

# **Conservation of Marine Resources in Seychelles**

Report on  
Current Status and Future Management

by  
RODNEY V. SALM  
IUCN Consultant

Report of  
International Union for Conservation of Nature and Natural  
to the government of Seychelles  
prepared with the financial support of the  
United Nations Environment Programme  
and  
the World Wildlife Fund

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## FOREWORD

The importance of marine resources and the delicacy of the support system upon which they depend is becoming increasingly appreciated at both national and international levels. The current IUCN and World Wildlife Fund Marine Conservation Programme specifically addresses to this fact.

Seychelles relies heavily on marine resources, not only as food for the inhabitants and for export, but also on the economic potential of the aesthetic characteristics of the physical and biological components of the surrounding marine ecosystem. In this regard, the government of Seychelles has not only responded to international concern over the protection of marine resources but has taken some measures to protect and to regulate the exploitation of these resources.

The government recognises that these measures are inadequate for the long-term sustenance of these resources and has accordingly sought advice to elaborate a more realistic approach. The present report, and the recommendations therein, attempts to outline basic conservation needs for the maintenance of the productivity of the marine resources and suggests steps that need to be taken to meet them. It is the result of an approach to the IUCN by the government of Seychelles which is concerned, amongst other things, with the scientific management of marine turtles as an economic resource. The report suggests short and long-term measures comprising physical protection, scientific requirements, conservation education, and possible alternative approaches for the implementation of these suggestions. The suggestions envisage that there will initially be the need for external assistance if the Seychelles is to realise soon the proper protection and management of the marine resources.

The author has previously worked on marine turtles of the west Indian Ocean and has spent a few years in Seychelles. This background is reflected in the analysis of the marine conservation needs discussed in the report as well as in the action proposals put forward.

The IUCN, although contributing directly through administrative, technical and scientific advice, wishes to acknowledge contribution made to this consultancy from the United Nations Environment Programme and the World Wildlife Fund.



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## SUMMARY

### Observations

1. Terrestrial aspects of conservation have been well addressed by both national and interested external bodies. But there is disproportionately little progress in the coastal and marine environments (3.1).
2. Except as broadly stated in the general conservation policy, the government of Seychelles has no clear policy specific to marine resources. The seas and outer islands are regarded as a vast untapped resource yet to be exploited. (3.2).
3. Legislation affecting natural resource management is inadequately enforced. There are many islands in Seychelles spread over a huge area of ocean. Thus remote but vulnerable resources, such as turtles on their nesting beaches, are easily poached and near impossible to control. (3.4, 3.5 and 3.9).
4. Coastal resources are threatened by poorly planned development (e.g. siltation caused by dredging and erosion, sewage pollution, land reclamation, garbage disposal at sea) and increased tourism, causing an increased demand for corals and shells, increased damage to coral reefs by careless divers, collectors, boats and anchors. (3.10.1).
5. The east coast of Mahé, from the airport north and including Northwest Bay, is an area of intense development and high impact on coastal habitats (e.g. coral reefs, mangroves, mudflats). Expansion of fisheries and exploration for oil and gas will speed development and further strain the natural resources of this area. (3.10.1 (v to xi)).
6. Financial constraints, a deficit of suitably qualified and experienced personnel, and comparatively little assistance from external organisations hamper progress in the conservation and development of marine resources.
7. Public awareness of environmental issues and of the need for management of marine resources is practically non-existent. (3.11).



## Perceived needs

There is clearly the need for :

1. Survey and research leading to the identification and evaluation of coastal and marine habitats so that a representative sample of important areas may be protected and excluded from overexploitation and other damaging activities.
2. A coastal zone management plan aimed at reducing the impact of development on natural resources, and in which ecological considerations are weighted equally with development requirements.
3. Guidelines for the development of the outer islands.
4. An environmental education and information dissemination programme to increase public awareness of :
  - the need for and objectives of natural resources management and protection,
  - the importance of certain habitats to the continued productivity of marine resources,
  - the consequences of damaging activities to marine resources.
5. An effective ranger or marine police corps. This requires training of personnel and the supply of equipment such as outboard motors.
6. External expertise and financial assistance.
7. Integration of external conservation and research efforts to avoid duplication of activities.

In Seychelles the perceived needs are seen to be environmental education, ranger training, and research, especially on turtles. It is hoped that this report will indicate other marine conservation requirements.

### Principal recommendations

1. Environmental education expert (s) be sought to :
  - a. assist in designing and initiating an environmental education programme for the school curriculum
  - b. design and implement an environmental information dissemination programme aimed at the entire population. (3.11 & 4.3.5)
2. A consultant be sought to assist in establishing an effective marine ranger or police corps. (3.5 & 4.3.6)
3. A marine conservation consultant be sought to identify and evaluate critical marine habitats. (4.3.2 & 4.3.3)
4. Coastal zone management policy be defined.(4.3.4)
5. Coastal Zone Management Committee be formally constituted. (4.3.4)
6. A coastal zone management plan for Mahé, Praslin, La Digue and satellite islands be detailed and implemented. (4.3.4)
7. Aldabra be considered for World Heritage status. (4.3.8)
8. Conservation research be integrated. (4.3.1)
9. More conservation research be focussed on the marine environment. (4.3.2)
10. A fishery expert be sought to review effects of commercial industrialised fishery development and to advise on the management of living marine resources within the EEZ. (3.9.6, 4.3.2-3)



## CONSERVATION OF MARINE RESOURCES IN SEYCHELLES

### I. INTRODUCTION

This report results from a proposal submitted in April 1976 by the Seychelles Government to the International Union for Conservation of Nature and Natural Resources (IUCN) .

#### 1.1 Objective

The objective of this report is to define the status of marine conservation in the Republic of Seychelles and to recommend actions to meet the perceived most urgent needs.

#### 1.2 Terms of Reference

The Consultant was required to complete the following tasks during January 1978 :

- a. to mobilise his own background knowledge on the marine conservation requirements of the Seychelles, supplemented by other available materials;
- b. to visit the Seychelles to determine perceived marine conservation needs in light of the present political and institutional situation;
- c. to coordinate such a visit with visits to other useful sources of relevant information;
- d. to use data obtained in (a) and (c) to define marine conservation requirements and priorities, together with their implementation;
- e. to visit the IUCN, Morges, for consultations with the secretariat during the preparation of the report and of an action plan for submission to the government of the Seychelles.

#### 1.3 Acknowledgements

Many people were contacted. The author is grateful to them for their time, advice and suggestions. Particularly helpful were the Minister and members of the Ministry of Agriculture and Land Use, Seychelles, Dr. D.R. Stoddart and Dr. D. Hall. Susan T. Walker contributed much to library and field research. Roger Wilson commented extensively on this report and many of his suggestions are incorporated.

Furthermore, the drafts of the report were reviewed and commented upon by the Marine Steering Committee of the IUCN/WWF Marine Conservation Programme and by members of relevant specialist groups of the IUCN Survival Service Commission. Their contribution has been most valuable.

IUCN supported this project and the secretariat sent ahead letters of introduction without which the author would never have met the rather tight schedule. Financial support was drawn from the United Nations Environment Programme and the World Wildlife Fund through the IUCN.

## 2. BACKGROUND

### 2.1 Geography, Geology and Climate

Mahé, the principal island of Seychelles, lies more than 1000 km from closest countries and almost directly east of Mombasa, Kenya. It is situated on the Seychelles Bank at approximately 4°40'S, 55°30'E. The Seychelles Bank itself lies between about 4° and 5°S, and 55° and 56°E. Estimates of the size of the bank vary from 31,000 km<sup>2</sup> (Braithwaite, 1971) to 43,000 km<sup>2</sup> (Stoddart, 1971). The figure 64,000 km<sup>2</sup> is often quoted, but this probably includes the nearby Amirantes Bank and other banks and atoll lagoons in waters of Seychelles jurisdiction.

