



# Biodiversity and Socio-economic Information of Selected Areas of Sri Lankan Side of the Gulf of Mannar

Report submitted by IUCN Sri Lanka Country Office to BOBLME Project  
Component 2.4 Collaborative Critical Habitat Management: Gulf of Mannar

## Final Report



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## ACRONYMS

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1DAY	Inboard One Day Boat
ADF	Assistant Director Fisheries
BOBLME	Bay of Bengal Large Marine Ecosystem
BRW	Black and Red Ware
CBO	Community Based Organization
CCD	Coast Conservation Department
CEA	Central Environmental Authority
CR	Critically Endangered Red List category
DD	Data Deficient Red List category
DFO	District Fisheries Officer
DoA	Department of Agriculture
DoF	Department of Fisheries
DS	Divisional Secretariat
DSDs	Divisional Secretariat Divisions
EN	Endangered Red List category
FAO	Food and Agriculture Organization of the United Nations
FCS	Fisheries Co-operative Society
FI	Fisheries Inspector
FIDs	Fisheries Inspector Divisions
GA	Government Agent
GIS	Geographic Information System
GN	Grama Niladhari
GND	Grama Niladhari Division
GoM	Gulf of Mannar
GPS	Ground Global Positioning System
ha	Hectare
IMUL	Inboard Multiday Boats
INGO	International Non Governmental Organization
IUCN	International Union for Conservation of Nature and Natural Resources
MC	Municipal Council
MCM	Million Cubic Metres
MENR	Ministry of Environment and Natural Resources
MFAR	Ministry of Fisheries and Aquatic Resources
MTRB	Mechanised Traditional Boats
MTRB	Motorised Traditional Boat
NAQDA	National Aquaculture Development Authority
NARA	National Aquatic Resources Research and Development Agency
NBSB	Non-Motorised Beach Seine Boats
NGO	Non-Governmental Organization

NSF	National Science Foundation
NT	Near Threatened Red List category
NTRB	Non-Traditional Motorised Boats
OFRP	Outboard Fibre Reinforced Plastic Boat
PS	Pradeshiya Sabha
RRA	Rapid Rural Assessment
SWM	Solid Waste Management
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VU	Vulnerable Red List category

## EXECUTIVE SUMMARY

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The 30-year separatist war in the north, northwest, northeast and east of Sri Lanka precluded any systematic field-based scientific studies in these parts of the country, and the Gulf of Mannar (GoM) and bordering areas was no exception. In the aftermath of the war, conflicts have arisen between Sri Lankan and Indian fishers over the exploitation of GoM by Indian fishers and negotiations at governmental level are ongoing to bring about a settlement. In this scenario, it was felt opportune to commence some basic studies to gather baseline data on biodiversity of the GoM and socio-economic conditions of fishery communities dependent its resources.

The Government of Sri Lanka is taking steps to propose the Sri Lankan side of the Gulf of Mannar as a Biosphere Reserve under UNESCO's Man and the Biosphere Programme. A significant amount of baseline data on biodiversity and related aspects must be compiled for this purpose. As a prelude, the National Science Foundation (NSF) requested IUCN to undertake a rapid biodiversity assessment of coastal and marine resources in the GoM and Palk Bay area, with the assistance of the University of Ruhuna and financial support from the Mangroves for the Future Programme.

However, pertinent socio-economic data required for a meaningful analysis to make recommendations on the sustainable use of GoM resources was lacking. Hence, a rapid socio-economic study was carried out to complement the biodiversity information on the Gulf of Mannar, and to disseminate both the biodiversity assessments and socio-economic findings among local stakeholders and at the national level. This study was funded by the Bay of Bengal Large Marine Ecosystem (BOBLME) Project of FAO. Since the initial biodiversity study concentrated on coastal and marine biodiversity, IUCN undertook biodiversity surveys of terrestrial areas and inland water bodies to have more complete information on biodiversity for dissemination.

The Project started in November 2010 and was completed in January 2011.

The area identified for the rapid socio-economic survey comprised of four coastal Divisional Secretariat Divisions (DSDs) of Mannar District bordering the Gulf of Mannar (GoM), namely Musali, Nanaddan, Mannar and Mantai West, and two coastal DSDs of Puttalam District, namely Kalpitiya and Vanathavillu. All information contained in the report was gathered through secondary sources, consultations with local officials, key informants interviews and field observations.

The rapid floral and faunal surveys were conducted to cover the entire coastal area of GoM.

Baseline archaeological information of the coastal belt of the GoM was collected through literature and field surveys. All sites visited were photographed, documented and GPS coordinates recorded. GIS base maps were prepared for the study area using Survey Department maps updated with Google Pro images and ground-truthing.

The study area is mainly in the dry and arid zone of the country, where mean annual rainfall is between 700-1,000 mm. The main rainy season is the north east monsoon from October to April which accounts for about 60-70% of the annual rainfall.

The terrain of the district is flat and gently undulating. The soils are Reddish Brown Earths, Low Humic Gley soils, Red Yellow Latosols, Regosols, Solodized- Solonetz, Solonchaks and Grumosols. Regosol soil is mainly found in the Mannar Island and Red Yellow latosols are found distinctively in coastal regions. The area located in the dry zone lowlands falls under two agro-ecological zones, DL3 and DL4.



The mean annual temperature is more than 28<sup>0</sup>C. Generally, the hottest month in the GoM is May for both districts, and the temperature ranges from 25-29<sup>0</sup>C with higher temperatures normally recorded between May and August.

Rivers and streams are the major sources of fresh water and nutrient supply to the shallow coastal basin and the lagoons and estuaries in the GoM area. There are nine major rivers covering a land area of 9,113 km<sup>2</sup>, apart from seasonal, minor streams that flow to the coast.

The availability of ground water is limited and most of the water requirements are fulfilled by the National Water Supply & Drainage Board and Irrigation Department, with great difficulty.

The Gulf of Mannar influences two districts, Mannar and Puttalam. According to the available statistics the total population of the six coastal DSDs in the GoM study area amounts to 215,472.

The majority in Mannar District are Sri Lanka Tamils (51%), followed by 26% Muslims, and 13% Indian Tamils. Sinhalese (8%) and others (2%) constitute the rest. In contrast, the majority in Puttalam district is Sinhalese (73.7%), followed by Muslims (18.8%) and Sri Lanka Tamils (6.8%); the others (1.7%) are a mix of Burghers, Malays, Indian Tamils and other minorities.

The land use pattern of the coastal areas of Mannar District varies according to the DSDs. Mantai West and Musali DSDs have considerably larger areas under tropical forest cover and marsh lands than Mannar and Nanaddan DSDs which have relatively high populations. Forest cover is 57% and is the major land use.

Transport facilities in Mannar are improving, and many new roads are being constructed. However, the railway transport system has been completely destroyed during the separatist civil war. Arrangements are underway to construct the railway lines and the associated infrastructure.

Mannar District has two main educational zones: Madu zone for the interior and Mannar zone for the coastal areas. The health infrastructure has been hugely damaged and health and sanitation facilities in the area are very weak. The drainage system in Mannar and Nanaddan DSDs is outdated and almost all the streets are flooded during the rainy season. Electricity is mainly from hydro-power supplied by the Ceylon Electricity Board. According to the recent findings, there is a rapid development of telecommunication facilities in the area with the involvement of the private sector. Mobile telephony has developed fast.

GoM has biodiversity-rich ecosystems that are providing valuable services. Forests, inland wetlands, coastal and marine, and agricultural lands are major coastal and terrestrial habitat types found here. The most common terrestrial natural vegetation types are tropical dry mixed evergreen forest and dry thorny scrubland. Coastal habitats consist of mangroves, salt marsh, sand dunes and beaches as well as inter-tidal habitats including coral reef, algal communities and sea grass beds.

The terrestrial habitats of the GoM possess 12% of the flowering plant species found in Sri Lanka. A total of 583 plant species (in 119 families) were recorded and among them eight species are endemic and 11 species are nationally threatened.

A total of 496 inland faunal species were recorded within the inland coastal habitats of GoM, including 31 endemics, 66 migratory birds, two introduced freshwater fishes and eight domesticated mammals. Among them, 46 species were recognized as nationally threatened.

The invasive species, *Prosopis juliflora*, Water hyacinth (*Eichhornia crassipes*) and Cat's tail (*Typha angustifolia*) are spreading rapidly. The uncontrolled grazing by goats, cattle and donkeys that goes on is a matter of concern.

The development activities proposed need to give adequate consideration to biodiversity conservation. Of particular concern is the possible increase of firewood collection by people in the resettlements, illegal logging for timber, and extensive land clearing for agriculture.

Gulf of Mannar Reef, Vankalai Reef, Arippu Reef, Silvatturai Reef and Vidattaltivu Lagoon which have been identified as environmentally important areas with high biodiversity should receive special consideration and protection.

Fishery is the backbone of the people living around GoM. The fishers need to know well their resource base, and should respect the need for sustainable extraction. Destructive fishing practices observed during the study are dynamiting, monofilament (*Thangus*) nets, brush piles and multi hook artificial bait for cuttlefish, surukku nets, SCUBA diving and trawling. There is an ongoing feud between the Indian and Sri Lankan fishermen. Indian fishermen use a large number of big trawlers in Sri Lankan waters violating territorial user rights. There are allegations and counter-allegations, and the Governments should address this issue.

Holothurians (sea cucumber), gastropods (conch) and bivalves (oysters) are being collected without permits and without conforming to the recommended sizes. This will affect the sustainability of this sector.

The entire Mannar coast does not have a proper fishing harbour. All fibreglass boats and other smaller boats land on the beach while trawlers and multi-day boats anchor in the sea. Fish marketing is not well organised; the middle men make unjust profits at the expense of the fishermen. Other issues of concerns related to fishery are insufficient ice production, unsatisfactory handling of fish resulting in quality deterioration of the catch, poor processing facilities.

Agriculture is one of the main occupations in the District of Mannar. Considerable areas of paddy land in the district, abandoned due to the conflict, are to be cultivated in the coming season.

The displaced families are returning and there is a great demand for land for cultivation and for settlement; forest areas in Musali Division and Mantai West are being cleared to meet the demand. A farmer family owns about 2-5 acres of paddy land and an upland home garden. Farmer income is mainly from paddy cultivation. Almost all the farmers own livestock and engage in tank fishing. Cattle and goats are reared for milk and meat.

Paddy is cultivated mainly in the Maha season; a mere 5% of the paddy lands are cultivated in Yala as irrigation water is inadequate. Shortage of buyers for paddy, inadequate rice processing mills and storage facilities are highlighted as some issues.

Many agencies are involved in the agriculture sector, performing different functions. Inter agency coordination in planning is inadequate and lack holistic approach.

Agricultural extension services are weak. They lack sufficient staff, technical capacities, and opportunities for interaction with counterparts in other areas and exposure to modern tools and methods. As a result communities lack access to new information on sustainable agricultural practices.



Gulf of Mannar is rich with archaeological monuments and traditional legends. These include several Miocene fossil (5 to 28 Million years), many prehistoric human settlements belonging to the Palaeolithic and Mesolithic periods and proto-historic and historical monuments.

Many archaeological monuments have been destroyed and some of them have been converted to other uses. The remaining sites are in a vulnerable state and immediate action has to be taken to preserve them.

