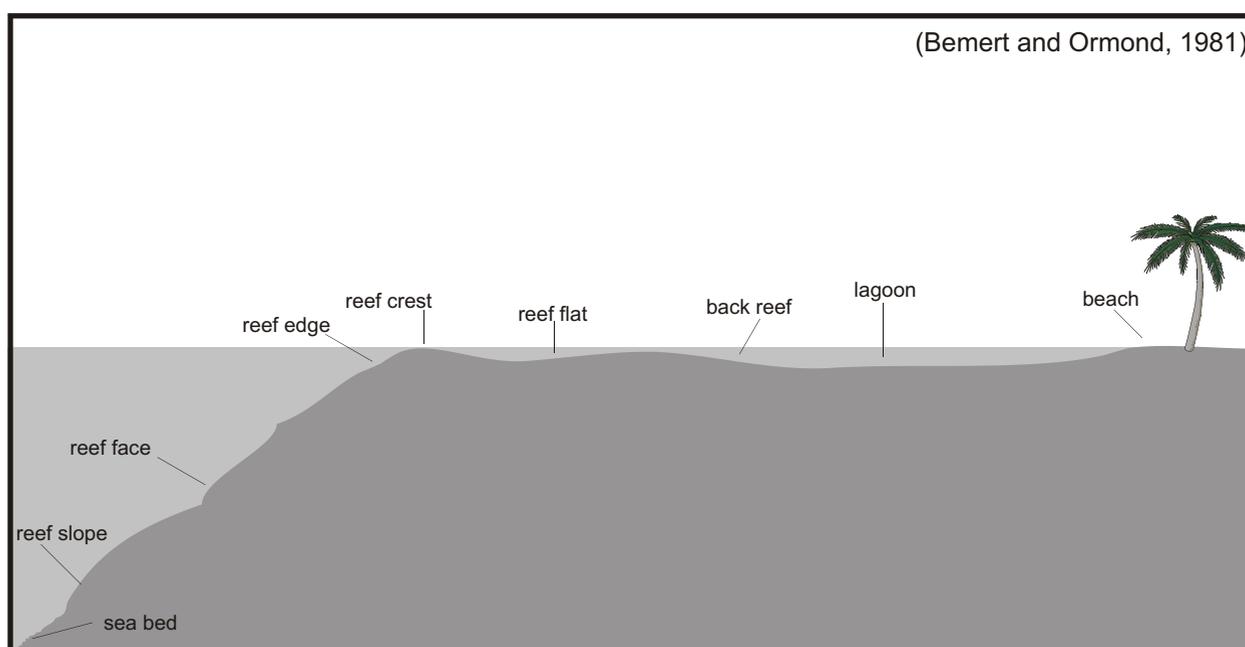
The above sequence generates three samples, one for each step. For example, Sample ID 991 and 993 are quadrat samples and 992 is a 20 minute reef edge swim sample. The geo-references of the start and finish quadrats were taken as the start and finish, respectively, of the 20-minute reef edge swim.

SAMPLE ID		NO. OF SHEETS		Reef (mobile) Survey Datasheet				
S-METHOD				REGION				
COLLECTOR				PLACE NAME				
				PLACE SOURCE				
DATE(START)				DATE(FINISH)				
START UTC				FINISH UTC				
				Sheet Check		Check date		
				Data Entry		Entry Date		
SAMPLE NOTES								
continue overleaf →								
GEOREFERENCES								
G-Code	GeoPS	S-Code	Sphe roid	N/S	E/W	Zone	Latitude/UTM-Northing	Longitude/UTM Easting
-----								
G-ID	Feature	Number/Present	G-ID	Feature	Number/Present	G-ID	Feature	Number/Present
585	Aeth roгаа		589	Pom imperator		610	Lab dimidiatus	
641	Ac bifasciatus		590	Pom maculos		342	Lar quadriline	
598	Balist viridesc		635	Pseudob flavi		632	Macropharyng	
604	Bol muricatum		587	Pyg diacanthus		369	Ostraciidae	
639	Car melanopt		638	Triacnodon ob		599	Oxymon halli	
640	Car wheeleri		582	Variola louti		361	Plectroglyphid	
583	Cp argus					340	Pom sulphure	
395	Cp hemistikto					376	Pseu fridmani	
584	Cp miniata					606	Sc ferrugineus	
381	Cp oligosticta					607	Sc frenatus	
611	Ch auriga					608	Sc niger	
616	Ch austriacus					605	Sc sordidus	
614	Ch fasciatus					628	Th klunzingeri	
615	Ch lineolatus					338	Th lunare	
612	Ch melannotu					594	Zeb veliferum	
380	Ch mesoleuc					595	Zeb xanthuru	
618	Ch paucifasci							
619	Ch semilarvat							
624	Chei undulatus							
385	Ep fasciatus							
388	Ep fuscogutt							
389	Ep summana		341	Abudefduf spp.				
390	Ep tauvina		596	Acanth sohal				
592	Gen caudovitt		366	Amblyglyphido				
620	Gonoc larvatu		602	Amp bicinctus				
570	Green Turtle		586	Anthias squam				
571	Hawksbill turtl		597	Balist undulat.				
621	Hen diphreute		593	Ce. multispin				
622	Hen intermed		603	Cetosc bicolor				
588	Hol xanthotis		623	Ch fasciatus				
643	Lutj argenitm		329	Ch lunulatus				
367	Lutj bohar		370	Chro caerulea				
600	Lutj gibbus		372	Chro dimidiata				
373	Lutjmonostig		382	Ct striatus				
636	Macolor niger		391	Dasc aruanus				
613	Meg trifasciali		625	Epib insidiator				
601	Plect gaterinus		629	Gom caeruleus				
637	Plect pictus		630	Hal hortulanus				
580	Plec maculatu		631	Hal marginatus				
581	Plec truncatus		627	Hem fasciatus				
591	Pom asfur		384	Hem melapter				

Figure 6: An example of a Reef (mobile) Survey Datasheet

<b>SAMPLE ID</b> 9999		<b>NO. OF SHEETS</b> 1		<b>Example Completed Shoreline/ Beach Intertidal Field Datasheet</b>							
<b>S-METHOD</b> 234 10x10 Quadrat		<b>COLLECTOR</b> ARDS & TB									
<b>REGION</b> Djibouti				<b>PLACE NAME</b> Iles Moucha							
<b>DATE(START)</b> 13/05/98				<b>DATE(FINISH)</b> 13/05/98							
<b>START UTC</b> 13:42				<b>FINISH UTC</b> 13:58							
<b>Sheet</b> TB		<b>Check date</b> 26/05/98		<b>Data Entry</b> TB		<b>Entry Date</b> 26/05/98					
<b>SAMPLE NOTES</b>											
There is a nearby sewerage outfall and a pile of litter on the strandline. There are many old car tyres. Approximately 100 Ibis are foraging amongst the mangrove roots about 50 m from the quadrat. There are signs of moderate grazing pressure. No disease or cutting.											
<b>GEOREFERENCES</b>											
<b>G-Code</b>	<b>GeoPS</b>	<b>S-Code</b>	<b>Spheroid</b>	<b>N/S</b>	<b>E/W</b>	<b>Zone</b>	<b>Latitude/UTM-Northing</b>	<b>Longitude/UTM Easting</b>			
1604	Magellan 3000 XL	110	WGS84	N	E		1304.431	04309.132			
<b>G-ID</b>	<b>Checklist</b>	<b>G-ID</b>	<b>Feature</b>	<b>SS</b>	<b>SSS</b>	<b>Value</b>	<b>G-</b>	<b>Feature</b>	<b>SS</b>	<b>SSS</b>	<b>Value</b>
537	Agriculture	563	Avicennia marina	1		40					
403	Algal turf	24	Height	1		1.5					
154	Algal assemblage	657	Rhizophora	2		20					
563	Avicennia marina	24	Height	2		2.0					
545	Beach	562	Halophyte	3		40					
617	Bridge	49	Photograph	4		3					
558	Building	39	Direction	4		0					
552	Calcareous	49	Photograph	5		4					
85	Channel	39	Direction	5		90					
634	Culvert	49	Photograph	6		5					
27	Depth	39	Direction	6		180					
39	Direction	49	Photograph	7		6					
559	Dirt road	39	Direction	7		270					
535	Domestic										
534	Fisheries										
573	Fishing Line										
576	Fishing net										
577	Fishing trap										
335	Gravel										
562	Halophyte										
24	Height										
546	Intertidal										
542	Liquid waste										
633	Mud										
572	Other wetland										
49	Photograph										
105	Rock										
33	Salinity										
93	Sand										
121	Seagrass										
90	Silt										
554	Solid jetty										
543	Solid waste										
560	Tarmac road										
318	Temperature										
553	Terrestrial										
35	Turbidity										
579	Vessel										
11	Width										

Figure 7: An example of a completed Shoreline and Beach Intertidal Field Survey Datasheet



**Figure 8: Characteristics of a typical fringing reef**

The depth range of each sample was noted and incorporated into the database. Fish species composition should be interpreted in light of the depth at which observations were made. Visual assessment never ranged deeper than 10 m because SCUBA assessment was not possible.

#### **Percentage cover assessments**

Certain sessile (benthic) features were assessed for percentage cover for each reef assessment quadrat and also for each reef edge swim. These features were drawn from the list of life-form categories developed for use in surveys in South East Asia (AIMS, 1997). Exceptions were “algal turf” which is a generic term used to cover all forms of non-calcareous algae that are too small to be distinguished by the unaided human eye as individual plants. This contrasts with macroalgae which are large enough to be distinguished as individual plants. ‘Gravel’ matches the term ‘rubble’ used elsewhere (AIMS, 1997).

#### **Numerical Assessments**

Certain sessile (benthic) and anthropogenic features were assessed numerically, and these are incorporated into Figure 5.

#### **Specific Criteria for Selection of Fish Species**

Fish for the checklist were selected using a variety of criteria reflecting those used elsewhere (DAWSON SHEPHERD *ET AL.*, 1992) and reflecting the need to address the PSR model. Nocturnal and cryptic species were not assessed. Extremely rare fish, except those with particular tourism or fisheries significance, were not assessed because encounter could be due to chance rather than to any other factor.

All Red Sea butterflyfish and angelfish (except for the Angelfish, *Centropyge multispinnis*, which was noted as present or absent because it is relatively ubiquitous and cryptic) were counted because of their importance as indicators of reef health. All groupers and the humpheaded wrasse, *Cheilinus undulatus*, were counted, together with selected species of grunt and snapper and one species of Sparid, because of their significance in reef fisheries. The bumphead parrotfish, *Bolbometopon muricatum*, was also counted because of its ability to damage coral in a way that may look like anchor damage and also because of its possible susceptibility to sport-fishing pressure (LIESKE and MYERS, 1994).

The presence or absence of various other reef-dependent fish species was also noted. These species were selected to provide representatives of most of the families of reef-dependent fish that were not counted. Presence or absence was used because of logistical constraints and because it has been determined elsewhere (DAWSON SHEPHERD *ET AL.*, 1992) that a reef fish community may be characterised more efficiently by presence or absence of fish than by relative abundance.

### **Statistical Analysis**

Data collected during the study represent point samples over a wide area. Upon repetition of the survey methodology, it will be possible to decipher trends and patterns over time in the data. However, tests performed on the non-parametric baseline data presented here will not be robust and may be misleading. Given the wide geographical coverage of the study, variation is high. The value of parametric statistics applied to the data of this study is low. Average values have been calculated in some cases, but they must be interpreted cautiously.

### **Workshop and Environmental Management Plan**

The survey and socio-economic data were used to prepare a draft Environmental Management Plan (EMP) that was submitted to the PERSGA focal point in Djibouti on the 26<sup>th</sup> April 1998. After extensive discussions, amendments and translation into French, a public presentation was given at a Workshop on 30<sup>th</sup> April 1998. Amongst the invitees to the presentation were representatives of all the major stakeholders in the region, including Local Government, tourism organisations, the Djiboutian Navy, and local scientific institutions.

### **Project Proposal**

A logical framework for implementation of the EMP was prepared following guidelines specified in the Manual of Project Cycle Management (CEC, 1993) produced by the European Community. This framework is presented in Appendix 1.

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# Results

## Introduction

This section of the report presents the data collected on indicators of pressure and state during the study. The location of each Sample ID (S-ID) is shown in Map 2 to Map 7. No specific data were collected on response indicators, although discussions throughout the field phase were geared toward developing the response measures and indicators addressed in the EMP. The section is structured as follows:

### *Intertidal*

- Beach/Shoreline Indicators: Quadrat Method - Pertinent data on mangroves and litter as assessed using the beach/shoreline quadrat method;

### *Sublittoral*

- Reef Indicators: Secchi Disk Method - measurements undertaken to estimate the visibility of the water column at sample locations, at the time of sampling;
- Reef Indicators: Quadrat Method - Data collected during reef edge quadrat assessments;
- Reef Indicators: Reef Edge Swims - Data on sessile and reef associated pelagic indicators assessed during reef edge swims. Sub-sections indicate whether the data have been assessed as percentage cover, numerically, or as presence or absence.

## Beach/Shoreline Indicators: Quadrat Method

### Mangrove

Of the two species, *Avicennia marina* was most frequently encountered. Forty quadrats contained *A. marina*, 22 contained *Rhizophora mucronata*, and 16 contained both species. Percentage cover of *A. marina* ranged from a minimum of 5% at three sample sites on Iles Moucha to a maximum of 70% at Khor Angar. Percentage cover of *R. mucronata* ranged from a minimum of 5% to a maximum of 50% (observed at eight sites). Percentage cover of both species combined (i.e. total mangrove within quadrats) ranged from 10% (in four samples) to 80% at Collines de Godoria (S-ID 1038).

Ten of the quadrats showed evidence of cutting; three of grazing; 14 of disease; nine of litter; and four quadrats with mangrove showed signs of other impacts including changes in water circulation (Iles Moucha), wind damage (Iles Moucha), insect infestation, and vandalism (graffiti on trees near the Sheraton Beach, Iles Moucha). Where both species of mangrove were found in a sample quadrat, it was observed that disease, where it occurs, appeared to affect both species. General observations appeared to indicate that this was also the case for a suspected insect infestation at sites on Iles Moucha and at Collines de Godoria.

Twenty-three quadrats (57%) showed no evidence of the pressure indicators assessed in this survey, although it was common for impact indicators to be observed close to sample locations.

## **Solid Waste (rubbish and litter) and Liquid Waste**

Solid waste was recorded within 30 beach/shoreline quadrats. The number of individual items recorded ranged from a single item to over 1000 items within one quadrat at Djibouti City (S-IDs 1122 and 1123). Items varied in composition, but the most frequently observed form of litter was plastic. On Ile Maskali, and to a lesser extent on Iles Moucha, dumping grounds were discovered in the mangrove stands in the vicinity of the beach chalets. The beaches of Ile Maskali, Iles Moucha, Khor Ambado, and Sable Blanc were all littered, but to varying degrees.

No beach tar or oil pollution was recorded in the samples. Liquid waste in the form of sewage was recorded at a sample site near Djibouti City (S-ID 1121).

## **Reef Indicators: Secchi Disk Measurements of Visibility**

Sixty-one measurements of visibility were performed independently or in conjunction with a reef quadrat or reef edge assessment. The highest visibility - 35 m - was at Iles des Sept Frères. Turbidity is probably naturally low in this region and sedimentation on coral communities was observed to be very light. Waters around Djibouti City and Khor Ambado were highly turbid during the field period of this survey.

## **Reef Indicators: Reef Edge Quadrat Method**

Seventy-two quadrats (10 m by 10 m) were visually assessed for percentage cover of various life forms and abiota. Figure 9 illustrates the data for sessile indicators assessed in quadrats as compound bar graphs.

Living hard coral was absent from only two, (Ile Maskali S-ID 971 and Iles Moucha S-ID 981), of the 72 quadrats. Where present, percentage cover ranged from 5%, offshore from the main tourism beach on Ile Maskali (S-IDs 963 and 965), to 90% on Hamra Island, Iles des Sept Frères (S-ID 1058). At this latter site the dominant coral was *Acropora*, forming a coral garden. In 26 samples, percentage cover of live hard coral was equal to, or greater than, 50%. Dead coral was observed in only one sample quadrat on Iles Moucha (S-ID 1087). In this quadrat percentage cover was low, with a value of only 1%. However dead coral with a covering of algae (DCA) was observed in 25 quadrats. Values for DCA ranged from a minimum of 4% on Iles Moucha (S-ID 1087) to a maximum of 20%, on Ile Maskali (S-ID 959), Sable Blanc (S-ID 1075) and Iles Moucha (S-ID 1089).

Soft coral was observed in 19 reef quadrat samples. The maximum observed soft coral cover was 40% at Kadda Dabali (S-ID 1049) and Rhounda Dabali (S-ID 1052).

Macroalgae were recorded in 38 of 72 reef assessment quadrats. The percentage cover in a quadrat ranged from 1% at Sable Blanc (S-ID 1068) to 60% at the Pecherie, Djibouti City (S-ID 1117). A cover of 50% was recorded in the vicinity of Iles Moucha at two sites (S-IDs 1003 and 981). No macroalgae were recorded during quadrat assessments performed around the islands of Iles des Sept Frères.

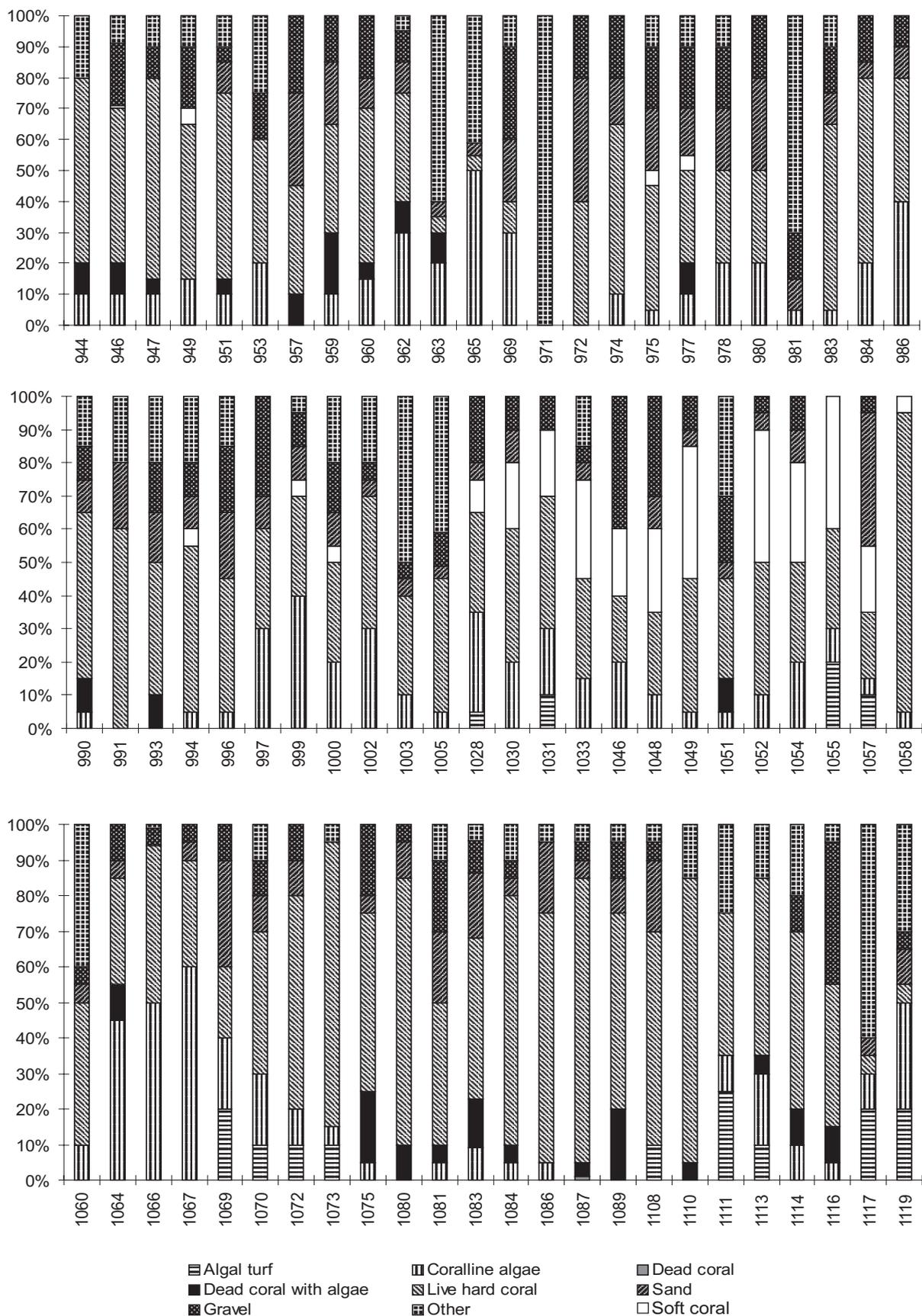


Figure 9: Percentage cover of various lifeforms and abiota for seventy two reef assessment quadrats

Algal turf was observed in 13 of 72 quadrats. Where observed, percentage cover ranged from 5% at Khor Angar (S-ID 1028) to 25% at “Radio Mast,” - Djibouti City (S-ID 1111).

Coralline algae was observed in 62 of 72 quadrats. Values ranged from 5% at 17 sites to a maximum percentage cover of 60% at Sable Blanc (S-ID 1067).

### Reef Indicators: Twenty Minute Reef Edge Assessment Swims

#### Sessile Benthic Fauna: Percentage Substrate Cover Assessments

Results for the assessment of biotic and abiotic benthic substrate features, measured as percentage cover, in 34 reef edge swims are presented in Figure 10.

Percentage cover of living hard coral ranged from 5% to 70% at Pecherie, Djibouti City (S-ID 1109). Where living hard coral was

observed, percentage cover exceeded 20% in all but three samples. Data are shown in Maps 2a to 7a.

Macroalgae were recorded in 24 of the 34 reef edge assessments. Percentage cover ranged from 1% at Sable Blanc (S-ID 1068) to a maximum of 60% at a site lying near the Navigation Buoy off Ile Maskali (S-ID 970). Macroalgae were not recorded during reef edge swims performed at Iles des Sept Frères.

Algal turf was observed in six of the 34 reef edge assessment swims. Percentage cover in those samples ranged from 5% at Khor Angar (S-ID 1029) to 20% at Pecherie, Djibouti City (S-ID 1118).

Coralline algae was observed in 27 of 34 reef edge swims. The highest percentage cover recorded was 48% at Sable Blanc (S-ID 1068). A further 13 reef edge swims had a percentage cover of 20% or more. These edge swims were not concentrated geographically.