But for two sandy cays, the islands on the Seychelles Bank are all granitic. It is thought that these islands are crumbs of Gondwanaland, or the vestiges of an ancient eastern extension of the African continent, dating back 600 million years to the Precambrian (Baker, 1963; Lionnet, 1972). Estimates of the number of islands on the Seychelles and other banks vary from 83 to over 100, with 89 or 92 most frequently quoted. Of the 92 islands listed in Appendix I, 43 are granitic and, together with St Helena in the Atlantic, are the only granitic oceanic islands. The remaining 49 islands are coralline : some are sandy cays, such as the Amirantes, and others are either sea level atolls, such as Desroches, or elevated atolls, such as the Aldabras (Stoddart, 1967, 1970; Stoddart & Wright, 1967). The high-profile granitic islands rise to 914 metres at Morne Seychelloise on Mahé. The coralline islands are low-lying, flat, and seldom rise more than 6 m above sea level.

The Seychelles islands spread south-south-west from just below the equator towards the northwestern tip of Madagascar. They cover a huge area of ocean. The total land area is 277 km<sup>2</sup>, compared to 43,000 km<sup>2</sup> for the Seychelles Bank.

The climate of the area is determined by two alternating monsoons, or seasonal winds. The strong, dry winds of the southeast monsoon, averaging 10-12 knots (17-20 km/h) blow from May to October. The erratic northwest monsoon, alternating between periods of calm, terrific squalls and torrential rains, blows from December to March. November and April are the transitory months. Rainfall is high on the granitic islands, twice that on the mountain tops, but decreases south over the coralline islands. The mean annual temperature varies from 24° to 30°C, but varies with altitude and among the granitic and coralline islands. The relative humidity is always high, averaging between 75% and 80%.

## 2.2. Oceanography

The equatorial current sweeps west over the Chagos, Nazareth and Saya de Malha Banks, and through the southern islands of Seychelles. Its northern limit rarely reaches the Seychelles Bank. All year long the equatorial counter-current, lying between the equatorial current in the south, and the monsoon current in the north, sets east over the Seychelles Bank. In November, the northern limit of the counter-current is about 3°N. It moves south during the following months and in February, at 2°-3°S, is at its most southerly (Hydrographer of the Navy, 1973). Between the equatorial current and the equatorial counter-current is an area of turbulence with lateral and vertical mixing between and within these water masses. A dome of upwelling cold water, rich in phosphate, rises to the surface southeast of the Seychelles Bank in this turbulence zone (Tarbit, pers. comm.). Currents around islands are locally defined and are the product of winds, tides and bathymetry.

There are both high and low energy coasts in Seychelles though most coasts alternate between one and the other depending on monsoons. The south and east coasts generally have greatest wave stress. The granite islands are deeply indented consequently some bays remain sheltered irrespective of season.

## 2.3 The Marine Environment

As intertidal zone is part land and part sea, terrestrial influences continue below tide lines. Shallow coastal habitats should never be considered distinct from land : these are the habitats most likely to be affected by activities on land. The terrestrial influences may be constructive, such as the contribution of nutrients, or they may be destructive, such as pollution, siltation, dumping, or reclamation.

There have been very few studies of the species composition in mud or sandflats, back-reef lagoon, reef-flat, seagrass bed, or upwelling habitats (Farrow, 1971; Lewis, 1969; Lewis & Taylor, 1966; Taylor, 1968.; Taylor, 1971; Taylor & Lewis, 1970), and none on productivity.

Fringing mangroves are found in many sheltered bays along the east coast of Mahé, but true swamps are uncommon. The best representative mangrove swamp on Mahé is that on the La Plaine Estate between Port Glaud and Port Launay on the west coast. Reclamation caused severe damage to the swamp. This has been halted and the forests are recuperating. Other small, but fine, examples of mangrove swamp are found at Barbarons and Grande Anse also on the west coast.

One might speculate a link between the occurrence of scyllarid lobsters and penaeid prawns which are found off the Mahé west coast to these mangrove swamps. Mangrove swamps are also found on Curieuse, Praslin, La Digue and Silhouette of the granitic islands, and in the lagoons of certain atolls, notably Aldabra and Cosmoledo.

The granitic islands of Seychelles are not surrounded by extensive reef formations. Unlike the coralline islands and atolls, which are a product of prolific coral growth, the granitic islands of Seychelles have been colonised by corals, but do not owe their existence to them. The remarkable feature of reefs around the granite islands is the amount of dead coral. Of all the coastal habitats, reefs have been the most extensively described (Barnes et al, 1971; Braithwhite, 1971; Frazier & Polunin, 1973; Lewis, 1968; Rosen, 1971; Salm, 1977; Stoddart, 1971; Taylor, 1968).

#### 2.4 Socio-economic Background

For a history of early visitors to Seychelles and a brief history of colonisation see Lionnet (1972). Seychelles is a melting pot of nations. Miscegenation started in 1838, the time of abolition of slavery. By 1911, because of mixing, classification of Seychellois by racial groups was hardly possible. Today a number of ethnic groups, including African (clearly dominant), European, Asian, and Oriental, are still apparent. The population of Seychelles is about 60,000, and is growing fast. About 93% of the population live on the islands of Mahé, Praslin and La Digue, and about 3% live on a few of the 49 coralline islands. Thus most of the islands are uninhabited, many are sparsely inhabited, and a few have sizeable resident populations.

Until the advent of tourism, Seychelles had an agricultural economy. Copra (dried coconut kernels), cinnamon, vanilla, patchouli and guano were the main exports within recent times. In the past major exports included timber and tortoises. But intensive harvest of both these resources soon led to their economic extinction. By 1800 the giant tortoise (Testudo gigantea) was practically extinct on all islands, but Aldabra; and timber exports dwindled and collapsed during the early part of this century. Since the opening of the airport in July 1971, tourism has rapidly become the major industry. Fisheries cater principally to local markets, but some fish is exported. Operations are under way to increase the fisheries effort and export. Fisheries may soon outrank tourism to become the major industry.



### 3. CURRENT CONSERVATION STATUS

#### 3.1 A Recent History of Nature Conservation in Seychelles

In 1970 Mr. John Procter was seconded to Seychelles by the Ministry of Overseas Development (ODM) to advise on nature conservation and the establishment of national parks and reserves. Procter spent 3 months in the islands and submitted a report (Procter, 1970) that was published by the Seychelles government.

Following Procter's report, the Seychelles government published a White Paper (Government of Seychelles, 1971), setting out government policy on conservation matters. Not all recommendations proposed by Procter were incorporated into the White Paper. Nevertheless, its publication reflects the interest in natural resources management by the government of the time. Procter returned to Seychelles for a number of years to help implement some of his recommendations.

Procter's report and work mainly concerned the terrestrial environment and coastal and marine environments remained comparatively neglected. Early in 1972, Mr. Iain Robertson was sent to Seychelles to advise on the location and management of marine parks and reserves. Robertson's visit resulted from a proposal submitted in March 1971 by the Seychelles government to IUCN. The report of this survey (Robertson, 1972) did not enjoy the success of Procter's : it was not published and had limited distribution. It was used as a basis for early marine conservation action in Seychelles.

The conservation momentum, initiated by Procter's work and report, has slowed down. This is understandable. The movement started with good, but big ideas (there are those who say that these ideas were initiated by expatriates keen to make Seychelles the conservation show-piece of the world). The ideas flourished through the formative stages of planning and design, but when the time came for setting up the necessary infrastructure they proved too ambitious and broad for the existing funds and personnel. Many of the ideas are good, but Seychelles is a small nation with a proportionately small budget for conservation.

#### 3.2 Current Government Policy

The present conservation policy in Seychelles remains as published in the White Paper (Government of Seychelles, 1971) . In this paper, conservation is defined as meaning :

"the wise use or management of renewable natural resources so that at the end the resource is no poorer nor less able to renew itself than at the beginning".