Land-based pollution is the main source of pressure on the GoM resources. Waste generation in the study area has not received much attention. The waste generated is about 17 MT per day, and is increasing.

Proper solid waste management mechanisms are not available in any of the local authorities in GoM area; only the Kalpitiya Pradeshiya Sabha has made some progress. Waste collection is unsatisfactory; more than 50% of the waste generated is not collected. Considerable amounts of waste is dumped in the coastal waters and beaches, which is of concern to the health and productivity of the GoM.

The findings of the studies were disseminated through several modes: preparation of a training module for teachers prepared in English and Tamil languages, outreach material (multimedia presentations, posters and a documentary), awareness programmes and spatial maps.

The study suggested additional awareness programmes based on the materials produced targeting fisheries sector, teachers and Navy officials. Capacity building of the local Fisheries Office in Mannar to be enhanced to effectively address illegal fishing practices and initiation of a dialogue on creating a trans-boundary marine protected area for the Gulf of Mannar, covering both Indian and Sri Lankan sides were also came out as suggestions of the study.

## CHAPTER 1 - INTRODUCTION

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The 30-year separatist war in the north, northwest, northeast and east of Sri Lanka precluded any systematic field-based scientific studies in these parts of the country, and the Gulf of Mannar (GoM) and bordering areas was no exception. The situation in the GoM region was more serious as scientific efforts in the area were scanty even before the war. The GoM is a rich resource exploited by the coastal communities in Mannar, Kilinochchi and Jaffna Districts, and in South India as well. Exploitation of coastal and marine resources during wartime was limited due to unsettled conditions, restrictions and regular naval patrols by Sri Lanka and India. However, with normalcy returning very fast after the war ceased in mid-2009, full exploitation of the coastal and marine resources is to be expected. Indeed, a steady increase has been noted in fishing activity in the GoM.

In the aftermath of the war, conflicts have arisen between Sri Lankan and Indian fishers over the exploitation of GoM by Indian fishers and negotiations at governmental level are ongoing to bring about a settlement. In this scenario, it was felt opportune to commence some basic studies to gather baseline data on biodiversity of the GoM and socio-economic conditions of fishery communities dependent on the resources of GoM.

Meanwhile, the Government of Sri Lanka wishes to propose the Sri Lankan side of the Gulf of Mannar as a Biosphere Reserve under UNESCO's Man and the Biosphere Programme. A significant amount of baseline data on biodiversity and related aspects must be compiled for this purpose. As a prelude, the National Science Foundation (NSF) requested IUCN to undertake a rapid biodiversity assessment of coastal and marine resources in the GoM, and this was completed with the assistance of the University of Ruhuna and financial support from the Mangroves for the Future Programme.

However, pertinent socio-economic data required for a meaningful analysis to make recommendations on the sustainable use of GoM resources was lacking. Hence, based on a proposal made to the Bay of Bengal Large Marine Ecosystem (BOBLME) Project, an agreement was entered into with FAO to primarily undertake a rapid socio-economic study to complement the biodiversity information on the Gulf of Mannar, and to disseminate both the biodiversity assessments and socio-economic findings among local stakeholders and at the national level, in partnership with BOBLME Project.

Since the initial biodiversity study concentrated on coastal and marine biodiversity, IUCN undertook biodiversity surveys of terrestrial areas and inland water bodies to have more complete information on biodiversity for dissemination.

The Project started in November 2010 and was completed in January 2011. This report provides a full account of the activities undertaken by the Project, its findings and recommendations that would facilitate management decisions on future activities. GoM has been narrowly defined in this report to capture the study area covering coastal areas of Mannar and Puttalam districts of Sri Lanka.

The purpose of the project was set out as follows:

- (i) Establishing the socio-economic status of communities dependent on coastal resources in the GoM
- (ii) Collection of biodiversity information from coastal and abutting inland areas of GoM
- (iii) Collection of information on important archaeological sites and related aspects

- (iv) Developing appropriate spatial maps to be used for decision-making in the management of GoM
- (v) Dissemination of information on biodiversity, socio-economic status, and archaeological and cultural values to the stakeholders (state agencies mandated with management responsibilities of the GoM, local government authorities, local-level officials, communities, education authorities and school children)

## CHAPTER 2 - METHODOLOGY

The methodology described here relates to the following surveys:

- Socio-economic survey
- Coastal and inland biodiversity surveys
- Survey of important archaeological sites and related aspects

IUCN fielded a team (please see Annex 1) comprised of members with expertise on social sciences, ecology, fisheries, archaeology, coastal resources planning, GIS and institutional aspects.

The approach followed in the study was to first collate available information found in various agencies and conduct primary data gathering only to bridge data gaps. These were supplemented with field observations in the case of specific socio-economic issues related to their interactions with GoM.

The rapid biodiversity survey, undertaken by the University of Ruhuna covered the Palk Bay area in addition to the GoM (Fig. 1) while the socio-economic studies were confined to the GoM (Fig. 2).



Fig. 1: Sampling sites (20) selected for the rapid biodiversity survey in the Gulf of Mannar and Palk Bay area

## 2.1 Socio-economic Survey

The study area identified for the rapid socio-economic survey is comprised of four coastal Divisional Secretariat Divisions (DSDs) of Mannar District bordering the Gulf of Mannar (GoM), namely Musali, Nanaddan, Mannar and Mantai West (Fig. 2), and two coastal DSDs of Puttalam District, namely Kalpitiya and Vanathavillu. The main objective of the rapid survey was to understand the interactions of the coastal populations in the six above noted coastal DSDs with ecological systems in the GoM. Although these interactions will no doubt go well beyond the coastal DSDs, IUCN concentrated on interactions within the coastal DSDs for the purpose of this study.

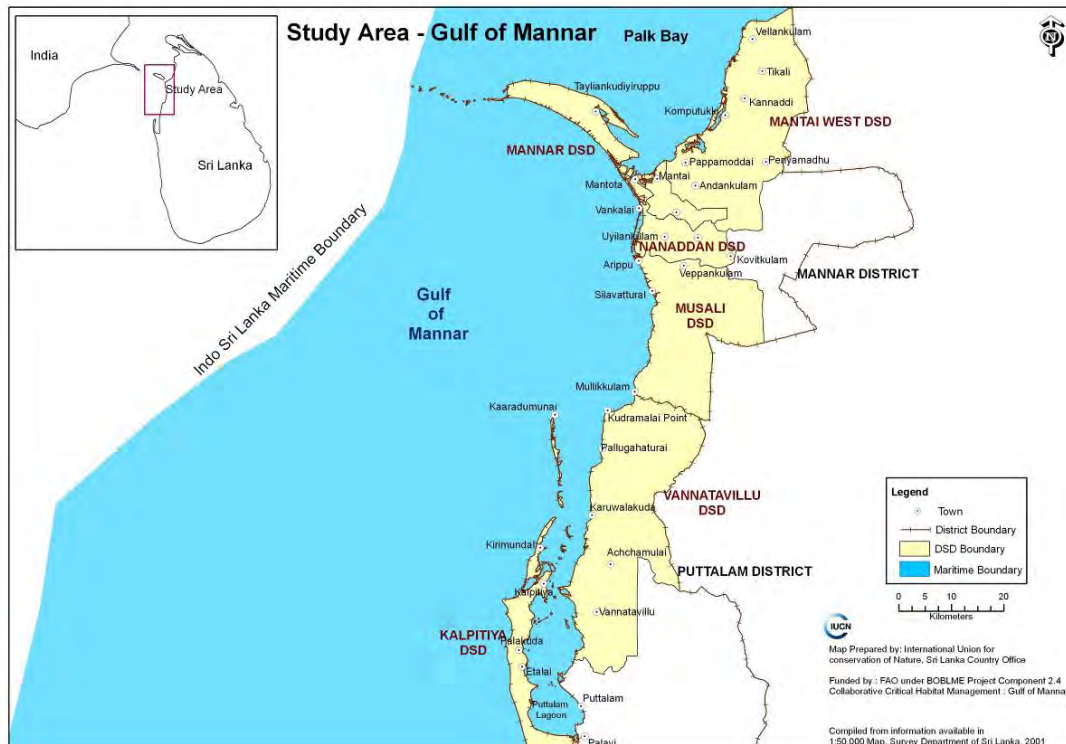


Fig 2: Areas selected for socio-economic assessment in the Gulf of Mannar

### 2.1.1 Data and information gathering

Comprehensive discussions with the Government Agent/District Secretary, Mannar and other key officials in the area preceded data/information gathering. All information contained in the report was gathered through secondary sources, consultations with local officials, key informants interviews and field observations. Checklists were used for interviewing key informants.

### Literature review

All accessible sources of secondary information on socio-economics of GoM were consulted, the main sources being Statistical Year Books of coastal DSDs of the two Districts, District-wide Statistical Year Books, National Census data, Administrative reports of Department of Fisheries, technical reports, Sethusamudram project related Sri Lankan studies, and research publications.

## Field observations

Field visits were made only to key sites to supplement the information collected through discussions, interviews and one-to-one meetings.

## 2.2 Coastal and Inland Biodiversity Surveys

The coastal and marine ecological aspects of GoM have already been documented<sup>1</sup> by IUCN's previous study along with the University of Ruhuna. As the previous study was confined to a rapid assessment of coastal and marine biodiversity, the present study included terrestrial ecological aspects within the coastal DSDs of Mannar. The main methodologies for floral and faunal surveys, which were carried out simultaneously, are given below.

### 2.2.1 Flora sampling

The rapid floral survey covered the entire coastal area of GoM. A similar approach has been successfully used in large-scale floral studies e.g. Ellary & Techeba, 2003. Plant species were identified and classified using the latest standard published guides and keys available in Sri Lanka. Some of the key references that were used to identify plants are Bambaradeniya (2002), Ashton *et al.* (1997); Dassanayake & Fosberg (1980-1991); Dassanayake *et al.* (1994-1995); Dassanayake & Clayton (1996-1999), De Vlas J & J de V Jong (2008) and Senaratna (2001). In addition to the survey results, the previous works, IUCN Sri Lanka, 2010 and Weeratunga, 2009, were also used to evaluate the floral list.

### 2.2.2 Fauna sampling

Information from field surveys supplemented with information from available literature was used to compile the faunal diversity within the GoM. Visual encounter surveys were carried out at random observation points in the different habitat types within the DSDs of Mannar District. Direct observations and indirect observations (pellets, pugmarks, scats, burrows, and communication with communities) were made to gather further information. Gathered information was verified using published field and taxonomic guides (D'Abrera, 1998; Bedjanic *et al.*, 2007; Goonatilake, 2007; Manamendra-arachchi & Pethiyagoda, 2006; Somaweera, 2006; Somaweera & Somaweera, 2009; Harrison, 1999; Phillips, 1935; Wijeyeratne, 2008). The previous publications used in the compilation of the faunal list of the GoM were: Bambaradeniya 2005a; Bambaradeniya 2005b; Bambaradeniya, 2007; De Silva, 1987; IUCN Sri Lanka, 2010; Kapurusinghe & Cooray, 2002; Siriwardane, 2003; Somaweera, 2006; and Weeratunga, 2009.