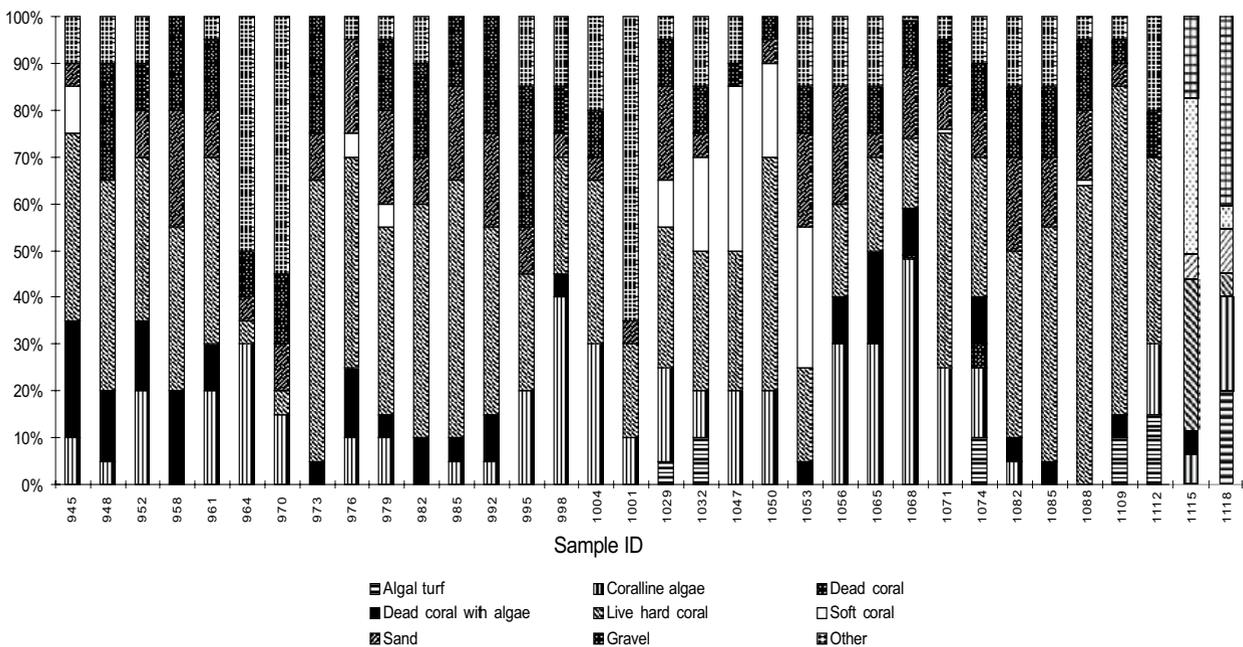
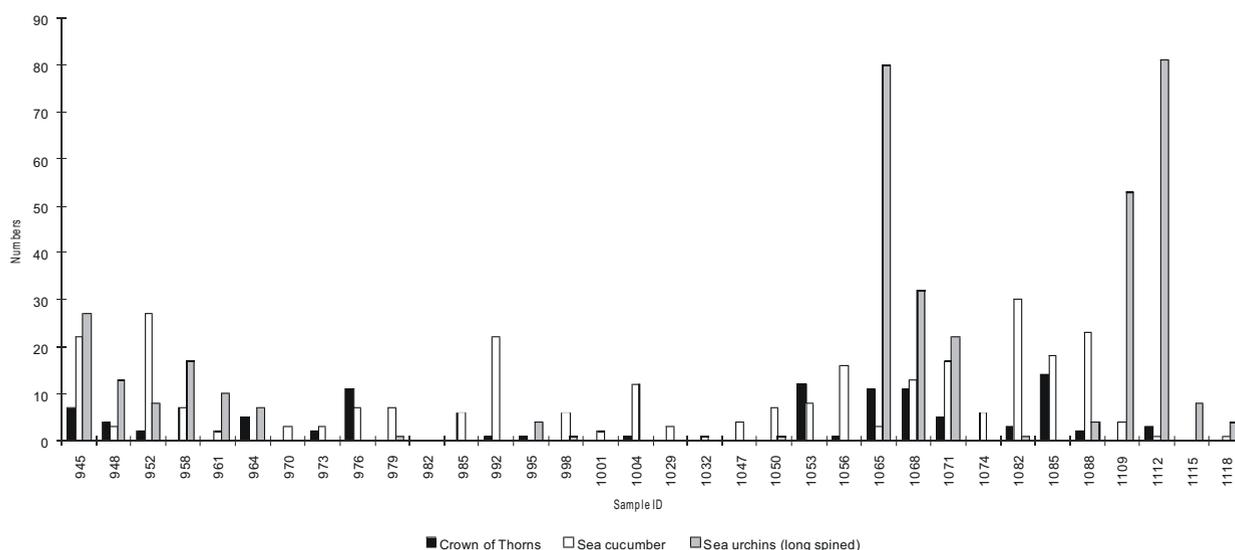


Figure 10: Percentage cover of various life forms and abiota in reef edge swims



**Figure 11: Numbers of selected sessile (benthic) biota counted in reef assessment edge samples**

Dead coral was observed in only one reef edge swim at Sable Blanc (S-ID 1068). Dead coral with algae (DCA) was noted in 21 reef edge swims. Values for DCA percentage cover ranged from 5% to 25% at Khor Ambado (S-ID 945).

Soft coral was observed in 10 samples. Percentage cover ranged from 1% on Iles Moucha (S-ID 1071 and 1088) to 35% at Rhounda Komayto, Iles des Sept Frères (S-ID 1047).

### Sessile Benthic Fauna - Numerical Assessments

The results for counts of selected sessile (benthic) biota in reef edge assessment swims are as follows:

#### *Anemones*

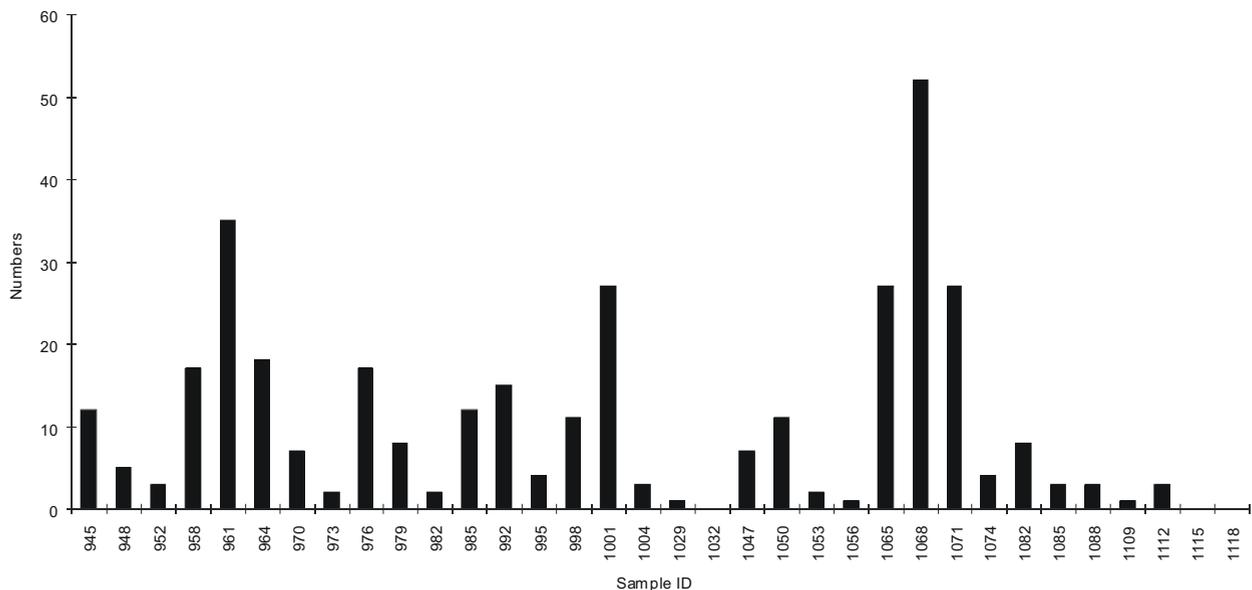
Anemones were observed in 13 samples. The maximum number observed in any one sample was seven at Rhounda Dabali, Iles des Sept Frères (S-ID 1053).

#### *Crown of Thorns starfish*

The number of Crown of Thorns starfish (COT) observed during the duration of the survey was low. Figure 11 illustrates the data for COT counted during reef edge assessment swims. Aggregations of COT were not observed. The maximum number of COT found in any one sample was 14 on Iles Moucha (S-ID 1085) with a count of 12 individuals found at Rhounda Dabali, Iles des Sept Frères (S-ID 1053). Counts of 11 starfish were observed in a further three samples. In total, 96 Crown of Thorns starfish were observed in the 34 reef assessment swims.

#### *Giant clams*

Giant clams were observed in all but three samples (Figure 12). Samples which did not contain giant clams were at Collines de Godoria (S-ID 1032), Djibouti City South (S-ID 115), and at Pecherie, Djibouti City (S-ID 1118). The number of clams observed ranged from one to a maximum of 52 at Sable Blanc (S-ID 1068). Thirteen samples contained more than 10 clams, and a total of 348 clams were observed in the 34 reef edge swims.



**Figure 12: Numbers of giant clams counted in reef assessment samples**

*Lobster*

A total of 15 lobsters were observed in six reef edge swims. The maximum number observed in any one sample was six on Hamra Island, Iles des Sept Frères (S-ID 1056).

*Sea cucumber*

Sea cucumbers were observed in all but three reef edge swims. Of the 34 reef swims, 10 contained 10 or more sea cucumbers. Counts ranged from one to a maximum of 30 on Iles Moucha (S-ID 1082). In total, 284 sea cucumbers were observed during the reef edge assessment swims.

*Sea urchin (long spine)*

The highest recorded count for long spined sea urchin (*Diadema*) was 81 individuals, counted at “Radio Mast”, Djibouti City (S-ID 1112). A further 80 individuals were also recorded during a reef swim at Sable Blanc (S-ID 1065). In total 374 urchins were observed during reef edge assessment swims. No large aggregations of *Diadema* were observed.

*Sea urchin (slate pencil)*

Slate pencil urchins were recorded in only five of 34 samples. The maximum number of 17 slate pencil urchins counted during a reef assessment swim was at the Navigation Beacon on Ile Maskali (S-ID 970). A further 11 were counted at Sable Blanc (S-ID 1071). Nine urchins were distributed between the remaining three samples.

*Top shells*

Top shells were found in only one sample. Two shells were found on Ile Maskali (S-ID 958).

**Reef Associated Fish and Pelagic Fauna - Numerical Assessments**

The numbers, by family, of selected pelagic species observed in Reef Edge Assessment Swims are as follows:

### Turtles

Hawksbill turtles were observed in three samples at Khor Angar (S-ID 1029), Collines de Godoria (S-ID 1032) and at “Radio Mast”, Djibouti City (S-ID 1112). On each occasion only a single animal was sighted.

### Shark

Sharks were observed in six samples. Four sharks were sighted at Hamra Island, Iles des Sept Frères (S-ID 1056), while single individuals were observed in all other samples.

### Angelfish

Total counts (the sum of all species) are shown in Figure 13. Angelfish were observed at all sites. Counts around Iles Moucha ranged from six (S-IDs 1004 and 1109) to 31 (S-ID 982). Twenty-eight samples contained 10 or more angelfish. Of the six species selected for observation, *Genicanthus caudovittatus* was not observed at any site, while *Holocanthus xanthurus* and *Pomacanthus imperator* were observed at only three and five sites respectively. Of these two, *H. xanthurus* was observed as a group of 11 individuals at Rhounda Komayto, Iles des Sept Frères (S-ID 1047). Members of *P. imperator* were only ever observed as solitary individuals.

*Arussetta* (formerly *Pomacanthus*) *asfur* was observed at all but one site at Kadda Dabali, Iles des Sept Frères (S-ID 1050). Counts for this species ranged from one to a maximum count of 20 at Ile Maskali (S-ID 961). *Pomacanthus maculosus* was observed in 31 of 34 samples. Counts ranged from one to 15 at Collines de Godoria (S-ID 1032), but 21 samples contained under 10 individuals. *Pygoplites diacanthus* was observed in 21 samples. Counts ranged from one to 15, with 14 of those samples containing under 10 individuals.

### Butterflyfish

Total counts (the sum of counts for all species observed in this survey) are shown in Figure 14. Of the ten species chosen for observation, two, *Chaetodon auriga* and *C. austriacus*, were not observed in any samples. The most frequently observed species of butterflyfish were *Gonochaetodon larvatus* (a total of 510 individuals) and *Heniochus intermedius* (a total of 45 individuals).

*Chaetodon semilarvatus* was observed in all samples. Counts ranged from one to 65 on Iles Moucha (S-ID 1085). Twenty-two samples contained 10 or more fish, and nine samples contained over 20 individuals.

*Heniochus intermedius* was also observed in all samples. Counts ranged from one at Pecherie, Djibouti City (S-ID 1118), to 48, Hamra Island, Iles des Sept Frères (S-ID 1056). Eighteen samples contained 10 or more individuals, while six samples contained more than 20.

Total butterflyfish counts (i.e. the sum of counts for all species) in Reef Edge Assessments ranged from eight at Sable Blanc (S-ID 1068) and Pecherie, Djibouti City (S-ID 1118), to 110 on Iles Moucha (S-ID 1085). Fifty or more butterflyfish were observed in 15 of 34 samples.

### Triggerfish

Two species of triggerfish were surveyed. Sightings of *Balistapus undulatus* were recorded as present or absent. This species was observed in 23 of 34 samples. Data for *Balistoides viridescens* were recorded as counts. This species was recorded at 12 sites. The maximum number observed in a single sample was six on Hamra Island, Iles des Sept Frères (S-ID 1056) and on Ile Maskali (S-ID 979).

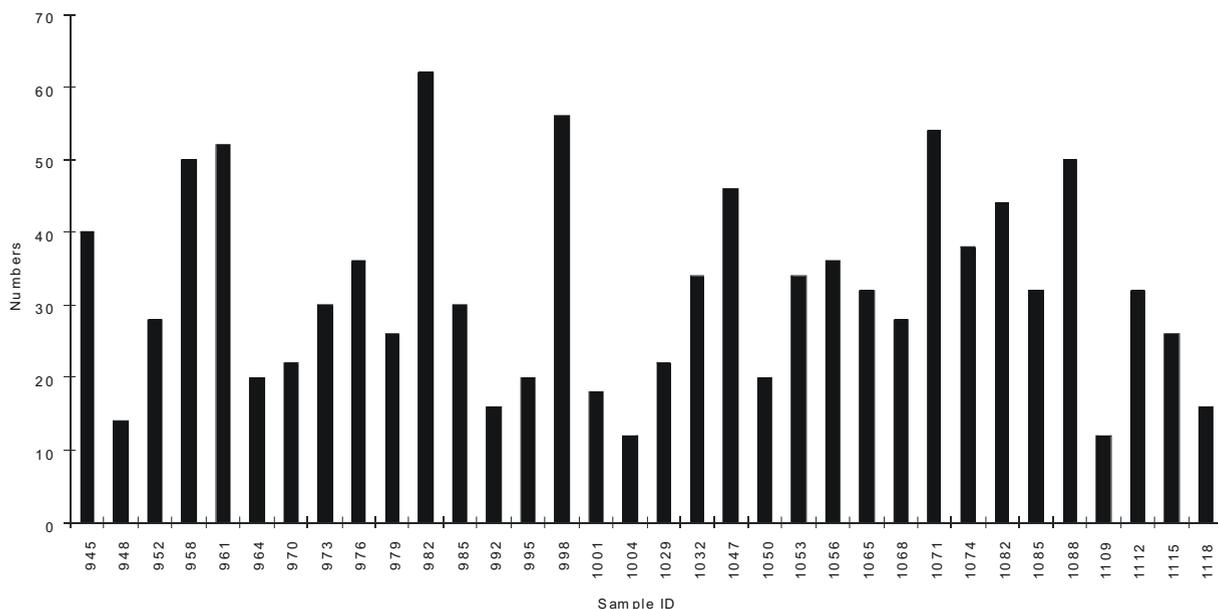


Figure 13: Numbers of angelfish (totals of those selected for observation) in reef edge assessment samples

Parrotfish

The Bumphead parrotfish, *Bolbometopon muricatum* was not observed during any Reef Edge Assessment Swims.

Grouper

Counts were recorded for 10 species of grouper during the present study. Two species of

grouper, *Variola louti* and *Plectropomus truncatus* were not observed in any sample. *Cephalopholis miniata* was only observed in one sample at Khor Ambado (S-ID 945), while a fourth species, *Epinephelus tauvina*, was only observed in two samples at Rhounda Komayto, Iles des Sept Frères (S-ID 1047) and Sable Blanc (S-ID 1071). No species was ubiquitous to all samples. The most frequently observed species, both in terms of the number of samples it occurred in, and total number of individuals

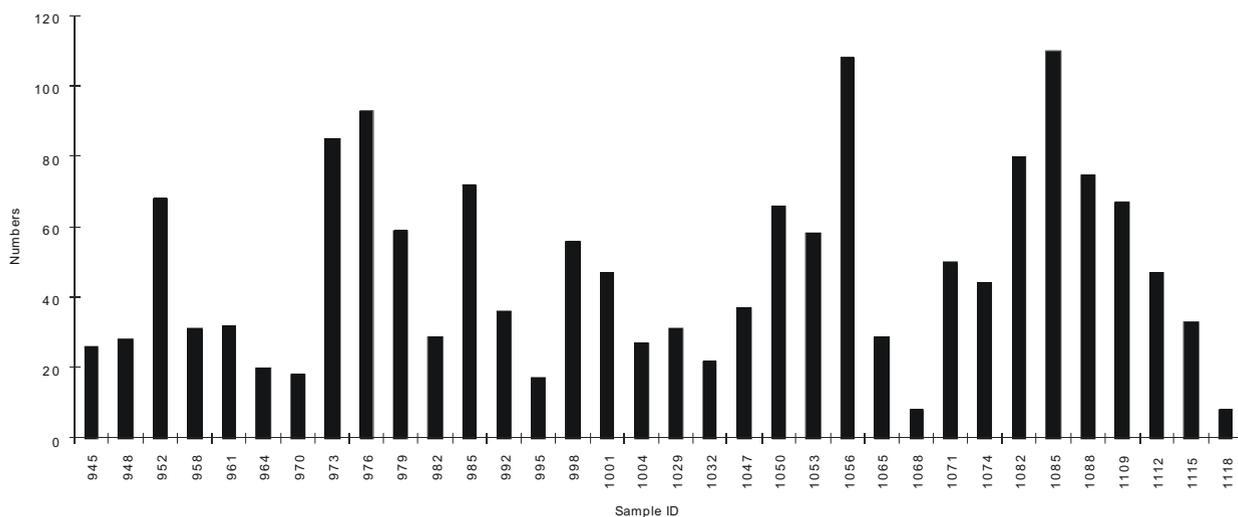
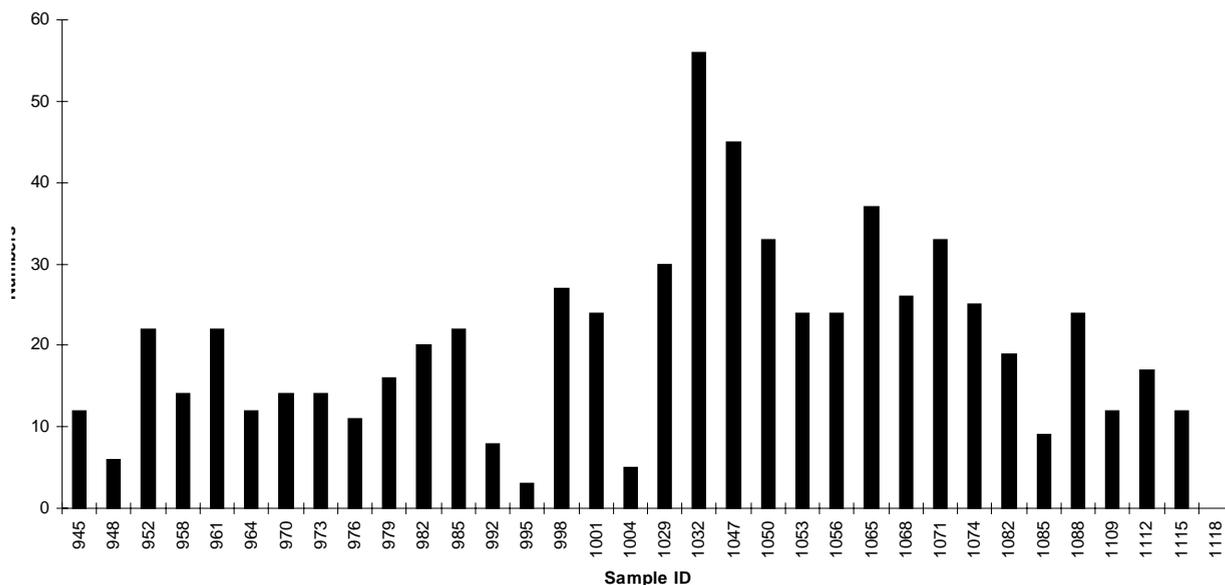


Figure 14: Numbers of butterflyfish (totals of those species selected for observation) in reef edge assessment samples



**Figure 15: Numbers of grouper (totals of those species selected for observation) in reef edge assessment samples**

counted was *C. hemistiktos*. This species was absent from only two samples, on Iles Moucha (S-ID 995) and Pecherie, Djibouti City (S-ID 1118). Counts of *C. hemistiktos* ranged from two to 27, all counts of this grouper were in areas containing living coral. This would suggest that this grouper is territorial and evenly distributed.

The total number of groupers observed (i.e. sum of all counts for grouper species) in each sample is shown in Figure 15. Counts ranged from zero at Pecherie, Djibouti City (S-ID 1118) to a maximum of 56 at Collines de Godoria (S-ID 1032). Twenty-eight samples contained 10 or more groupers, while 17 samples contained 20 or more groupers.

#### Grunt

Grunts were observed in 32 of the 34 Reef Edge Assessment Swims. *Plectorhynchus gaterinus* was observed in 30 samples. Counts for this species ranged from one to a maximum of 317 on Hamra Island, Iles des Sept Frères (S-ID 1056). *P. pictus* was observed in 10 samples. Numbers ranged from one to a

maximum of 30 again at Hamra Island, Iles des Sept Frères (S-ID 1056). In this particular sample a total of 347 grunts were observed (Figure 16).

#### Snapper

Six species of snapper were numerically assessed during this survey. One species, *Lutjanus argentimaculatus*, was not recorded in any sample, while a second species, *Macolor niger*, was only observed in one sample, Ile Maskali (S-ID 979). *L. kasmira* was observed in 20 assessments, and counts ranged from one to a maximum of 260, Ile Maskali (S-ID 979) (Figure 17).

*Lutjanus monostigma* was observed in 29 samples. Counts ranged from one on Iles Moucha (S-ID 992) to a maximum of nearly 2000 at Kadda Dabali, Iles des Sept Frères (S-ID 1050). More than 1000 *L. monostigma* were also observed in a sample on Hamra Island (S-ID 1056). More than 100 individuals were recorded in ten Reef Edge Assessment Swims.

