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# THE COASTAL ENVIRONMENTAL PROFILE OF HIKKADUWA, SRI LANKA

To support Special Area Management Planning  
for the Hikkaduwa Coast and Marine Sanctuary

Edited by

Keith Nakatani  
Arjan Rajasuriya  
Anil Premaratne  
Alan T. White

**1994**

Department of Wildlife Conservation

National Aquatic Resources Agency

Coast Conservation Department

Divisional Secretariat, Hikkaduwa

Coastal Resources Management Project of  
The University of Rhode Island

United States Agency for International Development

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Front Cover     Aerial view of the Hikkaduwa Marine Sanctuary and Town (Photo by Peter Fenz and supplied by Lalith de Silva, 105, Railway Avenue, Colombo 5)

Back Cover     upper left, Novice swimmers standing on reef (A. Rajasuriya)  
                  upper right, Glass-bottom boat in Sanctuary (A. White)  
                  lower left, Marine Sanctuary beach with anchored fishing boats in background (A. White)  
                  lower right, Coral reef fish in Sanctuary (A. White)

Maps             P.K. Kannangara

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## **List of Acronyms and Abbreviations**

AGA	Assistant Government Agent
ATBAHH	Association of Tourist Board Approved Hoteliers of Hikkaduwa
BOD	biochemical oxygen demand
CBO	community-based organization
CCD	Coast Conservation Department
CEA	Central Environmental Authority
CFHC	Ceylon Fishery Harbours Corporation
cm	centimeter
COD	chemical oxygen demand
CRC	Coastal Resources Center
CRM	coastal resources management
CRMP	Coastal Resources Management Project
CZMP	Coastal Zone Management Plan
CTB	Ceylon Tourist Board
DANIDA	Danish International Development Agency
DDC	District Development Council
DIG	Deputy Inspector General
DS	Divisional Secretariat
DWLC	Department of Wildlife Conservation
ED	Education Department
FCS	Fisheries Cooperative Society
GA	Government Agent
GN	Grama Niladhari
GNP	gross national product
GSL	Government of Sri Lanka
GTZ	German Technical Cooperation Agency
ha	hectare
HGBBA	Hikkaduwa Glass-Bottom Boat Owners' Association
HMSDPC/WG	Hikkaduwa Marine Sanctuary Development Program Committee/ Working Group
IISHRA	Hikkaduwa Small Hoteliers and Restaurant Association
ID	Irrigation Department
km	kilometer
l	liter
LC	Land Commissioner
LHI	Lanka Hydraulic Institute

m	meter
ml	milliliter
mg	milligram
mm	millimeter
MFAR	Ministry of Fisheries and Aquatic Resources
MPCS	Multi-Purpose Cooperative Society
MPPI	Ministry of Policy Planning and Implementation
NARA	National Aquatic Resources Agency
NAREPP	Natural Resources and Environmental Policy Project
NARESA	Natural Resources, Energy and Science Authority
NEAP	National Environmental Action Plan
NGO	non-governmental organization
NTU	Nephelometric Turbidity Unit
NWSDB	National Water Supply and Drainage Board
OIC	Officer-in-Charge
PD	Police Department
ppt	parts per thousand
PS	Pradeshiya Sabha
Rs	rupees
SAM	Special Area Management
sec	seconds
SLAAS	Sri Lanka Association for the Advancement of Science
Sp	Species
UDA	Urban Development Authority
URI	University of Rhode Island
UNDP	United Nations Development Program
UN/ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
WNPS	Wildlife and Nature Protection Society
WTO	World Tourist Organization

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Ministry of Fisheries and Aquatic Resources  
Ministry of Policy Planning and Implementation  
National Aquatic Resources Agency  
Pradeshiya Sabha, Hikkaduwa  
Urban Development Authority  
Wildlife and Nature Protection Society  
World Tourist Organization

Those non-governmental organizations which have contributed include the Glass-bottom Boat Owners Association, the Hikkaduwa Hoteliers Association and the Hikkaduwa Sanctuary Working Committee.

The numerous individuals who contributed are credited in the text or in Personal Communications and are all thanked for their assistance in this publication. Any errors and unpopular views that remain are assumed by the editors.

## Foreword

The Coastal Environmental Profile of Hikkaduwa, Sri Lanka provides an excellent summary of all the background information on Hikkaduwa town and Marine Sanctuary required to proceed with management planning and implementation for the area. As part of the Special Area Management approach to planning, the completed profile concludes the first phase of information gathering and synthesis before longer-term management can begin. The profile has evolved from a simple compilation of secondary information to its present inclusion of primary research findings and observations. It is the first publication on the environmental and management status of Hikkaduwa and will open channels for management implementation under the long term support of the National Environmental Action Plan.

This profile is a collaborative effort among all the agencies concerned with the management of the Hikkaduwa area and of the Marine Sanctuary. It summarizes the research findings of the National Aquatic Resources Agency work which began in 1985. The important points highlighted in the Hikkaduwa Management Plan prepared by the Urban Development Authority are included. Recent observations of the Coast Conservation Department and Department of Wildlife Conservation Officers are integrated along with the results of planning meetings facilitated by the Coastal Resources Management Project (CRMP) project officers Messrs. W.M. Karunaratne Banda and Mahasen Fernando.

The Ceylon Tourist Board has conducted several studies on tourism development in Hikkaduwa which have provided much useful background and current data on the status of tourism through the assistance of Mr. S. De Alwis. The Department of Fisheries has been equally cooperative in providing information.

Although many individuals have contributed to the final outcome of this publication, several have been essential in the process. Dr. J.I. Samarakoon of the CRMP helped steer the overall work; Mr. R.A.D.B. Samaranayake of the Coast Conservation Department and Mr. C. Jayawardena of the Department of Wildlife Conservation have assisted with editing; Mr. Mervyn Wijeratne of the CRMP kept administration on track; and G. Tantrigama of Sri Jayawardenepura University has provided results of his research on tourism in Hikkaduwa. The publication could not have been completed without the editing and layout assistance of Shawn Kelly of the University of Rhode Island and Indira Fernando of CRMP. The United States Agency for International Development is acknowledged for sponsoring a timely project.

It is hoped that this coastal profile will encourage improved management of the coastal resources of Hikkaduwa and stimulate a long-term process which can be replicated in other coastal areas of Sri Lanka.

W.A. Jayasinghe  
Director  
Department of Wildlife Conservation

## Preface

The coastal areas of Sri Lanka hold tremendous potential for environmentally sensitive economic development. If development continues to degrade the environment, however, all benefits to society will be lost. This prognosis is the same the world over and although the lesson is recognized by some in Sri Lanka, the lesson is not yet being heeded by all. The Hikkaduwa coast is one of the most densely developed tourist sites in the country. Many consider it a management problem without hope for improvement. But the feeling of those who contributed to this profile is different. They suggest that the trend is changing and that the environment of Hikkaduwa can be improved and maintained, the marine sanctuary can be protected and the tourism industry can continue to prosper and provide benefits to the local population.

Hikkaduwa is the site of an experiment called Special Area Management (SAM) which will facilitate the realization of these positive changes. It is helpful to understand the SAM approach to coastal management because this environmental profile is part of the SAM process and is a fundamental step towards development of a dynamic management plan for the area. The unique feature of SAM is that although we are talking about a 'profile' and a 'SAM Plan', implementation of management has already begun. When the first meeting was held in Hikkaduwa in early 1993 to identify a list of management problems of the marine sanctuary, the management or SAM process started. A key feature of the SAM approach is that it is participatory for all the individuals, community groups, agencies or businesses who have a stake in the resources to be managed. The SAM approach facilitates consensus decision making which encourages participation in management at all levels of government and the private sector.

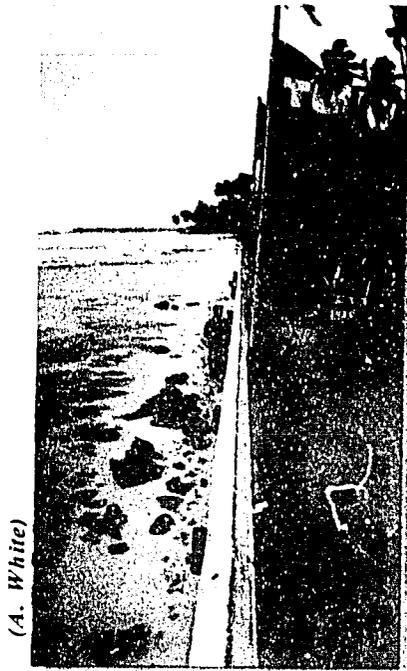
Although the Hikkaduwa Marine Sanctuary is under the jurisdiction of the Department of Wildlife Conservation, the history of management of the sanctuary indicates that effective protection of the sanctuary will only occur when a majority of users and stakeholders of the area are part of the management scheme. Simple enforcement of the rules is easier said than done and has failed in Hikkaduwa in the past. And, although the sanctuary is a management problem with bounded dimensions for a small marine area, the larger coastal strip of the town is a much more complicated situation. Thus, the only possible hope for improving the environment of the coastal strip of Hikkaduwa and the surrounding areas which impact on the sanctuary, is a management model which is highly participatory and at least partially voluntary.

Thus, the SAM approach, of which this profile is part, is a means to support integrated and participatory management of the Hikkaduwa SAM area. It will build on existing laws and regulations but will not be totally dependent on these. Rather, it will depend on the dynamic actions of community groups in collaboration with local and

national government agencies responsible for managing the site. The SAM approach has proven successful in other Asian countries and is being adapted to the situation in Sri Lanka. It can provide a model for the National Environmental Action Plan (NEAP), supported initially by the World Bank to ensure that effective integrated natural resources management begins in Sri Lanka. And, it will integrate the local economy, mostly supported by tourism, with a management approach which considers harnessing locally generated tourism revenues for environmental management. The potential for success through SAM is promising as long as all concerned are open to the process and collaborate to make it work. Let us proceed!

Alan T. White  
Manager  
Coastal Resources Management Project

# MAJOR ISSUES AND CONFLICTS IN HIKKADUWA



(A. White)

*Barrier wall of hotel on the beach without a setback*



*Fish landing on Marine Sanctuary beach*



(A. White)

*People walking on the reef and breaking the corals*



*Polluted waters of Mawakada canal near the sanctuary*



(A. Kajasuriya)

*Anchored fishing boat breaking the corals in the Sanctuary*



*Corals broken by glass-bottom boats in Sanctuary*

# Chapter 1

## INTRODUCTION

### Background on Hikkaduwa

In recent years, the pace of development in Sri Lanka has gradually accelerated. Gross National Product (GNP) has averaged a yearly growth rate of 4.3 percent between 1980-1990 (Central Bank of Sri Lanka, 1991). It increased to 4.6 percent in 1991, and with the Government's push for a stronger free-market economy, is likely to increase further in coming years. As an island nation, much of Sri Lanka's development is associated with maritime activities. The growth rate of the tourist industry in particular, especially in coastal areas, is expected to increase significantly. Growing international trade and commerce has resulted in increasing population shifts to the coasts, especially in the south, southwest and west (Baldwin, 1991). According to the 1981 census, 5.04 million people, or 34 percent of the total population lived in coastal Assistant Government Agent (AGA) Divisions.

With the accelerated pace of development, however, comes the tendency to overexploit resources, including coastal resources, beyond sustainable limits. This has resulted in not only environmental degradation, but also in a widening gap between the rich and the poor. In coastal areas, environmental problems are manifested by destruction of coral reefs, clear-cutting of mangroves, sandmining, overfishing, coastal erosion, water pollution and loss of biological diversity. These problems are exacerbated by the sociological problems and conflicts that result between different user groups. In many coastal areas, tourism has supplanted fishing as the most important economic activity. In Sri Lanka, these problems are the result of the increased intensity of development, coupled with the general lack of planned and coordinated management of coastal, and other natural resources.

In 1966, the Government of Sri Lanka adopted a policy of encouraging private sector investment in the tourist industry (Harris et al, 1967). The south coast area was identified as a major tourism development area. In order to stimulate activity, the Government offered a package of fiscal incentives to the private sector. Now, the beach areas of Hikkaduwa have developed into one of the most popular tourist areas of Sri Lanka. The main attractions are the coral reefs, beaches, scenery and quality of the marine environment in general.

Hikkaduwa is located on Sri Lanka's southwestern coast in the Galle District of the Southern Province, approximately 100 km south of Colombo and 15 km north of Galle, at latitude 6°09'N and longitude 80°08'E (Figure 1.1). A Multiple Use Marine Sanctuary,

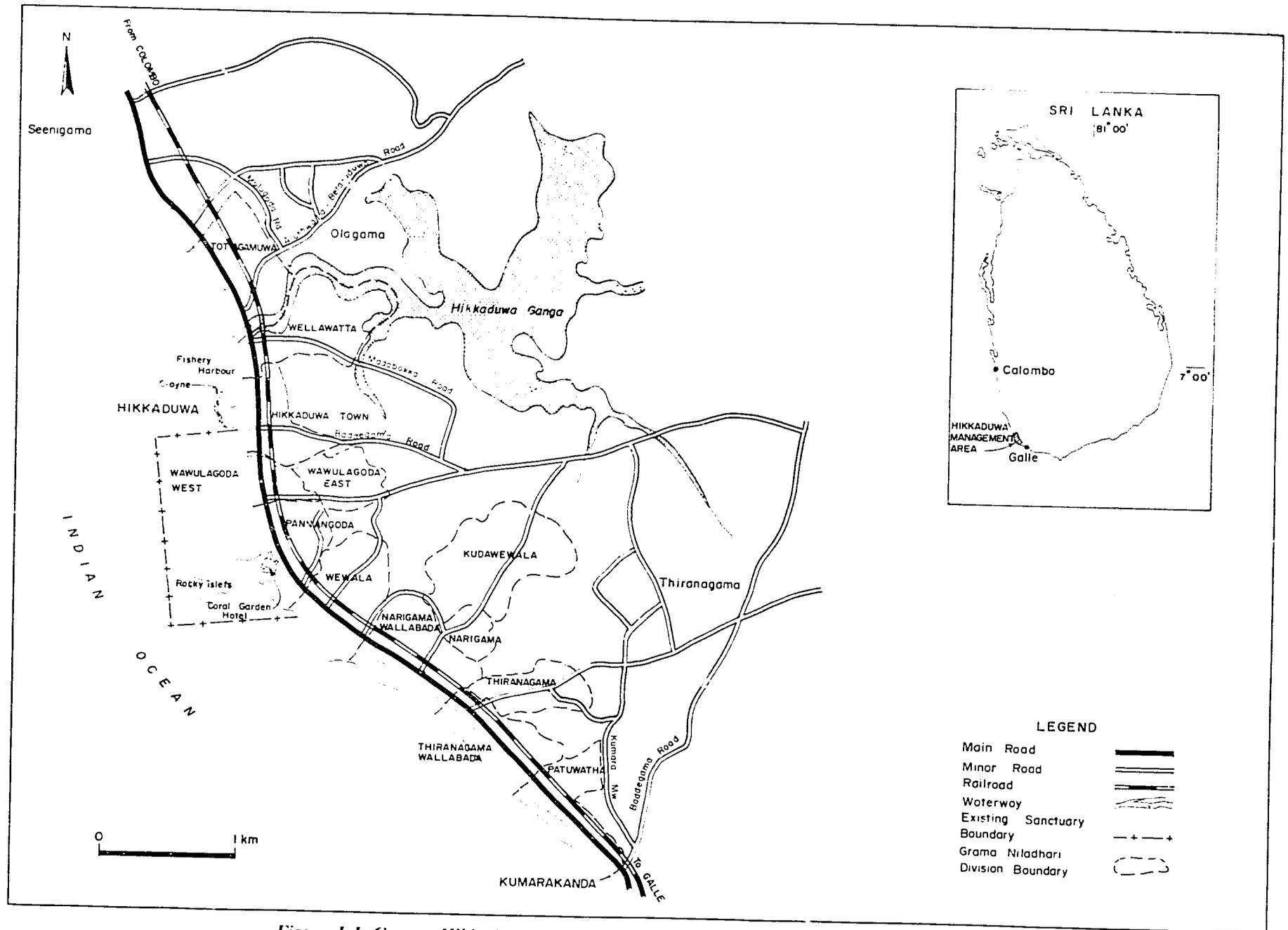


Figure 1.1 Greater Hikkaduwa-area with Marine Sanctuary and Grama Niladhari Divisions

45 ha (1 ha=2.471 acres) in extent and consisting of the reef lagoon and adjacent areas, was declared in May 1979 through the Fauna and Flora Protection Ordinance under the Department of Wildlife Conservation. It is the first of only two marine sanctuaries in Sri Lanka resulting from recommendations for about 20 marine protected areas. Recently, a proposal was made and approved to expand the size of the Sanctuary to 100 ha (Figure 1.2).

Today the local economy of Hikkaduwa is driven primarily by the tourist industry. Surveys show that over 1,500 people are directly employed in the industry and there are over 300 tourist related establishments (CTB, 1992b). Most of the establishments are owned by people living in the area and the total revenue generated in 1992 was around Rs. 188.16 million (\$US 3.84 million) (De Alwis, 1993; Tantrigama, 1994).

Along with its increased popularity and development, however, have come a host of environmental and sociological problems. These problems for which immediate management attention is required, include:

- Degradation of the coral reef;
- Declining coastal water quality;
- Depleted coral fish populations;
- Sedimentation of the coral reef;
- Inadequate solid waste disposal systems;
- Coastal erosion;
- Inadequate anchorage facilities for fishing boats;
- Increasing traffic congestion; and,
- Conflicts between different user groups.

Hikkaduwa is the most striking example in Sri Lanka of the problems resulting from unplanned and uncoordinated tourism development. The repercussions of this have adversely affected the environmental and sociological attributes, which are its main tourist attractions. It is still possible, however, to reverse these negative trends and rehabilitate degraded natural resource quality by addressing the various management problems in a well-planned, systematic and integrated manner.

### **Special Area Management (SAM) for Hikkaduwa**

The Department of Wildlife Conservation (DWLC), the Coast Conservation Department (CCD), and the National Aquatic Resources Agency (NARA), with assistance from the Coastal Resources Management Project (CRMP) of the Natural Resources and Environmental Policy Project (NAREPP) are initiating a Special Area Management (SAM) program at Hikkaduwa. The overall objective is to develop and implement a local-level, coastal resource management plan by facilitating the participation of government agencies and community groups, using a community-based and multi-sectoral strategy, in which the local community is encouraged to assume a primary role in planning and implementation. The second volume of *Coastal 2000: Recommendations for a Resource Management Strategy for Sri Lanka's Coastal Region* (Olsen et al, 1992) produced by CCD and the CRMP (Sri Lanka), strongly recommends a policy of "participatory resource management" at the local level using the Special Area Management approach. The Coastal Zone Management Plan (CCD, 1990) approved for implementation by the Cabinet of Ministers in 1990 also points out the need for community participation in the planning and implementation of management strategies. Such an approach can result in effective

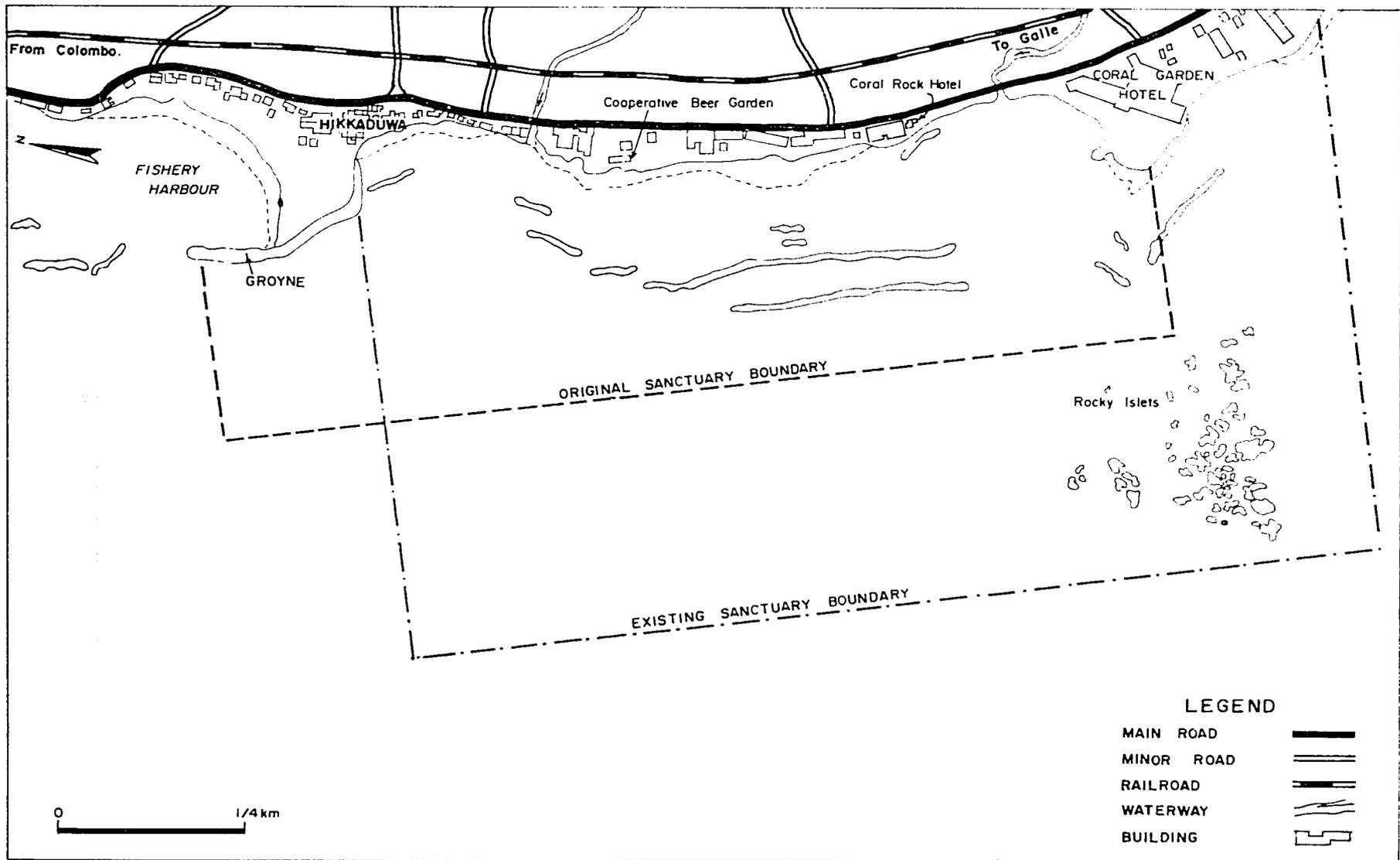


Figure 1.2 Hikkaduwa Marine Sanctuary and boundaries

resource management, as well as tangible benefits to be derived by the community. The sense of community ownership of activities, whereby the community assumes a role as the custodian of the resources, is the key to this approach as discussed in a concept paper on Special Area Management by Wickremeratne and White (1992). The SAM approach to coastal resource management has proven its effectiveness in several successful projects in Southeast Asia (White, 1989). It can now provide a model for implementation of the National Environmental Action Plan of Sri Lanka.

The overall SAM area of concern is shown in Figure 1.1. Although the entire SAM area covers 403.5 ha as discussed in Chapter 2, a smaller portion including the marine sanctuary and the adjacent coastal strip are of immediate importance for the SAM planning efforts.

### **Past Management Efforts**

After the Hikkaduwa Marine Sanctuary was declared in 1979, NARA took a lead role in documenting the status of the coral reef and recommending management actions for the sanctuary. A management plan and zonation scheme for the sanctuary was devised and combined with a larger area development plan for Hikkaduwa under the Urban Development Authority in 1985. This plan, discussed in Chapter 7, has not been implemented but highlights the concern of government and the Hikkaduwa community for managing the area. Thus, the present Special Area Management program builds on past experience.

### **The Hikkaduwa Environmental Profile**

The compilation of this environmental profile is one of the first steps in the formulation of a management plan. The profile serves as a source of background information and baseline data on the project area, providing a broad perspective on the physical, biological and socio-economic characteristics, the institutional and legal framework, and the management issues and opportunities for management. Its objectives are to:

- Identify the constraints, opportunities and objectives for management and development of the coastal resources associated with the Hikkaduwa Marine Sanctuary;
- Define management issues which should be addressed by the SAM Plan;
- Provide a source of information to be used by policy-makers, planners, implementing agencies, researchers and individuals;
- Synthesize mapped information which will constitute a visual database;
- Compile baseline information for monitoring and assessing trends in environmental change resulting from the SAM process; and
- Provide a source of information for environmental impact assessments of development projects within the SAM implementation area.

Information for this profile was collected from secondary sources consisting of published and unpublished documents, maps, government files, gazette notifications and

aerial photographs, and from primary sources based on short-term investigations, interviews with local residents, government officials and specialists, and group discussions at the community level.

As yet, no coastal resources management projects using the SAM approach have been implemented in Sri Lanka. There is, however, widespread acknowledgement that immediate attention is required for coastal resource management, and to be effective, it is necessary for the implementing agents to catalyze the active participation of local communities and economies in the process. The implementation of the Hikkaduwa SAM plan can result in effective coastal resource management, as well as provide valuable lessons for other such future projects to be undertaken in Sri Lanka, whether they be in coastal or other sensitive environmental areas.

## Chapter 2

### GEOGRAPHY AND PHYSICAL SETTING

#### Climate

Hikkaduwa is located in Sri Lanka's wet zone on the south coast as shown in Figure 1.1. Annual rainfall in the area has averaged 2,073 mm for the last 10 years (Figure 2.1). There are two distinct rainy seasons, the southwest monsoon from mid-April to mid-June, averaging about 280 mm/month, and the northeast monsoon from mid-September through November, averaging about 255 mm/month. The driest part of the year is January through March, averaging 75 mm/month. The windiest time of year generally coincides with the southwest monsoon. Data collected for the last 10 years for Galle, which is representative of Hikkaduwa, shows that from May to October the average wind speed is 10.9 km/h, whereas from November to April it averages 6.5 km/h (Figure 2.2). There is little variation in the mean monthly temperature. Temperature data for Galle, which again is representative of Hikkaduwa, shows that the average range is from a low of 26.2°C in January to a high of 28.1°C in April (Figure 2.3).

