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A SURVEY OF THE COASTAL ZONE OF SRI LANKA

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COAST CONSERVATION DEPARTMENT

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PREFACE

The Survey of the Coastal Zone of Sri Lanka which led to this Report was undertaken by the University of Colombo at the request of the Coast Conservation Division of the Ministry of Fisheries. The field programme which encompassed the entire coastal zone of the Island was started in August 1981 and continued till February, 1982. The base maps for field investigations were prepared at the Departments of Geography in Colombo and Matara. The training of field investigators, monitoring and supervision of field work, data processing, preparation of final maps and the Survey Report were handled by the author at the Department of Geography of the University of Peradeniya.

The original draft of this report was in three volumes, namely:

- Vol. I : The Descriptive Text
- Vol. II : Appendix Tables
- Vol. III : Map Folders

The present publication is an edited version of the descriptive text with some statistical data given in Appendix Tables from the Volume II. There were 362 coloured maps at the scale of 1 : 6500 in Volume III, covering the entire coast line of Sri Lanka. The interested reader may refer to these maps which are available at the Coast Conservation Department.

Over 60 persons from different universities in the Island have participated in the survey activities. Their names and the functions they performed in the Project are given below:

Coordination

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1. P. M. Karunaratne
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3. H. W. Karunasena
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Northwestern Coastal Zone

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2. S. C. Caroes
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4. S. Sebamalai

Northern Coastal Zone

1. A. Ariyaratnam
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3. N. Balachandran
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5. S. Shanmuganathan
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2. M. Rajakumar
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4. W. S. M. Herath Banda
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Southwestern Coastal Zone

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In addition to the persons mentioned above, several officers of the Coast Conservation Division of the Ministry of Fisheries also actively participated in the survey activities. They included

Mr. Renton de Alwis
Mr. H. V. Dayananda
Mr. P. Amarasinghe and
Mr. Indra Ranasinghe

I must express a special word of thanks to Mr. Renton de Alwis, former Deputy General Manager, Planning, Coast Conservation Division who initiated interest in this Project and worked with great enthusiasm and dedication to see it through.

Finally, I must record my gratitude to the late Prof. S. Wijesundra, then Vice-Chancellor, University of Colombo and the former Director, Coast Conservation, Mr. S. R. Amarasinghe for providing us with the rare opportunity of seeing with our own eyes the entire coastal Zone of Sri Lanka, including the islands off the Jaffna Peninsula.

C. M. Madduma Bandara

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November, 1989.

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CHAPTER I

INTRODUCTION

1.1 Location and Historical Significance

The Island Republic of Sri Lanka, located in the Indian ocean between the latitudes of 5°55'N and 9°51' N and the longitudes of 79°41' E and 81°53' E, covers an area of 65610 square kilometres. It consists mainly of an elongated pear-shaped tropical island with a maximum length of 434 kilometres from Dondra Head on the South to Point Pedro on the North, and a maximum width of 227 kilometres from Colombo on the West Coast to Kalmunai on the East Coast. There are also a few small islands scattered along its coast. The midway location of Sri Lanka astride the sea routes between West and East facilitated its use as a stepping stone across the great Indian ocean by people of many nations throughout the ages. The coastline of Sri Lanka with its numerous bays, anchorages and natural harbours afforded adequate shelter for the sailing ships of ancient and medieval times. Since the second century A.D., when the Island first became familiar to Greek and Arab sailors, it has been a port of call and an emporium of sea-borne trade between the West and the East. At Mahatiittha (modern Mantai) on the mainland opposite Mannar, ships from various countries sold and exchanged merchandise and also took away pearls, precious stones and many other products of Sri Lanka.

Due to its midway location it was also possible for many travellers to visit Sri Lanka from early periods of her history. Probably no island in the world has been more frequently mentioned in the records of travellers than Sri Lanka (Cook, 1951). Thus travellers from the Far East like Fa-hsien (411 A.D.) and those from the West like Marco Polo (1293 A.D.) and those from the Arab world like Ibn Batuta (1344 A.D.) gave a special place to Sri Lanka in their travel records. Marinonlli, the Papal envoy to China who visited Sri Lanka in the early 14th century, reported that "paradise" itself existed in Sri Lanka, while Marco Polo referred to it as the "best island for its size in the world."

In olden days, Sri Lanka was so well known to western civilization, that Ptolemy—the veteran map maker of the 2nd century A.D. was compelled to depict Sri Lanka as an extraordinarily large equatorial island occupying the area that should have at least partly been occupied by peninsular India. His map was the earliest to show the coastal areas of Sri Lanka in some detail (Fig. 1). For Ptolemy the entire coastline of Sri Lanka consisted of capes, bays (havens) and headlands. It is clear that details of the coastline were obviously better documented, than most topographical information given for the interior parts of the country. Several centuries later when Robert Knox visited Sri Lanka in the 17th century more information on the coastline was available to the navigators. (Fig. 2) it is interesting to note how Knox's map depicts Kalpitiya peninsula as a separate island on the west coast. Some of the coastal features, particularly lagoons, are also not properly represented in Knox's map. In spite of these minor deficiencies Knox's map reflects the remarkable knowledge of the coastline possessed by the Dutch in the 17th century. The vestiges of Dutch rule in Sri Lanka are still seen in the physical structures preserved at numerous points along the coastline.

The political and commercial interest shown in Sri Lanka by the leading maritime nations of the West since the beginning of the sixteenth century resulted in the mapping of its coastal areas in greater detail and with greater accuracy than for many other tropical islands. The British Admiralty Charts and old topographic maps provide information useful even today on off-shore phenomena as well as on coastal features.

1.2 Environmental Setting

Physiographically, Sri Lanka is an extension of peninsular India, from which it is separated by a shallow sea. It is thought that the separation took place during the Miocene times when a belt of the Miocene sea covered the South-eastern part of South India. However, the drifting appears to have begun much earlier in the Mesozoic era (Gondwana period) when according to Wagner's theory Sri Lanka drifted in an anticlockwise direction creating an upturned "V" shaped isobath pattern in the Gulf of Mannar (Kularatnam, 1954). Even today, the southern tip of India and Sri Lanka stand upon the same continental shelf. The shelf around Sri Lanka ends abruptly

in the South and East, but broadens towards the North and Northwest forming the Pedro Bank and the Mannar Pearl Banks respectively. It has an average width of about 20 km around the Island. The Palk Strait is barely 15 fathoms deep while elsewhere the mean depth of water is only about 36 fathoms beyond the continental shelf the sub-marine elevations drop abruptly to 500 fathoms within 3 km and 1000 fathoms within about 15 km. Beyond this there is a steep descent of over 3000 fathoms bringing it to the general bottom level of the Indian Ocean.

As a result of the Miocene marine transgression in the Northern and Northwestern parts of the Island, a sedimentary limestone cover was formed. This extends to the sea in many places. However the rest of the coastline has a crystalline rock base which is a complex of granites, gneisses and other Precambrian rocks. Where the coastline goes across the strike of the rocks the occurrence of bays increases as in the Northeastern parts of the coast. The crystalline rocks are capped by lateritic formations in many parts of the wet zone coastal areas. Laterites have been discovered even below sea level in some localities. Coral reefs and sandstones are two of the most important near-shore formations found around the Island. Coral reefs are particularly noticeable along the southern part of the coastline from Puttalam to Batticaloa. Sandstones are prominent in places such as Minihagalkanda in the Southeast and Mullaitivu on the Northeastern coast.

Except during the Miocene period, Sri Lanka has not experienced any major changes of sea level leading to significant changes in its coastal configuration. The evolution of the Jaffna peninsula is related to the recession of the Miocene sea (Puvanarajan, 1968). Large tracts of the present coasts of Sri Lanka are the outcome of minor Quaternary sea level changes. Evidence of such sea level fluctuations are found both on the continental shelf and on the coastal zone. Among others, Deraniyagala (1958) studied sea level changes in the Northwestern coastal areas. Receded cliffs have been recorded by Swan (1964) for the Southwestern coastal zone, while Cooray (1956) refers to raised beaches on the Kollupitiya-Mount Lavinia Coast. Cooray has also made an aerial study of the evolution of the Northwestern coastal belt (Cooray, 1968). Apart from such geomorphological evidence, the historical records also provide information on short period sea-level changes. The Mahawamsa for example refers to the disappearance of an island with the name 'Giri', and to the sea encroaching upon the land in the Kelaniya area. During the more recent periods of history, changes in the coastline due to coastal erosion have also taken place in many areas. Sinigama Devale near Hikkaduwa, which was accessible by land about 50 years ago, is now completely cut off from the mainland. Similarly Deraniyagala (1958) refers to a large building near Arippu (Doric's Bungalow) which was built in the 19th century at a distance of about 200 yards inland from the cliff edge, but has now fallen off the receding cliff. These changes caused by erosion are particularly noticeable on the South and Southwestern coasts.

The climate along the coastline varies considerably, from the wet humid tropical type of the Southwestern coast to the semi-arid type in the Northwestern and Southeastern parts of the Island. In general, the climates of the coasts of Sri Lanka are affected by the insularity of the landmass, its proximity to the equator and the Indian monsoons. The Southwest monsoon prevails from Mid-May to September and the Northeast monsoon from October to February. Although associated with rainfall, the term monsoon basically means a wind. It is this aspect of the monsoon that affects most coastal processes as well as human activities in the coastal zone. It is in the seasonally moisture deficient drier areas, that beach sands become sufficiently dry to be transported and re-deposited in dunes. Just as the agricultural cycle is adjusted to the monsoons creating *Maha* and *Yala* seasons, the fishing industry is also adjusted to monsoons as reflected by the fishing season (*Walala*) and the off season (*Warakan*). It also leads to the migration of fishermen from the West coast to the East coast and vice-versa. Similarly, even tourist activities nowadays shift between the West coast and the East coast in harmony with the monsoons.

1.3. Coastal Processes

The dominant processes that operate on the coastline of Sri Lanka are often determined by or related to the monsoons. When the winds are on-shore the seas become rough and when they are off-shore calm conditions tend to prevail. Calm conditions can also be expected during the inter-monsoonal periods.



KNOX'S MAP OF CEYLON (1681 AC)

Figure 2

The swell that originates in the Bay of Bengal or in the Arabian Sea is experienced more or less throughout the year. However, as Table I.I indicates, it approaches the Island mainly from a Southerly direction. The heavier swell strikes the coastline obliquely, and promotes long-shore transport of beach materials despite the refraction it undergoes in shallow water (Swan, 1979). In the Coastal Zone sheltered from the waves of the open sea and in the islands and peninsulas in the Northwest calm conditions prevail throughout the year. Thus it is a zone where aggradation is dominant. In other parts of the Coastal Zone beaches exposed to the monsoons undergo seasonal depletion and accretion depending on whether the monsoon is off-shore or on-shore.

In the Indian Ocean currents also reverse their direction with the change of the monsoons. Thus there is a tendency for the water to move from Southwest to the North east during the period from March to September and in the opposite direction from September to March. However, shallow seas in the Gulf of Mannar and the Pedro Bank break this continuity of circulation by deflecting the currents.

Since Sri Lanka is in a micro-tidal environment the Island is almost unaffected by tides. Around the coast of Sri Lanka the rise and the fall of the tide is hardly perceptible. The highest tides hardly exceed one metre above mean sea level. There is little change in the level of water at the mouths of most Sri Lankan rivers. As a result they are often blocked by sand bars or banks

Table I.I.
Seas and Swell of Sri Lanka

Direction of Approach	J	F	M	A	M	J	J	A	S	O	N	D
Dominant Direction												
Sea	NE	NE	NW	W	W	W	W	W	W	W	W	NE
Swell	NE	NE	S	W	SW	W	W	W	W	W	S	NE
Next dominant direction	N	N	NE	NW	SW	SW	SW	SW	SW	SW	NE	N
	N	N	NE	S	W	SW	SW	SW	SW	SW	SW	N
Next dominant direction	NW	NW	N	SW	NW	NW	NW	NW	NW	NW	N	NW
	SW	S	NW	SW	NW	S	NW	NW	NW	S	W	S
Next dominant direction			WSW									
	S	SW	SW	NW	S	S	S	S	S	NW	NW	SW
											NE	SW

Source: Atlas of Sea & Swell Charts, Indian Ocean, U.S. Navy, extracted from Swan, 1979

of mud. This has led to the formation of large shallow, coastal lagoons around the Island. In fact low-tidal conditions of Sri Lankan river mouths stand in contrast to many West European river mouths or to those of the Ganges where the tides rise over 5 metres. Although, in Sri Lanka the highest tides hardly rise over one metre, a combination of high tide and swell can cause severe erosion along some segments of the coast.

Sand and other materials from which beaches are formed are supplied mostly by the rivers. There are some 103 rivers with distinct basins in the Island which discharge into the sea carrying with them sediment in suspended form or as bedload. These sediments are carried back and forth and are re-worked by the waves or moved along the coastline by coastal currents and long-shore drifting. These processes lead to the formation of aggradational features such as sand-spits and tombolos. They also occasionally block the river mouths and contribute to the formation of lagoons and bays. The material eroded from the coastline forms another source of beach material. Thus the Southwestern coast particularly between Galle and Matara, is poorly supplied with sandy beaches because it represents tracts from which sand is transported to other areas by the long-shore drift.

1.4. Coastal Types

The coastal processes activated by the monsoons are affected by a host of other physical and biological factors. Geomorphologically, the aspect or orientation of the coastline is one of the most significant factors that determines the nature of the coastline in Sri Lanka. Thus the south-western and southern parts of the coastline directly facing the southwest monsoon receive the full brunt of the high monsoonal winds and the swell caused by it, unlike the north western

coastal areas that are sheltered from their effects. The type of rocks found along the coast line may enhance the rate of solution and erosion by the waves as in the Miocene areas or impede it because of the resistive properties of certain rock types such as charnockites, gneisses and granites. The coastal vegetation plays an important role in the formation and stabilisation of coastal sand accumulations. The dryness of the climate combined with strong winds leads to the formation of sand dunes in many parts of Sri Lanka—a rare phenomenon in the low energy coastal environment of the equatorial regions. The different combinations of these coastal processes produce different coastal types around the Island.

A common belief is that the southern half of Sri Lanka has submergent coasts and the northern half emergent coasts, caused by the tilting of the island with the fault running East-West between Colombo and Pottuvil and with the down-tilt in the South. As Swan (1965) has pointed out, this is an attractive but an unwarranted explanation of misunderstood facts. There is evidence to suggest that as far as the coastline is concerned, Sri Lanka has been tectonically stable during the recent periods of geological history. It is difficult to assume that processes of isostatic recovery after the Pleistocene which were common in most North European countries were operative on a similar magnitude in Sri Lanka. The oscillations of sea level in Sri Lanka have been of a minor nature. Both positive as well as negative changes are evident in South-western as well as in North-eastern coastlines. Therefore, a simple classification of coastal types as 'emergent' and 'submergent' will not hold in the Sri Lankan context.

In general, the entire coastal plain of Sri Lanka can be considered as a plain of submergence. It is true that there is evidence of emergence in the form of raised beaches, wave-cut terraces and elevated coral reefs here and there around the coast. However, owing to the slight rise of sea level observed since the middle of the 19th century, the dominant characteristics are those of submergence. The presence of broad flat alluvial plains virtually at sea level behind partly silted up lagoons shut off from the sea by low sand bars and spits, is indicative of this sequence of events.

Considering the morphological variations, the coastal plain of Sri Lanka can be divided into four regions (Cooray, 1967).

- | | |
|------------------------------------|----------------------------------|
| (i) The Mannar Coastal Plain | (iii) The Pottuvil Coastal Plain |
| (ii) The Trincomalee Coastal Plain | (iv) The Bentota Coastal Plain |

On the basis of erosional stability, Swan (1965) has recognized nine types of beaches in the southwestern Coastal Zone of Sri Lanka between Colombo and Tangalla. This classification is found to be useful in studying the problem of coastal erosion in the areas concerned, although it may not be applicable to beaches of all types found in the Island.

1.5 Coastal Erosion

Coastal erosion is the most widely discussed problem relating to the Coastal Zone of Sri Lanka. This is because the worst affected part of the coastline happens to be the most densely populated part of the country. Thus the Southwestern Coastal Zone dominates the thinking on coastal planning in Sri Lanka.

Coastal erosion is defined as a condition where the beach is unable to withstand the energy of nearshore currents, waves and breakers. Considerable extents of land are eroded in the process of dissipation of such energy. Under natural conditions a coastline tends to reach a balance between its erosive and depositional forces, thereby attaining a certain steady state over a period of years. However, eustatic or isostatic changes may cause a rise in the level leading to a greater loss of coastal land. Such situations are normally rare and take long periods of time to regain their balance once they occur. What often happens is that man encroaches on nature's domains and subjects himself to heavy penalties. In the context of coastal phenomena there is a certain belt along the coast line with an ecosystem developed in harmony with nature. When man encroaches on these lands and disturbs these ecosystems for his housing, cultivation or recreational purposes then it becomes necessary to guard against the forces of nature. Thus unplanned and uncoordinated human activities without a proper understanding of the ways of nature often lead to unexpected problems.

Coastal erosion is also accelerated by the capricious activities of man himself. These include mining of sand from rivers and beaches, the breaking and mining of Coral reefs and the

removal of coastal vegetation. An example is the Kelani river from which an estimated 400,000 cubic metres of sand are removed, annually when the total bedload of the river is around 600,000 cubic metres (Economic Review, 1980). Similarly, coral mining is extensively practised in the Southwestern Coastal Zone resulting in accelerated coastal erosion.

Preventive measures introduced without scientific planning may also lead to coastal erosion. Coastal structures introduced as adhoc engineering devices can have negative effects in the long run. Thus in certain situations, piling of boulders to combat erosion can provide additional tools for the waves to attack coastal lands with increased vigour. Modern coastal engineering offers a variety of solutions to erosion problems such as construction of groynes, revetments and artificial beach nourishment.

1.6. Conservation and Management

Since Sri Lanka's coastal waters have been used by colonial naval powers over a long period of time, there is a wide variety of coastal structures that have been left behind by them. The Portuguese and Dutch forts, jetties and canals still bear testimony to the intense activity along the coastal zone in colonial times. The relatively higher population pressure on the south-western coastal lowlands has also led to the launching of coastal protection programmes in these areas particularly during the last century. The current wave of tourist activity in the Coastal Zone has added a new dimension to the country's coast conservation problems. For purposes of tourism massive structures are now being built for hotels on the water-front preventing public access to the beaches. These hotels often increase coastal pollution through waste disposal.

The current interest in coastal problems can be traced back to the 1940s when efforts were made to construct adhoc protective structures in places where the impact of erosion was most severely felt. During this period several Government agencies such as the Departments of Public Works, Railways, and Irrigation, introduced coast protection measures to suit the individual requirements of these agencies.

Since National Independence in 1948 development activities related to fisheries, commerce and agriculture led to the construction of more and more maritime structures such as breakwaters, quays, and fishery harbours which have often been introduced without adequate investigations and research studies. This has nearly always had the effect of aggravating the existing problems inevitable can't be reconciled.

The first attempt to coordinate coastal management activities was made when the subject of coastal protection was transferred to the Colombo Port Commission in 1964. Since 1960 successive Governments have invited foreign consultants to study and report on the coastal conservation problems. These included studies by Zeaper (1960) of the Netherlands, Eaton (1961) of the U.S.A. and more recently by the UNDP. With the expansion of the tourist industry a stage has now been reached where it is necessary to bring all coastal areas within a sound plan of development. If this is not done a chaotic situation will inevitably result in many parts of the Coastal Zone in the near future.

Recognizing this need the Government initiated the present programme of coast conservation in January 1978 with the transfer of coast conservation functions from the Colombo Port Commission to the Ministry of Fisheries. The Coast Conservation Act was passed in Parliament in June 1981, with the aim of laying the foundation for the rational development and management of coastal resources.

Any plan of development to be successful requires an understanding of the existing state of the Coastal Zone. The study that led to this report was an attempt to fulfil this need in a modest way. The present report thus forms only another contribution to the commendable efforts now being made by the Coast Conservation Department, to conserve for future generations the beauty, usefulness and stability of the Coastal Zone of Sri Lanka.

CHAPTER II

OBJECTIVES AND SCOPE OF THE SURVEY

2.1. Objectives

The Coast Conservation Act of 1981 provides for surveys of the Coastal Zone aimed at inventorising coastal structures, coral reefs, mineral deposits, recreational areas, sand and coral mining areas, and areas faced with coastal erosion hazards, and at conducting a census of all workers currently engaged in activities related to the Coastal Zone. The present survey was designed as a reconnaissance study of the nature and location of coastal structures, landuse patterns and landforms in the entire Coastal Zone (See Fig. 3).

The specific objective of the inventory of coastal structures was to observe and map the natural and man-made coastal structures through field observations. These structures included the following:

- i. Revetments and Boulder walls.
- ii. Groynes.
- iii. Breakwaters.
- iv. Piers and Jetties.
- v. Sewage outfalls.
- vi. Headlands and other natural features.
- vii. Reefs and rock outcrops.
- viii. Hotels, houses and other buildings.

In the case of artificial structures, the location, dimensions, age, functional condition and the area served by them were among the features that were observed. Regarding natural structures, their location, natural history, morphology and a general understanding of their characteristic features were to be obtained.

The second major aspect of the project dealing with landuse and landforms in the coastal zone was undertaken with the following objectives.

- (i) Designing out a classification for the mapping of landuse in the Coastal Zone.
- (ii) Preparing an inventory of landuse in the coastal zone mapped at the scale of 1: 6500 using air photographs with ground follow up.
- (iii) Describing the existing land uses in an area specific manner.
- (iv) Preparing an inventory of the major geomorphological features in the Coastal Zone.
- (v) Describing the major landforms found within the Coastal Zone.

Since the entire coastline of the country was covered on foot by survey investigators, several other observations not directly related to the two major objectives referred to above were also made wherever possible. These included observations on the following:

- (i) Beach material (particularly beach sands).
- (ii) Dominant vegetation types, and
- (iii) Dominant human activities.

Accordingly, a reconnaissance study of the coastal zone of Sri Lanka remained the underlying objective of the entire survey. The survey was not intended to be an engineering study or a land survey where surveying instruments had to be used. In the field studies undertaken, the basic tools used were the available air-photographs and topographic maps. The main strategy was to scan the entire coastline and observe and inventorise all items of significance found falling within the Coastal Zone.

2.2 Scope of the Survey

The Coast Conservation Act defines the Coastal Zone as the area lying within a limit of three hundred metres landwards of the Mean High Water Line and a limit of two kilometres of the Mean Low Water Line. The survey was designed to study the features in the landward coastal zone of 300 metres from the Mean High Water Line. Nevertheless, the reefs, rock outcrops and structures, which could be examined from the beach were studied and recorded wherever possible.

Although the entire Coastal Zone of Sri Lanka including that of the main islands came within the purview of the survey, the smaller islands off the North-western Coast had to be mapped from air photographs. No field investigations were undertaken. Thus, while all the larger islands such as Talai Mannar, Kayts, Punkudutivu, Nainativu and Delft were surveyed in the field, small islands such as Sinnativu, Iranativu and Palativu were mapped from airphotographs. Similarly, while bays were included in the field survey, lagoons were left out except those of Jaffna, Mannar and Puttalam which are open to the sea throughout the year. Here also the inner part of Jaffna lagoon to the east of Elephant Pass was mapped mainly from airphotographs. The lagoons which are not often open to the sea with their unique ecosystems deserve a separate study organized on a different footing.

Certain parts of the coastline with poor accessibility such as those falling within the Yala National Park had to be mapped by approaching the coastline in boats. The coastal zone falling within the Wilpattu National Park was covered on foot. It was approached from its southern and northern boundaries. The salt marshes and estuaries with silty beaches where access was difficult were mapped by observing them from a distance with the help of airphotographs.

Although the entire Coastal Zone of the Island as defined in the Act was encompassed by the survey, particular attention was paid to the water-front. The landuse in the rest of the coastal zone was mapped out on the basis of a classification especially developed for the purpose.

The total length of the Coastal Zone covered by the field survey was:

(i) Coastline Open to the Sea (including bays)	1639 km
(ii) Coastline of the islands*	281 km
Total	1920 km

*Excluding the coastline of the islands mapped from air photographs)

Apart from the quantitative observations made on coastal features and artificial structures, a large number of coastal residents were interviewed in order to obtain qualitative information on the history of the coastline close to their homes or fishing camps. The sample was of course purposely selected and was largely determined by the availability of respondents. In addition, information on hotels and Government buildings was obtained from officials of concerned institutions.

An attempt was made to perfect a questionnaire for each kilometre covered by the field survey; a total of 1920 questionnaires were completed in this manner. In addition to recording information in the field, samples of beach material were inspected at the margin of creeping vegetation for texture and colour.

The Coastal Zone covered by the survey is depicted in 41 one-inch topographical maps (Table 2.1).

Table 2.1:
One Inch Maps Covering the Coastal Zone

<i>Name of Map</i>	<i>Dates of Revision, Edition and Printing</i>
1. Colombo	Printed 1973, printed 1973.
2. Negombo	2nd Revision 1946, Fourth Edition 1948.
3. Chilaw	3rd Revision 1946, Fourth Edition 1950.
4. Battulu Oya	2nd Revision 1943, Third Edition 1947
5. Puttalam	Revision 1965, Printed 1972.
6. Kalpitiya	2nd Revision 1943, Third Edition 1947.
7. Kudiremalai	Revised 1938, Reprinted 1980.
8. Marichchukkadai	Revised 1938, Reprinted 1958.
9. Murunkan	Revised 1972, Printed 1972.
10. Mantai	Revised 1972, Printed 1981.

<i>Name of Map</i>	<i>Dates of Revision, Edition and Printing</i>
11. Talaimannar	Revised 1971, Reprinted 1980.
12. Tunukkai	Latest Revision 1938, Fourth Edition 1950.
13. Pooneryn	Revised 1937, Partly Revised 1971, Reprinted 1972.
14. Delft	Revised 1961, Printed 1968.
15. Kayts	Latest Revision 1938, Printed 1939.
16. Jaffna	Revised 1959, Reprinted 1980.
17. Point Pedro	Revised 1959, Reprinted 1971.
18. Elephant Pass	Revised 1938, Reprinted 1971.
19. Iranamadu	Revised 1972, Reprinted 1974.
20. Mullaitivu	Revised 1936, Reprinted 1969.
21. Kokkilai	Revised 1972, Reprinted 1980.
22. Padawiya	Revised 1972, Printed 1973.
23. Nilaveli	Revised 1943, Reprinted 1960.
24. Trincomalee	Revised 1952, Reprinted 1967.
25. Kathiraveli	Revised 1951, Reprinted 1971.
26. Vakaneri	Revised 1962, Printed 1969.
27. Kalkudah	Revised 1967, Printed 1970.
28. Batticaloa	Revised 1939, Reprinted 1971.
29. Kalimunai	Revised (Partly) 1968, Printed 1971.
30. Tirrukkovil	Revised (Partly) 1968, Printed 1970.
31. Pottuvil	Revised 1965, Printed 1968.
32. Panama	Revised 1965, Printed 1969.
33. Yala	Revised 1936, Reprinted 1971.
34. Kataragama	Revised 1965, Printed 1968.
35. Hambantota	Revision 1935, Third Edition 1945.
36. Ambalantota	Revised 1955, Reprinted 1967.
37. Matara	Revised 1972, Printed 1967, 1974.
38. Galle	Revised 1943, Reprinted 1967.
39. Ambalangoda	Partly Revised 1971, Reprinted 1972.
40. Alutgama	Revised 1974, Printed 1980.
41. Panadura & Horana	Revised 1972, Printed 1979.

CHAPTER III

SURVEY METHODOLOGY

In view of the extensive area to be covered by the survey and the large number of investigators needed, and in order to minimise any operator variation, certain methodological procedures had to be adopted for the survey from its very outset. The methodology of an inquiry of this nature also determines to a considerable extent the degree of reliability that can be placed on the inferences drawn from it. Therefore, the procedures outlined below are not necessarily standard ones but have been developed to suit the special requirements of the Survey and the constraints of available time and resources.

3.1. Cordination of Investigations

As noted earlier, there were two major objectives of the survey, namely, to prepare an inventory of coastal structures and to map the contemporary landuse pattern in the Coastal Zone. It was planned from the very outset to coordinate investigations related to both these objectives so as to avoid duplication of field effort. These two aspects of the Coastal Zone are also interrelated to a considerable extent, despite the fact that some of the structures have only historical significance today. Information on both structures and landuse were recorded on the same data recording schedules and the same investigators were used to observe both aspects. The mapping of geomorphological information was also done in a similar way.

3.2 Operational Definitions

As indicated in the outline of the scope of the survey, almost all the field observations were confined to the land area of the Coastal Zone as defined by the Coast Conservation Act No. 57 of 1981, i.e. the area lying within a limit of 300 metres from the Mean High Water Line (MHL). It was found that precise identification of the MHL on the ground is not easy during field investigations. Therefore the seaward limit of natural vegetation, particularly that of creeping vegetation, was taken to represent the MHL. Almost ubiquitous natural vegetation types such as *Maha ravana ravula* (*Spinifex littoreus*) and *Bimilamburu* (*Ipomea pescaprae*) helped to a great extent in defining this limit.

Since hardly any surveying instruments were used in the field survey, the 300 metres landward distance from the High Water Mark was estimated by pacing. It was found that, owing to the location of buildings, parapet walls and fences, and similar obstructions, it would take a long time to precisely demarcate the Coastal Zone on the ground in many places even with surveying instruments. Although measuring tapes were used occasionally to measure the dimensions of certain structures where feasible, most field measurements were only visual approximations.

3.3 Organization of Field Work

In order to facilitate the organization and supervision of field investigations, the coastline of the whole Island was divided into 8 zones. (Table 3.1 and Fig. 3).

Table 3.1

Zone	Extent	Length in km.	Number of Investigators assigned
Zone I	Colombo-Puttalam	286	4
Zone II	Puttalam-Elephant Pass (including Talaimannar)	380	4
Zone III	Elephant Pass-Chempiyanpattu	181	6
Zone IV	Islands off Jaffna Peninsula	218	
Zone IV	Chempiyanpattu-Foul Point	266	4
Zone V	Foul-Point-Pottuvil	204	6
Zone VI	Pottuvil-Hambantota	127	4

<i>Zone</i>	<i>Extent</i>	<i>Length in km.</i>	<i>Number of Investigators assigned</i>
Zone VII	Hambantota-Galle	123	6
Zone VIII	Galle-Colombo	135	6
	Total	1920	40

Zones II and III included the islands lying off their coasts. Although Talai Mannar is included in Zone II the information relating to the islands off Jaffna Peninsula are presented separately in the Report. Each zone was assigned to a field supervisor of the rank of Assistant Lecturer in a university, and a group of graduate investigators who worked under his supervision. The number of investigators assigned to each zone varied between 4 and 6 depending on the length of the coastline to be covered and the estimated amount of work involved.

All supervisors and investigators went through a training programme immediately prior to the beginning of the field survey. This included a day visit to a selected segment of beach by the Project coordinators and supervisors, and a three day workshop attended by the officers of the Coast Conservation Department, Project coordinators, field supervisors and investigators. During this workshop the investigators who were all graduates with Special degrees in Geography, were given a practical training for the field survey. This included the preparation of base maps, questionnaire schedules, and other necessary materials related to the zones assigned to them.

Every attempt was made to select investigators from the coastal areas and to assign them field stations close to their homes. Thus Mannar Zone (Zone II) was covered by 4 investigators from that area while the Jaffna Zone (Zone III) was covered by 6 investigators from the Jaffna Peninsula. Therefore, most of the investigators were familiar with the coastal environments investigated by them.

All field investigators were issued with specific instructions as to how they should conduct the survey. On the first day of field work, supervisors accompanied their investigators to the respective areas and demonstrated how the field measurements and recording of information should be done. Investigators were instructed to cover the entire length of the coastline assigned to them on foot and directly observe the phenomena they mapped. Each investigator had a fairly accurate estimate of the length of his pacing and carried a field note book to record his observations in addition to mapping the Coastal Zone and filling the questionnaire schedules. The investigators were expected to go to the field in pairs, particularly in the more hazardous stretches of the coastal zone.

The supervision of the work of investigators was carried out in two ways. The supervisors were required to visit their investigators on at least five occasions during the survey and whenever they thought it necessary. The Project coordinators visited each group of investigators as and when necessary during the period of the survey.

3.4. Mapping Procedure

Base maps were prepared at the scale of 1 : 6,500 on tracing paper before the beginning of the field survey. These base maps were made by enlarging the available airphotographs upto the required scale and inserting the locations of a few prominent landmarks on to them. In most maps the enlargement was made mechanically by the Air Photo Reader available at the University of Colombo. Although 1974 air-photographs were available for most areas, investigators had to depend on 1956 photographs for some localities, particularly in the Northern region. Since the mapping was done through direct observation and with the aid of base maps of uniform scale, the age of the air photographs did not significantly affect the mapping procedure.

For all purposes of the field survey, a distance of one kilometre has been considered as the operational unit for mapping and collection of information. Thus the Colombo lighthouse was taken as the 'beginning' or zero point and each kilometre from there was reckoned in a clockwise direction. An investigator was expected to cover one kilometre (or two kilometres for a pair) per day on the average. In this way investigators had adequate time to observe and record

relevant information during their traverses. This also gave them sufficient time to prepare for each day's work in advance. The questionnaire schedules were also designed to record information for each kilometre covered.