The stated principles which the government were to observe are :

- a. Examples of natural habitats must be preserved for the people of Seychelles and for the world at large, in order to make it possible to study individual species and to retain biological systems where natural processes can be studied and put to beneficial use by man.
- b. Extensively distributed natural resources should be protected and developed to ensure that they remain a source of food, materials or revenue.
- c. Appropriate areas should be protected and developed for public recreation and enjoyment, both for the people of Seychelles and for tourists.

There has not been sufficient identification of natural coastal or marine habitats to meet principle (a). The distribution of coastal and marine resources has not been mapped, other than incomplete work on turtle nesting beaches. Consequently, these resources are not adequately protected as intended by principle (b). Principle (c) has been observed to some extent : the Ste Anne Marine National Park was established on the 19 March 1975. It is the first of three proposed marine parks and reserves. Other areas include the Port Launay Marine National Park and the Curieuse Special Marine Reserve. There is some progress, albeit slow, toward establishing protected status for these latter two areas.

Present development policy includes the construction of airstrips on as many islands as possible, especially the remotest, to improve inter-island communications. This offers tremendous potential for tourist-oriented island development, which carries with it threats to important habitats and resources.

### 3.3. Conservation Legislation

Conservation legislation was recently the subject of revision by a consultant (Roger Wilson) seconded to Seychelles by the Ministry for Overseas Development (report not yet

released). Assuming the recommended revised legislation will be gazetted in toto by the Seychelles government, the islands then have a solid legal base for the control and management of their natural resources. An obvious deficiency of the current legislation is that there are few provisions for the protection of habitat (e.g. turtle nesting beaches or fish nursery grounds). Conservation legislation affecting marine or coastal resources is listed in Appendix 2.

### 3.4 Administration of Policy

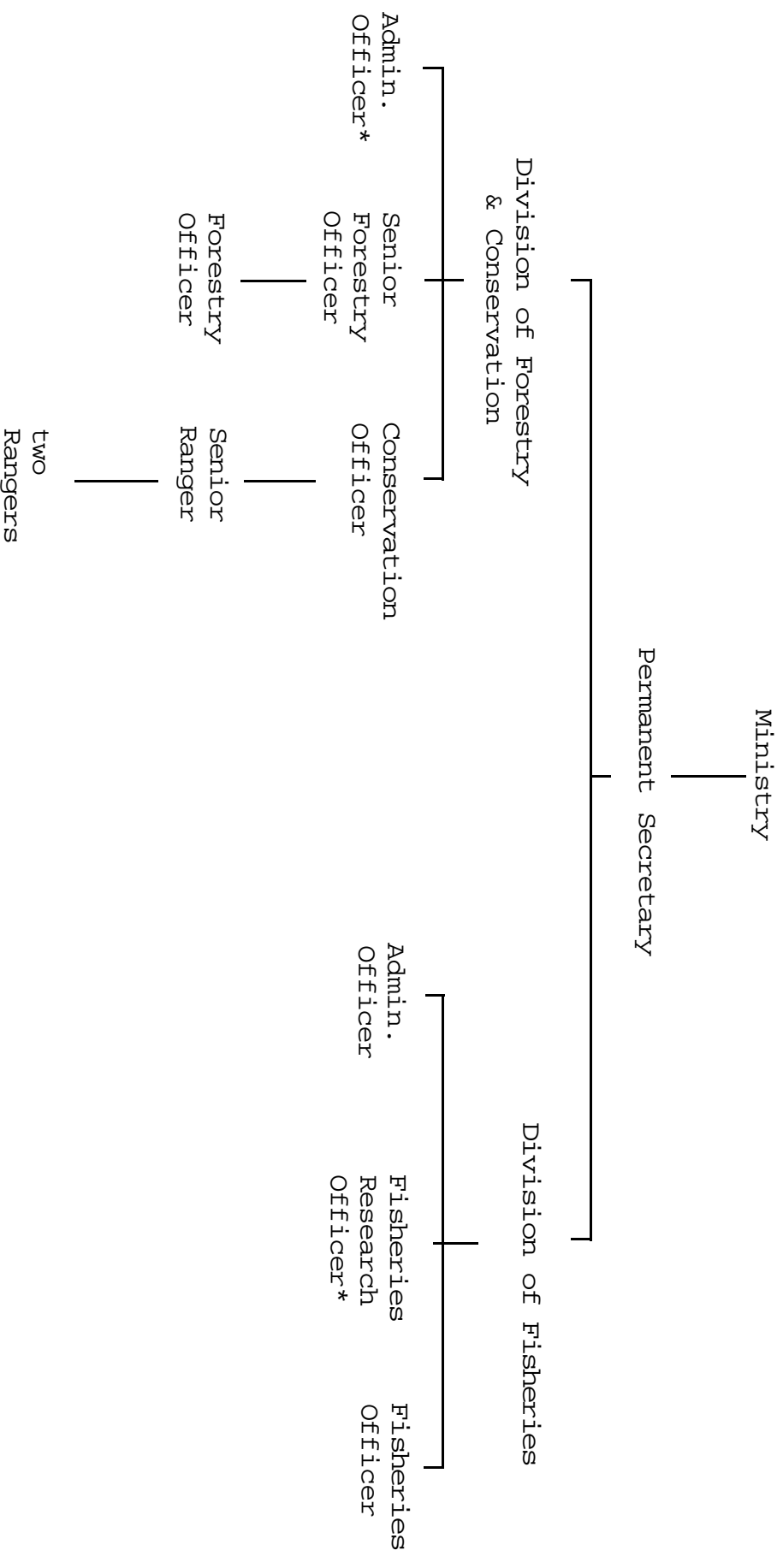
#### 3.4.1 Ministry of Agriculture and Land Use

The Ministry of Agriculture and Land Use (hereinafter referred to as the Ministry) is responsible for natural resources management. Within the Ministry, and as the names suggest, the Division of Forestry and Conservation is concerned with forest habitats and general conservation (including endangered and endemic species, land, coastal and marine habitats, plants and animals), and the Division of Fisheries is concerned with management of fisheries operations and catch processing. Both of these divisions, through the Permanent Secretary, answer to the Minister. Within the Ministry the positions directly involved with resources management and conservation are as shown on the chart (see page 9).

#### 3.4.2 National Parks and Nature Conservancy Commission

On 12 January 1978, at the 19th Meeting of the National Parks and Nature Conservancy Commission (hereinafter referred to as the Commission) whose members include the Permanent Secretary to the Ministry, the Senior Forestry Officer, the Conservation Officer, two Seychellois businessmen, and four expatriates; no expatriates were present. Conspicuous by their absence were Fisheries Officers or qualified representatives on marine environment.

The Commission is responsible, on behalf of the Seychelles Government, for national parks and nature reserves throughout the Seychelles. In theory, the Commission should administer the Ste Anne Marine National Park. In practice, the park is administered by both the Commission and the Division of Forestry and Conservation. The park is patrolled daily, if their one outboard motor is running, by any of the three Rangers or the Conservation Officer. The police launch may occasionally assist in this task. I did not attend the 19th Meeting, but was called in and asked to report my thoughts on the needs of Seychelles to the Commission members. Two points endorsed by the



- 1  
- 6  
- 1

\* not Seychellois

Commission members were : the necessity for an environmental education programme and a ranger training programme. In addition, I was asked to investigate channels for obtaining two 20 h.p. outboard motors which are needed for patrolling the Ste Anne Marine National Park.

### 3.5 Law Enforcement

The sixth recommendation of the delegates to the Regional Meeting on Marine Parks and Reserves in the northern Indian Ocean held at Tehran, Iran, was that national ranger training institutions be established where necessary, and that :

"the fullest use be made of existing facilities and manpower of other institutions on a regional or multinational basis" (IUCN, 1976).

There is certainly the need for such a training programme in Seychelles.