## 2.3 Archaeological and Related Aspects

Baseline archaeological information of the coastal belt of the GoM was collected through literature and field surveys. The literature review included books, journal articles, Archaeological Department reports, and also one-inch maps (1:63,000) published by the Survey Department. During the field survey, previously recorded archaeological sites were visited, where possible. A concurrent surface recognition survey to locate archaeologically significant sites was also carried out during the biodiversity survey. Several sites were traced by discussion with local people and government officials. All sites visited were photographed, documented and GPS coordinates recorded. Some of the previously recorded sites could not be visited due to security concerns.

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<sup>1</sup> Rapid Biodiversity survey of Mannar Biosphere, Sri Lanka sponsored by the IUCN  
Biodiversity and Socio-economic Information of selected areas of Sri Lankan side of the Gulf of Mannar



## 2.4 Preparation of GIS Maps

GIS base maps were prepared for the study area using Survey Department maps updated with Google Pro images and ground-truthing. Attempts were made to present key findings of the biodiversity assessment and socio-economic assessment on GIS maps by overlaying for easy understanding and decision-making.

## 2.5 Dissemination of Findings

Natural resources management is often about managing and influencing people and their relationships with resources. Education and awareness provide a means of communicating with people, motivating them to modify beliefs and behaviour to best ensure the sustainable use of resources.

Increased awareness of local stakeholders of problems and options for their mitigation, help to create a demand for effective resources management. An informed and caring community is an essential element for creating a lasting framework for GoM coastal resources management.

Enhancing public awareness has an important role in all stages of resource management processes, from the initial identification of problems to the implementation of management strategies. The objectives of awareness and education programmes were:

- Build consensus on coastal problems that need special attention
- Draw attention to the need for an integrated approach
- Clarify various perspectives and interests in specific GoM coastal issues
- Generate a receptive political and social content for changes in the policy and management approaches

The means for achieving these objectives were:

- Awareness creation amongst school children through teacher training and Department of Education officials using a teacher's guide in Tamil encompassing biodiversity and socio-economic information
- Awareness workshops for senior government officials using outreach materials
- Awareness workshops for Fisheries Department officials
- Fisher community awareness building using posters and documentaries

## CHAPTER 3 - STUDY FINDINGS

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### 3.1 The Physical Setting

Mannar District is bordered to the west by the Gulf of Mannar, to the north by Kilinochchi District, to the south by Wilpattu National Park and to the east by Anuradhapura District. It has a total land area of 2,002 km<sup>2</sup> of which, over 50% is covered with forest. The district has a coastline of 222 km (including lagoons), a fresh water area of 4,867 ha and a brackish water area of 3,828 ha.

#### *Soils and agro-ecology*

The terrain of the district is flat and gently undulating. The soils in the Mannar District are Reddish Brown Earths, Low Humic Gley soils, Red Yellow Latosols, Regosols, Solodized- Solonetz, Solonchaks and Grumosols. Regosol soil is mainly found in the Mannar Island and Red Yellow latosols are found distinctively in coastal regions. Fig. 3.1 shows the soil types in Mannar.

The area located in the dry zone lowlands falls under two agro-ecological zones, DL3 and DL4.

DL3 is the latosol and regosol region which covers basically the Mannar island region and part of Madu and Musali Divisions. Agricultural settlements are possible on the sandy regosols and deep latosols with underlying fresh water. Coconut, cashew and mango are the main tree crops on such soils.

DL4, the greater part of this region, is made up of grumosols, solodized solonetz, solonchacks and soils on marine calcareous sediments. In Mannar District, very productive irrigable land in the Giant's tank area comes under DL4. The unirrigable areas of this region are best used for livestock – open ranching of cattle and goats.

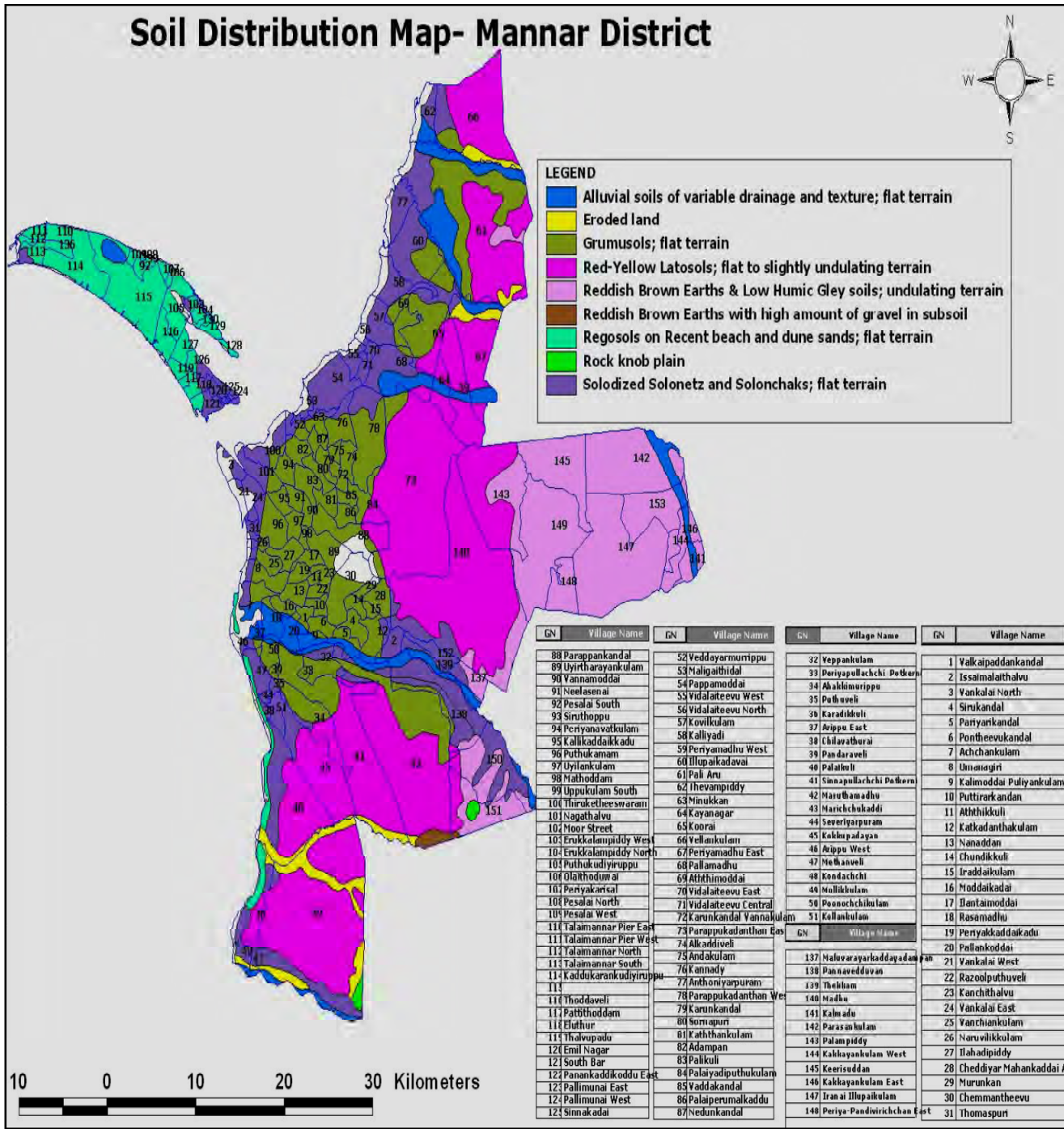


Fig. 3.1: Soil types in the Mannar District

The agro-ecological map of Mannar is at Fig. 3.2.

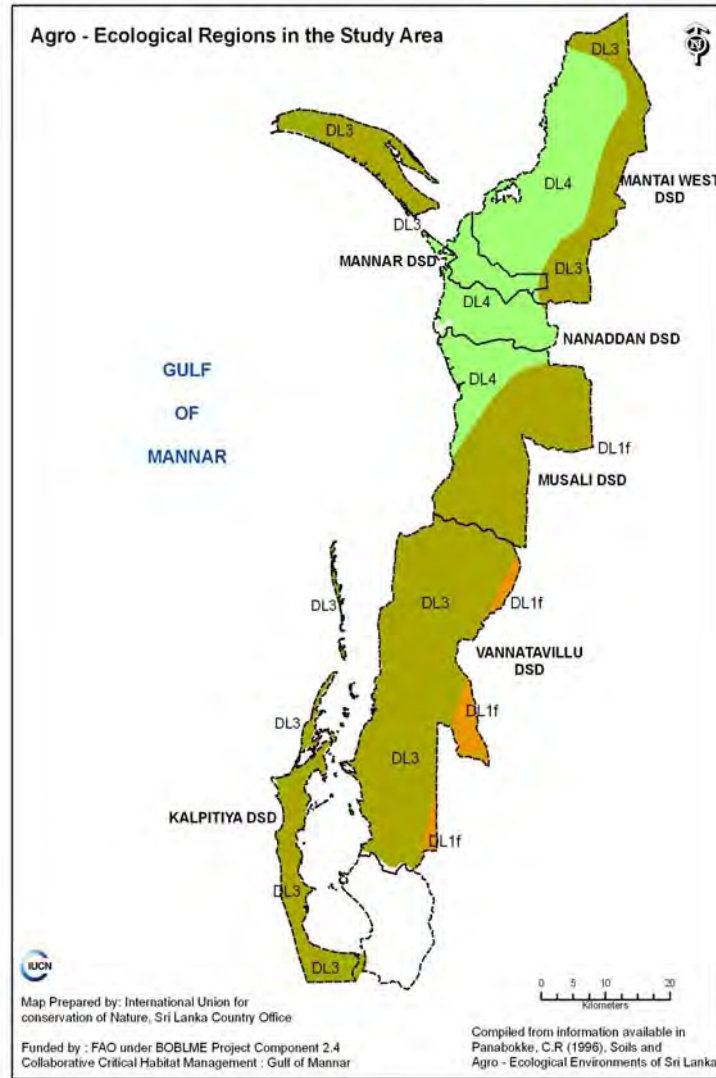


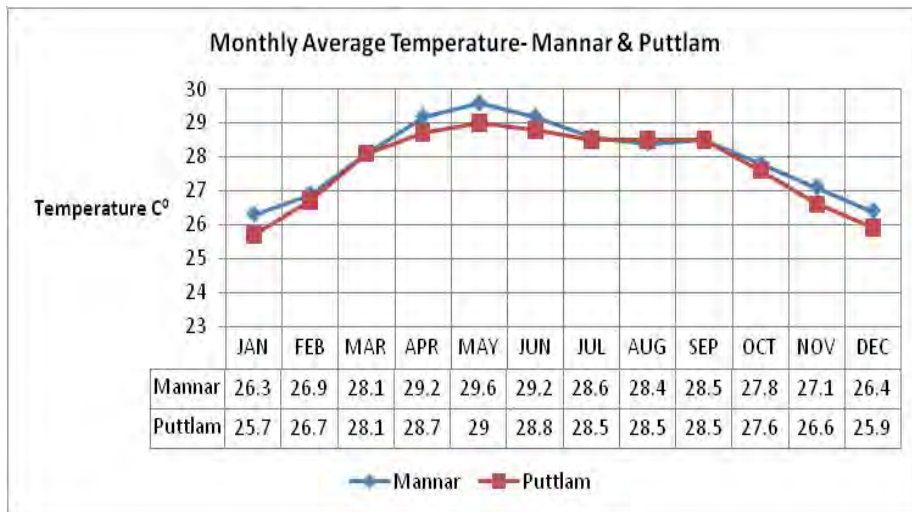
Fig. 3.2: Agro-ecological zones of Mannar

### Rainfall

The study area is mainly in the dry and arid zone of the country, where mean annual rainfall is between 700-1,000 mm. The main rainy season is the north east monsoon from October to April which accounts for about 60-70% of the annual rainfall. Sometimes, minor rains are received from the south west monsoon during May to September. Long periods of drought exceeding 200 days per year are common in the area (Madduma Bandara, 1989).