3.5. Questionnaire Schedules

In addition to the recording of information on base maps, the field investigators each carried a questionnaire schedule and recorded detailed information on coastal structures and landuse. During the training programme, investigators became familiar with the questionnaire, and how each question should be answered, and how each box should be filled. On the first day of fieldwork, their supervisors also demonstrated how information should be recorded in the questionnaire schedules. The supervisors had to go through each questionnaire completed by the investigators and certify them after proper scrutiny.

The questionnaire schedule which ran into 18 type written pages had blank spaces to be filled after observation and measurement as well as after interviews with coastal residents. The main headings under which information was sought by the questionnaires were as follows:

- (i) Locational Particulars (Map Coordinates, G. S. N. Division, Landuse, etc.).
- (ii) Geographical Description
 - (a) Whether straight coast, sandspits, bay, headland, etc.
 - (b) Rock types.
 - (c) Nature of beach material
 - (d) Dominant vegetation types
 - (e) Dominant human activities
- (iii) History of the Shoreline-whether receding or developing and the approximate rate of recession or development.
- (iv) Man-made Structures-
 - (a) Revetments, Boulder Walls, Groynes, etc.
 - (b) Breakwaters, Piers and Jetties
 - (c) Sewage outfalls
- (v) Natural features-Headlands, Reefs, Rock outcrops, islands, etc.
- (vi) Hotels, Houses and Other Buildings
- (vii) Vegetation types-Sandy shore, Mangrove, Saltmarsh, Forest and Grass, etc.
- (viii) Landuse-Agricultural, Recreational, Commercial, Residential, etc.
- (ix) Water-Front structures-An enumeration of Houses, Boutiques, Hotels, etc.

3.6. Data Processing

The raw data collected during the field survey and information contained in the questionnaires and base maps were analysed with the following aims:

- (a) extraction of statistical information from the data schedules and,
- (b) preparation of a folder of maps covering the entire coastal zone of the Island.

so as to make the symbols and colour schemes meaningful even to a user from outside Sri Lanka.

The final legend, prepared with the above considerations in mind, had over 70 symbols and a number of colour combinations. Depending on the type of information to be portrayed, these symbols and colours had to be used occasionally in an overlapping manner. In order to make the maps more meaningful to the local reader. One-Inch Topographical Map symbols were adopted where possible. Nevertheless, the international code developed by the ITC of the Netherlands was used as a basic guide.

As noted earlier the general scale of the maps was 1:6,500 or approximately 10 inches to a mile, which had also been the scale of base maps. This scale was considered appropriate to depict the information collected in view of the fact that most types of information could be accommodated without making the map over-crowded. At present to the best of our knowledge there have been no other maps of the same scale, or maps containing the same quantum of information on the coastal zone of Sri Lanka.

In the organization of data we were guided by the recent division of the coastal zone into some 46 segments for planning purposes by a "Committee appointed to demarcate tourist

development areas of the coastal belt of Sri Lanka'. For the purposes of processing data we have incorporated these 46 divisions in the 8 zones around which the field survey was organized (See Table 3.2) below.

Table 3.2:
Zones and Segments of the Coast Line

<i>Zone No.</i>	<i>Zone</i>	<i>Segment</i>	<i>Length in km.</i>
I.	Colombo-Puttalam (286 km)	Colombo light house to Kelani river	15
		Kelani river to Negombo Lagoon	27
		Negombo to Mahaoya	9
		Maha Oya to Karukkupona	42
		Karukkupona to Talawila	59
		Talawila to Puttalam	134
II	Puttalam-Elephant Pass (380 km)	Puttalam to Mannar	113
		Talaimannar Island	63
		Vidattaltivu to Mannar	22
		Vidattaltivu to Elephant Pass	182
III	Elephant Pass- Chempiyanpattu (181 km)	Elephant Pass to Jaffna	93
		Jaffna to Point Pedro	72
		Point Pedro to Chempiyanpattu	16
IV	Chempiyanpattu to Foul Point (266 km)	Chempiyanpattu to Mullaitivu	61
		Mullaitivu to Kokilai	36
		Kokilai to Irakkandy Bridge	43
		Irakkandy Bridge to Trincomalee	17
		Trincomalee to Foul Point	109
V	Foul Point-Pottuvil (204 km)	Foul Point to Vakarai	40
		Vakarai to Kaldudah	34
		Kalkudah to Batticaloa	32
		Batticaloa to Pottuvil	98
VI	Pottuvil-Hamban- tota (127 km)	Pottuvil to Heda Oya	7
		Heda Oya to Hambantota	120
VII	Hambantota to Galle (123 km)	Hambantota to Tangalle	41
		Tangalle to Dondra Head	34
		Dondra Head to Matara	5
		Polhena	3
		Polhena to Weligama Bay	8
		Weligama Bay	8
		Weligama Bay to Koggala	12
		Koggala to Unawatuna	7
Unawatuna to Galle	5		
VIII	Galle to Colombo (135 km)	Galle Municipal Limits	14
		Galle to Dodanduwa	9
		Dodanduwa to Hikkaduwa	9
		Hikkaduwa to Ambalangoda	11
		Ambalangoda to Ahungalle	10
		Ahungalle to Kosgoda	5
		Kosgoda to Induruwa Railgate	6
		Induruwa Railgate to Bentota Estuary	7
		Bentota Estuary to Beruwela Light House	4
		Beruwela Light House to Maggona Headland	8

<i>Zone No.</i>	<i>Zone</i>	<i>Segment</i>	<i>Length in km.</i>
VIII	Galle to Colombo (135 km) Contd.	Maggona Headland to Kalutara	7
		Kalutara Lagoon	5
		Kalutara to Thalpitiya Ela	9
		Thalpitiya Ela to Panadura Ganga	5
		Panadura Ganga to Mount Lavinia	17
		Mount Lavinia to Vanderwert Place, Dehiwela	2
		Vanderwert Place to Colombo	7

The tabulation of statistical data was arranged according to the above coastal segments and zones, in the hope that they would prove useful that way for planning purposes.

3.7 The information collected on the base maps was transferred after necessary editing to cartographic maps of the same scale, i.e. 1 : 6,500. Therefore, there was hardly any loss of information in the preparation of the final maps

The most important aspect of map preparation was the development of an appropriate classificatory legend. The legend had to be on one hand comprehensive enough to incorporate almost all the features observed in the coastal zone. On the other hand, it had to be concise enough not to be too unwieldy. Furthermore, the legend had to be prepared in such a way that it could be followed by a local user of the maps without much difficulty. At the same time, it was thought desirable to conform to international conventions in coastal map making

CHAPTER IV

THE WESTERN COASTAL ZONE

4.1 Location

The Coastal Zone stretch between Colombo (Light House) and Puttalam (town limits) defines the Western Coastal Zone for the purposes of the survey. This includes six segments of the coastal zone recognized for coastal development planning. The total length of the Western Coastal Zone surveyed comprises 286 kilometres of coast line including that of the Kalpitiya Peninsula. The main alignment of this coast line is north-south except in a short stretch that falls within the Dutch Bay and Puttalam lagoon. The coast-line runs more or less parallel to the 80°E longitude and extends between 6.55°–8.20°N latitudes (See Figure 3).

4.2 Prominent Features

Immediately to the north of Galle Buck¹ the first major feature encountered in the Western Coastal Zone is the Colombo harbour. The harbour with its long breakwaters, quays and jetties form the biggest man-made complex of coastal structures in the island. To the north of Colombo harbour is the fishery harbour at Modera. The area up to the mouth of the Kelani Ganga is thickly populated with a dense network of roads and buildings. At the mouth of the Kelani Ganga there are some sand bars and islets, the biggest of which is Crow Island. The Kelani Ganga which reaches the sea along a meandering path has an annual discharge of about 4660×10^3 acre feet of water. The removal of river sand which is a common practice here, undoubtedly affects the beach formation processes in the vicinity of the river mouth.

The segment of the coastline from the Kelani estuary to Negombo (Meegamuwa) is basically a straight coastline. There are two major coastal features in this area, namely the Muthurajawela marsh and the Negombo lagoon. The Negombo lagoon is formed by a large sand bar, which runs from Pamunugama to Duwa near the town of Negombo. The Hamilton Canal which begins its north-ward journey from the mouth of the Kelani Ganga, traverses more or less through the entire Western Coastal Zone, only interrupted occasionally by lagoons and estuaries.

The Maha Oya estuary near Kochchikade forms the next important landmark. Two prominent sand bars are found on the two banks of the Maha Oya estuary. From Maha Oya estuary to Chilaw (Halawata) the coastline remains straight without any prominent land marks. The Deduru Oya estuary to the north of Chilaw displays several sand bars and islets somewhat similar to those at the Kelani estuary. The Deduru Oya is often considered to be the geographical boundary between the Wet Zone and the Dry Zone. From Deduru Oya to Udappu is a straight coast line behind which is a zone of continuous canals and Marshlands!

Udappu, is located at the southern end of the Kalpitiya Peninsula which represents the longest sandspit formation in the country. The Kalpitiya sea board has some of the prime fishing areas of the west coast such as Talavila and Kandakuliya. There are several small islands to the north of Kalpitiya such as Erumativu, Periya Arichchal and Ippantivu. Some of these islands are uninhabited and are subject to seasonal changes. The eastern coast of the Peninsula which borders the Puttalam lagoon is more densely inhabited than its western coast, except at the southern end of the lagoon where some salt marshes form a dominant landscape feature. The Negombo-Puttalam canal joins the Puttalam lagoon near Palavi and from Palavi to Puttalam a few salterns and a small area somewhat polluted by waste disposal can be observed.

4.3. Environmental Setting

The climate of the Western Coastal Zone ranges from the wet humid climate near Colombo to the Dry Zone climate of Puttalam. The average annual rainfall of Colombo around 2300 mm gradually decreases northwards towards Puttalam which receives only 1140 mm. Thus the Western Coastal Zone includes all three major climatic regions of the island, namely, the Wet Zone, Intermediate Zone and the Dry Zone. The coast line which mainly faces the west, except

¹ Galle Buck is an anglicisation of the original Sinhala word Galbokka

in the eastern coast of the Puttalam lagoon, receives the full brunt of the south west monsoonal winds and their accompanying swell. However, unlike in the south western coast, here the south westerly winds reach the coast line somewhat obliquely, facilitating conditions of longshore drift from south to north. This aspect of the climate is primarily responsible for the formation of most coastal features particularly those related to sand spits in the northern segment of this zone.

The western coastal zone comprises of two underlying geological formations. From Colombo upto a point north of Chilaw around Sinnapadu, the main geological formation is a complex of Archean gneisses and granites. Here the gneisses of two types are found, Wannai Gneiss to the North of Colombo and Bintenna Gneiss towards Colombo. In most places within the gneiss-granite region, a laterite formation rests on the parent rock, extending to the shore line and occasionally even beyond it. Considerable deposits of peat are found at Muthurajawela to the north of Colombo. To the north of Sinnapadu the second major geological formation, namely that of Miocene limestone could be seen. Small pockets of clay deposits are found in the area around Palavi and Bangadeniya. One of the geological formations important to coast conservation is the beach rock, which can be observed in many places along this coast line (Cooray, 1968).

The five-fathom submarine contour is located within five kilometres of the coast line, and runs along almost the entire Western Coastal Zone. However, the 10 fathom submarine contour is located at a distance of 10–15 kilometres away from the shore line except along the west coast of Kalpitiya Peninsula. Thus there is a relatively wide belt of shallow sea with depths ranging from 5 to 10 fathoms in most places of the western sea-board. This contrasts somewhat with the southern and south-western coastal areas where the ten-fathom submarine contour almost hugs the coastline. The prominent crenulation of the ten-fathom contour near the mouth of the Deduru Oya is of some geomorphological significance since it could be an indication of the extension of the estuary further into the sea during an earlier age.

4.4. Results of the Field Survey

A summary of geomorphological information collected during the field survey is presented in Appendix Table 1. It should be noted that the data presented in this Table are based on ground observations made by field investigators at distances of one kilometre. In some instances it was possible to observe and record more than one geomorphological feature even within a distance of one kilometre. The information recorded for each kilometre in the field is grouped into the 6 segments referred to earlier and for the Western Coastal Zone as a whole. Thus Appendix Table 1 shows three major sets of geomorphological information pertaining to the Western Coastal Zone, namely, geomorphological description, nature of beach material and the history of the shoreline. The first set of data indicates that nearly two thirds of the coast line is straight and sandspits and lagoons are the most dominant features. Off-shore reefs are observed in nearly one third of the coastline. Sea cliffs are almost totally absent and rock outcrops are hard to come by. As can be seen, offshore reefs and sandspits become more preponderant towards the northern parts of the zone. The reefs while providing some protection to the shoreline, pose obstacles to small fishing vessels. In some places, gaps have been made on the reefs by fishermen to take their boats across. In contrast to the South Western Zone headlands are rare, except in a small stretch to the north of Talawila in the Kalpitiya peninsula. A wrecked ship lying at Palliyawatta is observed to be creating the effect of a headland in a coastline which is otherwise straight.

The field observation on beach materials indicate that boulders, cobbles and pebbles which are characteristic of cliffed coastlines are rare in the Western Coastal Zone. Nearly 90 per cent of the coastline has sandy beaches while short stretches of silty beaches are observed near river mouths and lagoonal areas. Brownish sands which cover (account for) nearly 20 per cent of the area investigated are seen more in the northern areas and in the Puttalam lagoon. Black sands which are particularly dominant in the Maha Oya–Karukkupona stretch and the Kelani-Negombo stretch deserves special mention these black sands are particularly noticeable on the beach at Kammala, a village to north of the Maha Oya estuary.

Some information on the history of the shoreline was obtained wherever possible from the residents of the coastal zone. Such information is based on personal experiences of the res-

pondents during their life time. The interviews were mainly centred around the question as to whether the coastline has receded or developed and the approximate distances if it was possible to recall. Appendix Table 1 gives the responses received for the 20-30 years period for which there was a reasonable amount of information available. This indicated that in the 92 kilometres covered (32% of the total length of coast) the coastline has receded at an average rate of 2–3 metres per annum during the last 20–30 years. On the other hand the shore line is reported to have been developing along 59 km (20% of the total). The average annual rate of development is computed to be less than one metre. Furthermore, while the recedence of the coastline was observed in all the six segments of the zone, its development was reported only from three of them.

The dominant natural vegetation types in the coastal zone were also observed and recorded during the field survey. This was based on a classification of vegetation into the following categories.

1. Sandy shore vegetation
 - (a) on flat beaches
 - (b) on sand dunes
2. Mangrove vegetation
3. Salt marsh
4. Forest, and
5. Grass

The results of the survey of the vegetation types (Appendix Table 2) show that the most dominant type in the coastal zone is sandy shore vegetation in which the low creeping type was the most common. This included species such as Bimtamburu (*Ipomea pescaprae*) and Maha Rawana Ravula (*Spinifex littoreus*). Mangrove and dune vegetation came second and third in terms of abundance. Much of the mangrove vegetation was mature with species such as Kadol (*Avicennia*) and Wetake (*Pandanus tectorius*). The dune vegetation was confined to the coastal zone north of Karukkupona. Salt marsh vegetation with dominant species such as 'lunugas' was confined to the lagoonal areas to the Kalpitiya Peninsula. Forests were seen only in a few locations of the same area. Similarly grass, shrubs and littoral woodlands were also mostly observed in the northern part of this coastal zone.

A study of the dominant human activities of the western coastal zone indicates that this zone possesses some prime fishing areas in the country (see Table 4.1). Beaching boats and lagoonal fishing particularly in the Dutch Bay are the most common types of fishing in this zone. Madel fishing was observed along 72 kilometres (25% of the total length) and dry fish wadiyas (clusters of huts) were found along 63 kilometres. These latter two types of fishing activities are mostly concentrated in the area around the Kalpitiya Peninsula. Among the other human activities, tourism had become important in the recent past in the coastal zone immediately to the north of Negombo. Along the coast line between Colombo Light House and Kelani River, activities connected with the Colombo harbour dominates, with some fishing activities in the Modera area.

4.5 Problems and Areas of Concern

As indicated in the Previous section, the Western Coastal zone is more a zone of erosion than an area of deposition. Most stretches of this zone are protected by barrier reefs. Due to the orientation of the coastline and the relatively low density of population particularly in the north, the problem of coastal erosion is not as acute as in certain other areas. However, serious problems of coastal erosion exist locally within the zone, as can be seen in places such as Kandakuli and Talawila along the western coastline of Kalpitiya Peninsula. At Kandakuli fishermen have placed a large number of sand bags to protect their hamlets. At Talawila an old cemetery and several domestic wells could be seen beyond the waterfront, indicating the loss of land through erosion in the recent past. Severe erosion can also be seen in the Iranawila-Toduwawa stretch of coast. It is claimed by local residents that erosion here had been accelerated by the construction of a fishery harbour. Some villagers complained that about 30 metres of land had been lost in about 10 years and that some of them lost even their houses. Similarly, the Kochchikade-Palangaturai area also faces a serious threat of erosion. There are about 20 revetments within a distance of about 6 km in this stretch, constructed mainly by the tourist hotels.

Table 4.1
Dominant Human Activities in the Coastal Zone from Colombo to Puttalam

Segment of the coast line	Length of coast line (Km.)	Number of kilometres at which specified activities were observed													
		Fishing						Other activities							
		Beaching boats	Off shore	Ma-del	Lagoon	Prawn & crab	Dry fish wad's	Coral mining	Sand mining	Tourism	Coconut based industry	Salt industry	Others		
Colombo Light House to Kelani River	15	03	01												10
Kelani River to Negombo Lagoon	27	16		02	01	13	02			03	03				
Negombo Lagoon to Maha Oya	09	08		01	01	01	01			08					
Maha Oya to Karukkupona	42	40	06	08		03	02		02						
Krukkupona to Talawila	59	33	04	34			31			02					
Talawila to Puttalam	134	89	03	27	103	03	27	05		02	01	02			
Total	286	189	14	72	105	20	63	05	01	17	07	02			10
% of kilometres at which specified activities were observed (for each group)		69.85	4.87	25.08	36.56	6.96	21.95	1.74	0.34	5.92	2.43	0.67			3.48
% of total mentions (for each group)		40.82	3.02	15.55	22.68	4.32	13.61	11.90	2.38	40.47	16.66	4.76			23.80

Apart from erosion, the blocking of estuaries by sandbars poses another problem to coastal residents. Although some estuaries such as that of the Kelani Ganga and the Maha Oya are directly connected with the sea, smaller estuaries which are connected to the Hamilton Canal tend to get blocked seasonally. Thus, in times of heavy rains, the villages have to clear these blocks in order to avoid flooding. The problem can occur even in larger estuaries as those of the Deduru Oya.

Coral mining which has reached serious proportions in the South Western Zone is still not so common in the Western Coastal Zone. However, it is observed that it is practised in certain parts of the Kalpitiya Peninsula. Similarly, at present sand mining is practised on a wide scale in the area upstream of the Kelani Ganga estuary. Pollution caused by sewage outfalls and waste disposal is seen mainly near larger towns. This problem is particularly evident around Puttalam, Kalpitiya, and in the coastal zone between Negombo and Chilaw. The processing of larger varieties of fish and turtle on the beach as observed at Kandakuliya also leads to pollution of beaches, particularly where scavenging animals like pigs are absent. The hunting of turtles although discouraged by law was observed to be going on unabated in places like Kandakuliya.

CHAPTER V

THE NORTHWESTERN COASTAL ZONE

5.1 Location

The North Western Coastal Zone is defined as that segment of the coast which extends from Puttalam to Elephant Pass (Alimankada). It also includes Talaimannar and other smaller Islands that are located in the North western seas. The North western coastal zone, extends between latitudes 8°.20' N and 9°.35'N and longitudes 79°50' E and 80.20' E, and forms the longest stretch of coastline covered by the survey. Although the field surveys were limited only to the mainland and Talaimannar island, the smaller islands off the coast were mapped from available airphotographs. The total length of the mainland segment of this zone was found to be 380 km while Talaimannar island had 63 km of coast. Except in the Jaffna lagoon area and Talaimannar island the coastline generally faces a northwesterly direction.

5.2 Prominent Features

The North western Coastal Zone begins from the township of Puttalam which had been famous for salt and dry fish since olden days. The coast line to the north of Puttalam passes through the delta of Mi Oya which discharges into the Puttalam lagoon, where the calm waters favour the development of deltaic conditions. The Mi-Oya delta in fact forms one of the most well preserved natural deltas in the Island. The next major coastal feature before the Kala Oya estuary is the Karaitivu lagoon which can be described as 'lagoon within a lagoon', Karaitivu forms the last major settlement in this part of the coast (line) until one reaches the fishing settlements near Mannar. Apart from the salt pans, some peculiar forms of fibrous and globular aquatic vegetation can be seen afloat near the beaches of the Karaitivu lagoon.

The Kala Oya which discharges into the Dutch Bay at a point about 10 km to north of Karaitivu forms another delta similar to that of the Mi Oya. Here the river mouths are larger and are covered by extensive mangrove swamps. The volume of discharge from the Kala Oya increased after the diversion of Mahaweli waters into the Kala Oya basin in 1976. This increase of fresh water at the river mouth is likely to affect the estuarine fauna and flora.

The coastline from Kala Oya to Silavatturai remains uninhabited except for a few fishing camps at places such as Karuwalakuda, Kollankanatta and Pallangaturai. A part of the coastal zone here falls within the Wilpattu National Park. A coast line formed of low cliffs forms the main coastal feature in this area. Some ruins of an ancient harbour can be seen between Kollankanatta and Pallangaturai. A few off-shore islands parallel to the coastline such as Aligahakele and Karaitivu can be observed from the coast. The Kudiramalai point and the mouths of the Moderagam Aru and the Kala Kal Aru are the only prominent coastal features until one reaches the mouth of the Malvatu Oya. The Malvatu Oya (Aruvi Aru) also forms a small delta to the north of Arippu with several islets and off-shore bars. The area around the right bank of the Malvatu Oya estuary is historically important since it is believed that King Vijaya and his retinue landed there in the 5th century B.C. The brownish colour of the soil here is supposed to have given the name Tambapanni (Taprobane) to the island. It is however, doubtful in the light of coastal erosion, whether the original historical site is still preserved as part of the land.

To the north of Malvatu Oya a series of lagoons such as the Periya Kalapuwa and Vidattaltivu lagoon form the dominant features of the coastal plain. Talaimannar island which extends to Adam's Bridge forms the largest island on the northwest coast. Talaimannar island together with the town of Mannar and smaller settlements such as Erukkulanpidy and Pesalai, form the densely settled island in this area. It is a railway terminal. Recent oil explorations have made it well known. Wild ponies and donkeys are a common sight in Talaimannar island. Mantai, a small settlement located to the north of Mannar road had been famous in history as an ancient port. Similarly the shallow seas around Mannar are well known for their pearl oyster beds.

There are hardly any prominent settlements on the coast, except those small fishing villages such as Vidattaltivu, Paravanpidy, Varavil and Pallikulam until one reaches Kalmunai which marks the tip of the Pooneryn Peninsula. There are a few streams such as Punkadi Aru, Pali Aru

and Mandekal Aru reaching the sea in this stretch of the coast. The Devil's Point near Ponnaveili and the Palaitivu island off the coast form the only prominent landscape features in the area.

After passing Kalmunai on the tip of the Pooneryn peninsula, one enters the southern coast of the Jaffna lagoon which has its own characteristic landscape. Most of the coastal features in the Jaffna Lagoon are depositional in the area around Pooneryn. The Pooneryn peninsula itself has probably developed as a long sand spit. There are several other smaller sand spits and islets to the East of it. The Sangupiddy and Nagatevanturai jetties are the only land marks on the southern coast of the Jaffna lagoon until one reaches the Elephant Pass salterns. Small villages on the southern coast of the Jaffna lagoon attract settlers from the Jaffna peninsula to which it is linked by a ferry service.

5.3 Environmental Setting

The entire North-western Coastal Zone is underlain by sedimentary Miocene limestone rocks which outcrop occasionally in the northern parts of the coast line. These limestones are generally fossiliferous and Miocene marine vertebrates are reported from Aruakallu, while marine shells occur upon the sub-cliffs near Kudiramalai (Deraniyagala 1958). The limestone bedrock is covered by beach deposits and alluvium in most parts of the coastal plain. Deep bores indicate that the coastal plain has been built up on a post-Miocene land surface formed by the development of off-shore barriers, cutting off of lagoons and their subsequent infilling by fluvial sediments (Cooray, 1968). Gunatilaka (1975) estimated that an approximately 16 km wide strip of coastal plain has been built up in this area since post-Miocene times. In certain places around Mannar the depth to the underlying bedrock surface was found to be over 100 metres.

The coastal plain below an elevation of 30 m. extends more than 25 km inland in most places to the north of Mannar. (Fig. 4). The only area with an elevation above 30 m. is found in the southern part of the coastal zone where Kudiramalai rises over 75 m above sea level. Some of the shallowest seas around the island are found near the Northwest coast. Here the 10 fathom isobath extends to more than 50 km into the sea at certain places. The submarine contours also indicate submerged river courses, particularly those of the Malvatu Oya and the Kala Oya located between Kalpitiya and the Talaimannar island (Deraniyagala 1958).

Most parts of the North-western Coastal Zone are sheltered by barrier islands, off-shore bars and spits. Although the North west coast is in general a prograding one characterised by rapid depositional regression, there are problems of coastal erosion in certain localities.

Climatically, the Northwestern Coastal Zone forms one of the driest areas of Sri Lanka. In early demarcations of climatic regions in the Island this area is indicated as an 'Arid Zone'. The mean annual rainfall as reported from Pomparippu, Mannar and Talaimannar rain gauging stations is less than 1000 mm. Long periods of drought exceeding 200 days per year are common in the area. The only months in which there is some water surplus are those of the Northeast monsoonal period. The mean maximum temperatures exceed 90°F in April at both Puttalam and Mannar. Thus a combination of conditions of low rainfall, high temperatures and high excavation rates tend to create an 'arid' appearance in the coastal landscape. A large part of this coastal zone still remain sparsely populated and therefore, some natural vegetation cover still remains in the area. In contrast to the extensive coconut plantation areas on the West coast, Palmyra palms begin to appear in greater numbers as one moves northwards. Jungles of Palmyra cover many parts of the Talaimannar island. A few Baobab trees which were introduced several centuries ago from East Africa can still be seen in places like Errukkulampidy.

5.4 Results of Field Survey

The observations made on coastal features along the northwest coastline are summarized in Appendix Table 3 which shows that more than 67 per cent of this coast consists of straight coastlines. Lagoons and bays are observed in more than 40 per cent of the distance covered in the field survey. This is mainly due to the presence in the area of a few large lagoons such as the Puttalam and Jaffna lagoons and bays such as Portugal and Dutch Bays. The coastline tends to remain straight even within these bays and lagoonal areas. Islands form the next dominant geomorphological feature, although information on most small islands are not presented in Appendix Table 3. As noted before, reefs are observed mainly off the stretch of the coast between Puttalam and Mannar. The relative scarcity of headlands and coastal rock

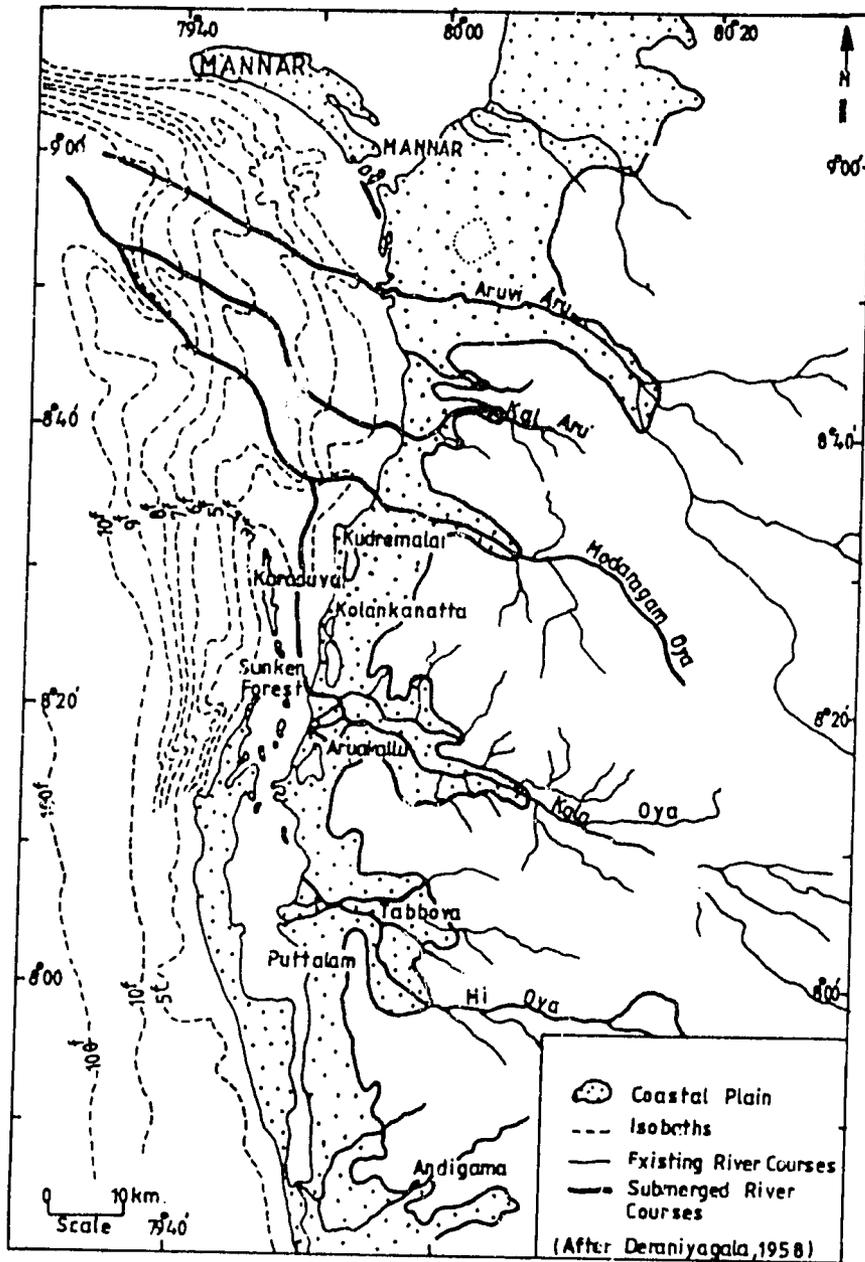


Fig. 4 Submerged River Courses of the Northwest of Sri Lanka

outcrops reflects the effects of underlying limestone rocks on the formation of coastal features, and the generally prograding nature of the coast line. This contrasts clearly with the dominant landscape features of the South western Zone. However, it appears that the recession of the Northwestern coastline had been quite widespread in the recent past. Thus in 70 per cent of the distance covered in this study the coastal residents reported a recession of the coast line within the last 20 to 30 years at an average rate of 2-3 metres per annum. The field observations on the nature of beach material indicate that most beaches are silty in the Northwest, particularly in the lagoonal areas. Sandy beaches that come next in frequency are observed in about 35 per cent of the coastline. Where the beaches were sandy the dominant colour of the sands was found to be black, a feature which deserves further investigation and attention.

The observations made on dominant vegetation types in the Coastal Zone are given in Appendix Table 4. This indicates that sandy seashore vegetation which is observed in 63% per cent of the coast line is most preponderant type. However, mangroves and salt marshes are also observed in more than 25 per cent of the coast line, while dune vegetation accounted for nearly 20% per cent. The forested areas in coastal zone are found mainly in the Puttalam to Mannar stretch where the Wilpattu sanctuary extends to the coast line, and in the area between Vidattallivu and Elephant Pass. In these two areas a variety of grasses was also observed in the Coastal Zone.

The information collected on the principal human activities of the area indicates that fishing is the most important economic activity in the Northwest. As Table 5.1 shows, beaching boats is the most common form of fishing which was observed along 57 per cent of the coast. However, off-shore and lagoonal fishing which are reported from over 30 per cent of the coast also occupy an important place. Some 49 dry fish wadi were reported from the North Western Coastal Zone.

Some of the prominent fishing centres in the country such as Pesalai, Vankalai and Talaimannar are found in the North western coastal area. Shark, Turtle, Yellow-fin-tuna and Devil Ray are some of the common types of aquatic animals/fauna found in this zone. In the lagoonal areas Lobster, Sea Crab, Prawn, Sea Cucumber and Beche-de-mer represent some of the important types of aquatic food animals caught. There are several beche-de-mer factories in the area. As noted earlier, from ancient times the Gulf of Mannar had also been famous for Pearl fishing. Although this industry is not so important now, the Government is planning to boost and revitalise it again.

Salt industry and sand mining are two other important activities in the area. Sand mining is particularly common in the Mannar island area while the salt industry is confined to Elephant Pass and a few other locations such as Karaitivu.