There are no suitably qualified or experienced personnel to fulfill the role of marine rangers and insufficient funds to support a large specialised force of such personnel. Currently, there are three rangers who are all in their early twenties. They lack self-confidence and, it seems, credibility. The outboard motor of their patrol boat is small (10 h.p) and easily outpaced by poachers. The rangers are powerless to demand a poacher accompany them to a police station if the poacher refuses.

The police launch assists with patrols of the Ste Anne Marine National Park. The poachers stand in awe of the police. Evidently, Seychelles requires a powerful, well-equipped patrol corps backed by heavy penalties for offenders. This corps could either be a special branch of the police - a marine police corps, a coast guard equivalent, or a highly trained and respected ranger force. The duties would extend beyond water patrols to periodic island wide land patrols to check contraventions of fisheries and conservation legislation, such as illicit landings of turtles. Thus training and equipping of a ranger corps must be instituted and considered as an integral part of the marine conservation programme.

### 3.6 Existing Marine Parks

Ste Anne Marine National Park

Ste Anne Marine National Park was established under the National Parks and Nature Conservancy Ordinance, Section

4 of 1973. The major criterion for the selection of the Ste Anne area for a marine park seems to be its value to tourism. The White Paper (Government of Seychelles, 1971) states that the :

"primary object is to conserve the exceptionally rich and varied marine life and to protect the reefs and shores from damage and disturbance, in order to preserve the area for the enjoyment of the public".

The park includes the islands of Ste Anne, Moyenne, Round, Long and Cerf, together with adjacent reefs and sea covers a diversity of habitats. Within the park collection of shells is prohibited and fishing is restricted to a few fishermen. Fishermen resident within the park boundaries may use one casier (basket trap) and handlines. Fifteen Victoria-based fishermen who traditionally left Mahé to fish the waters of the area may place two casiers each within the park, but may not use handlines. One elderly Mahé based fisherman, too old to lift the heavy casiers, is permitted to use a handline.

The reefs are in poor condition : the corals, which are predominantly dead, were probably killed by siltation caused by the dredging of the harbour. Nevertheless, there is a great diversity of habitats and consequently a great variety of species. There are exposed and sheltered fringing reefs, patch reefs, coral-encrusted granite boulders, and rocks covered by soft corals, sand-flats and seagrass beds, intertidal rocks and beaches.

Each of these habitats has something unique - the indicator species - though many have species in common.

### 3.7 Other Protected Coastal Areas

Under the Protection of Shells Regulations (S.I. 91/1969) of the Protection of Shells Ordinance (Cap. 138) of 1965 no shells may be collected from the following areas :

Mahé - Rat Island south to Point au Sel; and  
NE Point north to the northern boundary  
of the Carana Beach Hotel Site.

La Digue - La Passe north to Grosse Roche

Praslin - Anse Boudin east to Pointe Zanguilles.

All around the following islands - Cousin, Curieuse, Ste Anne, Cerf, Cachée, Long. Moyenne and Round.

Because of severe manpower shortage these laws cannot possibly be enforced.

### 3.8 Proposed Marine Parks and Reserves

#### 3.8.1 Port Launay Marine National Park

This will include the reefs lying in Port Launay and Baie Ternay. The boundary excludes the beaches so that they may be freely available for normal recreational purposes. The park was proposed by the Commission and the proposal carried in the White Paper (Government of Seychelles, 1971) While the beaches of Port Launay and Baie Ternay are excluded from the proposal in the White Paper, it is most likely that they will be included. Management plans may include provisions for normal recreational purposes within the constraints of the protected beach guidelines, national park regulations, and the Beach Control Act. There is reef fringing the rocky shores at either end of the Port Launay beach. The fringing reefs are of the boulder type (principally Porites spp.) characteristic of areas of calm, silty sea and erratic temperature and salinity. The back-reef zones are shallow and covered by the stalked seaweed (Turbinaria). Reef development is not extensive and living corals are few.

A continuous fringing reef borders the shallow lagoon at the head of Baie Ternay. Grooved and cut by numerous surge channels this section of reef offers refuge to a host of large and small reef fishes. The deeper reefs fringing the northern and southern rocky headlands are amongst the most beautiful of all reefs around Mahé. There are few hard corals, but they are alive and healthy - at least where shell collectors have not reached. The dead coral colonies are settled by soft corals. These alcyonarian assemblages are unmatched anywhere else on Mahé.

#### 3.8.2 Curieuse Special Reserve

The following is an extract from the Seychelles Government's White Paper concerning this reserve :

"It is intended that the reefs lying between Curieuse Island and Praslin should form an area to be designated as a Special Reserve, the object of which will be to protect the rich and varied reef community. The Commission is satisfied that traditional methods of fishing will not interfere unduly with the efficient management of this Special Reserve, and it is accordingly intended to permit fishing by traditional methods to continue in the area".

This area contains a variety of habitats and a fine coral reef at Anse Petit Coeur, This reef once supported vigorous stagshorn coral (Acropora spp.) growth : this has all died and subsequently been resettled. Young colourful coral colonies cover most of the underlying dead coral presenting a model opportunity for the study of reef succession. Reef fringes the south-eastern arm of Curieuse in an almost continuous band. Much of the coral is dead, especially in the lower fore-reef region, but the fish life is remarkably rich and varied. In addition, there are boulder reef, deep patch reef, algal reef-flat, mangrove swamp, intertidal rocky shore, and sandy beach habitats.

### 3.8.3 Cousin and Aride Special Reserves

Cousin and Aride Islands are established Special Reserves

The International Council for Bird Preservation (ICBP) own and run Cousin Island. This Special Reserve was established principally to safeguard the Seychelles brush warbler (Bebrornis seychellensis) and nesting seabirds. The island has a resident scientist and a staff of rangers. Revenue from coconuts and visitor landing fees help defray the costs of running Cousin.

The Society for the Promotion of Nature Conservancies (SPNC), represented by Mr. Christopher Cadbury, have bought Aride Island, now a Special Reserve, for its bird life. Aride, one of the most beautiful of the granite islands, is the nesting site of masses of seabirds including fairy terns (Gygis alba), noddy terns (Anous stolidus & A. tenuirostris) and white-tailed tropic birds (Phaeton lepturus). Frigate birds (Fregata sp.) roost and display there.

The Commission has proposed that the jurisdictional area of these reserves be extended 200 m offshore to include the reefs all round the islands.

### 3.8.4 Aldabra Atoll

Aldabra is strictly controlled by the Royal Society, London. The Society maintains a scientific research station and supports personnel on West Island (Picard). In 1980, the Royal Society will cede responsibility for Aldabra to the Seychelles government. There is an unofficial proposal to designate the entire atoll a Strict Natural Reserve. The Seychelles government White Paper defines a Strict Natural Reserve as :



"an area set aside to permit the free interaction of natural ecological factors without any interference excepting that deemed indispensable for the safeguard of the very existence of the reserve"

However, there are proposals for limited tourist and fisheries development, and the continued removal of tortoises from Aldabra. This would render Aldabra unsuitable for Strict Natural Reserve status as defined in the Government White Paper.

### 3.9 Marine Resources Protection and Utilisation

#### 3.9.1 Turtles

In April 1976 the Seychelles government submitted a proposal to IUCN for assistance with conservation of their turtles. Both the green turtle (Chelonia mydas) and the hawksbill turtle (Eretmochelys imbricata) have a long history of legally controlled harvest, and of poaching, in Seychelles. The green turtle is principally caught for its flesh, but in the past was extensively harvested for an export trade in calipee (constituent of turtle soup), episodic exports of cawan (plastron scutes) and oil and bones. Stoddart (1976) describes the green turtle trade of Aldabra and Seychelles.