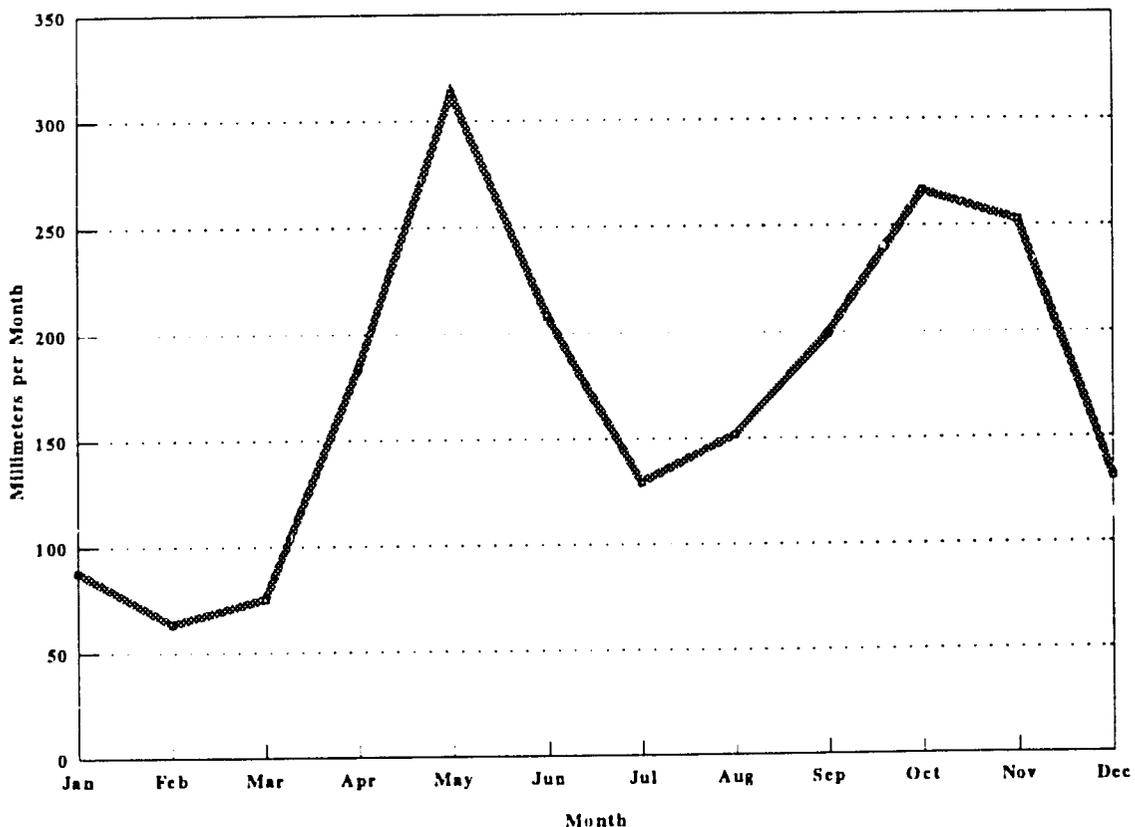


Figure 2.1 Mean monthly rainfall for Hikkaduwa area, 1983-1992 (Meteorology Department)

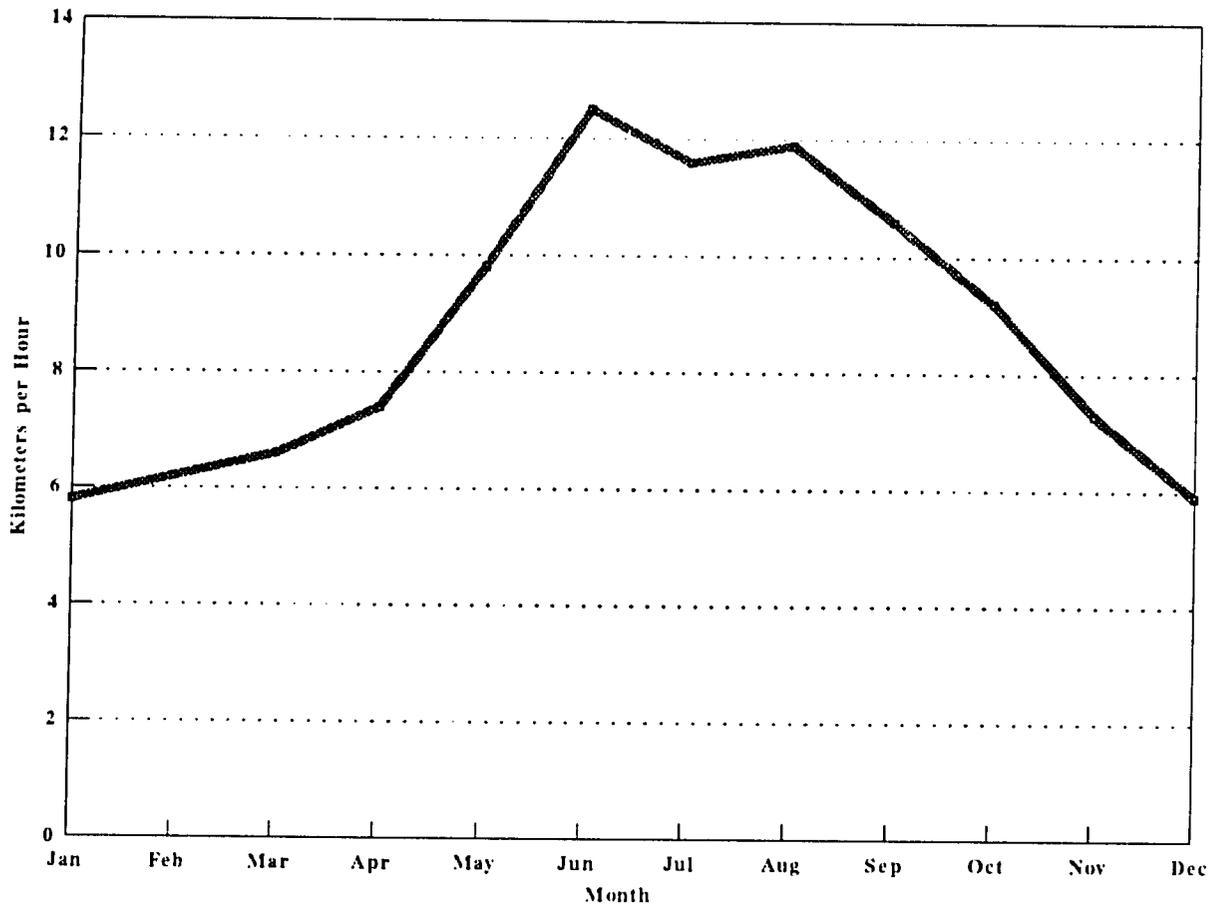


Figure 2.2 Mean monthly wind speed in Galle, 1983-1992 (Meteorology Department)

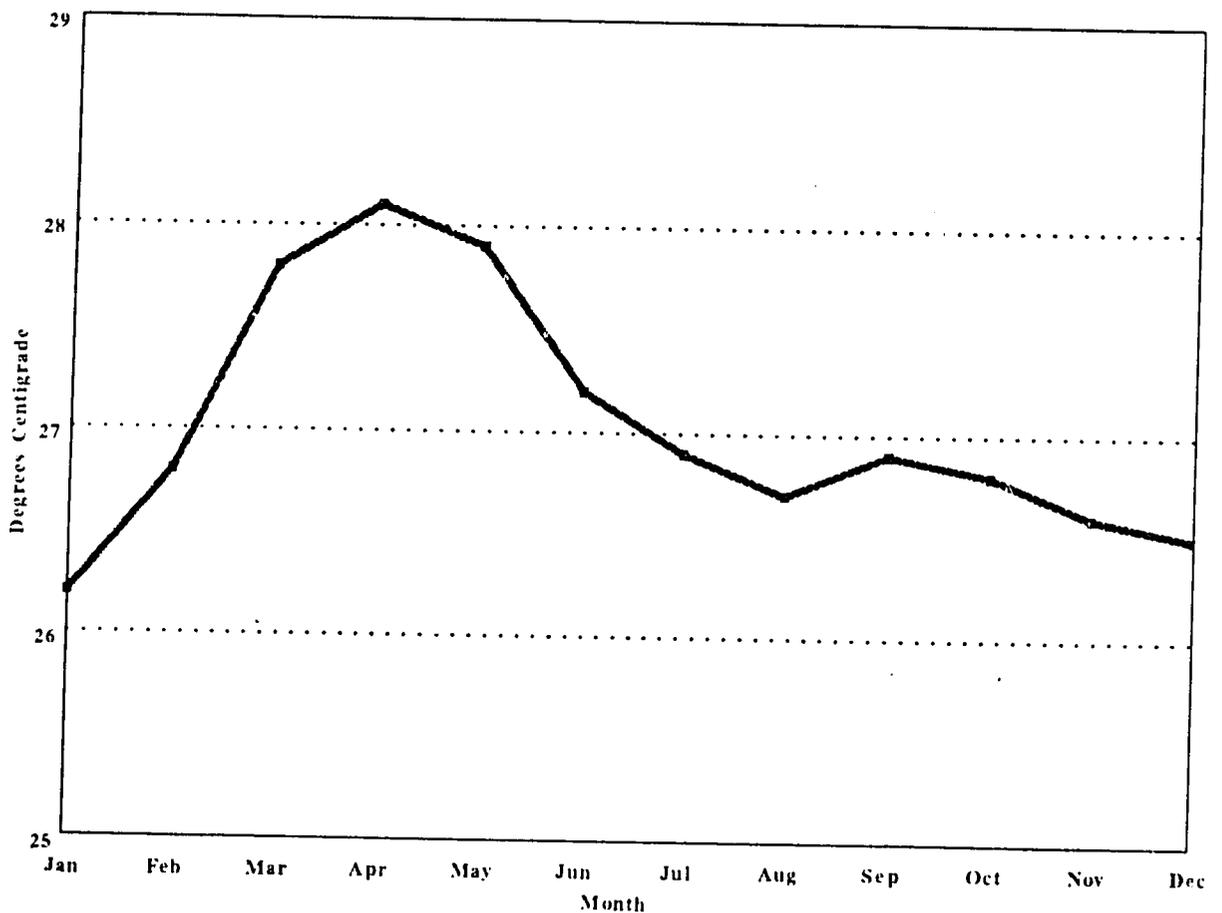


Figure 2.3 Mean monthly temperature in Galle, 1983-1992 (Meteorology Department)

## Land Characteristics

The land extent of the SAM area is 403.5 ha and is comprised of 13 Grama Niladhari (GN) Divisions which are the smallest national administrative units (Figure 1.1). The GN Divisions range in size from 54 ha, Kudawewala, to 11 ha, Narigama (Table 2.1). The area is generally less than 30 m in elevation and is drained by the Hikkaduwa River and its feeder streams. The main focus of SAM activities, however, will be in a much smaller area defined by the Marine Sanctuary and the land area immediately adjacent to it, and along the beaches adjacent to and south of the Sanctuary. This area is generally between Galle Road and the shoreline, located in the center of Hikkaduwa town and continuing south almost to Kumarakanda.

*Table 2.1 Size of the 13 Grama Niladhari Divisions in the Hikkaduwa SAM area (CRMP, 1993)*

G.N. Divisions	Size (ha)
Totagamuwa	42.5
Wellawatta	43.5
Hikkaduwa Town	29.2
Wawulagoda West	18.2
Wawulagoda East	22.3
Panangoda	25.9
Wewala	27.3
Narigama/Wallabada	44.9
Narigama	11.0
Kudawewala	54.0
Thiranagama/Wallabada	25.8
Thiranagama	21.9
Patuwatha	37.0
Total	403.5

## Coastal Waters

The Sanctuary is located between the "Fisheries Harbor" groyne to the north and the Coral Gardens Hotel to the south, and extends seawards out to the Rocky Islets. (The groyne was built by the Irrigation Department in 1960 to prevent sand bar formation at the mouth of the Hikkaduwa River. The area protected by the groyne was subsequently used by fishermen to anchor their boats and called the "Fisheries Harbor").

A hydrographic and ecological survey conducted by the National Aquatic Resources Agency (NARA) in 1987 showed that most of the sea floor seawards of the fringing and lagoon reefs lies at a depth of 4 to 33 m. It is covered with greenish silty sand composed mainly of coral debris. Most of the sea floor west of the Rocky Islets have a ridge and valley topography indicating high energy wave convergence and divergence.

There is very little variation in water temperature in a depth range of 5-30 m, (30.1°C at 5 m and to 29.6 °C at 20 m). There is also little variation in salinity at different depths, averaging about 36.3 ppt, +/- 0.6 ppt (Table 2.2). The average nitrite and orthophosphate levels are 5.21 and 21.76 mg/liter respectively.

Surface currents within the reef area initially flow in a northeasterly direction. Subsequently they flow parallel to the beach, then in a northwesterly direction towards the

*Table 2.2 Average water temperature and salinity at Hikkaduwa (NARA, 1987)*

Depth (m)	Temperature (C) (Number of Samples)	Salinity (ppt) (Number of Samples)
0	-	36.8 (13)
5	30.1 (18)	36.5 (16)
10	30.1 (15)	36.2 (14)
15	29.8 (12)	36.3 (12)
20	29.6 (08)	35.7 (08)
25	29.9 (05)	36.1 (05)
30	30.0 (03)	36.7 (03)

*Table 2.3 Maximum and minimum monthly wave heights at Hikkaduwa (LHI, 1991)*

Month	Significant Wave Height (m)		Average Zero Crossing Wave Period (sec)		Maximum Wave Height (m)	
	Maximum/Minimum	Maximum/Minimum	Maximum/Minimum	Maximum/Minimum	Maximum/Minimum	Maximum/Minimum
Oct '88	1.51	0.62	9.90	4.78	2.42	0.91
Nov	2.15	0.57	8.77	3.97	3.11	0.81
Dec	0.87	0.44	9.48	4.05	1.74	0.66
Jan '89	1.19	0.40	9.58	3.98	1.91	0.57
Feb	1.23	0.42	9.32	3.76	2.20	0.58
March	0.91	0.40	11.28	3.84	1.54	0.63
April	1.93	0.68	9.46	4.75	3.15	1.05
May	2.80	0.92	8.11	4.62	4.20	1.43
June	2.49	1.21	7.97	5.02	4.29	1.78
July	2.17	1.25	7.28	5.44	3.42	1.81
Aug	3.07	1.22	7.36	4.86	4.42	1.80
Sept	2.50	1.00	9.24	4.85	3.85	1.49
Oct	2.23	0.88	6.82	5.04	3.63	1.37

sea and finally move back in the direction of the breakwater. The speed of the surface current ranges from 12 cm/sec to 34 cm/sec. At a depth of 1 m, the current speed is 25 cm/sec (NARA, 1987).

During a one year period from October 1988 to October 1989, the maximum recorded tidal range did not exceed 0.8 m and the mean tidal range was about 0.4 m (LHI, 1991). The maximum water level recorded was 0.6 m in April and the minimum was -0.52 m in July. The monthly variation of the water level was about +/- 0.1 m and the average monthly mean value was about +/- 0.05 m.

The maximum and minimum significant wave heights for the southwest monsoon period are 3.07 m and 0.92 m respectively. For the northeast monsoon the heights are 1.23 m and 0.4 m respectively, and for the inter-monsoon period, 2.23 m and 0.4 m respectively (Table 2.3).

## Summary

The most dominant feature of the coastal setting in Hikkaduwa is its exposure to the high wave energy of the Indian Ocean during the southwest monsoon period of April to August or September. For about 6 to 7 months of the year, the waves and currents limit access to the marine environment and imposes a natural control on tourism and fishing. This exposure also impacts the beaches, causes erosion and makes the coral reef area generally inaccessible at these times. However, the coral reefs, especially those within the Sanctuary, mitigate these forces to some extent within their immediate vicinity.

## **Chapter 3**

### **NATURAL RESOURCES**

Sri Lanka, endowed with an abundance of natural beauty and environments, draws an increasing number of foreigners each year. Tourists were originally attracted to Hikkaduwa in particular by the clean, sandy beaches, sunny climate, unpolluted coastal water, well-preserved coral reefs, and abundance of diverse marine organisms. Though large numbers of tourists continue to come to Hikkaduwa, the health of the coastal and marine environment has deteriorated significantly since the late 1970s. The need to preserve and improve the quality of the natural resources of the area is well-recognized, so that tourists will continue to come and so the local economy will remain vibrant. The important natural resources of Hikkaduwa and their condition are described below.

#### **Beaches**

The sandy beaches at Hikkaduwa are a primary attraction for both tourist and tourist related businesses which has resulted in overcrowding. There are two distinct sections of beach which extend for about 4 km, at times intermittently, between the Hikkaduwa River and Kumarakanda to the south (Figures 1.1, 5.3 and 5.7). It is a concave curved beach with cyclic processes causing alternating local erosion and accretion. The beaches within the SAM area are moderately affected by natural erosion. (The problem is exacerbated by the heavy use of the coast and coral mining on the outskirts of Hikkaduwa town center.)

The northern section, from the Hikkaduwa River to the Sanctuary's southern boundary by the Coral Gardens Hotel, is mostly occupied by large hotels, with sections of sandy beaches and rock revetments. These beaches, which include those of the Wawulagoda West and the northern part of the Panangoda Grama Niladhari (GN) Divisions, are generally small, intermittent and fronted by coral reefs. Although the overall level of beach use is much less than the southern section, because of the restrictive size, the density of beach use is much higher (see Chapter 5). The live coral formations meet both the headland and the harbor, thereby blocking any significant longshore supply of sand. At the same time, breaches in the reef cause a regular loss of sand from the area.

The southern section extends from just beyond the southern boundary of the Sanctuary to Kumarakanda. A sandy beach continues from several meters past the southern boundary of the Coral Gardens Hotel to the south. This area includes the southern part of the Panangoda and Wewala, Narigama/Wallabada, Thiranagama/Wallabada and Patuwatha GN Divisions. This is where the majority of the smaller, "informal" tourist establishments are located. It is separated from the northern section by

a rocky “mid-section” near the Coral Gardens Hotel. The beach here is much more extensive than the northern section beaches. There are rocky reefs along this area, but with very little coral. During the tourist season, the intensity of beach use is very high.

For both sections, the beach is generally narrow, from 5 to 50 m wide, depending on the season. During and immediately after the Southwest monsoon, from late May to late September, sand is lost and the beaches are non-existent in some places. After the monsoon, the beaches are restored through the natural transport of sand. The beaches are also confined by structures such as Hotels and the Galle Road, which runs parallel, 100 m or less from the shoreline.

## Coastal Water Quality

The water quality in the Sanctuary and nearby coastal areas is variable. There are several sources of direct and distributed discharges of wastes, which include:

- A primary treatment direct discharge from the Coral Gardens Hotel and several other large hotels;
- Indirect discharges from smaller (30-60 room) hotels and other establishments;
- Direct discharges from two brackish water canals;
- Direct discharges from glass bottom and fishing boats anchored in the area; and,
- Stormwater drain outfalls which spill rainwater and general runoff from the highway and surrounding areas.

A one-year monitoring program conducted by NARA from June 1993 through May 1994 has determined the relative extent of pollution in the area (De Alwis et al, 1994). Parameters measured were 1) physical (turbidity, pH, dissolved oxygen (DO)); 2) chemical showing nutrients (nitrates, nitrites, phosphates, ammoniacal nitrogen); 3) chemical indicating level of pollution (biochemical oxygen demand (BOD)); 4) bacteriological indicator of pollution (faecal coliform bacterial counts); and 5) productivity (chlorophyll a). The sampling sites are shown in Figure 3.1 and described in Table 3.1 which indicates the variation in exposure to potential pollution sources among the sampling points. Two of the sampling points were close to direct discharges of hotels on the Sanctuary beach and one was a control site in clean water. The methods used were standard for the parameters measured and are described by De Alwis et al (1994). In addition, the study group consulted 34 hotels and restaurants in the Hikkaduwa beach area to determine the number of guest nights per year, the amount of waste generated, the method of disposal of wastes and the amount of water consumed.

The results (mean values, minimum and maximum levels, standard deviations) of water quality measurements for all the sampling sites and parameters measured during the 12 month period are shown in Table 3.2.

In the sanctuary sampling sites (Stations 1-4), the physical parameters did not vary much during the year and do not display extreme or unexpected values. The nutrient values were higher during the months of July through November but not significantly.

BOD in the sanctuary varied between 1 and 8 mg/liter indicating the buffering capacity of marine waters. BOD exceeded the tolerance limit set by the Sri Lanka Standard Institution and the Environmental Quality Standards of the Central Environmental Authority (CEA) on one occasion at Stations 1 and 3 and twice at 2. Faecal coliform

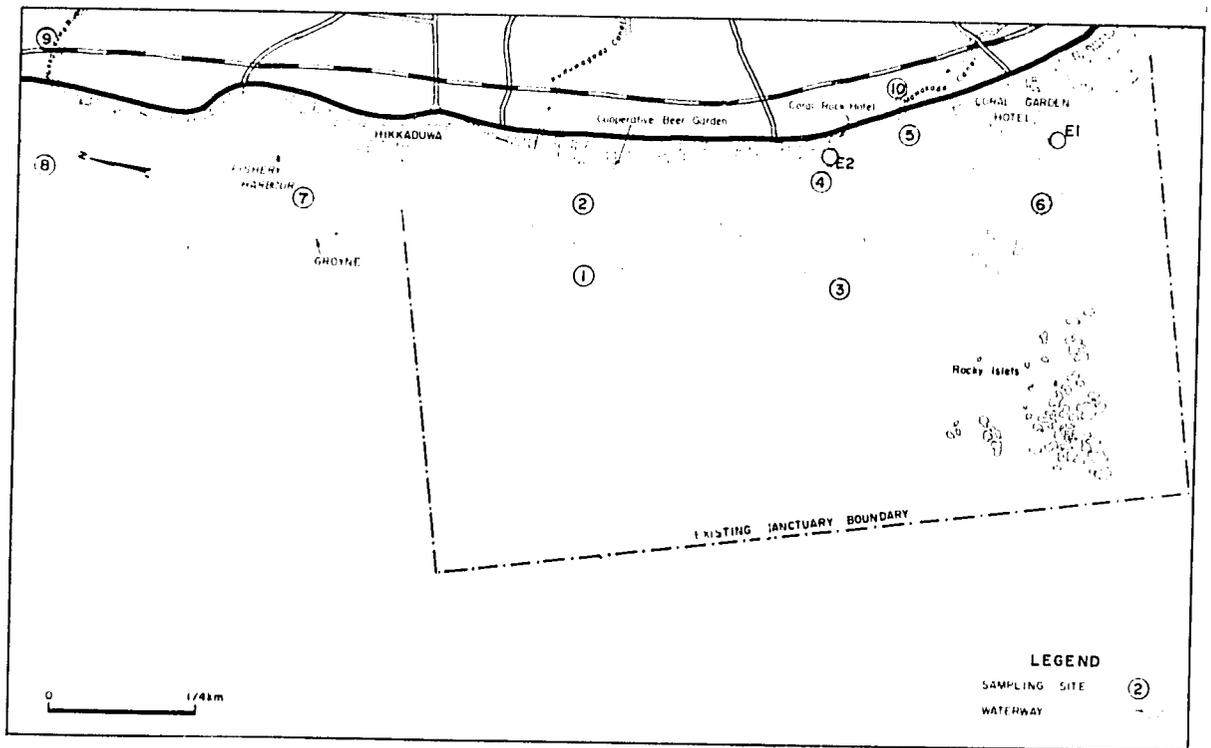


Figure 3.1 Water quality sampling stations for survey of June 1993 - May 1994 (De Alwis et al, 1994)

Table 3.1 Description of sampling stations for water quality study (numbers shown on Figure 3.1)

Station No.	Description
1	Healthy coral reef area in the sanctuary
2	Shallow water area near the beach where bathing is common
3	Healthy coral reef area in the sanctuary
4	Shallow water area near the shore where boats are anchored, hotels concentrated in close proximity to this site
5	Fresh water stream outlet and where sand bar usually prevents water flow
6	Shallow water area where the effluent from Coral Garden Hotel is located
7	Fisheries harbor, about 50 fishing boats anchored and operated from this place
8	The mouth of the major fresh water inlet, Hikkaduwa River; free mixing of sea water was observed and no sand bar formation was recorded and stream flows throughout the year without any obstacle
9	Upstream of the Hikkaduwa River, originates and flows through an agricultural area; salinity of the water changes due to daily tidal variations; bathing activities were observed
10	Mawakada canal flows through a built up area; water flow blocked by sand bar and fluctuates with precipitation
11	Induruwa, unpolluted site selected for the comparison of water quality with the area under consideration in Hikkaduwa
Effluent 1 (E1)	Effluent released regularly from the Coral Garden Hotel after treating biologically at the inhouse treatment plant
Effluent 2 (E2)	Liquid wastes released from the Coral Rock Hotel depending on season

Table 3.2 Results of water quality sampling from 11 stations and 2 effluent outlets in the Marine Sanctuary and the surrounding area (De Alwis et al, 1994)