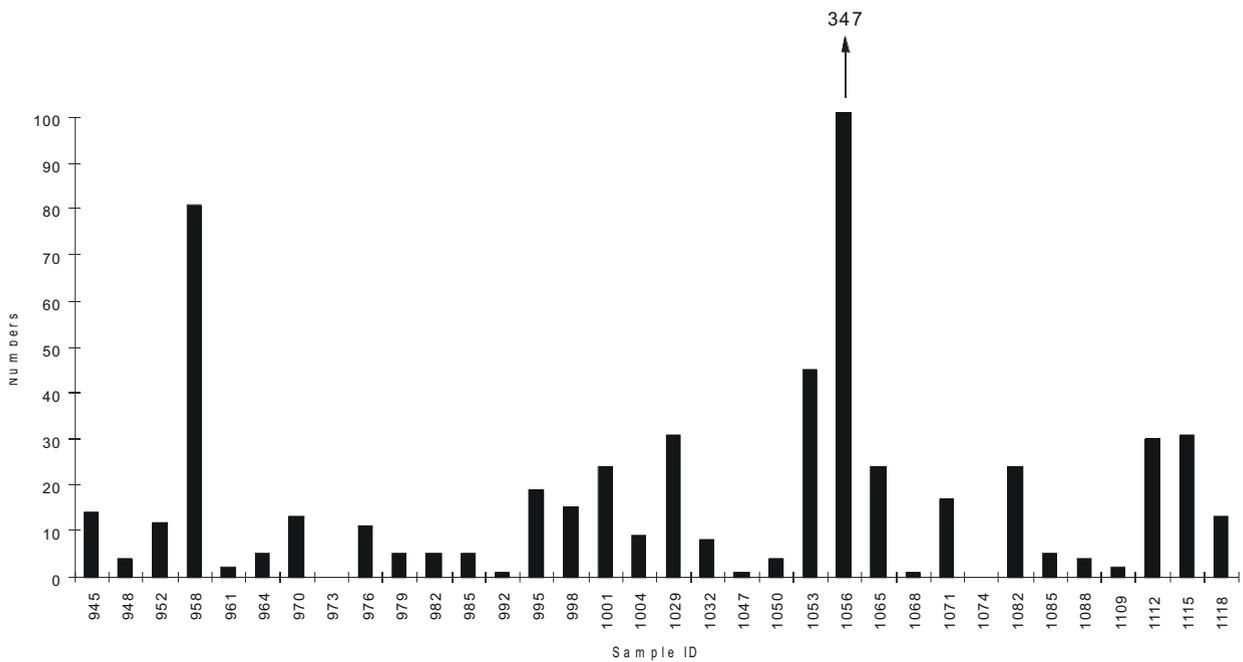


Figure 16: Numbers of grunt in reef edge assessment samples

*Sparid*

One species of sparid, *Acanthopagrus bifasciatus*, was numerically assessed. This species was observed in nine samples. Counts

never exceeded 10 individuals in a single assessment swim. The maximum of 10 was recorded on Iles Moucha (S-ID 1088). The total number of sparids summed for all assessments was only 31.

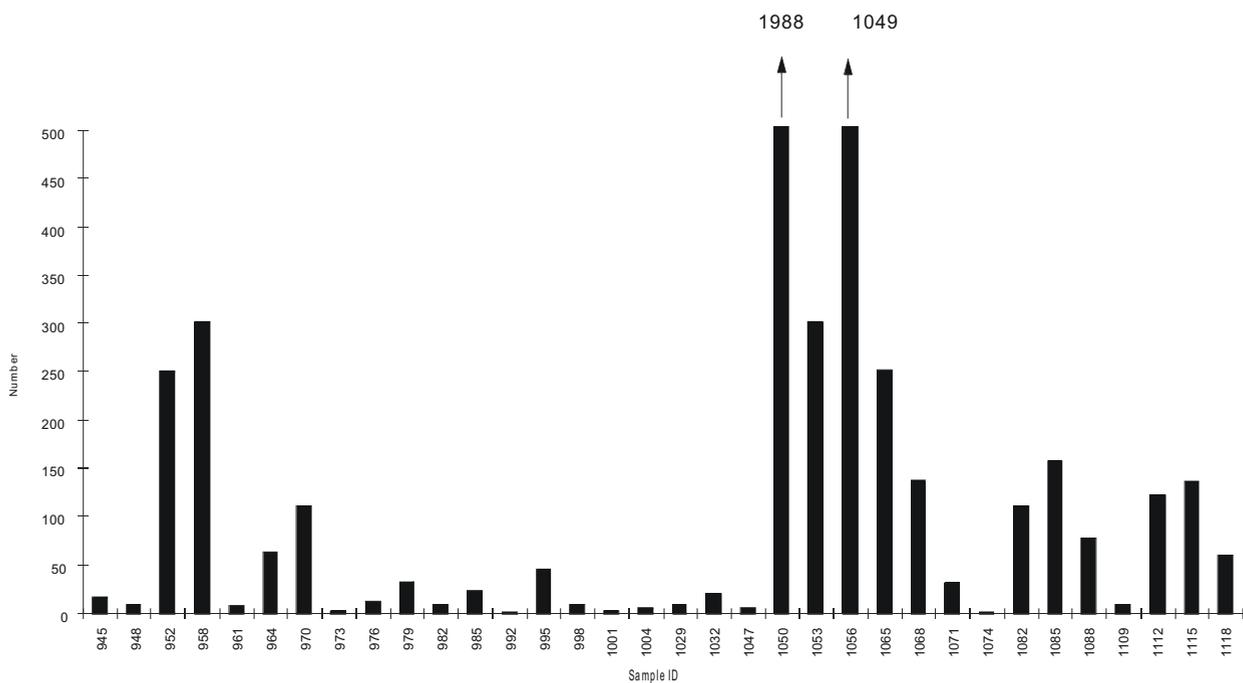


Figure 17: Numbers of snapper in reef edge assessment samples

### Wrasse

Only one species of wrasse, *Cheilinus undulatus*, the humpheaded wrasse, was identified. This fish was recorded in 14 samples. The highest count was five, observed on Ile Maskali (S-ID 970). In total 28 individuals were observed during all of the 34 reef edge assessment surveys. Pre-spawning of this species was observed in the vicinity of the Maskali reserve.

### Reef Associated Fish and Pelagic Fauna - Presence or Absence Assessments

The presence or absence of selected coral reef fish in 34 reef edge assessment samples are as follows:

#### Damselfish

Presence or absence of six species of damselfish were noted in Reef Edge Assessment Swims. *Plectroglyphidodon* spp. were not observed in any sample. *Chromis dimidiata* was only observed in one sample on Hamra Island, Iles des Sept Frères (S-ID 1056). The most frequently observed damselfish were *Abudefduf* spp. which were observed in all assessments.

#### Parrotfish

Five parrotfish were assessed for presence or absence. *Scarus ferrugineus* was present in all samples, and *S. sordidus* was absent from only one sample at Rhounda Komayto, Iles des Sept Frères (S-ID 1047). *S. niger* was observed in 26 samples, and *Cetoscarus bicolor* was present in 20 samples. *S. frenatus* was absent from all.

#### Surgeonfish

Of the four species of surgeonfish recorded for presence or absence, one species,

*Zebrasoma xanthurum*, was ubiquitous. *Z. veliferum* was found in all but three samples. *Ctenochaetus striatus* and *Acanthurus sohal* were recorded as present in 31 and 18 Reef Edge Assessment Swims respectively.

### Wrasse

Thirteen species of wrasse were recorded as present or absent. Of those, three species, *Gomphosus caeruleus*, *Thalassoma lunare* and *Larabicus quadrilineatus* were present in all samples. *Halichoeres hortulanus* was absent from only two samples. In contrast, *T. klunzingeri* and *Macropharyngodon bipartitus* were absent from all samples. Although *H. marginatus* was only present in 15 samples, the remainder of the thirteen wrasse species was recorded in more than 20 Reef Edge Assessment Swims.

#### Other species

*Ostraciidae* spp. (boxfishes) were only present in four samples, while *Oxymonacanthus halli* (the filefish) was absent from all samples as were *Pseudochromis fridmani* and *Pseudanthias squamipinnis*. The absence of *O. halli* is interesting because this species is an obligate corallivore. Data for coral cover demonstrates good coral cover at many sites. However, the data does not give information regarding the coral species present and it may be that despite adequate cover the specific coral species on which *O. halli* feeds were absent from the samples.

### Anthropogenic Pressure Indicators - Numerical Assessments

The results of indicators of human activity noted during Reef Edge Assessment Swims are summarised as follows:

### Fishing line

Fishing line was observed in 19 of 34 samples (Figure 18). Of these, 10 samples contained two or more pieces of line, with a maximum count of five pieces of line observed in three assessments on Ile Maskali (S-IDs 964 and 970) and Iles Moucha (S-ID 1109).

### Fishing nets

Fishing nets were only observed in one sample at Hamra Island, Iles des Sept Frères (S-ID 1056). Only one net was observed in this sample.

### Fishing traps

Fishing traps were not observed in any sample.

### Solid waste

Solid waste was observed in 12 of 34 samples (Figure 18). The maximum number of pieces of solid waste observed in one sample

was eight on Ile Maskali (S-ID 970). Six items were recorded at Khor Ambado, Seghir (S-ID 952), and five in a sample at “Radio Mast”, Djibouti City (S-ID 1112). In total 29 items were counted whilst conducting Reef Edge Assessment Swims.

### Anchor Damage

Damage to corals that was unequivocally caused by anchoring was noted in nine Reef Edge Assessments. Two of these sites were around Ile Maskali (S-IDs 958 and 961); three were off the beach at Sable Blanc (S-IDs 1067, 1068, and 1069); three were situated around Iles Moucha (S-IDs 1084, 1085, and 1086). Signs of minor anchor damage were noted also at Rhounda Dabali, Iles des Sept Frères (S-ID 1053). Suspected damage from small anchors was observed outside locations to the south of Ile Maskali and Iles Moucha. The reef flat at Sable Blanc exhibited damage most likely to have been caused by small anchors or by trampling.

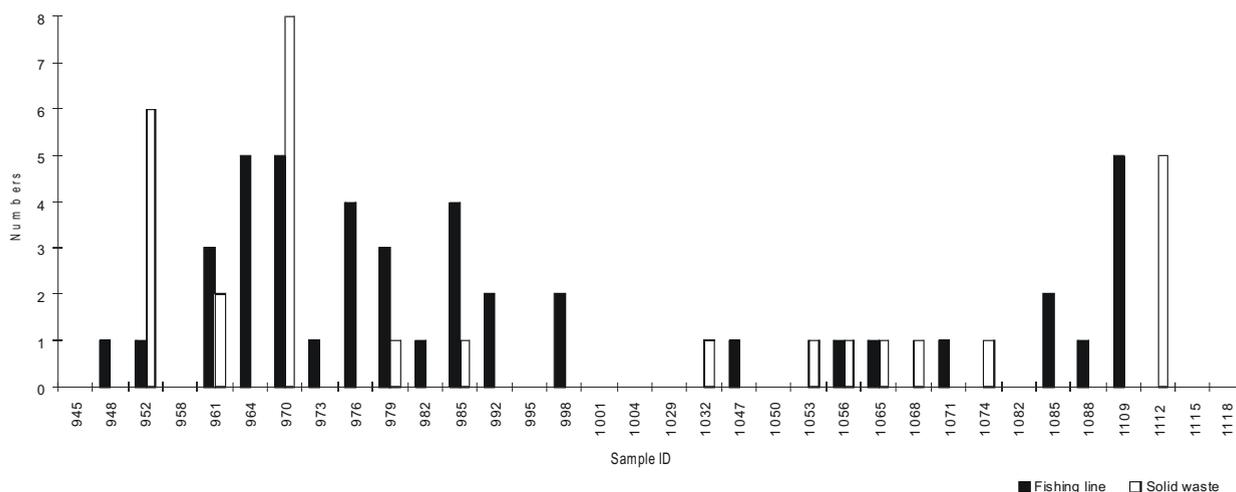


Figure 18: Evidence of human impact in reef edge assessment samples



Scenes from Djibouti



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# Overall Assessment

## Introduction

Discussion is limited because the data collected represent single point samples in time, and some general conclusions could be spurious if based upon such field data. For each location visited, the general status of the habitats present is assessed based upon the data collected; the range of visitor activities encroaching upon the habitats is identified; and the impacts of the activities are identified and discussed.

## Iles Moucha and Ile Maskali

### Status

Iles Moucha and Ile Maskali are known to exhibit an unusual diversity of marine and coastal habitats in a very small area (PERSGA, 1997b). Previous reports indicate that the status of these resources is highly variable. From this study it appears that visitor pressure is not on a scale sufficient to irrevocably damage the environment of the archipelago. Effective management and implementation of the EMP will result in the alleviation of pressure.

The reefs lying off the main beach of Ile Maskali (currently demarcated with mooring buoys) are in a very poor condition (S-IDs 963, 964, and 965). Towards the south-western tip of the island, near the navigation beacon (S-IDs 969, 970, and 971), the reefs are also very poor and turbidity is very high.

In contrast to the above, most other reef sample sites around Iles Moucha and Ile Maskali exhibited moderate to very good live coral cover. Indeed, live coral cover was estimated at 30%, or over, in 31 of 34 samples. Sample sites on patch reefs and coral gardens in the reserve to the south of Ile Maskali exhibited good live coral coverage with associated fish populations that are, in general, characteristic of balanced reef systems. Live coral cover at sites on the fringing reefs to the north of Iles Moucha and Ile Maskali was moderate to good ranging from 25 to 40% cover, and framework corals at these sites appeared substantive and robust. Additionally, the patch reefs in the channel between Ile Maskali and Iles Moucha are reasonably well developed in parts despite their shallow and accessible situation. BARRATT and MEDLEY (1988) record poor coral offshore of the “Sheraton Beach” on Iles Moucha (S-IDs 991, 992, and 993). Here, the fringing reef fragments a little into patches of varying quality, but the overall condition appeared average in relation to most other sites visited around the islands. Hence, there may have been a moderate recovery at this particular location. Otherwise, the study tends to corroborate the pattern of reef states observed by the earlier study of BARRATT and MEDLEY (1988).

Turtles were observed offshore from Cha Bouffar, Ile Maskali (S-ID 966), and evidence of recent or current nesting was also recorded at this location. No indication of turtle nesting was recorded on the beaches visited on Iles Moucha. Dolphin were present in the waters off Ile Maskali. Pre-spawning of *Cheilinus undulatus* was also observed.

Mangroves occur on both Ile Maskali and Iles Moucha where both *Avicennia marina* and *Rhizophora mucronata* occur. The growth of *R. mucronata* on Iles Moucha could have been, in the recent past, amongst the most impressive in the Red Sea and Gulf of Aden region. The trees exhibit high density and impressive proportions. Natural factors, however, appear to have resulted in a substantive die-back of the *R. mucronata*. This may be due to a change in the water circulation patterns resulting from beach movement. There appeared to be a natural sand bar across what was formerly a tidal channel through to the mangrove stand. Water circulation in a neighbouring tidal creek with healthy mangroves appeared to be higher than that in the deteriorated stand. The appearance of the trees is characteristic of mangroves that have had to face a reduction in water circulation due to coastal construction and land fill. Wind has since toppled many of the trees and the remaining ones are now subject to attack from disease and insect infestation.

Seeds and flowering were recorded at low levels on *R. mucronata* scattered around the archipelago of Iles Moucha.

### Visitor Activities

The most significant visitor activities affecting Iles Moucha and Ile Maskali relate to tourism. The following activities were identified in the area:

- sport fishing by tourists and French military personnel and subsistence fishing by local fishermen using hook and line,
- SCUBA diving, snorkelling, and swimming,
- boating and water skiing,
- chalet construction,
- bonfires (tourists and local fishermen),

- walking through mangroves,
- French military exercises.

### Pressures

Tourist activity is the most significant source of pressure currently affecting the marine and coastal resources of Ile Maskali and Iles Moucha. The intensity resulting from these activities increases sharply at the weekend in correlation with the greatly increased number of tourists making the journey from the capital city.

The study of corals around Iles Moucha and Ile Maskali revealed that no damage could be attributed directly to in-water activities such as SCUBA diving, swimming and snorkelling. However, observations made at the other resorts indicate that public awareness of the consequences of damaging activities whilst diving/snorkelling is very low. A more substantive investigation of diver damage and souvenir collection is recommended.

Damage, possibly attributable to small anchors, was observed on the reefs in the channel between Ile Maskali and Iles Moucha. Additional coral breakage was observed in the reserve, but the cause of this damage is not certain. It can be difficult to attribute coral breakage to anchoring, particularly when anchors are small and the materials used for anchoring vary considerably. During the study, only one sport fishing vessel was recorded anchored in a particularly sensitive site to the south of Ile Maskali. All other vessels encountered were moored to jetties, hauled up onto the beach, or anchored on sand. The coral gardens to the south of the islands and the table coral stands of *Acropora* on the sandy plateau near the fringing reef to the north of Iles Moucha are highly vulnerable to anchoring. Extensive damage, however, was not detected. Further work is required to monitor vessel activity at times of peak tourism.

Crown of Thorns starfish were not present in numbers indicative of a potential outbreak. However, the presence of COT warrants close monitoring since their numbers can increase dramatically over a short period of time and their effect can be devastating to reefs over a wide area.

Sites on the fringing reefs to the north of Iles Moucha and Ile Maskali exhibited a relatively high cover of broken *Acropora* now colonised by coralline algae. This breakage is probably not the result of anchoring but reflects an historic die-off, possibly as a result of a bleaching event, with most breakage occurring subsequently due to wave action. However, living substrate cover is substantive and may be indicative of a regenerating system.

Currently there are no facilities on the islands for sewage reception. Information on the main methods of removal was not detailed, and the most likely explanation is that sewage is discharged into the sea directly from the chalets or from containers. At current levels, sewage discharge around Iles Moucha and Ile Maskali is unlikely to pose a significant threat to the marine resources. Indeed, no direct evidence was observed during the present study of the detrimental effects of sewage pollution. However, the high percentage cover of macroalgae at sites of poor coral cover, on Ile Maskali (S-ID 963) for instance, could indicate eutrophic conditions (CLARK, 1996), although this requires further investigation. Indeed, the potential threats of sewage discharge require investigation, particularly in light of the further development of tourism planned for the area.

Natural impacts affecting the mangroves included disease, wind damage, and a possible insect infestation. Additionally, alterations in water circulation appear to have affected mangroves, especially *R. mucronata*, on Iles Moucha as previously discussed. Fire does not

appear to have been a recent problem, although the potential risk for significant fire damage is now high due to the abundance of dead and dry wood. Anthropogenic pressures on the mangroves include chopping for chalet construction and firewood, vandalism, trampling, and littering. Mangroves continue to be used as dumping grounds on both Iles Moucha and Maskali. This was especially true on Ile Maskali and to the rear of the chalets on the western beaches of Iles Moucha. Both local fishermen and tourists were responsible for the littering and wood chopping for construction and firewood. Vandalism was confined to the tourist element judging by its nature. Owing to the relative inaccessibility of the mangroves, other pressures which seriously affect the mainland mangrove stands, such as grazing, were not recorded on Iles Moucha nor Ile Maskali.

The beaches of Iles Moucha and Ile Maskali are in good condition, although littering is an unsightly problem in some locations, particularly on Ile Maskali. The litter may also be a hazard to turtles and other marine fauna (CLARK, 1996). The apparent unchecked construction of chalets and absence of suitable receptacles for litter are the main causes of the proliferation of litter, with both construction materials and consumables being discarded along the beaches and in the nearby shrubs and mangroves.

Often overlooked is the effect of visitor presence and noise on important wildlife that has to share habitats and resources with humans. The presence of turtles nesting on Ile Maskali draws attention to a potential conflict. Despite only limited signs of physical disturbance on the beach, the presence of humans and the open access of the beach could begin to deter turtle nesting on this beach and may well have done so already at other locations. It is recommended that the full extent of turtle nesting on the archipelago be investigated.

## Khor Ambado and Sable Blanc

### Status

Sample sites on the coastal fringing reefs of Khor Ambado were assessed as having an average living hard coral cover of 52%. This is high cover compared to many other sites in Djibouti and elsewhere in the Red Sea despite very turbid conditions at the time of the survey. BARRATT and MEDLEY (1988) also describe moderate coral conditions in spite of a high sediment load in the water column and it could be that the coral community is relatively well adapted to chronic sedimentation. Species diversity of benthic and sessile organisms appeared low relative to other study sites visited, and *Porites* and *Pocillopora spp.* were observed to be the dominant reef forming corals on the reef edge and reef slope. Coral and other fauna were relatively rare on the back reef and reef flat.

The fringing reef directly offshore from the tourist beach at Sable Blanc had large *Porites* coral cascades on a steep reef slope which dropped off to sand at approximately 20 m. Most colonies exhibited signs of minor impact possibly due to disease or sedimentation damage. However as one progressed eastward along the coast, the reef appeared in moderate to good condition with coral cover within samples of up to 80%. The influence of localised factors such as wadi out-washing and run-off, rather than current visitor pressures, appeared to dictate the overall reef condition.

The reef flat at Sable Blanc exhibited a greater array of small coral colonies and living substrate cover than the reef flat at Khor Ambado. No swim was performed over the reef flat, but general observations indicated that the predominant coral species on the reef flat were *Pocillopora spp.* Small colonies of *Acropora* were also present on the reef flat particularly to

the west of the main tourist beach. No significant signs of recent bleaching, other than COT feeding scars, were recorded on the reef face or reef flat. However, a significant number of corals on the reef flat were broken, perhaps from reef walking.

Observations of fish were rendered difficult due to the poor visibility at Khor Ambado and at times near Sable Blanc, but the data does not suggest a population affected heavily by impacts such as fishing, sedimentation, and pollution. Indeed the high counts of certain commercially valuable species at Sable Blanc, such as wrasse and snapper, were encouraging.

### Visitor Activities

Many tourists and military personnel visit the resort of Khor Ambado from the capital city each weekend. Access to the resort is only possible with a 4-wheel drive vehicle, but this does not appear to deter visitors at these peak times. At other times during the week, visitor pressure appeared to be substantially lower.

The predominant activities recorded at the beach resort of Khor Ambado were:

- swimming, snorkelling, and walking to the reef edge,
- beach based activities such as barbecues, bonfires, and other social gatherings,
- dining and drinking at the restaurant facilities available, and
- firewood collection (though no cutting was directly observed).

The activities at Sable Blanc were similar to those at Khor Ambado, but several vessels visited the beach and were anchored periodically up on the sand behind the reef flat.

No fishing activities from either beach were recorded, but a single vessel was observed anchored offshore and within a kilometre of the beach at Khor Ambado. This vessel was engaged in sport fishing and SCUBA diving. Information from local people indicated that vessel traffic to these beaches, and sport fishing, increased substantially at peak visitor times over the weekend.

Development of tourist amenities is not monitored and controlled on either of the beaches at the present time.