The green turtle is the subject of much emotion in Seychelles. Motivated by desire to have turtle legally back in their diet, the Seychellois have developed several arguments. The first and longest persisting is the argument that the green turtle is protected in Seychelles but not in surrounding waters. Neighbouring countries, the argument holds, kill and eat turtles which nest and are protected in Seychelles, while the Seychellois are denied this privilege. Early in 1975 the "stable stock" argument appeared. People questioned continued total protection of green turtles arguing that after 10 years of protection there is no evidence for an increase of stocks. In fact, there has been no evidence of an increase in stocks because there have been no efforts to monitor these. Thus the "stable stock" argument in turn spawned the "lack of international interest" argument. The implication here is that : no international interest means no more crisis, and no more crisis gives positive feedback to the "stable stock" argument. Underlying all these arguments in the same stimulant : a desire for turtle meat back in the diet.

The Green Turtles Protection Regulations (SI 91/1968 & SI 102/1968) were repealed on the 7th June, 1976, and replaced by revised regulations. The present Green Turtles Protection Regulations (SI 43/1976) seem satisfactory. No females may be caught, and males may only be caught from March 1st to October 31st which is the non-breeding season. The problem lies not with turtle protection legislation, but with its enforcement. However, there is no legal protection of nesting beaches except where these fall within park or reserve boundaries, such as Aldabra, where green turtles nest, Cousin Special Reserve, and Ste Anne Marine National Park, where hawksbill turtles nest.

The hawksbill turtle is caught for its scutes (tortoise shell) which are used to manufacture souvenirs for tourists. The scutes of a 73 cm turtle nets about Rs. 200.00 (ca. \$ 32.00). Stuffed turtles of the same size sells for about Rs. 400.00 (ca \$ 64.00). A public debate on turtle conservation, organised by Chong Seng (Conservation Officer) and Harris (Fisheries Officer) attracted the attention of the public through radio and press. Curio dealers recognised the need for conservation of hawksbill turtle stocks to preserve their industry.

There are several recent accounts of breeding, biology, management and protection of turtles in Seychelles (Diamond, 1976; Frazier, 1971, 1974, 1975; Hirth, 1968; Jackson, 1976; Salm, 1976a, 1976b).

### 3.9.2 Exploitation of sea birds

For many years the Seychellois have collected the eggs of the sooty tern (Sterna fuscata) and the noddy tern (Anous stolidus) for consumption. In 1970, 1600 cases of 700 eggs each were landed on Mahé for sale in the markets (Procter, 1970). These eggs were collected on Desnoeufs Island. The Ministry stations one man on the island during the tern breeding season to supervise egg collection. Egg collection is forbidden on half of the island. There is tremendous wastage through breakage during collection and transport of the eggs to Mahé. Procter (1970) briefly discusses the value of bird's eggs in the diet of the Seychellois.

Young shearwaters (Puffinus pacificus) are removed from their underground nests shortly before fledging, killed, sometimes salted, and eaten. Current sea bird exploitation is largely based on recommendations of several researchers.

### 3.9.3 Corals and shells

Both corals and shells are extensively collected for sale to tourists. This relatively recent industry seems to be growing. The trumpet triton (Charonia tritonis) is the only protected shell in Seychelles.

### 3.9.4 Coral reefs and tourism

The contribution of coral reefs to tourism cannot be overlooked. There are glass-bottom boats, charter boats, and dive tour operators all specialising in tours of the coral reefs. There are shops which sell snorkelling and diving equipment, guide books, underwater cameras, and film. Group tours catering specifically to divers are arranged in Europe. The publicity gained for Seychelles by its submarine life is not measurable but is immense.

### 3.9.5 Lobsters and other crustaceans

The demand for spiny lobsters (Palinurus spp.) by restaurants and hotels is high. Lobsters have become scarce in the shallower reefs around the corallines. Scyllarid lobsters and penaeid prawns found off the west coast of Mahé are, as yet, an untried resource.

The mangrove crab (Scylla serrata) and fresh water prawn (Macrobrachium sp.) are caught in small numbers for local consumption or occasional sale in the markets. The habitat of both is very limited rendering stocks vulnerable to over-exploitation. This resource must not be allowed to follow the fate of the robber crab (Birgus latro) which has been eaten into extinction in almost all the islands.

### 3.9.6 Fisheries

There have been recent large scale developments in fisheries. In a recent massive collaborative effort the British and the French governments will be assisting the development of a tuna fisheries in Seychelles. The French are to provide four modern fishing vessels. The British will provide the shore-based cold storage facilities. It is envisaged that 4-5 thousand tons of tuna will be caught annually. The fish will be blast frozen and exported. Incidental catch of green turtles by Japanese tuna fishing boats was used as one of the reasons for repeal and revision of the Green Turtles Protection Regulations. Increased tuna fishing effort will increase the incidental catch, and possibly conflict with the present revised turtle regulations, or at least provide a loophole for its abuse.

The government may wish to seek advice on the ways in which foreign aid for development could be used so that there is a sustained long-term benefit to the country and that the local fish resources and substance industry are not damaged by industrialisation through competition for employment, physical damage to resources or market competition for products. Proper use and conservation of the tuna resources can only be achieved by cooperation with other Indian Ocean states and territories because the resources are continuous with those in the 320 km or 200 mile zones (EEZ's) of other nations as well as with the remaining high seas area.

The people of Seychelles are heavily dependent on fish and other marine products such as octopus (reputedly being depleted) and cockles (Donax sp.) for food.

### 3.9.7 Guano

Sea bird guano (a useful phosphatic fertiliser) has been mined for nearly a century in Seychelles. The guano started on the granitic islands, moved through the Amirantes, and settled on St. Pierre, Assumption and Astove. Guano is still mined on Assumption, and possibly St. Pierre, from where it is shipped to Mauritius.

## 3.10 Threats to Marine Resources

### 3.10.1 Man-induced

#### i. Fisheries

There is no evidence for over-exploitation or damaging fisheries in Seychelles. Casiers (bucket traps) are not usually set on coral reefs or used to catch reef fishes.

Green turtles are caught incidentally on longlines set in Seychelles waters by Japanese and North Korean tuna fishing vessels. The magnitude of this catch is unknown.

#### ii. Coral and shell trade

The demand for souvenirs by tourists has caused uncontrolled stripping of corals from some reefs and general decimation of mollusc populations. Until the end of 1971, molluscs were commonly seen on most reefs. Now they can be exceedingly difficult to find. Areas that are extremely denuded are Ste Anne Marine National Park (now better controlled), Port Launay,

Baie Ternay, the reefs of Northwest Bay on Mahé from Danzilles to flot (North Islet), the western reefs of La Digue, and Albatross Rocks. .

iii. Tourists

Foreign tourists on boats from La Digue, or charter vessels from other islands, visit Albatross Rocks, amongst other reefs. On occasion, these visitors wield crowbars to overturn corals and pry free the clam Tridacna. Tourists, by their own actions and their demand for coral and shells, have exacted a heavy toll from the Seychelles reefs.

iv. Boat and anchor damage

Careless anchoring by boats, schooners, and even ships, on shallow patch reefs at low tides, is the cause of much damage to corals. The glass-bottom boats visiting Ste Anne Marine National Park reputedly occasionally anchor on coral reefs. This seems unlikely, but evidence of anchoring on some of the patch reefs is apparent.

v. Siltation

Siltation resulting from the dredging of the harbour at Port Victoria has evidently killed much coral in the region of the Ste Anne Marine National Park. Within the park there are coral colonies powdered with fine silt, even entirely buried. As fisheries expand the demand for a fisheries harbour will increase. Construction of a fisheries harbour will involve dredging operations in the vicinity of Port Victoria. This is a necessary development, but it will increase the siltload. This bodes poorly for the already silt stressed habitats in and around the Ste Anne Marine National Park. Siltation caused by erosion must date back to earliest logging days. Today it is a real hazard in places around Mahé. During January 1978, after a night of heavy rainfall, the sea ran red with silt in places. The cove below Vista do Mar was entirely red.