5.5 Problems and Areas of Concern

Even in the Northwestern Coastal Zone which is noted for depositional features, coastal erosion appears to be one of the major problem in some localities. This is particularly noticeable in the stretch between Kudiramalai and Mannar which is less sheltered from coastal currents. Silavaturai and Vankalai represent some of the badly affected areas. Historical places such as Alli Rani Fort at Silavaturai are now faced with the threat of total collapse caused by wave action. The problem of coastal erosion in this area is partly aggravated by migrant fishermen who clear patches of coastal vegetation haphazardly for camping and fuelwood.

Although this is not a thickly populated area, sand mining is now assuming significant proportions. This is particularly evident in the Pesalai and Tarapuram areas. Among other purposes, the sand is used in these areas to construct roads and reclaim low-lying areas. Coastal pollution is still not a serious problem in the North west. However, the pollution of water by oil released ejected from mechanised fishing boats poses some problems in the fishing areas. A few fishermen from Pesalai and Vankalai expressed the fear that this can affect lagoonal fishing in future.

Table 5.1
Dominant Human Activities in the Coastal Zone from Puttalam to Elephant Pass

<i>Segment of the coast line</i>	<i>Length of coast line (Km)</i>	<i>Number of kilometres along which specified activities were observed</i>										
		<i>Fishing</i>					<i>Other Activities</i>					
		<i>Beaching boats</i>	<i>Off shore</i>	<i>Ma-del</i>	<i>Lagoon</i>	<i>Prawns & crab</i>	<i>Dry fish wadi</i>	<i>Sand mining</i>	<i>Coconut based industries</i>	<i>Salt industry</i>		
Puttalam to Mannar	113	79	30	27	46	40	18	04	01	03		
Talaimannar Island	63	28	20	36	11	10	20	07		02		
Mannar to Vidattallivu	22	03	05			07	03	01				
Vidattalivu to Elephant Pass	182	107	71	01	89	67	08			05		
Total	380	217	126	63	146	124	49	12	01	10		
% of kilometres at which specified activities were observed (for each group)	100	57.10	33.15	16.58	38.42	32.63	12.89	3.15	0.26	2.63		
% of total mentions (for each group)	100	29.93	17.38	8.69	20.14	17.10	6.76	52.17	4.34	43.47		

CHAPTER VI

THE NORTHERN COASTAL ZONE

6.1 Location

The coastline from Elephant Pass (Alimankada) to Chempianpattu in the northeast, covering the entire Jaffna Peninsula is defined as the Northern Coastal Zone. It is situated between latitudes 9° 49' and 9° 25' N and longitudes 70°39' E and 80° 40' E. The islands lying to the west of the Peninsula are considered separately at the end of this chapter. The Jaffna lagoon which is open to the sea was included in the field survey, while the Thondamanaru lagoon had been excluded. The total length of the Northern Coastal Zone thus defined was found to be 181 km excluding the off-shore islands. The coastline which faces different directions in different parts of peninsula exhibits a wide variety of coastal landscapes.

6.2. Prominent Features

The southern coast of the Jaffna Lagoon extends eastwards from Elephant Pass to a point close to Kariyavayar—a small village near the Jaffna District boundary. Apart from the lagoonal beaches near Elephant Pass the continuity of this coast line is occasionally interrupted by the mouths of a few north flowing dry zone streams such as Kanakarayan Aru, Puluthi Aru, Kodikathai Aru, Piramenthal Aru and Theravil Aru. The northern coastline of the Jaffna lagoon passes through several hamlets such as Chundikkulam and Vannankulam and rejoins the northern side of the Elephant Pass. This coastline is characterized by several sandspits, offshore bars, islets and tidal flats. Long groves of wild palmyra palms form the main feature of this area. The eastern segment of the Jaffna lagoon also forms part of the Chundikkulam sanctuary.

The northern coast of the Jaffna Lagoon to the west of Elephant Pass is essentially a straight coastline that extends upto the municipal limits of the city of Jaffna. Almost the entire coastal zone in this stretch is formed of sandy open spaces. The Jaffna urban sprawl extends upto the coast line in the area between Columbuturai and Nawanthurai. This area has the largest concentration of man-made coastal structures in the whole of Jaffna Peninsula. The Old Dutch Fort is one such dominating structure. Between Nawanturai and Valuki Aru there is an extensive open area subject to floods occasionally, and around which a long embankment had been constructed. The Valuki Aru with a prominent estuary forms the largest surface stream basin in the whole of the Jaffna Peninsula.

From Valuki Aru to Mathagalthurai is a zone of coastal deposition, except for a small stretch to the north of Thiruwadinilayam. The prominent sandspits in the north western parts of the peninsula indicate rapid beach development. Some fishermen reported that they have had to shift their dwelling houses towards the water front because of beach development. The northern coastline from Mathagal to Thumpalai on the other hand is basically a coast of erosion where low sea-cliffs and boulders of limestone rock are often observed near the beach. Thondamanaru Aru which represents the northern outlet of the Vadamarachchi lagoon is one of the most prominent features of the northern coast. To the east of Mathagal where the venerable Theri Sanghamitta is believed to have landed, one comes across settlements such as Keerimalai, Kankasanturai, Valvedditurai and Point Pedro. Of these Keerimalai is famous as a beach resort with hot springs and Valvedditurai as a port noted for contraband goods. Point Pedro forms the biggest town in the north eastern corner of the peninsula.

The north eastern coast of the Peninsula begins from Tampalai and extends upto Chalai. The stretch of coast between Tampalai and Chempianpattu is a dune-country *par excellence*. Moving sand dunes can be observed between Manathkadu and Nakar Kovil (Sivakumaran 1978).

The islands lying off the western coast of Jaffna Peninsula constitute the largest congregation of islands within the territorial waters of Sri Lanka. The bigger islands among these include Kayts, Punkudutivu, Karaitivu, Analativu, Nainativu and Delft. Kayts (which has the shape of a kite on the map) forms the biggest and nearest island of them all, while Kachcha-

tiue is the furthest. Nainativu or Nagadipa is one of the places believed to have been visited by the Lord Buddha and therefore even today is one of the most venerated places of worship for Buddhists from all over the country. Delft is the largest island located away from the coast of Jaffna Peninsula. The western parts of this island still remain uninhabited and a breed of wild horses introduced by the Dutch several centuries ago still survive there.

6.3 Environmental Setting

Geologically, the entire Northern Coastal Zone falls within the Miocene limestone belt. This limestone appear on the surface in some localities such as Mathagal, Myliddy and in the island of Delft. In most other areas the limestone bedrock is covered by a veneer of beach deposits, moving sands or red soils. The depth of the soil cover can vary upto three metres from surface. The type of limestone found in the Northern Coastal Zone is mostly a coral limestone that exhibits a whitish colour. It is quarried for cement manufacture as at Kankecanturai or for use as building stones. Owing to its soluble and cavernous nature, limestone forms good groundwater reservoirs as exemplified by the bottomless well at Puttur. A large proportion of the shallow wells in the Jaffna peninsula, tap this ground water body for agriculture as well as for domestic use. The use of ground water resources in Jaffna is now reaching a stage of over-exploitation (Arumugam and Balendran, 1968). Some springs originating from limestone can be seen at places such as Keerimalai on the northern coast.

The climate of the Northern Coastal Zone is semi-dry with many characteristics common with the rest of the Dry Zone of Sri Lanka. Although the rain gauging stations at Jaffna and at Point Pedro record a mean annual rainfall of around 1200 mm, rain is highly seasonal. Nearly 60% of the total rainfall is received within a period of 3 to 4 months during the north-east monsoon. The mean annual temperature is around 27° C and remains high throughout the year without much seasonal variation.

The Jaffna peninsula stands upon a broader continental shelf than many other parts of the Island. It is essentially an area of lagoons and islands. The Jaffna and Thondamanaru lagoons, the two large lagoons in the peninsula dominate the geography of the Peninsula. Due to the presence of such lagoons and islands close to the peninsula, large tidal flats and silty beaches are a common feature in this area. Only the northern and northeastern coasts are exposed to the full impact of wave action.

6.4. Results of Field Survey

A summary of the coastal features observed during the field survey is given in Appendix Table 5. This shows that in nearly 75 per cent of the distances covered by field investigators a straight coastline was the dominant feature. Sandspits and lagoons occupied second and third places respectively in terms of frequency. These latter features were found to be particularly prominent in the stretch from Elephant Pass to Jaffna. On the other hand reefs and limestone rock outcrops were more frequently observed along the coastline from Jaffna to Point Pedro. As indicated earlier, deltas, estuaries and surface streams with the exception of Valuki Aru found to be extremely rare in the Northern Coastal Zone

The field observations made on beach materials indicate that most beaches in the northern region are sandy or silty. Some 65 per cent of the beach sands examined were whitish in colour. Unlike in the North Western Zone, black sands were relatively rare here. It is interesting to note that in over 50 per cent of the distance covered by the field survey the coastline had been developed during the last 20 to 30 years. Only in 37 per cent of the total distance of the coastal zone had there been some loss of land. The developing beaches were found mostly in the stretch between Elephant Pass and Mathagal, while the receding coastlines were most common in the stretches from Mathagal to Point Pedro and from Point Pedro to Chempianpattu. Some of the most prominent developing beaches in the region were found in the area immediately to the west of Mathagal. The rate of development had however been much slower compared to the rate of recedence.

The field observations made on coastal vegetation type are listed in Appendix Table 6. This table shows that, as in other areas, the most dominant vegetation type is the sandy-sea-shore vegetation (38 percent). However, the preponderance of salt march vegetation (34 per cent) is also a striking feature. A mangrove type vegetation had also been observed in some

18 per cent of the coastline surveyed. Mangroves were particularly noticeable in the coastal zone between Elephant Pass and Jaffna, while dune vegetation was most common in the area between Point Pedro and Champianpattu. In most parts of the coastal zone of the northern region, palmyra grows wild. It is therefore included in the category of littoral woodlands. The grassy types of vegetation were most commonly found in the Northeastern coastal areas of the peninsula.

Human Activities

The dominant human activities in the Northern Coastal Zone are given in Table 6.1. This table shows that the most important human activity in the area is fishing, and the most common type of fishing is with beaching boats. Beaching boats were observed in 70 per cent of the distances covered. Off-shore fishing was reported for 18 per cent of the northern coastline, in which there were some 57 dry fish wadi at the time of the survey. The dry fish wadi were particularly numerous along the coastal zone from Jaffna to Point Pedro and from Point Pedro to Champianpattu. The main fishing centres in this zone were Mathagal, Myliddy and Thalaiyady. Lagoonal fishing on the other hand was mostly confined to the Jaffna lagoon.

Among other human activities, coral mining is reported only from the coastal zone from Jaffna to Point Pedro. Sand mining on the other hand was observed in a wider area covering all three coastal segments of the Northern Zone. Tourism is not so widespread here except locally in places such as Keerimalai.

The Islands

The islands to the west of the Jaffna peninsula share many features in common with the peninsula although they differ in several important natural characteristics. Geomorphologically, about 67 per cent of the coastline of the islands was found to be 'straight' (see Appendix Table 7). Although there were not many sandspits and lagoons as in the peninsula, most islands had offshore reefs. There were also more rock outcrops and headlands in the islands than in the Peninsula. The beaches of the islands were also more pebbly and sandy than in the mainland. Some 61 per cent of the sand beaches had white beach sands; black sands were almost absent. One of the important differences in the islands was that most coastlines facing west, were found to be receding due to erosion. They amounted to 36 per cent of the distance traversed. In contrast, developing beaches were more common in the peninsula than receding ones. The residual limestone pillars in the Samithoddamunai area on the west coast of Delft is a clear example of the high rate of erosion in the islands. The north west coasts of the peninsula are to some extent protected by the sheltering effect of the islands.

Owing to their relative isolation the different islands also exhibited certain differences in coastal vegetation. Thus mangroves were more common in the islands (74 per cent) than in the Peninsula (see Appendix Table 8), while on the other hand, salt marsh and dune vegetation types were common in the peninsula than in the islands. Grass type vegetation was quite common in the island of Delft, where a breed of wild horses was found to be grazing on them. Despite certain differences, sandy seashore vegetation, particularly creeping vegetation and low shrubs, formed the dominant vegetation types both in the islands and the peninsula.

Fishing was the dominant economic activity both in the peninsula and in the islands (see Table 6.2). In the islands however, ma-del fishing was much more common than in the peninsula. This may also be taken as one indication among several of the fact that near-shore fishing is still economically viable and that the fishery is not over-exploited in the islands. It also appears that coral mining is not practised in the islands except in certain Parts of Kayts Beach sand mining for building purposes is quite common in the islands owing to the absence of rivers and hence of river sand. In general, there appears to be a decrease in human activities in the coastal zones of the islands owing to out-migration of people in recent years (Balasunderampillay 1982).

6.5 Problems and Areas of Concern

The Northern Coastal Zone is one of the few areas of the country where the coast line is found to be developing in many places. However, the threat of coastal erosion exists particularly in the islands and in the northern part of the peninsula. In general, the Northern Coastal Zone when compared with that of the Southwest, can be considered as a region which has not been

Table 6.1
Dominant human activities in the Coastal Zone from Elephant Pass to Chempiyanpattu

Segment of the coast line	Length of coast line (Km)	Number of kilometres at which specified activities were observed										
		Fishing					Other Activities					
		Beaching boats	Off shore	Ma-del	Lagoon	Prawn & crab	Dry fish wadi	Coral mining	Sand mining	Tourism	Salt industry	Mineral industry
Elephant Pass to Jaffna	93	73	22	03	38	06	10		17	01	03	
Jaffna to Point Pedro	72	44	24	02	01	15	31	17	17	05	03	
Point Pedro to Chempiyanpattu	16	10	15	14		07	16		03			02
Total	181	127	61	20	39	28	57	17	37	06	06	02
% of Kilometres at which specified activities were observed (for each group)	100	70.17	33.70	11.05	21.55	15.47	31.49	9.39	20.44	3.31	3.31	1.1
% of total mentions (for each group)	100	38.25	18.37	6.02	11.74	8.43	17.16	25.0	54.41	8.82	8.82	2.94

Table 6.2
Dominant human activities in the Coastal Zone of the Islands off Jaffna Peninsula

Segment of the coast line	Number of kilometres at which specified activities were observed												
	Length of coast line (Km)	Fishing						Other Activities					
		Beaching boats	Off shore	Ma-del	Lagoon	Prawn & crab	Dry fish wadi	Coral mining	Sand industry	Tourism	Coconut based industry	Palmyra based industry	
Mandativu	20	07	04			03	04			03			
Punkudutivu	45	45	01	36	15		05		04				
Delft	28	21	21	08			19		06				
Puliyantivu	03	03	03	01									
Analaitivu	11	08	08	03			04		07				
Paraitivu	02	02	02	02									
Eluvativu	08	01	03	01		04	04					04	
Naynativu	11	09	10	01			06		08				
Kayts	65	17	18	48	08	33	06	02	17	01	01		
Karaitivu	25	12	13	12	03	03	13		06	01			
Total	218	125	83	112	26	43	61	02	48	05	01	04	
% of kilometres at which the specified activities were observed (for each group)	200	57.33	38.07	51.37	11.92	19.72	27.98	0.91	22.01	2.29	0.45	1.83	
% of total mentions (for each group)	100	27.77	18.44	24.88	5.77	9.55	13.55	3.33	80.0	9.33	1.66	6.55	

much affected by destructive human activities. Tourism has hardly begun in these areas except in the stretch between Jaffna and Point Pedro where this industry caters mostly to local tourists and pilgrims. There appears to be much scope for the development of some form of tourism particularly in the islands.

The density of settlements is relatively less in the western coast, compared with some interior parts of the Peninsula, except near certain big towns such as Jaffna, Point Pedro and Valvedditurai. This is one of the reasons for the absence of serious coastal problems such as pollution, and accelerated erosion due to human activities. So far no housing schemes have been started in the coastal zone here, unlike in several other parts of the country. Nevertheless, it would be useful to monitor the environmental impact of limestone quarrying and other activities connected with the cement industry at Kandesanturai. Special attention may be paid to the new harbour development activities at Kankesanturai.

CHAPTER VII

THE NORTHEASTERN COASTAL ZONE

7.1 Location

The coastal zone extending from Chempianpattu in the northeastern coast of the Jaffna peninsula to Foul Point at the southern end of the Trincomalee Bay is considered here as the Northeastern Coastal Zone. The Northeastern Coastal Zone thus defined, is located between the latitudes of 9° 38' N and the longitudes of 81° 19' N and 80° 22' N. This Zone includes the Trincomalee Bay which itself has a coastline of approximately 104 km. The total length of the coastal zone surveyed (excluding lagoons) was estimated to be 266 km. The entire coastline except that of the Trincomalee Bay faces a northeasterly direction thereby exposing itself to the north-east monsoonal winds and the accompanying swell and other coastal process.

7.2 Prominent Land Marks

In accordance with the demarcation of coastal segments for development purposes, Chempianpattu is considered to be the beginning of the Northeastern Coastal Zone. For the purposes of the field survey, Chalai which marks the end of the Jaffna Peninsula was treated as the northern boundary of the Northeastern Coastal Zone. From Chempianpattu to Chalai, a continuous straight coastline with scattered fishing camps is the most common sight. Talaiady forms the most important fishing settlement in this area. The exceptionally low price of fish here is a consequence of poor marketing and the lack of adequate refrigeration facilities.

Chalai marks the beginning of the mainland segment of the North Eastern Coastal Zone of Sri Lanka, where the main characteristic is a series of lagoons and bays. The first major lagoon south of Chalai is the Nandi Kadal which undergoes significant seasonal changes in its water spread area. In this stretch the coast line is dotted with numerous fishing camps particularly near Mullaitivu, which is the main township in the area.

The straight coast line characteristic continues until one reaches the Nayaru Lagoon. The mouth of this lagoon dries up during the dry season when one can walk across it. Along vehicle tracks. Alampil and Chenmalai are two small fishing settlements on the Eastern shores of Nayaru lagoon. However, in the fishing camps on the main coastline, it is migrant fishermen from Nemo and Udappu who are frequently seen. Kokkilai is the second largest lagoon in the area next to Nayaru. Here one can find several villus or marshy areas close to the coast line such as Periyavillu to the north of Kokkilai village.

Pulmoddai (or Puhulmote in Sinhalese), where the Mineral Sands Corporation factory is located, lies between the Kokkilai lagoon and the Yan Oya estuary. Here the coastal sands are rich in ilmenite. The main function of the factory is their extraction and processing. The ruins of the famous Buddhist temple of Tiriyai are found to the south of Yan Oya. Having passed through Periyakarachchi lagoon one enters the main tourist area of the north east coast line. Here, the Nilaveli beach is the main tourist attraction, although many tourist activities have spread outwards up to Trincomalee in recent times.

It is well known that Trincomalee has one of the first natural harbours in the world. It was developed by the British during their regime. Trincomalee played an active role as a port of call for Allied ships during the Second World War. The main Trincomalee Bay includes several smaller bays within it such as Black Bay, Dutch Bay, China Bay, Tambalagam Bay, Koddigar Bay and Shell Bay. Most of these bays are bounded by headlands such as Konesar Malai, Rocky Point, Elephant Point, Ostenburg Point, Plantain Point, Cod Point and Round Point. Foul Point (or Kevuliya) is the last of these head lands. There is also a series of much smaller bays or coves such as Nicholson's Cove, Yard Cove, Malay Cove, Snug Cove and Dead Man's Cove. Several islets such as Elephant Island, Sober and Round Island are found scattered inside the main bay.

There are a few small settlements along the discontinuous road that runs round the Bay. The most prominent of these are Kinniyai, Mutur and Sampur. The Mahaweli Ganga has several mouths discharging into the Koddigar Bay. Thus, if one proceeds along the road running

round the bay from Trincomalee to Foul Point, at least five ferries, namely Kinniyai, Upparu, Gengai, Podowkattu and Mutur have to be crossed.

7.3 Environmental Setting

Geologically, the Northeastern Coastal Zone falls within 2 major rock groups:

- (a) The highland series rocks in the Trincomalee area, and
- (b) The Vijayan series rocks lying to the north of Kuchchaveli and to the south of Mutur.

These parent rocks are overlain by a variety of beach deposits and alluvium brought in by many rivers that discharge along to the Northeastern Coast. Apart from the Archaean rocks there are smaller outcrops of fossil-bearing sandstones in most part of the Northeastern Coast. One example is the sandstone outcrop which can be observed in the area between Senmalai and Nandikadal. In certain places of the Northeastern Coast, beach sands are rich in minerals such as Ilmenite and Rutile. The Mineral Sands Corporation factory at Pulmoddai extracts and processes some of these minerals.

The structural trends in the Northeastern region are even more important in the development of its coastal features than its lithological variations. This is one of the few areas where the coastline runs across the strike of the rocks. It partly explains the frequency of the occurrence of many bays and lagoons along this part of the coast, which have been created mainly by differential erosion of a bedded series of rocks (Cooray, 1956). The presence of high cliffs which is a rare phenomenon in most other parts of the coastal zone of Sri Lanka, and the existence of submarine canyons off Trincomalee Bay, may also have some relationship to the geological structure of the area.

The climate of the Northeastern Coast is basically of the 'Dry Zone type'. The mean annual rainfall at Trincomalee is around 1700 mm. of which over 60 per cent falls within a period of four months from October to January. This is also the season of the Northeast monsoonal winds. The mean air temperature is high, around 82°F, and remains fairly uniform throughout the year. These climatic characteristics have favoured the development of sand dunes in many areas of this coastal zone. Although the climate is relatively dry in the Northeastern Coast, it is also an area which has recorded some of the highest daily rainfall intensities in the country. Thus Mullaitivu had a record fall of 31.18 inches of rain in 24 hours on 18th December 1911 while Nedunkerni recorded 31.72" inches on 15th December 1897.

7.4 Results of the Field Survey

The information collected on the coastal features of the Northeastern Coastal Zone during the field survey are listed in Appendix Table 9. This shows that in nearly 60 per cent of the distance covered, a straight coastline was the dominant feature. However, the most striking feature of this coast line was the presence of a series of bays and lagoons. About 40 per cent of the coastal zone was thus found within bays while 19 per cent of it was in lagoons.

Compared with most other areas of the coastal zone, boulders (20 per cent) and rock outcrops (15 per cent) were observed along considerable distances along the coast line. The presence of headlands and cliffs particularly between Trincomalee and Foul Point gives a special character to the Northeastern Coastal Zone. Sand dunes were quite common in the coastal zone between Mullaitivu and Chempiyanpattu, although they are not as well developed as in the Nakarkovil-Manalkadu area of the Northern Coastal Zone.

The observations made on the nature of beach material indicate that over 70 per cent of the beaches in the Northeast Coastal Zone were sandy. Nevertheless, there was a significant number of beaches with cobbles (18 per cent) and pebbles (17 per cent). Although the colour of beach sand was predominantly white (42 per cent), there were considerable stretches of brown and black sands. The brown sands were seen mostly in the silty beaches to the north of Mullaitivu, while black sands were frequently observed in the coastal zone between Mullaitivu and Irakkanda bridge. A peculiar type of beach sand was observed in the area around the Arisimalai estuary. These were sands with exceptionally rounded grains with an appearance like that of polished 'samba' rice. In the areas of Shell Bay, Sampur and Foul Point, the beach material had a high content of sea shells.

Table 7.1
Dominant human activities in the Coastal Zone from Chempiyapattu to Foul Point.

Segment of the coast line	Length of coast line (Km.)	Number of kilometres at which specified activities were observed										
		Fishing							Other Activities			
		Beaching boats	Off shore	Mar-tel	Lagoon	Prawn & crab	Dry fish wad's	Coral mining	Sand mining	Tourism	Coconut based industry	Mineral extraction
Chempiyapattu to Mullaitivu	61	57	39	55	01	37	40		02			
Mullaitivu to Kokkilai	36	22	01	32	02	03	22			02	04	
Kokkilai to Irakkandy Bridge	43	17	03	34	06	03	06	02		04		09
Irakkandy to Trincomalee	17							02		10		
Trincomalee to Foul Point	109	20	01	17	17	14	13		04	07	04	
Total	266	116	44	169	26	57	81	04	06	23	08	09
% of kilometres at which the specified activities were observed (for each group)	100	43.61	16.54	63.53	9.77	21.43	30.45	1.50	2.26	8.65	3.01	3.38
% of total mentions (for each major group)	100	23.53	8.92	34.27	5.27	11.56	16.43	8.0	12.0	46.0	16.0	18.0

A receding shore line was observed in 43 percent of the kilometre segments covered by the field survey. Only 6 percent of the coastline was found to be developing. According to the information collected, the rate of recedence per annum was around 1.52 m. while the rate of development per annum was only 0.64 m. It may therefore, be concluded that the Northeastern Coast is predominantly a coast of erosion than one of deposition.

The observations made on coastal zone vegetation (see Appendix Table 10) clearly indicate that sandy shore vegetation is the dominant vegetation type (80 percent) in the North east as in most other areas of the Island. Nevertheless, other types of vegetation particularly dune vegetation (47 percent) was quite prominent in the northern parts of the zone between Kokkilai and Chempyanpattu. The North eastern Coastal Zone also represents one of the few areas of the country where the forest cover along the coast is still preserved. Littoral woodlands are frequently observed in several places of the Trincomalee Bay and in the coastal segment between Chempiyanpattu and Mullaitivu. The latter area was also observed to have several stretches under mangrove vegetation and salt marshes.

As in many other coastal areas of the Island the most important human activity in the Northeast Coastal Zone was fishing (see Table 7.1). Thus some form or other of fishing activities were observed in at least 65 per cent of the coast line surveyed. Ma-del fishing was the most common method and was practised along 63 percent of the coast line. Beaching boats and off-shore fishing were more frequently observed in the coastal zone to the north of Kokkilai. Dry fish wadi were also found in greater numbers in the northern area than in the southern parts of this coastal zone. Prawn and crab fishing was frequently observed in the northern parts of this zone as well as in the Trincomalee Bay area.

Among activities other than fishing, tourism and extraction of minerals and sand were the most prominent. Tourism was largely confined to the Nilaveli area, and to the Trincomalee township. Mineral extraction activities were to a great extent centred around Pulmoddai, where the Mineral Sands Corporation factory is located. However, mineral sands are brought even from coastal sites which were 5–10 km. away from the factory. The long trenches from which the mineral sands were dug out can be seen in most places close to the beach in this area.

7.5 Problems and Areas of Concern

As indicated earlier, the North eastern coast is predominantly a receding coastline rather than a developing one. Therefore, the problem of coastal erosion exists in certain localities of the coastal zone, particularly where the density of settlement is higher. Thus in the coastal stretch between Uppuveli and Nilaveli most fishing settlements are threatened by severe erosion. No attempt appears to have been made to control erosion in this area. Similarly in the Sinnakin-niya area near Gengai the roadway is already in the process of being washed away. Here local residents have used empty tar barrels and small boulders to prevent the total collapse of the road.

Coastal pollution is observed in areas near major settlements and in places close to factories and other industrial establishments. At least 8 sewage outfall structures were observed in Trincomalee. At the site of the Mineral Sands factory at Pulmoddai, there are outlet pipes carrying waste water to the beach. Some pollution can also be observed in the area around the Trincomalee Petrol depot and some caused by fuel from passing ships.

CHAPTER VIII

THE EASTERN COASTAL ZONE

8.1 Location

The stretch of coast that extends from Foul Point (Kevuliya) to Pottuvil is considered as the Eastern Coastal Zone. The total length of this Zone is approximately 204 km excluding the lagoon beaches. It is situated between latitudes 8° 30' N and 6° 35' N and longitudes 81.15 E and 81.47 E. The entire coastline faces the east except near Foul Point and in areas with bays and lagoons.

8.2 Prominent Land marks

Moving south of Foul Point one can see a series of lagoons and marshy lands in the coastal zone. The first large lagoon encountered is the Ullakallie lagoon to the east of Seruvila. To the south of this lagoon a major tributary of the Mahaweli Ganga—the Verugal Aru flows into sea exhibiting some deltaic conditions around its estuary. This is a low-lying area with marshy lands. The Verugal Aru flows through a sparsely populated area having forest cover and infested by crocodiles. To the south of Kathiraveli, another large lagoon with the name Uppar can be seen. At Vakaraï, a settlement located near the mouth of the lagoon, two prominent sand bars have developed. A straight coastline is the main feature between Vakaraï and Mankerni. To the south of Mankerni, several bays such as Thennade, Pulavikuda, Vandeloos, and Kalkudah are located around the mouth of the Maduru Oya. One of the finest beaches of Sri Lanka, namely Passekudah, is located in this area near Valaichchenai. Proceeding further southwards from Valaichchenai one comes to Batticaloa (Madakalapuwa) one of the largest towns on the east coast. The Batticaloa lagoon which can be considered to be one of the largest natural lagoons in the Island, extends from Eravur to Kalmunai, a distance of nearly 60 km. From Kalmunai to Akkaraipattu a straight coastline becomes the dominant feature again. However, the mouth of the Gal Oya, located to the south of Kalmunai displays some deltaic conditions. Another large lagoon in the area, namely Periya Kalapuwa is found between Akkaraipattu and Tirukkivil.

8.3 Environmental Setting

The climate of the Eastern coastal zone is of the 'Dry Zone'. Although the annual rainfall at Batticaloa exceeds 1700 mm., about 25 percent of it falls in December. The mean daily maximum temperature remains high (around 30°C) throughout the year. While the highest recorded temperature exceeded 38°C the lowest fell below 18°C. The prevailing wind directions in Batticaloa are predominantly Northeast during the period from November to March. In most other months the winds are variable or calm particularly in the morning hours. During the southwest monsoons the wind directions in Batticaloa are mostly Southeasterly. There is a significant difference between the morning (7 km ph) and afternoon (14 km ph) windspeeds. The highest windspeeds have been recorded in January, February and March.

One of the most important features of the climate in the East Coast is the occurrence of tropical cyclones. These cyclones cause extensive damage to taller types of coastal vegetation accelerate the normal rate of erosion significantly. The cyclone of 1978 devastated large coconut plantations in and around the coast and blew the roofs off from many buildings and houses. The stumps of coconut trees destroyed by the cyclone were a common sight in most areas of the Eastern Coastal Zone, even three years later at the time of the field survey.

The Geological map of the Eastern coastal area shows two major rock groups, namely (a) Khondalite-Charnockite series and (b) Birtenna Gneisses. Both groups are Precambrian metamorphic rocks. The Khondalite rocks occupy a small area around Foul Point at the Northern end of the zone. The khondalites include a variety of common country rocks such as quartzites, gneisses granulites, crystalline limestones and dolomites.

Birtenna gneiss is also found in a large part of the Eastern Coastal Zone. The well banded black and white gneisses form typical rock formations of this group.

The bedrocks mentioned above are covered by a thick mantle of superficial material in most parts of the coastal zone. These superficial materials include

- (a) regosols or recent beach and dune sands.
- (b) alluvial soils and
- (c) solodized solonetz soils.

Of these three types, regosol is a pale brown, imperfectly drained coarse sand, usually 2 to 4 feet in depth, which overlies a greyish sandy clay loam of residual origin. The coconut estates in the area are mostly found to contain these soils. The solodized solonetz are soils which have a shallow sandy top soil which overlies a strongly alkaline subsoil of much heavier texture. The subsoil is very hard when dry and very sticky when wet. The alluvial soils of loamy to sandy texture are found in riverine areas and in estuaries.

8.4 Results of the Field Survey

The data collected on the coastal features of the Eastern Coastal Zone during the field survey are listed in Appendix Table 11. This shows that over 80 per cent of the distance covered had straight coastlines. However, bays (48 percent) lagoons (23 percent) and sand spits (28 percent) were found to be the other dominant features of the Eastern Coastal Zone. Some (32 percent) were frequently encountered from Vakarai to Kalkudah and between Batticaloa and Pottuvil. Similarly, reefs and rock outcrops were mostly seen in the northern most segment of the Coastline between Foul Point and Vakarai.

The observations made on the nature of beach material shows that sandy beaches are the most common type. About 75 per cent of the beach sands were found to be white in colour. However, there were considerable stretches of brown sands in the Foul Point–Vakarai stretch and black sands in the Batticaloa–Pottuvil stretch.

Information collected on the history of the shoreline shows that 54 per cent of the coastline was receding while only 22 percent was developing. The annual rate of recession was therefore more than twice as great as that of development. However, compared to most other areas, the proportion of developing beaches is quite significant mainly because of the presence of sandspits.

The results of observations made on vegetation types in the Eastern Zone are summarised in Appendix Table 12. This shows that the most dominant vegetation type is dune vegetation which is found in nearly 70 percent of the coastal zone. Well-developed sand dunes are present in many places along the coast from Akkaraipattu to Pottuvil. When the dunes are located very close to the sea, their windward side is often devoid of vegetation. However, on the crest of the dunes lowcreeping plant species such as *Ipomea pescaprae* (Bintamburu) and *Spinifex Littorus* (Maharawana rawula) are found. Sandy shore vegetation which forms the dominant vegetation type in most other areas occupies only the second place (52 percent) while mangroves were observed in 41 percent of the coastline. Mangroves occur near estuaries and in small lagoons. The following types of species were identified in the groves of mangrove vegetation. (i) *Rhizophora* (ii) *Bruguiera* (iii) *Sonneratia caseolaris* (iv) *Ceriops tagal* and (v) *Avicennia officinails*. Several of these can be seen at the Mahaweli Ganga estuary near Muttur. On the higher ground behind the mangrove proper is a mixed woodland with mangrove plants and species characteristic of littoral woodlands such as *Litsea littoralis*, *Calophyllum* and *Terminalia cetappa*. These species however, appear to be less tolerant than *Rhizophora* to high salinity levels and tend to be absent from areas subject to frequent inundation by sea water. Coastal forests were quite significant in the northern parts of the coastal zone between Foul point and Kalkudha while grasslands were more dominant in the Batticaloa–Pottuvil stretch.