### Climate

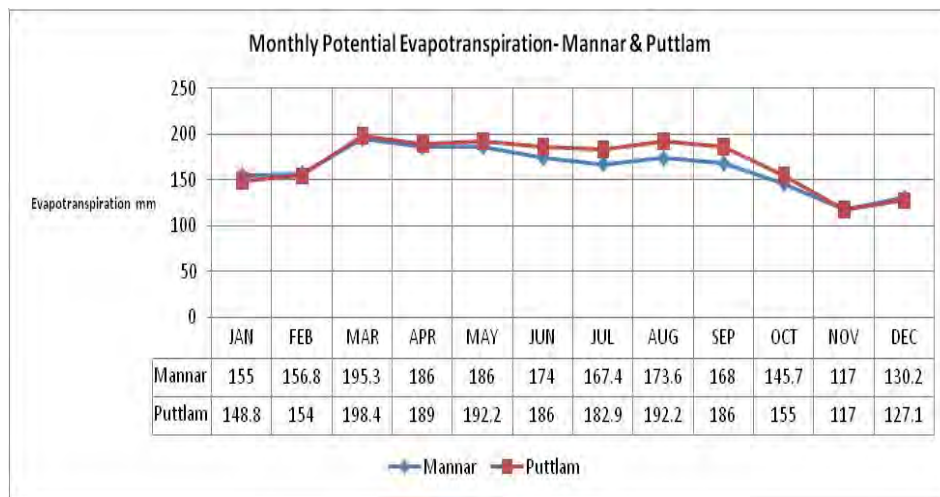
The mean annual temperature is more than 28°C. Generally, the hottest month in the GoM is May for both districts, and the temperature ranges from 25-29°C (Fig. 3.3) with higher temperatures normally recorded between May and August.



**Fig. 3.3: Monthly average temperature of Puttalam and Mannar**

Source; Strategic Environmental assessment report from Kalpitiya Tourism Development area, 2008.

In keeping with the temperature trends, the evapo-transpiration values in the area also show higher values, above 150 mm (Fig. 3.4), compared to the country's average values of around 80 to 100 mm. Evaporation is directly influenced by the water chemistry (salinity level) of lagoons and estuaries systems. Most of the lagoons in the arid zone show hyper-saline conditions during the dry period due to high evapo-transpiration.



**Fig. 3.4: Monthly potential evapotranspiration in Mannar and Puttalam**

Source: Strategic Environmental Assessment report from Kalpitiya Tourism Development area, 2008

### Water resources

The entire GoM area falls in the north western coastal stretch, where elevation is below 30m plain that extend up to 25 km inland in most places of north of Mannar. The only area where elevation is above 30m is found in Kudiramalai, where elevation rises up to 75m above the mean sea level. GoM coastal area is the shallowest seas around the island where 10m fathom isobaths extend up to 50 km into the sea at several places (Madduma Bandara, 1989).

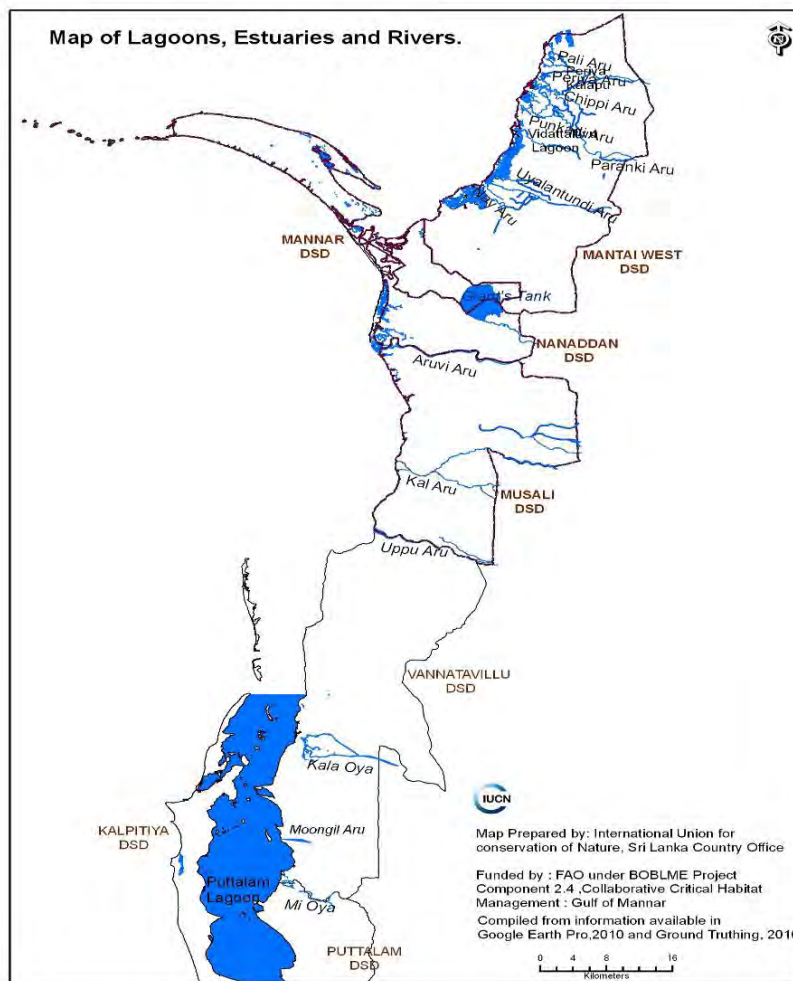


Submarine contours indicate that there are submerged river courses, particularly those of the Malwatu Oya, Kal Aru and Modaragam Oya in Mannar, and Kala Oya in Puttalam (Madduma Bandara, 1989) providing necessary nutrients to the coastal and marine ecosystems. The coastal areas are comprised of many rivers, wetlands, lagoons, beaches, deltas of the Aruvi Aru (Malwatu Oya) and salt marshes. Although the rivers south of the Mannar islands are shallow, slow wave actions with small magnitude waves and the currents produce low sand barrier islands with alluvial deposits. However, erosion has been observed in certain localities, such as, Arippu, Musali, Vankalai, Talaimannar and South Bar Area.

**Rivers and streams**

Rivers and streams are the major sources of fresh water and nutrient supply to the shallow coastal basin and the lagoons and estuaries in the GoM area (Fig. 3.5). These ecosystems are mainly dependent on this fresh water supply as the rainfall is very low. Any changes in fresh water supply would have a significant impact on livelihoods as well as ecosystems in the area.

There are nine major rivers covering a land area of 9,113 km<sup>2</sup>, apart from seasonal, minor streams that flow to the coast. These main rivers from Mantai West to Vannatavillu DSD discharge about 1,706 MCM fresh water into the coastal areas annually (Table 3.1).



**Fig. 3.5: Lagoons, estuaries and rivers in GoM**



### Ground water resources

Ground water and river basin map of the study area is at Fig. 3.6. Ground water resources in the area have not been adequately studied. The availability of ground water is limited, and a study is required to rationalise its use. Most of the water requirements are fulfilled by the National Water Supply & Drainage Board and Irrigation Department, with great difficulty.

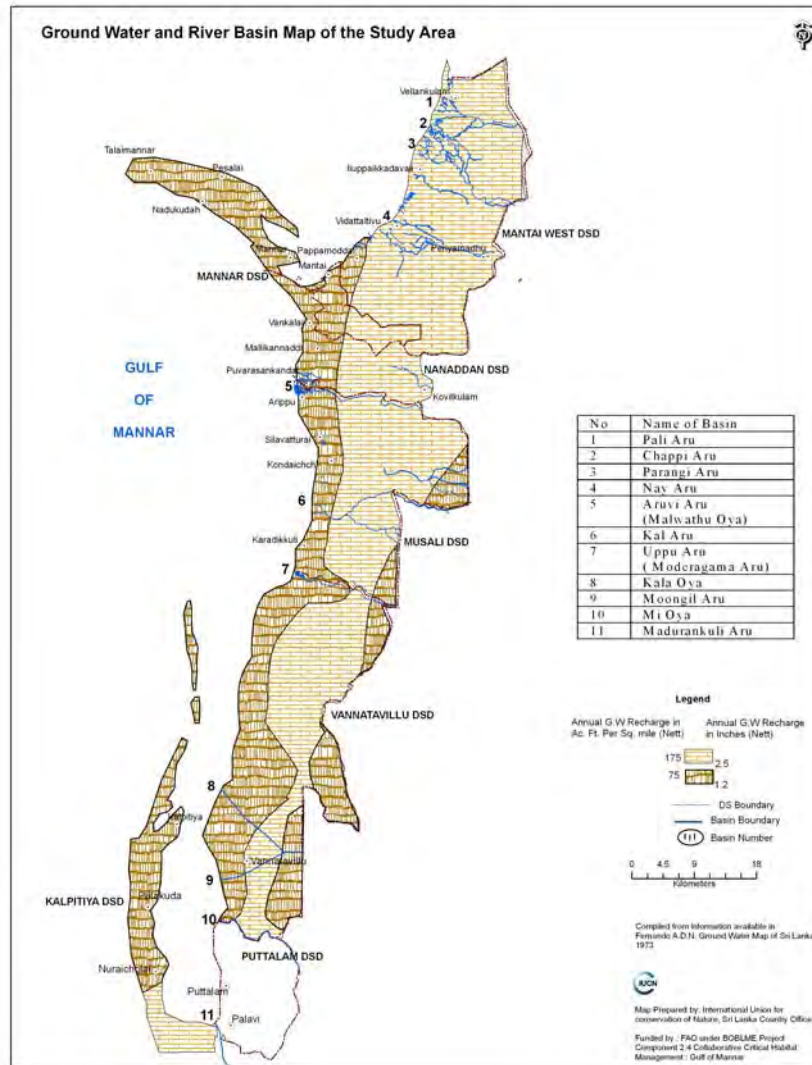


Fig. 3.6: Ground water resources

Most of the irrigation systems in the area are connected to the rivers directly and indirectly. For example, Giant's Tank, one of main agricultural water sources in the area is connected to the Aruvi Aru and the discharge level of the Aruvi Aru is linked to the existing irrigation system. Table 3.1 shows the size of the catchment, volumes of rainfall received and discharged, and the volume discharged from each river as a percent of the rainfall volume.

The amount of water discharged by Aruvi Aru, Kala Oya, Parangi Aru and Modaragama Oya is much less than that of similar rivers in the wet zone. This limits the productivity of the coastal and brackish water ecosystems in the GoM area.