### Pressures

The draft SAP document (PERSGA, 1997a) and Country Report for Djibouti (PERSGA, 1997b) review all the general impacts affecting the resources in the vicinity of Khor Ambado. The main impacts recorded directly for both Khor Ambado and Sable Blanc are as follows:

- trampling of live coral on the reef flat (Sable Blanc and Khor Ambado),
- damage from small anchors on the reef flat at Sable Blanc (no moorings are currently installed),
- littering of the reef flat at Sable Blanc,
- littering of both beaches – (Khor Ambado was more heavily affected),
- beach disturbance from vehicle access at Khor Ambado,
- evidence of souvenir collection at Sable Blanc for sale to tourists.

Crown of Thorns abundance at both beach sites and further around the coast at Sable Blanc was low, maximum of 11 (S-IDs 1065 and 1068). However, the presence of COT at these sites warrants close monitoring. Potential feeding scars were more abundant at Sable

Blanc than the actual number of COT recorded, and this may indicate an under-estimation of the COT numbers at the site.

## Djibouti City Area

### Status

The reefs of Djibouti are clearly under pressure from Man. Despite this, the living hard coral cover measured at sample sites in the vicinity of Djibouti City averaged 39% with a maximum of 80% coral cover composed predominantly of *Pocillopora* (S-ID 1110). Water turbidity was very high at all sites investigated. Patches of coral substrate were widely spaced and interspersed with mud and soft sediment. Living coral is currently able to persist in small patches around the capital and very close to the port area.

Mangrove stands in the vicinity of Djibouti City are comprised of a single species, *A. marina*. The mangrove stand judged in best condition persists because of its position within the security perimeter of the President's Palace. Other mangroves are currently offered no protection. Anecdotal evidence and signs of recent cutting indicate that the mangrove cover within and around Djibouti City has been reduced rapidly in the last five years or so. Growth and rejuvenation are stunted. Bird populations, mostly flamingos and ibis, continue to populate the remaining mangroves, but their numbers have reduced markedly (N. MOHAMED, pers. comm.).

### Visitor Activities

Most human activity affecting the marine and coastal resources in the vicinity of Djibouti City relates to the daily activities of Djiboutian inhabitants of the city and refugees. Apart from small vessel traffic in the port area, most tourists

now appear to travel further for recreational activities and their affect on local resources is small.

The following activities were, however, in limited evidence:

- souvenir collection from reefs,
- hand-net and line fishing on fringing reefs, and
- subsistence collection of materials from mangrove stands.

### Pressures

The main impact from tourist activities is likely to be littering of beaches in the vicinity of the main hotels with coastal access. Water-sports such as sailing, jet-skiing, and motor-boating are popular close to Djibouti, but the impact of these activities is likely to be negligible when compared with that of coastal development and large vessel shipping activity.

The mangrove stands in the vicinity of Djibouti City were the most threatened of the sites visited during the study. Heavy littering and sewage pollution is a problem. Cutting for construction and firewood is a significant pressure, and evidence of grazing was seen in the form of flocks of goats retreating from the mangroves at Dorale and Balbala to the west of the capital.

### Iles des Sept Frères

#### Status

The rapid appraisal of reef resources formed only one day's input into the study, but revealed some interesting observations.

Currently the status of the coral habitats, as shown from the sample swims, is good. Live coral cover for the islands averaged 34% (+/- 19%), and although this is not very high, observations of general substrate diversity indicate that most parts of the archipelago exhibit balanced and healthy reefs. Impact, where it occurred, was difficult to attribute to any specific cause and may simply reflect long-term environmental disturbances. There are specific localities, such as the site known as the "Japanese Garden" off Kadda Dabali (S-IDs 1049, 1050, and 1051), which, if managed appropriately, have the potential to be very attractive locations for tourism.

Perhaps most importantly, no indications of a COT epidemic, either current or recent, were recorded in the samples. PICHON (1990) describes a COT outbreak at Iles des Sept Frères which was so severe that even the primary structural corals were being destroyed. Certainly, the "Japanese Garden" has escaped the results of any epidemic, should it have occurred there, and other patches of *Acropora* encountered at the islands show no signs of a recent epidemic. The findings of the present study may indicate that the scale of the original outbreak was localised, or that there has been a remarkable recovery in the reef system. However, COT are present at Iles des Sept Frères, and measures of their abundance should be a component of any future monitoring programme.

#### Visitor Activities

Visitor activities known to occur at Iles des Sept Frères include:

- snorkelling and SCUBA diving,
- sport fishing,
- subsistence fishing by local people (nets and line discovered), and

- illegal fishing by non-Djiboutian nationals and non-tourists.

One vessel carrying tourists was moored overnight at the islands and visited several sites including “the Japanese Garden”. The vessel anchored on sand at this location since no mooring facilities are currently provided. Passengers of the vessel engaged in snorkelling and diving activities around the boat. Only one fishing vessel was encountered. General visitor activity around the islands was estimated as very low at present, but tourism from the capital city is said to be extending to Iles des Sept Frères more and more often.

The proximity of these sensitive habitats to busy shipping traffic through the Bab el Mandeb is a cause for concern, and verbal reports were given of the continuing pressures from illegal Yemeni and Somali fishing. However, these activities were not witnessed during the survey.

### Pressures

Currently, anthropogenic impacts around the islands are very low. Indicators of fishing activity were observed (discarded net and line), but there is no evidence that the present level of local fishing is unsustainable. Other impacts are negligible, but careful monitoring of increased visitor activity in the area is recommended due to the unique nature of the habitat and its potential for revenue generation through well-managed tourism.

## Collines de Godoria, Khor Angar, Ras Siyyan

### Status

Given that mangrove is generally limited in the region, the mainland mangrove stands at Collines de Godoria, Khor Angar, and Ras

Siyyan represent a very valuable natural resource base. Both *Rhizophora mucronata* and *Avicenna marina* occur at Collines de Godoria and Khor Angar, but only *A. marina* is present at Ras Siyyan where the mangrove forms a very long and narrow fringe along the beach-line. In contrast, the mangrove stands at Collines de Godoria and Khor Angar are substantial, and perhaps half a kilometre or so wide in places (the entire perimeter of these stands has not been mapped). No flowers, seeds, or other signs of regeneration were recorded at any of the three mangrove sites.

The reefs at all three sites were briefly surveyed in addition to the mangrove work. The reefs are not significantly affected by visitor activities at the present time.

### Visitor Activities

The SAP document (PERSGA, 1997a) and Country Report for Djibouti (PERSGA, 1997b) review general activities and threats to the mangrove resources at these three locations. The following non-tourist related activities were identified:

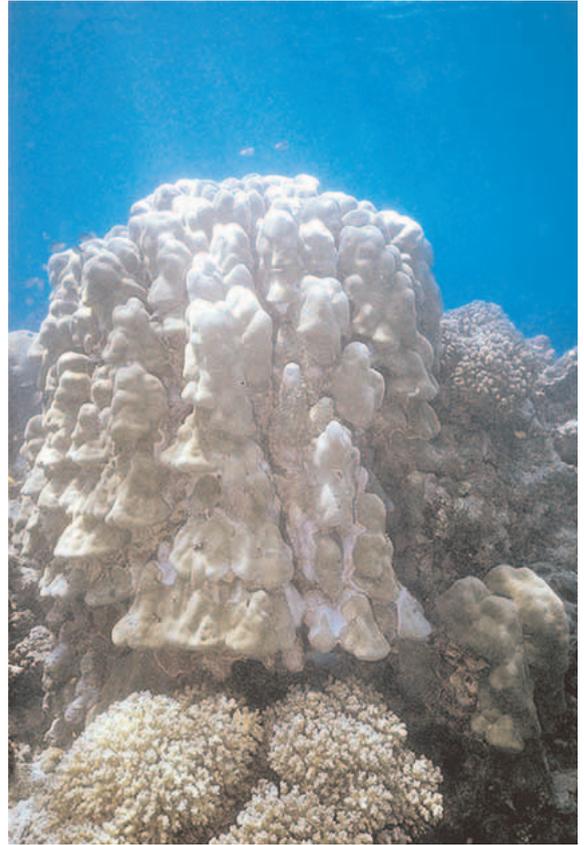
- mangrove cutting for construction and firewood,
- fishing and collection of crustaceans and molluscs in channels and from the roots of mangroves,
- livestock grazing on mangroves (particularly *A. marina* at Ras Siyyan),
- collection of molluscs and lobster from the reefs offshore of Collines de Godoria.

### Pressures

The main threat to the mangrove resources of these areas is direct habitat destruction

through the activities mentioned in the previous paragraph. The most threatened of the three stands of mangrove was at Ras Siyyan where anthropogenic impacts such as grazing and cutting combined with disease and a possible insect infestation increases the pressure on the trees. At all three sites, signs of human presence (including wood bundles and improvised shelters) were common on the periphery of the mangrove stands. Vehicle tracks were encountered at Khor Angar and several routes for livestock access were observed in the mangrove of Collines de Godoria.

Information from local fishermen suggests that the level of impact on the mangroves may have been reduced in the year of the study due to abnormally high rainfall in the highlands. It has often been the practice of local herdsman and nomads to bring their livestock to the coast to feed on the mangroves when plant material on higher ground has been reduced by the onset of summer. The onset of the dry season was delayed in the year of the study possibly due to the global effect of *El Nino*. Consequently, resources other than coastal mangroves may well have sustained grazing requirements.



Scenes from Djibouti



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# *Environmental Management Plan*

## **General Introduction**

The Environmental Management Plan (EMP) reflects a precautionary *response* to actual and potential pressures identified during the survey and from other sources. The EMP provides a framework for the development of effective, long-term management. It aims to encourage the sustainable development and sustainable utilisation of the biological resources of the Djiboutian coastline.

Central to the design and implementation of the EMP is the establishment of a single Authority with a national mandate for sustainable development. This Authority could be known (possibly) as the **Djibouti Biodiversity Protectorates Authority (DBPA)**. This Authority would be responsible for sustainable development of specific areas recommended in any EMP. Such areas to be '*Areas of Special Environmental Interest*' (ASEIs). It was indicated and agreed by the Djiboutian colleagues during development of the EMP that no suitable Authority existed and that a new Authority should be formed. This view was endorsed by the National Workshop.

A preliminary project planning matrix for implementation of the EMP, based on a logical framework design<sup>2</sup>, is given in Appendix 1.

The Plan focuses on five major inter-related outputs:

- The establishment and operation of the Djibouti Biodiversity Protectorates Authority;
- The development of a monitoring programme based on environmental indicators;
- The development of a decision support tool to assist management planning;
- Promotion of public awareness and environmental education;
- Capacity building for the DBPA and related organisations.

## **Pre-conditions**

The pre-conditions focus on the need for the Government to commit to the project through the following activities. Firstly, the Government is called upon to gazette the Djibouti Biodiversity Protectorates Authority and the Areas of Special Environmental Interest. Gazetting implies legal designation and empowerment to achieve the project purpose specified in this management plan. It is implicitly recognised that this may include the generation of revenue for the DBPA from the ASEIs. Secondly, Government would be required to provide a guarantee to meet the local costs and recurrent funding for the Authority for the lifetime of the project (5 years) and beyond. Donors should, for their part, commit to providing the external funding and resources as required.

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<sup>2</sup> The logical framework is a management tool that aims to promote good project design and strengthen project implementation and evaluation by clearly stating the defined logic and component of the project. The links within the framework should be logical and related to each other. For instance, the purpose of the project should fulfil the goal. The internal logic of the framework can be checked by asking the question 'how' in moving down the hierarchy and the question 'why' in moving up the hierarchy.

### **Output 1**

The first output establishes the DBPA, making it operational by the end of the first year of the project. Until this output has been achieved the remaining four outputs are unlikely to be undertaken and indeed would have no sustainable effect if they were undertaken.

### **Output 2**

Environmental indicators have been used as a tool to monitor environmental changes since the beginning of the 1990s. However, their applicability to marine systems, and specifically the Red Sea, has not been thoroughly explored. The validity of the Pressure-State-Response mechanism in integrated coastal management has been demonstrated by OLSEN *ET AL.*, (1997) and it has been further justified in the section titled 'Methods'.

The environmental indicators selected for the fieldwork in the present study may be considered as the preliminary set of marine environmental indicators for Djibouti. Clearly the selection and subsequent monitoring of additional indicators will need to be established as part of the overall Environmental Management Plan. The Government should formally agree the final list of selected environmental indicators.

### **Output 3**

Once information concerning the environmental indicators has been collected it will be essential to have easy access to, and interpretation of, the data in order for it to be a useful tool in the management process.

The main activities involved in Output 3 will be the development of a Geographical Information System (GIS) support tool. Such a system should be compatible with the basic GIS tools already available and those being developed at ISERST.

### **Output 4**

One factor affecting the success of any sustainable development area in the long-term is the degree of dissemination of the information to the wider public. It is particularly important to deliver the message of sustainable use to the coastal consumer groups such as tourism developers, industry and fishing communities. Promotion of the DBPA through a public awareness programme would be another valuable contribution to the EMP.

### **Output 5**

The final Output focuses on the need for training staff at the DBPA in environmental management techniques. The problems associated with sending key members of staff away for long-term training, either at home or abroad, is recognised. Long-term training programmes would remove key members of staff from their duties in the Authority, significantly reducing the overall effectiveness of the organisation. Also, training of personnel to overseas higher education standards frequently means that they are lost to the organisation in the long-term. As such, there is the need to prioritise short-term (e.g. oil spill contingency planning, environmental indicators, environmental economics, ranger training, etc.) versus long-term training. The idea of long-term overseas training should not be excluded, particularly for younger people before they commence formal employment. This allows them to apply learned skills. However, the 'learning-by-doing' and 'on-the-job-training' approach offered by short-term and distance-learning is now widely accepted, and prioritised in the development project.

The effectiveness of the EMP approach and the DBPA should be monitored on a regular basis through national and international workshops.

## Activities

Activities explain how the project will be accomplished and are the action components needed to accomplish the outputs. A series of activities have been devised to meet each of the five outputs in the logical framework. These activities are considered to be appropriate to the situation encountered in April 1998. Activities, like outputs, are intended to be flexible, particularly over the lifetime of the project and may be expected to change in the light of further discussions with the various agencies involved.

The following activities associated with Output 1, the establishment and operation of the DBPA, were agreed at the Workshop in Djibouti:

- the establishment of ASEIs;
- the appointment of a Technical Committee, charged with further development of the EMP;
- the development of a set of visitor management guidelines and the application of those guidelines to the proposed ASEIs;
- investigation into, and the development of, recurrent funding mechanisms; and
- assessment of liability and legal procedures.

## Objectively Verifiable Indicators

The indicators demonstrate results, and as performance measures, they enable successful accomplishment of the objectives to be recognised. As a result the indicators at the Goal, Purpose, and Output levels have been qualified and, where possible, quantified.

## Assumptions

There are three major assumptions in the logical framework which are external to the project and cannot be managed by the project. They are:-

### *Natural influences on key indicators are not significant*

As the possible impact of natural processes of future climate change on the environmental indicators cannot be evaluated, the project must be designed on the assumption that the goal can be fully achieved provided that there is no significant impact through natural processes.

### *Government commitment to project continues*

In order for the project to be completely successful and achieve the stated objectives, the Government must be prepared to commit funds and staff to the Authority until such time as the Authority might become self-sustaining. In addition, meeting the pre-conditions of the project should signify Government commitment to the project.

### *Wealth generated to meet recurrent costs of management*

The Environmental Management Plan for the DBPA relies on the development of local wealth generating mechanisms to meet the recurrent costs of the Authority in the long-term. While these mechanisms will be established as part of the EMP, there is no guarantee that they will be totally effective. For example, collection of revenues through litigation might be both time consuming and unproductive and therefore outside the control of the project.

## **The Djibouti Biodiversity Protectorates Authority (DBPA)**

There are several precedents for single authority management of development areas in the Red Sea:- Tourism Development Authority in Egypt, Aqaba Region Authority in Jordan, Royal Commission for Jubail and Yanbu in Saudi Arabia.

However, none of the Authorities listed above have a mandate specifically linked to environmental conservation and sustainable development. The examples given are 'sector plus environment' rather than 'environment plus sector' and are used here to illustrate that there are sectoral authorities operating in the Red Sea area that could be models for any new 'environment-sector' authority. It might be more advantageous to use examples taken from other parts of the world such as the Nature Conservancy in the USA, or the National Trust in the UK, the Marine Parks Authority in the Seychelles, or the Montego Bay Authority in Jamaica. These might be better examples of autonomous or para-statal authorities. In view of the fact that there is no existing authority in Djibouti with this integrated and holistic mandate, it is suggested that a new authority be formed or an appropriate, existing authority be so mandated.

It is worth noting that autonomous, semi-autonomous, and para-statal delegation of responsibility by Government for environmental management and sustainable use of designated 'areas' is now viewed as an opportunity rather than a constraint by donors, NGOs, and the private sector, and therefore attracts external funding.

### ***Title to Resources***

The Government should gazette the DBPA title to certain land and sea areas and the

resources contained within, above and below these areas. Wealth generated from the use of natural resources can be linked directly to meeting the costs of effective environmental management of these resources.

### ***Operational Principles***

The legal articles of the DBPA should specify that areas under the Authority will be managed in an environmentally integrated and sustainable manner according to the guidelines specified in the Convention on Biological Diversity which Djibouti signed on 27<sup>th</sup> August 1995 and came into force on 28<sup>th</sup> January 1996.

### ***Revenue Generating Powers***

The DBPA needs to have a non-limiting range of revenue generating options. In accepting the principle of revenue generation it should be accepted also that the DBPA priority is towards *in-situ* environmental conservation to fulfil national objectives within the framework of the Convention on Biological Diversity and that revenue generation is purely to support more effective environmental conservation. In addition, a mechanism should be established for channelling wealth generation from other sectors of the economy, particularly tourism, to contribute to the costs of effective environmental management. It follows that the Government has an obligation to subsidise management costs should this be necessary.

The Government should gazette agreement to mechanisms for generating and disbursing revenues to meet the recurrent costs of managing these areas. Mechanisms may include:-

- Government subsidies;
- National Environmental Trust Fund grants;
- Environmental cost-recovery and transit levy on goods passing through

Djiboutian waters and on services (e.g. tourist levy);

- Entry and use licenses, leases on land and sea in ASEIs (individuals wishing to use ASEIs for the purpose of recreation - swimming, snorkelling, SCUBA diving or sport fishing - would be charged a fee; charges would be levied for any tourist beaches created, buildings erected);
- Revenue from environmental services (e.g. waste oil reception facilities);
- Regional Environmental Trust Fund.

### ***Infrastructure Development and Revenue Generation***

It should be noted that the development proposals for the DBPA should contain a component for infrastructure improvements. Suggestions to be evaluated include:-

- sewage treatment works,
- solid waste reception, disposal or recycling,
- water management,
- energy generation and conservation,
- environmental rehabilitation,
- waste oil reception facilities.

These are all infrastructure developments that are considered to be critical to the control of land-based sources of pollution, which are included in the Jeddah Convention, and the maintenance of biodiversity, which is regulated by the Convention on Biological Diversity. Consideration should be given to allocating title to the DBPA to manage and generate revenue from these infrastructure developments.

### ***Red Sea Environmental Transit Tax***

A system may be developed for charging vessels transiting through the Red Sea and Gulf

of Aden to support national and regional environmental initiatives under the Jeddah Convention.

The risks to the coastal and marine environments of the Red Sea and Gulf of Aden from vessels in transit is reflected in high potential pay-outs and insurance premiums. One possibility may be to create a mechanism for limiting liability of vessels who pay a transit tax to a Regional Environmental Trust fund. Such contributions could be used to subsidise the costs of developing capacity to mitigate against environmental accidents. Nations bordering the Red Sea should also move to maximise the liabilities resulting from such accidents. The establishment of regional or national taxes is a complex and difficult issue to resolve. However, nations do have the right to set the conditions of passage through their waters provided that this is accepted and notified by the International Maritime Organization (IMO).

### ***DBPA Managing Board***

It is essential that the Authority operate transparently, is open to public scrutiny, and is operated under a duly constituted and representative Board. Authority staffing should be the minimum necessary to provide a Secretariat to the Board and to set and monitor contract compliance.

The Authority shall comprise:

- A duly constituted and authorised Technical Board comprising representatives of Government agencies with interests in the designated sustainable development areas including:-
  - Ministry of Agriculture, Fisheries and Forests,
  - Ministry of Education,

- Ministry of Natural Resources,
- Ministry of Interior and Police,
- Direction des Affaires Maritimes,
- Institut Supérieur d'Etudes et de Recherches Scientifiques et Techniques (ISERST),
- Djibouti Municipality.

Non-Governmental organisations should be granted observer status if agreed by the board.

- A Chairman who shall be representative of the Ministry of Environment, Tourism and Handicrafts.
- The Board shall meet at least six times a year.
- Minutes will taken at Board meetings.
- The Board shall employ a Managing Director and such other essential officials as may be necessary to fulfil its duties.
- Wherever possible the Board should arrange to contract out such services as may be necessary to meet its mandate including research and monitoring for management, environmental impact assessment and enforcement. The contracting out of services is central to the efficiency of the Authority. Contracting out of services will minimise the recurrent costs reflected by the alternative, which would be larger numbers of Authority staff.

#### **Reporting and Accountability**

- The Board should report annually to the Council of Ministers, or equivalent, the actions taken within the DBPA programme.
- The operations of the DBPA should be subject to annual independent environmental and financial audit.

## **Areas of Special Environmental Interest**

The ASEIs specified in the Environmental Management Plan are those considered, on initial survey, to:-

- represent the coastal and marine habitats in Djibouti with the highest biodiversity,
- be highly sensitive or vulnerable to human impacts and which should be afforded some conservation status, and
- generate or have the potential to generate wealth in support of effective environmental management.

**The areas recommended for inclusion in the EMP as Areas of Special Environmental Interest (ASEIs) are indicated below, and their general locations are indicated in Map 1.**

The importance of establishing boundaries for each selected area should be recognised, but it is also important that these boundaries should reflect the goals and objectives of the specific area management plans (CLARK, 1996). Guidelines for possible boundaries have been included in the list below:-

- The complex of islands and reefs and their associated resources within a 5 km radius:
  - Iles Moucha and Ile Maskali,
  - Iles des Sept Frères.
- The area 1 km offshore and inshore of the high water mark of the following mainland beaches:
  - Khor Ambado.
- The area 1 km offshore and from the high water mark to 500 m inland from

the edge of the mangrove fringe at the following mainland locations:

- Collines de Godoria,
- Ras Siyyan,
- Khor Angar.
- The whole of the mangrove stand in the vicinity of the Presidents' Office in Djibouti City:

The International Maritime Organization should be notified of these areas and asked to process international recognition of their vulnerability and the consequent increased liability resulting from any damage to them by vessels, oil spills, etc.

It is assumed that, in time and if effective, the DBPA should be given title to the environmental management of and revenue generation from additional areas.

### ***Liability***

It is essential that users likely to impact those areas under the management of the DBPA are held accountable for the full liability of damage to the environment. This should encourage investment in the necessary preventative measures to limit liability and also ensure adequate indemnity in the event of an accident.

Therefore, any party who deliberately, or through negligence, causes environmental damage to an ASEI should be liable to the full assessed value of any damage caused as agreed under independent international adjudication organised through PERSGA.