A listing of the dominant human activities in the Eastern Coastal Zone is given in Table 8.1. As in most other coastal areas fishing was the most important human activity. Beaching boats and Ma-del formed the most common fishing methods. Off-shore fishing and dry fish wadi were frequently observed in the coastal zone between Batticaloa and Pottuvil. Lagoon fishing activities were also largely confined to the southern parts of the zone. Among the other activities, sand mining as well as coral mining were frequently observed in the Batticaloa–Pottuvil stretch. Tourism formed a dominant activity, particularly in the Kalkudah–Passikuddah areas of the coast line. Coconut based industries were observed only in the Batticaloa–Pottuvil segment.

Table 8.1
Dominant Human Activities in the Coastal Zone from Foul Point to Pottuvil

<i>Segment of the coast line</i>	<i>Length of coast line (Km)</i>	<i>Number of kilometres at which specified activities were observed</i>												
		<i>Fishing</i>						<i>Other Activities</i>						
		<i>Beaching boats</i>	<i>Off shore</i>	<i>Ma-del</i>	<i>Lagoon</i>	<i>Prawn & crab</i>	<i>Dry fish wadi</i>	<i>Coral mining</i>	<i>Sand mining</i>	<i>Tourism</i>	<i>Coconut based industry</i>	<i>Palmyra based industry</i>		
Foul Point to Vakarai	40	05		16	01		09							
Vakarai to Kalkudah	34	10	12	16	01		09				03			
Kalkudah to Batticaloa	32	20	17	22	03	01	13		04		05			
Batticaloa to Pottuvil	98	58	44	33	26	01	33	05	54		27	08		03
Total	204	93	73	87	31	02	64	05	58	35	08	03		
% of kilometres at which the specified activities were observed (for each group)	100	45.58	35.78	42.64	15.19	0.98	31.37	2.45	28.43	17.15	3.92	1.47		
% of total mentions (for each group)	100	26.57	20.86	24.86	8.96	0.57	18.29	4.58	53.21	32.11	7.33	2.75		

8.5 Coastal erosion is still not a serious problem in most parts of the Eastern Coast. However, the cyclone of 1978 caused severe erosion of beaches such as Kalkudah, Punnakudah and Valaichchenai. In certain places 10–15 metres of the beach had been eroded during the cyclone. Sand mining is practised on a limited scale in the area from Kalkudah to Pottuvil. This was observed mostly in areas such as Naddhankudi, Mannanai and Kaluwanchikudy, where new housing schemes were started recently. As a result of sand mining certain parts of the Kalmunai town had come under the threat of erosion. Although there are well developed coral reefs between Valaichchenai and Batticaloa, coral mining has still not reached serious proportions. However, it was practised on a large scale in 1979 around Kalkudah and Panichchankerni. Coral mining is now confined to a small area around Tirankulam and Kaluwanchikudy. At Kaluwanchikudy, large heaps of sand are collected to prepare mounds for betel and vegetable cultivation.

Environmental pollution by waste disposal is not very marked on the East Coast except near Batticaloa. However, chemicals and other effluents from the Valaichchenai paper mill are diverted to a canal leading to the beach. Although pollution due to these industrial wastes is not clearly observable in this area, it can become a serious threat in the future. The processing of fish on the beach, though not a serious pollution problem yet, can affect tourism in certain areas.

The clearing of coastal vegetation for chena cultivation has been observed in several parts of the Coastal Zone. Unlike in the interior of the country, forest clearance along the coast, can lead to accelerated wind erosion of the terrain so exposed owing to the sandy nature of soils. In some places between Pottuvil and Batticaloa, sand is blown away during the dry season and tends to be deposited in the paddy lands and highland plantations. Chena cultivation was also observed in the Coastal Zone between Foul Point and Vakarai.

CHAPTER IX

THE SOUTHEASTERN COASTAL ZONE

9.1 Location

The segment of the coast that extends from Pottuvil to Hambantota is defined as the Southeastern Coastal Zone. The total length of this zone covered by the field survey was approximately 127 km. It is located within the longitudes $81^{\circ} 31' E$ and $81^{\circ} 50' E$ and latitudes $6^{\circ} 08'$ and $6^{\circ} 51'$. The northern part of this zone between Pottuvil and Kumbukkan Oya falls within the Amparai Administrative District and the area to the southwest of Kumbukkan Oya falls within the Hambantota District. In general the coastline faces a Southeasterly direction.

9.2 Prominent Land Marks

The Southeastern Coastal Zone represents an area which is not much affected by human activities, except around Pottuvil in the north and Hambantota in the south. Nevertheless, there is evidence to suggest that this area has had human settlements since the early periods of Sri Lanka's history.

To the south of Pottuvil where the Southeastern Coastal Zone begins, is located one of the most attractive beach resorts of the country – Arugam Bay. Arugam Bay is formed by a small headland near the mouth of the Sittu Aar – a distributary channel of the Heda Oya. The road from Pottuvil ends at Panama – an old Sinhalese settlement located on the right bank of the Wila Oya. Apart from Panama there are also a few other small settlements in the area such as Helawe Eliya and Kumana. Folklore indicates that settlers of Panama and Kumana were people who had fled from the Kandyan territory after the rebellion of 1818. From Panama begins a coastline with frequent sand-bars and dunes interrupted only by the estuaries of rivers and numerous lagoons which bear ancient Sinhalese names. The Yala National Park begins at Okanda and extends up to Palatupana. The section of the Park between the Kumbukkan Oya and the Menik Ganga is considered a part of the Strict Natural Reserve. Geologically important Miocene sandstone beds are found at Minihagalkanda located between Uda Potana and Agara Eliya. Coastal settlements begin to appear again after Palatupana. Kirinda is one such important settlement where the famous Sinhalese queen Viharamaha Devi is believed to have landed. However, a similar claim is made by Muhudu Maha Viharaya located at Pottuvil. According to the latter claim, Queen Viharamaha Devi landed at the site of Muhudu Maha Viharaya and had her wedding ceremony at the site of Magul Maha Viharaya at Lahugala where the matrimonial pedestal is still preserved. Before reaching Hambantota which marks the end of the zone, one comes across Bundala and Koholankala which are famous for their salterns, lagoonal fishing and buffalo curd. A sand-bar developed at the mouth of Bundala Lagoon is one of the most picturesque coastal formations one comes across in a journey along the coastal zone of the Island.

9.3 Environmental Setting

The climate of the Southeastern Coastal Zone may be described as semi-arid except between Pottuvil and Panama, where Dry Zone characteristics prevail. In other parts of this zone, the rainfall conditions are more or less similar to those in Mannar. Thus at Hambantota the mean annual rainfall is 1075 mm, while that in Yala is around 950 mm. The seasonal variation in rainfall at Hambantota is however not so great as in most other parts of the Dry Zone. Panama on the other hand receives an annual rainfall of 1560 mm. The mean maximum temperatures remain high, around $85^{\circ}F$, while the mean minimum temperatures do not fall below $75^{\circ}F$. At Hambantota the dominant wind directions are northerly and northeasterly during the November-January period and southwesterly and westerly during the April to October period. Thus southwesterly winds prevail for a longer period throughout the entire dry season. This climate favours the formation of sand dunes aided by an environment of xerophytic vegetation.

There are two famous lighthouses bearing the names Kuda Ravana Kotuwa (Little Basses) and Maha Ravana Kotuwa (Great Basses) located off the Southeastern Coast (Douglas 1874). The isobaths near the southeastern shoreline indicate a somewhat complicated submarine

topography which is not usual in most other parts of the continental shelf. Here one can find submarine ridges parallel to the coastline, formed at 5 fathom and 10 fathom isobaths. Geologically, the entire Southeastern Coastal Zone is made up of Bintenna Gneisses except in a small area where Miocene sandstone beds such as those at Minihagalkanda are found. Bintenna Gneisses belong to the Vijaya series of rocks which were formed during the Precambrian age. The Minihagalkanda beds are considered important from a geological point of view owing to the dearth of geological deposits of that age in the Island. These beds outcrop in an area of about 5 km. located to the east of the Manik Ganga estuary. They extend about 0.4 km. inland from the shoreline and are dissected in some places. by gully erosion. The lowest layer of these beds is formed of ferruginous grit and sandstone which are non-fossiliferous. This is overlain by a thick layer of grey and yellow sands and clays. The topmost part of the beds contain a fossiliferous limestone cover. Apart from sandstones, almost all other rock outcrops are made of banded gneisses which become visible occasionally at headlands and similar locations. The beach materials, mainly dune sands and alluvium, cover the rest of the coastal zone.

9.4 Results of the Field Survey

The geomorphological observations made during the field survey (Appendix Table 13) indicate that only 4 percent of the coastline can be considered as straight coastline. This is a much lower figure for that category than that for the Eastern Zone. The rock outcrops (24%), lagoons (21%) estuaries (17%), bays (15%) and headlands (11%) produce a varied coastal landscape in this area. However, the most dominant feature of this coastal zone is the presence of sand dunes of varying sizes. In most places these dune fields extend from 200–to 1000 m. inland from the highwatermark.

The location of some of the prominent dune fields are as follows:

<i>Coastal Tract</i>	<i>Approximate length of dune field (km)</i>	<i>Approximate width of dune field (m)</i>
(i) from Kirindi Oya estuary towards Kirinde	03	300
(ii) from Amaduwa to Patanangala	12	100–200
(iii) from Patanangala to Menik Ganga estuary	07	300
(iv) from Uda Potana estuary towards Panama	05	100
(v) from Andarakala lagoon to Girikula lagoon	08	300–800

The highest of these dunes vary between 3 to 10 metres in most places, although sand dunes exceeding 10 metres are not uncommon. There is a variety of dunes including berms, fore-dunes, cliffed fore-dunes, and parallel dunes. There are also a number of crescentic dunes in the area between Patanangala and Okanda. Most dune fields were observed to be under littoral woodland when they extend beyond 200 m. from the high-water mark.

Rock outcrops other than Minihagalkanda sandstones, could be seen in several places. Some examples are Kirinda, Palatupana, Amaduwa, Patanangala, Butawa and Kimbulagala. They extend right up to the waterfront in places such as Kirinda, Patanangala and Amaduwa.

The Southeastern Coastal Zone is also a zone of many lagoons and bays. At least 16 major lagoons and 6 prominent bays can be seen between Bay and Embilikala lagoon near Hambantota. There are at least 12 salterns of different sizes associated with these lagoons. A large number of estuaries are formed in this zone by the rivers and Oyas flowing south eastwards. Some of the prominent estuaries are those of the Heda Oya, Wila Oya, Manik Ganga and Kirindi Oya. Sea cliffs which are not too common on Sri Lankan coasts can be seen in several places of the Southeastern Zone. The cliffs at Kirinde, Hambantota, Butawa, Patanangala and Itikala lagoon provide some examples. Most of these cliffs are associated with headlands; at least 11 headlands can be seen along the coastline between Hambantota and Pottuvil.

Table 9.1
Dominant Human Activities in the Coastal Zone from Pottuvil to Hambantota

Segment of the coast line	Length of coast line (km)	Number of kilometres at which specified activities were observed					
		Fishing				Other activities	
		Beaching boats	Off shore	Ma-del	Pawn & crab	Tourism	Salt Industry
Pottuvil to Heda Oya	07	02	01	02	–	04	–
Heda Oya to Hambantota	120	20	01	02	03	03	06
Total	127	12	02	04	03	07	06
% of kilometres at which the specified activities were observed (for each group)	100	9.45	1.57	3.15	2.36	5.51	4.72
% of total mentions (for each major group)	100	63.15	10.52	21.05	15.78	53.84	46.15

A large proportion of the beaches (69%) covered by the field survey were sandy beaches. However, there were rocky beaches along the coastline between Palatupana salterns and Amaduwa. Silty beaches were almost totally absent in this coastal zone. Although the dominant colour of beach sands was white (41%) there were considerable stretches of black sands (35%), brown sands and beach sands of other colours were also found occasionally.

The information collected on the history of the shoreline indicates that in some 30% of the distances covered the shoreline was receding, while it was recorded that it is developing along 17 percent. The average rate of recession per annum was around 0.96 m. while the rate of development was only around 0.34 m. Therefore, in general the Southeastern Coastal Zone can be considered as a zone where erosion predominates.

The observations made on natural vegetation in the area are listed in Appendix Table 14. This shows that in 93 percent of the distances surveyed the dominant vegetation type was dune vegetation. The three types of vegetation observed on sand dunes, namely creeping vegetation, shrubs and woodlands show some zonation parallel to the coastline in many places, with creeping vegetation near the shore and woodlands towards the landward margin of the Coastal Zone. In the Coastal Zone between Patanangala and Panama littoral woodlands even reach the high-water mark where elephants roam. Most woodlands exhibited thorny (eg. Pathok, Daluk and Kukulkatu), stunted and gnarled habits (e.g. Eraminiya and Demata), which are common to semi-arid climates. Other types of vegetation observed apart from dune vegetation, were sandy sea-shore vegetation (20%) and mangroves (14%). Although salt marshes were almost absent, grass dominated vegetation types (6%) were observed on a few stretches.

Due to the sparsely populated nature of the area and the presence of the Yala National Park, only a few scattered human activities were found in the Southeastern Coastal Zone. These included fishing, tourism and the salt industry (see Table 9.1). These activities were also concentrated mainly in the Pottuvil to Panama and Hambantota to Palatupana stretches. The rest of the area falls within the Yala National Park. Nevertheless, the Hambantota salt industry and tourism at Arugam Bay are well known activities in the area. Although observed to be practised only along less than 10% of the coastline surveyed, beaching boats were the most popular method of fishing. The other forms of fishing were observed only in a few places.

9.5 Problems and Areas of Concern

It appears that the fishing industry has much scope for development in this area. In spite of the presence of many lagoons in the area, lagoonal fishing is concentrated mainly along the Pottuvil coast. Fishing in the areas falling within the National Park, particularly around Patanangala, is limited to migratory fishermen holding permits issued by the Fisheries Corporation. This occasionally leads to minor disputes between fishermen and Wild Life Department officials.

The tourist industry as at present is concentrated in such places as Arugam Bay, Amaduwa and Hambantota. The demand for land is on the increase. Particularly in the Coastal Zone between Pottuvil and Ulla. In this area tourist 'cabanas' are a very frequent sight. Despite the poor facilities offered this area had become attractive to tourists due to the certain rare freedom they can enjoy on some sections of the beach. Although there is hardly any environmental pollution in these areas at present, there is what one may call 'cultural pollution'. A hotel project which was started near Panama had apparently been abandoned on the orders of the Government because of its proximity to the Ruhunu National Park.

The natural facilities available for salt manufacture in this area also seem to be under-utilized. Despite the many lagoons which are suitable for salt, production only the salterns at Malala, Koholankala, Maha Lewaya, Bundala and Palatupana were found to be functioning. Several other salterns which functioned in the past have apparently been closed down.

CHAPTER X

THE SOUTHERN COASTAL ZONE

10.1 Location

The coastal strip between Hambantota and Galle is defined here as the Southern Coastal Zone. It is located between longitudes 80°.13' E, and 81°.09' E and latitudes 6°.02' N to 6°.08' N. The total length of coastline surveyed was 123 kilometres.

10.2 Prominent Features

In the coastal tract from Hambantota to Tangalle a continuation of most features of the Southeastern Zone can be observed. A series of lagoons and lewayas such as Karagam lewaya, Lunawa kalapuwa, Kalamatya kalapuwa and Rekawa kalapuwa are found along this stretch. Similarly, beaches with sand dunes form another major coastal feature. Several estuaries are formed by streams such as the Walawe Ganga, Ranna Oya and Kirama Oya. Proceeding further westwards from Tangalle, one observes that the number and the size of lagoons decrease rapidly, the only exceptions being the Mawella kalapuwa and the Koggala lake. Similarly, the frequency of occurrence of sand dunes diminishes and rocky beaches become a dominant coastal feature between Tangalle and Dikwella.

The southernmost tip of the Island represented by the Dondra Head is located between Dikwella and the estuary of the Nilwala Ganga. Matara which is situated at the estuary of the Nilwala Ganga is the largest town on the southern coast. Almost the entire coastline from Dikwella to Galle is marked by narrow sandy beaches, a few headlands and some small cliffs. The Weligama Bay and the Galle Harbour form two prominent bays of the south coast. Both the Nilwala Ganga and Polwatta Ganga which are two major southern rivers in the south exhibit unique meandering paths before they reach the sea. From Dikwella the main road to Colombo runs quite close to the beach in many places, thereby exposing itself to the threat of marine erosion. The Fort of Galle which marks the end of the Southern Zone is built on one of the most prominent headlands of the entire coast of Sri Lanka. Both Matara and Galle are historic cities which gained great prominence during the period of European colonial rule.

10.3 Environmental Setting

The climate of the Southern Coastal Zone changes from the dry, warm and seasonal climate of Hambantota, through the Intermediate Zone represented by Tangalle, to the warm and humid Wet Zone climate of Galle. The mean annual rainfall figures for Hambantota (1075 mm.) Tangalle (1342 mm) and Galle (2573 mm) indicate this change quite clearly. The marked seasonality of the Dry Zone type rainfall climate of Hambantota gradually becomes blurred when one proceeds westwards and finally at Galle a year round moisture surplus regime becomes the general pattern. This distinct variation of climatic types in the Southern Zone manifests itself in the formation of characteristic coastal features, and particularly in those associated with the occurrence of beach dunes. The transition of climatic conditions along the coast from dry to wet types is also reflected to a considerable extent in the coastal plant communities.

The entire Southern Coastal Zone is underlain by Precambrian rocks of the Tijayan series. The dominant rock types are charnockites, granites, gneisses, granulites and quartzites. Some near-shore sandstone beds of the Miocene age can be observed in a few sites at Devundara, Kottegoda, Ahangama, Hungama and Ussangoda. These sandstone beds become clearly visible at low-tide in certain places. Most of the low cliffs in the Southern Coastal Zone are formed of either granites or laterites. The occurrence of laterites becomes more and more frequent as one approaches the Wet Zone. The coral reefs which represent an important organic element in the area are often seen along the breaker zone of waves. Most coral deposits belong to the Holocene age and are relatively resistant to marine processes. The parent rocks occasionally outcrop at headlands and cliffs. In other places they are overlain by superficial material such as beach sands, sand dunes and river alluvium.

10.4 Results of Field Survey

Some results of the observations made on coastal features during the field survey are given in Appendix Table 15. This shows that cliffs (48%) in the Southern Coastal Zone are as im-

portant as straight coast lines (47%). This is unique when compared with other areas of the country. Boulders are observed in 39 percent of the distances covered while reefs were seen in 38 percent of them. The bays (38%) and headlands (30%) also occupy an important place among the coastal features observed in the Southern Zone. However, lagoons, bays and sand-spits are concentrated mainly in the stretch between Hambantota and Dondra Head. Similarly, cliffs, headlands, boulders and rock outcrops were mostly concentrated along the coastline from Tangalle to Dondra Head. On the other hand straight coastline are the dominant feature between Matara and Koggala.

The observations made on the nature of beach material indicate that beaches were sandy in 72 percent of the distances covered by the survey. Cobbles and pebbles were found in 32 per cent while silty beaches were observed in 17 per cent. A clear variation was observed in the colour of beach sands in the eastern and western parts of the Coastal Zone. White sands were dominant in the area from Weligama to Galle, while brown, black and other coloured sands were frequently found between Hambantota and Weligama.

The information collected on the history of the coastline, shows that in 85 per cent of the distances covered, in the survey, the shore line was receding. This was most conspicuous between Dondra Head and Unawatuna. The average rate of recedence per annum was reported to be around 0.95 mm. Developing beaches were observed only between Hambantota and Tangalle and at the Weligama bay. The average rate of development is reported to be in the region of 0.30 m. Thus, in general, the rate of recedence was found to be more than three times the rate of development in the Southern Coastal Zone.

The observations made on vegetation types in the area surveyed, indicates that sandy seashore vegetation is present almost throughout the entire zone (97%). (see Appendix Table 16). Nearly 80 percent of the sandy shore vegetation was found to be creepers. However, shrubs and littoral woodlands were mostly seen on the coast between Hambantota and Dondra Head. Dune vegetation, salt marshes and mangroves were observed to have an equal distribution of about 20 percent each of the distance covered. These three types of vegetation were also concentrated mainly in the area between Hambantota and Tangalle. Most of the mangroves observed were mature while thorn scrubs dominated the salt marsh species. Although forest type vegetation was limited to small patches specially around Hambantota, some grass cover was observed throughout the coastal zone, with concentrations between Hambantota and Dondra Head. In general, the occurrence of natural vegetation types decreased rapidly from Hambantota to Dondra Head. Some of the plant species observed in the Southern Zone are listed in Table 10.1 below:

Table 10.1
Coastal Plant Species observed in the Southern Coast Zone

<i>Pedaliium murex</i> (Pedalicaceae)	ඇත් මනලර පි
<i>Sesuvium portulacastrum</i> (Ficoideae)	මහ සාරණ
<i>Emilia sonchifolia</i> (Compositae)	කඩ පහර
<i>Phyla nodiflora</i> (Verbenaceae)	පිරිමන ඇත්ත
<i>Hydrophylax maritima</i> (Rubiaceae)	මහල ගැල මකාල
<i>Ipomea pescaprae</i> (Convolvulaceae)	මහල බිත්තියරුව
<i>Indigofera enneaphylla</i> (Leguminosae)	රත් මකාමනාස
<i>Crotalaria podocarpa</i> (Leguminosae)	අඹනගිවිය
<i>Phaseolus trilobus</i> (Leguminosae)	බිං මැ
<i>Canavallia podocarpa</i> (Leguminosae)	මහල අවර
<i>Euphorbia rosea</i> (Euphorbiaceae)	මුදු අඳ කිවිය
<i>Agyneia bacciformis</i> (Euphorbiaceae)	ඇත් මිටපක්කා
<i>Tribulus terrestris</i> (Zygophyllaceae)	මහකප
<i>Spinifix littoreus</i> (Graminae)	මහ රාමනා රිචල
<i>Cyperus arenarius</i> (Cyperaceae)	මහල කළාගරුව
<i>Jatropha curcas</i> (Euphorbiaceae)	රට මඩුව
<i>Pandanus tectorius</i> (Pandanaceae)	මහල මැලමකයිසා
<i>Stchetarpheta indica</i> (Verbenaceae)	හඟ මහල
<i>Barringtonia speciosa</i> (Lecythidaceae)	පුද්දිල
<i>Barringtonia racemosa</i> (Lecythidaceae)	දිය මිදෙල්ල

Table 10.2
Dominant Human Activities in the Coastal Zone between Hambantota and Galle

Segment of the coast	Length of coast line (Km)	Number of kilometres at which specified activities were observed										
		Fishing					Other Activities					
		Beaching boats	Off shore	Ma-del	Lagoon	Prawns & crab	Dry fish wadi	Coral mining	Sand mining	Tourism	Coconut based industry	Palmyra based industry
Hambantota to Tangalle	41	06	05	22	08	25	01	04	01	02	02	
Tangalle to Dondra Head	34	16	12	16	02	07	01	03	07	04	25	
Dondra Head to Matara	05	04										
Polhena	03	02							02	01	03	
Polhena to Weligama Bay	08					01		04	05	01	04	
Weligama Bay	08	05		01					01	02	03	01
Weligama Bay to Koggala	12	07						06	05	02	11	
Koggala to Unawatuna	07	01						03	03		07	
Unawatuna	05	04	01					01		02	03	
Total	123	45	18	40	10	33	02	23	25	13	60	01
% of kilometres at which the specified activities were observed (for each group)	100	36.59	14.63	32.52	8.13	7.20	1.63	18.70	20.33	10.57	48.78	0.81
% of total mentions (for each group)	100	30.40	12.16	27.02	6.75	22.29	1.35	18.85	20.49	10.65	49.18	0.81

The results of observations made on dominant human activities in the Southern Coastal Zone are listed in Table 10.2. This shows that fishing, coconut based industries, coral and sand collection and tourism are the major activities in the area. Beaching boats were observed almost right along the coast. However, much of the fishing activities other than beaching boats were concentrated in the area between Hambantota and Dondra Head. Thus ma-del fishing, lagoonal fishing and dry fish wadi were hardly ever observed along the coast between Dondra Head and Galle. The prime fishing area in the Southern Coastal Zone appears to lie in the stretch between Tangalle and Dondra Head. Here, 3 1/2 ton boats and 17 1/2 feet fibre glass boats are used for off-shore fishing. A large number of fishermen also migrate from places such as Kottegoda and Kudawella during the off season (Premadasa 1979). A list of the more important types of fish caught in the Southern Coastal Zone is given in Table 10.3.

Among the other prominent activities of the area, coconut based industries were observed in nearly 50 per cent of the Coastal Zone with more or less on an even geographical distribution. Similarly, sand and coral mining activities were also widespread and observed in about 20 per cent of the area surveyed. The collection of corals is done in the following ways:

- (a) mining in inland areas near the coast;
- (b) collection of pieces of coral that are washed ashore;
- (c) the breaking of offshore live coral reefs
- (d) large scale removal of stratified sea shells, particularly in the Hatagala, Kalamatiya and Hungama areas.

Of these different types of coral extraction the first type is practised particularly around Galle in real mining style using water pumps, labour gangs etc.

Tourism provides one of the important sources of income for coastal residents of the Southern Coast. Thus small-scale tourist guest houses are observed at Tangalle, Dondra Head and Polhena. Larger hotels are seen at Galle and Koggala where one of the longest beach side hotel structures in the country can be seen.

Table 10.3

Some Common Fish Varieties caught in the Southern Coastal Zone

<i>Sphyraena obtusata</i>	පනලියා
<i>Sphyraena jello</i>	දිලොටා
<i>Sillago sihama</i>	කැලන්දා
<i>Lactarius lactarius</i>	පපුන්දා
<i>Carangoides malabaricus</i>	පහලියා
<i>Gnathanodon speciosus</i>	කැබර පටුලා
<i>Chorinemus lysan</i>	නිල් කටුලා
<i>Chorinemus tala</i>	භංකටුලා
<i>Pristipomoides typus</i>	කැලියා
<i>Lutianus kasmira</i>	ඉටි රන්දා
<i>Leiognathus splendens</i>	කැබ කැබල්ලා
<i>Leiognathus equulus</i>	පස්කැබල්ලා
<i>Otolithus ruber</i>	පන්දා
<i>Rastrelliger kanagurta</i>	කුම්බලා
<i>Katsuwonns pelamis</i>	කැලියා
<i>Euthynnus affinis</i>	ඉපුලියා
<i>Chiloscyllium indicum</i>	කැන පොරු
<i>Ginglymostoma ferrugineum</i>	පැකැල් පොරු
<i>Rhincodon typus</i>	දිනිපතු පොරු
<i>Galeocerda Cuveri</i>	පකාටි පොරු
<i>Scoliodon sorrakowah</i>	භතුරු පොරු
<i>Scoliodon palasorrah</i>	කිටි පොරු
<i>Hypoprion macloti</i>	භද්ද පොරු

Squalus zygaena	දරුණු මාලු
Raja djiddensis	කිටි මාලු
Raja lyma	ඒක මාලු
Raja Uarnak	මාලු මැහැරුණු මාලු
Raja Narnak	මාලු මැහැරුණු
Raja Narinaria	මාලු මැහැරුණු

10.5 Problems and Areas of concern

It could be seen from the data given in Appendix Table 15, that the erosion hazard in some parts of the Southern Coast is reaching serious proportions. Studies conducted by Zeaper (1960), Eaton (1961) and Swan (1974) also indicate the different localities of the zone where the erosion problem is most acute. It is generally believed that the erosion threat is greater in the more densely populated areas in the western parts of the Southern Zone. During the field survey it was observed that the erosion problem exists locally in places such as the beach facing Galle Bazaar, Kataluwa, Ahangama, Wella Devalaya area of Unawatuna, Kapparatota, Gandara, Kottegoda and Tangalle. A moderate rate of erosion could be observed in places such as Polhena, Matara, Rekawa and the Hambantota town area.

With increasing density of population and the concomitant increase of human activities, pollution of coastal areas becomes a common phenomenon. In the Southern Coastal Zone pollution occurs in several ways. The mining of inland coral in the coastal zone has left behind a large number of abandoned pits in areas such as Galle, Kataluwa, Ahangama and Polwatu-modera. The pollution of coastal waters by petroleum oils could be seen at the Galle Harbour, Mirissa and Tangalle. Similarly, at the salterns where diesel engines are used for pumping water, the diesel oil from these engines tends to pollute the surrounding water bodies. In the more urban areas of the Southern Coast sewage outfall structures and waste disposal points pollute the beaches.

Coconut based industries were observed frequently in most part of the Southern Coastal Zone. The processing of coconut husks for coir extraction involves retting them in stagnant pools of water for several months. This causes pollution of most water bodies in the coastal zone and creates obnoxious smells in many areas.

CHAPTER XI

THE SOUTHWESTERN COASTAL ZONE

11.1 Location

The Southwestern Coastal Zone is defined as that stretch of the Coast which extends from Galle to Colombo (Lighthouse). It is situated between the longitudes 79°.50 E and 80°.15'E and the latitudes 6°.00'N to 6°.56'N. The total length of the Southwestern Coastal Zone covered by the field survey was 135 km. This area is depicted in 5 one-inch topographical map sheets and 26 aerial photographs (1:40,000). Almost the entire coastline faces the Southwest, thereby exposing itself to the full brunt of the Southwest monsoon.

11.2 Prominent Features

The Southwestern Coastal Zone is the most densely populated part of the country. Therefore, most of the coastal resources of the area are heavily utilized, and there are even signs of over-exploitation in several cases. The coastal tract from Galle to Gintota is a densely populated area most of which falls within the Galle Municipality. The Gin Ganga estuary is the first major land mark one comes across in the journey from Galle to Colombo. The Gin Ganga which carries about 1446×10^3 acre feet of water annually (Bocks, 1959) also carries a heavy sediment load. As a result an impressive sand bar is formed at its mouth. From Gintota to Bentota is a series of lakes, lagoons and lowlying areas. Some of the prominent lakes are Ratgama Lake, Madampe Lake, Randombe Lake and Dedduwa Lake. Many southwest flowing streams such as the Hikkaduwa Ganga, Talawatte Ganga and Madu Ganga tend to form lagoons of varying sizes. There are large marshlands around Akurala and Madampe Lake. In this part of the coast Hikkaduwa and Bentota are two of the well known tourist resorts in Sri Lanka. The Randombe-Balapitiya area with its numerous headlands and curved beaches forms one of the most picturesque coastal landscapes on the southwest coast (see Fig. 5).

The Bentara Ganga is the second major river to the north of the Gin Ganga. The lakes and lagoons which are so numerous in the Gintota-Bentota stretch become less frequent to the north of Bentota. The only exceptions are the Bolgoda Lake at Moratuwa and the Beira Lake in Colombo. However, there is reason to believe that some of the low-lying paddy lands in the interior areas around Kalutara formed lakes in the past. The Bentota Ganga which marks the boundary between Pasdun Korale to the north and Walallawita Korale to the south had been an important cultural boundary in recent periods of history. There is a saying among the Sinhalese, that, 'not even a kitten should be brought from beyond the Bentota Ganga if it had already opened its eyes'.

An examination of air-photographs in the area around the estuary suggests that the river had possibly changed its course in recent periods of geological history. The Bentota Ganga also forms a long sand bar at its mouth creating the beautiful Bentota Beach.

The coastal tract between Aluthgama on the right bank of the Bentara Ganga and Kalutara on the left bank of the Kalu Ganga has some prominent headlands in the Southwest Coast, such as those at Beruwala and Maggona. This is an area of predominantly Muslim settlements. The Kaluganga which has a basin area of some 2690km² carries a larger volume of water (6190×10^3 acre feet) than any other river in the Island. The enormous amount of river sediment transported by the river has led to the formation of two sand bars at its mouth creating a small lagoon in the Kalutara South area.

The coastal zone between Kalutara and Colombo forms the most densely populated area of the Island. From Paiyagala the railway line runs continuously along the coast with the Colombo – Galle Road on its right. Thus both the railway tract and the Galle Road remain under the threat of erosion in several places. As one elderly resident of Sinigama remarked during the field survey, the present road is the 'third Galle Road' in the Werallana-Totagamuwa area. This area also has pollution problems created by an urban environment, where for a long time the beach and the lagoons have been considered to be dumping grounds for solid wastes and outlets for sewage disposal.