**Table 3.1: Annual fresh water discharged by main rivers and streams into the Gulf of Mannar**

Basin No.	Name of Basin	Catchment Area in (km <sup>2</sup> )	Annual Rainfall in mm	Rainfall Volume in MCM	Volume Discharged to the Sea MCM*	Runoff as percent Rainfall
86	Pali Aru	451	1096	494	169	34
87	Chappi Aru	66	1233	81	25	31
88	Parangi Aru	832	1233	1026	312	30
89	Nay Aru	560	1100	616	210	34
90	Aruvi Aru (Malwatu Oya)	3246	1332	4324	196	4
91	Kal Aru	210	950	200	66	33
92	Moderagama Aru	932	1125	1049	329	31
93	Kala Oya	2772	1192	3304	386	12
94	Moongil Aru	44	1064	47	13	28
	Total	9113	-	11141	1706	-

\*MCM (Million Cubic Metres)

Source: Survey Department of Sri Lanka 2007,

### 3.2 People and their Livelihoods

#### *Demographic features*

The Gulf of Mannar influences two districts, Mannar and Puttalam. According to the available statistics the total population of the six coastal DSDs in the GoM study area amounts to 215,472 (Table 3.2).

**Table 3.2: Population, population density and land extent in the Puttalam and Mannar Districts**

Item No.	District	Divisional Secretariat Division	No. of Grama Niladari Divisions	Land Extent (km <sup>2</sup> )	Population (as per 2009 statistics book of DSDs)	Population Density (per km <sup>2</sup> )
1.	Puttalam*	Kalpitiya	34	167	87,415	524
2.		Vanathawillu	33	716	17,574	25
	Sub-total				104,989	
3.	Mannar	Talaimannar	49	217	51,579	238
4.		Mantai West	36	659	27,334	12
5.		Nanaddan	31	134	20,965	156
6.		Musali	20	458	10,605	23
	Sub-total				110,483	33
	Total		203	2351	215,472	???

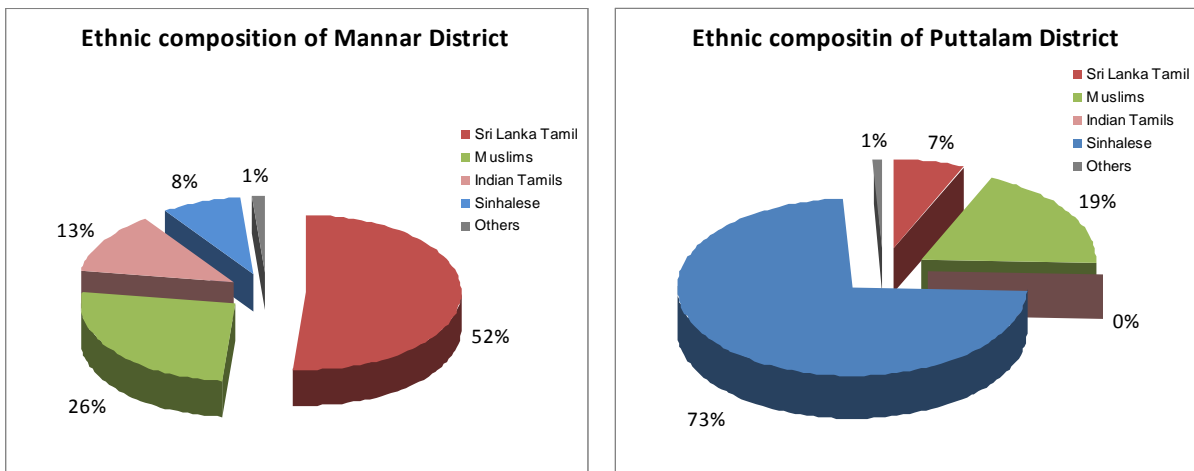
Source; Statistics books prepared by Mannar District Secretariat.

Kalpitiya DSD (87,415) has the highest population followed by Talaimannar DSD (51,579) with population densities of 524/km<sup>2</sup> and 238/km<sup>2</sup> respectively. Mantai West and Musali have the lowest

densities with 12/km<sup>2</sup> and 23/km<sup>2</sup> respectively. Kalpitiya DSD and Talaimannar DSD were not directly affected by the internal conflict and were under government administration but Mantai West was under the separatist control for a significant period. Musali DSD and Nanaddan DSD were also affected by the war; the latter not seriously.

The low population density in some areas is a result of migration due to the conflict. Population statistics are changing by the day, due to ongoing resettlement after the war.

The ethnic composition of two districts is presented in Fig. 3.7.



**Ethnic composition in the Mannar District**  
(Source: Department of Census and Statistics, 2009).

**Ethnic composition in the Puttalam District**  
(Source: Department of Census and Statistics, 2009).

**Fig. 3.7: Ethnic composition of Mannar and Puttalam Districts**

The majority in Mannar District are Sri Lanka Tamils (51%), followed by 26% Muslims, and 13% Indian Tamils. Sinhalese (8%) and others (2%) constitute the rest. In contrast, the majority in Puttalam district is Sinhalese (73.7%), followed by Muslims (18.8%) and Sri Lanka Tamils (6.8%); the others (1.7%) are a mix of Burghers, Malays, Indian Tamils and other minorities (Dept. of Census and Statistics, 2009).

The population of the Mannar and Puttalam districts have undergone changes in the recent past due to a number of reasons, as follows:

1. The Tamil population in these two districts increased, during the initial stages of the internal conflict (over the past 3 decades), due to an influx of a large number of families from other districts such as Vavuniya, Jaffna, Mullaitivu, Kilinochchi, Trincomalee and Batticaloa.
2. Some Tamils, particularly Indian Tamils, migrated to Tamilnadu in India and to other Tamil dominated urban centres in Sri Lanka during the war.
3. A large number of Muslims from Mannar District migrated to other districts with a high Muslim population such as Anuradhapura, Kurunagela and Puttalam, and to a lesser extent to Kandy and other remote Muslim dominated areas of the country. The influx to Puttalam was greater than the other districts.
4. After the war members of all communities have returned to Mannar from other districts as well as from India.

These population shifts have, no doubt, had an effect on the coastal resource base, including fisheries and coastal resources extraction, as well as on socio economic aspects.

The total labour force in the Mannar district in 1997 was 67,600 of which, 87.6 % were employed. Currently, most people in the district are engaged in fishing and agricultural activities, which are the two major sources of livelihood. Agriculture is a key economic sector in the district providing livelihoods for over 15,000 families. Over 50 % of the population in Mannar is involved in paddy cultivation. The land available for cultivation is 37,160 ha (19% of total land area) consisting mainly of paddy lands, subsidiary crops and homestead lands and horticultural lands.

Fishing is a major contributor to the local economy of Mannar District. It is the main source of livelihood for a large segment of the population in Talaimannar and Musali DSDs, where over 50% of the population relies heavily on fishing activities. The district is a major supplier of sea foods such as prawn, crab, and cuttlefish for the rest of the country. It also contributes to export of non-conventional, yet highly profitable marine resources such as sea cucumber and conch.

### 3.3 Land Use

The land use pattern of the coastal areas of Mannar District varies according to the DSDs (Table 3.3). Mantai West and Musali DSDs have considerably larger areas under tropical forest cover and marsh lands than Mannar and Nanaddan DSDs which have relatively high populations. Forest cover is 57% and is the major land use. In agriculture, paddy occupies 12%, followed by perennial crops such as coconut, cashew and palmyrah.

The important, clearly visible change in land use in the Mannar District is the expansion of homesteads, due to expanding settlements (Figs. 3.8 & 3.9). There are no discernible changes in other land uses over the past three decades.

**Table 3.3: Land use pattern of coastal DSDs of Mannar**

Land use in Mannar District in hectares								
Category			Mannar Town	Nanaddan	Musali	Mantai West	Total	%
Agriculture	Paddy	Major	1,775	4,742	2,280	4,150	12,947	10%
		Minor	0	25	225	1,400	1,650	1%
		Rainfed	100	125	330	535	1,090	1%
	Highland crops		1,589	189	352	804	2,934	2%
	Perennial crops	Cashew	200		1,768		1,968	2%
		Coconut	2,010	134	175	71	2,390	2%
		Palmyrah	3,360	1,700	220	680	5,960	5%
Sub total			9,034	6,915	5350	7,640	28,939	
Forests	State				31,650	15,859	47,509	37%
	Other			3,240	6,211	16,987	26,438	20%
Sub total				3,240	37,861	32,846	73,947	
Residential areas, water bodies, other plantations			13,654	4,840	4,211	4,350	27,057	21%
Total			22,688	14,996	47,423	44,836	129,943	100%

Source: Land Branch, District Secretariat, Mannar 2008.

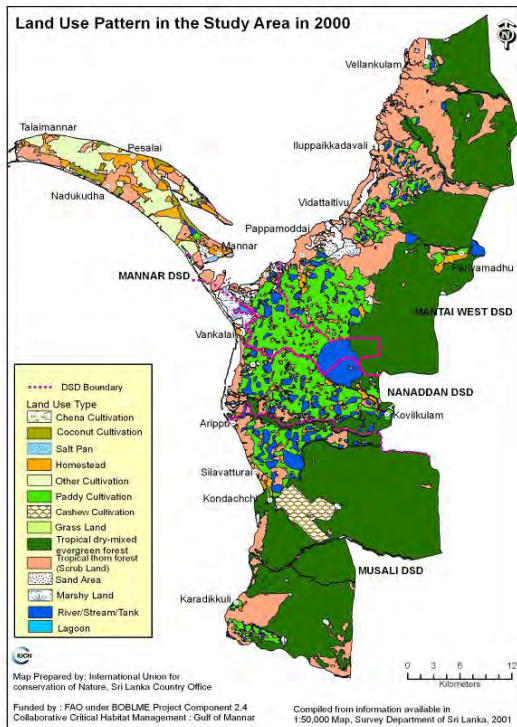


Fig 3.8: Land use pattern of GoM in 2000

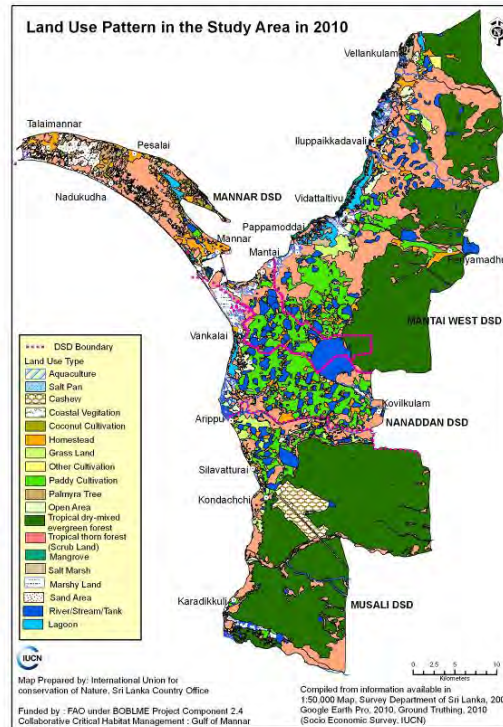


Fig. 3.9: Land use pattern of GoM in 2010

### 3.4 Infrastructure, Services and Civil Administration

#### Transport facilities

Transport facilities in Mannar are improving, and many new roads are being constructed. The main Mannar to Madavachchiya road has been repaired and the road to the north is being renovated rapidly. The road network in Mannar is improving faster than envisaged by the community.

However, the railway transport system has been completely destroyed during the separatist civil war. Arrangements are underway to construct the railway lines and the associated infrastructure.

#### Education

Mannar District has two main educational zones: Madu zone for the interior and Mannar zone for the coastal areas. According to available data and information only 11 of the 16 schools in the Mannar education zone are functioning and the others remain closed for security reasons.