Station Parameter	Sampling Stations*											Effluent	Effluent
	1	2	3	4	5	6	7	8	9	10	11	1	2
Salinity ppt	33.2±1.69 (30-35)	33.1±2.03 (29-35)	32.8±1.96 (30-35)	32.8±3.06 (25-35)	31.4±4.37 (20-35)	33.1±2.13 (29-35)	28.4±7.1 (8-35)	25.4±7.47 (11-35)	20.9±8.5 (5-32)	2.9±3.4 (0-8)	33.5±1.7 (31-35)		
Turbidity NTU	2.9±0.67 (1.9-4)	3.3±0.90 (2.4-7)	3.4±1.24 (1.4-5.6)	4.2±1.17 (2.6-1)	5.1±1.38 (2.5-8.5)	3.3±1.23 (1.6-6.2)	5.5±1.71 (2.7-8.9)	4.2±1.02 (2.6-5.8)	4.8±1.39 (3.2-8.6)	5.9±1.73 (3.3-8.2)	2.5±.68 (1.5-3.7)	34.4±15.6 (5.6-55)	35.7±9.93 (16.48)
Suspended Solids mg/l	1.9±0.16 (1.78-2.1)	2.8±1 (1.8-3.8)	2.3±0.15 (2.1-2.4)	2.0±0.15 (1.9-2.2)	2.5±0.34 (2.12-2.8)	2.1±0.29 (1.82-2.4)	5.9±0.7 (5.2-6.62)	2.9±0.14 (2.82-3.1)	4.1±0.12 (3.96-4.2)	15.5±3.5 (12-19)	1.8±0.11 (1.68-1.9)	55.6±15.45 (40.1-71)	41.5±3.5 (38-45)
pH	7.9±0.15 (7.6-8.2)	7.9±0.15 (7.6-8.2)	7.9±0.24 (7.2-8.7)	7.9±0.15 (7.6-8.2)	7.8±0.23 (7.1-8.2)	8.0±0.1 (7.5-8.3)	7.8±0.16 (7.5-8.2)	7.8±0.17 (7.5-8.1)	7.7±0.21 (7.3-8.1)	7.5±0.25 (7.0-7.98)	8.0±0.07 (7.9-8.2)	6.3±0.72 (5.0-7.6)	6.2±0.30 (6.0-6.8)
DO mg/liter	7.9±1.10 (5.4-10.2)	8.0±1.08 (6.2-10.8)	7.7±0.93 (5.9-37)	7.7±1.22 (4.6-10.4)	7.2±1.31 (5.4-9.8)	8.5±1.59 (5.4-11.2)	7.5±1.01 (5.8-8.2)	7.4±1.54 (4.4-11.2)	7.3±1.46 (4.8-10.8)	4.3±2.32 (0-8.0)	8.0±1.28 (6.0-10.2)	2.5±3.41 (0-12.2)	0.5±0.13 (0-0.4)
BOD mg/liter	2.6±1.86 (1.0-8.0)	3.5±1.87 (1.2-8.0)	2.5±1.71 (1.0-6.0)	3.0±1.27 (1.0-5.0)	4.5±2.06 (1.0-8.0)	4.6±1.54 (1.8-7.0)	5.6±3.13 (1.9-16)	3.6±0.93 (1.9-5.0)	6.5±3.82 (1.3-16)	15.2±7.43 (7.0-28)	1.6±0.69 (0.8-3.0)	162±162.1 (20-663)	149.3±40.03 (85-220)
NO <sub>3</sub> N µg/liter	5.9±6.30 (0.47-22.5)	5.5±6.05 (0.20-22.4)	5.3±6.51 (0.03-22.1)	6.0±6.16 (0.28-22.7)	5.2±5.48 (0.20-19.1)	5.5±5.67 (0.41-20.0)	6.7±7.07 (0.14-23.8)	5.6±5.86 (0.68-20.6)	4.8±4.43 (0.04-17.2)	4.4±5.11 (0.12-18.0)mg/l	1.5±1.38 (0.30-5.45)	2.7±2.18 (0.33-6.67)mg/l	1.2±0.95 (0.38-3.12)mg/l
NO <sub>2</sub> N µg/liter	0.7±0.46 (0.06-1.69)	0.7±0.46 (0.05-1.95)	0.8±0.53 (0.05-2.0)	0.9±0.60 (0.08-2.4)	0.8±0.50 (0.07-1.87)	0.77±0.57 (0.01-1.93)	1.14±0.81 (0.11-3.81)	0.8±0.34 (0.41-1.69)	0.8±0.43 (0.31-1.63)	0.2±0.51 (0.006-1.58)mg/l	0.6±0.56 (0.21-2.29)	0.6±1.92 (0.09-7.29)mg/l	0.02±0.006 (0.018-0.036)mg/l
NO <sub>3</sub> N µg/liter	2.7±2.09 (0.15-7.53)	3.1±2.80 (0.21-12.66)	2.7±2.66 (0.11-11.51)	2.9±2.39 (0.15-10.61)	5.2±7.30 (0.26-33.24)	2.5±1.90 (0.12-7.18)	4.3±4.11 (1.19-18.36)	4.2±5.12 (1.4-23.32)	4.1±4.31 (1.28-19.67)	2.7±2.70 (0.67-8.32)mg/l	1.8±1.40 (0.51-5.74)	11.5±6.88 (1.24-26.47)mg/l	12.9±6.5 (2.19-21.34)mg/l
Phosphate µg/liter	1.5±1.37 (0.01-6.12)	1.4±1.50 (0.01-6.20)	1.4±1.33 (0.05-5.61)	1.4±1.45 (0.6-23)	1.4±1.43 (0.009-6.14)	1.5±1.22 (0.03-5.35)	1.8±1.26 (0.40-5.82)	1.6±1.46 (0.11-6.53)	1.6±1.35 (0.11-5.66)	0.1±0.36 (0.008-1.15)mg/l	1.5±0.95 (0.033-3.3)	1.6±1.55 (0.40-6.46)mg/l	0.7±0.36 (0.39-1.44)mg/l
Chlorophyll a µg/liter	0.59±0.383 (0.1-39)	0.38±0.352 (0.1-15)	0.59±0.416 (0.03-1.29)	0.80±0.558 (0.1-94)	0.84±1.027 (0.4-42)	1.23±1.730 (0.7-4)	0.78±0.520 (0.1-73)	1.20±0.857 (0.20-3.53)	2.28±1.807 (0.26-6.68)	1.43±0.754 (0.58-2.82)			
Faecal Coliforms/100 m/liter	3.4±6.99 (0-26)	91±205.00 (0-820)	32.4±91.48 (0-360)	149±281.46 (0-1080)	80.1±145.0 (0-480)	166±356.711 (0-1220)	827±1633.32 (0-4800)	710±1762.15 (0-7100)	629±1192.37 (0-3600)	1582±2700.6 (0-7200)	2.66±3.14 (0-9)	4.9x10 <sup>6</sup> ±1.17x10 <sup>7</sup>	2.47x10 <sup>7</sup> ±3.67x10 <sup>7</sup> (1.0x10 <sup>6</sup> -1.01x10 <sup>8</sup> )

\* Locations shown on Figure 3.1

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bacteria varied from 0 to 1080/100 ml in the sanctuary sites and did not surpass the standards of CEA.

The Hikkaduwa River (Station 9) and the Mawakada canal close to the Coral Garden Hotel (Station 10) release water to the Marine Sanctuary. The water quality was variable and contained considerable evidence of pollution. The comparison of the measurements are shown in Figure 3.2 for the key indicators of pollution for all the sites monitored.

The Hikkaduwa River had good levels of dissolved oxygen whereas the Mawakada canal showed low DO levels with anoxic conditions noted on one occasion. BOD was also high in the Mawakada canal. Faecal coliform counts obtained from the Hikkaduwa River varied from 10 to 3600 cells/100ml and counts in the Mawakada canal went as high as 7200/100 ml indicating contamination of the water in both sources (Figure 3.2).

The water quality in the enclosed fishery harbour showed comparatively higher levels of nutrients, faecal coliform and BOD as sampled from Station 7.

The hotel effluent sampling sites showed high BOD and faecal coliform counts in the effluent released. Results also revealed that the high BOD of the effluent from the Coral Garden Hotel was quickly reduced after mixing with sea water. This was also true for high faecal coliform bacteria upon mixing.

The questionnaire survey results, shown in Table 3.3, indicates the maximum potential BOD, phosphate and nitrogen contributed per day to the marine environment from the beach hotels. The levels indicated in Table 3.3 are dependent on the number of people staying in the hotels in a month and assume that the waste is released into the environment, which is not always the case. Thus, BOD loading to the environment varies by the month as shown in Figure 3.3. The highest loads occur from November to March, during the peak tourist season.

It is noted by De Alwis et al (1994) that all the hotels, except one, released their effluent on land. Only the Coral Garden Hotel has a treatment plant for liquid wastes. All the other hotels have soakage pits and septic tanks. Although soakage pits and septic systems are generally effective if their design capacity is not surpassed, ground water as well as beaches are gradually polluted by seepage during rainy periods. Further, overflowing of concrete tanks, cracked septic tanks and deliberate pumping of sewage effluents into the sanctuary were noted during the study period.

*Table 3.3 Potential pollutant loads from hotels on the beach environment of Hikkaduwa (De Alwis et al, 1994)*

Month Year 1993	Total number of guest nights	BOD Kg/day	Phosphate Kg/day	Nitrogen kg/day
January	23068	14.53	1.08	5.38
February	21452	13.5	1.0	5.0
March	21543	13.57	1.005	5.02
April	13022	8.2	0.61	3.04
May	9149	5.76	0.43	2.1
June	7367	4.64	0.37	1.72
July	6168	3.89	0.29	1.44
August	14338	9.03	0.67	3.35
September	11835	7.46	0.55	2.76
October	11239	7.08	0.52	2.62
November	15168	9.56	0.71	3.54
December	19945	12.6	0.93	4.66

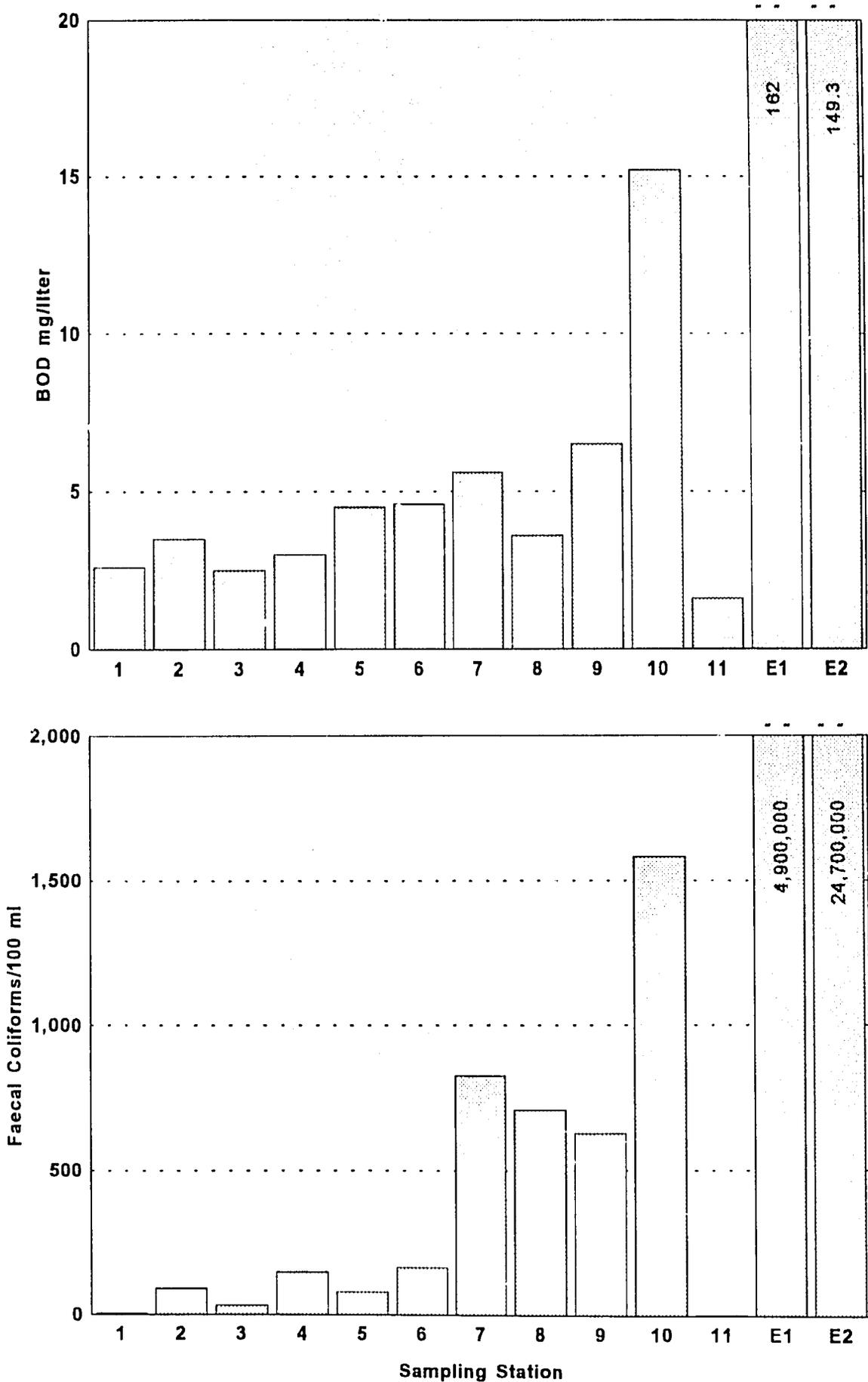


Figure 3.2 Relative mean variation in pollution indicators (BOD and Faecal Coliforms/100 ml) from 11 sampling stations in Hikkaduwa (De Alwis et al, 1994)

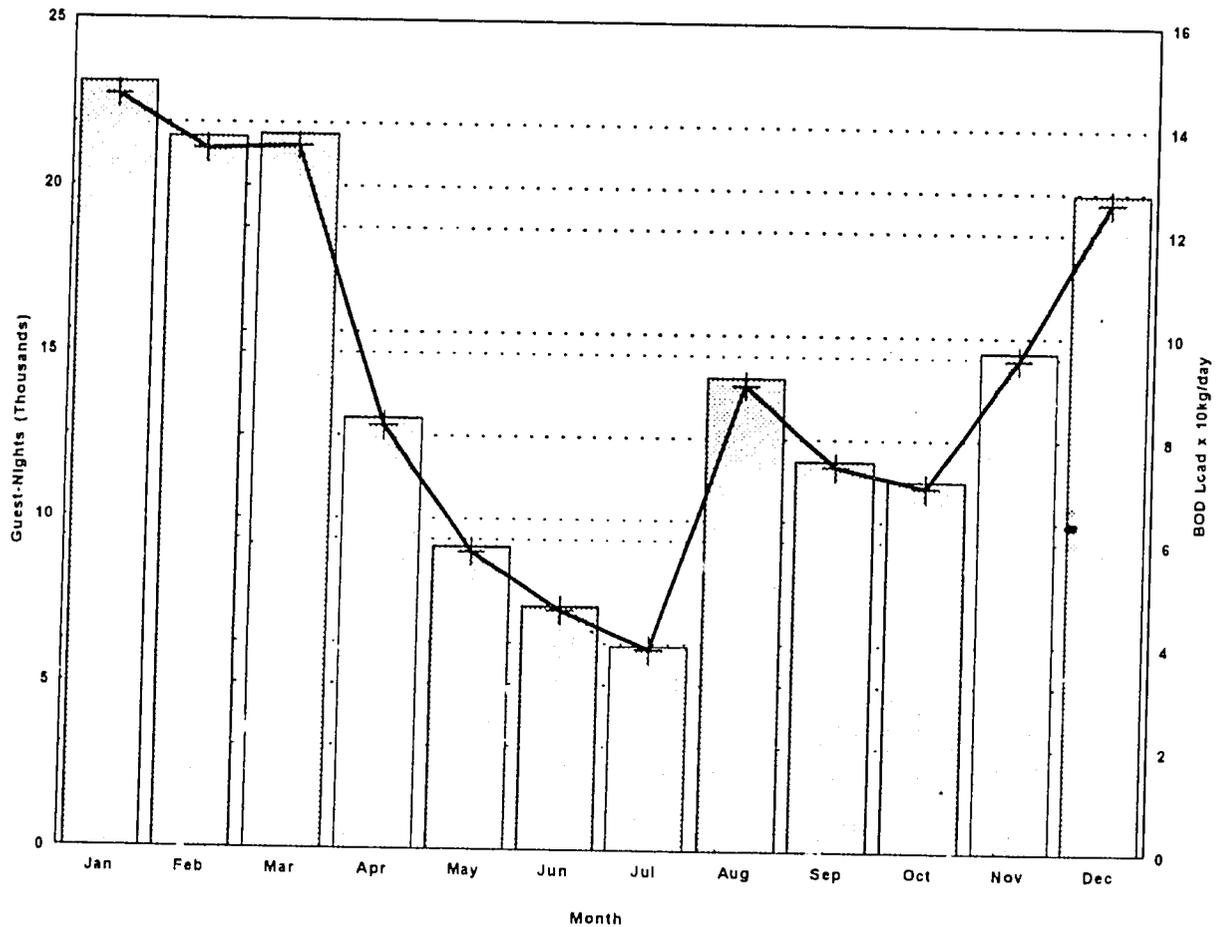


Figure 3.3 Potential BOD loads per month from a sample of 34 hotels (De Alwis et al, 1994)

In summary, the water quality of the Hikkaduwa Marine Sanctuary is still suitable for recreational use and for the healthy growth of the coral reef. Water quality in the sanctuary area has remained relatively unpolluted because of the buffering action and self-purification capacity of the sea water. Nevertheless, there is little room for complacency because loads of BOD, total nitrogen, total phosphates and bacteria counts indicate considerable pollution present in close proximity to the sanctuary. The sources of this pollution are two brackish water canals, the direct discharge of one hotel, indirect discharges (seepage or pumping) from other hotels, direct discharges from glass bottom and fishing boats and indirect runoff from the highway area.

The hotel pollutant contributions are point sources and can be managed but the canal water ways represent a collection of wastes from many dwellings and businesses. Coral growth is very poor in the immediate vicinity of the canals due to this nutrient pollution and increased sedimentation. The sediments come from upper watershed deforestation and beach erosion.

### Coral Reefs

Coral reefs are a primary tourist attraction at Hikkaduwa, but as in other locations in Sri Lanka have suffered extensive degradation. Long-time residents of Hikkaduwa have stated that "entire sections" of reef have been destroyed. In recent years, the prevalence of coral mining has decreased in the immediate Hikkaduwa area. The large number of glass bottom boats operating without regulations, are now the main cause of coral reef destruction within the Sanctuary. The boats hit the corals, anchors are dropped, tourists,

foreign as well as local, stand and walk on the corals. Anchoring and dumping of oil by fishing boats is also a major problem. In addition, polluted water from fish holds and waste oil are dumped directly into the Sanctuary. The reef has been completely destroyed where the fishing boats are anchored. Further, fishermen continue to widen the gap in the reef in front of the Cooperative Beer Garden Restaurant to bring larger boats into the Sanctuary. Sedimentation of the coral reef is another cause of degradation. Much of this sediment is stirred up and deposited on coral as a result of boat movement within the Sanctuary.

The remaining coral reefs occur primarily as fringing reefs in the Sanctuary between the Coral Gardens Hotel to the south and the Fisheries Harbor groyne to the north (Figure 3.4). The reef extends for about 130 m seawards before dropping to soft substrate at 7-10 m. The reef is separated from the shore by a 2-3 m deep channel parallel to shore. In the south, it abuts directly onto the shore. Spur and groove formations are found on the seaward face of the reef, particularly in the southern section. There is generally no marked coral zonation. A series of sandstone and rocky substrate reefs are also found just beyond the Rocky Islets at about 20 m. These are scattered with occasional coral colonies and gorgonians.

Surveys were conducted by NARA in 1985, 1992 and 1994 to assess the condition of the coral reef within the Sanctuary. Information collected during the surveys included the status of the coral reef, extent of live hard coral cover, dead coral, live soft coral, reef

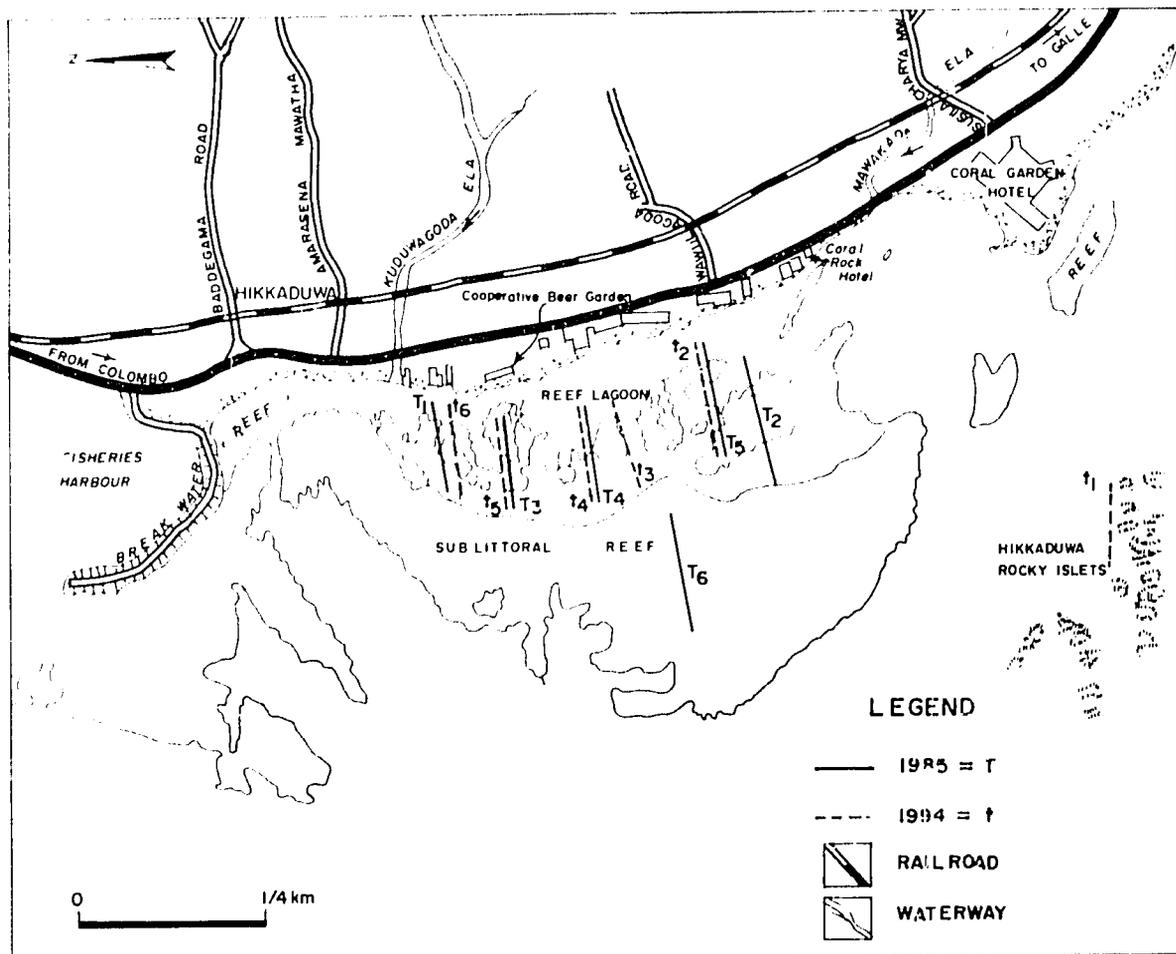


Figure 3.4 Location of coral reef and line transects for NARA surveys in 1985 and 1994

substrate, algae and sea grass; and the abundance and diversity of reef fish. The effects of anchoring boats within the reef lagoon, use of glass bottom boats, discharging waste water from hotels and prevalence of reef walking and ornamental fish collection was also noted.

Five line transect surveys were conducted within the reef lagoon, and one transect was conducted on the seaward reef slope and reef edge area in 1985 and one near the Rocky Islets in 1994 (Figure 3.4). Permanent transect points could not be fixed in 1985 due to the removal of pegs by snorkelers and others. In 1994 five permanent transects were laid within the reef lagoon and one was laid on the northeastern side of the Rocky Islets. Each transect was 50 metres in length and was laid perpendicular to the shore. They were laid from the reef crest towards the shore. The distance between the transects within the reef lagoon was approximately 75 to 100 metres (Figure 3.4). The results of the surveys in 1985 (De Silva and Rajasuriya) and 1994 (Rajasuriya) are summarized in Tables 3.4 and 3.5 respectively.

In 1985, live hard coral cover was 18.8 percent within the reef lagoon, dead coral 29.0 percent and coral rubble 8.2 percent. On the reef slope and edge, no coral damage was observed. Soft corals were among the dominant groups with a cover of 40 percent. A relatively uncommon marine alga, *Caulerpa filicoides* (Ranatunga and De Silva, 1986), yet to be recorded in Sri Lanka, was one of the dominant green algae on the reef slope at a depth of 5-10 m. In general, there is little seagrass and algae in the area. Overall, the coral diversity was relatively high with 60 species of hard coral distributed among 31 genera of which 17 species and 3 genera were new records for Sri Lanka (De Silva and Rajasuriya, 1985). Table 3.6 lists the coral genera and species observed in 1994 which is slightly less than in 1985.

In 1992 and 1994, NARA conducted surveys to note changes in reef structure, health of the reef and user patterns (Rajasuriya, 1992; 1994). Because permanent transects could not be established in 1985, transect lines were laid as close as possible to the previous locations. Estimated live coral was 22 percent in 1992 and 34 percent in 1994 as shown in Table 3.5. The increase in coral cover is significant for the reef lagoon and indicates that it is at least stable. However, live coral cover along transect 4 which is located where the fishing boats are anchored has decreased considerably from 21.7 percent in 1985 to 13.2 percent in 1994 whilst the amount of dead coral has increased from 77.9 percent in 1985 to 86.8 percent in 1994 (Tables 3.4 and 3.5).

De Silva and Rajasuriya in 1985 recommended zoning the Sanctuary for different uses (Figure 3.5). Although the proposed zonation was not implemented, it is useful to refer to it because they demarcated the zones according to user patterns within the sanctuary. The following was their analysis in 1985:

Zone A (general use): The dominant form of coral within this area belongs to the family Acroporidae. They are mostly the branching species of *Acropora* and foliaceous types of *Montipora*. The live coral area is confined to the southern section of this zone, due to constant disturbance in the middle and northern sections. This disturbance is mainly from the anchoring of fishing boats within the reef lagoon, glass bottom boats ramming the coral reef and visitors walking on corals. Corals in the vicinity of the anchorage have been almost totally destroyed as the fishermen have now increased the size and length of the anchor chains. Increased siltation was also noticed in the northern part of zone A. However, coral regeneration was observed on some coral patches.