At Mare Anglaise a muddy stream discharging over the fringing reef formed a 1 km long red streak in the sea. At Anse Etoile a red plume extended at least 500 m out from the shore. North of the old pier at Victoria a huge expanse of sea turned orange.

In an attempt to control erosion, it is required that all agricultural plots be terraced, and, after completion of building, construction companies are obliged to landscape the property. But there are no provisions to control erosion during construction.

vi. Modification of current patterns

Dredging and dumping of spoils may alter currents patterns with catastrophic consequences to downstream habitats. There is no evidence that this has happened in Seychelles.

vii. Piers, groynes and breakwaters

Construction of solid piers, groynes or breakwaters in a country like Seychelles which has alternating monsoons may have serious effects; for example a pier built in 1948 on the south side of Ste Anne Island blocks the seasonal movement of sand. During the northwest monsoon the sand moved east along the southern shore behind the fringing reef, and during the southeast monsoon it returned west. After construction of the pier sand moving east piled up behind the pier and smothered the reef. Re-colonisation by corals is prevented by seasonal covering with sand.

viii. Sewage

Raw sewage (supposedly treated) flows from hotels into Northwest Bay, Mahé. There is no direct evidence for ill effects of the sewage, but in 1974/75 extensive patches of stagshorn coral off Mare Anglaise in Northwest Bay were infected with black-line disease.

ix. Land reclamation

Garbage disposal is a problem on any island system. In Seychelles garbage is dumped over mudflats and covered with earth. This, together with dredge spoils, has been the form of land reclamation around Victoria. Currently there are two active dumps : one covers about a hectare of mudflat at Northeast Point and is destined to become a housing estate; the second is a private dump of the Sey Brew factory. Here drums, cartons and bottles are dumped within a retaining wall and periodically burned. About 1/10 ha of fringing mangrove within full view of the road has been destroyed to create this unsightly dump.

x. Litter

Litter, particularly broken bottles and cans, is a huge problem and a danger on beaches and underwater throughout the islands. The refuse of many boats is simply thrown overboard. The nature and location of litter suggests that certain hotels dump garbage off-shore. The Northwest Bay of Mahé from just south of Northolme to Vista do Mar is especially bad. Plastic bags and rags entangle coral colonies and vegetable scraps, tin cans and bottles are rolled by the surge into gullies and crevices.

Locally produced beer and soft drink bottles are returnable. But at Rs. 2.40 (ca \$ 0.40) per case of 24 empties it is scarcely worth the effort.

xi. Oil

Burmah Oil is soon to start a seismic survey of the Seychelles Bank. If likely oil or gas bearing deposits are located, exploratory drilling operations will ensue. Discovery of oil or gas will cause booming drilling and shore-based operations, and supportive boat and ship activity.

3.10.2 Natural. Threats

i. Rainfall

Heavy rainfall coincidental with low spring tides may kill corals and other lagoonal or shallow sub-tidal life. It is probably this kind of episodic phenomenon, together with other factors such as the vulnerability of species to emersion, that limits the upward growth of coral reefs.

ii. Waves and alternation of monsoons

Certain coral species in Seychelles will not grow in surf (Braithwaite, 1971), so the upper limit of their growth is determined by wave action in one monsoon or the other. Wave planation together with rainfall and vulnerability to emersion probably all limit the upward growth of reefs.

Coral reefs and fringing mangroves, such as are found along the wave-stressed east coast of Mahé, are barriers against coastal erosion. Waves shape beaches through eroding them in one monsoon and building them up in the other.

iii. Temperature stress

The dome of upwelled water, described in the section on oceanography, occasionally blows onto the Seychelles Bank. In April the temperature of the upwelled water is 19°C compared to 29°-30°C for surface waters around the islands (Tarbit, pers. comm.). Sudden flushing of shallow coastal habitats with water 10°C cooler than usual would certainly stress these habitats, and may be a cause of the banks of dead coral around Seychelles.

Broadly speaking, the three phenomena (rain-fall, wave action and temperature stress) described above may be construed as threats. In fact, they are natural factors which contribute to the morphology and development of reefs and other coastal habitats, such as beaches, mangrove swamps and algal flats. Development of reefs and beaches is a dynamic process of erosion and accretion. If natural accretion is impeded (e.g. by pollution, siltation or mechanical damage) these three factors can become real threats.

3.11 Attitude Towards Marine Conservation in Seychelles

The attitude of the government appears to be one of openness to advice. The Royal Society have approached the Seychelles government for support, in principle, of a programme fulfilling certain of the guidelines in MAB Project 7. Unofficially the proposal was favourably received. At the time the Cabinet was unable to offer an official decision due to the pressure of priority issues. Recent developments are that the Seychelles government would welcome a research programme under MAB Project 7 organised through the Royal Society. The possibility of an IUCN marine conservation programme also met with unofficial encouragement. A merger of the IUCN and Royal Society interests, which complement and to some extent duplicate each other, would probably retain the sanction the Royal Society now enjoys.

The Permanent Secretary to the Ministry of Agriculture and Land Use gave informal assurance that logistic support, within the capabilities of the Ministry, would gladly be arranged for participants in a marine conservation programme. The facilities offered included assistance with immigration, laboratory, storage and work space, library use, and limited land and water transport.



Public awareness of environmental issues and of the need for management of marine resources is practically non-existent in Seychelles. There is a nucleus of people, albeit small, who recognize the need for the protection and management of certain areas or species, and their efforts are directed to this end.

Sections 4.71 and 4.79 of the Procter (1970) report concern the importance of public education and dissemination of information. The former recommends that the public be informed of the objectives and work of the Department of Natural Resources (this department does not exist but has an equivalent in the Division of Forestry and Conservation). The latter recommends the government to undertake a feasibility study of an oceanarium, possibly linked to a research centre, on Ste Anne Island. There is a clear need for greater emphasis on dissemination of information. An aquarium is to be built on Mahé. This is a private enterprise and quite independent of government assistance. The proprietor of the aquarium is keen to initiate an education programme for school children in the aquarium. A useful adjunct to such an education would be the demonstration of relationships between species and habitats, and habitats and production.

Early in 1977 the need for an environmental education programme in Seychelles was realised. The Permanent Secretary of the Ministry contacted the WWF education department and received in reply (letter of 12 April 1977 from Mark Boulton) descriptions of techniques and programmes available.

The Minister of Education has responded favourably to the suggestion of environmental education in the school curriculum (Savy, pers. comm.). Members of the Ministry made the specific request for assistance in setting up an appropriate education programme. They requested an adviser and slide-tape equipment. It now remains for an adviser to go to Seychelles to initiate a programme.

The American government has promised videotape equipment to the Ministry for an agriculture extension programme in the schools. The equipment will come with an instructor who will stay in the islands for 6 months. It is intended that the equipment be used for some conservation programmes.

#### 4. IMPLEMENTATION OF MARINE CONSERVATION IN SEYCHELLES

In Seychelles the major requirements for marine conservation are deemed to be : environmental education in schools, ranger training, and supply of outboard motors for park patrol. It is apparent that these alone are insufficient. The objective of marine conservation should be to increase the self sufficiency of the islands by sustaining natural productivity areas as a resource for the benefit of present and future generations of Seychellois, and to eliminate, at least as near as possible, destruction of valuable natural coastal and marine resources. This objective is best met by the formulation of a coastal zone management plan. The coastal zone is broadly defined as the area in which the land and sea interact. The plan details development areas or areas due for protected status. Education, which must reach the entire population, ranger training, and equipment, help the plan to work.

##### 4.1 The Role of Protected Areas

###### 4.1.1 Process continuity

Habitats (such as coral reefs, seagrass beds, algal reefs, fish feeding ground, mudflats, mangrove swamps) reflect a successional stage of a process. This process involves a system of energy inputs and stresses all of which must be identified and included in a protected area. Mangrove swamps, for example, are fish and penaeid prawn nursery grounds. Simply stated, the swamps with their floral and faunal assemblages reflect a particular brackish environment by, for example, maintaining unimpeded tidal flux and the flow of feeder streams.