#### Health and sanitation

The health infrastructure has been hugely damaged and health and sanitation facilities in the area are very weak. Public health issues such as dengue, malaria and other diseases are common. There is a severe shortage of medical personnel and services such as laboratory facilities are poor.

#### Drainage and water supply

The drainage system in Mannar and Nanaddan DSDs is outdated and almost all the streets are flooded during the rainy season. Most of the drains in Mannar are being reconstructed but much needs to be done in the rest of the district.

Potable water supply is another area of concern. A limited amount of drinking water is now sourced from irrigation systems.

### **Electricity**

Electricity is mainly from hydro-power supplied by the Ceylon Electricity Board. Due to the ongoing upgrading of the infrastructure, there are long power cuts. There are power interruptions during the night as well. With the current improvements to the systems, it is hoped that the electricity supply will be normalised in due course.

### **Telecommunication facilities**

According to the recent findings, there is a rapid development of telecommunication facilities in the area with the involvement of the private sector. Mobile telephony has developed fast.

### **Business**

Public as well as the private sector are engaged in businesses but are faced with transport problems. Marketing of agricultural produce and fishery too is affected due to transport difficulties.

### **Civil administration**

The civil administration is returning to normalcy, but there are hardships. The necessary cadres and other support services are inadequate. The civil administration system is being strengthened to address the basic issues of the people. But there are several challenges to be overcome, as follows:

- *Bringing normalcy to livelihood and social life of the community:* A large portion of the population left the area during the conflict, affecting community harmony and organisation as well as established livelihoods
- *Improving civil administrative systems:* Administrative systems in the area did not function properly during the war, and the shortcomings of the last three decades need to be addressed. There is a dearth of staff in the state sector institutions; 50 of the 124 cadre positions in staff grade are vacant; 92 of the 252 management assistant positions are vacant; 55 of the 148 technical cadre positions are vacant. These positions must be filled to ensure proper functioning of the administration.
- *Enhancing local level political leadership:* Community Based Organizations (CBOs) have ceased to function for several decades. Issues relating to fishery such as the conflicts with Indian fishers, enforcement of fishing regulations etc. which apply to a large segment of the population need clear political leadership and effective community participation. The situation in the agriculture sector is similar.
- *Improving business community and private sector involvement:* The area has huge potential to develop businesses after the war. The businesses require support of state agencies and services to expand.
- *Improving infrastructure facilities, water, sanitation, waste management, roads etc.:* Currently, infrastructure improvement is underway but it has to keep pace with the rapid development envisaged. Special attention is needed on waste management, as this will be a growing problem. Tourism and recreational activities need attention, which will also provide job opportunities to people.
- *Addressing issues related to land ownership:* Land related issues in the area are gaining ground primarily as a result of rapid resettlement. There are claims that most of the lands in the Musali and Mantai West are being acquired by others. People have lost their deeds in the war, and it is necessary to address these issues to prevent escalation of land related conflicts.



### 3.5 Biodiversity

#### + Floral diversity

As already indicated, over 50% of the district is under forest cover; largely tropical dry mixed evergreen forest and dry thorny scrublands (Fig. 3.10). Other habitats include coastal types such as mangroves, salt marsh, sand dunes and beaches as well as inter tidal habitats including coral reef, algal communities and sea grass meadows. The Mannar Island and a coastal belt of the mainland have been identified as arid zones based on their climatic features. Consequently the vegetation is largely dry thorny scrubland with isolated trees. The scrubland is the secondary vegetation that has developed after clearing of primary forest.

The mangroves and salt marshes are distributed predominantly in the coastal area of Puttalam lagoon and along the coastal stretch from Vankalai to Vidattativu. The current survey recorded a total of 583 plant species (in 119 families) from Mannar Bay and the coastal belt from Kalpitiya to Puttalam. Among them eight species are endemic and 11 species are nationally threatened (IUCN & MENR, 2007). Among the endemic species, *Pupula (Vernonia zeylanica)*, *Neralu (Cassine glauca)* and *Dendrophthoe ligulata* were recorded from the coastal belt. *Opulu (Cynometra iripa)*, *Keera Kadol (Scyphiphora hydrophyllacea)* and *Psilanthus wightianus* are critically endangered species. *Kaluwara (Diospyros ebenum)* and *Wal-kahambiliya (Tragia plukenetii)* are the endangered species in the dry mixed evergreen forest. *Jatropha glandulifera* which has been recorded only from Mannar and Matale district and *Pancratium biflorum* which has a limited distribution in the country were also recorded along the coast (Annex 2).

The habitat types found in the Mannar Bay area were identified and grouped according to the following classification adopted by the Ministry of Forestry and Environment (1999).

- (A) Forests and related habitats
  1. Tropical dry-mixed evergreen forests
  2. Tropical thorn forests (scrublands)
  
- (B) Inland wetland habitats
  1. Streams and rivers
  2. Villu grassland
  3. Man made tanks



Fig. 3.10: Forest cover in the study area

(C) Coastal and marine habitats

1. Mangroves
2. Salt marshes
3. Woody scrub jungles, sand dunes and beach vegetation
4. Mud flats
5. Sea grass meadows
6. Lagoons and estuaries

(D) Agricultural lands

1. Small crop holdings (mainly vegetables)
2. Crop plantations (coconut/cashew)
3. Home gardens
4. Paddy lands

In addition to the major vegetation types, several sub types were identified and documented in order to accommodate site specific variants among the vegetation (Fig. 3.11).

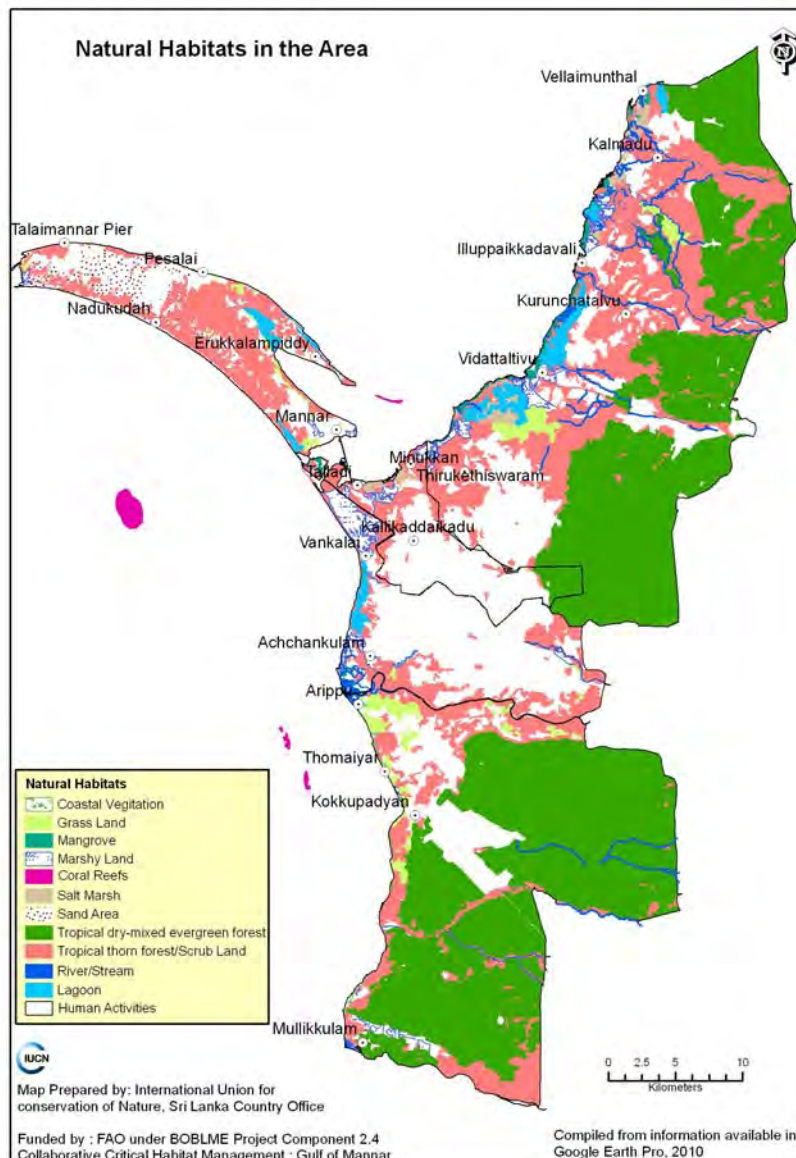


Fig. 3.11: Natural habitats in the area

The following section describes the floristic composition, floristic structure and the species diversity of the above habitats.

### **Tropical dry mixed evergreen forests**

The largest contiguous stretches of tropical dry mixed evergreen forest can be seen in the Musali and Vanathavillu DSDs. This forest has a unique well-developed shorter tree structure compared to dry mixed evergreen forests in the rest of dry zone. Within this forest stretch, degraded vegetation patches dominated by Rana-wara (*Cassia auriculata*), Kohomba (*Azadirachta indica*), Divul (*Limonia acidissima*) and Maila (*Bauhinia racemosa*) were observed. These patches are believed to be the areas where historically settlements were found.

Dry mixed evergreen forest has four recognisable strata such as continuous canopy, a sub canopy, shrubs and herbaceous plants. The canopy assembled densely well grown trees, while shrubs and herbs are poorly grown. Dry mixed evergreen forest habitat is dominated by Palu (*Manilkara hexandra*), Buruta (*Chloroxylon swietenia*) *Tammanna* (*Mischodon zeylanicus*), Wira (*Drypetes sepiaria*), Kapukinissa (*Hibiscus eriocarpus*), Tarana (*Tarenna asiatica*) and Bu-nelu (*Stenosphonium cordifolium*). The presence of *Manilkara hexandra* as the dominant tree species in the canopy layer is an indication of the undisturbed nature of the forest.

Kaluwara (*Diospyros ebenum*), Panakka (*Pleurostyliia opposita*), Neralu (*Cassine glauca*), *Chloroxylon swietenia* and *Manilkara hexandra* are the most valuable timber species in this forest. The medicinal plant species such as Pupula (*Vernonia zeylanica*), Sudu-welangiriya (*Capparis zeylanica*), Thimbiri (*Diospyros malabarica*), Tel-kaduru (*Sapium insigne*), Ingini (*Strychnos potatorum*) and Ratambala (*Ixora coccinea*) were also recorded within this forest. Palu (*Manilkara hexandra*), Wira (*Drypetes sepiaria*), Kudu-miris (*Toddalia asiatica*) and Madan (*Syzygium cumini*) species provide valuable wild fruits. Batu-karavila (*Momordica denudata*) and Thumba-karavila (*Momordica dioica*) are used as vegetables by villagers and they are also important as a wild relative of the cultivated Karavila species (*Momordica charantia*). Green leaves of Neeramulliya (*Hygrophila schulli*), Anguna (*Wattakaka volubilis*) and Kowakka (*Coccinia grandis*) are used as leafy vegetables.

### **Tropical thorn forests (scrublands)**

Tropical thorn forests are found intermixed with dry evergreen forests in the Vanathavillu and Musali DSDs. However, contiguous scrublands were observed within Mantai West, Nanaddan and Mannar DSD. Kalapu-andara (*Prosopis juliflora*) has already invaded the coastal areas including the natural scrubland area as well as abandoned paddy fields. As a result, the area under scrubland dominated by *Prosopis juliflora* has increased in several areas.