**Table 3.4 Percent coral reef substrate cover in the Marine Sanctuary 1985 (De Silva and Rajasuriya, 1985)**

Substrate	Transects*						Mean (without 6)
	1	2	3	4	5	6	
Sand	43.9	40.4	45.5	47.6	22.9	20.0	40.1
Coral Rubble	-	-	3.8	-	37.2	-	8.2
Dead Coral	17.6	33.2	34.4	30.3	29.6	-	29.0
Total Dead Substrate	61.5	73.6	83.7	77.9	89.7	20.0	77.3
Live Hard Coral	31.7	18.2	16.3	21.0	6.4	40.0	18.7
Live Soft Coral	-	-	-	0.70	-	40.0	0.2
Total Live Coral	31.7	18.2	16.3	21.7	6.4	80.0	18.9
Algae Seagrass	6.8	8.2	0	0.40	3.8	0	3.8

\* See figure 3.4 for locations

- 1 = In front of Posiedon Diving Station
- 2 = In front of Coral Rock Hotel
- 3 = In front of Co-operative Beer Garden Restaurant
- 4 = In front of Dharshana Guest House
- 5 = Between Coral Rock Hotel and the Blue Coral Hotel
- 6 = Seaward Reef slope

**Table 3.5 Percent coral reef substrate cover in the Marine Sanctuary 1994 (Rajasuriya, 1994)**

Substrate	Transects*						Mean	Mean (without 1)
	1	2	3	4	5	6		
Sand	-	1.1	-	25.1	30.1	26.0	13.7	16.5
Coral Rubble	8.9	2.8	4.6	-	9.3	12.2	6.3	5.8
Dead Coral	13.7	13.1	47.9	9.7	-	11.3	15.9	16.8
Rock (old Coral)	11.6	33.0	0.5	24.7	25.8	3.4	15.4	16.4
Other Sediment	1.0	5.4	4.1	27.3	-	2.2	6.7	7.8
Damaged Coral	-	5.8	3.5	-	-	-	1.6	1.9
Total Dead Substrate	34.2	55.8	60.6	86.8	65.2	55.1	59.6	64.7
Live Hard Coral	65.8	43.80	39.4	13.2	30.4	42.0	39.1	33.8
Live Soft Coral	-	-	-	-	0.7	0.2	0.2	0.2
Total Live Coral	65.8	43.80	39.4	13.2	31.1	42.2	39.3	34.0
Algae Seagrass	-	0.4	-	-	3.70	2.7	1.10	1.30

\* See figure 3.4 for locations

- 1 = Near Rocky Islets
- 2 = Between Coral Rock Hotel and the Blue Coral Hotel
- 3 = In front of Underwater Diving Instructors Diving Station
- 4 = In front of Dharshana Guest House
- 5 = In front of Co-operative Beer Garden Restaurant

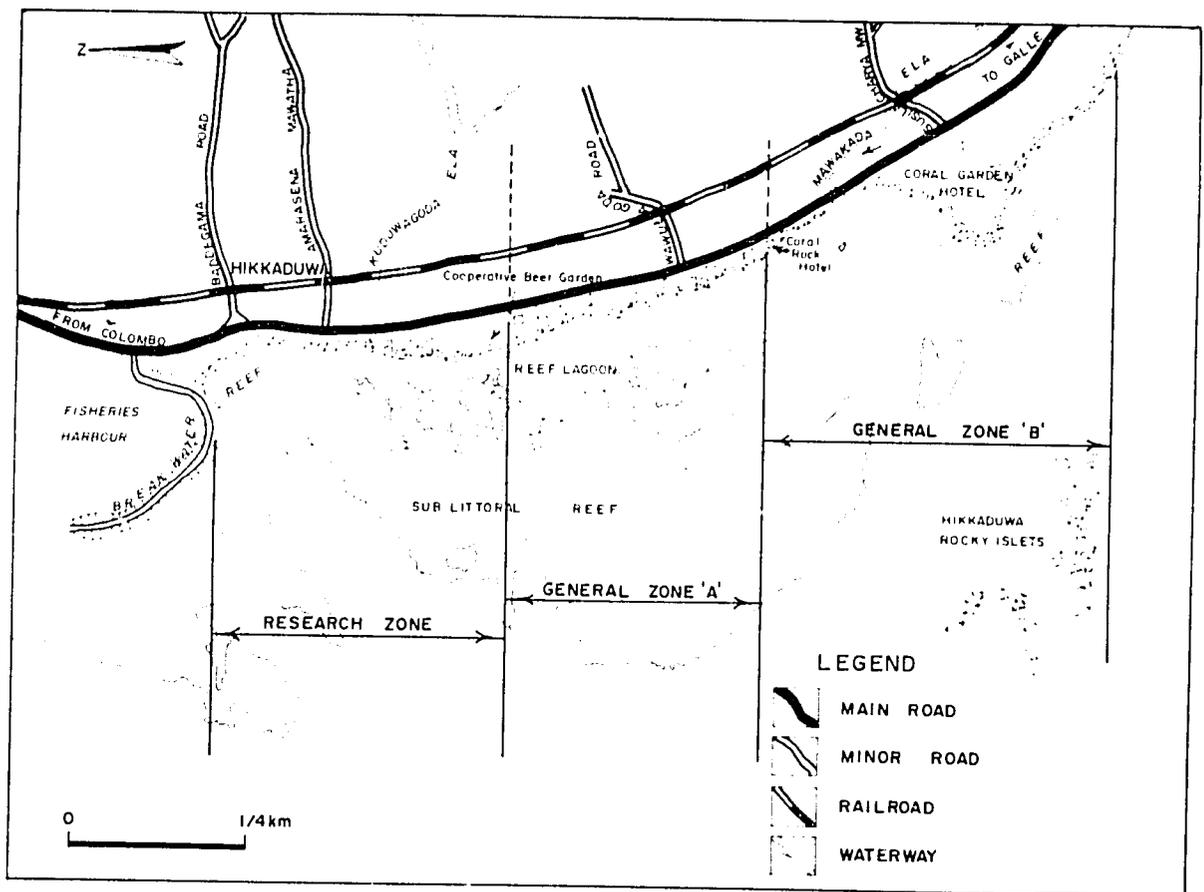


Figure 3.5 Zonation of Hikkaduwa Marine Sanctuary proposed by De Silva and Rajasuriya, 1985

Table 3.6 Coral species recorded for Hikkaduwa Marine Sanctuary, December 1993 (Rajasuriya, 1994)

<p><b>Family: Acroporidae</b>  <i>Acropora formosa</i>  <i>Acropora anthocercis</i>  <i>Acropora robusta</i>  <i>Acropora solitariaensis</i>  <i>Acropora aculeus</i>  <i>Acropora hyacinthus</i>  <i>Acropora</i> spp  <i>Montipora acquituberculata</i>  <i>Montipora verrucosa</i>  <i>Montipora</i> spp</p>	<p><b>Family: Faviidae</b>  <i>Favia favyus</i>  <i>Favia speciosa</i>  <i>Favites flexuosa</i>  <i>Favites abdita</i>  <i>Goniastrea edwardsi</i>  <i>Goniastrea retiformis</i>  <i>Montastrea curta</i>  <i>Montastrea valenciennesi</i>  <i>Platygyra lamellina</i>  <i>Platygyra sinensis</i>  <i>Leptoria phrygia</i>  <i>Cyphastrea chalcidicum</i>  <i>Plesiastrea versipora</i>  <i>Echinopora lamellosa</i></p>	<p><b>Family: Poritidae</b>  <i>Porites</i> sp  <i>Goniopora</i> sp</p>
<p><b>Family: Agariciidae</b>  <i>Pavona varians</i>  <i>Pavona minuta</i>  <i>Gardneroseris planulata</i></p>	<p><b>Family: Fungiidae</b>  <i>Podabacia crustacea</i></p>	<p><b>Family: Mussidae</b>  <i>Symphyllia recta</i>  <i>Symphyllia radians</i>  <i>Acanthastrea echinata</i></p>
<p><b>Family: Astrocoeniidae</b>  <i>Stylocoeniella guentheri</i></p>	<p><b>Family: Pocilloporidae</b>  <i>Pocillopora damicornis</i>  <i>Pocillopora verrucosa</i>  <i>Pocillopora eydouxi</i></p>	<p><b>Family: Merulinidae</b>  <i>Hydnophora exesa</i>  <i>Hydnophora microconos</i></p>
<p><b>Family: Dendrophylliidae</b>  <i>Turbinaria peltata</i>  <i>Tubastrea</i> sp</p>		<p><b>Family: Oculinidae</b>  <i>Galaxea fascicularis</i>  <i>Galaxea astreata</i></p>
		<p><b>Family: Thamnasteriidae</b>  <i>Psammacora contigua</i></p>
		<p><b>Family: Milleporidae</b>  <i>Millipora platyphyllia</i></p>
		<p><b>Family: Stylasteridae</b>  <i>Distichopora violacea</i></p>

**Zone B (general use):** Live coral patches in reasonably good health grow around the Rocky Islets, which are located in this zone. Due to heavy visitor pressure, however, some have been damaged. Most glass bottom boats operate within this zone. Although this zone contains the highest amount of live coral the abundance of reef fish was relatively low.

**Research Zone:** Visitor pressure is less in this zone due to the prevailing strong currents. Siltation is evident, especially in the lower sections of the coral patches. Although live corals were in relatively good health, reef fish were mostly absent. The reef close to the Fisheries Harbor groyne is covered by municipal refuse that may have been carried by currents and deposited as a result of breaching on the southern side of the groyne. Long-term effects of sand transport through this breach are unknown.

## Reef Fish

Fish abundance and diversity were recorded along the same transects used to measure the coral cover in 1994. Fish were counted in an area of 500 square metres per transect which consist of five metres on either side of the transect and the water column above the transect. The time elapsed per transect was approximately 30 minutes. Although the overall diversity of reef fish is fair, 168 species belonging to 76 genera distributed among 40 families (Table 3.7), the abundance and density of fish has decreased over the last 15 years. This can mainly be attributed to the removal of tropical fish for the aquarium trade and also to the disturbance caused by boats. Glass bottom boat owners indicated that nets are laid on the deeper sections of the reef to trap spiny lobsters. These nets reduce reef fish populations. Dynamite fishing occasionally occurs just outside the Sanctuary's southern boundary. Fishing, using traditional methods is allowed within the sanctuary. The major portion of the catch which is seasonal include Herrings, Rabbit fishes, Needlefish and Mackerels. Occasionally other colourful reef species such as Oriental Sweetlips and Wrasses are also caught. Pollution caused by hotel wastewater is expected to adversely affect the coral and reef fish, as well as reducing underwater visibility.

The 1994 research establishes baselines for diversity of fish, coral and their abundance. As shown in Table 3.7, the mean number of species observed per transect is 71.6 species per 500m<sup>2</sup>. The fish abundance for those species counted is a mean of 619.5 fish individuals per 500m<sup>2</sup>. These numbers will be extremely useful to note changes, by monitoring the reef fish community in years to come.

## Minerals

Coral reef limestone is the most important mineral in the area. Limestone is found mainly along the coast, with secondary deposits upto 1 kilometer inland. Sand is abundant in the SAM area along the beaches and is mined in limited amounts. Sand has been dredged from the Fisheries Harbor, because the silting of the harbor limits the number of boats that can anchor there. The sand was then used to fill in marshy area within the free trade zone at Koggala.

**Table 3.7 Fish species observed in Hikkaduwa Marine Sanctuary in December 1993 and counted along line transects in March 1994 (Rajasuriya, 1994)**

Scientific Name	Common Name	T1	T2	T3	T4	T5	T6
Family: Acanthuridae							
<i>Acanthurus lineatus</i>	Striped Surgeonfish	17	30+	21	8	17	31+
<i>Acanthurus leucosternon</i>	Powder Blue Surgeonfish	8	7	5	3	3	9
<i>Acanthurus triostegus</i>	Convict Surgeonfish	50+	6	8	11	15	30+
<i>Acanthurus blochi</i>	Tail-ring Surgeonfish	8+	2	-	7	-	2
<i>Acanthurus pyroferus</i>	Mimic Surgeonfish	3	-	-	-	-	1
<i>Acanthurus xanopterus</i>	Yellowfin Surgeonfish	5	-	2	3	2	1
<i>Acanthurus tennentii</i>	Leutenant Surgeonfish	-	-	2	1	-	-
<i>Acanthurus bariene</i>	Roundspot Surgeonfish	3	-	7	-	-	6
<i>Acanthurus</i> sp	Surgeonfish	70+	20+	22+	14+	17+	16+
<i>Ctenochaetus striatus</i>	Striped Bristletooth	10+	3	5	5	7	9
<i>Naso lituratus</i>	Orange Unicornfish	1	-	5	7	8	1
<i>Naso brevirostris</i>	Spotted Unicornfish	3	-	-	4	1	-
<i>Zebriasoma veliferum</i>	Sailfin Tang	-	-	1	1	-	2
<i>Zebriasoma scopas</i>	Brushtail Tang	4	-	6	-	-	3
Family: Apogonidae							
* <i>Apogon robustus</i>	Cook's Cardinalfish						
* <i>Chelodipterus lineatus</i>	Tiger Cardinalfish						
* <i>Chelodipterus macrodon</i>	Eight-lined Cardinalfish						
Family: Balistidae							
<i>Balistapus undulatus</i>	Undulate Triggerfish	6	4	3	2	4	2
<i>Rhinecanthus aculeatus</i>	Painted Triggerfish	-	3	1	1	2	1
<i>Rhinecanthus rectangulus</i>	Wedge-tail Triggerfish	2	-	-	-	1	1
* <i>Balistoides viridescens</i>	Titan Triggerfish						
Family: Belontiidae							
<i>Tylosurus</i> sp	Needlefish	-	1	-	5	-	-
Family: Blenniidae							
* <i>Ecsenius bicolor</i>	Two-coloured Blenny						
Family: Canthigasteridae							
<i>Canthigaster amboinensis</i>	Spotted Toby	-	-	-	-	-	1
<i>Canthigaster solandri</i>	Solander's Toby	-	2	-	-	2	-
Family: Carangidae							
<i>Caranx melanopygus</i>	Blue-fin Trevally	-	-	1	-	-	-
<i>Caranx</i> sp	Trevally	2	-	-	-	3	-
Family: Carcharimidae							
* <i>Carcharinus melanopterus</i>	Blacktip Reefshark						
Family: Chaetodontidae							
<i>Chaetodon auriga</i>	Thread-fin Butterflyfish	-	-	2	2	6	5
<i>Chaetodon vagabundus</i>	Vagabond Butterflyfish	2	-	1	1	2	4
<i>Chaetodon decussatus</i>	Black-finned Butterflyfish	8	3	5	6	8	10
<i>Chaetodon citrinellus</i>	Citron Butterflyfish	5	-	-	-	7	1
<i>Chaetodon guttatisimus</i>	Peppered Butterflyfish	2	-	-	-	1	-
<i>Chaetodon meyeri</i>	Meyer's Butterflyfish	3	1	1	3	-	7
<i>Chaetodon xanthocephalus</i>	Yellowhead Butterflyfish	2	-	-	-	1	1
<i>Chaetodon plebeius</i>	Blue-bloched Butterflyfish	2	3	-	-	-	1
<i>Chaetodon melannotus</i>	Blackback Butterflyfish	-	-	2	1	-	1
<i>Chaetodon rafflesi</i>	Raffle's Butterflyfish	1	-	-	-	-	-
<i>Chaetodon trifasciatus</i>	Redfin Butterflyfish	9	8	23	20	9	38
<i>Chaetodon trifascialis</i>	Chevron Butterflyfish	5	5	8	3	8	8
<i>Chaetodon lunula</i>	Raccoon Butterflyfish	-	1	-	2	8	1
<i>Chaetodon falcula</i>	Sickle Butterflyfish	-	-	-	-	-	2
<i>Chaetodon collare</i>	Brown Butterflyfish	-	2	-	2	5	2
<i>Chaetodon lineolatus</i>	Lined Butterflyfish	-	1	-	-	-	-
<i>Heniochus pleurotaenia</i>	Indian Ocean Bannerfish	-	-	1	-	-	-
Family: Cirrhitidae							
* <i>Cirrhitichthys pinnulatus</i>	Freckled Hawkfish						
* <i>Cirrhitichthys oxycephalus</i>	Pixy Hawkfish						
* <i>Paracirrhites forsteri</i>	Forster's Hawkfish						

Scientific Name	Common Name	T1	T2	T3	T4	T5	T6
Family: Diodontidae <i>Diodon hystrix</i>	Porcupine fish	-	-	-	-	-	1
Family: Eleotridae <i>Ptereleotris evides</i>	Spot-tail Gudgeon	4	-	-	-	-	-
Family: Fistulariidae <i>Fistularia</i> sp	Cornetfish	2	-	-	-	-	-
Family: Gobiidae * <i>Cryptocentrus</i> sp * <i>Gobiodon citrinus</i> * <i>Gobiodon</i> sp	Goby Fourbar Goby Goby						
Family: Grammistidae <i>Grammistes sexlineatus</i>	Golden-striped Soapfish	-	-	-	-	1	1
Family: Gerriidae <i>Gerres</i> sp	Silverbiddy	-	5	-	-	-	7
Family: Haemulidae <i>Plectrohinchus orientalis</i> <i>Plectrohinchus schotai</i>	Oriental Sweetlip Somber Sweetlip	-	5	1	5	3	14
Family: Hemiramphidae <i>Hemiramphus</i> sp	Halfbeaks	-	6	-	8	-	7
Family: Holocentridae <i>Sarigoentron diadema</i> <i>Sarigoentron spinterum</i> <i>Sarigoentron caudomaculatum</i> <i>Neomphion sammara</i> <i>Myripristis adustus</i> <i>Myripristis bernoldi</i> <i>Myripristis murdani</i>	Crown Squirrelfish Sabre Squirrelfish Tailspot Squirrelfish Spot-fin Squirrelfish Shadow-fin Squirrelfish Bigscale Soldierfish Blotcheye Soldierfish	1 1 - - - 11 -	- 10+ - - 7 24+ 6	- 1 - - - - -	- - - - 2 - -	- 13+ - - - 2 -	8 6 2 1 - 13 -
Family: Kyphosidae <i>Kyphosus</i> sp	Drummer	9	-	-	4	-	6
Family: Labridae <i>Chelodactylus chlorurus</i> <i>Coris formosa</i> <i>Gomphosus varius</i> <i>Haliichoeres contriquadrus</i> <i>Haliichoeres marginatus</i> <i>Haliichoeres scapularis</i> <i>Haliichoeres zeylonicus</i> <i>Haliichoeres nebulosus</i> <i>Anampses lineatus</i> * <i>Anampses</i> sp <i>Hemigymnus fasciatus</i> <i>Hemigymnus melapterus</i> <i>Thalassoma hardwickei</i> <i>Thalassoma janseni</i> <i>Thalassoma lunare</i> <i>Thalassoma quinquevittata</i> <i>Stethodius trilineatus</i> <i>Labroides dimidiatus</i> * <i>Labroides bicolor</i> <i>Labrichthys unilineatus</i> (Unidentified Juveniles)	Floral Wrasse Clown Coris Bird Wrasse Checker-board Wrasse Dusky Wrasse Zigzag Wrasse Zeylon Wrasse Nebulous Wrasse Lined Wrasse Wrasse Barred Thicklip Half and half Thicklip Sixbar Wrasse Jansen's Wrasse Moon Wrasse Five stripe wrasse Three-lined Wrasse Blue streak Cleaner Wrasse Bicolour Cleaner Wrasse Tubelip Wrasse	- - 6 - 5 - - - 1 6 - 10+ 1 - - 2 7 1 33+	- - 3 1 6 - - - - - - 1 - 10+ - - 3 4 - 25+	1 1 6 - 15 1 - - - - - 1 - - - - - - - 1 - 42+	1 1 1 - 6 3 - - - - - - - - - 2 - - - - - - 19+	- - 11 - - - - - - - - 13 14 - - - - - - - - - - 8+	6 - 14 4 10 2 5 2 - - 4 4 21 1 20+ 1 3 11 - - - - - 51+
Family: Lethrinidae <i>Lethrinus harak</i> <i>Lethrinus ornatus</i> * <i>Lethrinus nebulosus</i>	Black spot Emperor Ornate Emperor Spangled Emperor	2 - -	1 - -	- - -	3 1 -	4 - -	3 - -
Family: Lutjanidae <i>Lutjanus decussatus</i>	Checkered Snapper	-	-	-	1	1	2

(Table 3.7 continued)

Scientific Name	Common Name	T1	T2	T3	T4	T5	T6
<i>Lutjanus fulvus</i>	Yellow-margined Sea Perch	4	1	-	-	3	1
<i>Lutjanus lunulatus</i>	Crescent Snapper	-	-	-	-	1	-
<i>Lutjanus kasmira</i>	Blue-striped Snapper	-	-	-	4	-	-
<i>Lutjanus rivulatus</i>	Blue-spotted Snapper	-	-	-	-	3	-
<i>Lutjanus fulviflamma</i>	Golden Snapper	-	-	-	1	2	2
Family: Monacanthidae							
<i>Aluteria scripta</i>	Scribbled Filefish	1	-	-	-	-	-
<i>Oxymonacanthus longirostris</i>	Harlequin Filefish	1	-	-	-	-	-
<i>Canthierius pardalis</i>	Honey-comb Filefish	-	-	-	-	2	-
<i>Amansey scopas</i>	Broom Filefish	2	5	3	-	-	3
Family: Mugilidae							
<i>Mugil</i> sp	Grey Mullet	2	4	-	12	-	9
Family: Mullidae							
<i>Parupeneus barberinus</i>	Dash-dot Goatfish	1	5	1	2	-	2
<i>Parupeneus indicus</i>	Indian Goatfish	-	-	-	1	-	1
<i>Parupeneus thaloleucatus</i>	Yellow stripe Goatfish	-	8	1	3	2	-
<i>Parupeneus bifasciatus</i>	Two-barred Goatfish	-	-	-	-	1	-
<i>Parupeneus cyclostomus</i>	Gold-saddle Goatfish	-	-	-	-	-	2
<i>Parupeneus forsskali</i>	Forsskali's Goatfish	-	-	3	-	-	-
Family: Muraenidae							
<i>Echidna zebra</i>	Zebra Moray Eel	-	-	-	-	-	1
<i>Gymnothorax javanicus</i>	Giant Moray Eel	1	-	-	-	-	-
<i>Gymnothorax</i> sp	Moray Eel	-	-	-	-	1	-
Family: Mugiloidae							
* <i>Parapercis clathrata</i>	Latticed Sandperch	-	-	-	-	-	-
* <i>Parapercis</i> sp	Sandperch	-	-	-	-	-	-
Family: Ostracnidae							
<i>Ostracion meleagriles</i>	Spotted Boxfish	-	-	-	-	-	1
<i>Ostracion cubicus</i>	Yellow Boxfish	4	-	-	-	-	-
<i>Ostracion</i> sp	Boxfish	1	-	-	-	-	-
Family: Pempheridae							
<i>Pempheris vanicolensis</i>	Vanikoro Sweeper	-	7+	-	-	-	-
<i>Pempheris ovalensis</i>	Silver Sweeper	-	-	-	-	11+	-
Family: Pomacanthidae							
<i>Pomacanthus semicirculatus</i>	Koran Angelfish	1	-	-	-	4	1
<i>Pomacanthus annularis</i>	Bluering Angelfish	1	-	-	-	-	-
* <i>Pomacanthus imperator</i>	Emperor Angelfish	-	-	-	-	-	-
<i>Centropyge multispinis</i>	Many-spined Angelfish	2	-	1	1	-	-
<i>Apolomichthys vanthurus</i>	Indian Yellow Tail Angelfish	1	-	-	-	-	-
Family: Pomacentridae							
<i>Abudefduf vaigtensis</i>	Indo-Pacific Sergeant Major	100+	11+	66+	16	98+	82+
<i>Abudefduf sordidus</i>	Black-spot Sergeant Major	4	-	-	2	2	7
<i>Abudefduf septemfasciatus</i>	Seven-bar Sergeant Major	7	1	2	6	6	13
<i>Stegastes nigricans</i>	Dusky Gregory	-	12	4	16	7	10
<i>Stegastes lividus</i>	Blunt-snout Gregory	-	-	1	5	1	-
<i>Neoglyphidodon bonang</i>	Ocellated Damsel	-	-	-	-	3	1
<i>Chrysiptera leucopoma</i>	Surge Damsel	19	-	-	-	8	32
<i>Chrysiptera biocellata</i>	Two-spot Demoiselle	-	1	1	-	-	1
<i>Chrysiptera glauca</i>	Grey Demoiselle	-	-	-	7	12	-
<i>Chrysiptera unimaculata</i>	One-spot Damsel	-	3	1	-	8	-
<i>Plectroglyphidodon lacrymatus</i>	Jewel Damsel	50+	15+	-	6	7	16
<i>Plectroglyphidodon dicki</i>	Dick's Damsel	75+	11+	75+	5	10	77+
<i>Pomacentrus chrysurus</i>	White-tail Damsel	12	5	-	19	12	25+
<i>Pomacentrus similis</i>	Blue Damsel	1	-	-	2	1	1
<i>Neopomacentrus acaesum</i>	Yellowtail Damsel	200+	-	-	17	-	-
<i>Neopomacentrus taeniurus</i>	Freshwater Demoiselle	15+	-	-	-	-	-
<i>Chromis viridis</i>	Blue-green Puller	20+	135+	175+	-	-	-
<i>Chromis ternatensis</i>	Ternate Chromis	25+	-	2	-	-	-
<i>Chromis dimidiata</i>	Twotone Chromis	8	1	-	-	-	-
<i>Dascyllus aruanus</i>	Humbug Dascyllus	-	-	8	-	-	-
<i>Dascyllus trimaculatus</i>	Three-spot Damsel	5	-	-	4	-	7

Scientific Name	Common Name	T1	T2	T3	T4	T5	T6
Family: Pluticidae							
<i>Platax orbicularis</i>	Orbicular Batfish	-	1	-	-	-	-
<i>Platax tetra</i>	Tetra Batfish	-	2	-	-	-	-
Family: Serranidae							
<i>Epinephelus merra</i>	Honeycomb Grouper	1	-	-	-	1	2
<i>Epinephelus hexagonatus</i>	Hexagon Grouper	2	1	-	-	-	1
<i>Epinephelus fasciatus</i>	Grouper	1	-	-	-	-	-
<i>Cephalopholis argus</i>	Peacock Grouper	-	1	2	-	-	3
Family: Scaridae							
<i>Scarus rubriviolaceus</i>	Ember Parrotfish	6	-	1	-	2	1
<i>Scarus dimidiatus</i>	Five saddle Parrotfish	-	4	2	-	1	4
<i>Scarus ghobban</i>	Yellow scale Parrotfish	-	-	-	3	-	-
<i>Scarus taenatus</i>	Bridled Parrotfish	3	2	-	-	-	3
<i>Scarus sordidus</i>	Daisy Parrotfish	5	-	-	-	5	-
<i>Scarus</i> sp	Parrotfish	29+	11+	7	19	15	13+
Family: Scorpaenidae							
<i>Pterois voltans</i>	Fire Lion fish	1	-	-	-	1	-
<i>Scorpaena</i> sp	Scorpion fish	-	-	-	1	2	-
Family: Siganidae							
<i>Siganus lineatus</i>	Golden lined Spinetail	8	16+	24+	9	19+	11
<i>Siganus virgatus</i>	Double barred Spinetail	1	-	-	1	-	2
<i>Siganus canaliculatus</i>	White spotted Spinetail	4	5	13	15	14+	7
<i>Siganus stellatus</i>	Brown spotted Spinetail	2	-	-	-	-	-
<i>Siganus latvis</i>	Java Rabbitfish	7	-	-	-	-	-
Family: Sphyraenidae							
<i>Sphyraena tello</i>	Pickhandle Barracuda	8+	-	-	-	-	-
<i>Sphyraena barracuda</i>	Great Barracuda	-	-	-	-	-	-
Family: Tetraodontidae							
<i>Arothron hispidus</i>	Stars and Stripes Pufferfish	-	-	-	-	-	-
<i>Arothron nigropunctatus</i>	Black spotted Pufferfish	3	-	-	1	1	-
<i>Arothron</i> sp	Pufferfish	-	-	-	-	-	-
Family: Zanchidae							
<i>Zanclus cornutus</i>	Moorish idol	-	1	6	4	5	6
Total number counted per transect		977	492	630	364	478	776
Species counted per transect		84	61	58	68	67	92

\* These species were recorded during the general survey in December 1993, but were not sited along transects in March 1994.