11.3 Environmental Setting

The climate of the Southwestern Coastal Zone belongs to the 'hot-wet-lowland tropical' type. Galle and Colombo are the two main meteorological stations in this area with fairly long weather records. The mean annual temperature at both stations is in the same range with 77.6°F (25.2°C) at Galle and 80.5°F (26.95°C) at Colombo. The annual seasonal variation of temperature is almost negligible. Similarly, mean annual rainfall in Colombo is around 94.31 in (2400 mm) while at Galle it is 98.95 in. (2514 mm). Thus although the rainfall in Galle is slightly higher, both Colombo and Galle exhibit basically similar climatic characteristics. There are however certain differences in the wind directions and velocities between Colombo and Galle during different seasons. Thus in Colombo the dominant wind direction in the period from March to October remains southwesterly and westerly. In Galle, westerly winds remain dominant during the period from April to October while southwesterly winds remain weak in July and August. Thus the dominant wind direction during the South-west Monsoon remains westerly in Galle while it is southwesterly in Colombo. Similarly, observations made on wind velocities indicate that Colombo can experience daily wind mileages of over 150 (240 km) during the May to September period. The daily wind mileages in Galle on the other hand appear to be much higher throughout the year and exceed 250 (400 km) in the period from May to September. This shows that the geographical location of Galle makes its coast more vulnerable to wave action and other related coastal processes generated by the strong westerly winds.

Almost the entire Southwestern Coastal Zone is underlain by metamorphosed and partly migmatized rocks consisting of charnockites and metasediments. These are granulite facies rocks belonging to the Pre-Cambrian age. Calc granulites and gneissic rocks are often seen in the area around Galle, Gintota, Arangaia and Aluthgama. In the area between Aluthgama and Beruwela the main rock type is garnet-sillimanite-granites and biotite garnet-graphite-gneisses. Most of the headlands observed on the southwestern coastline are made of charnockites and granitic gneisses. At the southern end of the Galle Harbour area there are some crystalline limestone rock outcrops.

Laterite occurs as a surface duricrust of variable thickness over the crystalline rock basement. It is particularly noticeable in areas such as Dadella, Hikkaduwa, Beruwela and Maggona. The headland areas of Magalkanda, Naigala and Molligoda are formed of an indurated lateritic cover. Quarternary alluvial deposits form a common type of superficial cover over the bedrocks, particularly in the valleys and estuaries of the Gin Ganga, Bentara Ganga, Kalu Ganga and Panadura Ganga. Unconsolidated sands and littoral sandstones are found at the sand bars and sand spits along the coast. A few peaty areas are also found in the flood plains of Bentara Ganga, and the Kalu Ganga and several other marshy lands. Along the inland margin of the coastal zone, at least four different types of soil were observed, namely,

- (a) red yellow podzolic soils with soft or hard laterite in rolling or undulating terrain,
- (b) bog and half-bog soils on flat terrain,
- (c) alluvial soils of variable texture on flat terrains and
- (d) regosols or recent beach sands, also on flat terrain.

11.4 Results of the Field Survey

The observations made on the nature of the coast in the Southwestern Zone are summarised in Appendix Table 17. This shows that the most dominant feature of the area was a straight coastline, which was observed in some 87 per cent of the distances covered. In terms of the frequency of observation, beaches with rock outcrops came second. Reefs were observed in some 29 per cent of the coast line while headlands were seen in 23 per cent. In most headlands there were cliffs and stacks. In the Maggona headland there are cliffs as well as sea holes. One example is the Ginnanguliya cave which, according to the villagers, extends about 3 miles inland. Bays and estuaries were also observed in 18 per cent and 17 per cent respectively of the total distance covered. Sandspits which were observed mostly along the estuaries and deltas were not so common. In general, erosional features were found to be far more frequent than depositional ones in the Southwestern Coastal Zone. Although off-shore islands do not form a major landscape feature in the Southwestern Coastal Zone, there are many rocky islets which are larger than average rock outcrops. Some of the prominent ones are the Hikkaduwa Bird

Sanctuary islets, Sinigama Island, Nanga Andu Gala, Kaputuduwa, Kaikawalagala and Kaluwamodera Island. It is possible that most of the islands and islets in the area from Hikkaduwa to Maggona had been connected to the mainland in the past.

The observations made on beach materials indicate that 88 percent of the Southwest coast had sandy beaches. There were only 10 percent silty beaches. The beaches with pebbles and cobbles were rather rare and very localised. The dominant colour of the beach sand was found to be brown, while white sands were observed mostly between Galle and Hikkaduwa. Some of the brown sands around Beruwala had high natural radioactive levels. Black sands were observed here and there throughout the entire zone except between Thalpitiya Ela and Colombo. Black sands were particularly noticeable in the Kosgoda-Induruwa stretch and in the Kalutara-Thalpitiya Ela stretch.

The information collected mostly from coastal residents on the history of the coast line shows that in some 81 percent of the distance covered, in the survey the shore line had receded. Only in 21 percent of them had some shore line development in the past 20–30 years taken place. These developing beaches were mostly associated with the Gin Ganga, Bentara Ganga and Kaluganaga estuaries. The average annual rate of recession of the coast line in the South from the coastal tract between Maggona and Thalpitiya was where the coastline receded between 20–40 metres within a period of 20 to 30 years. A similar rate of recession was reported from the area between the Bentara Ganga estuary and the Beruwela lighthouse. Some villagers reported that rock outcrops in the area from Mahamodera to Dadalla formed part of the mainland 20 to 30 years ago. In the Akurala area near the 52/2 culvert the ruins of an old Colombo–Galle Road could still be seen. Some old maps of the Hikkaduwa area available in the Survey Department show how Sinigama Devale island was depicted as a tombola about 50 years ago (Fig. 6).

The observations made on the coastal vegetation types are listed in Appendix Table 18. This shows that sandy seashore vegetation was almost ubiquitous (97 percent) throughout the zone. Among the sandy sea shore vegetation communities, low creeping vegetation types such as *Ipomea pescaprae*, *Cenavalia josea* and *Spinifex littoreus* were the dominant species. Among the low shrubs were plant species such as *Scaevola sericea* (කක්කඩ) which could be seen in the areas of Balapitiya, Aluthgama, Maggona and Paiyagala. *Clerodendrum inerme* (මකන්මහන්ද) *Morinda citrifolia* (ඉතලය) and *Pandanus tectorius* (පැටපකයික) were observed here and there along the coast line but mostly in the areas of Mahamodera, Beruwala, Maggona and Paiyagala.

The other major vegetation type along the southwest coast besides sandy sea shore plant communities, observed was mangrove vegetation which was noticed in at least 31 per cent of the distance covered. Most mangroves observed were mature and highly localised, particularly along the landward margins of river mouths in the Kosgoda, Maggona, Paiyagala and Waskaduwa areas. The dominant mangrove species included *Bruguiera* (පල්කට්ටු) *Avicennia* (පණ්ඩ) *Excoecaria* (මකල) *Lumnitzera* (කැට්ට) and *Aegiceras* (ගින්න කට්ටු). There were many other species of shrubs such as *Terminalia catappa* (මකාට්ටු) *Calophyllum Walkeri* (කින) and *Cerbera manghas* (කළුපුල්) and *Scaevola sericea* (කක්කඩ) scattered here and there along the coast.

The information collected on dominant human activities in the zone is given in Table 11.1. This shows that fishing is the most important activity and was observed in over 75 percent of the Coastal Zone surveyed. The most common method of fishing in the area is by beaching boats and is practised in all the 17 segments of the coastline. Madel which formed the next most popular method of fishing was observed mostly in the area between Kosgoda and Thalpitiya Ela. Off-shore fishing was confined mainly to the Galle and Beruwela areas. A list of the varieties of fish caught in two important fishing areas around Ambalangoda and Paiyagala is given in Appendix Table 19. There is also some fresh water fishing in the numerous fresh water lakes located close to the coastline.

There are several activities in the Southern Coastal Zone other than fishing. These include coconut based industries, tourism, sand mining, coral mining, and mineral extraction. Of these activities coconut based industries are spread all along the coastal zone and observed in at least

Table 11.1
Dominant human activities in the Coastal Zone from Galle to Colombo

Segment of the coast line	Length of coast line (Km)	Number of kilometres at which specified activities were observed										
		Fishing						Other activities				
		Beaching boats	Off shore	Ma-del	Lagoon	Prawn & crab	Dry fish wadis	Coral mining	Sand mining	Tourism mining	Coconut based industry	Minerals extraction
Galle Municipal limits ..	14	06	05					02	01	02	06	
Galle to Dodanduwa ..	09	07						08	02	01	09	01
Dodanduwa to Hikkaduwa	09	03						07	03	09	08	02
Hikkaduwa to Ambalangoda	11	11						08	04	02	10	01
Ambalangoda to Ahungalla	10	10							03	02	09	
Ahungalla to Kosgoda ..	05	05							04	01	05	
Kosgoda to Induruwa Rail Gate ..	06	06	01	03		01			01	01	04	
Induruwa Rail Gate to Bentota Estuary ..	07	02		03		01			02	05	05	
Bentota Estuary to Beruwala light house ..	04	03	01							04	04	
Beruwala light house to Maggona head land ..	08	08	03	04			01		01	03	08	
Maggona head land to Kalutara ..	07	05		07					04		07	
Kalutara lagoon ..	05	02		04	01				01	03	03	
Kalutara to Thalpitiya Ela ..	09	05		06	01				02	03	08	
Thalpitiya Ela to Panadura Ganga ..	05	05							02	02	03	
Panadura Ganga to Mt. Lavinia ..	17	16							08	03	10	
Mt. Lavinia to Vanderwert Place ..	02	02										
Vanderwet Place to Colombo ..	07	02										
Total ..	135	103	10	27	02	02	01	25	38	47	99	04
% of kilometres at which the activities were observed (for each group) ..	100	76.29	7.40	20	1.48	1.48	0.74	18.51	28.14	34.81	73.33	2.96
% of total mentions for each group) ..	100	72.02	6.89	18.62	1.37	1.37	0.68	11.73	17.84	22.06	46.47	1.87

73 per cent of the distance surveyed. Toddy tapping, coir products manufacture and coconut wood carving are some of the activities based on the coconut palm which is grown in homesteads and small holdings in the area.

In recent times tourism has gained prominence as a major income generating activity in certain parts of the southwest coast. The well developed tourist centres in this area include Hikkaduwa, Bentota, Beruwela, Mount Lavinia and Colombo. Apart from these main centres, tourism is found on a smaller scale at places such as Narigama, Tiranagama, Patuwatta, Ahungalla and in several places between Ambalangoda and Bentota, and between Kalutara and Hikkaduwa. In fact, in certain areas almost every household in the coastal zone had some involvement with tourism. In several places sections of the beach area have been marked out as 'private beaches', particularly by the bigger hotel owners. This restricts the freedom of local people to move along the beach freely—a freedom they have traditionally enjoyed.

Coral mining forms an important economic activity, particularly in the coastal stretch between Galle and Ambalangoda. Buried coral deposits occur inland in the stretch from Hikkaduwa to Ambalangoda. Mining of this coral has become a flourishing cottage industry. Apart from inland coral mining there are some places where coral is extracted from the off-shore reefs. Coral is used mainly for lime burning in these areas. The mining of coral is believed to be accelerating erosion and threatening the stability of some beaches, particularly those around Hikkaduwa. Sand mining is practised all along the southwest coast particularly around townships.

The extraction of minerals from the land within the coastal zone is observed in several localities. The ilmenite deposit at Kaluwella near Galle has been used for many years. This is a black ilmenite-bearing sand deposit about half a mile in extent. The other mineral sand deposits in the southwest coast include monazite deposits at Kaikawela (near Induruwa) and Beruwela. The beach sand here is rich in monazite and contains as much as 40 per cent of this mineral at certain places. These deposits were exploited from time to time by an experimental plant for separation of monazites. The extraction of mineral sand had also been observed occasionally along the coast between Galle and Ambalangoda.

11.5 Problems and Areas of Concern

Coastal erosion remains the single most important problem in this densely populated Coastal Zone of the Island. The historical information collected on the recession of the shore line shows that considerable tracts of land have been lost through erosion by marine action. In fact the rate of erosion in certain other parts of the country has been found to be even greater than what is observed in the Southwestern Zone. However, due to the pressure of population, land values are much higher in the Southwest. The damage due to erosion is therefore higher than in the most other areas. Similarly, the network of roads, railway and other infra-structural facilities have a higher density in the Southwestern area. Consequently, the potential for erosion damage is much greater in the Southwest than anywhere else in the country. In other words, although the natural rates of erosion in the south-west may not be much different from those in some other areas of the Island, the damage caused by erosion is obviously much higher in the Southwest. Therefore the problem in the southwest becomes primarily a matter of environmental economics and inappropriate landuse.

It is possible to identify three different types of erosional areas in the southwest on the basis of the severity of erosion and erosion damage, namely (a) areas of severe erosion—such as Hikkaduwa, Sinigama, Pereliya, Telwatta, Kahawa, Akurala, Madampagama, Moragalla, Beruwala to Polkotuwa, and Dummal Modara to Maggona. (b) areas of moderate erosion—such as the coast from Galle to Kumarakanda, Kaikawalagala to Induruwa, Katukurunda to Kalutara, Waskaduwa, Korlawella and Angulana. (c) Areas of low erosion. These include some areas where the beach was observed to be developing as at Bentota, and Kalutara.

In recent years, however, in the coastal areas to the north of Hikkaduwa and Beruwala there has been accelerated erosion as an unwelcome result of the construction of breakwaters for new harbours.

The mining of corals and sand and the clearing of natural vegetation cover appears to have disturbed the ecosystems and the sand budget of the coastal zone. The coral reefs provide some natural protection to the beaches. Their destruction paves the way for strong waves to reach the shoreline unhindered. The clearing of vegetation and the removal of sand from the beaches also tend to have an impact on the beaches similar to that of coral mining.

In view of the high population density of the area and the location of large urban settlements, sewage as well as industrial wastes tend to pollute the beaches. The survey revealed that there were more than 22 major sewage outfall structures in the area between Galle and Colombo. The old Sinhala idiom that "all the dirt goes to the Bay of Beruwela" (or its more recent version "all the dirt goes to Beira Lake") vividly summarizes this situation. The booming tourist industry has added to the problem of pollution through construction of beach resorts too close to the water front, although it is against the industry's own interests. Tourism also affects the social and cultural values of coastal residents thereby creating another type of pollution—'cultural pollution'. As noted earlier the freedom of the people to move about freely on the beaches is also hindered by the demarcation of 'private beaches' by some hoteliers.

CHAPTER XII

WATER – FRONT STRUCTURES

12.1 Introduction

The preparation of an inventory of man-made coastal structures is one of the major objectives of the present survey. In view of the fact that the investigations on structures and land use were conducted simultaneously during the field survey, the study of structures was approached in two ways. Firstly an inventory of all the structures found at the water-front during the field survey were inspected and recorded. For this exercise the water-front was considered as the zone of 10 metres bordering the shoreline at the time of the survey. Investigators moved along the beach and recorded information on all the structures that fell within the water-front zone. The houses, hotels and other buildings which came within this zone were enumerated and information about them was recorded in detail. Secondary, all the buildings found within the coastal zone (which extended upto 300 metres) were recorded under the relevant landuse categories as part of the landuse investigations.

12.2 Types of Structures

The field survey revealed that there is a considerable variety of man-made structures at the water-front. A list of these structures is given in Appendix Tables 20 to 28. These structures were classified according to the functions they perform into the following categories:

1. Erosion preventive structures (revetments, boulder walls, masonry walls and groynes)
2. Structures related to ports and harbours (breakwaters, piers, jetties etc.)
3. Residential structures (houses, both permanent and temporary).
4. Tourist and commercial structures (hotels, tourist shops, boutiques, industrial premises and fish sales centres).
5. Transport structures (roads, both major and minor, and railways).
6. Fishermen's huts (including both semi-permanent and temporary sheds put up by fishermen within 10 metres of the shoreline).
7. Other buildings and structures (including various Government buildings).

For each of these categories an enumeration was carried out and all relevant information such as the dates of construction, numbers and sizes were compiled. The effort made here was confined to an analysis of the distribution of these structures in different coastal areas of the Island.

12.3 Structures in the Western Zone

A summary of water-front structures observed in the Western Coastal Zone is given in Appendix Table 20. This shows that among the erosion preventive structures, the most frequent type in the Western Zone comprised of revetments. They were found to be mostly evident in the coastal segment between the Negombo lagoon and the Maha Oya, where about 25 revetments were reported within 9 kilometres. The groynes came next in terms of frequency. Most groynes were seen in areas such as Lansiyawatta to the north of the Kelani Ganga and in the Negombo-Maha Oya stretch. The boulder walls formed the next popular structures in this category, particularly within the stretch between the Kelani estuary and the Negombo lagoon. Masonry walls were also found mostly within the same segment, as well as in the area from Talawila to Puttalam. Altogether there were about 164 erosion preventive structures in the Western Coastal Zone at the time of the survey. In addition, the use of sandbags as a temporary erosion preventive device was observed in Negombo as well as at Kandakuliya.

Almost all the structures related to harbours were seen in the Colombo harbour area. The only exceptions were three jetties observed on the coast between Talawila and Puttalam.

The residential structures included both permanent and temporary dwelling houses. Altogether there were about 1063 houses on the water-front. Although there were about 22 hotels in this zone, only four were found to be on the waterfront. Boutiques, fish sales centres and fishing sheds were mostly seen in the area from Talawila to Puttalam. The large number of

other buildings in the Colombo harbour area were mostly warehouses. The waterfront structures also included the impressive Dutch fortress at Kalpitiya. In the category of transportational landuse some 2km of roads and 3 km of railways were observed within the waterfront zone.

12.4 Northwestern Zone

Compared with most other areas of the country, there were relatively few coastal structures in the Northwestern Zone (see Appendix Table 21). The only noteworthy erosion preventive structures were masonry walls which were observed near Puttalam and in some parts of the Talaimannar Island. The only groyne seen in the area was found at Vankalai. There was a considerable number of permanent (105) and temporary (161) dwelling houses on the water front. Although there were no railways within the waterfront zone except at the Talai-Mannar pier area, there were about 8 km of major and minor roads.

The most numerous structures on the waterfront zone consisted of fishing sheds which were mostly temporary huts put up by fishermen. The presence of these fishing sheds in greater numbers is partly due to the large number of dry fish wadi observed within this zone.

One noteworthy structure observed in the area is the Alli Rani fort at Silavaturai which is under the threat of erosion. Two impressive Dutch forts are found at Mannar and Pooneryn (meaning Flower City). The latter of course lies outside the Coastal Zone. Most of the Dutch forts were built at a time when pearl fishing was very popular. An old lighthouse structure was seen in the Vidattativu village.

The presence of a considerable number of sewage disposal structures around Puttalam is a problem that needs attention.

12.5 Northern Zone

The Northern Coastal Zone represents an area with relatively few coastal structures except near the big cities and towns such as Jaffna, Valvedditurai and Point Pedro (see Appendix Table 22). The most popular erosion preventive structure in this area is the masonry wall. At least 36 masonry walls were observed in this zone during the field survey. Revetments were almost mentioned. Although hotels and tourist activities were rather rare in the Coastal Zone, there was a considerable number of boutiques (25) on the waterfront.

A large number of permanent houses (830) were observed on the water-front in the Coastal Zone particularly near the big cities, obviously due to the greater demand for land. Over one thousand fishing sheds were seen on the waterfront of the Northern Coastal Zone. Most of these were found in the area between Jaffna and Chempianpattu.

Two important aspects of the distribution of structures in the northern zone pertain to (a) sewage disposal and (b) the presence of roads within the waterfront area. There were about 37 sewage outfall structures and 29 km of road within a distance of 72 km between Jaffna and Point Pedro.

The islands off Jaffna Peninsula were different from it in several characteristics (see Appendix Table 23). Among the erosion preventive structures in the islands a considerable number of revetments were observed particularly in Nainativu, Kayts and Karaitivu where the population density is higher and the problems of erosion more visible. Another difference between Jaffna Peninsula and the islands was the presence of a large number of jetties in the latter. Some 21 of them were seen during the field survey. This is understandable in view of the regular movement of people between the islands and the peninsula. Among the similarities between the Peninsula and the islands, the presence of a greater number of permanent houses in the water-front, the existence of a large number of fishing sheds, boutiques and roads (46 km.), may be mentioned. The exceptionally large number of fishing sheds (1306 reported) in the islands is explained by the presence of a large number of dry fish wadi there.

12.6 The Northeastern Zone

A significant feature of the distribution of structures in the Northeastern Coastal Zone is their high concentration in the Trincomalee area (see Appendix Table 24). Revetments (09), boulder walls (05) and masonry walls (23) were almost entirely confined to the area from Trincomalee to Foul Point. The largest number of erosion mitigating structures in this segment comprised of masonry walls. There were about six groynes in this area, three each in Mullaitivu and Trincomalee.

In view of the importance of Trincomalee as a harbour, a considerable number of piers (6) and jetties (17) have been constructed. These can be seen in the stretch between Trincomalee and Foul Point. About 231 houses were observed on the water-front of which about 50 per cent were found to be permanent structures. Although there were about 27 hotels within the Coastal Zone only seven of them were located on the water-front. One significant feature of the distribution of hotels was that unlike other structures they were not confined to the Trincomalee area alone. Nearly 70 per cent of hotels were located between Kokkilai and Trincomalee particularly around the famous Nilaveli beach. The number of fishing sheds on the water-front also showed a rapid drop towards from the South. They were almost absent in the area between Irakkandy and Trincomalee.

There were 19 km of road and 2 km of railway within the water-front area with a considerable length within the Trincomalee area. A large number of buildings falling into the category of 'other buildings' can be seen in Appendix Table 24. Most of these structures were Government buildings, harbour buildings or buildings used for defence purposes. A large number of sewage disposal structures (19) seen in Trincomalee indicate not only pollution but their use at different times in the past. In most of the tourist areas around Nilaveli, there were no sewage outlets to the beaches.

12.7 Eastern Coastal Zone

The Eastern Coastal Zone has very few maritime structures (see Appendix Table 25). Thus there were hardly any erosion preventive structures, harbour structures, or sewage outfalls. There were however about 1138 houses on the water-front although nearly 70 per cent of them were temporary. There was a considerable number of hotels in the Kalkudah-Batticaloa stretch (13) and in the Batticaloa-Pottuvil stretch (06). In fact the southern boundary of this zone marked the beginning of another important tourist area on the east coast namely the Arugam Bay area. Unlike in the Northern and North eastern Coastal Zones, the number of fishing sheds on the beaches in the east coast was relatively small (104). However, a considerable number of boutiques and fish sales centres were observed in the area between Batticaloa and Pottuvil. The category of other buildings in Appendix Table 25 included mostly government buildings such as bus depots and rest houses.

12.8 Southeastern Zone

As indicated in Chapter IX the Southeastern Zone represents an area of sparse human settlements except near Pottuvil and Hambantota (see Appendix Table 26). Thus only 23 houses, both temporary and permanent were observed on the water-front. Nevertheless, there was a sizeable number of hotels, particularly in the Pottuvil area (07) and in Hambantota (06). The hotels at Arugam Bay were mostly small-scale guest houses or cabanas.

Only 58 fishing sheds were observed on the waterfront. The considerable number of other buildings observed were mostly those that were associated with salterns or with the Yala National Park.

The only erosion preventive structures seen were a few masonry walls and groynes between Kirinde and Hambantota. The two Jetties observed were also located at Hambantota. There were 4 sewage outfall structures at Hambantota, all located on the beach facing the bazaar. The petrol shed at Hambantota near the beach is a possible source of pollution.

12.9 Southern Coastal Zone

The Southern Zone is an area of relatively dense human settlements which exhibits an array of maritime structures (see Appendix Table 27). Groynes and boulder walls were found to be the most common erosion preventive structures. The most prominent groyne fields were found at Kanattegodda, Dondra Head, Matara, Weligama and Aranwela. The revetments and masonry walls were mostly seen in the area between Tangalle and Dondra Head. Although harbour structures were not many in this zone, there were three breakwaters, two piers and two jetties.

The most conspicuous feature of this zone is the presence of a large number of permanent houses (1096) on the water front. There were also 34 hotels spread along most segments of the zone. The heaviest concentration of hotels in the Southern Coastal Zone was found in the

area between Weligama and Koggala. A large number of boutiques (169) were also seen along the coastline, with their frequency increasing in the direction towards Galle.

There were about 55 km of both major and minor roads and 8 km of railways that came within the water-front area. This gives an indication of the magnitude of the potential threat from erosion to transport routes in the area.

12.10 Southwestern Zone

The Southwestern Coastal Zone is the most densely populated part of the country and has the largest number and variety of coastal structures (see Appendix Table 28). The construction of groynes appears to be the most common method adopted to combat erosion in the southwest. There were about 80 groynes between Galle and Colombo with significant concentrations in the stretches between Hikkaduwa and Ambalangoda, between Panadura Ganga and Mount Lavinia, and between Vanderwert Place (Dehiwela) and Colombo. The main groyne fields (with 6 to 12 groynes) were observed at Totagamuwa, Telwatta, Kahawa, and Galle Face. Smaller groyne fields with 3 to 5 groynes were observed at Paiyagala, Beruwela, Kalutara and Moratuwa. The groynes observed at Telwatta were of a different type. They consisted of a series of concrete cylinders named as 'Kulasinghe' groynes, named after the well known Sri Lankan engineer.

Revetments were found to be the most numerous erosion preventive structures next to groynes. There were about 44 revetments in this zone many of them being found between Galle and Ambalangoda. There were also 22 boulder walls and more than 20 masonry walls within this zone. The longest masonry walls were those found in the vicinity of Colombo and Galle. There were eight breakwaters and ten jetties in this zone, with most of them being found in the Galle harbour area. It should be noted that the Colombo harbour is not included in the Southwestern Coastal Zone.

Altogether about 3389 houses were found on the water-front of the Southwestern Zone. The number of permanent houses observed was rather low compared with the number of temporary houses reported from the stretch between the Panadura Ganga and Mount Lavinia. In this stretch the land between the railway line and the beach is occupied by a large number of small temporary houses. This area (including the segment upto Thalpititiya Ela) also had the largest number of fishing sheds (171) in the zone. The only other area which had a large number of fishing sheds was the stretch between Dodanduwa and Ambalangoda.

At least 60 hotels were observed on the water-front in the Southwestern Zone, as well as a considerable number of tourist shops in the area between Bentota and Beruwala. Two major tourist complexes can be recognized on the Southwestern Coast between Colombo and Galle. One of them is centred around the Bentota beach while the other is found between the Hikkaduwa Ganga and Dodanduwa. Tourist establishments are so numerous in these two areas and vary so widely in size that it would be difficult to differentiate tourist structures from residential structures except through an in-depth investigation.

The city of Galle is included in the Southwestern Zone. A considerable number of boutiques were also reported from the stretch upto Dodanduwa. Fish sales centres on the water-front were also quite numerous in this area upto Hikkaduwa.

There were some 45 km of road and nearly 14 km of railway within the water-front area. This shows the vulnerability of transport routes in the southwest to wave action particularly during the monsoons. As mentioned earlier the main Colombo-Galle road has to be relocated several times in the past in certain areas. Even today direct wave attack on the Galle road could be seen in several places. Some 24 industrial premises and 20 major sewage disposal structures were observed within the Southwest Coastal Zone. As could be anticipated most of the sewage disposal structures were found in the two major cities of the zone i.e. Colombo and Galle. Nevertheless, there were several sewage outfall points in the Beruwala-Maggonna stretch. Industrial premises were mostly observed in the Hikkaduwa-Ambalangoda area and in the Beruwala-Maggonna area.

12.11 National Situation and Areas of Concern

A summary of man-made structures in the coastal zone of the entire country is given in Appendix Table 29. This shows that there was a total of about 560 erosion preventive structures

around the country. Of this number, 162 were groynes concentrated mainly in the Southwestern, Western and Southern Coastal Zones. Revetments were as frequent as groynes (151) but were more widespread. Although the western and Southwestern Coastal Zones had the largest number of revetments they were observed even in the islands off Jaffna. Masonry walls had a greater spread around the country than any other erosion preventive structure. Thus the highest number of masonry walls were found in the Northern, Western and Northeastern Coastal Zones. Boulder walls, on the other hand were seen mostly in the Western, Southwestern and Southern Coastal Zones.

As could be expected, structures related to harbours were found mostly in Colombo, Trincomalee and Galle. However, a large number of jetties were seen in the islands off Jaffna.

Altogether there were about 9393 houses on the water-front of the coastal zone of Sri Lanka. Of this number a little more than half were permanent structures. The largest concentration of houses was in the Southwestern and Western Coastal Zones. The Northern, Western and Eastern Coastal Zones also had around 1000 houses each.

The number of hotels on the water-front was found to be around 151. It should be mentioned however, that the total number of hotels in the Coastal Zone is much larger than that. We reckon it to be in the region of 250. The frequency of tourist shops was roughly proportional to the number of hotels. The largest number of such boutiques was found in the Southern and Southwestern Coastal Zones. There were some 5111 fishing sheds and 208 fish sales centres on the coastline around the country. While the largest number of fishing sheds was observed in the northern parts of the country between Puttalam and Trincomalee the largest number of fish sales centres was found in the Eastern Coastal Zone.

Altogether there were 243 km of roads and 27 km of railway on the water front. Most of the roads on the water-front were found in the Southern and Southwestern Coastal Zones. The railways on the water front were however found mainly in the Southwestern Zone. Similarly industrial premises were observed in the thickly populated areas of the Southwestern and Northern Coastal Zones. The largest number of sewage outfall structures was observed in the Northern Coastal Zone. However, the Southwestern Coastal Zone had about 20 major sewage outfalls.

In general, it appears that the number of erosion preventive structures is related to the rate of erosion as well as to the density of population and the distance from Colombo. Thus while the Southwestern Zone received much attention, other areas away from Colombo particularly the northern coast and to some extent the southern coast do not seem to have received adequate attention. The Southern Coastal Zone has the largest number of permanent houses on the water-front and its average rate of coastline recession was much greater than that in the Southwestern Coastal Zone. Similarly, in the northern coast of Jaffna Peninsula the rate of shoreline recession is much greater than in the Southwest. The former also has a considerably high population density.

As could be expected the number of sewage outfall structures is greater in the major cities. Nevertheless, Puttalam and Jaffna, and to a lesser degree Trincomalee appear to have some pollution problems due to sewage disposal. Industrial premises are also on the increase in some of these areas leading to potential pollution problems.

A cursory examination of the location of tourist hotels on the water-front indicates clearly that such hotels are not necessarily associated with big cities. In fact they tend to develop away from the cities and are clustered in certain areas of the Coastal Zone. Thus at least seven tourist clusters can be identified around the Island. The Nilaveli, Kalkudah-Passikudah and Arugam Bay on the east coast and Hikkaduwa, Bentota and Koggala in the southwest and Negombo on the west coast represent some of these clusters.

It is these clusters, not the entire coastal zone, that should receive particular attention in coastal zone management planning in relation to tourism development.

The largest number of fishing sheds and fish wadi were found on the northern coast. Due to the rapid increase of land values in recent times there is a tendency for these temporary sheds to be converted to permanent housing. Some of these sheds seen during the field survey had

concrete floors and lockable doors etc. It would be worthwhile to monitor this transaction permanent settlements where feasible. It should be noted that there were several new housing projects within the coastal zone which are not suitably located in terms of their stability or the needs of coast conservation.

The threat to roads and railways from erosion exists in most parts of the country, particularly in the Southwestern, Southern and Northern Coastal Zones. Most of these transport routes have obviously been built without anticipating the dangers involved. Urgent preventive measures are needed to check erosion in some of these threatened localities.

A considerable number of old and unused structures were seen in most places around the coast. Many magnificent forts are left to decay or in some places such as Alli Rani, they are left to be swallowed by the waves. It is worthwhile to preserve these structures and to put them to some useful purpose, connected perhaps with tourism. A large number of apparently unused buildings were also seen particularly in the Trincomalee area. About 27 lighthouses were observed during the field survey excluding those operational as at Great Basses and Foul Point.

CHAPTER XIII LAND UTILIZATION

13.1 Introduction

As indicated in chapter II (Section 2.1 p.17), the landuse investigations were undertaken with five main objectives: The last two of these objectives were related to geomorphological features and have been dealt with in the descriptions of individual coastal zones (see Chapters IV to XII). This chapter is devoted to a discussion of the results of the survey in relation to the first three objectives, namely:

- (a) developing a classification for mapping of landuse,
- (b) preparing an inventory of landuse types, and
- (c) describing existing uses of land in the Coastal Zone in an area specific manner

13.2 Classification of Landuse

In advance of the field survey a classification of landuse types in the Coastal Zone was attempted on the basis of available information. Based on this classification, information on landuse types in different parts of the Coastal Zone was collected through field inspection. The major types of landuse and their sub-types as inventorized are listed in Table 13.1.