Three major vegetation strata can be recognized within the scrubland forest: the impenetrable thorny shrub layer, isolated canopy trees and herbaceous plant layer. Many plants have microphyllous leaves and the exposed shrubs are much branched and dense formed with lianas and climbers. The ground layer abounds with herbaceous plant species, as direct sunlight reaches the ground. Many shrub plant species are well adapted to xerophytic conditions that prevail. These adaptations include thick and small leaves with waxy cuticles, succulent stems [e.g. Hiressa (*Cissus quadrangularis*), Muwa-kiriya (*Sarcostemma brunonianum*) and Nawa-handi (*Euphorbia tirucalli*)] for protection against strong sunlight and to minimize transpiration; seeds that remain dormant till the rainy season; the ability to withstand heavy structural damage caused by herbivores, drought or wind, and the ability to regenerate fast during the wet season. The scrubland is totally different at the peak of the dry season due to leaf fall and drying giving a brown appearance.

The scrublands are dominant with *Acacia panifrons*, Kukul-katu (*Acacia eburnea*), Indi (*Phoenix pusilla*), Malithan (*Salvadora persica*), *Albizia amara*, and Katu-Andara (*Dichrostachys cinerea*). In Mannar Island, Tal (*Borassus flabellifer*) is found in scrublands representing the canopy trees and in the other areas it is replaced by *Manilkara hexandra*, and *Drypetes sepiaria*. *Acacia panifrons* is restricted to the scrublands at Mannar Island and the adjoining area.

Villagers use scrubland as sources of fuel wood, materials for house construction, domestic tools and traditional medicinal products. Some of the important medicinal plants found are Nawa-handi (*Euphorbia tirucalli*), Rana-wara (*Cassia auriculata*), Pupula (*Vernonia zeylanica*), Sudu-welangiriya (*Capparis zeylanica*) and Muwa-kiriya (*Sarcostemma brunonianum*). Tal (*Borassus flabellifer*) is the multipurpose tree species common in this part of the country, and its leaf, leaf stalk, stem, fruits etc. are used in a variety of ways. Heen-karamba (*Carissa spinarum*), Heen-eraminiya (*Ziziphus oenoplia*), and Debera (*Ziziphus mauritiana*) are the useful wild berries found in the scrub forest. Kara (*Canthium coromandelicum*), Anguna (*Wattakaka volubilis*) and Kowakka (*Coccinia grandis*) are the leafy vegetables common in this habitat. Malithan (*Salvadora persica*) root is extracted for toothpick production, which is a traditional practice of the Muslim community.

The invasion of *Prosopis juliflora* is a looming threat in the area, especially for natural coastal scrubland and the adjoining habitats.

### Mangroves

The largest mangrove area in the country is recorded in the Kala Oya and Malwathu Oya estuaries (Fig. 3.12). Manda (*Avicennia marina*), Maha-Kadol (*Rhizophora mucronata*), Sudu-Kirala (*Sonneratia alba*), Pun-kanda (*Ceriops tagal*) and Tela-kiriya (*Excoecaria agallocha*) are the dominant species, and are distributed in more saline and flat land areas. *Avicennia marina* is more abundant as a mono-specific species towards inland. However, *Avicennia* can be seen near the coastal edge in the Palakamunai area. Scrutinizing the floristic diversity of mangroves of the study area revealed that *Rhizophora mucronata* and *Avicennia marina* are the major mangrove species in the area. Associate mangrove species such as Bu-renda (*Clerodendrum inerme*), Suriya (*Thespesia populnea*), Beli-patta (*Hibiscus tiliaceus*) and *Tamarix indica* were also found.

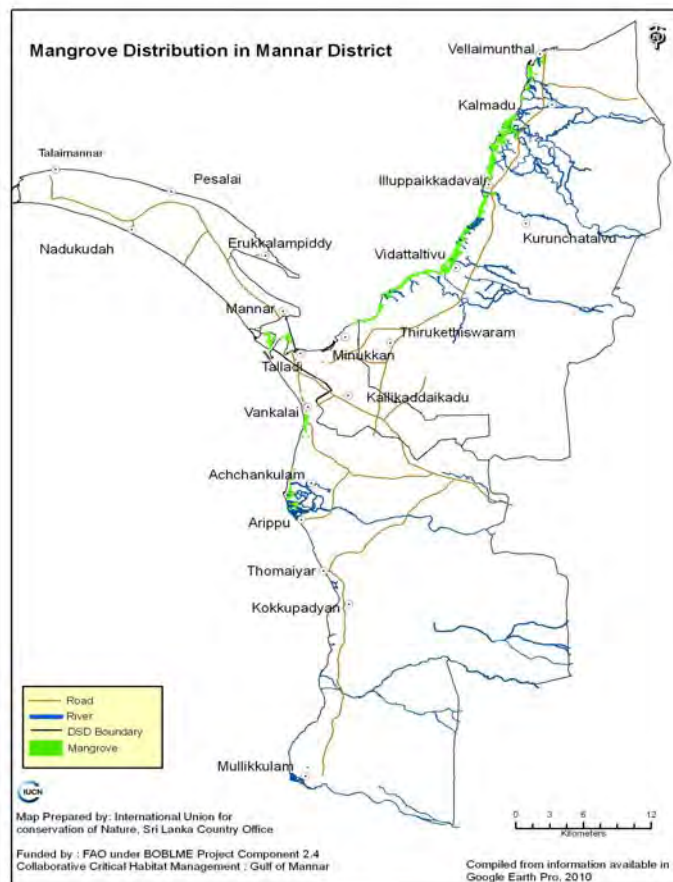


Fig.3.12: Mangrove distribution in the Mannar District

### Salt marshes

The Gulf of Mannar area is richer in salt marsh vegetation than other coastal areas of the country. Salt marshes are often associated with mangrove habitats and found in the inter-tidal flats of sand, silt or



clay; especially in flats protected by bars and cliffs from erosion by sea waves and currents (Abeywickrama & Arulnanam, 1993).

Salt marshes are dominated by low-growing small shrubs and herbs. Salt marsh sites dry up during the prolonged dry period (April-August) and excessive evaporation intensifies salinity. Often, crystallized free salt can be observed. Due to extreme soil salinity levels that prevail in these inter-tidal soils the vegetation consists of halophytes. GoM's extreme environmental conditions, increased soil salinity, desiccating salt spray, perennially high temperatures and excessive evaporation in these sites are not conducive to the growth of other plant species. The distribution of vegetation frequently shows a marked zonation due to submerged and exposed conditions found in these locations. In most areas plants include perennial herbs such as *Suaeda monoica*, *S. vermiculata*, *S. maritime*, *Salicornia brachiata*, *Halosarcia indica* and Maha-sarana (*Sesuvium portulacastrum*) as the dominants that cover the bare ground, with prostrate and upright shoots. The *Halosarcia indica* cover is able to trap wind-borne sand, prevents the wind-induced erosion and also enhances the nutrients in the soil. Some species show green, brown and red colouration enhancing the scenic beauty of the area.

Salt marshes also function as an important habitat and feeding grounds for coastal aquatic and migratory birds due to the high abundance of benthic invertebrates. *Suaeda maritima* is used as a leafy vegetable by the coastal communities.

### **Mud flats**

Mudflats are sedimentary inter-tidal habitats created by mud deposition in low energy coastal environments, particularly in sheltered areas during the low tidal season (Pathirana *et al.*, 2008). These sediments consist mostly of silt and clays with a high organic content and is associated with seagrass meadows. Mudflats are found scattered around Mannar islands and Mantai West area lagoons and bays (eg. Vankalai and Palakamunai).

These mud flats are important in processing nutrients for the ecosystem and providing feeding areas for fish at high tide and for birds, especially migratory birds, at low tide. Mudflat habitats commonly appear in the natural sequence of habitats between sub tidal areas and terrestrial inland vegetation. Several species of plants - mainly washed over sea grasses and algae - were observed in these habitats. Mudflats, like other inter-tidal areas, dissipate wave energy and thereby contribute to minimizing the impacts on salt marshes and flooding of low-lying lands.

### **Sea grass meadows**

Sea grass meadows are found in the shallow areas of sub tidal zone and is a major aquatic habitat type in the study area. They grow either homogeneously or heterogeneously in mixed populations forming thick and dense meadows on muddy, sandy, clay soil of the coastal area. The study area is a favourable habitat for sea grass due to shallow and limited water movement.

Sea grass meadows are extremely productive habitats that contribute to the sustenance of lagoon, bay and near-shore fisheries, and function as nurseries and habitats for many commercially important species of fish and crustaceans (Johnson & Johnstone, 1995). Sea grasses support a large number of organisms which directly or indirectly depend on them. They form the basis of a complex ecosystem supporting many forms of life ranging from plankton to dugongs, and hence contributing to increase the biodiversity associated with the coastal area. Sea grass ecosystems are recognized as nursery grounds and habitats of a large number of marine aquatic organisms, including the globally endangered marine mammal, Dugong (*Dugong dugon*). In addition, sea grasses provide substrata for epiphytes, which have been widely recognised as food for most of the juveniles that inhabit the sea grass meadows. During the present study, sea grass species such as *Waattala (Enhalus acoroides)*,

*Thalassia hemprichii*, *Syringodium isoetifolium*, *Cymadocea rotundata*, *Cymadocea serrulata*, and *Halophila sp.* were recorded. Sea grasses help reduce surface erosion in the sedimentation areas and maintain the nutrient cycle.

Sea weeds are also seen associated with sea grasses and are associated with micro or macro green, red, brown and blue green algae. One of the green algal species (*Gracilaria spp*) has been used to make a delicious drink, and currently it can be seen in a limited area. Harmful and unsustainable fishing methods such as drag nets and *ma del* have led to the degradation of sea grass meadows with an indirect adverse effect on fish catch in the area. Sea grass beds are also affected by unplanned establishment of fish landing sites, and fishing boats.

### **Sand dunes and beaches (including seashore vegetation)**

The sand dune and beach vegetation occur above the high tide mark which is least affected by tidal action in the coastal areas where the land is gently sloping towards the sea. The hillocks of sand dunes are infertile land that support vegetation, especially creeping species such as Maha-ravana-ravula (*Spinifex littoreus*) and *Launea tomentosa* etc.

The coastal beaches are dominated by Ruha (*Cynodon dactylon*), Maha-ravana-ravula (*Spinifex littoreus*), Rana-wara (*Cassia auriculata*), Indi (*Phoenix pusilla*), Andara (*Dichrostachys cinerea*) and Tal (*Borassus flabellifer*) towards the land side.

The physiognomy and floristic composition of the beach flora and associated minor sand dunes depend on the extent and steepness of the shore and the degree of ground stability. The vegetation located in the zone beyond the direct impact of waves and tides consists of few tree species, shrubs and herbs, which help to consolidate the surface soil by restricting wind induced erosion and by providing resistance to removal of sand by occasional sea waves. Trees are characteristically stunted as an adaptation to strong wind action and salt spray.