Mean number of Fish transect or number of Fish per 500m <sup>2</sup>	619.5
Mean number of species transect or number of species per 500m <sup>2</sup>	71.6
Total number of species	168
Total number of families	40
Total number of genera	76

\* See figure 3.1 for locations

- 1 = Near Rocky Islets
- 2 = Between Coral Rock Hotel and the Blue Coral Hotel
- 3 = In front of Underwater Diving Instructors Diving Station
- 4 = In front of Dharshana Guest House
- 5 = In front of Co-operative Beer Garden Restaurant
- 6 = In front of Posedon Diving Station

## Summary

Clearly, if Hikkaduwa is to maintain its popularity, the health of the marine environment and ecosystems must be maintained or improved. The condition of the natural coastal resources of Hikkaduwa depend upon a complex set of interactions between various natural forces and human activities. For example, the condition of the coral reefs is one of the factors influencing the abundance and diversity of marine organisms and the relative rates of coastal erosion. The condition of the coral reefs in turn depends on the quality of coastal water, rates of sedimentation and pollution from hotels and other sources, and rates of destructive human activity. Such complexity of interrelationships means that problems cannot be addressed in isolation, but must be looked at in terms of the overall ecosystem dynamics which includes humans and their uses of the beaches and coral reefs.

## Chapter 4

### POPULATION AND INFRASTRUCTURE

#### Population

In 1990, the population of the 13 GN Divisions in the SAM area was 13,815 or 6,300 males and 7,515 females (Table 4.1). The population density was 3,424/km<sup>2</sup>, as compared to 1,384/km<sup>2</sup> for the Hikkaduwa AGA Division. This reflects the largely urban nature of the SAM area. Changes in administrative boundaries made prior to 1990 make it difficult to gauge population trends. As the area is rather densely populated, the great majority of families (74 percent) own one half acre of land or less, and 13 percent of the families are landless (Table 4.2).

*Table 4.1 Population and density of 13 Grama Niladhari Divisions in Hikkaduwa SAM Area (MPPI, 1990)*

G.N. Divisions	Male	Female	Total	Population Density (per sq. km)
Totagamuwa	720	761	1,481	3,485
Wellawatta	695	815	1,510	3,471
Hikkaduwa Town	470	490	960	3,288
Wawulagoda West	326	332	658	3,615
Wawulagoda East	296	285	581	2,605
Panangoda	377	352	729	2,815
Wewala	405	710	1,115	4,216
Narigama				
Wallabada	1,146	1,754	2,900	6,459
Narigama	213	222	435	3,955
Kudawewala	301	316	617	1,143
Thiranagama				
Wallabada	298	333	631	2,446
Thiranagama	421	425	846	3,863
Patuwatha	632	720	1,352	3,654
Totals	6,300	7,515	13,815	3,424

## Religion

In the overall Hikkaduwa AGA Division, 98 percent of the population is Sinhala Buddhist. This is despite the colonial influence of the Portuguese and Dutch from the early 1500s to the late 1700s. Although society was based on a caste oriented structure in pre-colonial and colonial times, especially with regards to the determination of one's occupation, caste is no longer a factor in one's type of employment (Ross and Savada, 1990). In social interaction and politics, however, caste consciousness is still an important issue.

*Table 4.2 Land ownership in the Hikkaduwa SAM area (CRMP, 1993)*

Amount of Land Owned	Number of Families	Percent of Families
Landless	297	13
Less than 1/4 acres	1,016	45
1/4 to 1/2 acre	371	16
1/2 to 3/4 acre	252	11
3/4 to 1 acre	157	7
1 to 2 acres	123	5
More than 2 acres	63	3

## Health

Health services in the Hikkaduwa Division are available for most residents within a reasonable distance. There are two Government hospitals, two dispensaries, and 13 health clinics/centers. The most prominent diseases are filaria, dysentery and diarrhea. The prevalence of dysentery and diarrhea are due to the general lack of adequate sanitary facilities. Malnutrition is also a significant problem.

## Education

There are schools in almost every GN Division. The standard of education is comparable to other parts of Sri Lanka and possibly better in some instances due to the urban setting. According to the Department of Education, the lack of qualified teachers and facilities, such as desks, chairs, books and water are problems in Hikkaduwa as elsewhere.

## Water Supply and Electricity

The supply of potable water in the Division is a problem. There are two water tanks each with a 50,000 gallon capacity, which provide water over a distance of 13 km along the main road from the bridge at Wellawatta in Hikkaduwa to Gintota to the south. Water pumps have been established for a distance of 1/2 mile inland from the coast. Close to the coast, salt water intrusion makes groundwater unpotable.

Electricity is available for about 50 percent of the rural population. Rural poverty is the main reason why the entire population does not have electricity.

## **Transportation and Communication**

Galle Road is the main roadway in the Division and generally runs less than 100 m from the shoreline. The location of Galle Road so close to the shore has resulted in problems of overcrowding of tourist establishments on the seaward side and the road itself being threatened in places by coastal erosion. Some older residents of Hikkaduwa have mentioned that both Galle Road and the railway line were originally located close to the shore, because those areas were the most infertile and would allow maximum use of inland areas for agricultural purposes.

There are also a number of secondary and feeder roads, which are generally in poor condition. Transportation is mainly by bus and by foot. Bus service is provided on five other secondary roads. Other forms of transportation are motorcycles, bicycles, private vehicles and carts. Besides the Galle-Colombo road, there is also a railway line, which is mostly used for longer distance transport. Many tourists now use the railway along the southwestern coast.

On a typical day along Galle Road in the SAM area during the tourist season, over 7,000 vehicles pass through (De Alwis, 1993). The prevalence of buildings situated close to Galle Road accentuate its narrowness. This combined with the heavy volume of traffic and high speeds of vehicles poses a significant danger to pedestrians and cyclists and is a major distraction of the area. In 1993, a tourist was struck and killed by a speeding vehicle on Galle Road.

Postal service is readily available with 20 post offices in the Hikkaduwa Division. Most provide telephone services and some have facsimile.

## **Summary**

Although the Hikkaduwa SAM area is predominantly urban with a high population density and substantial tourism sector development, infrastructure is generally inadequate in the town. The main road, which cuts through the town, is the most obvious example of poorly located, disruptive and inadequate infrastructure. The lack of a central sewer system is also a striking example with consequential impacts on coastal water quality.

## **Chapter 5**

### **ECONOMIC SECTORS**

#### **Historical Background**

Evidence of human settlements in the Hikkaduwa area dates back to the 3rd century B.C. The Ruhuna Provincial Kingdom was established around this time. These communities were largely dependent on inland, not coastal, resources (CEA, 1983). By the 14th century, cinnamon growing was the major economic activity. Dodanduwa, south of Hikkaduwa became an important harbor for the cinnamon trade. Evidence indicates that Seenigama (just north of Hikkaduwa) was also used as a harbor.

After the Portuguese arrival in 1505 and the Dutch in 1638, most of the arable land was converted to cinnamon plantations. Landlessness among the traditional farming group resulted from this conversion to cinnamon growing because they were increasingly compelled to work as laborers on the plantations. The Dutch provided special privileges to certain laborers to ensure the continuation of the cinnamon industry. This enabled some of the Sri Lankan laborers to rise in social status and become land owners and community leaders.

Prior to the colonial period, the use of lime for construction purposes was limited, as it was restricted to royal palaces and buildings (Premaratne, 1985). During the Dutch period, the use of lime became more prevalent and resulted in the establishment of the coral mining and lime production industry in several areas of the southwest coast, including Hikkaduwa. Fishing was not an important economic activity during this period and was taken up mainly by landless groups.

With the replacement of the Dutch by the British in 1798, coconut cultivation replaced cinnamon cultivation as the most important economic activity. As coconut cultivation was much less labor intensive than cinnamon, a large number of people became unemployed. People increasingly turned to fishing or lime production as an alternative. By the late 1800s, the lime industry was firmly established. In 1895, a railway platform was constructed in Hikkaduwa for loading coral. The fishing industry continued to develop until nearshore fish stocks became over fished in the 1980s. The coir (coconut husk fiber) industry started at the turn of the century which has increasingly supplied fibre for handicrafts, rope and household products.

#### **Tourism**

Tourism in Sri Lanka was first sanctioned in 1930 under British rule when the Government began implementing a policy of tourism development. By 1948, the year of

Sri Lanka's independence, foreign tourist arrivals had reached 41,285 and by 1952 had increased to 66,185 (De Alwis, 1989). With the change of Government in 1956, however, came a change in Government policy to stop promoting tourism development. As a result, tourist arrivals declined to 23,666 by 1967 (CTB, 1992a). An example of the lack of Government interest is that tourist industry statistics were not maintained from 1958-1966.

The tourist industry began to revive after 1966, again after a change in Government and economic policy to support tourism development. Significant growth occurred in the 1970s and 1980s. Foreign tourist arrivals in Sri Lanka peaked at 407,230 in 1982, then gradually declined from 1983 due to civil unrest. This downward trend continued through 1989, when the number of tourist arrivals had fallen to 184,732. With the restoration of political stability in 1990, the number of visitors grew dramatically, reaching 297,888 in 1990, 317,703 in 1991, 393,669 in 1992, and 392,250 in 1993 (Figure 5.1). In recent years, the Government has intensified its efforts to promote the tourist industry, making it a central component of Sri Lanka's overall development plan.

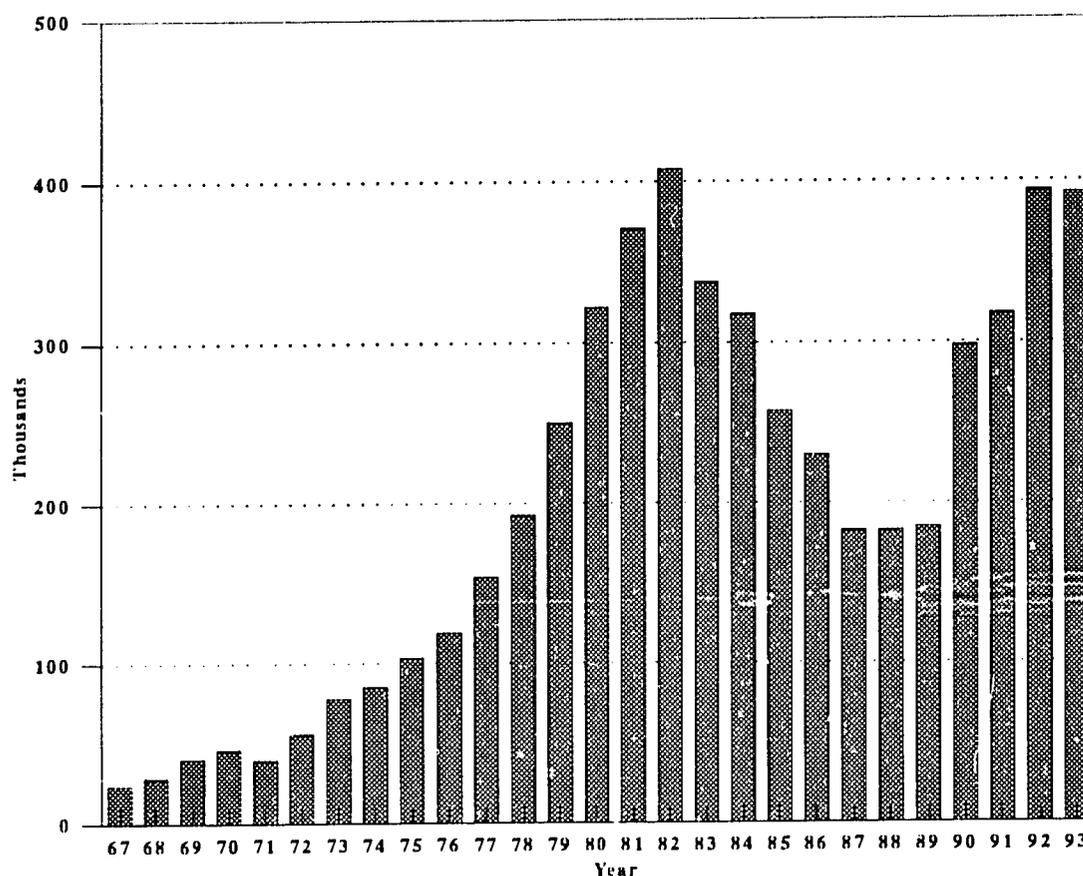


Figure 5.1 Tourist arrivals in Sri Lanka, 1967-1993 (Ceylon Tourist Board)

The first tourism master plan for Sri Lanka was published in 1967 (Harris et al, 1967). Environmental considerations for tourism development were generally recognized, with the inclusion of basic planning guidelines and architectural design recommendations for the formal, or larger-scale, tourist sector. Tourism development at Bentota followed the guidelines of the master plan and is an example of good planning. Environmental factors were generally not considered, however, during the growth of the informal sector. The second Tourism Master Plan (UNDP/WTO, 1993), has much more specific and wide-ranging environmental guidelines focusing on issues such as environmental impact assessments, waste water treatment, solid waste disposal, water management and conservation, and erosion.

The tourist industry in Hikkaduwa, as in other areas of Sri Lanka, experienced significant growth during the early 1970s and 1980s. Hikkaduwa has become the most popular coastal resort area in the country, with an estimated 294,545 guest-nights spent in Hikkaduwa in 1992 (Tantrigama, 1994). As the number of tourist arrivals increased dramatically during the 1970s, the informal tourism sector grew to meet the rising demand for services from the younger, "budget" tourists. Local Government agencies were not structured to respond to this rapidly developing informal sector, so activities proceeded in the absence of a plan. Such unplanned development, though stimulating the growth of local economies, has also resulted in negative environmental and social impacts, which, if left unchecked, will ultimately undermine the area's attractiveness to visitors. Hikkaduwa is the most striking Sri Lankan example of this phenomenon.

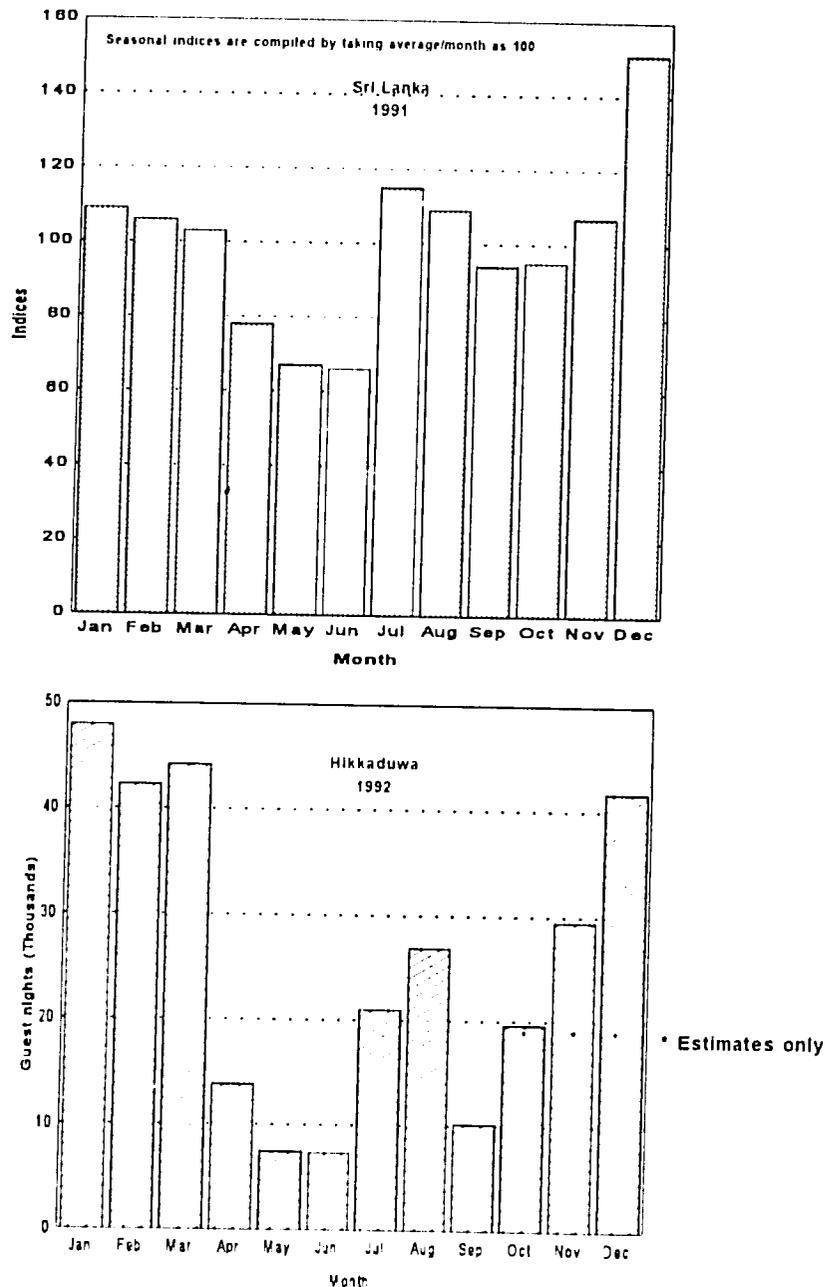


Figure 5.2 Seasonality of tourist traffic in Sri Lanka, 1991 compared with monthly guest nights spent in Hikkaduwa, 1992 (CTB, 1992a; Tantrigama, 1994)

At the beginning of its growth period in the 1960s, Hikkaduwa had only one formally recognized hotel, the Hikkaduwa Rest House, which was built during the time of British rule. The site is now occupied by the Coral Gardens Hotel. It was not until the 1970s that the first of Hikkaduwa's present day formal hotels was built. Meanwhile, the number of informal tourist establishments was growing rapidly and Hikkaduwa became known as the center of the informal tourist industry (not registered with the CTB) in Sri Lanka. The tourist season officially begins in November after the southwest monsoon and lasts through April, just before the beginning of the southwest monsoon (Figure 5.2).

Tourist activities in Hikkaduwa are concentrated primarily on the beaches and consist of swimming, snorkeling, boat rides, surfing, diving, sun-bathing and shopping (Figure 5.3). The glass bottom boat and snorkeling activities take place in the Sanctuary. The beaches in this area are part of the Wawulogoda West and Panangoda GN Divisions. The beaches are the smallest in this northern section and therefore have the highest density of use. The greatest number of beach users are in the southern section, especially in the Wewala and Narigama Wallabada GN Divisions, which have the largest segments of beach. The main activities there are sun-bathing and swimming.

The tourist industry is comprised of the formal and informal sectors. The formal sector is mostly larger establishments approved by the Ceylon Tourist Board (CTB), while the informal sector is made up of the smaller, unapproved establishments not registered with the CTB. In Hikkaduwa, there are nine hotels, seven guesthouses, three restaurants and eight shops in the formal sector, whereas in the informal sector, there are no hotels, 118 guesthouses, 37 restaurants and 149 shops. The total number of tourist establishments is 311, 9 percent of which are in the formal sector and 91 percent are in the informal sector (Table 5.1). The actual locations of most tourist establishments are shown in Figure 5.3 and listed by name in Table 5.2.

*Table 5.1 Formal and informal sector tourist units in Hikkaduwa (CTB, 1992b)*

G.N. Division	Hotels		Guest Houses		Restaurants		Shops		Sub-Total
	F	I	F	I	F	I	F	I	
Hikkaduwa Wellawatta	-	-	-	3	-	1	-	1	5
Hikkaduwa Nalagadeniya	-	-	-	1	-	-	-	-	1
Hikkaduwa West	-	-	-	1	-	-	-	4	5
Hikkaduwa Town	-	-	-	7	-	1	-	6	14
Hikkaduwa Nakanda	-	-	-	-	-	-	-	2	2
Wawulogoda West	4	-	-	10	-	1	6	25	46
Wawulogoda East	-	-	2	1	-	-	-	3	6
Wewala	4	-	3	20	3	6	2	25	63
Panangoda	-	-	-	12	-	9	-	52	73
Narigama Wallabada	1	-	-	31	-	15	-	9	56
Thiranagama Wallabada	-	-	-	14	-	-	-	-	14
Thiranagama	-	-	-	4	-	-	-	-	4
Patuwatha	-	-	2	12	-	4	-	2	20
Millagoda	-	-	-	2	-	-	-	-	2
Subtotal's	9	-	7	118	3	37	8	149	311
Total number of Units									

F Formal

I Informal

Figure 5.3 Beach access and land use by tourist establishments and private houses located in the coastal strip and listed in Table 5.2

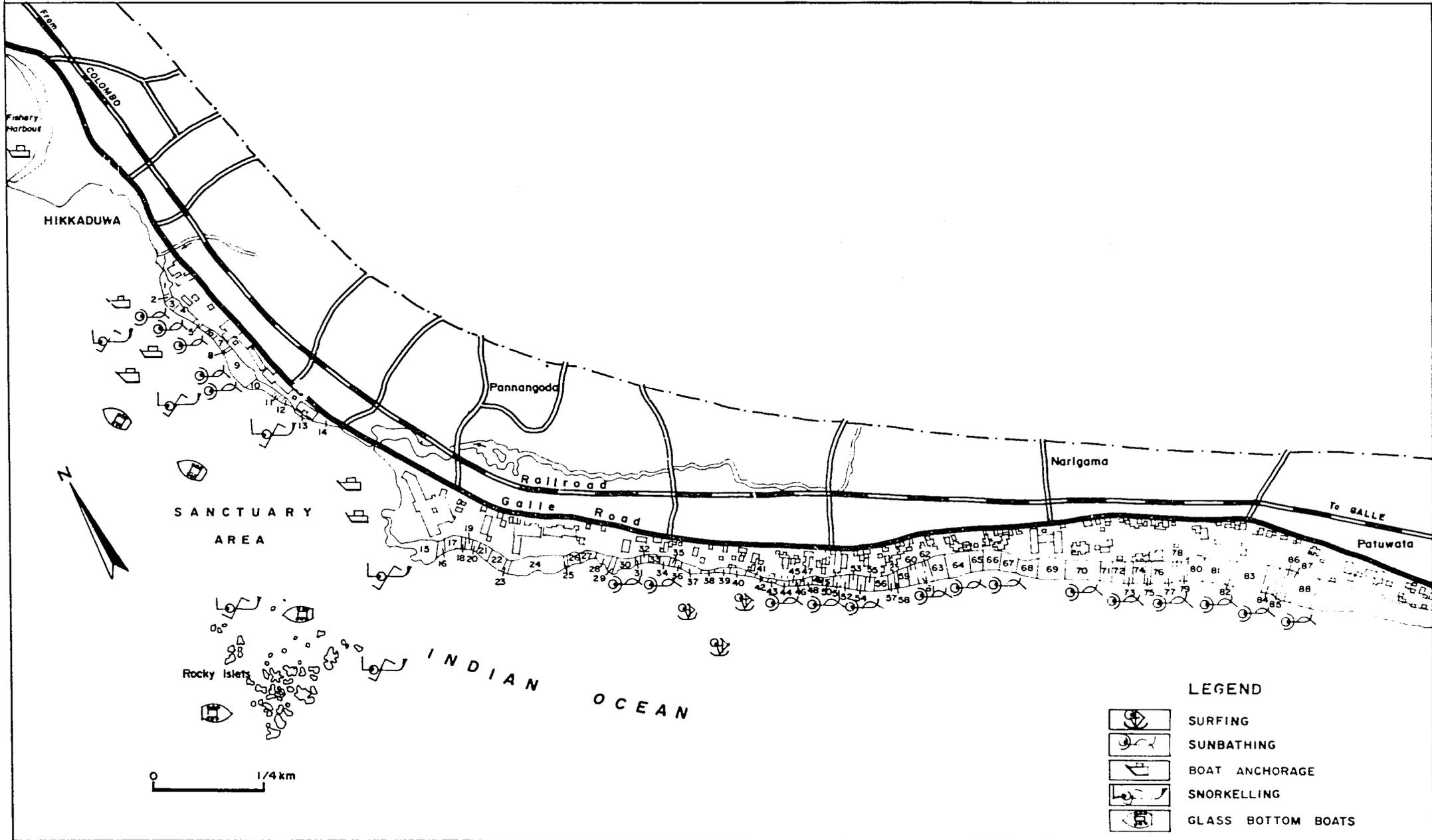


Table 5.2 The name, map number and beach front length (m) of tourist establishments and private houses located in the coastal strip as shown in Figure 5.3

Map Number	Name	Approximate Length of Beach Front (m)	Map Number	Name	Approximate Length of Beach Front (m)	Map Symbol	Name	Approximate Length of Beach Front (m)
1	Hikkaduwa Beach Hotel	53	31	Blue Note Guest House	10	61	Copacabana Guest House	15
2	Poseidon Diving Guest House	15	32	Buddi's Beach Guest House	22	62	Deutsche Knch Restaurant	12
3	Private House	28	33	Blues Brothers Guest House	17	63	Coconut Land	30
4	Bear Garden Restaurant	54	34	Restaurant (new)	16	64	Blue Moon Guest House	50
5	Dharshana	32	35	Sunny Beach Guest House	12	65	Devalaya	26
6	Star Fish Guest House	22	36	Villa Paradise Guest House	16	66	Sakura Beach Restaurant	36
7	Coral Sands Hotel	33	37	Dewasir Beach Restaurant	38	67	Harmony Guest House	32
8	International diving Station	5	38	Coconut Land	33	68	Rainbow Restaurant	41
9	Blue Corals Hotel	84	39	Bandula Beach Restaurant	16	69	Sunil's Beach Hotel	74
10	Coral Reef Hotel	77	40	Blue Mount Guest House	31	70	Ranmal Beach Restaurant	83
11	Mamas Guest House	24	41	Lion Paradise Guest House	31	71	Private House	27
12	Coral Rock Hotel	51	42	Surfing Beach Guest House	14	72	Private House	27
13	Coral Seas Guest House	11	43	Beach Villa Munich Guest House	09	73	Shop Vidya Restaurant	17
14	Shops	109	44	Ranjith Beach Guest House	31	74	Pala Restaurant	24
15	Coral Garden Hotel	338	45	Casalanka Guest House	13	75	Florida Inn Guest House	14
16	Curry Bowl Restaurant	14	46	Jupiter Guest House	32	76	Loide Beach Guest House	34
17	Swani Shops	34	47	Kuku's Guest House	06	77	Ocean View Cottage Guest House	12
18	Private Land/Shops	9	48	Hanse Surf Restaurant	19	78	Thir Beach Guest House	18
19	Lotus Restaurant	17	49	Golden Sand Beach Guest House	17	79	Private Land	11
20	Wewala Beach Hotel	12	50	Sun Beach Guest House	21	80	Pearl Island Guest House	35
21	Jayalath Restaurant	27	51	Hemingway Guest House	10	81	Cabana Guest House	73
22	Refresh Restaurant	38	52	Sunrise Restaurant	14	82	Private House/Guest House	11
23	Super Corals Hotel	57	53	Royal Beach Restaurant	14	83	Sim Row Villa Guest House	09
24	Reefcomber Hotel	130	54	Siltas Restaurant	15	84	Suit Lanka Guest House	22
25	Paradise Guest House	11	55	Brothers' Spot Restaurant	21	85	Golden Beach Guest House	16
26	Private House Guest House	31	56	Pitais Guest House	29	86	Shansh Garden Guest House	11
27	Nadishani Guest House	31	57	Seetha's Guest House	16	87	Nelum Inn Guest House	16
28	Nippon Villa Guest House	31	58	Fixi-Foxi Restaurant	7	88	Sansibar Guest House	51
29	Time and Tide Guest House	7	59	International Beach Guest House	21			
30	Richardsons Guest House	45	60	Sea Flower Guest House	14			

The absolute number of establishments, however, is not a true measure of the relative importance of the two sectors, because the capacity of formal establishments is much greater. Also, the formal sector establishments generate a disproportionately large share of the revenues. Formal sector hotels have a room capacity of 581 rooms and guesthouses 84 rooms. The room capacity of guesthouses in the informal sector is 681.