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# *Visitor Management Guidelines*

## **General Introduction**

This section contains management guidelines that address priority issues relating to visitor pressures and conservation in the areas visited. The management guidelines presented in this report are justified by the adoption of the precautionary principle (which is fundamental to the Convention on Biological Diversity), general observations made on-site, and a review of the available information. Other pressures may occur and these must be considered as requiring additional management responses.

The specific Visitor Management Guidelines outlined in this section cannot be effectively implemented without first addressing the issue of sustainable development and financing mechanisms in Djibouti as a whole. In addition, detailed management should be developed to take account of feedback from the users.

Site-specific visitor management guidelines are given for:

- Iles Moucha and Ile Maskali;
- Khor Ambado;
- coral reefs offshore from Djibouti City.

Pressure indicators identified during the field phase are considered for each of the locations listed above, and the current situation is presented. The objective of the stated action is given in order to maintain the focus for the authorities. Finally, an appropriate response, or

series of responses, is indicated. Only those pressures that are considered to be due to visitors are considered in this section.

## **Iles Moucha and Ile Maskali**

### ***Current Conservation Status***

The island complex contains two protected areas, both of which are marine. These are:

- Parc Territorial de Moucha, covering the coral reef from the lighthouse at Moucha to the Ile du Large (Banc Dankali not incorporated). All fishing activities of any sort and collection of coral and shellfish are prohibited.
- The Réserve Intégrale de Maskali Sud from the Maskali beacon south to 11°40'N, 43°10'E. This is a strict reserve status and all aquatic and sub-aquatic activities are prohibited.

### ***Recommended Status***

That the entire island complex, including terrestrial resources, should be re-designated as a National Park or a Multiple-Use Management Area (MUMA) (CLARK, 1996). The latter designation is preferred since this provides for the conservation of nature primarily oriented to the support of economic activities, although specific zones may be designated within these areas to achieve specific conservation objectives (for instance, the protection of turtle beaches). It is recommended that an Area of Special Environmental Interest (ASEI) around the archipelago be operated as a MUMA.

**Current Ecological Status of the Reefs:**

See results section.

**Main Impacts:** Human impact at the weekend, expatriate tourism. There are no statistics for visitor use. It is assumed that the relatively small ex-patriot population forms the bulk of the visitors and that each person is a regular visitor.

**Enforcement:** The current lack of enforcement of the legal status of the islands and a general disregard of the conservation status by the users will make it more difficult to introduce management options – especially those based on financial control. At the present time, the Department of Tourism has limited effectiveness in collecting the small fees, which are due from the chalets constructed on the islands. It is difficult to envisage how this

situation could improve and how new measures could be enforced without a significant effort to improve surveillance and monitoring through the implementation of the EMP presented in this report. It is very important that the current users are encouraged and educated into a different pattern of resource use backed up by suitable penalties. Charges can be introduced gradually once the DBPA has become established. It may take as much as five years before annual costs can be recovered.

It is important to develop a presence of enforcement backed up with effective statutory powers. A small force of rangers or wardens or even an environmental patrol unit will eventually be necessary to enforce the law and educate and assist users of the archipelago. Currently, statutory powers are not strong and policing is not effective.

**Visitor Management Guidelines Showing Each of the Pressures Identified During the Course of the Project**

<b>PRESSURE</b>	<b>UNCONTROLLED ANCHORING AND LANDING</b>
<b>Status</b>	Not illegal, even within the Park and Reserve. No restrictions currently in place. Effects have been reported as widespread and damaging. Pressure is likely to increase if unchecked.
<b>Objective</b>	To concentrate anchoring and landing activities into designated areas so as to reduce pressure on sensitive and vulnerable locations.
<b>Response</b>	<p>Precautionary zoning using demarcation buoys to indicate zones allowing anchorage in certain locations only; no anchoring to be allowed outside these areas. Recommended anchorages defined as follows:</p> <ul style="list-style-type: none"> <li>● Establish anchorage in sandy bay to south of Iles Moucha offshore from the Sheraton Beach. Installation of zoning buoys.</li> <li>● Install mooring buoys to the north of Iles Moucha and Ile Maskali. Installation supervised by the DBPA.</li> <li>● Provide adequate landing facilities for visitors at critical points near to anchorages. All jetties to be constructed on pillars and paths provided through coastal vegetation to avoid erosion.</li> </ul> <p>Visitor information to be provided prominently at suitable locations and to be provided through the military bases and the hotels.</p>
<b>Revenue</b>	<p>The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration.</p> <p>Fees to be derived from access charges for the facilities.</p>
<b>Policing</b>	<p>Boats anchored outside demarcated anchorages should have fines imposed, be confiscated or impounded and, if necessary, auctioned to pay for fine.</p> <p>Policing by users (forum to be developed) who report violations to appropriate authority.</p>

<b>PRESSURE</b>	<b>CONSTRUCTION OF CHALETS</b>
<b>Status</b>	Currently allowed on paying small annual fee to ONTA. Restriction on concrete bases, but not well enforced. Fees rarely paid and concrete bases frequently constructed. Locations not under rigorous planning restrictions. Consequently chalets have proliferated all over Iles Moucha and Ile Maskali.
<b>Objective</b>	To regulate coastal development.
<b>Response</b>	<p>To establish planning guidelines for any subsequent developments on the islands.</p> <p>Developments only to be allowed with express permission of the DBPA.</p> <p>To stop all new chalet construction with immediate effect.</p> <p>Demolish those breaking existing guidelines, or where fees have not been paid.</p> <p>Gradually upgrade or replace the remainder of the chalets.</p> <p>Provide visitor facilities (accommodation) as part of the DBPA, all revenues to accrue to the DBPA.</p> <p>Establish camping area(s) for visitor overnight stays. No camping allowed outside controlled areas. (See other pressure indicators of sewage and solid waste disposal).</p>
<b>Revenue</b>	<p>The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration.</p> <p>Fees from concessions and leases for existing chalets.</p>
<b>Policing</b>	<p>Unauthorised chalet or shelter construction, expansion or modification to be penalised by fines.</p> <p>Policing by users (forum to be developed) who report violations to the DBPA.</p> <p>Concessions and leases to be revoked on repetition of offence.</p>

<b>PRESSURE</b>	<b>LITTER (SOLID WASTE)</b>
<b>Status</b>	Currently a significant problem affecting the mangroves and beaches of both Ile Maskali and Iles Moucha. There are insufficient receptacles for deposition of litter, and there is no authority, programme, or procedure for systematic litter collection and disposal. No statutory controls are in place.
<b>Objective</b>	To reduce visual and physical impacts of litter disposal.
<b>Response</b>	<p>Dumping of litter in the mangrove, on the beaches, and in the water to be made illegal.</p> <p>An appropriate subsidiary management authority established or existing authority charged with provision of reception and disposal facilities on public beaches.</p> <p>Private operators to provide bins and to dispose of litter at agreed sites as a condition of their operating license.</p> <p>Litter bins to be installed every 250 m on the beach frontage, and at accessible locations around the islands.</p> <p>All chalets to install reception facilities.</p> <p>Information and public awareness posters installed along beaches and on the perimeters of the mangrove stands.</p> <p>Fines imposed on tourist operators not providing adequate facilities and individuals who litter.</p>
<b>Locations</b>	<p>All concessionaire beaches.</p> <p>Mangrove perimeters.</p>
<b>Revenue</b>	<p>The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and to fund environmental rehabilitation and restoration.</p> <p>Concessionaires to be so authorised and to charge users an environmental cost recovery fee as a condition of entering concessionaire areas.</p> <p>Concessionaires to pay the DBPA for concessions.</p>
<b>Policing</b>	<p>The DBPA to allocate task of policing for illegal littering to wardens.</p> <p>Random spot-checks and surveillance to be undertaken by wardens.</p> <p>Policing by users (forum to be developed) who report violations to appropriate authority (Direction des Affaires Maritimes and Direction de l'Environnement).</p> <p>Those who litter to be fined for each incident.</p> <p>Concessionaires to be fined for each bin not emptied within 24 hours of being notified. Concession to be revoked on repetition of offence.</p>

<b>PRESSURE</b>	<b>SPORT FISHING</b>
<b>Status</b>	Extraction of fish prohibited in Ile Maskali reserve, but not elsewhere. Enforcement of current restrictions is poor. Spear fishing is banned, but is known to continue amongst expatriates. Local people and expatriates are involved in fishing practice. Subsistence fishing occurs, but status not clear. Other guidelines required to address this issue and to provide alternative methods of subsistence to local people.
<b>Objective</b>	To reduce the reported depletion of commercially valuable reef associated fish in the region, and to mitigate the impact on the reef ecosystem by reducing the removal of key predators.
<b>Response</b>	Precautionary zoning to demarcate ‘no fishing’ zones. Individual tourists and tourism operators to pay licence fee for fishing within specified areas in the ASEI. Only line fishing and trolling under licence to be allowed in the ASEI. Complete ban on extraction of fish or other fauna from any mangroves in the ASEI. Fines imposed for disregard of the prohibited measures. Public awareness and information campaign established.
<b>Revenue</b>	The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration. Fishing licence fee to be used by appropriate authority for environmental rehabilitation and enforcement purposes.
<b>Policing</b>	Random spot checks on individual and tour operator licences to be undertaken by wardens. Illegal fishing to be fined and vessel confiscated upon repetition of the offence. Policing by users (forum to be developed) who report violations to DBPA.

<b>PRESSURE</b>	<b>DESTRUCTION OF MANGROVE</b>
<b>Status</b>	Expatriates and local people responsible for chopping and collection of wood for fires and construction. Vandalism by expatriates evident; mangroves also under threat from littering.
<b>Objective</b>	To maintain or rehabilitate the mangrove of Iles Moucha and Ile Maskali.
<b>Response</b>	<p>Impose complete ban on cutting and collection of wood for bonfires and chalet or shelter construction.</p> <p>Establish visitor exclusion zones to protect the most impacted mangrove areas.</p> <p>Bonfires on all islands only allowed subject to approval by the DBPA.</p> <p>Extraction of fauna from mangroves only if licensed by the DBPA.</p> <p>Concessionaires to provide litter deposit and collection points.</p> <p>Impose fine for illegal cutting, and possible imprisonment for vandalism.</p> <p>Public awareness and information programme to be introduced and co-ordinated in the field by wardens.</p>
<b>Revenue</b>	<p>The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration.</p> <p>Establishment of entry fees and concessions.</p>
<b>Policing</b>	<p>General surveillance and monitoring by team of wardens.</p> <p>Policing by users (forum to be developed) who report violations to the DBPA.</p> <p>Concessionaires to lose their concession if the area is found to be deteriorating through negligence as determined by an annual audit.</p>

<b>PRESSURE</b>	DIVER DAMAGE, TRAMPLING, AND SOUVENIR COLLECTION
<b>Status</b>	The reefs of Iles Moucha and Maskali are under increasing pressure from activities related to expatriate diving, tourism and exploration of reef flat environments. Direct breakage of coral and extraction of souvenirs are two such activities.
<b>Objective</b>	To prevent physical damage caused by in-water activities such as SCUBA diving and walking over reef flats, and to reduce the trade in souvenir items extracted from the reef and mangrove habitats.
<b>Response</b>	Regulate swimming activities in the vicinity of shallow reefs and demarcate swimming and non-swimming areas. Implement diver and swimmer environmental awareness programmes and distribute information to tour operators. Complete ban on souvenir collection within the borders of the ASEI. Impose and enforce a ban on souvenir purchase and export in the Republic of Djibouti as a whole. Impose fines on expatriates for purchasing souvenirs and on people engaged in souvenir collection and selling. Provide compensation mechanisms for loss of livelihoods.
<b>Revenue</b>	The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration. Funds for rehabilitation and enforcement can be obtained from diving operator licence fee for the ASEI. Establish access fees.
<b>Policing</b>	General surveillance and monitoring by team of wardens. Policing by users (forum to be developed) who report violations to the DBPA. Spot checks on operator diving licences.

<b>PRESSURE</b>	<b>THREATS TO TURTLE NESTING</b>
<b>Status</b>	Turtle nesting is known to occur on Ile Maskali.
<b>Objective</b>	To minimise disturbance of turtle nesting on Iles Moucha and Ile Maskali.
<b>Response</b>	<p>A study must be conducted to determine the full extent and timing of nesting on the archipelago.</p> <p>Demarcation of nesting grounds and gazetting of these localities.</p> <p>Special status applied to these nesting grounds.</p> <p>Limiting visits to the nesting grounds during nesting periods.</p> <p>Information signs to inform visitors of nesting times and code of behaviour.</p> <p>Public awareness programme and visitor information points to be established at main nesting sites.</p> <p>Visitor activities to be minimised in the vicinity of nesting grounds and visitor access to be managed.</p> <p>Boating activity to be restricted at nesting times in waters adjacent to the nesting grounds.</p> <p>Impose fines for disregard of protected area status.</p> <p>Impose and enforce fines for purchase or selling of turtle carapaces in the Republic of Djibouti.</p> <p>Turtle and egg collection only with the approval of the DBPA and according to its mandate.</p>
<b>Revenue</b>	<p>The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration.</p> <p>Tourists can be asked for voluntary contributions to assist in turtle conservation.</p> <p>Establishment of access charges and concessions.</p>
<b>Policing</b>	<p>Surveillance and monitoring of the turtle nesting grounds by wardens.</p> <p>On-the-spot fines and possible imprisonment for illegal disturbance or capture of turtles or turtle eggs and disruption of the environment of turtle nesting areas.</p> <p>Policing by users (forum to be developed) who report violations to the DBPA.</p>

<b>PRESSURE</b>	<b>SEWAGE</b>
<b>Status</b>	There are no regulations governing the disposal of sewage on land or into the waters of Iles Moucha and Maskali. At present sewage from the capital does not affect the islands' habitats.
<b>Objective</b>	To maintain or enhance the marine habitats of Iles Moucha and Ile Maskali by ensuring that unregulated sewage discharge from concessionaires (boats and beach) does not occur.
<b>Locations</b>	All concessionaire beaches, vessels, and private chalets.
<b>Response</b>	<p>All concessionaires to provide toilet facilities.</p> <p>All concessionaires on the islands to provide sewage holding tanks or facilities to treat sewage to secondary level to cope with the maximum projected sewage load in their concessionaire area.</p> <p>Concessionaires with sewage holding tanks must dispose of sewage to an approved sewage disposal site (a treatment works or landfill) on the mainland if possible.</p> <p>Overflow of holding tanks must not be allowed.</p> <p>Impose complete ban on sewage discharge into waters within the proposed ASEI.</p>
<b>Revenue</b>	<p>Concessionaires to be so authorised and to charge users an environmental cost recovery fee as a condition of entering concessionaire areas.</p> <p>The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration.</p>
<b>Policing</b>	<p>General surveillance and monitoring by team of wardens.</p> <p>Policing by users (forum to be developed) who report violations to the DBPA.</p> <p>Spot checks on concessionaire and individual sewage discharge mechanisms. Concession to be revoked on repetition of offence.</p>

## **Khor Ambado**

**Enforcement:** As for Iles Moucha and Maskali.

***Current Conservation Status:***

None.

***Recommended Status:***

The beach of Khor Ambado should be secured from uncontrolled development. The EMP defines the demarcation of a proposed ASEI encompassing Khor Ambado, the neighbouring bays and adjacent reefs.

**Visitor Management Guidelines:**

It should be noted that the visitor management guidelines have been compiled on the assumption that the Environmental Management Plan is implemented and that the products of that initiative (for instance, environmental education) will be available at the local level.

**Current Ecological Status and Main Impacts on Reefs:** See Overall Assessment section.

<b>PRESSURE</b>	DIVER DAMAGE, TRAMPLING, AND SOUVENIR COLLECTION
<b>Status</b>	The reefs of Khor Ambado are reported to be under increasing pressure from these impacts. Direct breakage of coral from trampling was observed. Souvenir collection still occurs, but is controlled by the poor visibility and distance of the living reef from the beach.
<b>Objective</b>	To prevent physical damage caused by in-water activities such as SCUBA diving and walking over reef flats, and to reduce the trade in souvenir items extracted from the reef and mangrove habitats.
<b>Response</b>	Regulate swimming activities and demarcate areas of sensitivity - particularly to the east of the main beach and the reefs lying off Khor Ambado Seghir. Implement diver and swimmer environmental awareness programmes and distribute information to concessionaires. Complete ban on souvenir collection within the boundaries of the ASEI. Impose and enforce a ban on souvenir purchase and export in the Republic of Djibouti as a whole. Impose fines on expatriates for purchasing souvenirs and on people engaged in souvenir collection and selling. Examine compensation for loss of livelihood.
<b>Revenue</b>	The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration. Funds for rehabilitation and enforcement can be obtained from diving operator licence fee for the ASEI. Concessionaires to be so authorised and to charge users an environmental cost recovery fee as a condition of entering concessionaire areas.
<b>Policing</b>	General surveillance and monitoring by beach warden(s). Policing by users (forum to be developed) who report violations to the DBPA. Spot checks on concessionaire diving licence.

<b>PRESSURE</b>	<b>LITTER (SOLID WASTE)</b>
<b>Status</b>	Currently a significant problem affecting the beach of Khor Ambado and Khor Ambado Seghir. There are insufficient litter bins, and there is no authority, programme, or procedure for systematic litter collection and disposal. No statutory controls are in place.
<b>Objective</b>	To reduce visual and physical impacts of litter disposal, including impacts on human health.
<b>Response</b>	<p>Dumping of litter on the beach and in the water to be made illegal.</p> <p>An appropriate subsidiary management authority established or existing authority charged with provision of reception and disposal facilities on public beaches.</p> <p>Concessionaires to provide bins and to dispose of litter at agreed sites as a condition of their operating license.</p> <p>Litter bins to be installed every 100 m on the beach frontage, and at accessible locations around the islands.</p> <p>Information and public awareness posters installed along beach.</p> <p>Fines imposed on tourist operators not providing adequate facilities and individuals who litter.</p>
<b>Revenue</b>	<p>The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and to fund environmental rehabilitation and restoration.</p> <p>Concessionaires to be so authorised and to charge users an environmental cost recovery fee as a condition of entering concessionaire areas.</p> <p>Concessionaires to pay DBPA for concessions.</p>
<b>Policing</b>	<p>DBPA to allocate task of policing for illegal littering to wardens. Random spot-checks and surveillance to be undertaken by wardens.</p> <p>Policing by users (forum to be developed) who report violations to appropriate authority (Direction des Affaires Maritimes and Direction de l'Environnement).</p> <p>People who litter to be fined for each incident.</p> <p>Concessionaires to be fined for each bin not emptied within 24 hours of being notified. Concession to be revoked on repetition of offence.</p>

<b>PRESSURE</b>	<b>SPORT FISHING</b>
<b>Status</b>	No current controls on sport fishing in the area.
<b>Objective</b>	To reduce the reported depletion of commercially valuable reef associated fish in the region, and to mitigate the impact on the reef ecosystem by reducing the removal of key predators.
<b>Response</b>	All waters in the Khor Ambado ASEI specified in the EMP to be a designated no fishing zone as a precautionary approach. Fines imposed for disregard of the prohibited measures. Public awareness and information campaign established.
<b>Revenue</b>	The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration. Charges for access to concessionaire beach can be utilised for costs of surveillance.
<b>Policing</b>	Random spot checks on individual and tour operator licences to be undertaken by wardens. Illegal fishing to be fined and vessel confiscated upon repetition of offence. Policing by users (forum to be developed) who report violations to DBPA.

**PRESSURE** UNCONTROLLED ANCHORING AND LANDING

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**Status** Effects have been reported as widespread and damaging. No direct record of impact made in present study, but pressure is likely to increase if unchecked.

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**Objective** To concentrate anchoring and landing activities into a designated area so as to reduce pressure on sensitive and vulnerable locations.

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**Response** Installation of approximately eight buoys at Khor Ambado and two at Khor Ambado Seghir.  
Installation to be supervised by the DBPA.  
Provide adequate landing facilities for visitors at critical points near to the anchorage. All jetty structures to be built on pillars.  
Visitor information to be provided prominently at suitable locations and to be provided through the military bases and the hotels.

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**Revenue** The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration.  
Fees generated from access charges.

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**Policing** Boats anchored outside demarcated anchorages should have fines imposed, be confiscated or impounded and, if necessary, auctioned to pay for fine.  
Policing by users (forum to be developed) who report violations to the DBPA.

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## **Reefs and Beaches in Vicinity of Djibouti City**

### ***Current Conservation Status:***

None.

### ***Recommended Status:***

Public beaches must be clearly marked and gazetted. Clear warnings of sewage outfalls must be posted on public beaches. Sewage treatment systems will have to be examined and improved if marine tourism is going to be safely developed and attracted to Djibouti City.

**Current Ecological Status of Reefs and Beaches:** Turbidity and raw sewage pollution are high. Reefs exhibiting high live coral cover are present, but are patchy and not widespread. Patch reefs are interspersed with mud. Beaches are heavily littered and there is currently inadequate sewage treatment before discharge close to the shore. Many beaches are heavily polluted.

**Main Impacts on Reefs:** Sewage pollution, litter, sedimentation, fishing, souvenir collection.

**Main Impacts on Beaches:** Litter, development and destabilisation, sewage.

<b>PRESSURE</b>	<b>LITTER (SOLID WASTE)</b>
<b>Status</b>	Currently a significant problem affecting all beaches of Djibouti City. There are insufficient litter bins, and there is no authority, programme, or procedure for systematic litter collection and disposal. No statutory controls are in place.
<b>Objective</b>	To reduce visual and physical impacts of litter disposal and reduce the effects on human health.
<b>Response</b>	<p>Dumping of litter on the beach and in the water to be made illegal.</p> <p>An appropriate subsidiary management authority established or existing authority charged with provision of reception and disposal facilities on public beaches.</p> <p>Concessionaires to provide bins and to dispose of litter at agreed sites as a condition of their operating license.</p> <p>Djibouti Municipality to provide bins and to arrange disposal of litter on public beaches and causeways.</p> <p>Litter bins to be installed every 100 m on the beach frontage, and at accessible locations.</p> <p>Information and public awareness posters installed along beach.</p> <p>Environmental education programme encouraged.</p> <p>Fines imposed on concessionaires not providing adequate facilities, information, and disposal support.</p> <p>Fines imposed on individuals who litter.</p>
<b>Revenue</b>	<p>The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and illegal activities to fund environmental rehabilitation and restoration.</p> <p>Concessionaires to be so authorised and to charge users an environmental cost recovery fee as a condition of entering concessionaire areas.</p> <p>Concessionaires to pay the DBPA for concessions.</p>
<b>Policing</b>	<p>DBPA to allocate task of policing for illegal littering to wardens. Random spot-checks and surveillance to be undertaken by wardens.</p> <p>Policing by users (forum to be developed) who report violations to the appropriate authority.</p> <p>Individuals who litter to be fined for each incident.</p> <p>Concessionaires to be fined for each bin not emptied within 24 hours of being notified. Concession to be revoked on repetition of offence.</p>

<b>PRESSURE</b>	<b>SEWAGE</b>
<b>Status</b>	The waters and beaches of Djibouti City are, in general, heavily polluted by raw sewage discharged over beaches, into mangroves and directly into the sea. Sewage is the main threat to development of marine tourism on the reefs and coast of Djibouti City. Currently, public access beaches are a health hazard.
<b>Objective</b>	To reduce the human health hazard, and to enhance the coastal and marine habitat of Djibouti City.
<b>Response</b>	Sewage collection, treatment, and disposal plan should be developed and implemented for Djibouti City. Sewage treatment systems should be introduced to treat sewage at least to secondary level. Imposition of a complete ban on the discharge of raw sewage within 1 km of public access beaches. Avoid discharges of treated sewage within 500 m of a public access beach. Disposal of sewage from vessels moored in the port area or within 5 km of the city should be prohibited. Municipality of Djibouti should develop guidelines for developers with regard to installation of suitable waste disposal procedures. Discharge of sewage and other forms of liquid waste into mangroves to be banned.
<b>Revenue</b>	Concessionaires to be so authorised and to charge users an environmental cost recovery fee as a condition of entering concessionaire areas. The DBPA must be empowered to obtain monies from fines in lieu of unpaid fees and from illegal activities to fund environmental rehabilitation and restoration.
<b>Policing</b>	Beach wardens to undertake surveillance and monitoring of public access beaches. Spot checks on concessionaire and individual sewage discharge mechanisms.