**Table 13.1
Classification of Landuse in the
Coastal Zone**

<p>(A) Agricultural Landuses</p> <ol style="list-style-type: none"> 1. Homesteads 2. Perennial Crops <ol style="list-style-type: none"> (a) commercial (b) domestic use 3. Seasonal Crops <ol style="list-style-type: none"> (a) commercial (b) domestic use 4. Livestock Farming 5. Farms <ol style="list-style-type: none"> (a) crops (b) livestock 6. Shifting Cultivation 	<p>(C) Commercial</p> <ol style="list-style-type: none"> 1. Tourist 2. Non-tourist <p>(D) Residential</p> <ol style="list-style-type: none"> 1. Permanent 2. Temporary <p>(E) Transportation</p> <ol style="list-style-type: none"> 1. Bus stands 2. Railways and railway stations 3. Major roads 4. Minor roads <p>(F) Mining</p> <ol style="list-style-type: none"> 1. Functional 2. Non-functional
<p>(B) Recreational</p> <ol style="list-style-type: none"> 1. Hotels 2. Parks 3. Sanctuaries 4. Playgrounds 5. Other recreational uses 	<p>(G) Services</p> <p>(H) Industrial</p> <p>(I) Defence</p> <p>(J) Fisheries</p> <p>(K) Vacant</p> <p>(L) Other landuses</p>

13.2 Definitions

In the above classification, homesteads are defined as village gardens with a house and some crops around it. Although in the case of perennial and seasonal crops both commercial and domestic types were considered, in most areas this distinction was rather blurred. Similarly, the distinction between livestock farming within and outside the 'farms' was only a matter of organization and scale of operation. Shifting cultivation on the other hand included only the practice of chena cultivation.

Unlike in agricultural landuse, the five types of recreational uses identified were mutually exclusive to a considerable extent. Nevertheless, the distinction between 'parks' and 'play grounds' was not always clear. Shops and boutiques along the Coastal Zone were included under 'commercial landuse'. Although two categories of shops and boutiques i.e. tourist and non-tourist are listed they are not strictly exclusive. Certain shops and boutiques were found to cater mainly for tourists.

Under residential landuses, there is a wide range of housing conditions. Houses with cemented floors and tile, asbestos or tin roofs were considered as 'permanent' while all other structures were considered 'temporary'.

Here again, many permanent houses or even temporary ones in some areas, were used to accommodate tourists. Therefore, they were both commercial and residential. Nevertheless, if a family was resident in such a house it was considered residential. The fishing sheds were found to be mostly temporary structures and were treated as a separate category.

Under landuse types related to transportation, major and minor roads were considered separately. For purposes of the survey all macadamized roads were considered as major roads and all gravel roads were treated as minor roads.

All types of quarrying coral and sand removal were included under 'mining'. The landuse category of 'services' included petrol sheds, medical services, post offices, banks, schools, garages, etc. Camps, firing ranges, naval bases, were included in the landuse category of 'defence'. The vacant lands included mostly infertile and saline lands as well as woodlands and forested areas which are not used for any obvious economic purpose. The last category, 'other landuse' was meant to include any type of landuse which has not already been specifically listed in the classification. Places of worship such as temples, kovils, mosques and churches and cemeteries are included in this category.

13.4 Landuse Mapping

As explained in Chapter III – Survey Methodology, the mapping of all coastal phenomena with spatial expression, including landuse was based on airphotographs and ground checking by teams of field investigators. The information obtained during field investigations was recorded on base maps on the scale of 1:6500. The presence or absence of different landuse categories in a given area was noted in the questionnaire schedules. In any location where land was being put to more than one use, the details of such uses were recorded.

As noted earlier, the basic mapping unit was one kilometre measured along the shoreline. An investigator was expected to cover a distance of one kilometre each day on the average and among other things to observe and record all the landuse types within a zone of 300 metres from the shoreline. Every investigator had to carry a One Inch Topographical Map of the area, a set of air photographs, a base map and questionnaire schedule. The different types of landuse were marked on the base maps, by adopting the same alpha-numeric codes as in the landuse classification. Thus 'A₂b' was used to denote Agricultural with perennial crops grown for domestic use, while 'C1' meant a commercial area with tourist shops. At the stage of the preparation of the final maps, conventional symbols and colour codes were used. Thus permanent residential areas were marked in grey, and paddy lands in green. Perennial crops were marked in yellow with a subscript to denote the crop (eg. 'c' for coconut). Colour codes were juxtaposed to indicate mixed landuse.

13.5 Results of the Survey

The results of the survey are presented in Appendix Tables 30 to 38. In these Tables collected landuse data are presented by coastal segments and zones. All-island statistics for different landuse types are presented in Appendix Table 39. These tables contain information collected on all landuse types given in the classification adopted. The more prominent observations in each Coastal Zone are discussed below.

13.6 Landuse in the Western Coastal Zone

Appendix Table 30 shows that perennial commercial crops, mainly coconut, form the most prominent land use category on the West Coast. They were observed in 65 percent of the distances covered. About 53 percent of the perennial crops are grown for domestic use.

Homesteads were observed along 31 percent of the coastline, but the frequency gradually declined as one proceeded northwards. The commercial coconut plantations on the other hand continue right upto Puttalam. There are no farms or tracts of shifting cultivation along this zone. Nevertheless, the rearing of livestock particularly pigs on a domestic scale is quite common. Fishing of course forms the most frequently observed activity along the coast.

Recreational land does not occupy a prominent place in the Western Coastal Zone. Such land was observed in less than 10 percent of the coastline. Nevertheless, hotels and their premises are found along 9 km of which 6 km lie in the stretch between Negombo and the Maha Oya. Shops and boutiques, particularly those of the non-tourist type could be seen in 27 percent of the distance covered. Residential landuse is quite prominent in this zone, and both permanent and temporary houses were observed in more than 50 percent of the distances covered.

Among the landuses related to transportation, major roads were observed in 87 km and minor roads in 91 km while bus stations were seen in about 5 km. Mining is not very common except in the Maha Oya Karukkupona area. It is interesting to note that services such as schools and hospitals were observed along about 78 kilometres surveyed. Vacant lands were observed in about 11 percent of the distance covered, particularly in the areas adjacent to the Puttalam lagoon. All other types of landuse such as churches and cemeteries were found in about 44 km. Since a large proportion of the population in these areas are Christians, churches and cemeteries near the beach are a common sight.

13.7 Northwestern Zone

The coastline between Puttalam and Elephant Pass still remains one of the most sparsely populated areas in the country. The only exceptions are a few townships like Mannar and Puttalam. In the southern parts of the zone, the majority of the residents are Muslims, while in the northern areas around Pooneryn the residents are Tamils who depend on agriculture and fishing for their livelihood.

The most frequent category of land that could be seen comprise vacant lands which are observed in about 107 km. These include both forested areas and large tracts of palmyra (see Appendix Table 31). The perennial commercial crops were observed in 64 km. Seasonal crops include mainly paddy in the Jaffna lagoon area. Residential areas and homesteads represent the next prominent landuse categories. But these were widely scattered and accounted for only 13 percent of the coastline. There are also a considerable number of non-tourist boutiques in this zone. Another important feature of the landuse pattern in the northwest is the presence of several minor roads along the coast. A number of service facilities such as schools, hospitals and bus stations are irregularly scattered along the coast.

The area with the highest density of settlements and intensity of landuse in the Northwest is the Talai Manner Island. But even there, over 20 percent of the Coastal Zone comprises of vacant lands.

13.8 Northern Zone

The three coastal segments that come within the Northern Coastal Zone and the islands lying off the Peninsula show considerable variation in landuse (see Appendix Table 32). However the stretch of coast between Point Pedro and Chempiyanpattu was mostly sand dune country, and hence vacant lands were observed all along this 16 km stretch. The only important human activity in this area is fishing. In all other areas of the Northern Coastal Zone, with the exception of some small islands, the intensity of landuse was found to be quite high.

In the coastal segment stretching from Elephant Pass to Jaffna perennial commercial crops dominate the landuse pattern and coconut lands are the most common type. There is also a considerable amount of land under seasonal crops both for commercial as well as for domestic use. These crops include tobacco and vegetables and are particularly noticeable in the Chavakachcheri area. However, due to long stretches of mostly uninhabited coastal lands along the Jaffna lagoon, vacant lands were observed in over 50 percent of the distance covered. In these areas fishing is the dominant economic activity.

The highest intensity of landuse in the Jaffna Peninsula is seen in the Coastal Zone between Jaffna and Point Pedro. However, between Jaffna and Mathagal, a considerable amount of

vacant lands were also observed. These are either areas liable to flooding or areas with groves of wild palmyra. The area between Mathagal and Point Pedro has the largest extents of permanent residential sites, the longest extent of roadways and the largest concentration of lands occupied by service facilities.

The land use in the islands varies from one island to another (see Appendix Table 33). Livestock farming, shifting cultivation and recreational land uses are almost totally absent in the islands. In Kayts, Karaitivu, Nainativu and Analaitivu the intensity of land use is as high as in some parts of the Peninsula. In most of the other islands, vacant lands were observed in as much as 80 percent of the Coastal Zone surveyed. Most perennial and seasonal crops are grown mainly for domestic use. Residential land use (permanent) was observed in some 56 percent of the distance surveyed. Most of the roads, particularly minor roads in the islands fall within the Coastal Zone. Fishing constitutes the main source of livelihood for most islanders. Due to their relative isolation and problems of transport commercial land use is virtually absent.

13.9 Northeastern Zone

With the exception of Mullaitivu, Nilaveli and Trincomalee areas the Northeastern Coastal Zone represents a coastline with thinly scattered settlements and low intensity of land use (see Appendix Table 34). In the coastal segment from Chempianpattu to Mullaitivu, for instance, homesteads are few and far apart. Vacant lands were observed in some 61 percent of the distance. Fishing forms the major livelihood of people almost throughout the coastline. Perennial crops, mainly coconuts, are grown for both commercial and domestic use. Privately owned coconut estates such as Fairfield and Taunton are found in this area. The large number of fishing wadis in the area has obviously inflated the figures relating to residential land use. Long tracks of minor roads are found running along the Coastal Zone in this stretch.

The pattern of land use in the Mullaitivu town is generally similar to that in the Chempianpattu area. The same pattern is continued from Kokilai to Irrakkandy. Two important characteristics in the Coastal Zone between Chempianpattu and Irrakkandy are the presence of livestock farming and chena cultivation. These features were almost totally absent in the Coastal zone.

In the Kokilai to Irrakkandy stretch more organized farms and tourist hotels have appeared in the recent past. This pattern of land use has become established in the area between Irrakkandy and Trincomalee also. Shifting cultivation all but disappears after Irrakkandy until it reappears around Foul Point in the south. Tourist hotels and tourist shops were increasingly observed along the 16 km of coast between Kokilai and Trincomalee. On the other hand there is a clear decrease in fishing activities in such areas.

The coastline from Trincomalee to Foul Point falls within the area of the well known Trincomalee natural harbour consisting of several bays. Here the homesteads and residential land use types are quite common upto Mutur. Between Mutur and Foul Point chena cultivation and most other features of the Mullaitivu stretch can be seen again. One common feature of the entire zone is the presence of many roads, both major and minor, along the coast.

13.10 Eastern Coastal Zone

The Eastern Coastal Zone represents an area of sparse settlements particularly in the two northern segments that extend between Foul Point and Kalkudah. In the southernmost part between Batticaloa and Pottuvil a moderate density of settlements and a well developed land use pattern can be observed (see Appendix Table 35). Although between Foul Point and Vakarai vacant lands comprise nearly 30 percent of the coastline covered in the survey, the cultivation of perennial crops mainly coconuts for domestic use is also quite common. While homesteads are found along 5 km of coast, temporary dwelling structures can be seen along 21 km.

Shifting cultivation was observed along 9 km. The area between Vakarai and Kalkudah on the other hand has more commercial coconut plantations. Although residential lands were observed in nearly 70 percent of the distances surveyed, vacant lands were also seen in over 40 percent of the coastline. The land uses associated with hotels appear more frequently towards its southern parts.

The coastal segment between Kalkudah and Batticaloa has a greater density of homesteads and other residential land uses. It also has a larger number of hotels and tourist shops. The

density of the road network is higher here than in the Vakarai area. Although commercially grown coconut plantations continue with the same frequency, coconut cultivation for domestic use is found to be on the increase. In spite of this increasing intensity of land use, vacant lands were observed along nearly 45° of the coast line.

The coastline between Batticaloa and Pottuvil has the highest density of population in the area. As a result the number of homesteads, residences, boutiques and service facilities are found to be somewhat high on this stretch. There is also a greater density of roads within the Coastal Zone. About 60 percent of the perennial crops, mainly coconuts, is grown for domestic use. Betel leaf is grown in the area around Kaluwanchikudy. Nevertheless, vacant lands can be seen along about 60 percent of the coastline while shifting cultivation was observed along 13 km.

13.11 Southeastern Zone

The Southeastern Coastal Zone is one of the most sparsely populated areas of the Island owing to the location of the Yala National Park within it. As can be seen in Appendix Table 36, the most prominent land use categories in this area are vacant lands and wildlife sanctuaries. The Yala National Park spreads across some 40 km of the coastline. The land given over for hotels and tourism is prominent at the northern end of the zone near Arugam Bay and in the area near Hambantota. Residential lands are observed only in scattered settlements, such as Panama and Kirinda. Most of the crops grown in this zone are for domestic use. It is interesting to note however, that chena (shifting cultivation) is not widely practised in the Coastal Zone in this area. This is mainly due to the availability of land for chenas in the interior, and the presence of the Yala National Park.

13.12 Southern Coastal Zone

The Southern Coastal Zone has a wide variety of land use types and a higher density of population than anywhere else along the East Coast (see Appendix Table 37). Yet, upto Tangalla the sparsely populated appearance of the Hambantota area continues because of the presence of large tracts of vacant lands and shifting cultivation. Tangalla in fact represents not only a zone of climatic transition but also a zone of land use transition.

The Coastal Zone between Tangalle and the Galle Municipal limits is an area of high population density. Over 60 percent of the coastline has homesteads within the Coastal Zone. This is particularly noticeable in the stretch from Tangalle to Dondra Head. The bulk of the perennial crops grown is for domestic use. Almost all the seasonal crops grown, particularly paddy and vegetables, are also for local use. Livestock farming is rarely seen. This contrasts clearly with the Western Coastal Zone where piggeries are quite common. Hotels, tourist shops and boutique catering to non-tourist consumers occupied more land than those catering to tourists. Permanent residences occupy nearly four times the land area occupied by temporary dwellings. Vacant lands are rarely seen in this area. There are many major roads (25 km) and minor roads (64 km) within the limits of the Coastal Zone.

Services such as schools and hospitals, and mining industrial premises were observed in more than 20 percent of the kilometre units covered by the survey. There are also four bus stations and two railway stations within the Coastal Zone. 'Other land use types' including temples and cemeteries were seen only along less than 4 percent of the coastline.

13.13 Southwestern Zone

The Southwestern Coastal Zone forms the most densely populated area in the country and shows the largest variety of land use types. For coastal management purposes this zone is divided into 17 segments. Although data in Appendix Table 38 is presented according to these segments, variation of land uses between them is relatively small except between the urban and rural areas. Thus the two segments representing Colombo i.e. between Mount Lavinia and Colombo Fort, show a special combination of urban land use types. Here homesteads are rare and agricultural land uses are almost totally absent. Hotels, playgrounds and commercial enterprises, permanent residential lands and services form the dominant land use types. Roads and railways also occupy a sizable portion of the Coastal Zone. It is interesting to note that many vacant blocks of lands are still available in this area. These are mostly to be found adjacent to the railway line on the seaward side and obviously represent railway reservations.

The landuse pattern in Galle, the other major city in the Southwestern zone is somewhat different from Colombo. Unlike in Colombo there are many homesteads within the Galle municipal area. Most rural landuse characteristics can be seen in the area immediately outside the city limits. Perennial crops grown both for commercial and domestic use and a considerable extent of vacant lands are found within the municipal limits. However, the density of permanent settlements is high. Most other landuses found in urban areas such as hotels, parks, playgrounds, commercial enterprises, industrial establishments and services are also present. The density of the road network within the coastal zone is quite high.

The Coastal Zone between the Galle Municipal limits and Mount Lavinia is somewhat similar in terms of most landuse characteristics. The only exceptions are tourist areas such as Hikkaduwa and Bentota. In most coastal townships such as Ambalangoda, Kalutara and Panadura a mixture of urban-rural landuse characteristics can be seen in the Coastal Zone. In areas such as Induruwa rural characteristics dominate, with prominent mosaics of paddy fields and vacant lands. On the other hand, vacant lands are almost totally absent in the Coastal Zone between Hikkaduwa and Kosgoduwa. Hotels and tourist shops can be seen in the majority of the coastal segments.

A considerable number of bus and railway stations fall within the Coastal Zone. Some 83 km of major roads were observed and 117 km of minor roads were seen. Mining activities are mostly concentrated in the stretch between Hikkaduwa and Ambalangoda. In general, most places along the Southwestern Coastal Zone are hives of human activities as is normally the case in areas of high population density.

13.14 National Level Situation and Areas of Concern

The survey reveals (see Appendix Table 39) that, apart from activities related to fishing, the most dominant use of land in the Coastal Zone of Sri Lanka is the cultivation of perennial crops for domestic use. The major perennial crop is of course coconut. An estimate of the number of coconut palms made L; the investigators suggests that there were approximately 80,000–90,000 of them on the water-front. Commercial coconut plantations were also observed along 37 per cent of the coastline surveyed.

Residential land for permanent housing represents the second most important category of landuse in the Coastal Zone. This type was observed in some 43 per cent of the kilometre units covered. Homesteads and temporary housing are equally important in most areas. These were observed along 30–40 per-cent of the coastline. The Vacant lands that were observed in some 41 per-cent of the coastline provide a crude indication of the availability of land for development purposes. However, much of this land is infertile and is to be found in remote parts of the country.

Minor roads were seen in some 41 per cent of the coastline while major roads were found in 23 per cent. There are some 103 bus stands and 41 railway stations within the Coastal Zone. Similarly, services including schools and hospitals, were observed in 16 per cent of the distances covered. If 'defence' establishments are also added to this, land given over to transport and service facilities and other state managed services represent a significant proportion of lands in the Coastal Zone of Sri Lanka. Furthermore, model villages have been established in some places along the Coastal Zone. It therefore becomes clear that the highest share of responsibility for the use or misuse of coastal lands lies with the Government.

One important problem of landuse in the Coastal Zone, particularly along the East Coast is the practice of chena cultivation. This was observed along some 62 km of the coastline. Since this is bound to have adverse ecological consequences on a fragile environment, some effective steps have to be taken to contain it.

Mining which included both coral mining and sand mining was observed along at least 10 per cent of the distance covered. Hotels and tourist areas in fact occupy less than 6 per cent of the Coastal Zone. Nevertheless, tourist activities are concentrated along some of the best beaches of Sri Lanka. The management of coastal lands in these areas has therefore become an important concern.

CHAPTER XIV

SUMMARY AND CONCLUSIONS

14.1 The Survey

The main objective of the survey of the Coastal Zone of Sri Lanka which led to this report was the preparation of an inventory of coastal features through field investigations with special emphasis on structures and landuse types. The Coastal Zone for this purpose was taken to be the 300 metre zone from the high water line, as defined in the Coast Conservation Act. In field investigations the seaward margin of creeping vegetation was considered to be the limit of the high water mark. Although the landward area of the coastal zone formed the main focus of the survey, observations were also made on the water-front and on offshore structures observable from the beach.

The survey encompassed the entire Coastal Zone of Sri Lanka including that of its offshore Islands. Field investigations were conducted on all major islands while the smaller ones were mapped with the aid of airphotographs. The distance covered on foot by the field investigators totalled 1920 kilometres excluding the beaches of lagoons. In order to improve the organization of field work, the entire coastline of the country was divided into 8 zones representing the 8 cardinal directions. However in the presentation of results of the survey, the 46 coastal segments identified by the Government for coastal management purposes have been incorporated in the 8 zones.

The fundamental unit of observation was the kilometre measured along the shoreline. Therefore investigators had to cover each kilometre on foot and record the relevant information on base maps and on questionnaire schedules specially prepared for recording field data. In addition field books were used to record any descriptive information which could not be accommodated in the questionnaire.

The task of mapping and collecting field data was accomplished with the assistance of 40 field investigators and 8 field supervisors. Each supervisor was responsible for the field work in a given zone, while a small team of investigators who resided in the area were assigned the tasks of making the necessary field observations. Simple field equipment such as latest available airphotographs and One Inch Topographical maps were used in field investigations. Final maps of the scale of 1:6500 were made from field base maps. Statistical information has been analysed by manual methods using desk calculators.

14.2 Information Collected

The survey has generated a considerable amount of information on the following aspects of the Coastal Zone:

- (a) Nature of the coastline (its geomorphological character, nature of beach material and history of the shoreline).
- (b) Dominant vegetation types (sandy-sea-shore, dune salt marsh, mangrove, etc.)
- (c) Dominant human activities (fishing, coral and sand mining, tourism, coconut and palmyra based industries, salt and mineral extraction industries).
- (d) Water-front structures (erosion preventive structures, structures related to ports and harbours, residential buildings, tourist and commercial premises, transportation structures, fishing sheds and other buildings).
- (e) Land utilization (agricultural, recreational, commercial, residential and landuses related to transportation and mining).

14.3 Nature of the Coastline

The results of the survey indicate (Appendix Table 40) that geomorphologically two-thirds of the coastline of Sri Lanka could be considered as 'straight coastline'. The lagoons that are wide open to the sea such as those of Puttalam and Jaffna accounted for 27 percent of the distance covered. The coastlines of other lagoons which are not so open to the sea such as those of Batticaloa, Kokkilai and Negombo did not come under the purview of this survey. The bays

occupied one-fourth of the coastline while sandspits were observed in 19 percent of kilometre units surveyed. Near-shore reefs were observed in 20 percent while there were rock outcrops in 13 percent. The major islands off the Northwestern Coast and the Jaffna Peninsula accounted for 16 percent of the coastline. This figure does not however include the smaller islands which were mapped only from airphotographs. Although high cliffs are rare on Sri Lankan coasts, low cliffs were present in 10 percent of the coastline. Headlands and boulder strewn beaches were seen along 9 percent of the coastline surveyed. Estuaries occupied 5 percent of the coastline while deltas were rarely seen except at the Mi Oya, Malvatu Oya and Mahaweli Ganga estuaries.

A field inspection of beach materials indicated that 62 percent of the beaches of Sri Lanka are sandy while only 14 percent were silty. The latter type was observed mostly in the northwestern coast. The beaches with cobbles and pebbles occupied 7 percent of the coastline. The observations made of the colour of beach sands show that 38 percent is white, 19 percent is black and 17 percent is brown, while all other colours accounted for only 7 percent.

The information collected on the history of the shore line of Sri Lanka indicates that in nearly 51 percent of the kilometre units covered, the shoreline has receded during the last 20–30 years. It has developed only in 15 percent of the distance covered by the survey. The average annual rate of recession reported was approximately 1.1m while the rate of development was only around 0.51m. A developing shoreline was observed mainly in the North and Northwest, while the receding shorelines were commonly observed in the South and in the Southwest.

14.4 Dominant Vegetation Types

An analysis of the information relating to dominant vegetation types in the Coastal Zone shows that sandy shore vegetation is present along 69 percent of the coastline surveyed. (see Appendix Table 41). Around 50 percent of sandy shore vegetation areas had low creeping plant types.

The second most frequent type of vegetation comprised of mangroves. Mature mangroves occupied 39 percent of the coastline while immature types were observed in 22 percent. Dune vegetation formed the third most common type (34%). Within the dune vegetation type, low creeping vegetation was the most dominant (31%). Low shrubs and littoral woodlands were observed in 28 percent and 15 percent of the coastline respectively in the areas surveyed.

Salt marsh vegetation types were observed in 29 percent of the coastline. Salt marshes are responsible for the occurrence of considerable extents of bare lands in some areas. Salt marshes with thorn scrubs occupied 6 percent of the coastline, while 7 percent of them were used as pastures. Among the other vegetation types in the Coastal Zone grasslands (26%) and forests (16%) were reported from several areas.

14.5 Dominant Human Activities

The dominant human activities observed in different areas of the Coastal Zone of Sri Lanka are presented in Table 14.1 Since fishing formed the most frequently observed human activity on the coastline, information on it was collected in some detail. This shows that, geographically, beaching boats form the most frequently observed (53%) method of fishing. Ma-del fishing which was the next most popular method has been observed along 30 percent of the coastline, particularly in the Northern and Northeastern Coastal Zones and in the islands off the Jaffna Peninsula. Off-shore fishing activities as observed along 22 percent of the coastline were quite common in the relatively calm seas off the north-western coast. Lagoonal fishing was observed along 20 percent of the coastline. The dry fish wadi, seen along nearly 20 percent of the coastline were found mostly in the northern and northeastern areas of the country between Puttalam and Pottuvil.

Among the other activities along the coastline, sand mining (12%) and coconut based industries (10%) were the most frequently observed types. Tourism was found to be an important activity along 153 km (8%) of the coast. Coral mining which was observed along 4.2 percent of the coastline has been confined largely to the southern and southwestern areas. It was also being practised to a certain extent in the Jaffna Peninsula. Other activities such as salt extraction, mineral exploitation and those related to harbours were limited to specific localities.

Table 14.1
Dominant Human Activities in the Coastal Zone of Sri Lanka

Segment of the coast line	Length of coast line (Km)	Number of kilometres at which specified activities were mentioned													
		Fishing							Other activities						
		Beaching boats	Off shore	Ma-del	Lagoon	Prawn & crab	Dry fish wadi	Coral mining	Sand mining	Tourism	Coconut based industry	Palmyra based industry	Salt industry Mineral extraction	Other	
Colombo to Puttalam ..	286	189	14	72	105	20	63	05	01	17	07		02		10
Puttalam to Elephant Pass ..	380	217	126	63	146	124	49		12		01		10		
(including Talaimannar Island)															
Elephant Pass to Chempianpattu ..	181	127	61	20	39	28	57	17	37	06			06	02	
Island off Jaffna Peninsula ..	218	125	83	112	26	43	51	02	48	05	01	04			
Chempianpattu to Foul Point ..	266	116	44	169	26	57	81	04	06	23	08			09	
Foul Point to Pottuvil ..	204	93	73	87	31	02	64	05	58	35	08	03			
Pottuvil to Hambantota ..	127	12	02	04		03				07			06		
Hambantota to Galle ..	123	45	18	40	10	33	02	23	25	13	60	01			
Galle to Colombo ..	135	103	10	27	02	02	01	25	38	47	99			04	
Total ..	1920	1027	431	567	385	312	378	81	225	153	184	08	24	15	10
% of kilometres at which the specified activities were observed (for each group) ..	100	53.46	22.43	29.51	20.04	16.24	19.67	4.21	11.71	7.96	9.57	0.41	1.24	0.78	0.52
% of total mentions (for each group) ..	100	33.13	13.90	18.28	12.24	10.06	12.19	11.68	32.50	22.09	26.56	1.13	3.44	2.16	1.42

14.6 Water-front Structures

Altogether some 560 erosion preventive structures were observed along the water-front of the country's entire Coastal Zone. Groynes and revetments which represented the most common devices for erosion prevention, accounted for nearly 60 percent of the total number of such structures. Groynes were mostly concentrated in the Southwestern, Western and Southern Coastal Zones. Prominent groyne fields were observed at Totagamuwa, Telwatta Kahawa, Kanattegoda and Dondra Head. Although revetments were found mostly in the Western and Southwestern Coastal Zones they were observed even in the islands off Jaffna. The largest number of masonry walls were found in the Northern, Western and Northeastern Coastal Zones. Boulder walls, on the otherhand, were seen mostly in the Western, Southwestern and Southern Zones.

Nearly 10,000 houses were observed on the water-front of the Coastal Zone of Sri Lanka. Of this total, a little more than half were permanent houses. The largest concentration of houses (both permanent and temporary) were seen in the coastal segment between Panadura and Mount Lavinia and in that between Tangalle and Dondra Head.

About 150 hotels were located on the water-front. It is estimated that at least 250 hotels (excluding guest houses) are located within the Coastal Zone. A cursory examination of the location of tourist hotels on the water-front indicates that they are not necessarily associated with big cities. Thus at least 7 tourist clusters could be indentified along the entire coastline of the country. Three of them were on the east coast, and the others on the west coast. Almost every house in these clusters had some involvement or other in tourism.

Altogether there were 243 km of roads (both major and minor) and 27 km of railway lines on the water-front. A large proportion of these roads and railway lines were in the more populous Southern and Southwestern Coastal Zones. Most of these transport routes have obviously been built during colonial times when the coastal areas became centres of trade and administration and coast conservation not a serious concern.

It appears that the distribution of erosion preventive structures is related not only to the rate of erosion, but also to the density of population and the demand for land. Thus although the erosion rates are much higher in the Southern, and Northern Coastal Zones, they have not received the same attention that is given to the Southwestern Zone. The large number of sewage outfall structures seen particularly around Puttalam, Jaffna and Trincomalee also deserve some mention.

Over 5000 fishermen's huts were observed around the Island. These fishing huts were associated with dry fish wadi and temporary fishing settlements. The sanitary conditions in these wadi are extremely poor. A trend towards making these temporary huts more permanent was observed in certain areas. It would be worthwhile to monitor this trend and plan for more permanent settlements where feasible.

A substantial number of old and unused structures were observed in several places. These included some magnificent fortresses which have been left to dilapidate or to be swallowed by the waves. There were also some 27 lighthouses around the Island excluding those at the Great Basses and Little Basses.

14.7 Land Utilization

The survey reveals that, apart from activities related to fishing the most widespread use of land in the Coastal Zone of Sri Lanka is cultivating of perennial crops for domestic use (46%). The major perennial crop is coconut except in certain parts of the Northern Coastal Zone where palmyra takes its place. Commercial coconut plantations were also observed along 37 percent of the coastline surveyed.

The secondmost important category of landuse in the Coastal Zone, is residential landuse mainly for permanent housing. This type of landuse was observed along some 43 percent of the coastline surveyed. Homesteads and temporary housing units are equally important (30-40%) in most areas. A recent addition to residential landuse is represented by the model villages and housing schemes appearing in the Coastal Zone. Some examples are provided by Kalmunai on the east coast and Ratgama on the southwest coast.

Land under transport routes and their reservations constitutes a significant land use category in many parts of the Coastal Zone. Thus minor roads were seen in some 41 percent while major roads were found in 23 percent. There were some 103 bus stands and 41 railway stations within the 300 metre Coastal Zone as defined by the Coast Conservation Act.

An important problem of land use in the coastal zone, particularly along the east coast is the practice of chena cultivation. This was observed along some 62 km of the coast line. Mining which included both coral extraction and sand collection was observed along at least 10 percent of the coastline.

One significant aspect of land use revealed by the survey is that the Government is one of the principal users of land in the Coastal Zone. Many of the State owned lands are under transport routes, plantations and services. Therefore, the responsibility of various Government Departments and Corporations for creating the present land use pattern in the Coastal Zone cannot be overlooked. Despite the intensive use of coastal lands in many parts of the Island, the survey reveals that vacant lands are still available along approximately 41 percent of the coastline. However, much of this land is infertile and located in remote parts of the country. Hotels and tourist areas still occupy less than 6 percent of the Coastal Zone. The survey shows that there are many more coastal tracts in Sri Lanka endowed with scenic beauty which remain under-utilized and available for development of tourism and recreational use.

14.8 Coastal Zone Management : Some thoughts for the Future

Since its major objective was the preparation of an inventory of the Coastal Zone, the survey was not designed or geared to be prescriptive. Nevertheless, on the basis of the experience gained in conducting field investigations some thoughts are expressed here in the hope that they will prove useful for future Coastal Zone management planning.

- (i) At present the land area falling within the Coastal Zone is defined only by an Act of Parliament. For any future planning exercise, it will be necessary to landmark the perimeter of the Coastal Zone by a proper land survey. This will help local officials in dealing with issues related to the management of the Coastal Zone. The land-marking process may be started in areas which deserve priority attention and may be extended later to cover the entire Island.
- (ii) It would be useful to label all the structures, buildings and other items of significance within the Coastal Zone by a suitable inventoring system. Apart from their use for identification purposes, the display of these labels on the walls of structures and buildings would help to instill a feeling among the local residents that they are living within a conservation zone.
- (iii) It was noted that the entire Coastal Zone of the country has been divided into 46 segments for the purpose of demarcating tourism development areas. It may be useful to consider aspects other than tourism as well and demarcate the Coastal Zone into permanent management divisions. This would facilitate better administration of the Coastal Zone in the future. In such a demarcation exercise, the natural and ecological homogeneity within a coastal segment should form one of the primary criteria.
- (iv) It has been noted that the State is the user of a substantial extent of lands falling within the Coastal Zone. Responsibility for some of the problems arising out of the misuse of land therefore, rests also with the State. This has obviously resulted from the poor coordination between and differences in the needs and outlook of various State agencies pertaining to the use of coastal lands. The present trend of building housing schemes and model villages on vulnerable tracts of the coastal zone provides the latest example of such misuse. Possible conflicts of interest between different State agencies are best anticipated and reconciled before they become acute. In this regard, the 300 metre limit may be imposed on all users of coastal lands irrespective of whether they are private organizations or State agencies.