###### 4.1.2 Maintenance of productivity

Naturally productive areas provide free what expensive mariculture projects can barely match. Such areas remain productive when incorporated, together with their nutrient sources, in a system of reserves and are kept free of perturbation.

###### 4.1.3 Replenishment areas

These are sanctuaries for fishes, lobsters, crabs or other desired species during important or vulnerable phases of their lives. They include feeding, spawning and nursery grounds. Freedom from disturbance in these areas promises high fisheries return and avoids economic extinction of commercially important species.

#### 4.1.4 Gene pool

A system of protected areas including healthy representative samples of habitat guarantees the continuity of native variety and stock which can be drawn upon to restore depleted areas.

For example, on land the last of the indigenous hardwoods and some of the endemic palms are confined to a few small areas on which reafforestation programmes have been able to draw.

#### 4.1.5 Endangered species protection

Within parks or reserves species threatened with extinction because of high demand, such as the green and hawksbill turtles, or habitat destruction are afforded special protection and their populations can be carefully monitored.

#### 4.1.6 Tourism

This is an important industry in Seychelles and deserves careful management of its attractions (such as beaches and coral reefs). While safety and accessibility are important criteria for selection of underwater sites for tourists, aesthetics is another of greater merit. Attractive reef areas of easiest access to tourists are also the most vulnerable by virtue of their proximity to land-based developments. Such areas may be monitored and tended within protected areas.

#### 4.1.7 Research and education

Natural research areas provide baseline data for comparative studies. These areas allow recognition and analysis of natural trends in populations or community succession for assessment against trends in impacted areas. Also these areas provide invaluable field opportunities for observation of living examples of principles taught in schools.

### 4.2 The Problem

Certain of the problems have been indicated in the preceding sections : there are no clearly stated ecological guidelines within which to evolve development policy, there are no trained enforcement personnel, and public awareness of environmental issues is practically non-existent. Efforts to right these deficiencies are hampered by severe shortage of funds. Seychelles is a small nation with a correspondingly small budget. Also, there are few

qualified personnel and fewer experienced personnel to contend with these deficiencies. Paucity of funds has led to inadequate equipment, such as outboard motors, for effective policing of protected areas; and to inadequate dissemination of information concerning the objectives of protecting areas.

#### 4.3 Specific Actions

##### 4.3.1 Integration of multilateral, bilateral and international conservation effort

There will be three main contributions : expertise, funding and equipment. To avoid duplication of effort and wastage of funds and energy, the activities of IUCN, ODM and the Royal Society must be coordinated. Already there is, and continues to be, the threat of some redundancy of effort : Robertson (1972) carried out a survey of coastal resources for IUCN (IUCN/WWF Proj. 726), Stoddart has proposed a project along MAB Project 7 guidelines under the aegis of the Royal Society, Wilson was recently seconded to Seychelles by ODM to review conservation legislation, and this report covers similar subjects to those mentioned above. Also, in addition to their involvement with Cousin Island, ICBP supports a warden on La Digue Island to locate and protect nests of the black paradise flycatcher (Terpsiphone coracina). ICBP also supports a scientist in the islands who is currently studying the breeding biology and habitat requirements of the magpie robin (Copsychus seychellarum) and the black paradise flycatcher.

These similar interests must be integrated. Integration would best be achieved by having a Seychelles based marine conservation consultant who , working together with a terrestrial conservation consultant, is active in survey or research, but who represents such foreign agencies as IUCN or UNESCO, directs the marine conservation programme, and initiates specific proposals from the Seychelles government as these become necessary. These coordinating activities should occupy not more than 15% of the consultant's time.

##### 4.3.2 Survey

The birds of Seychelles and their habitats, where not already protected, are under ICBP surveillance. Forest habitats are known and described, and are managed by the Division of Forestry. The coastal zone is comparatively little described and management is virtually non-existent. A coastal resources survey is urgently needed. Also needed is a report detailing habitats of high productivity, importance to fisheries and tourism, and threats to these habitats. A critical marine habitats

study fulfills these criteria well (Ray, 1976). The study involves intensive survey and some scientific research to supplement the existing insufficient data base. Such a study produces a high impact graphic model, with high predictive and adaptive qualities, which presents strong clear arguments for habitat and species management. It is important that the recommendations of the critical habitats report are clearly and forcefully displayed. The economic benefits of resources fostering and the catastrophic consequence of careless actions must be at once apparent to all.

There is no one in Seychelles qualified for this task, hence foreign expertise will have to be provided.

A survey approach to a critical marine habitats study is outlined briefly below.

- i. Literature search, including correspondence and meetings with research workers, to gather both published and unpublished habitat information.
- ii. Mapping of the distribution of habitats around the target islands from aerial photographs and preliminary field work. This produces a map of boundaries and is devoid of detail.
- iii. Interpretation of base map habitats according to data gathered in step 1. The partially detailed maps are used to identify sites for further survey.
- iv. Surveys of unstudied habitats : this produces detailed descriptions of environment, dominant faunal and floral assemblages, and resource value (e.g. high productivity, fish nursery/spawning/feeding ground, turtle nesting/feeding ground, contribution to tourism). An important component of this survey is the identification of critical habitats of commercial fish species. Stocks of such species are more stressed than non-commercial species and require careful management to ensure continuity of production at levels useful to fisheries. A consultant of the Fisheries Division of FAO might best meet this need. This contributes to the biological and environmental content of the maps.

- v. Socio-economic activity data gathering : activities include existing and proposed developments or protected areas, existing or proposed fisheries effort, tourist pressure, upstream sources of impact (for example sewage outfalls, erosion sites, etc.). This completes the data base for critical habitats identification and the threats to them.

#### 4.3.3 Research

Hard scientific data strengthens critical marine habitat evaluation. Some specific topics to be addressed are listed below :

- i. Assessment of the impact of reef fisheries including coral collection and mollusc depletion on reefs. How much of a threat, if any, do such fisheries constitute to reefs?
- ii. Investigation of coral mortality on Seychelles reefs. Is this mortality natural or man-induced? This involves comparative studies of growth and succession, diversity, and species structure under stressed and normal conditions. This first stage leads into an investigation of the specific impacts of temperature change, sewage pollution, fresh water, and siltation on coral growth and succession in Seychelles.
- iii. Measurement of back-reef lagoon and reef-flat algal productivity and nitrogen fixation. This allows assessment of the contribution of these habitats to coastal productivity.
- iv. Testing of island biogeography theory underwater : this indicates how large protected areas should be. Island biogeography theory, at least as tested on land, suggests that as area decreases so does the immigration rate, but extinction rate increases. Thus diversity decreases with decrease in area. Does this also apply underwater? If it does, steps must be taken to maintain the gene pool at a natural level of diversity and to reduce barriers (physical or spatial) to propagules.
- v. Bird eggs and turtle resource studies. How many people are involved in these industries and to what extent? How much are the industries worth both as a proportion of an individual trader's income, and as earners of foreign

exchange? What proportion of the population is reached by the industries, both traders and consumers? Basic biological data are also required so that the sustainable yield for these resources can be defined and the impact of the exploitations assessed.

- vi. The effects of the tuna fishery on other resources need to be evaluated. In particular, incidental catches of other species should be estimated and the effects of this on the populations of those species assessed. In addition, port construction and traffic of industrial facilities may cause physical damage or interference on local fishing grounds. This problem needs appraisal. Lastly, the tuna fishery and associated shore facilities may have an impact on the local fisheries for food and this needs to be anticipated and, if possible, corrected from the point of view of ecodevelopment in the islands. The maintenance of the local fisheries also calls for an evaluation of impacts other than by industrial fishing on the productivity of the inshore grounds, e.g. the effects of any changes in the coastal zone on the protection of young fish and other organisms.