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# *Appendices*

## Appendix 1: Project Planning Matrix for Implementation of the EMP

<b>PRELIMINARY PROJECT PLANNING MATRIX (PPM)</b>			
<b>Capacity Building for Sustainable Development: Djibouti Biodiversity Proectorates Authority (DBPA)</b>			
<b>INTERVENTION LOGIC GOAL:</b>	<b>OBJECTIVELY VERIFIABLE INDICATORS</b>	<b>SOURCES OF VERIFICATION</b>	<b>ASSUMPTIONS</b>
<p>Status of marine resources improved through implementation of sustainable environmental management plan.</p>	<p>Key state of the environment indicators show no environmental deterioration.</p>	<p>Audit reports</p>	<p>Non-anthropogenic influences on key indicators are not significant. Government commitment to project continues. Wealth generated meets recurrent costs of management. Pre-conditions are met.</p>
<p><b>PURPOSE:</b></p> <p>Improved techniques for management of marine and coastal ecosystems developed and promoted.</p>	<p>Reduction in the rate of environmental deterioration from the current level by the end of the project.</p>	<p>Monitoring against baseline data</p>	<p>Non-anthropogenic influences on key indicators are not significant. Government commitment to project continues. Wealth generated meets recurrent costs of management.</p>
<p><b>OUTPUTS:</b></p> <ol style="list-style-type: none"> <li>Djibouti Biodiversity Protectorates Authority established and operational.</li> <li>Monitoring programme based on environmental indicators developed and operational.</li> <li>Decision support tool based on GIS developed to assist management planning.</li> <li>Public awareness and environmental education programme introduced and effective.</li> </ol>	<ol style="list-style-type: none"> <li>BDPA created and functional by the end of the first year.</li> <li>Indicators selected and monitoring programme in place by end of year 2.</li> <li>Decision support tool developed by the end of year 2 and fully operational by the end of year 3. Interpretative material produced and distributed from end year 1 onwards.</li> </ol>	<ol style="list-style-type: none"> <li>Board Minutes</li> <li>Monitoring and audit reports</li> <li>Monitoring and audit reports</li> <li>Suitable media productions</li> </ol>	<p>Government invests in new institution.</p>

## Appendix 1: Project Planning Matrix for Implementation of the EMP (cont.)

<b>OUTPUTS Cont.....</b>					
<p>5. Capacity building in DBPA staff, local NGOs, Universities, private firms and government agencies to provide consultancy services and enhance the sustainable development capacity to the BDPA.</p>		<p>5. All BDPA and associated staff trained in related environmental management techniques by the end of year 5.</p>	<p>5. Qualified staff with certification</p>	<p>Staff made available to participate.</p>	
<p><b>ACTIVITIES:</b></p> <p>1.1 DBPA infrastructure developed.            1.2 Management Board selected and approved by a higher authority.            1.3 DBPA staff chosen and appointments approved.            1.4 Equipment selected and purchased for a) general administration b) transport.            1.5 Environmental Management Plan for the whole of the Djibouti Sustainable Development Area developed and implemented, incorporating: a) the establishment of Environmentally Special Areas, b) a system of surveillance and enforcement, c) best environmental practice advisory and monitoring service.            1.6 Recurrent funding mechanisms identified, approved by the Board and introduced.            1.7 Assessment of liability and litigatory procedure.            2.1 Key management indicators, based on pressure-state-response model identified and monitored.            2.1 Key environmental indicators, based on pressure-state-response model identified and monitored.</p>	<p><b>BUDGET:</b>            Infrastructure costs            Operational costs/overheads            Equipment            International Staff            Local Staff            Travel            Oil spill contingency            Environmental protection/rehabilitation Consumables            Miscellaneous            Training and publications            TOTAL</p>	<p>1.1 DBPA in place            1.2 Board minutes            1.3 DBPA staff in place            1.4 Equipment on-site            1.5 Approval of management plan and associated activities in Board papers            Monitoring reports            1.6 DBPA audited accounts            1.7 Board papers and monitoring reports</p>	<p>2.1 Monitoring and audit reports            2.1 Monitoring and audit reports</p>	<p>Government continues to invest in new institution.</p>	

## Appendix 1: Project Planning Matrix for Implementation of the EMP (cont.)

ACTIVITIES Cont.....			
<p>3.1 Decision support tool developed data entered and system functional. 3.2 Information from support tool incorporated into the management process. 3.3 Training programme for DBPA local staff in GIS techniques and environmental applications.</p>		<p>3.1 Functional database and GIS 3.2 Monitoring and audit reports 3.3 Staff trained</p>	
<p>4.1 Dissemination of information concerning the role and activities of the DBPA. 4.2 Development of interpretative materials for use within the Authority and for wider distribution to the general public and to educational establishments. 4.3 Development of a public relations role for liaison between the DBPA and local industry/tourism groups.</p>		<p>4.1 Project reports and scientific papers 4.2 Suitable materials 4.3 Monitoring reports</p>	
<p>5.1 International and national long-term courses attended in relevant environmental management themes. 5.2 International and national short-term courses attended in relevant environmental management themes. 5.3 International workshops held in Djibouti for exchange of information. 5.4 National workshops held in Djibouti for general dissemination of information and exchange of ideas.</p>		<p>5.1 Qualified staff with certification 5.2 Qualified staff with certification 5.3 Workshop proceedings 5.4 Workshop proceedings</p>	<p>Staff made available to participate.</p>

PRE-CONDITIONS
<ol style="list-style-type: none"> <li>1. Government gazettes* the seven areas indicated in the report as Biodiversity Protectorates.</li> <li>2. Government gazettes and empowers the DBPA to manage these protectorates according to the criteria set by the CBD.</li> <li>3. Government gazettes regulations necessary for the effective management of and generation of revenue from these Biodiversity Protectorates.</li> <li>4. Government provides suitable office accommodation etc. for the BDPA.</li> <li>5. Government exempts project from import duties.</li> <li>6. Government agrees to meet basic recurrent costs of the Authority.</li> </ol>

\*Gazetting implies legal designation and empowerment of the DBPA to achieve the goal and purpose specified in this logical framework

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## Appendix 2: The Maps

Map 1: Map of the Coastline of Djibouti to show Survey Areas

Map 2: Sample locations - Iles Moucha and Ile Maskali

Map 2a: Coral cover (as percentage) in reef assessment swims - Iles Moucha and Maskali

Map 3: Sample locations - Khor Ambado

Map 3a: Coral cover (as percentage) in reef assessment swims - Khor Ambado

Map 4: Sample locations - Djibouti City

Map 4a: Coral cover (as percentage) in reef assessment swims - Djibouti City

Map 5: Sample locations - Tadjoura

Map 5a: Coral cover (as percentage) in reef assessment swims - Tadjoura

Map 6: Sample locations - Collines de Godoria

Map 6a: Coral cover (as percentage) in reef assessment swims - Collines de Godoria

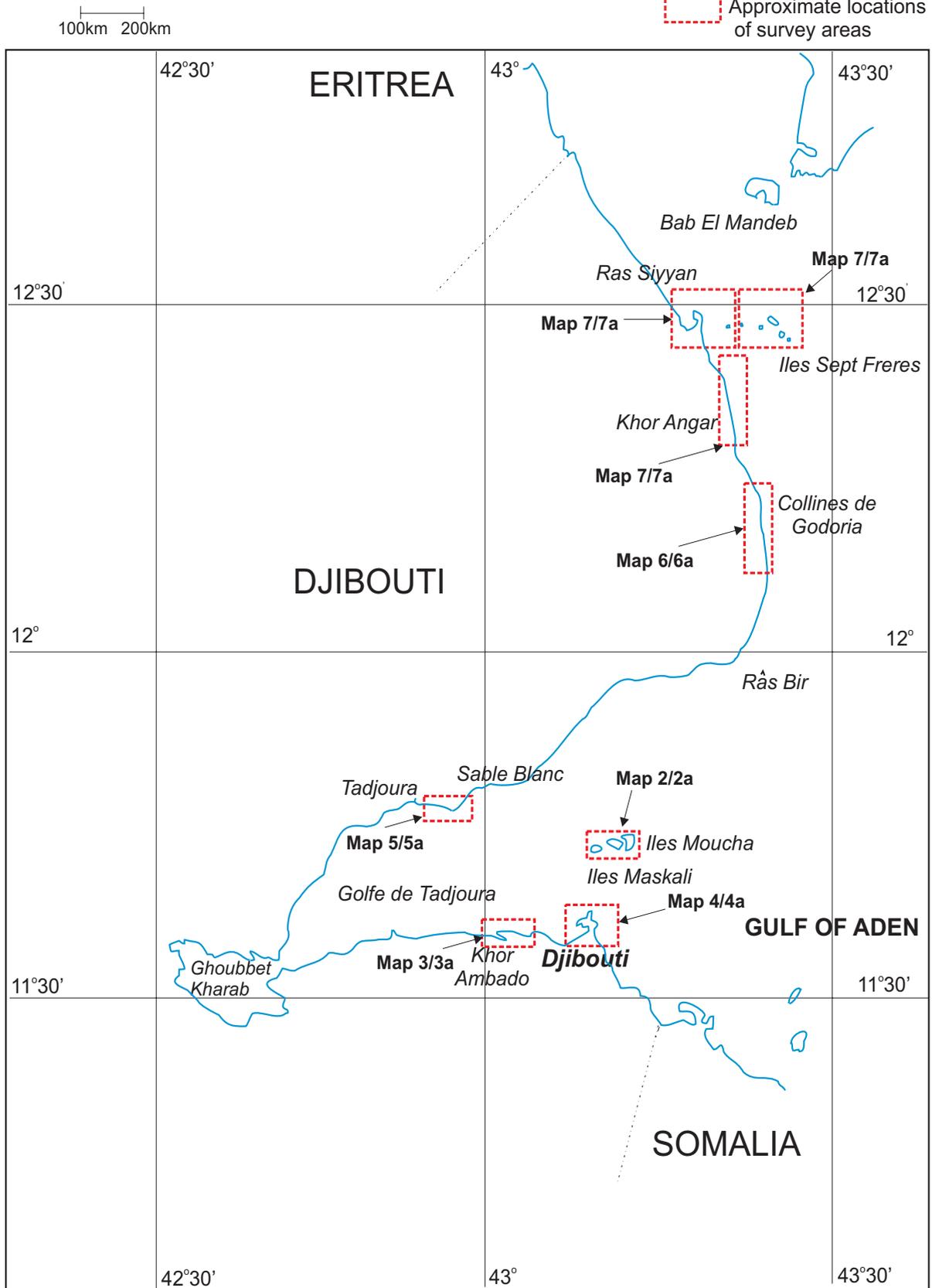
Map 7: Sample locations - Khor Angar and Iles des Sept Frères

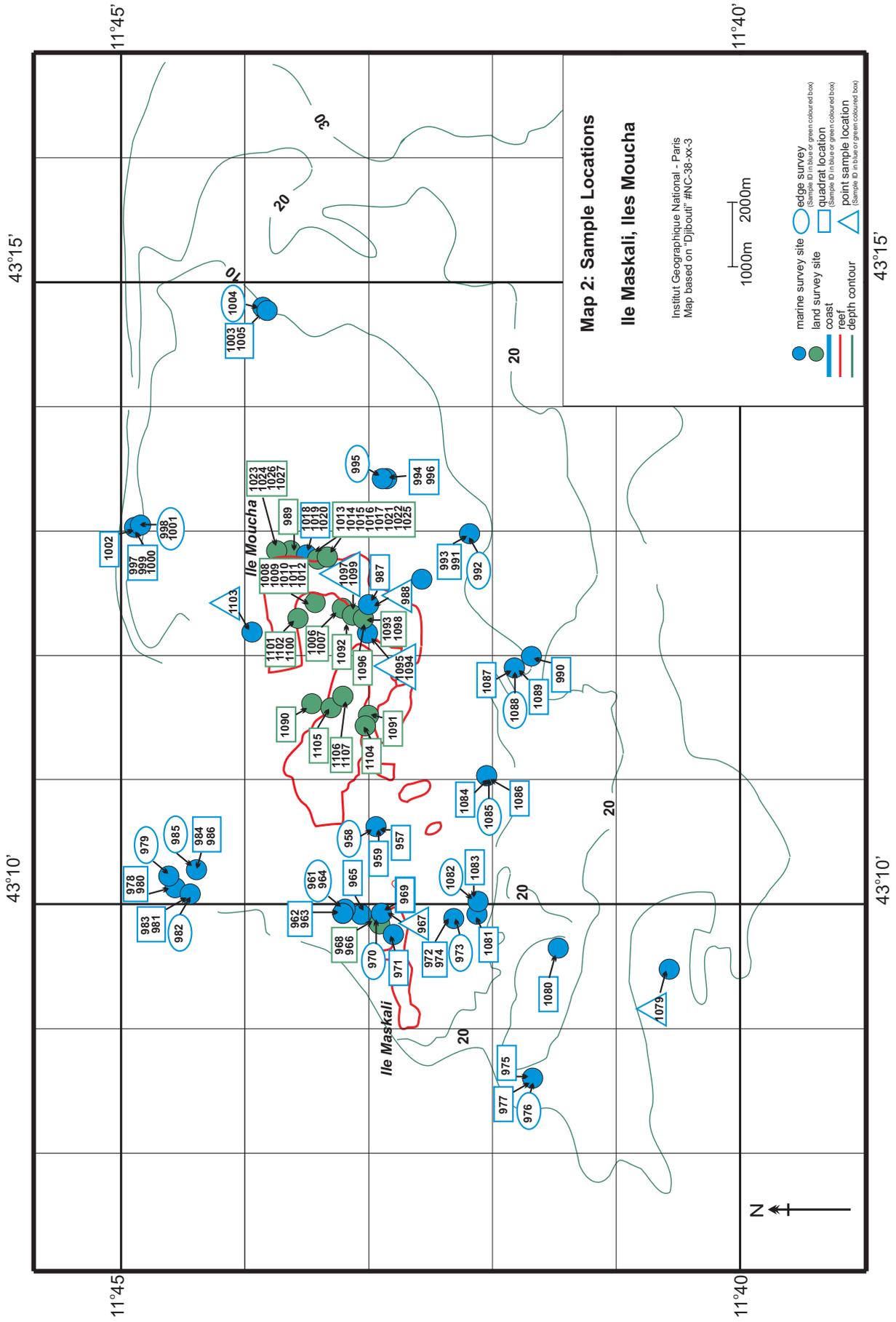
Map 7a: Coral cover (as percentage) in reef assessment swims - Iles des Sept Frères, Khor Angar, and Ras Siyyan

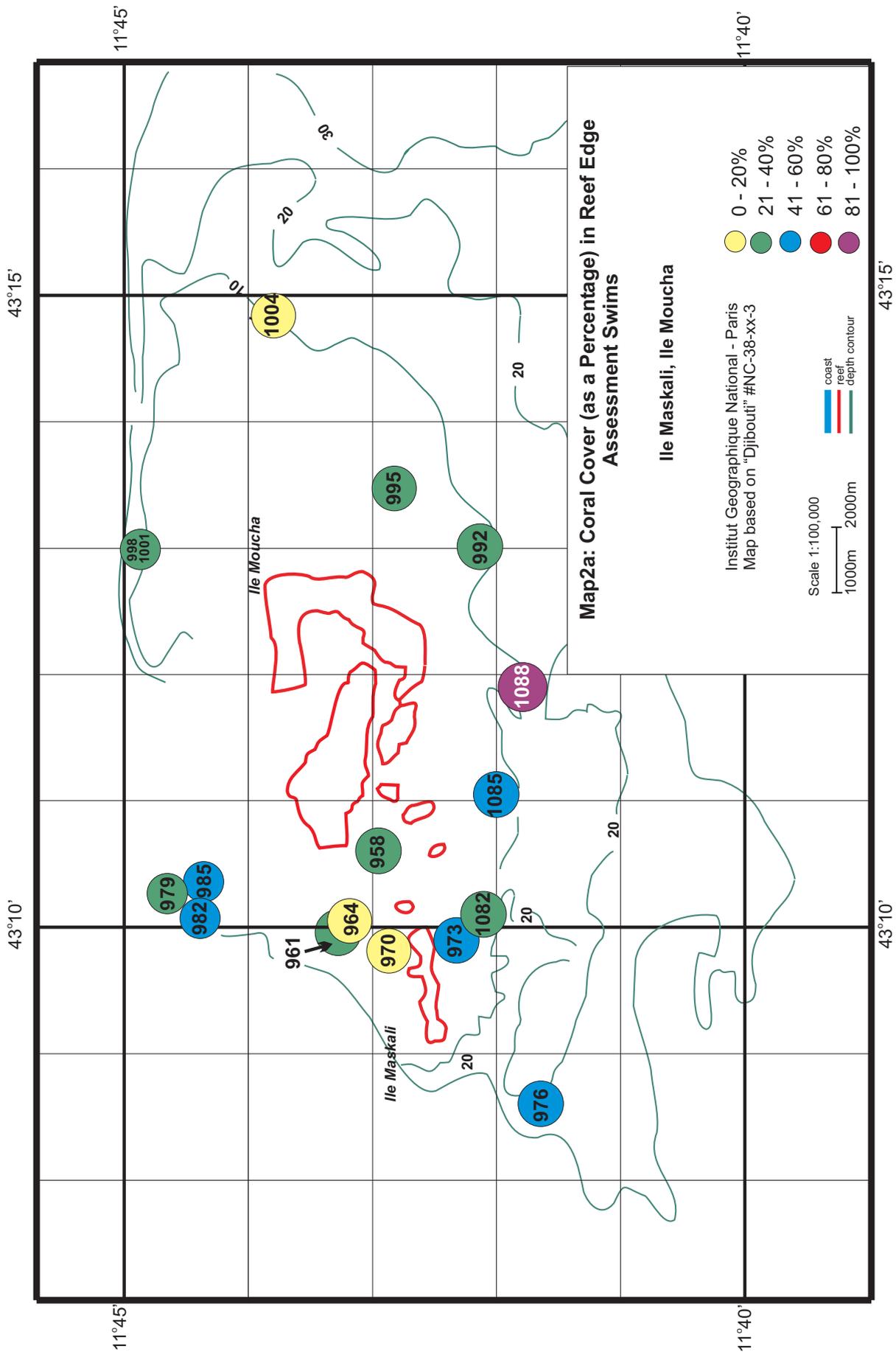


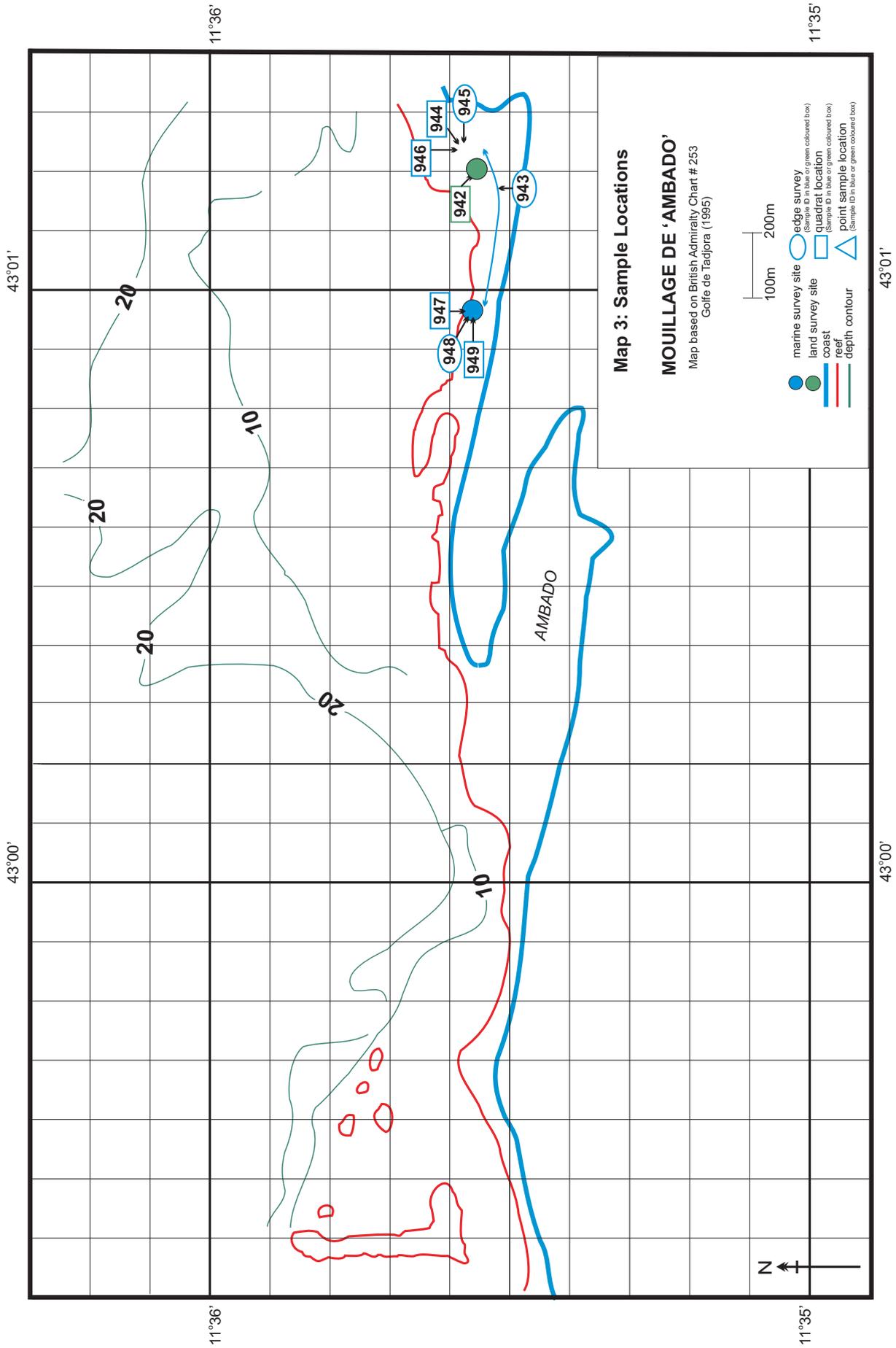
# Map 1: Map of the Coastline of Djibouti to Show Survey Areas