*Table 5.3 Formal and informal tourist industry employment in Hikkaduwa (CTB, 1992b)*

	Formal Sector				Informal Sector				Total	Percent of total
	Perm		Temp		Perm		Temp			
	M	F	M	F	M	F	M	F		
Hotels	293	52	307	36	-	-	-	-	688	45
Guest Houses	50	4	7	-	110	54	95	27	347	23
Restaurants	37	-	39	-	32	26	52	24	210	14
Shops	34	3	12	-	83	39	70	33	274	18
Totals	414	59	365	36	225	119	217	84	1,519	100

M male

F female

Tourism establishments for both the formal and informal sectors are concentrated mainly along Galle Road. The highest number of establishments are found in the Wewala, Narigama Wallabada, Wawulogoda West and Panangoda GN Divisions. In general, the formal tourist establishments are located in the central part of the SAM area and the informal establishments in the southern part. The density of establishments decreases as one heads south. Patuwatha is the southernmost GN Division of the SAM area and has the lowest density of tourist establishments. Future growth, especially of the informal sector, is likely to take place here.

A 1992 Ceylon Tourist Board survey, which includes most of the SAM area, found that 1,519 people are directly employed in the tourist industry in Hikkaduwa (Table 5.3). Fifty-eight percent are employed in the formal sector and 42 percent are employed in the informal sector. Permanent employees make up 54 percent of the total and temporary employees 46 percent. Males make up 80 percent of those employed and females 20 percent. People from the Hikkaduwa area make up 39 percent of those employed and people from outside the area 61 percent.

*Table 5.4 Permanent and temporary tourist industry employment in Hikkaduwa (De Alwis, 1993)*

	Permanent	Percent of Total	Temporary	Percent of Total
Males from area	276	22	107	9
Males from outside area	434	34	90	7
Females from area	75	6	25	2
Females from outside area	212	17	38	3
Totals	997	79	260	21

A survey of tourism establishments conducted specifically for the Hikkaduwa SAM project, included all the larger establishments and a random sampling of about 40 percent of the others. It showed that males make up 72 percent of those employed and females 28 percent (De Alwis, 1993). Permanent employees are 79 percent and temporary employees 21 percent. Those from the area account for 38 percent and those from outside the area 62 percent (Table 5.4). The larger establishments tend to prefer to hire people from outside of the Hikkaduwa area, because they believe less problems are caused. The smaller establishments generally hire people from the area.

Most of the tourist activities generate income for local, small-scale business people. One of the most lucrative of these businesses is the viewing of coral reefs from glass bottom boats. Presently there are 43 such boats made of fibre glass and fitted with outboard engines. In the late 1960s, there was only one wooden boat without an engine, using a separate glass case. Income is also generated by the rental of equipment for snorkeling, diving, surfing, bicycling and motorcycle riding.

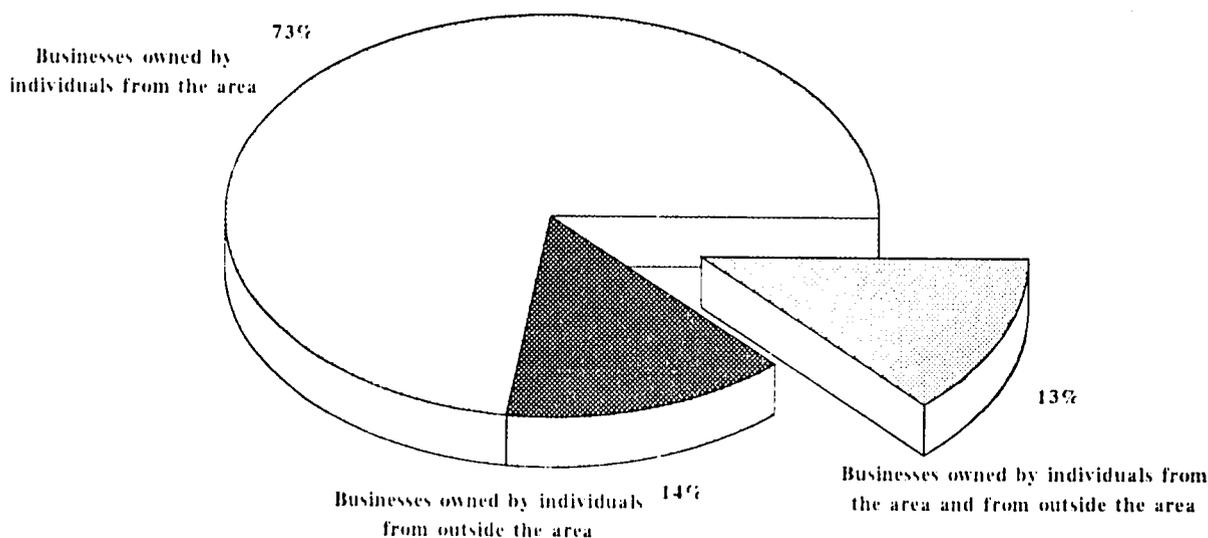


Figure 5.4 Ownership of tourist businesses in Hikkaduwa (De Alwis, 1993)

Table 5.5 Revenue and expenditure for selected\* tourist businesses in Hikkaduwa, 1991/1992 (DeAlwis, 1993)

	Total Revenue	Total	Net Income Expenditure
Total Amount (\$)	2,419,000	1,461,000	957,000

\* sample size 168

Indirect employment is created by the tourist industry in the need for guides, taxi drivers and other service personnel. The tourism survey concluded that the demand for the supply of local services was not being met. For example, large hotels are relying on outside suppliers for fish, meat, vegetables, fruit, dairy products and rice, because local producers are unable to consistently meet the demand. Also the demand for motorcycle rentals has grown, but there are often not enough motorcycles, because of the lack of spare parts for maintenance.

Over 72 percent of businesses belong to people from the area. Only 13.5 percent of the businesses belonged to people from outside the area (Figure 5.4). The rest of the businesses are owned by a combination of people from the area and from outside the area. The high percentage of local ownership means a large portion of revenues stay in the local economy (De Alwis, 1993; Tantrigama, 1994).

About 45 percent of the total revenue was generated by 10 percent of the establishments. The total revenue generated in 1991 by the 124 establishments surveyed was over \$ US 2.4 million (De Alwis, 1993). The net income generated for the establishments surveyed was over \$US 957,000 (Table 5.5). Total revenue for all establishments is estimated to be over \$US 3.8 million. This indicates the potential for the informal sector establishments to earn increased income by upgrading the quality of their services and charging higher rates. In addition to the revenue generated directly by the tourist industry, there is substantial demand for related services. No figures are available for the amount of revenue generated indirectly, but could be derived from known multipliers for economic activity.

## Fishing

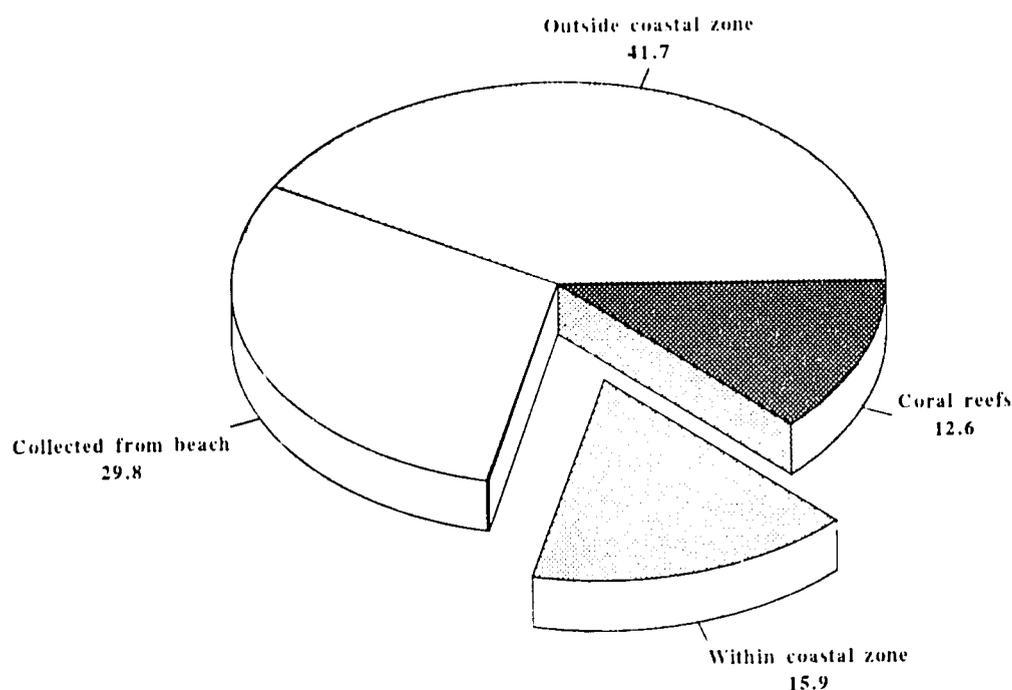
Although fishing has been relegated to a position of secondary importance economically in the area, it is still an important activity. About 600 fishermen are living in the SAM area. About 100 of them are engaged in tourist activities as well. According to a 1991 survey by the Coast Conservation Department, about 40 mechanized boats and 55 non-mechanized boats were landing at the mouth of the Hikkaduwa River. An additional 20-25 mechanized boats were landing and anchoring near the cooperative society, which is within the Marine Sanctuary (General Use Zone A). According to the Hikkaduwa Fisheries Inspector, the total fish catch for the Hikkaduwa harbor landing point in 1991 and 1992 was approximately 1,030,560 kg and 957,384 kg respectively.

Traditionally, the coral reef areas have been used for small-scale commercial fishing, and the collection of ornamental fish, molluses and coral. Although the removal of marine organisms other than a few edible species from the Sanctuary is illegal, permits are provided to less than 20 individuals to continue with traditional fishing practices. This type of fishing is by hook and line and by casting a net without using a boat. This is allowed because no damage is caused to the live coral, reef dependent fish are not caught and the income derived is vital to these few individuals. Such fishing occurs mainly between May and August. Larger numbers of fishermen, upto 100 or more, with or without boats, fish in the Sanctuary when shoals of Mackerel and Herring migrate in. This can happen at any time of the year. In general, however, fewer people are engaged in this type of fishing, because of the decline in recent years of fish shoal migration into nearshore areas. Another reason is that nearshore fishing is done with traditional net and angling methods, except for a few, and traditional fishermen now engage in fishing only as part-time employment.

“Light purse” fishing, though illegal, is common in offshore waters. This type of fishing is conducted at night and uses generators to operate powerful lights to attract fish. The fish are captured with purse seine nets. Dynamite fishing is also practiced in offshore waters over reef sites. Both types of fishing are believed to operate with political support.

### Coral Mining

Coral mining is a common and lucrative economic activity along the southwestern coast. Lime is used for construction purposes and is extracted from coral by small-scale producers. Over the last 15 years, there has been an increasing demand for lime due to the



*Figure 5.5 Average annual amount of coral obtained along the southwestern coast (Premaratne, 1985)*

*Table 5.6 Number of people involved in the coral mining industry along the southwestern coast (Premaratne, 1985)*

Type of Activity	Number	Percentage
Mining of land outside the coastal zone	422	25.7
Collection of coral debris from beaches	306	18.6
Mining coral reef	199	12.1
Mining land inside the coastal zone	132	8.0
Lime kiln workers	242	14.7
Lime kiln owners	192	11.7
Transport of lime	62	3.8
Marketing of lime	29	1.8
Others	60	3.6
Totals	1,644	100.0

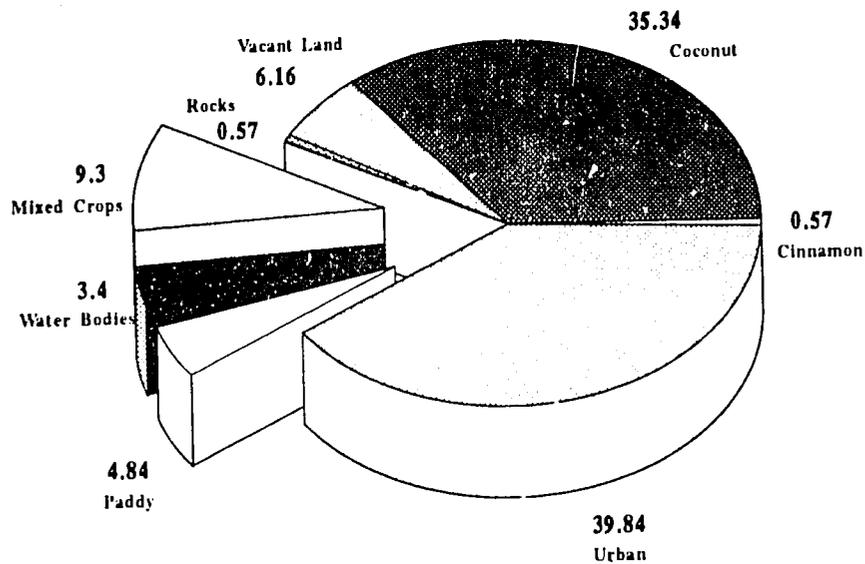
increasing rate of development. As such, there has been a corresponding increase in coral mining causing significant environmental degradation. Within the coastal zone, all types of coral mining and collection are illegal.

There are several sources of coral: from coral reefs, from land within the coastal zone, from land outside the coastal zone and from debris collected on beaches. Along the southwestern coast, the largest amounts of coral are obtained from land outside of the coastal zone (Figure 5.5) and the greatest number of coral miners are found in these areas (Table 5.6). Coral mining is a legal activity outside of the coastal zone, if a permit has been obtained. In addition to employment in mining and collecting coral, employment is also created for the processing (lime kiln workers), transporting and marketing. Often, those involved in the industry will be engaged in more than one activity. Those who mine coral from the reefs make about Rs. 150-200 per day, which is a relatively high wage compared to other types of employment (Banda, 1990). This is one reason why it is difficult to convince coral miners to switch to alternative means of livelihood. Generally, they work for 15-20 days per month, for four months of the year prior to the onset of the southwest monsoon.

In the SAM area and in the Hikkaduwa AGA Division in general, coral mining has decreased in recent years due to stricter law enforcement and coral mining has ceased in the Sanctuary. This is not the case, however, in other areas along the southwestern coast. A 1991 study of coral mining has found that 301 families were engaged in mining coral reefs in the Hikkaduwa AGA Division (De Silva et al, 1991). It is estimated that over 9,900 tons of sea coral are mined per year in the Hikkaduwa area. Of the GN Divisions included in the study, only one, Totagamuwa falls within the SAM area and forms its northernmost GN Division. Fifty-two families are engaged in mining coral reefs in Totagamuwa, which is almost 20 percent of the total number of families. Another 44 families, or 16.6 percent, work in lime kilns and 29 families, or 11 percent, work in other related lime production activities. The total percentage of families involved in lime production activities in Totagamuwa is roughly 47 percent. Some families may be engaged in more than one kind of activity. A number of lime kilns are also located in Totagamuwa.

## Land Use

The most common use of land in the SAM area is for urban purposes, which includes land used for residential, public, tourist, commercial, industrial and religious purposes. This accounts for 39.8 percent of the SAM area. This is closely followed by land used for coconut cultivation, 35.3 percent. Following that is land used for mixed crops, 9.3 percent, vacant land, 6.2 percent and paddy 4.8 percent (Figure 5.6). The amount of land used for paddy has been decreasing due to salinization of soil close to the coast. A schematic representation of land use in the SAM area is shown in Figure 5.7. For the Hikkaduwa AGA Division as a whole, 42 percent of land is used for the cultivation of coconuts, 32 percent for paddy, 9 percent for home gardens and 8 percent for cinnamon (MPPI, 1990; GSI., 1989).



*Figure 5.6 Percent land uses in the Hikkaduwa SAM area (CRMP, 1993)*

## Summary

Tourism is the present and projected economic force in Hikkaduwa and benefits derived accrue mostly to locally controlled businesses. In spite of tourism's success, problems of poor infrastructure, coastal environmental degradation and social tensions are increasingly cited by local business owners and tourists. Although the fishing industry is still economically important in Hikkaduwa, it is apparently declining and needs to be better integrated with tourism to supply local markets, enhance the low socio-economic position of fisherfolk and reduce the conflicts with the tourist industry over the use of beach and marine space for recreation.

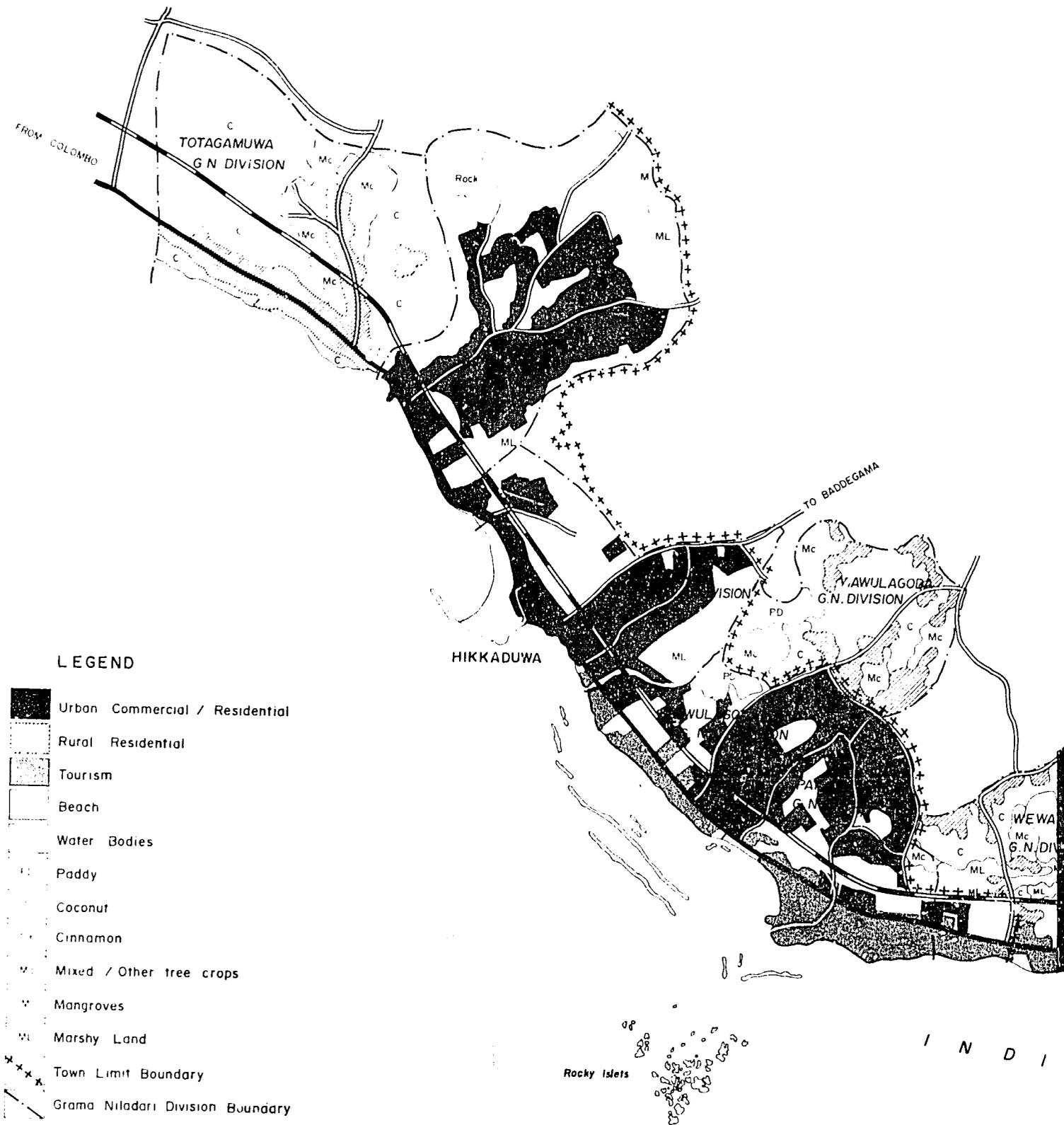


Figure 5.7 Overall land use and resource distribution in Hikkaduwa SAM area



highlighting beaches, water bodies, urban centers, tourism and agricultural uses

## **Chapter 6**

### **INSTITUTIONAL AND LEGAL FRAMEWORK**

#### **Institutional Framework for National Coastal Resource Management**

The management of coastal resources involves many Government agencies, as in the case of other natural resources in Sri Lanka. Sometimes responsibilities are overlapping and/or conflicting, and in other instances responsibilities are unclear. The primary management responsibility, however, rests with the Coast Conservation Department (CCD), which is responsible for:

- Formulating and implementing coastal protection and management activities;
- Regulating development within the prescribed “coastal zone” (see below) through permits;
- Evaluating development project impacts through discretionary environmental impact assessments;
- Preparing and implementing the Coastal Zone Management Plan; and
- Conducting surveys in cooperation with other agencies.

One main constraint faced by CCD is its limited legal jurisdiction. CCD's responsibility is within the “coastal zone”, which is defined as the area 2 km out to sea, 300 m inland, and 2 km inland for rivers and estuaries. CCD and other agencies also face the more common problems of lack of financial resources, equipment and trained personnel.

Unlike other Government agencies, however, CCD's mandate is more farsighted in that it was designed to help coordinate the sectoral management authority of other agencies. Thus far, CCD's coordinating role has been on a more informal basis. There is a need for CCD to place more emphasis on inter-agency coordination. To help accomplish this, more formal inter-agency coordinating mechanisms, such as Memoranda of Understanding, may be needed.

In the case of Hikkaduwa, because the Marine Sanctuary is formally under the jurisdiction of the Department of Wildlife Conservation (DWLC), CCD plays a coordinating role. This situation is a test of its broad interest in coastal zone management, as envisaged in *Coastal 2000* (Olsen et al. 1992), but is not under its direct control.

A general Government policy is to devolve responsibility to local authorities. In the present administrative framework, the Divisional Secretariat (DS) is the branch of Government, most suited to this role for the Hikkaduwa SAM activities. The DS implements the development projects of the Division and provides basic services to the inhabitants. Figure 6.1 outlines the administrative structure at the Divisional level.