#### 4.3.4 Coastal Zone Management Plan (CZM Plan) and follow-up

Of immediate concern are the major development areas of Mahé, Praslin, La Digue, and their satellite islands. Development of these islands must not irrevocably destroy or threaten important examples of natural habitat and valuable resources, or eliminate endangered species. The formulation of a CZM Plan is a multidisciplinary project. The first step should be the formal constitution of a CZM Committee. The Committee should comprise representatives of all concerned Ministries (e.g. Agriculture and Land Use, Economy and Development, and Tourism). The conservation consultant should contribute to the scientific side of this programme basing advice on the critical marine habitats findings. The objective should be the identification and evaluation of critical marine habitats for collation with development strategy. Through a process of mutual programme building within the constraints of both the Seychelles government and funding agencies the CZM Plan is produced.

Survey and research are essential components of a marine programme in Seychelles. Following the phases of data gathering and tender of recommendations, there must be an implementation phase. A follow-up programme must be weighted equally important with survey and research,

and planning objectives in the formulation of a CZM Plan. Thus research, knowledge, expertise, and even initiative, may come from outside a country, but conservation happens within.

#### 4.3.5 Education programme

The environmental education programme should emphasize the interrelationships among habitats and between the terrestrial and marine components of island ecosystems. This programme must consider endangered species but should concentrate on maintenance of natural resources in general. The Seychellois need to understand the importance of not destroying natural productivity or eliminating species. Only when they identify with management objectives will the islanders cooperate with area protection or other restrictions.

The education programme would be addressed best at two levels by an experienced educator in environmental sciences.

##### i. Education within schools

Slide-tape programmes would be the best for use in Seychelles schools. They are relatively less expensive, more versatile, and require less expertise than certain other methods, such as video-tape

##### ii. Dissemination of information

The benefits of conservation education in schools will be long in coming. The remainder of the population, including decision makers, businessmen, farmers, labourers and fishermen, also need to be approached through use of the available media : newspapers, special publications, films and radio.

#### 4.3.6 Ranger training

Cousin Island without a warden would be chaos; the ICBP supports the warden and rangers on Cousin. By the same token laws without enforcement or management areas without policing are of little consequence. The success of a resources management programme depends on the rigid implementation of recommendations, constant assessment of progress, and effective enforcement of regulations. The latter category requires an efficient ranger/marine police corps. Members of the Ministry made the specific request for assistance in the training of rangers. Kenya has rangers patrolling protected coastal areas.



An approach should be made to the Kenya government, ODM, or other sources for provision of a qualified person to design and implement a ranger training programme.

#### 4.3.7 Workshop on turtles

Turtles in the western Indian Ocean are an international resource, but their regional status is poorly known. This information is perhaps best gathered through a regional workshop on turtles. The countries concerned are : Seychelles, Mauritius, Comores, Madagascar, Kenya, Tanzania, La Reunion (Europa, Tromelin and Iles Glorieuses), Mozambique and South Africa. Country status reports should include data on which species occur, which are known to nest, location of known breeding sites, estimate of breeding population size, location and extent of feeding grounds, seasonal movement, what protection measures there are and how these are enforced, and how turtles are used and the extent of this exploitation. The result would be a regional picture from which action priorities can be identified and implemented.

#### 4.3.8 Aldabra

Aldabra is unique amongst the atolls in the Indian Ocean for its lack of human disturbance. Furthermore, it is an outstanding example of Indian Ocean evolutionary history, including geological process (it is a raised atoll with subfossil coral reefs exposed above water) and biological evolution (there are undisturbed floral assemblages, several endemic birds and large breeding populations of two endangered species - the giant tortoise and the green turtle). Thus Aldabra fulfills many of the criteria for inclusion in the World Heritage List.

It is important that a scientific presence be maintained on Aldabra. This presence has been an effective deterrent to poaching of tortoises and turtles from Aldabra and its surrounding waters. The Royal Society currently supports the scientific research station on West or Picard Island, Aldabra. However, the Society plans to hand the station over to the Seychelles government in 1980. Future plans for the management of Aldabra are being negotiated by the Royal Society.

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# APPENDIX I

## LIST OF ISLANDS UNDER SEYCHELLES JURISDICTION (from Lionnet, 1972)

<u>Mahé Group</u>	<u>Area (ha.)</u>	<u>Distance from Mahé (km)</u>
Mahé	14,480.0	-
Ste Anne	219.0	close
Sèche or Beacon	1.6	close
Round or Ronde	1.4	close
Moyenne	8.8	close
Long or Longue	21.0	close
Cerf	125.6	close
Cachée	2.0	close
Anonyme	9.6	close
Rat or Brûlée	0.8	close
Sud-Est or Southeast	18.4	close
Souris	0.4	close
Chauves-Souris	0.4	close
Petit Boileau	0.2	close
Ile aux Vaches Marines	5.2	close
Thérèse	72.4	close
Conception	60.4	close
L'Ilot de Lislette	4.4	close
Ilot or North Islet	0.2	close
<u>Islands north of Mahé</u>		
Mamelles	8.8	13.0
Silhouette	1,600.0	24.4
<u>Islands east of Mahé</u>		
Récifs	20.0	27.2
L'Ilot	small	44.8
Frégate or Frigate	201.6	51.2

<u>Praslin Group</u>	<u>Area (ha.)</u>	<u>Distance from Mahé (km)</u>
Praslin	4,040.0	38.4
Ile aux Fous	small	close to Praslin
Cousin	28.8	"
Cousine	25.2	"
Curieuse	282.8	"
St Pierre	0.6	"
Chauve-Souris	0.6	"
Ronde or Round	20.4	"
Aride	38.8	46.4
La Digue	960.0	48.0
Ave Maria Rocks	0.6	close to La Digue
Félicité	268.0	56.0
Albatross Rocks	0.6	close to Félicité
Petite Soeur or West Sister	34.4	59.2
Grande Soeur or East Sister	84.0	59.5
Marianne	95.2	59.2
<u>Coral islands on the Seychelles Bank</u>		
Bird or Ile aux Vaches	69.6	83.2
Denis or Oryxa	124.8	83.2
<u>Islands close to the Seychelles Bank</u>		
Plate	50.0	124.8
Coëtivy	917.2	240.0
<u>Amirantes</u>		
African Banks comprising North Island and		
South Island	32.0	218.8
Rémire or Eagle	26.4	216.0
D'Arros	148.0	228.8
St Joseph Atoll comprising		
St Joseph, Ressource, Fouquet,		
Benjamin, Carcassaye, Aux Chiens		
Pélican, Poule, Coco and		
Sable	121.2	close to D'Arros

<u>Amirantes</u> (contd.)	<u>Area</u> (ha.)	<u>Distance from Mahé</u> (km)
Poivre	110.0	243.2
Ile du Sud or South	135.6	close to Poivre
Marie-Louise	52.0	278.4
Desnoeufs	34.4	288.0
Etoile	1.6	296.0
Boudeuse	1.6	315.2
Desroches Atoll	320.0	208.8
<u>Alphonse Group</u>		
Alphonse	172.0	356.8
Bijoutier	1.6	close to Alphonse
St François	17.6	371.2
<u>Providence Group</u>		
Providence	155.2	611.2
Bancs du Sud or Cerf	110.0	close to Providence
St Pierre	166.8	640.0
Farquhar comprising Nord, Sud, Goélette, Lapin, Milieu & Déposés	777.6	688.0
<u>Aldabra Group</u>		
Cosmoledo Atoll comprising Menai, Wizard or Grande Ile, West-North or Nord, East-North or Nord-Est, Goélette, Grand Polyte, Pagoda, South or Sud	443.2	905.6
Astove	490.0	905.6
Assumption	1,094.0	995.2
Aldabra comprising West or Picard, Polymnie, Middle or Malabar, South or Grande Terre	15,129.6	1,000.0





APPENDIX 2. LEGISLATION AFFECTING MARINE CONSERVATION

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