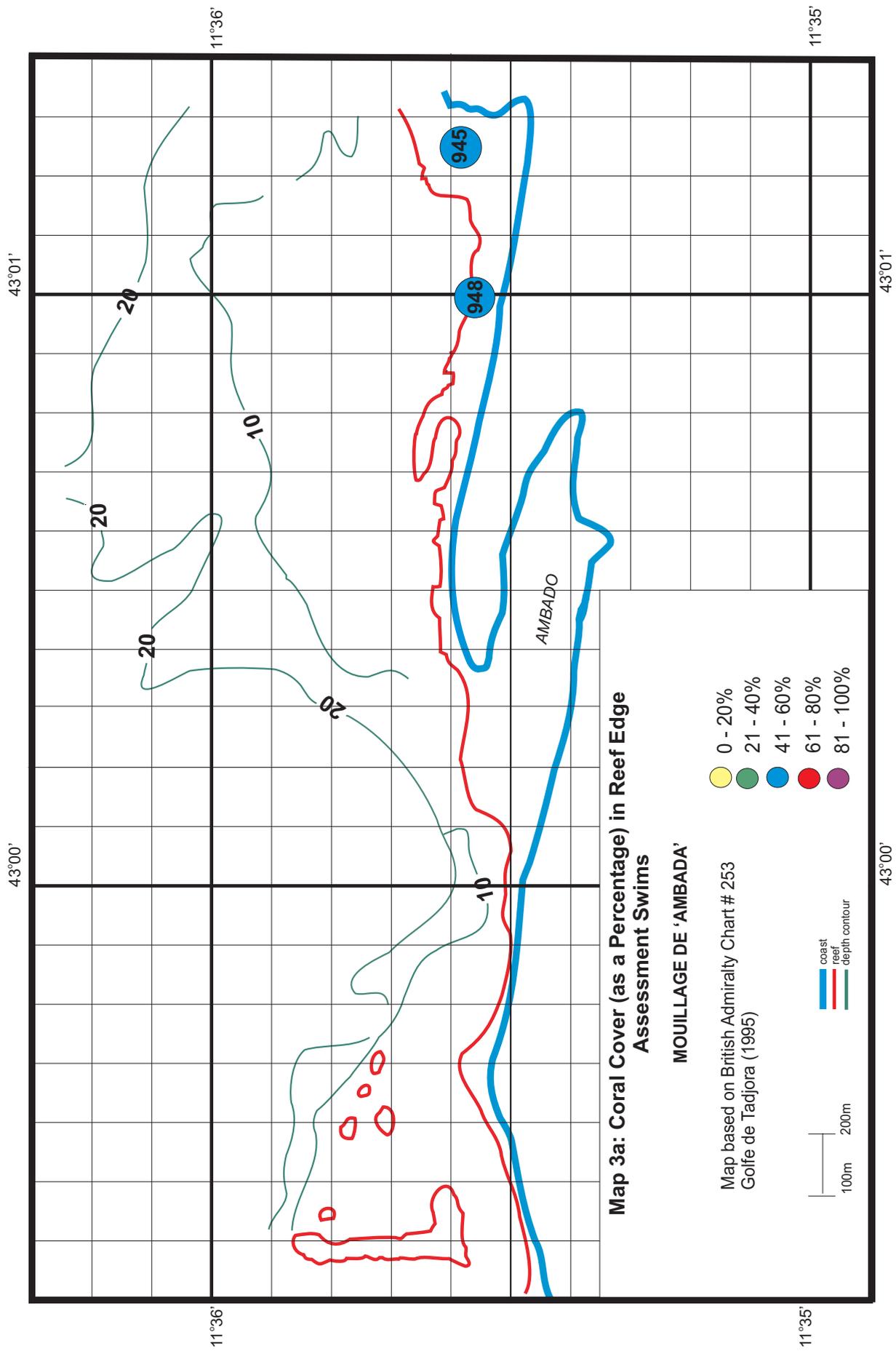
Based on British Admiralty Map 9  
Gulf of Aden

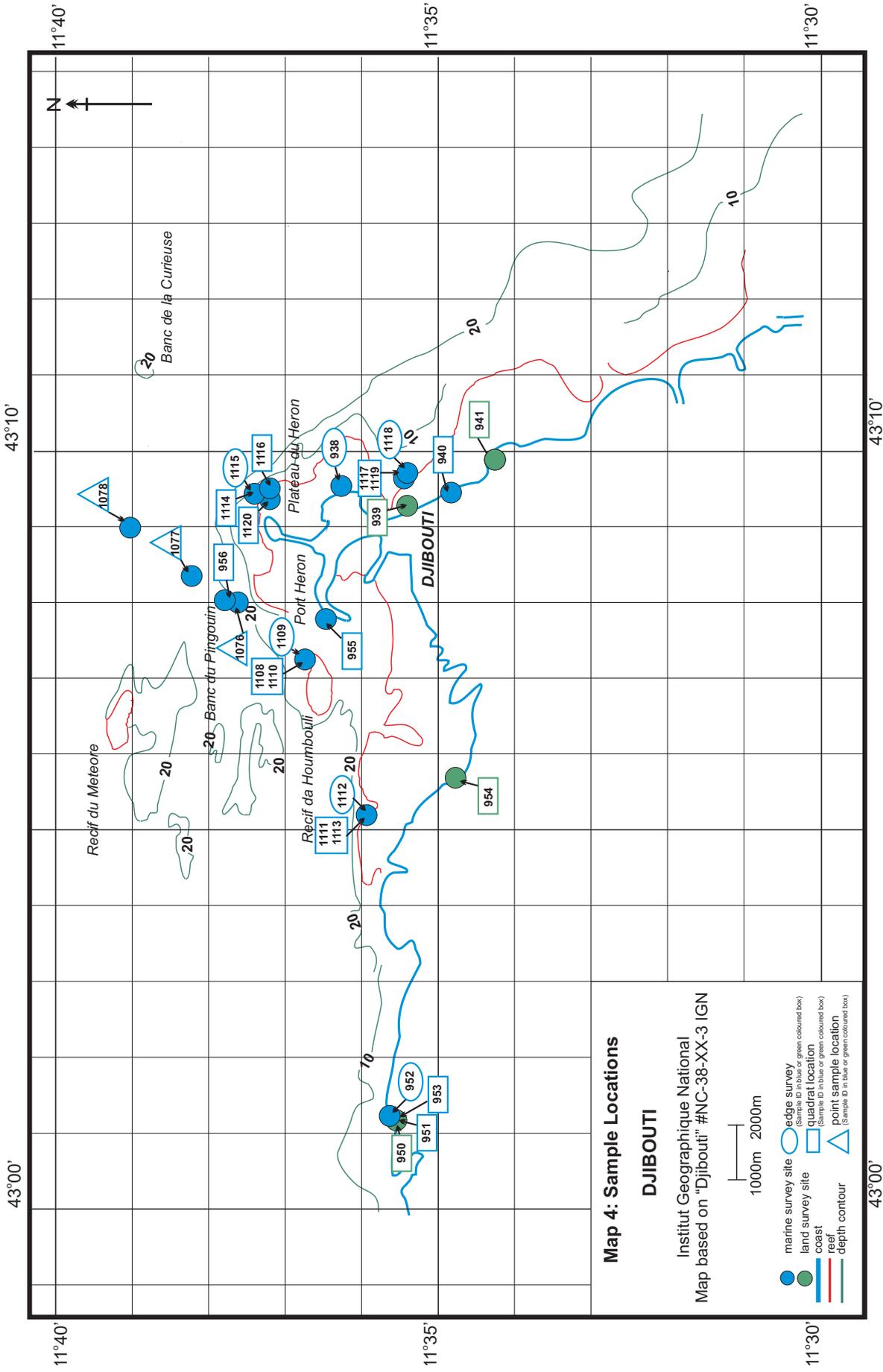




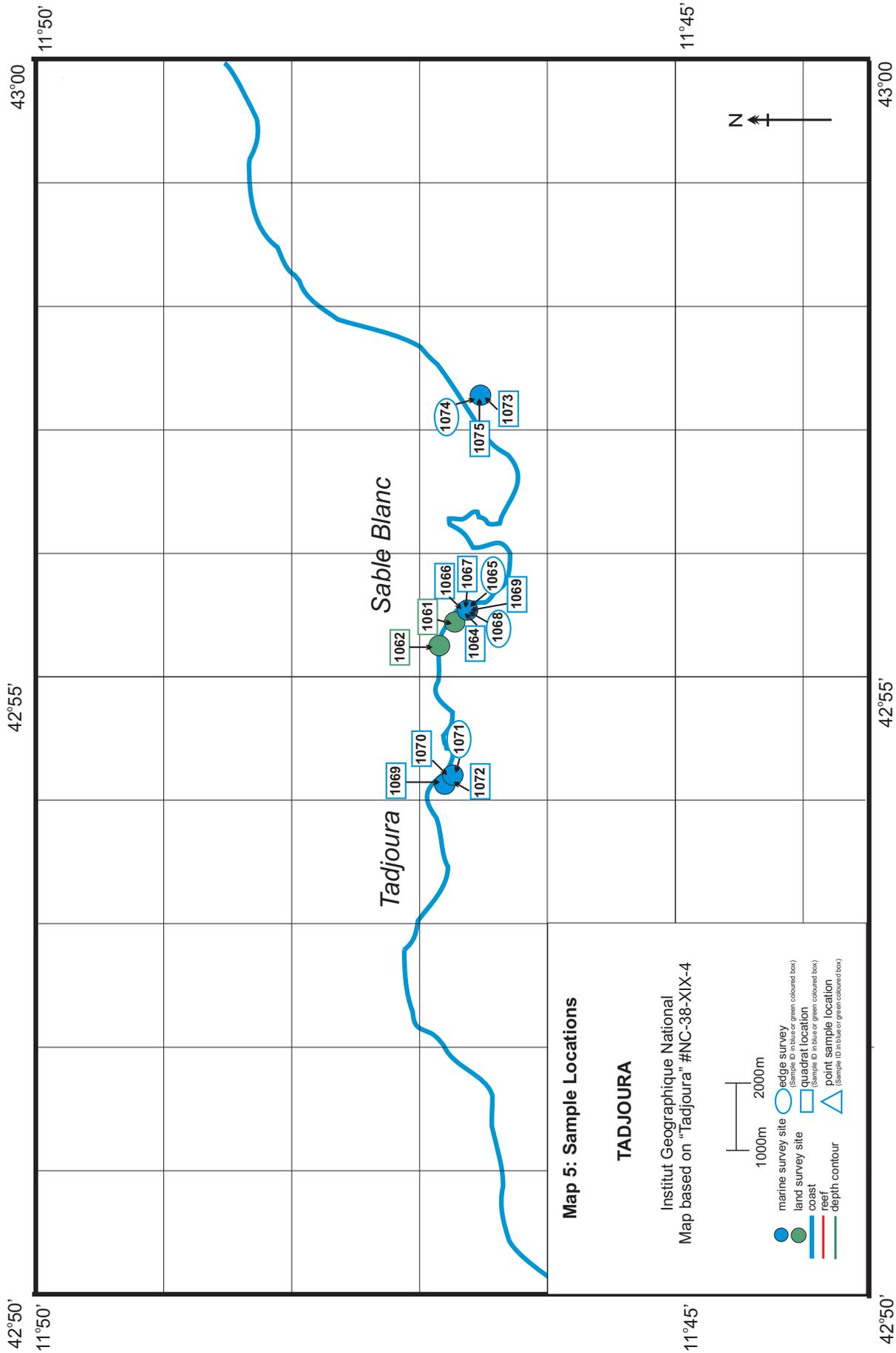


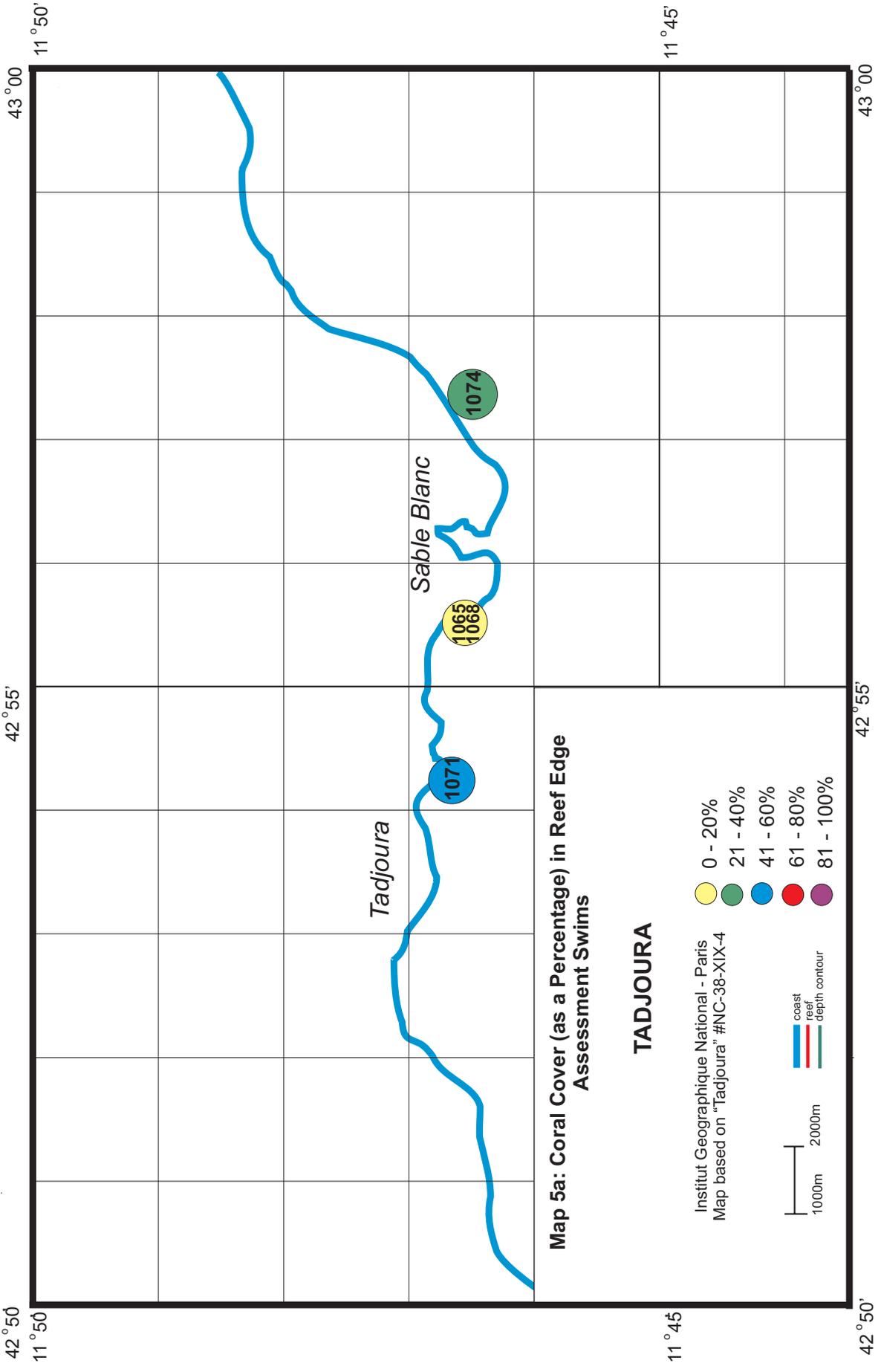


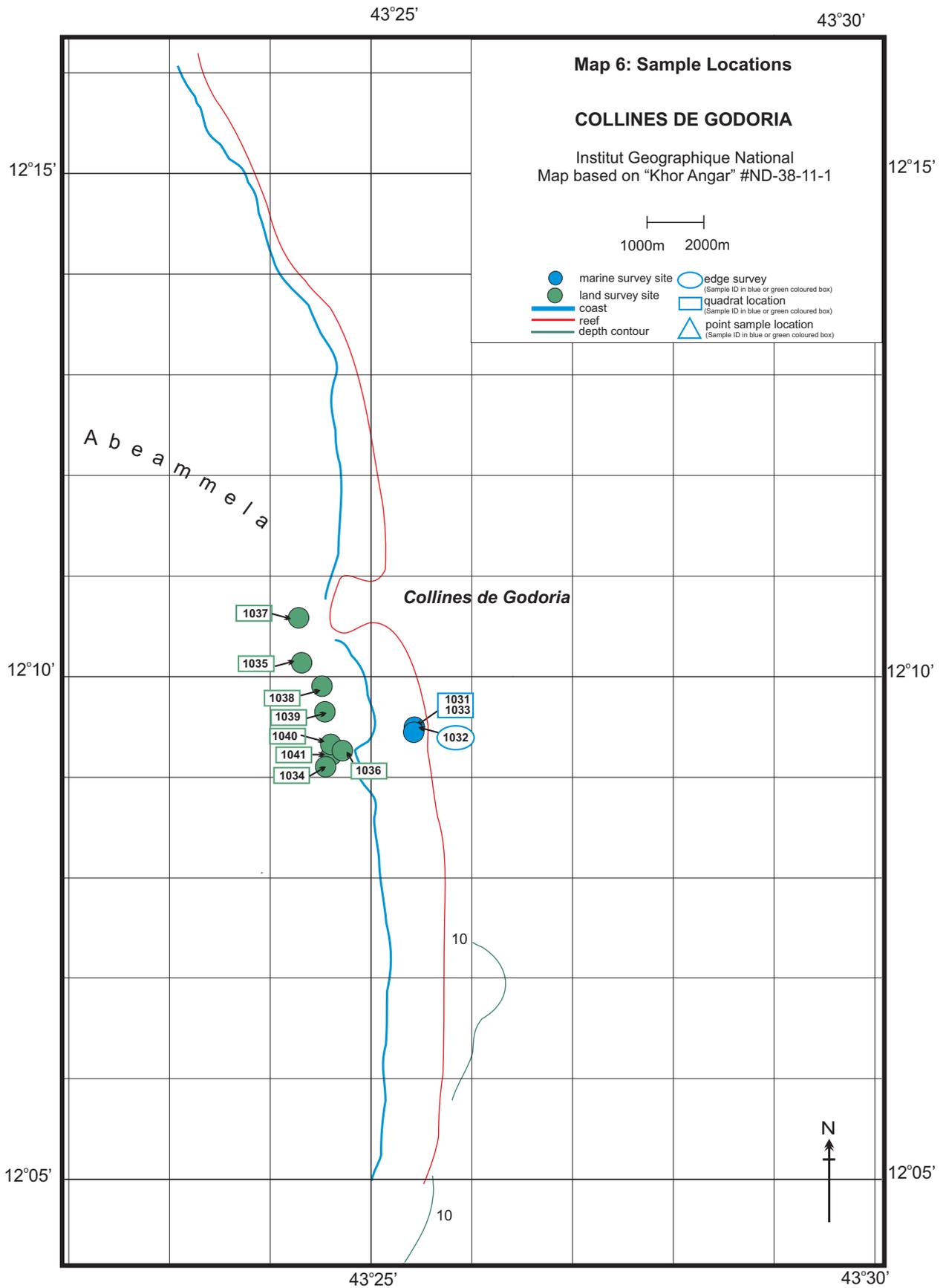












43°25'

43°30'

### Map 6a: Coral Cover (as a Percentage) in Reef Edge Assessment Swims

## COLLINES DE GODORIA

Institut Geographique National - Paris  
Map based on "Khor Angar" #ND-38-11-1

- 0 - 20%
- 21 - 40%
- 41 - 60%
- 61 - 80%
- 81 - 100%

1000m 2000m

— coast  
— reef  
— depth contour

12°15'

12°15'

A b e a m m e l a

Collines de Godoria

12°10'

12°10'