- (v) It was noted that most erosion preventive structures, particularly groynes, are found mainly in areas within easy reach of Colombo. It therefore appears that there is a need to extend a helping hand to other parts of the country which are as badly affected.
- (vi) Upto now the dominant approach in combating coastal erosion has been the adoption of 'hard solutions' or civil engineering measures. In future it may be necessary to seek more 'soft solutions' which are relatively less expensive. The preservation and propagation of erosion preventive vegetative communities may prove equally effective as engineering solutions. The survey reveals that certain creeping plant species on sandy shores and dunes are quite effective in mitigating erosion. 'Maharavana ravula' or 'ravanan meesai' (*Spinifex littoreus*) deserves special mention here. It is found almost everywhere in the Coastal Zone, except where it has been destroyed by man. It would be best to take effective measures to protect and propagate such plant species and littoral woodlands.
- (vii) *Chena* cultivation appears to be continuing unabated in the Eastern Coastal Zone in spite of the recent legislation prohibiting it. Since this is beginning to have a serious adverse ecological impacts on the surrounding areas, some action is necessary to contain it.
- (viii) Certain segments of the Coastal Zone appeared to have special problems of their own. Among them are:
 - (a) Outside the Southern and Southwestern areas where erosional problems are receiving some attention, there were several other places such as Talawila, Kandakuliyā, Arippu, Keerimalai, Uppuveli, Mutur and Kalmunai which deserve urgent attention.
 - (b) The coastal segments between Panadura and Mount Lavinia and between Tangalla and Dondra Head have an exceptional high density of housing units within the Coastal Zone.
 - (c) Pollution problems caused by sewage disposal need urgent attention in certain places such as Puttalam, Jaffna and Trincomalee.
 - (d) Fishing camps with clusters of temporary sheds are densely distributed in the Talai Mannar Island, Karaitivu, Delft and in the stretch between Chempiyanpattu and Mullaitivu. These settlements have serious problems of sanitation and waste disposal.
- (ix) Some of the historical structures in the Coastal Zone such as the Portuguese and Dutch forts need preservation. It may be possible to use some of these old buildings as tourist attractions.
- (x) Several areas of the Coastal Zone have considerable potential for the development of tourism. It may be useful to identify these areas and plan for the future, before tourism spreads haphazardly to these areas on its own.

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APPENDIX TABLE 1
Nature of Coastline from Colombo to Puttalam
(Number of kilometres along which the specified features were observed)

Segment of the coast line	Length of coast line (Km)	Geomorphological Description											Nature of beach material						History of the shore line					
		Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sandy	Silty	Colour of beach sand				Retreating	Developing
																			White	Brown	Black	Other		
Colombo Light house to Kelani River	15	02			01	01	01	01	14				03	01	01	05	02	01		01		03	02	
Kelani River to Negombo Lagoon	27	26	06	01	01	01							01		02	25	01	13	03	25		19	05	
Negombo to Maha Oya	09	03	03	01	02						01					09		06	04	08		07		
Maha Oya to Karukku- kupona	42	41	27	02		03					09	02				42		38	09	37		15	13	
Karukku- kupona to Talawila	59	55	56		09	01		01			01					59		57	07	19		23	19	
Talawila to Puttalam	134	32	48	106	17	01		03		23	78					112	11	103	33	12		25	20	
Total	286	164	140	110	30	07	01	05	14	23	91	02	04	01	03	252	14	218	56	102		92	59	
% of kilometres at which the feature was observed (for each section).	100	57	49	38	10	2	4	2	5	8	32	7	1	4	1	88	5	76	20	36		32	21	
% of total mentions	100	28	24	19	5	1	0.2	0.9	2	4	16	0.3	2	0.4	1	92	5	58	15	27		61	39	

APPENDIX TABLE 2
Dominant vegetation types in the Coastal Zone from Colombo to Puttalam

Segment of the coast line	Length of coast line (Km)	Description of vegetation (Number of kilometres along which specified types were observed)																					
		Dominant Vegetation					Sandy shore vegetation			Sand dune			Mangrove vegetation		Salt Marsh								
		Sandy sea shore vegetation	Dune vegetation	Salt marsh	Mangrove	Others	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Mature	Immature	Bare area	Salt marsh	Salt marsh pasture	Thorn scrub	Mixed	Forest	Gross		
Colombo Light House to Kelani River	15	06	03		03																		
Kelani River to Negombo Lagoon	27	25			17																04		
Negombo Lagoon to Maha Oya	09	07			03								19	02							04		
Maha Oya to Karukkupona	42	39			15								24								01		
Karukkupona to Talawila	59	13	45	02	10				12	01	10	45	20	16	32	02				03	08		
Talawila to Puttalam	134	70	56	65	68	01			16	39	63	43	30	28	69	19		59		23	11	16	
Total	286	160	104	67	116	01			102	66	84	88	50	44	147	23		59		23	14	16	78
% of kilometres at which specified types were observed (for each group)	100	35.71	23.21	14.96	25.89	0.22			12.85	8.31	10.58	11.08	6.30	5.54	18.51	2.9		7.43		2.9	1.76	2.02	9.82
% of total mentions (for group)	100	55.75	36.24	23.34	40.41	0.35			35.54	23.0	29.26	30.66	17.42	15.33	51.21	8.0		20.55		8.0	4.87	5.57	27.17

APPENDIX TABLE 3
Nature of coast line from Puttalam to Elephant Pass
(Number of kilometres at which the specified features were observed)

Segment of the coast line	Length of coast line (Km)	Geomorphological Description													Nature of beach material				History of the shore line				
		Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sandy	Silty	Colour of beach sand				Receding
																		White	Brown	Black	Other		
Puttalam to Mannar	113	68	04	70	58	19		09	01	27			06	14	12	32	48	05		24	02	63	
Talai Mannar Island	63	63	03	09	04			45	03				01			22	35			07		48	
Mannar to Vidattalivu	22	02	01		20											05				02		12	
Vidattalivu to Elephant Pass	182	124		93	75	13	01	02	01	02			01	01	02	75	55			26		143	01
Total	380	257	08	172	157	32	01	56	05	29			08	15	14	134	138	05		59	02	266	01
% of kilometres at which the feature was observed	100	68	2	45	41	8	0.2	15	1	8			2	4	4	35	36	1		16	0.5	70	0.26
% of total mentions (for each section)	100	36	1	24	22	5	0.1	8	0.7	4			3	5	5	43	45	8		89	3	100	0.37

APPENDIX TABLE 4
Dominant vegetation types in the Coastal Zone from Puttalam to Elephant Pass

Segment of the coast line	Length of coast line (Km)	Description of vegetation (Number of kilometres at which specified types were observed)																			
		Dominant Vegetation					Sandy shore Vegetation			Sand dunes			Mangrove Vegetation			Salt Marsh				Forest	Grass
		Sandy sea shore vegetation	Dune vegetation	Salt marsh	Mangrove	Others	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Mature	Immature	Bare area	Salt marsh	Salt marsh pasture	Thorn scrub	Mixed		
Puttalam to Mannar	113	30	19	13	43	59	74	21	18	17	04	52	13	14	14			06	53	30	
Talamannar Island	63	36	30	19	16	18	34	07	09	36	17	16	06	03	04			10			
Mannar to Vidattalivu	22	11		22		03	10	03			11	11	04	03	02	06	01	12			
Vidattalivu to Elephant Pass	182	163	25	54	42	145	103	53	05	12	14	44	21	49	23		01	09	45		
Total	380	240	74	108	101	225	221	84	32	65	46	123	44	69	43	06	02	37	98	30	
% of Kilometres at which the specified types were observed (for each group)	100	63.16	19.47	28.42	26.57	67.10	58.16	22.10	8.42	17.10	12.10	32.36	11.57	18.15	11.31	1.58	0.52	9.74	25.78	7.80	
% of total mentions (for each group)	100	45.89	14.15	20.65	19.31	20.6	19.64	7.47	2.84	5.78	4.09	10.93	3.91	6.13	3.82	0.53	0.17	3.29	8.71	2.69	

APPENDIX TABLE 5
Nature of coast line from Elephant Pass to Chempianpattu
(Number of kilometres at which the specified features were observed)

Segment of the coast line	Length of coast line (Km)	Geomorphological Description														Nature of beach material				Shore line				
		Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sandy	Silty	Colour of beach sand				Retreating	Developing
																			White	Brown	Black	Other		
Elephant Pass to Jaffna	93	57	45	48	01	01		02		05	01	01	04	06	04	22	02	78	24			02	80	
Jaffna to Point Pedro	72	63	03	03	01		02		02	01	05	29	23	11	16	08	27	01	13		03	34	10	
Point Pedro to Chempianpattu	15	16	13						01		02	01			01	10	15	02	04			13		
Total	181	136	61	51	02	01	02	02	02	07	06	32	25	15	22	13	59	18	93	28	03	18	52	90
% of kilometres at which the features was each section)	100	75	34	28	1	0.5	1	1	1	4	3	18	14	8	12	7	33	10	51	15	2	10	29	33
% of total mentions for each section)	100	42	19	16	0.6	0.3	0.6	0.6	6	2	2	10	8	12	17	10	46	14	65	20	2	13	37	63

APPENDIX TABLE 6
Dominant vegetation types in the Coastal Zone from Elephant Pass to Chernpiyanpattu

Segment of the coast line	Length of coast line (Km)	Description of vegetation (Number of kilometres at which specified types were observed)																			
		Dominant Vegetation					Sandy shore vegetation			Sand dune			Mangrove vegetation		Salt Marsh				Forest	Grass	
		Sandy sea shore vegetation	Dune vegetation	Salt marsh	Mangrove	Others	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Mature	Immature	Bare area	Salt marsh	Salt marsh pasture	Thorn scrub			Mixed
Elephant Pass to Jaffna	93	84	13	90	37		52	79	11	36	43	04	37	35	09	83	50	16	13	02	
Jaffna to Point Pedro	72	37	09	38	24		30	27	04	20	16	02	33	01	05	23	21	16	14		
Point Pedro to Chernpiyanpattu	16	16	14	11	05		16	06		14	02		03	04	02	09		02	03		
Total	181	137	36	125	66		98	112	15	70	51	06	3	40	16	115	71	34	30	02	14
% of kilometres at which the specified types were observed (for each group)	100	75.69	19.79	59.06	36.46		54.14	61.88	8.29	38.67	33.70	3.31	40.33	22.09	8.84	63.54	39.23	18.78	16.57	1.10	7.73
% of total mentions (for each group)	100	37.63	9.89	34.34	18.13		12.94	16.79	1.24	8.05	0.79	9.64	5.28	2.11	15.19	9.38	4.49	3.96	3.96	0.26	1.84

APPENDIX TABLE 7
Nature of cost line of the Islands off Jaffna Peninsula
(Number of kilometres at which the specified features were observed)

Segment of the coast line	Length of coast line (Km)	Geomorphological Description												Nature beach material						History of the coast line				
		Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sandy	Silty	White	Color of beach			Receding	Developing
																				Brown	Black	Other		
Mandaitivu	20	20	2				20				04				05								02	03
Punkudutivu	45	44	08	11			41		01			04		01	31		44	34					09	23
Delft	28	14		02	01		28		05		28	23		05	27	16							28	
Puliyantivu	03	03					03		01		03				03									
Analativu	11	08					09		01	01	11		01	01	11								05	
Parativu	02						02				01				02									
Eluvativu	08	04			01		08		03		01	04		05	07	06						02	08	
Naynativu	11	11					10				11	05			08								09	
Kayts	65	32	06	10	02		60	02	03		33				44		06						09	
Karativu	25	10	03	04	01		23		03		20	01			17	07	10	03					09	
Total	218	146	21	26	05		204	02	17	01	117	37	01	12	35	150	07	61	37		02	79	26	
% of kilometres at which the feature was observed (for each section)	100	77	10	12	2		94	9	8	5	54	17	5	6	16	69	3	28	17		9	36	12	
% of total mentions (for each section)	100	25	4	5	0.9		35	0.3	3	2	20	6	5	6	17	73	3	61	37		2	75	25	

APPENDIX TABLE 8
Dominant vegetation types of the coastal zone of the Island off Jaffna Peninsula

Description of vegetation (Number of kilometres at which the specified types were observed)

Segment of the coast line	Length of coast line (Km)	Dominant Vegetation					Sandy shore Vegetation			Sand dunes			Mangrove vegetation		Salt Marsh					Grass		
		Sandy sea shore vegetation	Dune vegetation	Salt marsh	Mangrove	Others	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Mature	Immature	Bara area	Salt marsh	Salt marsh pasture	Thorn scrub	Mixed		Forest	
Mandativu	20	07	01	15	15		07	03	01	07	02		15		16	13	11	06				
Punkudutivu	45	45		45			45	45		06	06				07	44	07	03	03			
Dolft	28	27	01	03	28		27	26		03					04	05						24
Puliyantivu	03	03			03		03	03				02	03									03
Analativu	11	1*		01	11		10	03				11	09	01	01							
Paraitivu	02	02		02		02	02				02	02										
Eluvativu	08	08			08		08	08				02	08									03
Nainativu	11	11			11		11	11				11	11									05
Kayts	65	57	09	44	61		55	42	15	09	03		61	62	25	44	14	07	08	01		13
Karativu	25	21	11	11	23		21	04	01	10	01		18	17	08	14						12
Total	218	192	22	119	162		189	147	18	35	12		150	140	61	212	32	16	11	01		60
% of kilometres at which the specified types were observed (for each group)	100	88.07	10.09	54.58	73.31		86.69	67.43	8.25	16.05	5.50		68.80	64.22	27.98	55.50	14.67	7.33	5.04	0.45		27.52
% of total mentions (for each group)	100	38.78	4.44	24.04	32.72		19.03	14.80	1.81	3.52	1.20		15.10	14.09	6.14	12.18	3.22	1.61	1.10	0.10		6.04

APPENDIX TABLE 9
Nature of coast line Chempiyapattu to Foul Point
Number of kilometres at which specified features were observed

Segment of the coast line	Length of coast line (Km)	Geomorphological Description													Nature of beach material							History of the shore line		
		Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sandy	Silty	Colour of beach sand				Receding	Developing
																			White	Brown	Black	Other		
Chempiyapattu to Mullativu	61	61	05	02													61	39	15		18	24	01	
Mullativu to Kokilar	36	36	07	04					03		07		03			34		20		14		20	08	
Kokilar to Irakkandy Bridge	43	41	09	07		06	01	01	02		05	02	11	02	01	38	01	18		17		21	04	
Irakkandy to Trincomalee	17	16						02			05		01	01		13		15		01	01	05		
Trincomalee to Foul Point	109	03		37	105			11	21	25	09	02	39	39	45	45	44	01	43		01	44	04	
Total	266	157	21	50	105	06	01	14	21	30	09	19	41	54	48	46	190	31	111	39	39	19	114	17
% of kilometres at which the feature was observed (for each section)	100	59	8	19	40	2	3	5	8	11	3	7	15	20	18	17	71	15	42	15	12	7	43	6
% of total mentions (for each sections)	100	33	4	11	22	1	2	3	4	6	2	4	9	14	13	12	50	11	55	19	16	9	87	13

APPENDIX TABLE 10
Dominant vegetation types in the Coastal Zone from Chempianpattu to Foul Point

Segment of the coast line	Length of coast line (km)	Description of vegetation (Number of kilometres at which specified types were observed)																				
		Dominant Vegetation					Sandy shore vegetation			Sand dunes			Mangrove vegetation			Salt Marsh				Forest	Grass	
		Sandy sea shore vegetation	Dune vegetation	Salt marsh	Mangrove	Others	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Mature	Immature	Bare area	Salt marsh	Salt marsh pasture	Thorn scrub	Mixed			
Chempianpattu to Mullaitivu ...	61	63	59	29	39		60	51	15	60	58	48	41	39	19	25		02			36	13
Mullaitive to Kokilai ...	36	35	26	07	07		35	25	20	23	21	12		06	05	03		02	01	01	11	15
Kokilai to Irakkandy Bridge ...	43	35	18	08	08		32	33	25	14	15	10	05	06	09	10		01	05	05	10	04
Irakkandy Bridge to Trincomalee ...	17	16	04				14	13	04	05	04	01	05	02								
Trincomalee to Foul Point ...	109	67	18	37	57		40	57	55	12	10	06	54	08	20	31		04	08	04	68	76
Total ...	266	213	125	81	111		181	179	119	114	108	77	105	61	53	69	07	16	10	125	120	
% of kilometres at which specified types were observed (for each group) ...	100	80.08	46.99	30.45	41.73		68.05	67.29	44.73	42.86	40.60	28.95	39.47	22.93	19.92	25.94		2.63	6.02	3.76	46.99	45.11
% of total mentions (for each group)	100	40.18	23.48	15.28	20.94		13.46	13.32	8.85	8.48	8.03	5.73	7.81	4.54	3.94	5.13		0.52	1.19	0.74	9.30	8.93

APPENDIX TABLE 11
Nature of coastline from Foul Point to Pottuvil
(Number of kilometres at which the specified features were observed)

Segment of the coast line	Length of coast line (km)	Geomorphological Description													Nature of beach material					History of shore line				
		Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Roughers	Cobbles	Pebbles	Sandy	Silty	Colour of beach sand				Receding	Developing
																			White	Brown	Black	Other		
Foul Point to Vakara	40	37	15	08	13	03				05	01	13	14	01	02	01	21		10	32	14		13	17
Vakara to Kalkudah	34	22	03	06	23	02		02		01	41	7	01				17	01	26	10	01		23	7
Kalkudah to Batticaloa	32	24	08	03	23	06				05	07	04	01	01		17	17		21	13	03		20	09
Batticaloa to Pottuvil	98	84	30	29	39		01				44	06	06	01		01	51		95	13	44		55	11
Total	204	167	56	46	98	06	01	02		11	66	33	25	03	03	02	106	01	152	68	62		111	44
% of kilometres at which the features was observed (for each section)	100	82	28	23	48	3	4	1		5	32	16	12	2	1	1	52	5	75	33	30		54	22
% of total mentions (for each section)	100	33	11	9	19	1	2	4		2	13	7	5	3	3	2	92	9	54	24	22		72	28

APPENDIX TABLE 12

Dominant vegetation types in the Coastal Zone from Foul Point to Pottuvil

Segment of the coast line	Length of coast line (Km)	Description of vegetation (Number of kilometres at which the specified types were observed)																				
		Dominant Vegetation					Sandy shore vegetation			Sand dunes			Mangrove vegetation		Salt Marsh						Forest	Grass
		Sandy sea shore vegetation	Dune vegetation	Salt marsh	Mangrove	Others	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Mature	Immature	Casual	Salt marsh	Salt marsh pasture	Thorn scrub	Mixed			
Foul Point to Vakarai	40	15	30	09	22	05	15	01		19	20	11	25	25		03	06	02	01	26	10	
Vakarai to Kalkudah	34	07	34	02	03		11			33	23	09	05	04	03				03	21	07	
Kalkudah to Batticaloa	32	18	28		08		16	05		24	28	13	09	06						03	19	
Batticaloa to Pottuvil	98	66	49	19	41		59	36	09	41	41	41	46	42	05	10	01		01	12	42	
Total	204	106	141	30	84	05	101	42	09	117	112	58	85	77	98	13	07	02	05	62	78	
% of Kilometres at which the specified types were observed (for each group)	100	52.0	69.1	14.7	41.2	2.45	49.5	20.6	4.41	57.4	54.9	28.4	41.7	37.7	3.92	6.37	3.43	0.98	2.45	30.4	38.2	
% of total mentions (for each group)		29.0	38.5	8.19	22.9	1.36	13.0	5.41	1.16	15.1	14.4	7.47	10.9	9.92	1.03	1.68	0.90	0.26	0.64	8.0	10.1	

APPENDIX TABLE 13
Nature of coast line from Pottuvil to Hambantota
(Number of kilometres at which specified features were observed)

Segment of the coast line	Length of coast line (km)	Geomorphological Description													Nature of beach material					History of the shoreline						
		Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sandy	Silty	Colour of beach sand				Receding	Developing		
																			White	Brown	Black	Other				
Pottuvil to Heda Oya ...	07	05		03	04	02			01	01						06									01	03
Heda Oya to Hambantota	120	57	04	23	15	19		02	13	15	01	30	06	02	01	82		52	40	12	12			37	19	
Total ...	127	62	04	26	19	21		02	14	16	01	30	06	02	01	88		52	22	44	12			38	22	
% of kilometres at which the feature was observed (for each section) ...	100	49	3	21	15	17		2	11	13	1	24	5	2	1	69		41	17	35	10			30	17	
% of total mentions (for each section) ...	100	32	2	13	10	11		1	7	8	5	15	6	2	1	91		40	15	34	9			63	37	

APPENDIX TABLE 15
Nature of coast line from Hambantota to Galle
(Number of kilometres at which specified features were observed)

Segment of the coast line	Length of coast line (Km)	Geomorphological Description														Nature of beach material							History of the shore line	
		Straight coast line	Sand pit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sands	Colour of beach sand					Retreating	Developing
																		Silt	White	Brown	Black	Other		
Hambantota to Tanqalle	41	16	04	14	11	02			01	07	08	11	03	07	02	05	29	04	02	26	13	22	29	06
Tanqalle to Dondra Head	34	11	11	10	25	01		04	03	20	25	09	07	25	19	08	21	07			05	20	30	
Dondra Head to Matara	05	04	01	01	01		01	01	01	02	04	03	02	01	02	01	04				01	03	05	
Polhena	03	03	01	01			01				03	03		01		01	03				01	03	03	
Polhena to Weligama Bay	08	05	01	01	04		01		01	05	05	01	02	01		06					04	01	08	
Weligama Bay	06	05		01	03		03	01	02	06		01		01		06					04	04	08	01
Weligama Bay to Koggala	12	10	01	02			01		02	05	11	04	04			10	04	05		09	05	12		
Koggala to Unawatuna	07	02	03									05	04	03		06	03	06			06	07		
Unawatuna to Galle MC Limits	05	02			03				03	03		02	05			03	03	02			04	03		
Total	123	58	22	30	47	03	01	11	06	37	59	47	24	48	25	15	88	21	15	26	40	67	105	07
% of kilometres at which the feature observed (for each section)	100	47	19	24	38	2	8	9	5	30	38	38	20	39	20	12	72	17	12	21	32	54	85	06
% of total mentions (for each section)	100	17	6	9	14	9	3	3	2	11	17	14	7	24	13	8	45	11	10	18	27	45	94	6

APPENDIX TABLE 16
Dominant vegetation types in the coastal zone from Hambantota to Galle

Segment of the coast line	Length of coast line (Kms)	Description of vegetation (Number of kilometres at which specified types were observed)																			
		Dominant Vegetation					Sandy shore vegetation			Sand dunes		Mangrove vegetation			Salt Marsh				Forest	Grass	
		Sandy sea shore vegetation	Dune vegetation	Salt marsh	Mangrove	Others	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Mature	Immature	Bare area	Salt marsh	Salt marsh pasture	Thorn scrub			Mixed
Hambantota to Tangalla	41	39	14	15	16		30	26	27	08	09	04	16	05		01	05	11	09	05	22
Tangalle to Dondra Head	34	33	06	06	07		25	22	33	04	02	04	02	06	01	04	02	02	04	02	31
Dondra Head to Matara	05	05		01	01		04	03	05				01	02							02
Polhena	03	03		02	01		03	02	03	03	02	03	01	01							01
Polhena to Weligama Bay	08	08		01			07	04	08							01					06
Weligama Bay	08	08					07	03	02				01			03					03
Weligama Bay to Koggala	12	12	03				12	05	05	03				01		03					10
Koggala to Unawatuna	07	07	01	02	02	01	07	01	02	02			01	01	01	02	01				03
Unawatuna to Galle MC limits	05	05					03	02	02	01											03
Total	123	120	24	27	27	01	98	68	85	20	13	11	22	16	02	14	08	13	13	10	81
% of kilometres at which the specified features were observed (for each group)	100	97.56	19.51	21.95	21.95	0.81	79.67	55.28	69.92	16.26	10.57	8.94	17.89	13.00	1.63	11.38	6.50	10.57	10.57	8.13	65.85
% of total mentions (for each group)	100	60.30	12.06	13.56	13.56	0.50	20.63	14.31	18.10	4.21	2.73	2.31	4.63	3.36	0.42	2.94	1.68	2.73	2.73	2.10	17.05

APPENDIX TABLE 17
Nature of coast line from Galle to Colombo
(Number of kilometres at which the specified features were observed)

Segment of the coast line	Geomorphological Description														Nature of beach material							History of the shore line		
	Length of coast line (Km)	Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sandy	Colour of beach sand					Receding	Developing
																		Silt	White	Brown	Bluish	Other		
Galle	14	08			07	03			04	04	07	09	25	06	01		07	01	07	02	03	10		
Galle to Dodanduwa	09	07	03	02	02	03		02		02		07	10			08	01	06	01			06		
Dodanduwa to Hikkaduwa	09	07	02		05	02	01		01	01		09	07	02		08		07	01			06	03	
Hikkaduwa to Ambalangoda	11	10			03	01		01		01		09	06	01		11				01		11		
Ambalangoda to Ahungilla	10	09			01	01				05	01		08			10						10		
Ahungilla to Kosgoda	05	05				01					01	03				05						04		
Kosgoda to Induruwa - Rat Gate	06	06			01					03	01		02	03	01	06			05	03		06	01	
Induruwa - Rat Gate to Bentota Estuary	07	06	03		01	03				07			03	01		01	05	03	06	02		04	07	
Bentota Estuary to Beruwala Light House	04	04					01			01	01	02	01			02	04		04	01		03	01	
Beruwala Light House to Miggon's headland	08	05		01	03			02	02	05	01		04	05		01	08	01	06			08	03	
Miggon's headland to Kalutara	07	06		01	01	03				01	01	01				01	07	01	01	06	01	08	03	
Kalutara to Kalutara	05	04	03	03		02										05	04	01	05	01		02	03	
Kalutara to Talpottuwa Est.	09	09	01			01										09	01		07	03	01	06	05	
Talpottuwa Est. to Pinnakoru Ganga	05	05				01										05						05		
Pinnakoru Ganga to Mt. Lavinia	17	16	01			02			01				03	02		13	01		11	08		15	02	
Mt. Lavinia to Vnderwert Place	02	02												02		02			02	02		02		
Vnderwert Place to Colombo	07	07								01				06		06			08	07		05		
Total	135	117	13	07	24	23	02	05	08	31	09	39	69	28	03	04	119	13	22	60	16	21	110	28
% of kilometres at which the feature was observed (for each section)	100	97	10	5	18	17	1	4	6	23	7	29	51	21	2	3	88	10	16	44	12	16	81	21
% of total mentions (for each section)	100	34	3	2	7	7	5	1	2	9	3	11	20	17	2	2	71	8	18	50	13	18	79	20

APPENDIX TABLE 19
Sinhalese Names of some Varieties of Fish, types of corals and sea weeds
found in the southwestern Zone.

අමතලන්ගොඩ ප්‍රදේශය:

වෙරළට ආසන්නව වාසය කරන වසන් වර්ග:

කැන්දා	කුකුළු පැටුරි	චූහුදු පැලිගොඩියා
හැලු චුරුපා	පකාරාචුරුපා	පකාලු චුරුපා
බහා	හැරුපැස්සා	හැරු කිට්ටියා
පොල් කිරි	හැරුපැල්ලා	පැන්පා (පස් කාරුපැල්ලා)
චූහුදු කුහිස්සා	බැස පැල්ලා	පොල්ලා
හුරුපැල්ලා	ලාගා	කරුපා
පොත්තනාපා	පොති පැරුපා	දැසපා
දත් ගිරපා	කිහිත්තා	ඉස්සා
පොකිට්ටියා	කුහිස්සා	කැලියා
පොද්දා	පිටුපා	ඉබුපා (දැචුරු පැහැතිය)
පවුපාලයා	පොලියා	පවුපා
බපයා	බප කැරුපැල්ලා	සාලයා
ඉටිපොරපා	පියා පැස්සා	දැටියා
කකුපා	හැරු කකුපා	ගිටි කකුපා (ගිටිහැරු පටුලා පෙට්ටිය)
සලා කකුපා (පවුරුපැල්ලා පැලියා හැරු)	කිටි පොල්ලා	හඳුස
හාරාගොනා පිටුපා	කැපලා	පැරු රත්තා
සලාදු පකාලු හැරුස දැන.)	පස්පාපා	

වෙරළ සහ දිගු ප්‍රදේශයේ වෙසෙන වසන් වර්ග

දැල්ලා	සකු දැල්ලා	පොතු දැල්ලා
පකාරාන් දැල්ලා	පොතු පොරා	පොස්සා
පොත්තියා (කපු ලාල්ලා)	දැලු පොලියා	පොදිල්ලා
ලා හුපා	කැලියා	ලාහුරු පොරා
චූදිල්ලා	සපුගඩියා	පුලා
පරුගොලා	රහදිපා	තලපා
කපුහැරුපා (පස් හැරුපැල්ලා වාසය කරයි)	කපුරත්තා	පැලු හත්තා
ලා පකාස්සා	හැරුපොලා පකාස්සා	පැලි පකාස්සා
හැරු හඳු	සපුලියා	පහුරු හඳු
පොත්තා (පැහැලි දිගු පිටු සැරු පොතු)	හපුලියා	පවුපා
පැලියා සිහින් සෙලා ගතියක් ගැනි	රහපා	කරුපා
සපොකි)	දෙවි පකාස්සා	පොරු පොලියා
හැරුබපා	දැස් පොලියා	පොලියා
සාපාලයා	පාවියා	පපුලියා
හැරු බලා	පකාරාන්පොතුබපා	බලා
පොල්ලා	කපු පො	කපුබලා
කපු පැරුපා	දැලු පොලියා	පැරුපා
කාකුකා	හුඳු පැන්පා	දැහැකියා
ඉඳුරා	පරුපා	පොල්ලා
හැටුරු හතා	දැල්ලා	පාලියා
පුලා	පොරුපා	කපුදැල්ලා
පාකරු හුරුපැල්ලා	බපයා	පැස්සා
පිහියම් පොල්ලා	පැරුපොත්තා	පැලියා
	කපුපැලා	ගිනිපහ (ලාස්සනා පාප පහියකි)

APPENDIX TABLE 19 (Cont)

දියඹ ප්‍රදේශයේ වෙසෙන අසුන්

කප්පරා	කොප්පරා	කෝරා
තලුමහ	මඩුපා	අලි මඩුපා
අහ මඩුපා	සෙම මඩුපා	වලි මඩුපා
පොල්කොල මඩුපා	පරවා	පැටි පරවා
කන්නාඩි පරවා	ගොලි පරවා	දියවල්ලා
ඇටවල්ලා	කපුරල්ලා	කට්ටාපා
කඳනැලා	පොරා	ගල් මෝරා
කිටි මෝරා	යක් මෝරා	උදුලු මෝරා
පුල්ලි මෝරා	කොටි මෝරා	භාල පාලයා
බුච්චලා	කොලවල්ලා	ඉරටවල්ලා
පෝවල්ලා	තලපතා	ලොවහ
අචමහ	බලයා	මුල්ලා
ලේනාටා	අලගොඩුපා	මරන්දා
පියා මැස්සා	දැල්ලා	යක් දැල්ලා
ගාකු දැල්ලා	කොටන් දැල්ලා	ඇස්ගෙඩි කොලවල්ලා
පුහුදු අඟ්ටයා	කනන්දා	මුල්ලා - කොල්පිත්

මේ භාරුවන විට කැස්බෑ වග ද මෙම වෙරළ ප්‍රදේශයේ දක්නට ලැබේ.

ගල් මල් වර්ග

කට්ටු ගල් මල්, කප් ගල් මල් (වටිනාකම පැඩිසි, ගල් නගර) (සිහින් කෝටුඵලක භැසයට තනිව විවිද.)

හිටි ගල් වර්ග

සට්ට ගල් සහ පතුරු ගල් - මේවා ජාල වර්ගයන්ය. පතුරු ආකාරය. සපයද අඩු අතර වටිනාකම ද අඩුයි.

අඩුගල් - අඩි 5 සහ 10 තරම් ගැඹුරින් ලැබේ, ඉහළ ප්‍රමාණය පැඩිසි, වටිනාකම පැඩිසි.

මගගල් - අඩි 20 ක් තරම් ගැඹුරින් ලැබේ, වටිනාකම පැඩිසි.

බැරටි භූමි - බැරටි යන සතාගෙන් ලබා ගන්නා මේවා හිටි ගල්වලට වඩා සපයෙන්නේ පැඩි සුදු ද කල් පැවැත්ම අඩුය. දියඹ කොටසින් ලබා ගනී.