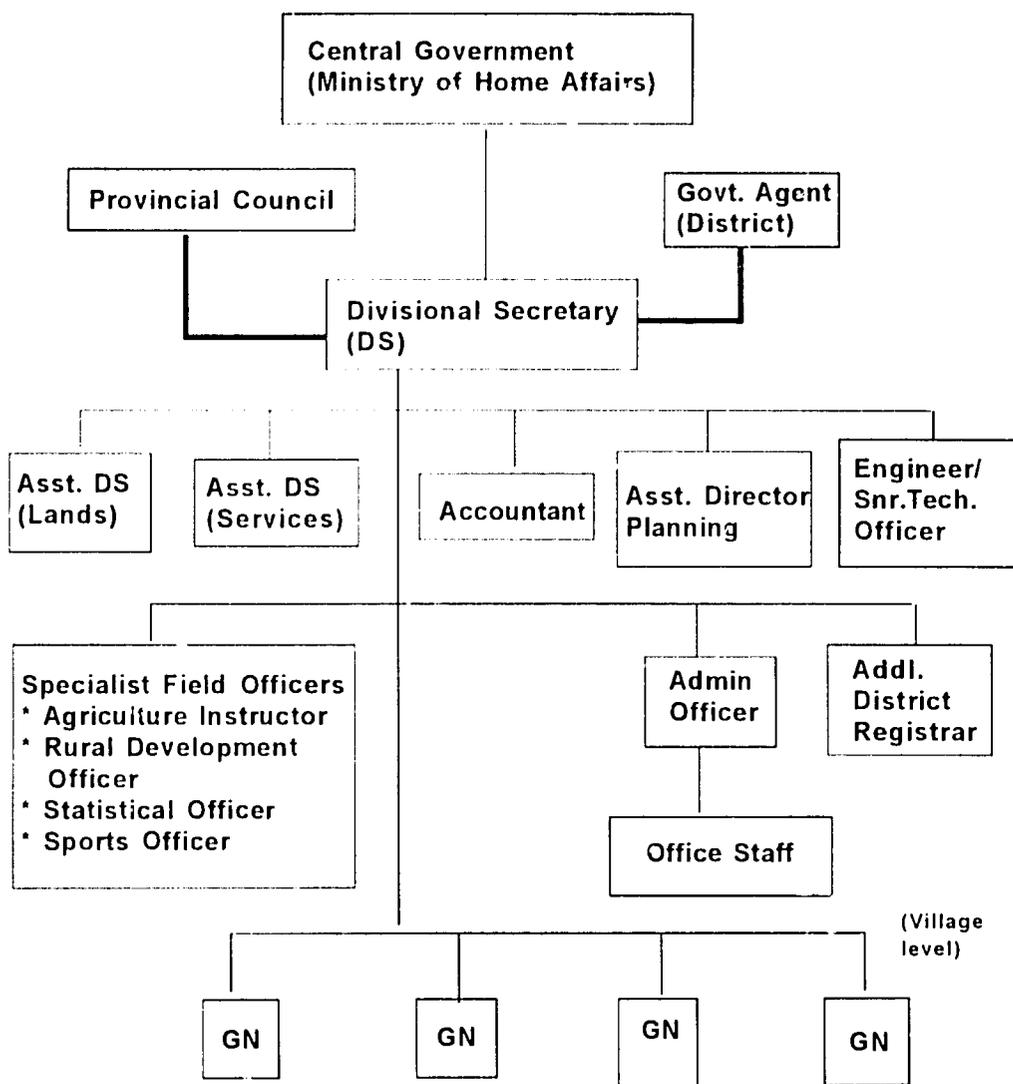


Figure 6.1 Government administrative structure at divisional level (Hewage, 1993)

Other Government agencies, which have primary responsibilities within coastal areas, with a potential role in the Hikkaduwa SAM include:

The Ministry of Fisheries and Aquatic Resources: Coordinates and monitors all activities relevant to fisheries and other aquatic resources. Formulates policy guidelines and recommends management plans. Implements development projects for fisheries and organizes cooperative societies.

The National Aquatic Resources Agency: Conducts research and development, monitoring, and research coordination functions, disseminates information, and provides advisory and consultancy services concerned with marine and inland aquatic resources management.

The Urban Development Authority: Manages development within and outside of the coastal zone, including all areas within one kilometer of the coastline, which it has designated as "urban". Undertakes studies relevant to the zoning of priority coastal areas. Formulates zoning related policy recommendations for the coastal zone.

The Ceylon Tourist Board: Implements coastal tourist development projects. Recommends and enforces tourism policies and guidelines affecting the coastal zone. Provides information on development plans. Provides information on proposed and adopted tourism policies and guidelines affecting the coastal zone.

Department of Wildlife Conservation: Responsible for the management of parks, reserves and sanctuaries, and conserving the biodiversity within those areas. Implementing agency for Hikkaduwa Marine Sanctuary.

The Central Environmental Authority: Formulates and coordinates environmental policy of various agencies in long-range planning and management. Recommends land use schemes and basic management policies for natural resources with an emphasis on fisheries, wildlife, forestry, and soil. Specifies standards, norms and criteria for environmental management, monitoring of environmental conditions, and initiates research and the dissemination of information. Coordinates environmental impact assessments of development projects and the licensing of pollution discharges, primarily of industries. Mandated to assist Divisional Secretaries to set-up "Environmental Councils" to address problems of water pollution, waste disposal and other environmental issues at the Divisional level.

Coast Conservation Advisory Council: Advises the Director of Coast Conservation on all development activities in the coastal zone. Reviews the Coastal Zone Management Plan, environmental impact assessments and requests for variances on permits.

Other Government agencies with secondary responsibilities within the coastal zone include the Sri Lanka Ports Authority; the Sri Lanka Land Reclamation and Development Corporation; the Ceylon Fisheries Harbor Corporation; the Forest Department; the Board of Investment; the Ministry of Irrigation, Power, and Highways; the Ceylon Electricity Board; the National Water Supply and Drainage Board; the Water Resources Board; the Geological Survey Department and the Low-Lying Areas Reclamation Board.

### **Institutional Framework for the Hikkaduwa Marine Sanctuary**

The management responsibilities for the Hikkaduwa Marine Sanctuary differ from most other coastal areas. Because its legal designation is that of a "sanctuary", the primary management responsibility rests with the Department of Wildlife Conservation. The Hikkaduwa Marine Sanctuary Development Program Committee (Table 6.1) monitors the implementation of the Program's activities. The Committee which meets quarterly, was established in 1991 and is made up of various Government officials and representatives of community groups. It is presently chaired by the State Minister for Rural Industrial Development and includes the Divisional Secretary, Hikkaduwa and representatives of the national and local government as well as national and local NGOs. A more action oriented Working Group was formed in January 1994, made up of a few selected members of the Sanctuary Committee, to review and guide the SAM plan as it evolves. This working group will be instrumental in ensuring efficient and technically accurate plan development. The institutional roles of the most important agencies and organizations for the Hikkaduwa SAM activities are indicated in Figure 6.2.

**Table 6.1. List of members of Hikkaduwa Marine Sanctuary Development Program Committee**

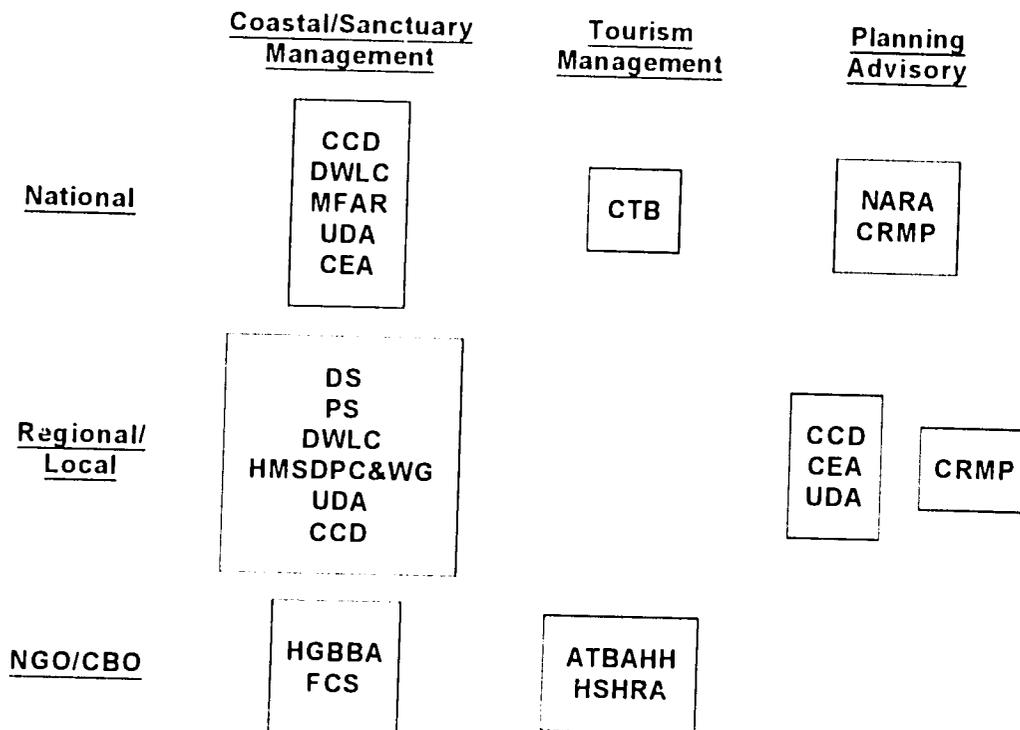
1. State Minister of Rural Industrial Development (Chairman)
2. Director, Department of Wildlife Conservation (DWLC)
3. Divisional Secretary, Hikkaduwa
4. Additional Divisional Secretary, Hikkaduwa
5. Project Manager, Coastal Resources Management Project (CRMP)
6. Project Officers, CRMP (2)
7. Coordinating Secretary to the State Minister of Rural Industrial Development
8. Director General, National Aquatic Resources Agency (NARA)
9. Director, Environmental division, NARA
10. Research Officer, NARA
11. Chairman, National Water Supply and Drainage Board (NWSDB)
12. Chief Engineer, NWSDB
13. Chairman, Pradeshiya Sabhawa (PS), Hikkaduwa
14. Secretary, PS, Hikkaduwa
15. Deputy Inspector General of Police, Galle
16. Officer In Charge, Hikkaduwa Police Station
17. Deputy Director, Urban Development Authority (UDA), Galle
18. Town Planner, UDA, Galle
19. Land Commissioner, Galle
20. Land Officer, Land Commissioner's Office, Galle
21. Manager, Planning Division, Coast Conservation Department (CCD)
22. Deputy Manager, Planning Division, CCD
23. Senior Environmental Scientist, Central Environmental Authority (CEA)
24. Assistant Director, Ceylon Tourist Board (CTB)
25. Research Officer, CTB
26. Chief Engineer, Ceylon Fishery Harbours Corporation
27. District Fisheries Extension Officer, Galle
28. Fisheries Inspector, Hikkaduwa
29. Provincial Director, Irrigation Department, Galle
30. Divisional Assistant, Irrigation Department, Galle
31. Assistant Director, Department of Education, Galle
32. President, Wildlife and Nature Protection Society
33. President, Hikkaduwa Small Hotelier's and Restaurant Association
34. Executive Director, Coral Sands Hotel
35. President, Hikkaduwa Glass Bottom Boats Association
36. Wetlands Project Officer, DWLC
37. Member of Parliament, Galle District

Unlike conventional, top down and planning first oriented approaches, a critical aspect of the SAM approach is the facilitation of community involvement in project planning and implementation. Currently, links are being established with community groups such as the Small Hoteliers and Restaurant Association and the Fisheries Cooperative Societies, and the formation of an association of glass bottom boat owners and operators is being facilitated. Also community action planning meetings with these groups are being facilitated and their planning and management capabilities are being strengthened. The SAM plan will be developed through this process.

### **Non-Governmental Organizations**

There are numerous Non-Governmental Organizations (NGOs), both indigenous and foreign, operating in Sri Lanka. The Sarvodaya Shramadana Movement, the largest indigenous NGO, however, is one of only two NGOs operating in the Hikkaduwa area.

Sarvodaya's mandate includes a wide range of development activities, including environmental activities. Their office is located at Thiranagama in the southern part of the SAM area. The other NGO is the Thrift and Credit Cooperative Society or "Sanasa". They provide small loans to individuals for a variety of activities. Thus far, neither of these NGOs have played a role in the SAM process at Hikkaduwa.



\*only the most important agencies relevant to the Hikkaduwa Marine Sanctuary listed

#### Acronyms

ATBAHH-Association of Tourist Board Approved Hoteliers of Hikkaduwa  
 CBO-Community based organization  
 CCD-Coast Conservation Department  
 CEA-Central Environmental Authority  
 CTB-Ceylon Tourist Board  
 CRMP-Coastal Resources Management Project  
 DS-Divisional Secretariat  
 DWLC-Department of Wildlife Conservation  
 FCS-Fisheries Cooperative Society  
 HGBBA-Hikkaduwa Glass Bottom Boat Association  
 HMSDPC&WG-Hikkaduwa Marine Sanctuary Development Program Committee and Working Group  
 HSHRA-Hikkaduwa Small Hoteliers and Restaurant Association  
 MFAR-Ministry of Fisheries & Aquatic Resources  
 NARA-National Aquatic Resources Agency  
 NGO-Non-government Organization  
 PS-Pradeshiya Sabha  
 UDA-Urban Development Authority

*Figure 6.2 Institutional roles for Special Area Management activities in Hikkaduwa*

NGOs have demonstrated the ability to implement development activities, at times when Government agencies are unable to do so, but it is also widely recognized that they are constrained by lack of qualified staff, funds and equipment.

### **Community-Based Organizations**

Community-based organizations (CBOs) are similar to NGOs in that they are non-governmental, but they differ in that they are usually not formally recognized institutions, do not receive donor funds, are not governed by a board of directors and are active in a

single, specific geographic area, such as a village. CBOs are common throughout the country. Usually they are organized with the help of a Government agency. The Fisheries Cooperative Societies are the CBOs most relevant to the Hikkaduwa SAM activities, and as mentioned above, are involved in the community action planning process.

Fisheries Cooperative Societies are established by the Ministry of Fisheries' Extension Offices to facilitate the provision of subsidies to fisherfolk for boats, engines, nets and other equipment, and disseminate information regarding fisheries management and regulations, and provide training. Several have been established in the area, but generally they are not active.

The societies in the Hikkaduwa area include those based in Kalavitigoda, Wellawatta, Hikkaduwa Wawulagoda, Hikkaduwa Kurunduwatta, Narigama, Thiranagama and Patuwatha.

Other community groups include Women's Societies, Multi-Purpose Cooperative Societies, Rural Development Societies and Youth Clubs. In general, they provide loans for various development activities and/or provide training for those activities. These groups may be a secondary priority in planning and educational activities.

### **Business Associations**

Currently, there are several active business associations in the area, the Small Hoteliers and Restaurant Association, which has about 40 members, the Glass-bottom Boat Owners' Association, the Association of Tourist Board Approved Hoteliers of Hikkaduwa and the Taxi Drivers' Association. The formation of the association of glass bottom boat owners is a recent result of the SAM activities. In general, the purpose of the associations is to focus attention on their respective concerns and participate in educational seminars relating to the tourist industry.

### **Laws Affecting Coastal Resources Management**

A number of laws relevant to coastal resources have been enacted in Sri Lanka, providing the basis for effective resource management. In practice, however, many laws are not complied with or enforced. Another factor is the lack of financial incentives and disincentives. The following is a list of laws relevant to the Hikkaduwa SAM Plan implementation:

- The Seashore Protection Ordinance, Gazette No. 7710 (1929), banned the removal of coral, sand and other substances;
- The Fauna and Flora Protection Ordinance, Gazette No. 8675 (1940), established the Ambalangoda-Hikkaduwa (Rocky Islet) Sanctuary;
- The Fisheries Ordinance, Gazette No. 12304 (1961), established a "Fisheries Protected Area" at Hikkaduwa;
- The Tourist Development Act No. 14 (1968) authorized the CTB to regulate services and prevent indiscriminate and unplanned development in resort areas. The Hikkaduwa Town Council Area was recommended for designation as a Resort Area on 8 January 1987;

- The Urban Development Authority Law No. 41 (1978) and Amendment Act No. 4 (1982), (a) made provisions for UDA to formulate and implement an urban land use policy for urban development areas by providing allotments, reservations or zoning of land for different purposes, the control of pollution and environmental quality, the provision of landscaping, and the preservation of views and prospects, places of historical and architectural interest, and scenic beauty and (b) designated all areas within 1 km of the coastline as “urban areas”;
- The Fauna and Flora Protection Ordinance, Gazette No. 37 (1979) established the Hikkaduwa Marine Sanctuary with the same boundaries as the “Fisheries Protected Area”;
- The Natural Heritage and Wilderness Act (1980) was amended in 1988 to require Environmental Impact Assessments and licenses for industries potentially producing air, water and/or land pollution;
- The National Environmental Act No. 47 (1980) (a) established the CEA and made provisions regarding its powers, functions and duties, and (b) made provision for the protection, management and enhancement of the environment, and for the prevention, abatement and control of pollution;
- The National Aquatic Resources Research and Development Agency Act No. 54 (1981) established the NARA to ensure the application of science and technology to the conservation of aquatic resources in the inland waters, coastal wetlands and offshore areas, disseminate information, and provide advisory and consultancy services;
- The Coast Conservation Act No. 57 (1981) (a) required CCD to develop a Coastal Zone Management Plan, regulate and control activities within the coastal zone, and formulate and execute coast conservation projects, (b) broadened the definition of coastal zones to include some portion of the water areas of lagoons, estuaries and rivers, (c) established uniform procedures for permit applications without distinction between development activities undertaken by private and state sectors, (d) encouraged collaboration among various government agencies involved in research and development activities within the coastal zone, (e) specified penalties for violation of the law, (f) authorized the Director of CCD to demolish unauthorized structures, and (g) established horizontal links between the law and other parallel legislations;
- The Amendment to the Coast Conservation Act No. 57 of 1981 (1988) (a) authorized the Director of CCD to delegate powers, duties and functions to government agents or public officers of any administrative district which contains a portion of the coastal zone, (b) banned the mining, collecting, possessing, storing, burning and transporting of coral, and the possessing of limestone kilns, (c) authorized the demolition of kilns and the seizure of boats engaged in illegal activities within the coastal zone, and (d) granted the public the right to use any beach;

- The Marine Pollution Prevention Act No. 59 (1981) authorized the Marine Pollution Prevention Authority to prevent, reduce and control pollution in Sri Lankan waters; and,
- The Specified Tourist Services Code (1984) provided for the classification, registration and licensing of all tourism-related establishments.

## Summary

The Hikkaduwa Marine Sanctuary Development Program Committee is a coordinating body representing all national agencies relevant to the management of the Sanctuary. Because of its large size, a smaller Working Group has been established to review and guide the development of the management plan and its implementation. Key agencies in the plan's implementation are the DWLC, CCD, the Hikkaduwa Divisional Secretariat and Pradeshiya Sabha. These agencies will work closely with the most affected community organizations. Critical legislation includes the 1979 declaration of the Marine Sanctuary, the Coast Conservation Act of 1981 which required the development of the Coastal Zone Management Plan, and the newly adopted policies of *Coastal 2000* which encourage SAM planning and implementation with local participation.

## **Chapter 7**

### **MANAGEMENT ISSUES AND OPPORTUNITIES**

#### **Special Area Management for Hikkaduwa**

The unique combination of qualities of the marine environment at Hikkaduwa and the Government's emphasis on encouraging the development of the tourist industry, have resulted in Hikkaduwa becoming one of the most popular tourist destinations in Sri Lanka. Tourism has supplanted fishing, farming and other endeavors as the most important economic activity in the area. This has contributed to significant economic progress for many of the area's residents. Hikkaduwa's success in developing the local economy has not been accomplished, however, without environmental and socio-economic costs. Hikkaduwa is in danger of becoming a victim of its own success. And as is common elsewhere, problems are largely the result of development that has proceeded without proper planning, coordination and regulation. If this is allowed to continue, it is only a matter of time before the cumulative effects will adversely affect the local economy and the quality of life in the area. Table 7.1 lists the management problems and causes. The problems perceived by the tourist industry and tourists are listed in Tables 7.2 and 7.3 respectively. Table 7.4 indicates the studies planned or ongoing for Hikkaduwa Special Area Management (SAM).

Due to the economic importance of Hikkaduwa, much attention has been given by various agencies to the situation there and numerous recommendations have been made. The recommendations have been made, however, within the sector-specific perspectives of the relevant agencies. The shortcomings of the sectoral approach are well-recognized, as is the need for action to bring together the various actors to develop and implement a comprehensive and integrated management plan regarding the issues described below.

The Hikkaduwa SAM process is being undertaken to address the various coastal resource management issues, using a multi-sectoral, community-based management approach. This profile is intended to provide background information on the SAM area to aid the development of an integrated, multiple-use management plan. The SAM approach emphasizes the role of local authorities and community members as the primary project planners and implementors. This is supported by Coast Conservation Department (CCD) policy, outlined in *Coastal 2000*, encouraging the SAM approach to coastal resource management, and is also compatible with the intent of the central Government to devolve authority to the local level. There is widespread recognition in Sri Lanka of the critical need to develop and implement effective locally-based coastal resource management plans to preserve, as well as develop, coastal resources in an ecologically and economically sustainable manner. The successful implementation of a SAM plan here will not only be beneficial to the immediate SAM area, it will also serve as a useful guide for the planning and implementation of future projects in Sri Lanka.

Table 7.1 Management problems and causes in the Hikkaduwa SAM area

Issues	Causes
<b>Environmental</b>	
• Coral reef degradation	Uncontrolled glass bottom and fishing boat activity; sedimentation; coral collection; tourists walking on corals; water pollution, collection of ornamental fish and lobster
• Deteriorating coastal water quality	Inadequate wastewater and solid waste disposal systems; oil dumped by glass bottom and fishing boats; pollutants discharged by two fresh water outlets and semi treated water discharged by hotels; runoff from highway drains
• Declining coral fish population	Collection for aquarium trade; habitat destruction; water pollution, disturbances caused by boats
• Sedimentation of coral reefs	Sediments discharged by two fresh water outlets, beach erosion, sediments brought by Hikkaduwa River.
• Dumping of solid waste on beaches, in water and on vacant lots	Inadequate solid waste disposal system
• Illegal fishing practices	Light-purse fishing, dynamite fishing, using small mesh nets, bottom-set nets for spiny lobsters.
• Coastal erosion	Natural causes; coral reef destruction; construction of coast protection structures
<b>Socio-Economic</b>	
• Inadequate fishing boat anchorage and landing facilities	Sedimentation of Fisheries Harbor; Harbor is too small Coral reef obstructs entrance into Fisheries Harbor
• Lack of alternative forms of income generation	Inadequate resources devoted to studying potential for alternative income generation and supporting their adoption
• Increasing traffic noise and congestion	Inadequate road infrastructure; increasing number of vehicles, untrained drivers; no control on speed
• Illegally constructed buildings, on beach	Non-compliance with setback laws
• Inadequate water supply	Inadequate infrastructure; groundwater affected by salt water intrusion
• Restricted beach access	High density of buildings in beach area
• Increasing density of beach and Sanctuary use	Larger number of tourists visiting the area
• Prostitution and drugs	Lack of alternative employment
<b>Institutional</b>	
• Overlapping/conflicting coastal resource management responsibilities of Government agencies	Poor coordination between Government agencies
• Inadequate planning, implementing and monitoring capability of central government and provincial level agencies	Inadequate number of personnel; lack of equipment; lack of financial resources
• Lack of community liaison/organizing experience in central Government and provincial agencies	Low awareness of the need for such capability; lack of in-country community liaison/organizing training programs; lack of financial resources
<b>Legal</b>	
• Lack of specific regulations for Hikkaduwa	Lack of agency to catalyze process
• Lax enforcement of existing regulations	Political interference
• Limited definition of "coastal zone"	Lack of awareness

*Table 7.2 Frequency of problems as perceived by the tourist operators in Hikkaduwa (De Alwis, 1993)*

Problem	Percent		Respondents*
	Severe	Moderate	None
Traffic noise	80	10	10
Traffic congestion	73	19	8
Unclean beaches	41	34	25
Harassment by touts	39	8	13
Degradation of marine habitat	38	35	27
Sea water pollution	35	35	30
Restricted beach access	25	27	48
Pedestrian traffic	20	43	37
Poor sanitation	11	50	39
Personal security	9	56	35
Overcrowded beaches	9	31	60
Too many tourists	5	45	50
Overdevelopment of tourist facilities	4	51	45

\* Sample size: 108

*Table 7.3 Problems as identified by a sample\* of foreign tourists in Hikkaduwa, December 1993 (Tantrigama, 1994)*

	Level of Problem					Average Opinion
	Excessive		Neutral		Minimal	
	5	4	3	2	1	
Crowded Beaches	2	6	24	32	38	2.03
Traffic	44	35	17	5	7	3.96
Harassment by Touts	26	35	25	11	9	3.54
Number of Tourists	5	12	52	25	16	2.68
Over-development	7	13	48	23	14	2.77

\* Sample size: 110

## Management Issues

Degradation of Coral Reefs: The quality of the coral reefs in the area has declined sharply over the years. In the past, coral mining was a major cause. In recent years, coral mining has decreased significantly due to stricter law enforcement. It still occurs, however, to the north of the Sanctuary. Damage to coral reefs occurring in the Sanctuary is due to (1) glass-bottom boats and fishing boats hitting the corals in shallow areas and from the dropping of anchors, (2) the collection of coral and ornamental fish, (3) sedimentation from beach erosion and fresh water outlet outflows, (4) water pollution from several sources, and (5) damage caused by tourists and others standing and walking on the corals (De Silva, 1987). Destruction of coral reefs exacerbates coastal erosion, reduces biodiversity and makes the area less attractive to tourists.

Deteriorating Coastal Water Quality: The quality of the nearshore waters is variable. Immediate attention is required to prevent pollution levels from significantly increasing. Primary causes of pollution are wastewater and semi-treated sewerage from

hotels and other businesses, two fresh water outlets carrying water in which coconut husks have been retted and the oil from various kinds of boats. Poor water quality will negatively affect marine life, is aesthetically unpleasing, and will make the area unhealthy for bathing. Sediments enter the marine water from the fresh water inlets during periods of rain and form nearshore run-off.

Declining Coral Fish Population: The quantity and variety of reef dependent fish and other marine organisms have also declined sharply over the years. This is mainly due to the collection of fish by local inhabitants for the aquarium trade and habitat destruction. Pollution from the sources mentioned above may be a secondary factor. Declining coral fish population is a loss of biodiversity, which again negatively impacts the tourist industry.