1032

10

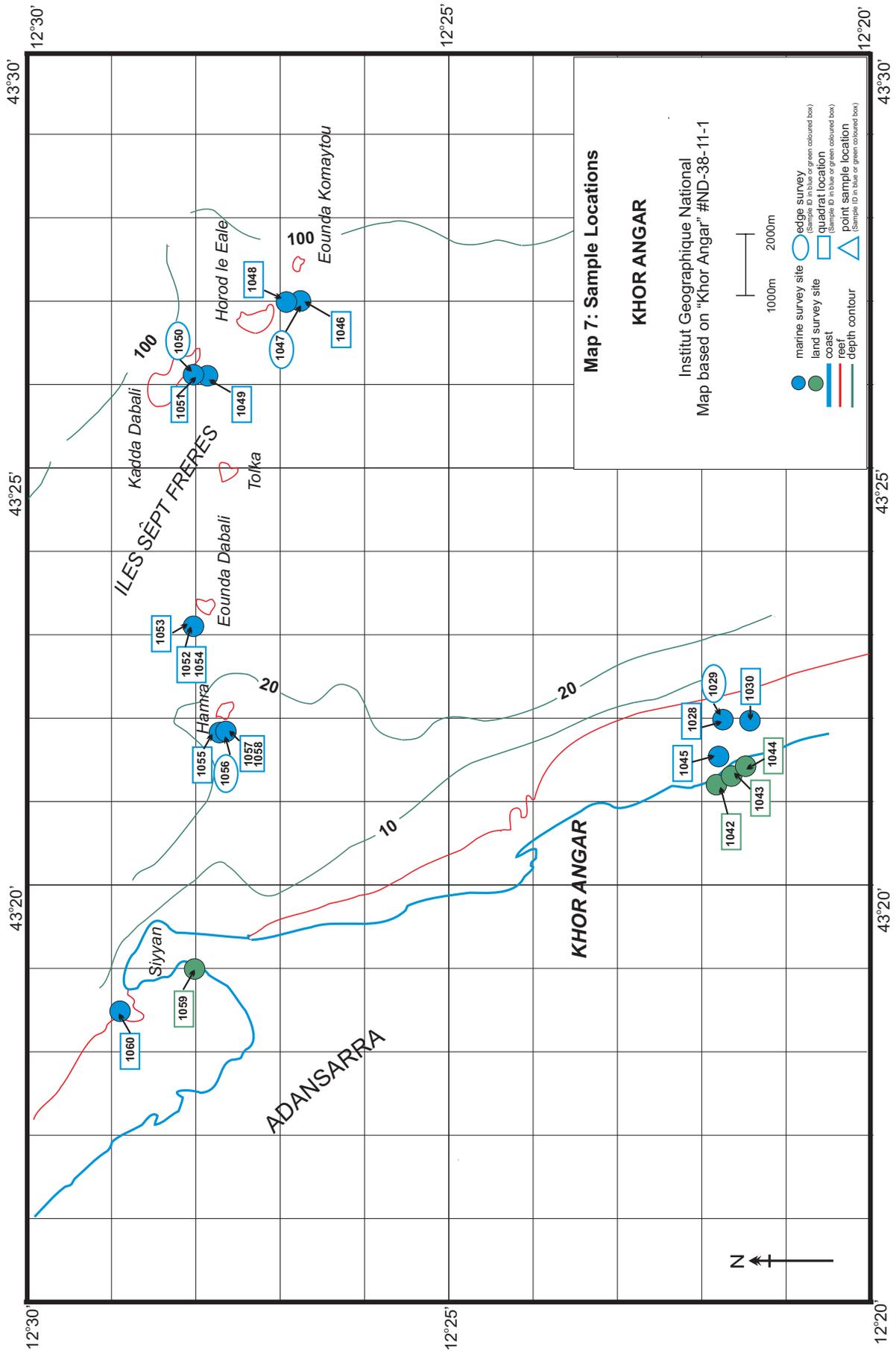
10

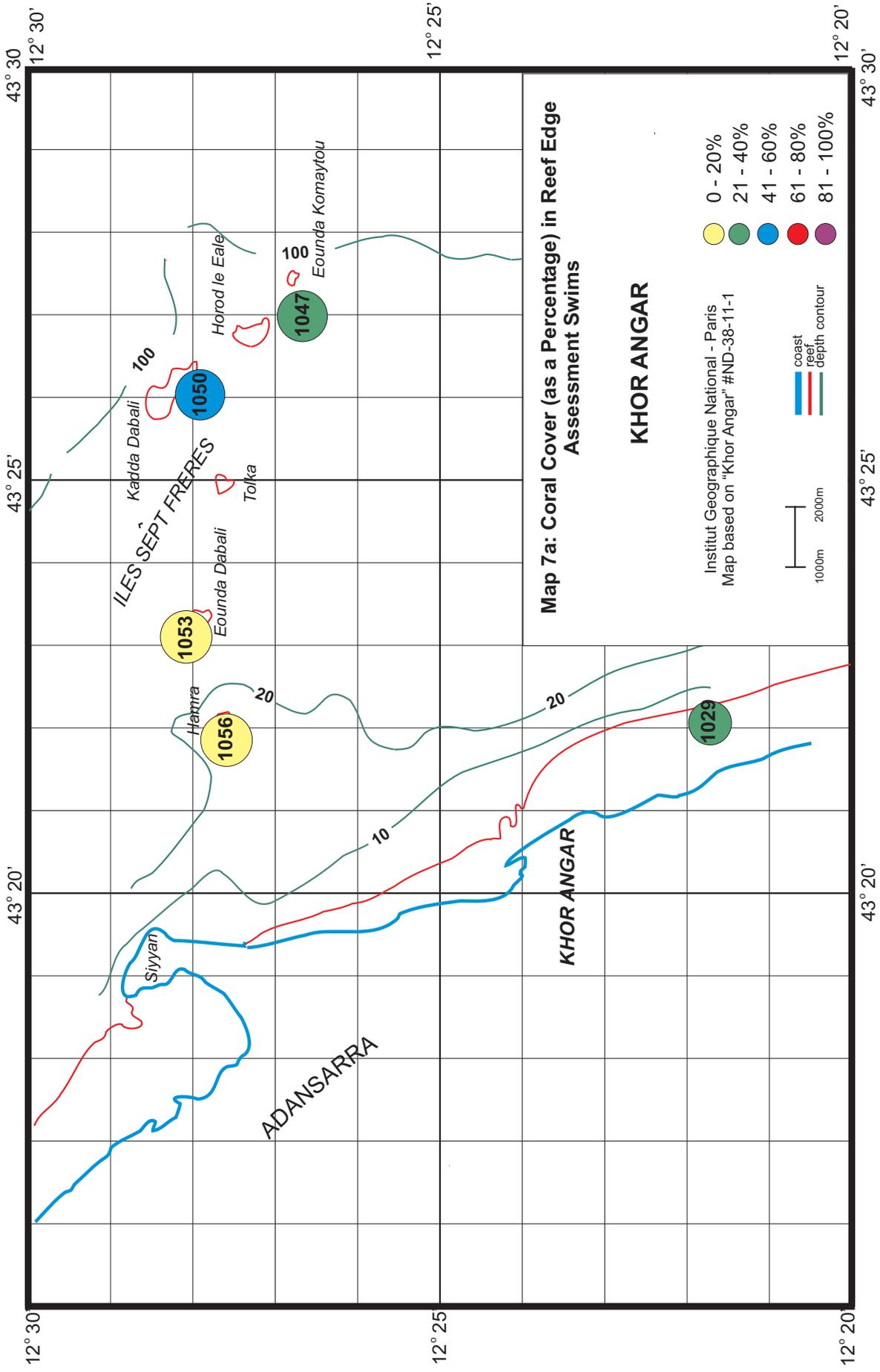
12°05'

12°05'

43°25'

43°30'







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## Appendix 3: Abbreviations and Acronyms

<b>Abbreviation</b>	<b>Full title</b>
AIMS	Australian Institute of Marine Science
ALECSO	Arab League Educational Cultural and Scientific Organization
ASEI	Area of Special Environmental Interest
CBD	Convention on Biological Diversity
CEC	Commission of the European Community
COT	Crown of Thorns
DBPA	Djibouti Biodiversity Protectorates Authority
DC	Dead Coral
DCA	Dead Coral with Algae
DMS	Data Management System
G-ID	Glossary ID number
EPA	Environmental Protection Agency (USA)
EEA	European Environment Agency
ESEE	European Society for Ecological Economics
GIS	Geographic Information System
GPS	Global Positioning System
ID	Identification Code
IMO	International Maritime Organization
ISERST	Institut Supérieur d'Etudes et des Recherches Scientifiques et Techniques
LHC	Living Hard Coral
MPAM	Ministère du Port et des Affaires Maritimes
MUMA	Multiple-Use Management Area
OECD	Organisation for Economic Co-operation and Development
ONTA	Office National du Tourisme et de l'Artisanat
OVI	Objectively Verifiable Indicator
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
PSR	Pressure-State-Response
SAP	Strategic Action Programme
S-ID	Sample ID number
SS	Sub-sample
SSS	Sub-sub-sample
TDA	Tourism Development Authority (Egypt)
UNEP	United Nations Environment Programme
UTC	Coordinated Universal Time (formerly Greenwich Mean Time – GMT)
UTM	Universal Transverse Mercator

## Appendix 4: Glossary

<b>Keyword</b>	<b>Definition of primary synonym</b>
<b>Biological Diversity</b>	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
<b>Checklist ID or Checklist</b>	The unique number identifying a combination of Glossary ID's and forming a particular field survey "checklist" in the database.
<b>Conservation of the marine environment of the Red Sea and Gulf of Aden</b>	Rational use by man of living and non-living marine and coastal resources in a manner ensuring optimum benefit for the present generation while maintaining the potential of that environment to satisfy the needs and aspirations of future generations. Such a definition of the term "conservation" should be construed as including conservation, protection, maintenance, sustainable and renewable utilization, and enhancement of the environment.
<b>Date (Start) or Date (End)</b>	The boxes on the field datasheet that contain the start date and end date, respectively, of the sample. The dates are in UTC.
<b>Ecotourism</b>	Tourism of a "scale that is small with limited ecological and social impacts" in contrast to nature-based tourism where scale is not the distinguishing feature but nature clearly is.
<b>G-Code</b>	The box on the field data sheet that contains the keyword code for the GPS (e.g. Magellan 3000XL) used to locate the sample point.
<b>GeoPS</b>	The box on the field datasheet that contains the name of the GPS used to locate the sample point.
<b>Glossary ID (G-ID)</b>	The unique number identifying a single combination of Keyword Codes and associated keywords in the database.
<b>Intergenerational Equity</b>	Principle 3 of Rio Declaration. The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.
<b>Intertidal Zone</b>	The zone generally considered to be between MEAN HIGH WATER and MEAN LOW WATER levels.
<b>Keyword Code</b>	The unique number identifying a keyword or phrase and its synonyms (in the database).
<b>Logical Framework</b>	A set of related concepts describing the project in operational terms in matrix form.

**Pollution (marine)**

Introduction by man, directly or indirectly, of substances or energy into the marine environment which results or is likely to result in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea-water and reduction of amenities.

**Precaution (precautionary principle)**

Where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.

**Pressure**

Pressure indicators quantify the stresses in the form of direct pressures, such as fishing, trampling, grazing, diver damage, wood cutting, etc.

**Reef Assessment**

An assessment by using a fish checklist and anthropogenic and sessile organisms checklists by swimming for 20 minutes along the fore reef slope and reef face margin. See checklists in the database for detailed lists.

**Reef Edge**

A point on the seaward side of the reef crest, which is the highest point of the reef. It may be a little lower than the reef crest and marks the beginning of the reef face.

**Response**

Response indicators describe the actions taken to improve the quality of the environment.

**Sample ID**

The unique number identifying and linking all the data from one sample.

**State**

State indicators describe the environmental conditions of the water, coastline, and reef systems, and the quality and quantity of specific natural resources.

**Start UTC/Finish UTC**

The boxes on the field datasheet that contain the start and finish times, respectively, of the sample. Times are in UTC.

**Sub-Sample reference (SS)**

The number entered into the SS column on the field datasheet that indicates which observations are related within the quadrat.

**Sub-Sub-Sample (SSS)**

The number entered into the SSS column on the field datasheet that indicates which observations are related within the Sub-Sample of a quadrat.

**Sustainable development**

Using resources in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs (The World Commission on Environment and Development “Our Common Future”).

**Zone (on field datasheet)**

The box on the field datasheet that contains the UTM zone of the sample site location.

## **Appendix 5: Acknowledgements**

We should like to make particular note of the great courtesy and hospitality shown to us by so many of the Djiboutian people. We would especially wish to commend our counterparts: Mr. Nasser Djama Abdi, Dr. Guedda Mohamed Ahmed, and Dr. Nabil Mohamed. The assistance offered to us by Dr. Chris Magin and Mr. Omar Habib of the GEF Djibouti Biodiversity Programme was invaluable. Mr. Mohamed Ali Moumen deserves special thanks for the role that he played as the focal point for PERSGA in Djibouti and for making every effort to facilitate our work.

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وقد تؤدي محدودية المواطن الطبيعية المتاحة لنمو أشجار الشورى في جيبوتي إلى الحد من توفرها وتوزيعها. إذ ليس من الشائع وجود البراعم وعلامات التكاثر الطبيعي، بيد أن هذا الأمر قد يكون تأثيراً موسمياً ليس إلا.

**الشواطئ والخط الساحلي:** توجد مواقع تقيس السلاحف البحرية في جزيرة مسكالي، غير أن عملية إلقاء النفايات تنتشر في شواطئ جزيرتي الموحا ومسكالي.

### خطة الإدارة البيئية

لقد تم اقتراح خطة للإدارة البيئية خلال ورشة عمل شارك فيها الممثلون الوطنيون ذوا الصلة. وقد حظيت الخطة المقترحة بدعم واسع النطاق واجماع تام. وتحت الخطة على إنشاء هيئة منفردة ينام بها مسئولية التنمية المستدامة للمناطق التي يتم تحديدها كمناطق ذات حساسية بيئية. وقد اقترح اطلاق اسم "هيئة محميات التنوع البيولوجي في جيبوتي" على الهيئة الجديدة. وحددت خطة الإدارة البيئية بأن تسترشد عملية تشغيل وإدارة هذه الهيئة بمعاهدة التنوع البيولوجي، وأن تهدف إلى توجيه جزء من الثروة الناتجة من تلك المناطق نحو الإدارة البيئية الفاعلة. وقد اقترح إجراء عملية محافظة بيئية للمناطق الثلاث التي تعتبر عرضة لمخاطر التأثيرات المباشرة للسياحة. وفي هذا الصدد تم تطوير إرشادات محددة لإدارة السياحة في تلك المناطق، مع التركيز على الضغوط البيئية واستجابات الإدارة حيال تلك الضغوط. وهذه المناطق هي:

- جزيرتا الموحا ومسكالي
- خور أمبادو
- شعاب مدينة جيبوتي

المثال) وذلك في أغلب المواقع، ومن المحتمل أن تزيد مستقبلاً إذا تركت دون إدارة. وهناك ما يدل على تحطم الشعاب من جراء عمليات الرسو الصغيرة والمشىء على الشعاب في منتجعي شاطئء سابل وخور أمبادو، بيد أن المستويات الحالية لهذه الضغوط ليست بالغة الحدة. ويحظى الموقع المعروف بـ"الحديقة اليابانية" بأعلى غطاء حي من الشعاب من بين كافة المواقع التي تمت زيارتها في جزيرة الأخوين، وهو لم يتأثر سلباً بانتشار نجمة البحر المعروفة بإسم "تاج الشوك" الذي شهدته المنطقة مؤخراً.

ولم تتم مشاهدة الشعاب المرجانية التي تتسم بحدة التدهور وانخفاض الغطاء الشعابي إلا في منطقة صغيرة في مسكالي قريياً من الشاطيء الرئيسي، علماً بأنه لم يتسن تحديد سبب هذا التدهور.

وقد كان انتشار "تاج الشوك" في المناطق التي تمت زيارتها مرتفعاً بما يثير الاهتمام ويستدعي الرصد. وعلى الرغم من ذلك، فإن انتشار هذه النجمة البحرية في جيوتي لم يصل لمرحلة "الذعر"؛ كما أن المواقع المتأثرة سابقاً قد استعادت وضعها الطبيعي بشكل جيد. وقد شوهدت أغلب حالات الانتشار في شاطيء سابل وفي الشعاب بمنتجع جزيرة الموحا. أما في المناطق الأخرى التي تمت زيارتها فلم تكن حالات الانتشار ذات شأن يذكر.

أما قنائد البحر (*Diadema*) فهي في الوقت الراهن لا تشكل مخاطر بالنسبة لأغلب الشعاب التي تمت زيارتها. إذ تمت ملاحظة أغلب قنائد البحر في المنطقة المتاخمة لمدينة جيوتي حيث تحتاج أعدادها إلى الرصد والمراقبة.

تتسم مجموعات الأسماك في كافة مواقع الشعاب بالتنوع الجيد، مما يعتبر مؤشراً لسلامة بيئة الشعاب المرجانية. و في أغلب المواقع تم العثور على المجموعات الرئيسية التي يستهدفها الصيادون. وعلى سبيل المثال، فقد وجدت أسماك الحمرة (snappers) في كل المواقع. ويدل وجود الأنواع المؤشرة الرئيسية، مثل التربياني (*humpheaded wrasse*)، على أن ضغوط الصيد تتراوح بين المعتدلة إلى المنخفضة في المناطق التي شملها المسح. ولم يتم تسجيل نوعي الطرادي (*Plectropomus*) والحريد (*bumphead parrotfish*)؛ وربما يكون ذلك من جراء تأثيرات جغرافية/حيوانية.

كما لوحظت في المنطقة المحمية بجزيرتي الموحا ومسكالي وجود دليل مباشر على أنشطة الصيد (الشباك والصيد الترفيهي بواسطة السياح).

تحظى بعض الشعاب في المنطقة المتاخمة لميناء مدينة جيوتي بوضع جيد على الرغم من ارتفاع معدل العكارة والتصريف من وادي أمبولي. وفي واقع الأمر، كان أعلى معدل غطاء للشعاب تم تسجيله على امتداد كل فترة المسح في منطقة ميناء مدينة جيوتي. وتجدر الإشارة إلى أن كل من الشعاب المرجانية المتدهورة والسليمة إلى حد معتدل لديها القابلية لاستعادة وضعها الطبيعي.

**أشجار الشورى:** لقد تمت ملاحظة ضغوط الرعي وقطع الأشجار وإلقاء النفايات وربما الأمراض في أغلب غابات الشورى التي تمت زيارتها في جزيرتي الموحا ومسكالي وفي الجزيرة الأم. وينبغي تخفيض هذه الضغوط. ويعتبر رأس سيان الموقع الأكثر عرضة للضغوط من جراء رعي الجمال وقطع الأشجار. وهناك أيضاً دليل واضح على قطع الأشجار في غابات الشورى بخور عنقر وكولينز دي غورديا.

وقد أدت العوامل الطبيعية (مثل الرياح الشديدة ومحدودية تدفق المياه وتكاثر الحشرات وربما انتشار الأمراض ونسبة الملوحة العالية) إلى موت أجزاء من أشجار الشورى في الموحا ومسكالي. وهناك تأثيرات مماثلة في خور عنقر وكولينز دي غورديا. ولا شك أن وطأة الضغوط الطبيعية تقاوم من حدة التأثيرات الانثروبوجينية على نظام الشورى.

## ملخص موجز

### مقدمة

تقدم هذه الوثيقة موجزاً وصفيًا للملاحظات التي تم تسجيلها أثناء دراسة الوضع الراهن للشعاب والمواطن الطبيعية في مواقع مختارة بجمهورية جيبوتي خلال الفترة من 15 إلى 30 أبريل 1998؛ كما تتناول الوثيقة مقترحات خطة الإدارة البيئية وارشادات إدارة الزوار للمناطق الرئيسية. وتشمل المناطق المختارة كل من جزيرة الموحا وجزيرة مسكالي وخور أمبادو وشاطيء سابل والشعاب المرجانية حول مدينة جيبوتي وجزيرة الأخوين وكولينز دي غورديا وخور عنقر ورأس سيان.

### أساليب المسح والدراسة

تم إجراء تقييم سريع ووضع خريطة لمؤشرات الوضع الراهن للموارد على الخط الساحلي وفي البحر باستخدام طائفة من أخذ العينات بالتقسيم الرباعي وإجراء المسوحات. وتم تحديد المرجع الجغرافي لكافة مواقع التقييم من أجل التوافق الكامل مع نظام المعلومات الجغرافية. ومن الممكن تكرار الأسلوب المستخدم من أجل إعداد قاعدة بيانات تفصيلية تتيح معلومات قيمة حول تغيرات الوضع الراهن للموارد الطبيعية. لقد تم استخدام نموذج (الضغوط - الوضع - الاستجابة) لتحديد استراتيجيات أخذ العينات وتطوير ارشادات الإدارة بالنسبة لمنطقة الدراسة. وقد تم اختيار عدد من العينات ذات الدلالة المؤشرة بهدف دعم نموذج (الضغوط - الوضع - الاستجابة). ونظراً لامكانية تطوير السياحة في جيبوتي، فقد تم استكمال نموذج (الضغوط - الوضع - الاستجابة) بتبني منهج المبدأ التحوطي من أجل التنمية المستدامة.

### برنامج العمل الميداني

تم إجراء المسح في 181 موقع ذات مراجع جغرافية محددة، وتجميع 66 مربعاً للشاطيء/الخط الساحلي، وأخذ عينتين اثنتين للشاطيء/الخط الساحلي، و72 مربع تقييم للشعاب، و34 عينة تقييم للشعاب و7 عينات أرضية مختلفة. كما تم أخذ 52 قياساً لدرجة العكارة بواسطة قرص "سكي". وتم تقييم 111 معلماً في هوامش الشعاب المرجانية بما في ذلك الطبقات الحية وغير الحية وعينات مختارة من الأسماك ومؤشرات منتقاة من التأثيرات البشرية. وتم تجميع المعلومات في الحقل على أساس المؤشرات المنتقاة باستخدام سلسلة من القوائم المصممة لاستيفاء المتطلبات التي تملئها أهداف المسح. كما تم تخزين كل المعلومات التي جمعت خلال المسح في نظام إدارة البيانات على أساس الكلمات الرئيسية. وأخذت كافة المعلومات مراجعها الجغرافية.

### النتائج الأولية

من الممكن استخلاص النتائج الأولية التالية من المعلومات المتاحة بنوع من الثقة.

**الشعاب المرجانية:** تعتبر أغلب الشعاب في المواقع التي تمت زيارتها في وضع بين المتوسط إلى الجيد، ويبدو أن بنية مجموعات الشعاب المرجانية، على وجه العموم، تتحدد بمقتضى العوامل البيئية الطبيعية، الحالية وفي الماضي أكثر مما تحددها الضغوط البشرية. وعلى الرغم من ذلك، فقد لوحظت علامات ضغوط الزوار (كما تتضح من خلال شبك الصيد والنفايات، على سبيل

الهيئة الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن، هي هيئة حكومية تهتم بالمحافظة على البيئات البحرية والساحلية في الإقليم.

تستمد الهيئة قاعدتها القانونية من الاتفاقية الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن (1982). وقد تم إعلان إنشائها في القاهرة في سبتمبر 1995 حيث اتخذت من مدينة جدة مقراً لها. تضم الهيئة في عضويتها كل من الأردن ، جيبوتي ، السعودية ، السودان ، الصومال ، مصر واليمن.

عنوان الهيئة : ص ب 53662 جدة 21583 المملكة العربية السعودية  
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لقد تم تنفيذ مشروع "مسح المواطن الطبيعية في جيبوتي وإعداد خطط لحمايتها" كمشروع مشترك بين الهيئة الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن والمنظمة العربية للتربية والثقافة والعلوم ، وهو من ضمن المشاريع التي اعتمدها مجلس الهيئة في اجتماعه الثاني بجدة في 26 أكتوبر 1996 . وقد قام بإعداد التقرير كل من الدكتور/ أليك دوسن شيبيرد والسيد/توم بيركت من مؤسسة هنتنق أكواتيك رسورسز (المملكة المتحدة) بموجب عقد مع الهيئة وبدعم مالي من المنظمة العربية للتربية والثقافة والعلوم.

تم إعداد التقرير من خلال المشروع المشترك رقم 04 - 1703 بموجب العقد رقم:  
C-13/PERSGA/97

التفاصيل الكاملة للتقرير بما فيها من جداول وقاعدة معلومات موجودة لدى الهيئة .

إن الملاحظات التي تم إبدائها في هذه الوثيقة تمثل وجهة نظر المؤلف وتحت مسؤوليته الخاصة ولا تمثل بالضرورة وجهات نظر الهيئة ، أو الجهات التي ساعدت في تمويل إعداد هذا التقرير . وكذلك لا يعبر عن أي وصف أو تفاصيل إجمالية وردت في التقرير ، عن فكرة معينة تُنسب للهيئة أو لأي جهة مانحة ، فيما يتعلق بالحدود القانونية لأي دولة أو منطقة أو مدينة .

يمكن إعادة إنتاج هذا المنشور كلياً أو جزئياً بأي شكل من الأشكال بدون موافقة أصحاب حقوق الطبع ، وذلك لأغراض تعليمية وغير ربحية بشرط أن يتم التنويه عن مصدر المنشور . وسوف تكون الهيئة الإقليمية شاكراً ومقدرة لاستلام أي منشور يستفيد من هذا التقرير كمصدر من مصادر المعلومات .

لا يسمح بنسخ هذا المنشور أو توزيعه إلكترونياً أو بيعه مرة أخرى أو لأي أغراض تجارية أخرى بدون ترخيص مسبق ومكتوب من الهيئة الإقليمية .

صورة الغلاف : غابات الشورى في جيبوتي

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الهيئة الاقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن

مسح المواطن الطبيعية فى جيوتى  
وإعداد خطط لحياتها