පඩියාගල කපතර වෙරළ ප්‍රදේශයේ වෙසෙන අසුන්වර්ග

කහපර්ව	කප් පර්ව	වලා පර්ව
කන්නාඩි පර්ව	පැටි පර්ව	ඇටනගල් පර්ව
දියවල්ලා පර්ව	මගුරුවෝ පර්ව	ප්‍රේනාපො පර්ව
කබර් පර්ව	මට්ටන්කලි පර්ව	පැන්පො පර්ව
කර්නසයා පර්ව	හින්නට් පර්ව	ලේනා පර්ව
චච්චාලයා		
අලි මඩුපා	මුක්කර මඩුපා	අහ මඩුපා
භූප්ප මඩුපා	වැලි මඩුපා	පඩුල් මඩුපා
පුල්ලි මඩුපා	ආදාපල්ලා මඩුපා	සෙවල මඩුපා
උදුල් මෝරා	පුහුර මෝරා	පොල්කොල මෝරා
සිනි මෝරා	කහ මෝරා	යක් මෝරා
ගල් මෝරා	ලාග්ග මෝරා	මඩ මෝරා
දැනි මෝරා		
අයින් පුල්ලි කට්ටා	කොටල්ලා කට්ටා	ඇටිලි කට්ටා
නැල්ලා කට්ටා	සැමිබියා කට්ටා	
කපු කාරල්ලා	අඟ කාරල්ලා	මස් කාරල්ලා
කෙල් කාරල්ලා	පුකදිග් කාරල්ලා	පල්දැක් කාරල්ලා
කාඩි පපතා		
යක් දැල්ලා	මාදැල්ලා	ගොඩදැල්ලා
මිට්ටියා	හැලිමි පැටියා	උතුරුගොටා
ලපයා	බැසා	රන්දැල්ලා
රන්බැසා	කපරන්තා	ගල්පලලා
රන්තා	කන්ගැට්ටා	ඇඟැට්ටා
පෙදිල්ලා	කලමියා	ලොවයා
තඟුපා	පොතබරා	සිල්ලා

APPENDIX TABLE 19 (Cont)

බමඩාරු තෙලියා සාලයා දඬුලාග්ගා පෙන්නනාපා හාල්මැස්සා බග්ගා ගල් ඉස්සා, සුදු ඉස්සා පුද්ධන්තා පොරු දල ගොඩපා බලයා කප දන්දිලොපා පුහුදු හිගා පනලි ජිලොපා පුහුදු ලොරා දෙමල කොප්පරා මුදු කුකුළා තොඩුම තිඹිරා වැටිපනලා මිල්ලා බොම්බෙලි පොතු කිරිල්ලා හඳපානසා	කුරලා පොරුදා සුසායා පුපුලාග්ගා කපුමැස්සා පිසිත්තාපා කුනිස්සා කබර ඉස්සා පන්නාපා දලගොඩපා පකලපල්ලා පොරු දඬුලොපා පුහුදු මගුරා කපුපල්ලා කුමබිලොපා සප්පරා වැටි කොප්පරා තලියා කුමබිලොපා තල්මහ දැටිස්සා බුපල්ලා ගොසායා සුදුදා	පනයිසා පොනිස්සා කපුලාග්ගා හරුල්ලා හැඳුල්ලා ඉස්සා පොනිටිස්සා කපුප් පන්නාපා ඉරුපලල්ලා පොරු ගගේ දඬුලොපා පුරල්ලා පොලොපා බොරුල්ලා තලපනා පෙරුන් තලයා දැටලල්ලා දොල කොප්පරා ගල්බල්ලා හබරලි පොරලි ඉලයා පනාමැඩියා
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දාර කැස්බොලා, මල් කැස්බොලා සහ පොතු කැස්බොලා යන වර්ග මෙම ප්‍රදේශයේ දක්නට ලැබේ.

මුහුදු පැලෑටි බිල්ලන් ගල තැඹිලියාප ගල්පුල්ලන්ගල දියඹ ගල	මුඩාප රුල්ලන්තා ගොඩගල් මුල්ලන්ගල	දිග්ගල මුදුල්ලොපා මෝදර මුඩාප
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APPENDIX TABLE 20
Water-front structures in the Coastal Zone from Colombo to Puttalam

Segment of the coast line	Length of coast line (Km)	Type of Structure (Numbers counted)																		
		Reverments	Boulder Walls	Masonry walls	Groynes	Break waters	Piers	Jetties	Sewage outfall structures	House (Permanent)	Houses (Temporary)	Hotels	Tourist shops	Boutiques	Industrial Premises	Fish sales centres	Roads (length in Km)	Railways (length in Km)	Fishing sheds	Other buildings
Colombo Light House to Kelani River ..	15	01	07	07	01	04	01	53												
Kelani River to Negombo Lagoon ..	27	14	16	11	18					70	01									
Negombo Lagoon to Maha Oya ...	09	25	06		02				02	53	129	04	01	01	03	02	03			
Maha Oya to Karukkupona ..	42	08	07	03	08					138	194									
Karukkupona to Talawila ..	59	03			03					10									18	
Talawila to Puttalam ..	134			10	04			03	05	119	272			16	02	09	01		23	01
Total	296	51	36	31	36	04	01	56	07	390	673	04	01	17	02	03	03	03	42	20

APPENDIX TABLE 21
Water-front structures in the Coastal Zone from Puttalam to Elephant Pass

Segment of the coast line	Length of coast line (Km)	Type of structures (Numbers counted)																
		Overseas	Coastal dikes	Maritime walls	Canals	Breakwaters	Piers	Wharves	Seawalls for harbours	Sea walls for navigation	Sea walls for fishing	Harbours	Reefs	Bulkheads	Revetment structures	Other buildings		
Puttalam to Mannar	114		05	01			01	01	07	161	02		02	01	03	110	02	
Talamannar Island	62	01	03			01				03			06		03	04	601	
Mannar to Vintalaviva	22																02	
Vidattaliva to Elephant Pass	167					01	02								01		36	
Total	365	01	05	01		02	03	07	105	161	03		09	01	03	08	758	02

APPENDIX TABLE 22
Water-front structures in the Coastal Zone from Elephant Pass to Chempianpattu

Segment of the coast line	Length of coast line (Km)	Type of Structures (Numbers count)																		
		Revetments	Fishing Walls	Masonry walls	Croquis	Break walls	Piers	Jetties	Sewage outlet structures	House (floor & roof)	House (Tentative)	Hotels	Tourist Sheds	Boutiques	Industrial Complexes	Public buildings	Roads (length in Km)	Railways (length in Km)	Fishing sheds	Other buildings
Elephant Pass to Jaffna	93		04	14				04	15	149	36			05						
Jaffna to Point Pedro	72	17	04	20		01		01	27	329	59	01							10	02
Point Pedro to Chempianpattu	16			02						352	38			02						01
Total	181	17	08	36		01		05	52	830	123	01	01	25	14	28	40	05	1021	03

APPENDIX TABLE 23

Water-front structures in the Coastal Zone of the Island of Jaffna Peninsula

Segment of the coastal line	Length of coast line (Km)	Type of Structures (Numbers counted)																		
		Revetments	Boulder Walls	Masonry walls	Groynes	Break waters	Piers	Jetties	Sewage outfall structures	House (Permanent)	Houses (Temporary)	Hotels	Towns/ shops	Botiques	Industrial Premises	Fish sales centres	Roads (length in Km)	Railways (length in Km)	Fishing sheds	Other buildings
Mandativu	20			01				01									0.3		29	
Punkudutivu	45							02									1.02			
Delft	28			02		02		01	14								21.3		397	
Puliyantivu	03																			
Analativu	11							02	05								6.1		80	
Parativu	02																			
Eluvativu	08							08	03				01				1.3			
Naynativu	11	03						03	91	10			09				8.1		86	
Kayts	65	11		02				01	13	03	01		02				6.7		42	03
Karativu	25	06		02			01	03	06	01							1.42		672	
Total	218	20		07		02	01	21	132	14	01		12				46.24		1306	03

APPENDIX TABLE 24
Water-front structures in the Coastal zone from Chempianpattu to Foul Point (Number of Counts)

Segment of the coast line	Length of coast line (Km)	Type of Structures (Numbers counted)																		
		Revetments	Boulder Walls	Masonry walls	Groynes	Break waters	Piers	Jetties	Sewage outfall structures	House (Permanent)	Houses (Temporary)	Hotels	Tourist shops	Boutiques	Industrial Premises	Fish sales centres	Roads (length in Km)	Railways (length in Km)	Fishing sheds	Other buildings
Chempianpattu to Mullaitivu	61									12	10									
Mullaitivu to Kokilai	36				03					03	30				02				850	
Kokilai to Irakkandy Bridge	43							01	02	91	01			01		03			118	
Irakkandy to Trincomalee	17										40					01			74	
Trincomalee to Foul Point	109	09	05	23	03		06	17	19	100	34	04	01	01	01					09
Total	266	99	05	23	06		06	18	21	116	115	14	03	11	03	18	19	2	1125	54

APPENDIX TABLE 25
Water-front structures in the Coastal Zone from Foul Point to Pottuvil

Segment of the coast line	Length of coast line (Km)	Type of Structures (Numbers counted)																		
		Reverments	Boulder Walls	Masonry walls	Groynes	Break waters	Piers	Jetties	Sewage outfall structures	Houses (Permanent)	Houses (Temporary)	Hotels	Tourist shops	Boutiques	Industrial Premises	Fish sales centres	Roads (length in Km)	Railways (length in Km)	Fishing sheds	Other buildings
Foul Point to Vakkara	40								02	67								01		
Vakkara to Kalkudah	34								25	143	02							01		
Kalkudah to Batticaloa	32							01	17	112	13	05	06		03	2		02		
Batticaloa to Pottuvil	98	01							348	428	06		37		75	24		94	07	
Total	204		01					01	390	748	21	05	43		78	26		104	07	

APPENDIX TABLE 26
Water-front structures in the Coastal Zone from Pottuvil to Hambantota

Segment of the coast line	Length of coast line (Kms)	Type of Structures (Numbers counted)														Fishing sheds	Other buildings									
		Residential	Storage Warehs	Miscellaneous Warehs	Factories	Break water	Piers	Docks	Wharves	Public buildings	Public Temples	Hotels	Tourist shops	Boutiques	Industrial Factories			Mineral services	Roads							
Pottuvil to Heda Oya	07																									
Heda Oya to Hambantota	120			02	06			02	04	16	07	06				05	02								09	
Total	127			02	06			02	04	16	07	13				05	07								58	13

APPENDIX TABLE 27
Water-front structures in the Coastal Zone from Hambantota to Galle

Segment of the coast line	Length of coast line (Km)	Type of Structures (Numbers counted)																		
		Revetments	Boulder Walls	Masonry wall	Groynes	Break waters	Piers	Jetties	Sewage outfall structures	House (Permanent)	Houses (Temporary)	Hotels	Tourist shops	Couiques	Industrial Premises	Fish sales centres	Roads (length in Km)	Railways (length in Km)	Fishing sheds	Other buildings
Hambantota to Tangalle	41		01	02	04			02	88	06	05	01	04		02	15				
Tangalle to Dondra Head	34	05	04	05	01	01			02	513	18	05	02	38	02	06	9		04	01
Dondra Head to Matara	05	01	04		04				340		03	05		02		3			01	02
Pothena	03	03		02	03				155		01		10		01	1				
Pothena to Weligama Bay	08	01							240				21			4				
Weligama Bay	08	04			05	01	01		72	54	02		03		03	6				
Weligama Bay to Koggala	12	04	11	01	07				277	07	08	05	38	01	04	12	6.5			
Koggala to Unawatuna	07	02	03		02	01			175		03		25			2	1.5			
Unawatuna to Galle	05		03	01					192	03	06		30		05	3			01	
Total	123	20	26	11	26	03	02	02	2111	8	34	13	169	05	21	55	8	07	03	

APPENDIX TABLE 28
Water-front structures in the coastal zone from Galle to Colombo

Segment of the coast line	Length of coast line (Km)	Type of Structures (Number counted)																		
		Revetments	Boulder Walls	Masonry walls	Groynes	Break waters	Piers	Jetties	Sewage outfall structures	House (Permanent)	Houses (Temporary)	Hotels	Tourist shops	Boutiques	Industrial Premises	Fish sales centres	Roads (length in Km)	Railways (length in Km)	Fishing sheds	Other buildings
Galle	14	07	06	07	08	03														
Galle to Dodanduwa	09	02		02	02			09	05	320	77	14	04	29	02	11	14	14	17	
Dodanduwa to Hikkaduwa	09	06	02	02	07	01				42	55			16		1	8	12	43	03
Hikkaduwa to Ambalangoda	11	10			18	01			02	310	111	24			19				94	01
Ambalangoda to Ahungalla	10				01	01				43	40	02		07			04	75	168	05
Ahungalla to Kosgoda	05									45	18	02					05		36	
Kosgoda to Induruwa Rail gate	06									02						01		01	01	
Induruwa Rail gate to Bentota Estuary	07	01	01	02	02	02			01			03		01					01	
Bentota Estuary to Beruwala Light House	04	04	01		01					01	01		03							01
Beruwala light House to Maggona head land	08	04	02	01	05	01			02	11		04	11	01						
Maggona head land to Kalutara	07		03	01	06		01		03	22	01			07	08		02			
Kalutara Lagoon	05	01			01				01	12	16	02		01	01	01	01	6	04	01
Kalutara to Thalpitaya Ela	09		03		01						19	02	02				01		02	
Thalpitaya Ela to Panadura Ganga	05									05					01		03	2.1	09	
Panadura Ganga to Mt Lavinia	17	03	02	02	13	01				15				04		02	02	01	144	
Mt Lavinia to Venderwert Place	02	02					01	01	01	08	2043	01		02	01	03			171	
Venderwert Place to Colombo	07	04	02	03	15					143										
Total	135	44	22	20	80	08		10	20	836	2538	60	16	56	24	43	45	13.72	690	11

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APPENDIX TABLE 29
Water-front structures in the coastal zone of Sri Lanka

Segment of the coast line	Length of coast line (Km)	Type of Structures (Numbers counted)																		
		Reverments	Boulder Walls	Masonry walls	Groynes	Break waters	Piers	Jetties	Sewage outfall structures	House (Permanent)	Houses (Temporary)	Hotels	Tourist shops	Boutiques	Industrial Premises	Fish sales centres	Roads (length in Km)	Railways (length in Km)	Fishing sheds	Other buildings
Colombo to Puttalam	286	51	36	31	56	02	01	56	07	390	673	04	01	17	02	12	03	03	42	10
Puttalam to Elephant Pass (including Talamannar Island)	380		01	08	01		02	03	07	105	161	03		09	01	03	08		758	02
Elephant Pass to Chempayanpattu	181	17	08	36		01		05	52	830	133	01	01	25	14	28	40	05	1021	03
Island of Jaffna Peninsula	218	20		07		02	01	21		132	14	01		12			46.24		1306	03
Chempayanpattu to Foul Point	266	09	05	23	06		06	18	21	116	115	14	03	11	03	14	19	02	1125	54
Foul Point to Pottuvil	204		01						01	380	748	21	05	43		78	26		104	07
Pottuvil to Hambantota	127			02	03			02	03	16	07	13			05	0.752			58	22
Hambantota to Galle	123	20	26	11	26	03	02	02	02	2111	78	34	13	169	05	21	55	08	07	03
Galle to Colombo	135	44	22	20	80	08		10	20	836	2533	60	16	56	24	43	45	13.72	690	11
Total	1920	161	99	138	172	16	12	117	113	4926	4467	151	39	342	49	208	242.9	27.22	5111	124

APPENDIX TABLE 30
Land utilization of the coastline from Colombo to Puttalam
(Number of kilometres at which specified types were observed)

Segment of the coast line	Length of coast line (Km)	Agriculture						Recreational					Com-mercial	Resi-dential	Transportation			Mining										
		Perenni-al crops		Season-al crops		Farms		Hotels	Parks	Sanctuaries	Play grounds	Others	Tourist	Non-tourist	Permanent	Temporary	Bus Stations	Rail Stations	Major roads (macadamized)	Minor roads (gravel)	Functional	Non-functional	Services	Industrial	Defence	Fisheries	Vacant	Others
		Commercial	Domestic Use	Commercial	Domestic use	Livestock Farming	Crops																					
Colombo Light House to Kelani River	15 01	01	02									02	04	02	01	01		07	01			05	01	01	03	01	09	
Kelani River to Negombo Lagoon	27 13	27	26	01	11	11		01	03	02	01	03	07	16	25	20		22	08		13		01	01	03	01	09	
Negombo to Maha Oya	09 05	09	08		01			06	03	05	00	07	07	07				08	04		07				26	08	07	
Maha Oya to Karukkupona	42 22	40	40		10	20		01	02	08	03	02	03	27	38	31		14	30	20	11	01			40	02	14	
Karukkupona to Talawila	59 07	34	19		02	25								05	33	38	01	06	06		02				50		07	
Talawila to Puttalam	134 40	76	56	04	17	36		01	01	04		01	01	19	65	61	03	30	42	02	02	40	06	01	122	18	06	
Total	286	88	187	151	05	41	56		09	09	26	10	13	20	78	170	158	05	87	91	04	02	76	08	02	248	30	44
% of kilometres at which specified land use types were observed (for each group)	100	31	65	53	2	14	20		3	3	9	4	5	7	27	59	55	2	30	32	1	7	27	3	7	85	11	15
% of total mentions (for each group)	100	17	35	29	94	8	10		21	13	39	15	19	5	18	40	37	3	47	50	67	33	19	2	5	61	7	11

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APPENDIX TABLE 33
Land Utilization in the Coastal Zone of the Island
(Number of Kilometres at which specified types were observed).

Segment of the coast line	Length of coast line (Km)	Agriculture						Recreational					Com-mercial	Resi-dential	Transportation		Mining		Industrial	Defence	Fishes	Tourist	Others								
		Peren-nial crops		Season-al crops		Farms		Crops	Livestock	Shifting cultivation	Hotels	Parks	Sanctuaries	Play grounds	Others	Tourist	Non-tourist	Permanent						Temporary	Bus Stations	Rail Stations	Major roads (macadamized)	Minor roads (gravel)	Functional	Non-functional	Services
		Homestead	Commercial	Domestic Use	Commercial	Domestic use	Livestock Farming																								
Mandativu	20	02	03	05	03	01											07								01					06	20
Punkudutivu	45	25	24	35	19	24											02	03	02	01		03	05	04	04		02	02	45	45	
Delft	28	13	13	24	11	11								02			02	16	18	02		03	22	06		03		26	26	22	01
Puliyantivu	03	02		03	01	01												03												03	03
Analaativu	11	10	08	10	09	09											09	09				01	09	08		01			11	05	
Parativu	02			02														02											02	01	
Eluvativu	08			08														08	03			02	02						05		01
Naynativu	11	09	01	10	09	09								01		01	11	05	03			04	06	09		03			11	09	02
Kayts	65	18	22	60	35	36								01	01	05	42	33	02			12	50	18	06	02	01	01	65	56	03
Karativu	25	01		24	03	04								01		02	21	18	03			03	11	06		01	01	01	25	19	
% of kilometres at which specified land use types was observed (for each group)	100	37	33	83	41	44								2	4	5	56	40	5			13	50	23	5	5	2	2	92	83	3
% of total mentions (for each group)	100	16	14	35	17	18								100	4	5	55	40	7			19	73	84	16	3	1	1	49	44	2

APPENDIX TABLE 34
Land utilization in coast line from Chempiyanpattu to Foul Point
(Number of Kilometres at which specified types were observed).

Segment of the coast line	Length of coast line (Km)	Agriculture										Recreational					Com-mercial		Resi-dential		Transportation				Mining		Others				
		Peren-nial crops		Season-al crops		Farms		Livestock	Shifting cultivation	Hotels	Parks	Sanctuaries	Play grounds	Others	Tourist	Non-tourist	Permanent	Temporary	Bus Stations	Rail Stations	Major roads (macadamized)	Minor roads (gravel)	Functional	Non-functional	Services	Industrial		Defence	Fisheries	Vacant	
		Homestead	Commercial	Domestic Use	Commercial	Domestic use	Livestock Farming																								Crops
Chempiyanpattu to Mullaitivu	61	07	26	48	01	04	01	04	01	03	02	02	02	01	02	33	28	06	02	12	28	04	02	04	03	01	61	61	03		
Mullaitivu to Kokilai	36	09	11	21	02	06	07	07	02	02	02	01	01	05	14	27			07	23			04	02		35	22	09			
Kokilai to Irakkandy Bridge	43	23	05	11	04	05	11	02	11	07	02	01	01	02	08	28	29			22	29	07	04	04	02	39	15	06			
Irakkandy Bridge to Trincomalee	17	16	11	13	01	02	01	01	10	06	05	06	13	05	09	34	56	18	02	01	17		03	02	01	16	08	04			
Trincomalee to Foul Point	109	46	07	36	12	02	01	10	06	05	06	13	05	09	34	56	18	02		40	57	11	12	41	13	34	261	145	31		
Total	66	55	60	129	01	21	18	12	04	31	22	14	08	18	10	20	55	102	110	08	02	80	154	11	12	41	13	34	261	145	31
% of kilometres at which specified land use types were observed (for each group)	100	21	23	49	3	9	7	5	2	12	8	5	3	7	4	8	21	38	41	3	7	31	58	4	5	15	5	13	98	58	12
% of total mentions (for each group)	100	14	16	34	25	6	5	3	1	8	36	23	13	29	16	7	19	36	38	3	8	33	63	48	52	8	2	6	5	28	6

APPENDIX TABLE 35
Land utilization of coastline from Foul Point to Pottuvil
(Number of Kilometres at which specified types were observed)

Segment of the coast line	Length of coast line (Km)	Agriculture							Recreational					Com-mercial		Resi-dential		Transportation				Mining		Services	Industrial	Defence	Fisheries	Vacant	Others		
		Perenni-al crops		Season-al crops		Farms			Shifting cultivation	Hotels	Parks	Sanctuaries	Play grounds	Others	Tourist	Non-tourist	Permanent	Temporary	Bus Stations	Rail Stations	Major roads (mac. damized)	Minor roads (gravel)	Functional							Non-functional	
		Commercial	Domestic Use	Commercial	Domestic use	Livestock Farming	Crops	Livestock																							
		Homestead	Commercial	Domestic Use	Commercial	Domestic use	Livestock Farming	Crops	Livestock	Shifting cultivation	Hotels	Parks	Sanctuaries	Play grounds	Others	Tourist	Non-tourist	Permanent	Temporary	Bus Stations	Rail Stations	Major roads (mac. damized)	Minor roads (gravel)							Functional	Non-functional
Foul Point to Vakarai	40	05	09	20		06		09							01	07	21							04		01	17	14	01		
Vakara to Kalkudah	34	01	25	06		05			02	01			01		01	11	16				02	16			03			18	15		
Kalkudah to Batticaloa	32	08	21	11		03			06				01	04	04	14	24	01			04	16	04		04	01		23	14		
Batticaloa to Pottuvil	98	57	23	60	02	29	03		13	04	01	05	17		19	52	75				20	70	54	06	22	02		65	72	20	
Total	204	71	78	97	02	29	17		22	12	01	01	05	19	25	84	36				26	113	58	06	33	03	01	123	115	21	
% of kilometres at which specified land use types were observed (for each group)	100	35	38	48	1	14	8		11	6	4	4	3	9	12	41	67				13	55	28	3	2	2		5	60	56	10
% of total mentions (for each group)	100	23	25	31	6	9	5		7	32	3	3	13	50	10	34	53				19	81	91	9	1	1	4	47	44	8	

APPENDIX TABLE 36

Land utilization of coast line from Pottuvil to Hambantota
(Number of Kilometres at which specified types were observed)

Segment of the coast line	Length of coast line (Km)	Agriculture							Recreational				Com-mercial		Resi-dential		Transportation				Mining		Services	Industrial	Defence	Fisheries	Vacant	Others	
		Perenni- al crops		Season- al crops		Farms			K-nets	Parks	Sanctuaries	Play grounds	Oltiers	Tourist	Non-tourist	Permanent	Temporary	Bus Stations	Rail Stations	Major roads (macadamized)	Minor roads (gravel)	Functional							Non-functional
		Commercial/ Domestic Use	Commercial	Domestic use	Livestock Farming	Crops	Livestock	Shifting cultivation																					
Pottuvil to Heda Oya	07	03	04					04					02	02	02	02	03			02	03			01				02	05
Heda Oya Hambantota	120	04	04	03				04	40				02	01	04	04	03	01		04	09			04	06	02	10	69	
Total	127	07	08	03				08	40			04	03	06	06	06	01		06	12			05	06	02	12	74		
% of kilometres at which specified land use types were observed (for each group)	100	6	6	06	2			6	32			3	2	4	4	4		8	4	9			4	9	2	8			
% of total mentions (for each group)	100	39	47	17				50	25			25	16	28	28	28		30	65			5	11	2	11	1			

APPENDIX TABLE 37
Land utilization in the Coastal Zone from Hambantota to Galle
(Number of Kilometres at which specified types were observed)

Segment of the coast line	Length of coast line (km)	Agriculture								Recreational					Com-mercial		Resi-dential		Transportation				Mining		Services	Industrial	Defence	Fisheries	Vacant	Others				
		Perenni-al crops		Seasonal crops		Farms				Hotels	Parks	Sanctuaries	Play grounds	Others	Tourist	Non-tourist	Permanent	Temporary	Bus Stations	Rail Stations	Major roads (macadamized)	Minor roads (gravel)	Functional	Non-functional										
		Commercial	Domestic Use	Commercial	Domestic use	Livestock Farming	Crops	Livestock	Shifting cultivation																									
Hambantota to Tangalle	41	14	16	25		11	02		02	04	01	01			02	03	25	11	01		08	21	03	02	03	05	02	33	22					
Tangalle to Dondra Head	34	20	23	29		04			01	03		01	02	03	04	10	25	02	02		12	17	04	04	06	04	01	27	01					
Dondra Head to Matara	05	02	05	05						02	02	02	02	02	02	02	05	02	01		03	03	01	01	04	02		04					01	
Polhena	03	02	02	03												01	03	10			02	02	01	01				01					01	
Polhena to Weligama Bay	08	06	04	08								02		02		05	05				05		06	01	02			03	01	02			02	
Weligama Bay	08	07	06	03		01				02	01	01			01	04	08	03			04	04		01	03	01	01	06	01				01	
Koggala to Unwatuna	07	07	01	03											01	07	01	01	01	01	07	07	02	02	05		02	01				02	01	
Unwatuna to Galle	05	04		02		01				02					01	03	05	02			03	05		04	03		04	01					01	
Total	123	72	62	89		17	04		02	05	12	05	06	06	06	12	34	94	23	04	02	52	64	23	13	12	24	05	88	27	05			
% of kilometres at which specified land use types were observed (for each group)	100	59	50	71		14	3		2	4	10	4	5	5	5	10	28	76	19	3	2	42	52	19	11	20	20	4	72	22	4			
% of total mentions (for each group)	100	29	25	36		7	2		8	2	34	14	17	17	17	7	21	58	14	3	2	43	53	64	36	18	13	3	49	15	3			

APPENDIX TABLE 39
Land utilization in the Coastal Zone of Sri Lanka
(Number of Kilometres at which specified types were observed)

Segment of the coast line	Length of coast line (Kms)	Agriculture							Recreational					Com-mercial	Resi-dential	Transportation			Mining													
		Perenni- al crops			Seasonal crops				Farms		Shifting cultivation	Hotels	Parks	Sanctuaries	Play grounds	Others	Tourist	Non-tourist	Permanent	Temporary	Bus Stations	Rail Stations	Major roads (macadamized)	Minor roads (gravel)	Functional	Non-functional	Services	Industrial	Defence	Fisheries	Vacant	Others
		Homestead	Commercial	Domestic Use	Commercial	Domestic use	Livestock Farming	Crops	Livestock																							
Colombo to Puttalam	286	88	187	151	050	41	56			09	09	26	10	13	20	78	170	158	05			87	91	04	02	78	08	02	248	30	44	
Puttalam to Elephant Pass (including Talaimannar Island)	380	23	64	34	22	21	01	05		02			02	01	02	26	51	39	13	02	02	33	83	12	02	18	07	06	17	107	14	
Elephant Pass to Chempianpattu	181	68	101	100	50	44		04		02	01	05	05	04	03	24	69	50	40	04	04	48	52	23	04	23	08	99	150	107	01	
Islands of Jaffna Peninsula	218	80	81	181	90	55								05	01	12	122	88	11	01	28	108	51	10	11	04	04	201	180	07		
Chempianpattu to Foul Point	266	55	60	129	01	21	18	12	04	31	22	14	08	18	10	20	55	102	110	08	02	82	54	11	12	41	13	34	271	151	31	
Foul Point to Pottuvil	204	71	78	97	02	29	17			22	12	01	01	05	19		25	84	36	01		26	113	58	06	33	03	01	123	115	21	
Pottuvil to Hambantota	127	07		08		03				08			40		03	06	06	06	01			06	12			05	06	02	02	12	74	
Hambantota to Galle	123	72	62	89		17	04		02	05	12	05	06	06	06	12	34	94	23	04	02	52	64	23	13	32	24	05	88	27	05	
Galle to Colombo	135	120	81	104	01	10	07	01	02	02	53	11	09	33	09	46	73	114	88	20	30	83	117	15	18	73	75	10	100	59	43	
Total	1920	584	704	893	171	281	103	22	08	62	119	45	95	71	107	333	812	698	103	41	445	794	197	67	314	148	73	210	788	240		
% of kilometres at which the specified land use was observed (for each group)	100	30	37	46	9	15	5	1	4	3	6	2	5	4	4	6	17	43	36	5	2	23	41	10	4	16	8	4	63	41	13	
% of total mentions (for each group)	100	21	25	32	6	10	4	7	3	2.2	29	11	23	19	17	24	76	54	46	7	3	32	57	75	25	11	5	3	44	28	9	

APPENDIX TABLE 40
The nature of coast line in the Coastal Zone of Sri Lanka
(Number of Kilometres at which specified types were observed)

Segment of the coast line	Length of coast line (Km)	Geomorphological Description														Nature of material								History of the shoreline	
		Straight coast line	Sand spit	Lagoon	Bay	Estuary	Delta	Island	Harbour	Head land	Cliff	Reefs	Rock outcrops	Boulders	Cobbles	Pebbles	Sandy	Silty	White	Colour of beach sand				Receding	Developing
																				Brown	Black	Other			
Colombo to Puttalam	286	164	140	110	30	07	01	05	14	23		91	02	04	01	03	252	14	218	56	02		92	59	
Puttalam to Elephant Pass (including Talaimannar Island)	380	257	08	127	157	32	01	56		06	29														
Elephant Pass to Chempyanpattu	811	136	61	51	02	01	02	02	02	07	06	32	25	15	22	13	59	18	93	28	03	18	52	90	
Island of Jaffna Peninsula	218	146	21	26	05			204	02	17	01	177	37	01	12	35	150	07	60	37		02	79	26	
Chempyanpattu to Foul Point	266	157	21	50	105	06	01	14	21	30	09	19	41	54	48	46	190	41	111	39	33	19	11	17	
Foul Point to Pottuvil	204	167	56	46	93	06	01	02		11	66	33	25	03	03	02	106	01	152	68	62		111	44	
Pottuvil to Hambantota	127	62	04	26	19	21			02	14	16	01	30	06	02	02	88		52	22	44	12	38	22	
Hambantota to Galle	123	50	22	30	47	03	01	11	06	37	59	47	24	48	25	15	88		15	26	40	67	105	07	
Galle to Colombo	135	117	13	07	24	23	02	05	08	31	09	39	69	28	03	54	119	13	22	60	16	21	110	28	
Total	1920	1264	356	218	487	99	09	299	55	175	195	375	253	167	131	133	1186	253	728	336	359	141	967	294	
% of kilometres at which the specified feature was observed (for each section)	100	66	19	27	25	5	5	16	3	9	10	20	13	9	7	7	62	14	38	17	19	7	50	15	
% of total mentions (for each sections)	100	31	9	13	12	2	2	7	1	4	5	9	6	9	7	7	63	14	47	21	23	9	77	23	

APPENDIX TABLE 41
Dominant vegetation types in the coastal zone of Sri Lanka

Segment of the coast line	Length of coast line (Km)	Description of vegetation (Number of kilometres at which specified types were observed)																			
		Dominant Vegetation					Sandy shore vegetation			Sand dune			Mangrove vegetation			Salt Marsh				Forest	Grass
		Sandy sea shore vegetation	Dune vegetation	Salt marsh	Mangrove	Others	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Zone of low creeping vegetation	Zone of low shrubs	Littoral woodland	Mature	Immature	Bare area	Salt marsh	Salt marsh pasture	Thorn scrub	Mixed		
Colombo to Puttalam	286	160	104	67	116	01	102	66	84	89	50	44	147	23	59		23	14	16	78	
Puttalam to Elephant Pass including Talaimannar Island)	380	240	74	108	101		225	221	84	32	65	46	23	44	69	43	06	02	37	98	30
Elephant Pass to Champianpattu	181	137	35	125	66		98	112	15	70	61	06	73	40	16	115	71	34	30	02	14
Island of Jaffna Peninsula	218	192	22	119	162		189	147	18	35	12		130	140	61	121	32	16	11	01	60
Chempianpattu to Fou: Point	266	213	125	81	111		181	179	119	114	108	77	105	61	53	69	07	16	10	125	120
Pouf Point to Pottuvil	204	106	141	30	84	05	101	42	09	117	112	58	85	77	08	13	07	02	05	62	78
Pottuvil to Hambantota	127	26	118		18		16	14	15	117	119	49	17	04							08
Hambantota to Galle	123	120	24	27	27	01	98	68	86	20	13	11	22	16	02	14	06	13	13	10	81
Galle to Colombo	135	131	04	04	42	01	117	35	02	02	01		33	18	01	63	02	02	03		27
Total	1920	1325	648	561	727	01	1127	884	432	595	541	291	755	422	210	437	133	108	133	314	496
% of kilometres at which the specified types were observed (for each group)	100	68.97	33.73	29.20	37.84	0.41	58.66	46.01	22.48	30.97	28.16	15.14	39.30	22.48	10.53	22.74	6.92	5.62	6.92	16.34	25.81
% of total mentions (for each group)	100	40.53	19.82	17.16	22.23	0.24	16.36	12.83	6.26	8.63	7.85	4.22	10.96	6.26	3.04	6.34	1.93	1.56	1.93	4.55	7.21