Illegal Dumping of Solid Waste: Solid waste is being illegally dumped on the beach, in the water, on vacant lots and in canals because of the lack of an adequate solid waste disposal system. Again, this is aesthetically unpleasing.

Illegal Fishing Practices: The "light-purse" method of fishing, which uses bright lights powered by generators, is common and lucrative. Dynamite fishing occurs occasionally just outside the Sanctuary and more commonly further out to sea. Both light-purse and dynamite fishing operations are well-organized and are believed to operate with political sanction. The use of illegal small mesh and bottom-set nets for lobster is also a problem.

Coastal Erosion: The entire southwest coast is affected by natural erosion. The degradation of the coral reefs exacerbates the problem, as does the construction of illegal structures too close to the shore. The reef area between the Coral Gardens and the Fisheries Harbor is subject to a gradual loss of sand and beach but is generally stable. Coast protection structures, especially revetments, increasingly occupy the beach front. Such structures can, however, sometimes exacerbate erosion problems (Hale and Kumin 1992). The groyne constructed at the northern end of the Sanctuary has also changed the transport of sediments. Although the beaches within the SAM area are only moderately affected by natural erosion, being somewhat protected by the coral reefs, the beaches to the north, from the Hikkaduwa Bridge to Akurala, about 7 km from Hikkaduwa, are severely affected. As an indication, the Seenigama Temple, 2 km from Hikkaduwa, which is now located on an island about 150 m offshore, was once connected to the mainland. For the Galle District in general, it has been estimated that the net erosion rate has been 0.2 to 0.3 meters per year (CCD, 1986; 1992).

## **Socio-Economic and Resource-Use Conflict Issues**

Inadequate Fishing Boat Anchorage and Landing Facilities: The Fisheries Harbor cannot accommodate all the boats in the area due to siltation, which has decreased its capacity. Also, the only route into the harbor, between the end of the groyne and some shallow rocks, is narrow and is dangerous in rough seas. In 1993, two fishermen drowned after their boat was pushed onto the rocks by rough seas and sank. Consequently, many boats are forced to anchor elsewhere, such as in the Sanctuary. Also, due to tourism development along Hikkaduwa's beaches, fishermen have gradually lost sites where they can land and repair their boats. For example, they are presently using an area adjacent to the Cooperative Beer Garden, but this land will eventually be used by the Department of Wildlife Conservation to build an office and educational center for the Sanctuary.

Lack of Alternative Forms of Income-Generation: Some forms of income generation, such as coral mining and the collection of coral fish, are not dependent on tourism, but are having a negative impact on the tourist industry. A study on coral mining along the southwestern coast has concluded that it is difficult to convince those involved in coral mining to switch to other forms of employment, primarily because the alternatives are not as financially lucrative (Premaratne, 1985). Another reason is that those involved in coral mining tend to have a low level of education, making it difficult for them to find suitable employment, such as in the tourism industry.

Other studies have concluded, however, that there is a need for services, such as in providing hotels with perishable foodstuffs, but there have been no studies as to the feasibility of transitioning coral miners into these service-oriented occupations. Other potential sources of income-generation may be shrimp culture, white fibre production and expansion of the handicrafts industry.

Increasing Traffic Noise and Congestion: Over 70 percent of the respondents to a 1993 survey cited traffic noise and congestion as frequent problems (De Alwis, 1993). Galle Road is the only main road through the area. Increased vehicular traffic also endangers pedestrians and cyclists and generally creates an unpleasant environment.

Illegally Constructed Buildings on the Beach: Construction of new buildings within the coastal zone requires a permit from CCD. Some structures, however, are built without permits. Many of the structures are small, temporary, do not significantly exacerbate coastal erosion and are owned by the poorer segments of the population. Larger buildings with concrete foundations, however, worsen the erosion problem and decrease the available beach space.

Inadequate Water Supply: Water supply for domestic, as well as tourist industry consumption is a significant problem, with people already using salty water. Many residents rely on groundwater; as the area develops and more wells are sunk, there will be increased salt water intrusion. The inability to provide potable water can negatively impact health and will limit future development.

Restricted Beach Access: The large numbers of buildings constructed close to the beach restricts access to the beach in most areas. Exacerbating the situation are coastal erosion and the construction of rock revetments, which has reduced the area of sandy beaches.

Increasing Density of Beach and Sanctuary Use: Overcrowding on the beaches during the tourist season is an increasing problem. Contributing factors are coastal erosion, increasing density of structures on the beach and the construction of revetments. Some tourist activities are not compatible. For example, motoring of glass bottom boats in the same area as swimmers and snorkelers endangers the swimmers and snorkelers. Also the increasing number of glass bottom boats operating without regulation are causing damage to the marine environment.

Prostitution and Drug Use: Observation suggests that prostitution, primarily homosexual, is prevalent. Drug abuse is also a serious problem. Both have obvious negative social impacts, including the spread of sexually transmitted diseases. The prevalence of prostitution is difficult to reduce, because it is a lucrative form of income-generation.

## **Institutional Issues**

### Overlapping/conflicting coastal resource management responsibilities of

Government agencies: There are a number of Government agencies responsible for coastal resource management. Clearer definitions are needed regarding management responsibilities and inter-agency coordination to reduce overlaps and conflicts.

### Inadequate planning, implementing and monitoring capability of central

Government and provincial level agencies: The CZMP is a "problem oriented" plan with a strong focus on regulatory responsibilities. This requires central Government and provincial level agencies to have effective planning, implementation, monitoring and enforcement capabilities, which are presently lacking (Perera, 1991). The main reasons for this are inadequate personnel, lack of equipment and lack of financial resources.

Lack of community liaison/organizing experience in central Government and provincial level agencies: The mandate stipulated by the Constitution's Thirteenth Amendment to devolve powers and functions to the provincial level, recognizes the need for Government agencies to develop closer and more cooperative working partnerships with local communities. Awareness is growing that active community participation in planning, implementation and monitoring is vital to the success of natural resource management and development. Unfortunately Government agencies do not have significant experience and training in community-based, participatory planning and resource management, nor are they in a position to take on such responsibilities. Constraints to doing so are due to the limited in-country community liaison training programs and the lack of financial resources.

## **Legal Issues**

Lack of specific regulations for Hikkaduwa: Regulations are needed, specifically for Hikkaduwa, for the operation of fishing and glass bottom boats within the Sanctuary and for their maintenance. A number of recommendations have been made by CCD, National Aquatic Resources Agency (NARA) and others regarding the number of glass bottom boats to be permitted, the number to be allowed to operate at a given time, the routes they should use, and how they should be maintained and licensed (see "NARA Recommendations" and "CCD Recommendations, 1991"). These regulations are currently being discussed by Government officials and community groups.

Lax enforcement of existing regulations: More effective enforcement is needed for existing regulations, regarding the removal and possession of coral, the discharge of untreated wastewater and solid waste, the illegal construction of structures on the beach and illegal fishing practices. Also there is a need for the Ceylon Tourist Board (CTB) to classify, register and license all tourism establishments as legislated, in collaboration with the Pradeshiya Sabha (local government). Some of these illegal practices are politically sanctioned.

Limited definition of the "coastal zone": The existing legal mandates are limited in geographical extent. As mentioned previously, the responsibility for the immediate Sanctuary area is that of DWLC, while CCD is responsible for the area 2 km out to sea, 300 m inland, and 2 km inland for rivers and estuaries. Forces operating outside of those boundaries, however, impact on the Sanctuary, such as dynamite fishing and ships dumping oil at sea. Therefore, there is a need to develop a more integrated legal mechanism to encompass a broader geographical area for Hikkaduwa and other coastal areas.

## Existing Management Recommendations for Hikkaduwa Area

### Recommendations to the Cabinet Sub-Committee on Urban Development

The following recommendations were made in the "Memorandum to the Cabinet Sub-Committee on Urban Development", submitted by the Working Committee comprised of the Central Environmental Authority (CEA), CTB, CCD, the Ministry of Fisheries, the Galle District Development Council and the Treasury, and coordinated by the Urban Development Authority (UDA), on 11 February, 1987.

NARA Recommendations: Redesignating the Sanctuary as a Marine Park primarily for recreation, education and research. This would involve (Figure 3.5):

1. Zoning of the area with boundaries extending along the beach from the groyne of the Fisheries Harbor to the southern end of the Coral Gardens Hotel, and 2 km out into the sea from the permanent beach vegetation line. It should also include the Rocky Islets and surrounding coral reef (this has been endorsed by the enlargement of the Sanctuary in 1944).
  - Research Zone: The area from the northern boundary of the Cooperative Beer Garden Restaurant to the Fisheries Harbor groyne. The following activities would not be allowed: (1) the entry of any boats into the lagoon reef area of this zone, (2) the use of diving or snorkeling gear by unauthorized persons, and (3) the removal of any marine organisms unless for research by authorized persons.
  - Zone A (general use): The area between the present Cooperative Beer Garden Restaurant and the southern boundary of the Coral Rock Hotel. The following activities would not be allowed: (1) use of anchors and chains, (2) standing and walking on corals, (3) removal of fish, corals and other marine organisms unless a permit is issued, and (4) use of glass bottom boats.
  - Zone B (general use): The area from the southern boundary of the Coral Rock Hotel to the southern boundary of the Coral Gardens Hotel, including the Rocky Islets and surrounding corals. The following activities would not be allowed: (1) removal of fish, corals and other marine organisms unless a permit is issued, and (2) standing, walking and anchoring of boats on the reefs.
2. Prohibiting the removal of marine organisms, anchoring of boats in the reef lagoon and the improper discharging of wastes from tourist establishments and boats.
3. Diverting fresh water outlets away from the Sanctuary.
4. Providing resting platforms for swimmers and mooring buoys at several locations for tourist activities.
5. Relocating the mechanized boats anchored within the reef lagoon to the Fisheries Harbor.
6. Giving support to the police to enforce the regulations to prevent illegal fishing and removal of marine organisms from the Sanctuary.
7. Controlling the number of glass bottom boats through registration and issue of permits.
8. Dredging the Fisheries Harbor to expand capacity.
9. Providing garbage bins along the beach to facilitate garbage disposal.

### CCD Recommendations

1. Nourishing the Coral Gardens Cove with sand, extending the groyne on the south side, reinforcing the reef-arch on the north side and installing a low sill/breakwater in the middle of the cove.
2. Nourishing the Hikkaduwa Cove with sand, building a retention groyne on the south side and possibly installing a reef plug.
3. Excavating and dredging the Hikkaduwa harbor to Hikkaduwa Ganga Reach, and possibly installing a groyne and breakwater.

### CTB Recommendations

1. Classifying, registering and licensing all tourist establishments in order to regulate them, under the Tourist Development Act No. 14 of 1968.
2. Amending Act No. 14 so that the Minister of Tourism and Rural Industries can declare an area for tourism development in order to promote, plan and encourage the development of tourist facilities within such an area.
3. Conducting an inventory of sewage and waste disposal facilities in the area, and developing a plan for inland forms of waste disposal.
4. Requiring all hotels to actively participate in the management of aquatic resources, to provide information to tourists about minimizing damage to aquatic resources and to prevent tourists from collecting corals.
5. Introducing a standard sign-board system for the guidance of visitors and requesting the hotels to undertake a tree planting campaign.

### UDA Recommendations

1. Implementing the Wellawatta Integrated Development Project, which includes developing the Wellawatta Commercial Center, filling the Kurunduwatta Marsh in order to relocate the weekly market, relocating the Kumara and Mahamaya High Schools to sites outside of the tourist areas, improving the existing playground, providing a building for the District Development Council/Galle, relocating the Multi-Purpose Cooperative Society building in order to make way for the proposed Sanctuary office and educational centre, improving the main bus stand, filling the Kuduwegoda marsh for housing and building a shopping area on the site vacated by the two schools.
2. Widening Galle Road at Hikkaduwa Town to relieve traffic congestion.
3. Building a Galle Road by-pass road from the Hikkaduwa bridge to Kumarakanda.
4. Developing surface drains for the Wellawatta Integrated Development Project area and for the widening of Galle Road.
5. Extending the Ambalangoda Water Supply Scheme to Hikkaduwa.
6. Developing a central sewage system.

### **Other Recommendations**

#### UN/ESCAP Recommendations (1985)

A UN/ESCAP report on coastal management in Sri Lanka (1985), strongly stated that "responsibility should never be removed from the decentralized action-oriented departments of Government, e.g. Local Bodies, which are much closer to the threatened or damaged coastal environment".

CCD Recommendations (1991)

- Reduce the number of hotel owned glass bottom boats.
- Introduce a rotation system which allows boats to do business on specific dates.
- Demarcate routes along which boats may proceed so they do not hit the coral.
- Install anchoring buoys in snorkeling areas.
- Prepare guidelines for tourists and boatmen describing legal and illegal activities.
- Develop a training program for boatmen so they understand and comply with the system.
- Ban boat activity in the proposed zone during the monsoon season.

CTB Recommendations (1992b)

- Restrict further development in beach areas to the land side of Galle Road.
- Create a Tourist Police Post to mitigate conflicts between local residents and tourists.
- Bring all informal sector establishments under official control.
- Grant liquor licenses to those informal sector restaurants conforming to the standard CTB criteria.
- Create a special unit of the CTB to work with the Police and the formal and informal sectors to coordinate educational seminars regarding natural resource management, compliance with laws, drug abuse and sexually transmitted diseases.
- License site guides and beach boys with the help of the Local Authorities.

Water Quality Consultant Recommendations (MPI 1992)

- Sample wastewater effluent from the Coral Gardens Hotel from the present system and compare to a system operating under continuous aerated conditions.
- Identify specific pollutants from brackish water outlets, including Biological Oxygen Demand, Chemical Oxygen Demand, metals and toxic organic pollutants. Monitor flows and, if large quantities of pollutants are found, identify the sources of upstream pollution as a first step.
- Control discharges from fishing boats by performing activities such as discarding old fish, fish scraps and oil from cleaning, further out to sea, or relocate the boats to a site away from the reefs.
- Prevent destruction of coral reefs by glass bottom boats by undertaking a public awareness campaign and educating boat owners and operators.

CEA Recommendations

- Conduct a feasibility study on a common wastewater treatment plant for hotels.

**Actions Taken Based on Recommendations**Based on NARA Recommendations

- The number of glass bottom boats is limited to 50.
- Police have been empowered to impose fines on those caught removing marine organisms from the Sanctuary, which has decreased the amount of coral and other organisms being removed.

- The Sanctuary boundaries have been expanded

#### Based on CCD Recommendations

- Coral Gardens Hotel has built a small groyne to help retain sand on the nearby beaches. The groyne is smaller than the one recommended by CCD.
- The Fisheries Harbor has been partially dredged. About 10,000 cubic m has been removed for use at the Koggala Free Trade Zone.
- The beach near the Coral Gardens Hotel may have been nourished with sand by natural processes resulting from the breaching of the Fisheries Harbor groyne.
- CCD has coordinated education programs for local authorities and business people about precautionary measures to minimize damage to aquatic resources.

#### Based on CTB Recommendations

- Some information is provided by hotels to tourists about minimizing damage to aquatic resources.
- Some signboards have been posted to guide tourists.

#### Based on UDA Recommendations

- A section of Galle Road was widened to relieve traffic congestion but resulted in higher speeds of vehicles which increase noise and danger to pedestrians.
- The bus stand has been improved.
- The playground has been improved.
- A building has been provided to the District Development Council.

#### Other Actions Taken

- The groyne at the Fisheries Harbor was breached by the Ministry of Fisheries to reduce the sedimentation of the harbor but is now silted.
- The National Water Supply and Drainage Board is implementing the District Water Supply Program in eight towns of the Southern Province, including Hikkaduwa. The project is funded by the Asian Development Bank. The funding for the entire project is Rs. 788 million. Rs. 65 million was allocated for Hikkaduwa. The work on the Hikkaduwa section was completed in mid-1993 and involved rehabilitating the existing system, including pipelines and intake structures. It will not be operational until after late 1994. Until then, the old system is being used.

#### **Actions Taken for Hikkaduwa Special Area Management**

- A field office has been established in the SAM area, with two project officers based there.
- Baseline socio-economic surveys have been conducted of the SAM area.
- Target community groups are being strengthened and organized, and community action planning meetings are being facilitated.
- Educational workshops on the SAM planning process and coastal resources management have been conducted for GNs and other local Government officials.

- Two color posters regarding coral reef conservation have been printed for educational purposes. One is a wall poster to be displayed in prominent buildings and public areas. The other poster will be displayed on glass bottom boats and at the landing areas of the boats.
- The construction of a boat has been completed for patrolling by the DWLC.
- Three DWLC Guards have been assigned to Hikkaduwa and 5 volunteer guards appointed.
- A Glass Bottom Boat Association has been formed.
- This environmental profile is complete with detailed maps of the SAM area.
- The SAM Plan is being drafted with community and government collaboration.

Because information is lacking for several issues critical to the Hikkaduwa SAM Project, studies are underway by the CRMP regarding the coral reefs, coastal water quality and the tourist industry. The objectives of the studies are listed in Table 7.4.

*Table 7.4. Studies planned, ongoing or completed for the Hikkaduwa SAM Plan*

Type of Study	Objectives
Coral Reef Studies ongoing through NARA and local community assistance	<ul style="list-style-type: none"> <li>• Provide information for mapping of the resource at 1:5,000 scale*</li> <li>• Quantify indicators for coral reef health which can be monitored and compared with past data*</li> <li>• Document current use patterns and management problems which lead to management recommendations*</li> <li>• Involve local community participation</li> <li>• Upgrading the quality of the reef, recolonization of damaged areas</li> <li>• Regular monitoring of the coral reef.</li> </ul>
Tourism Studies with CTB	<ul style="list-style-type: none"> <li>• Establish baseline indicators for measuring benefits and liabilities from tourism</li> <li>• Describe relationships between categories of informal and formal sector establishments in terms of compatibility and conflicts*</li> <li>• Analyze benefits accruing to the local community in terms of employment, purchases of requirements and other economic activities*</li> <li>• Assess the economic costs of perceived problems such as crowding and congestion, damage to heritage resources, access to beach and visual impacts of urbanization*</li> <li>• Assess dependence of tourist industry on the environmental quality of sea water, marine habitat, available beach spaces, density of beach use and thresholds which should not be surpassed</li> <li>• Analyze foreign exchange earnings and average profit margins for different investments</li> <li>• Assess the carrying capacity of the area for further tourism development</li> </ul>
Water quality studies conducted by NARA	<ul style="list-style-type: none"> <li>• Establish 11 sampling sites, from which samples will be taken once a month for one year*</li> <li>• Determine level and sources of pollution*</li> <li>• Propose management actions</li> </ul>

\* Completed in 1994

## Other Studies in the Hikkaduwa Area

The National Water Supply and Drainage Board has recently completed a wastewater disposal feasibility study for Hikkaduwa. The study covers the area along Gall Road from the Hikkaduwa Beach Hotel, near the main bus stand, to the Viska Cabana Gardens in the Thuranagama Wallabada GN Division. It includes 65 hotels, guesthouses and restaurants, which account for most, but not all, of the tourist establishments in this area. A central treatment collection system using extended aeration oxidation ditches has been recommended. Fully treated effluent is to be discharged to the sea with a short outfall. The system is estimated to cost SUS 2 million.

The World Health Organization (WHO) is also funding a wastewater treatment and solid waste disposal feasibility study coordinated by the Central Environmental Authority. The study will recommend methods to improve existing treatment and disposal systems and the development of new systems. The study should be completed by early 1994.

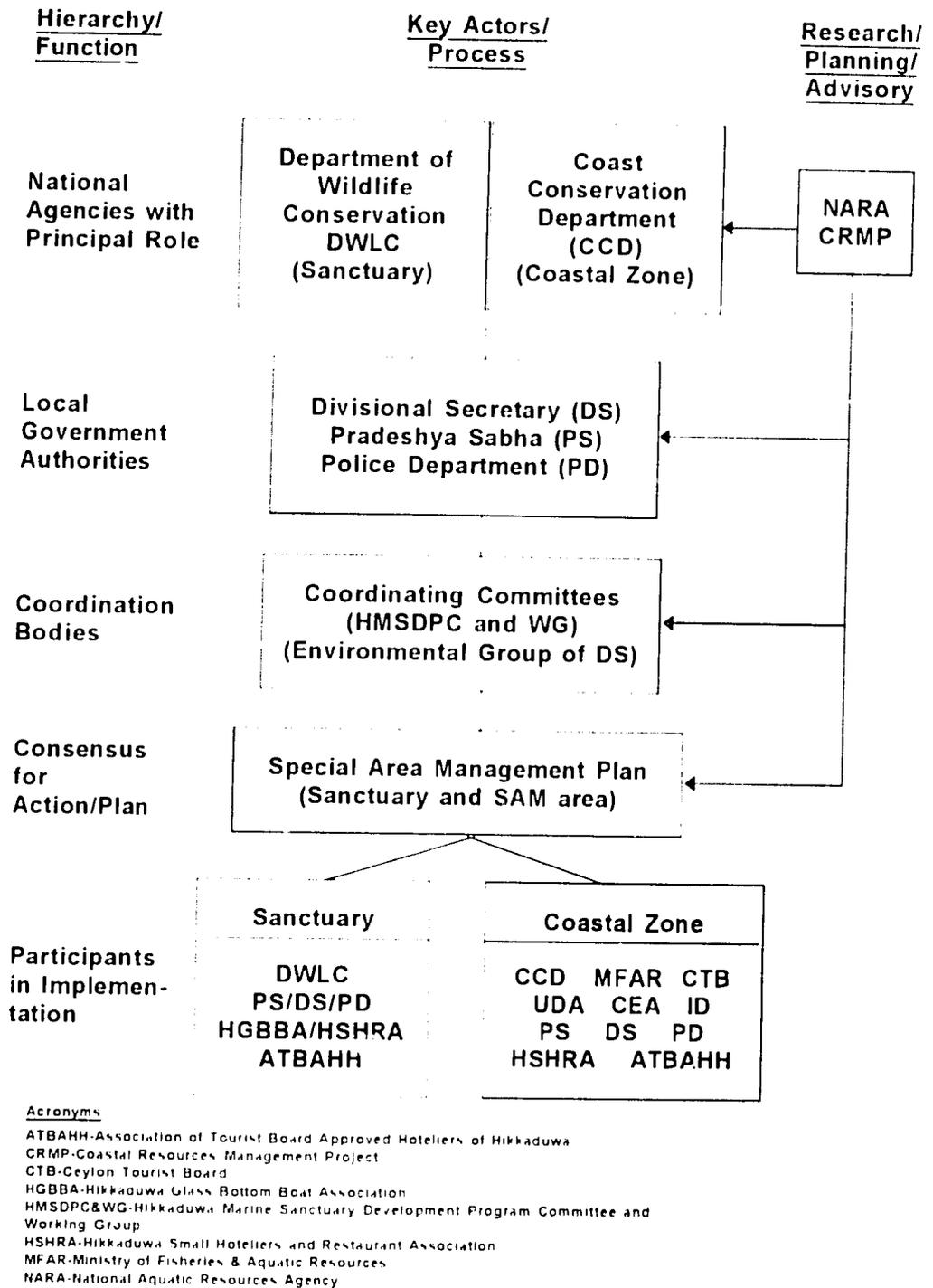
The Ministry of Fisheries and Aquatic Resources is in the first part of the 6-year Fisheries Sector Development Project funded by the ADB. The project area is the southwest coast and includes Hikkaduwa and Dodanduwa. Studies are planned regarding the following issues in 1994 and 1995.

- Coastal Engineering: Activities will include site reconnaissance, surveying and leveling, bathymetric and littoral drift studies, tide and current measurements, and sedimentation analysis. The purpose of these studies is to determine the feasibility of rehabilitating existing structures such as harbors, breakwaters and jetties. It is not intended to construct new structures.
- Credit Facilities: Alternatives to fishing will be studied for income generation. It is intended that loans will be provided through the Fisheries Cooperatives to individuals for income generating activities.
- Development of Social Infrastructure: 60 villages will be identified in the overall project area for development improvements of access roads, drinking water, marketing, health and education facilities. It is likely that one or two villages within the Hikkaduwa SAM Project area will be selected.

## Additional Information Needs

Sedimentation Patterns: Sedimentation patterns are influenced by natural as well as man-made factors. Observations seem to indicate that the groyne built at the north end of the Sanctuary has changed the pattern of sedimentation. Subsequently, the deliberate breaching of the groyne changed the pattern again. It is necessary to understand the dynamics of the existing patterns and quantify rates of sedimentation before any other actions are taken.

Sources and Levels of Income Generation Other than from Tourism: Sufficient data has been collected and is in the process of being analyzed regarding income generated by tourism, but not by other sources. It would be useful to know how much income is earned outside of the tourist industry. For example, fishing is clearly still an important economic activity, but there is little information available about the amount of income generated.



*Figure 7.1 Institutional framework for planning and implementing the Hikkaduwa SAM Plan*

There is also no reliable information available for traditional or other sources of income generation, such as the handicraft and coir fibre industries.

Water Supply and Conservation: There is a need to determine alternative sources of water supply. Also investigations are needed to determine ways to conserve and more efficiently regulate existing sources.

Prevalence of Prostitution and Drug Abuse: It is important to know the impact of tourism on sociologically detrimental activities like prostitution, drug abuse and other forms of crime, so that strategies can be adopted that reduce their prevalence.

### **SAM Plan Development and Implementation**

This profile is the first step in the development of a Special Area Management plan for Hikkaduwa. The ongoing process of plan development will make use of the profile as a source of baseline information for the area. SAM plan development is a collaborative process, focused at the community level and involving many meetings with community groups comprised of glass bottom boat owners, hoteliers and restaurateurs, and fishermen, as well as with local Government officials, the Sanctuary Development Committee and national agency representation with jurisdiction over Hikkaduwa's coastal resources. The institutional scheme envisaged for management is shown in Figure 7.1. The key to success in SAM plan development is that all stakeholders, community and government, agree in principle on the actions to be carried out under the management plan. And unlike conventional management plans, which are often static, SAM plans are meant to be dynamic, open to change and reflective of the decisions and actions of those agencies and community groups with key roles in implementation.

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