### **+ Faunal diversity**

The Gulf of Mannar area is comprised of a variety of marine and brackish water ecosystems. Additionally, terrestrial and freshwater ecosystems such as tropical dry mixed evergreen forests, scrub forests, villus, rivers and manmade tanks can be observed in the vicinity of the coastal belt of the GoM. Due to the close proximity to the Indian mainland, GoM coastal ecosystems harbour a large number of migratory bird species which directly land from the Indian mainland during the winter migratory period (Bambaradeniaya *et al.*, 2007). During the annual water bird census, a total of 166,300 water birds were recorded from this region (Talaimannar, Adams bridge, Vankalai) in 2003 (Siriwardena, 2003). Therefore, these ecosystems are important as feeding, resting, and roosting grounds for migratory birds.

A total of 398 vertebrates including freshwater fishes, amphibians, reptiles, birds, and mammals and 98 invertebrates (dragonflies and butterflies) were reported within the six coastal DSDs in the Gulf of Mannar. Among the vertebrates are 31 endemic and proposed endemic species, 66 migrant bird species, two introduced freshwater fishes and eight domesticated mammal species. Among the recorded species there are five listed as Critically endangered (CR), 10 as Endangered (EN), 31 as Vulnerable (VU), 36 as Near Threatened (NT) and four as Data Deficient (DD) in the 2007 Red List of Threatened Fauna and Flora of Sri Lanka (IUCN Sri Lanka & MENR, 2007) (see Table 3.4 and Annex 3).



**Table 3.4: Faunal species recorded in Sri Lanka and the Gulf of Mannar region.**

Animal Group	Recorded in Sri Lanka		Recorded in the GoM			Conservation status of the species recorded in the GoM				
	Total	Endemic	Total	Endemic	Mi/Ex/Do	CR	EN	VU	NT	DD
Dragonflies	121	50	14	0	0	0	0	0	0	0
Butterflies	245	25	84	0	0	1	0	4	8	0
Fishes	87	48	36	6	2	0	0	3	2	2
Amphibians	112	96	17	3	0	0	0	0	0	0
Reptiles	207	117	55+13*	10	0	2	4	8	6	0
Birds	492	26+7**	205	3+5**	66	2	1	5	16	2
Mammals	107+28*	20	59+13*	4	8	0	5	11	4	0
Total	1371+28*	382+7**	470+26*	26+5**	76	5	10	31	36	4

\* marine species; \*\* Proposed endemics, Mi -Migrant, Ex- Exotic, Do- Domestic; CR-Critically Endangered; EN- Endangered; VU- Vulnerable; NT- Near Threatened; DD- Data Deficient.

There are 36 freshwater fish species recorded in the bodies of freshwater along the coastal region such as rivers, tanks, villus, and channels mainly spread out along the Vanathavillu, Musali and Nanaddan DSDs. Six endemic species, *Labuca lankensis*, *Puntius melanomaculatus*, *Puntius singhala*, *Clarias brachysoma*, *Orizias cf. dancena*, and *Channa ara* have been recorded from previous surveys. *Trichogaster pectoralis* and *Oreochromis mosambicus* have been introduced for inland fishery development. Two freshwater fish species were identified as Nationally Vulnerable (IUCN Sri Lanka & MENR, 2007).

Amphibian diversity in the region is much lower compared to the other faunal groups. A total of 17 amphibians were recorded in inland water bodies, and amongst them were three endemic amphibians (*Bufo atukoralei*, *Polypedates cruciger*, and *Hylarana gracilis*) which were recorded along the riverine forests at the Kala Oya, Modaragan Ara, Kal Ara, and Malwatu Oya.

A total of 69 reptile species were recorded within the region and among them were three marine turtles (*Chelonia mydas*, *Lepidochelys olivacea* & *Erytmochelis imbricata*) and 10 species of sea snakes. Gulf of Mannar is known to be an important foraging site and a migratory route of the *Erytmochelis imbricate* population inhabiting the South Asian marine region (Kapurusinghe and Cooray, 2002). The Gulf of Mannar also provides habitats for 10 endemic species, 14 nationally threatened (2-CR, 4-EN and 8-VU) and six Near Threatened species (IUCN Sri Lanka & MENR, 2007). *Bungarus caeruleus*, *Naja naja*, *Daboia russelii* and *Echis carinatus* are the lethal, venomous snakes in the region. The lizard, *Chamaeleo zeylanicus* is confined to this arid region, especially the scrub forests, and is a Near Threatened species (Somaweera & Somaweera, 2009). The Critically Endangered *Gerarda prevostiana* has been found in the Kala Oya estuary; there are only five known sightings of this species from the vicinity of the Kelani basin, Negombo Lagoon, and Kala Oya basin (Somaweera, 2006).

Birds are the most significant faunal group in the Gulf of Mannar. Adams' bridge and Mannar Island are important gateways for migratory bird species into the country from the Indian mainland. A total of 205 bird species have been recorded along the coast of Gulf of Mannar.

Among them 66 species were identified as migratory species. Most of the water birds use mud flats around the Vankalai, Vidattaltivu and Mantai West as their first resting and feeding ground. Three endemic and five proposed endemic bird species were also recorded in the forest areas of the region

especially Musali, and Vanathavillu DSDs. The Gulf of Mannar also provides shelter for eight Nationally Threatened species (2-CR, 1-EN and 5-VU) and 16 Near Threatened species. Critically Threatened *Anas poecilorhyncha* and *Sterna saundersi* are known to breed only in the Mannar region. Most of the forest occurring species take refuge in the Vanathavillu and Musali DSDs where the Tropical dry-mixed evergreen forests yet remain. Wilpattu National Park provides shelter to a large number of native and migratory bird species within its different habitat types. Healthy populations of *Francolinus pondicerianus* can be seen as small flocks in the open habitats along the region. This species was a popular game bird among the hunters during the colonial period.

A total of 59 terrestrial mammal species and 13 marine mammals have been recorded from the GoM region. Among them four species are endemic (*Macaca sinica*, *Semnopithecus vetulus*, *Paradoxurus stenocephalus* and *Moschiola meminna*), and eight species are introduced. Northwest sub species of endemic Purple Faced Langur (*Semnopithecus vetulus harti*) population can be seen in the riverine forests at Kala Oya and Modaragan Ara. This sub species has unique morphological features compared to the neighbouring dry zone sub species (*S. v. philbriki*) which can be seen in the North Central Province and the Eastern Province. *Elephas maximus* is only found in the deciduous forest and scrub lands in the Vanathavillu and Musali DSDs. Elephant aggregations were observed near the freshwater waterholes at Illuvankulama and Periya villu areas in the Wilpattu National park during the dry season. Elephants were found roaming in the Musali DSDs where the new resettlement sites were established. In future, elephant-human conflict may be expected within these areas with the establishment of agricultural lands.

A healthy feral Donkey (*Equus asinus*) population can be seen in the Mannar Island and three colour forms were observed. It is believed that the donkeys have been introduced to the country by Arabian traders in ancient times. Unlike in Mannar, Kalpitiya has a donkey population with genetic abnormalities due to inbreeding. Four Nationally Endangered and eight Vulnerable mammal species were recorded in the area. Among the threatened endangered species, *Hipposideros galeritus*, *Kerivoula picta*, *Prionailurus rubiginosus* and *Melursus ursinus* are found in the Wilpattu National Park in the Vanathavillu DSDs.

The largest mammal of the world, *Balaenoptera musculus* which is globally endangered, is also observed in the GoM. *Dugong dugon* which was one of the common marine mammals recorded a few decades back is now found occasionally. During the study period, two dugongs had been killed by fishermen using dynamite, and were intercepted by security forces while being brought ashore for sale.

A total of 14 dragonflies and damselflies were recorded from the region. Among them *Pantala flavescens* is the most common species which was found throughout the region. A rare damselfly, *Pseudagrion decorum* that had been recorded from the Giant's tank in Mannar by Bedjanic *et al.* (2007) was not recorded during the current survey.

Butterfly fauna of the Wilpattu National Park (Vanathavillu DSD) and Kalpitiya Peninsula (Kalpitiya DSD) has been well studied (Weeratunga, 2009; IUCN Sri Lanka, 2010). Of the 84 butterfly species that have been recorded along the coastal region of GoM, five were nationally threatened species - *Azanus ubaldus* being Critically Endangered and *Colotis fausta*, *Colotis aurora*, *Chilades parrhasius* and *Deudorix epijarbas* being Vulnerable - and another eight were Near Threatened species (IUCN Sri Lanka & MENR, 2007).

The DSD-wise distribution of fauna is presented in Table 3.5.

**Table 3.5: Divisional Secretariat Division-wise distribution of faunal species**

Animal Group	KAL	VAN	MUS	NAN	MAW	MAN
Dragonflies	1	9	1	1	1	6
Butterflies	38	82	5	4	3	12
Fishes	0	36	0	0	0	0
Amphibians	6	16	4	4	2	4
Reptiles	27	59	6	6	6	22
Birds	90	147	68	44	106	69
Mammals	26	64	19	11	10	20
Total	188	413	103	70	128	133

KAL - Kalpitiya DSD; VAN - Vanathavillu DSD; MUS - Musali DSD; NAN - Nanaddan DSD; MAW - Mantai West DSD; MAN - Mannar DSD.

Kalpitiya DSD: Kalpitiya consisting of a number of Islands is rich with mangroves, salt marshes, mud flats, sand dunes, and scrublands. These habitats support a number of indigenous and migratory birds and a large number of butterfly species. As it is rich with migratory birds and marine mammals there are good opportunities for future development of ecotourism activities. Dugong, once common in the lagoon but now known to be one of the most Vulnerable marine mammals is also found here. A total of 188 faunal species were recorded from the DSD with bird species (90) and butterfly species (38) being the most abundant.

Vanathavillu DSD: There are a number of natural habitats in Vanathavillu, which is also home to the Wilpattu National Park, the largest in the country. Moreover, there are several forest reserves (eg. Tabbowa Sanctuary) in close proximity to this DSD. Consequently, the highest number of faunal species (413) were recorded from Vanathavillu DSD including 147 bird species, 82 butterfly species, 64 mammal species, 59 reptile species, and 36 freshwater fish species. Due to its scenic value and high faunal diversity, this DSD has the potential to be developed for eco-tourism activities. The traditional local knowledge on wildlife also can be profitably utilized in future tourist activities. However, most of the DSD's natural habitats and their ecology have not been studied well and this offers considerable scope for research.

Musali DSD: Natural habitats of Musali have been extensively cleared for new settlements and this has affected wildlife. Due to the war situation this area has not been explored since the late 1970's. During the current survey, it was possible to document 103 faunal species including 68 birds, 19 mammals, six reptiles, five butterflies, four amphibians, and a single dragonfly. Elephants were observed in very close proximity to the new settlements even during daytime. Once the farming activities start human-elephant conflicts are more than likely and calls for action to forestall such conflicts.

Nanaddan DSD: A large area in Nanaddan has been farmed since historic times under the Giant's Tank irrigation system. Therefore, the natural habitats have been converted to paddy fields and small tanks. As the current survey was carried out during the dry season, faunal diversity was very low in the DSD; only 77 faunal species were recorded.

Mantai West DSD: Mantai West, rich in natural habitats, supports a large number of faunal species. Large mud flats and salt marshes in the Vankalai and Palakamunai areas are feeding grounds for migratory water birds. Due to its importance for migratory birds, Vankalai was declared as a Ramsar wetland in mid 2010. The nearby mangrove vegetations in Vidattaltivu and Palakaimunai also serve as feeding and roosting grounds for native and migratory bird species. Hence, the Department of

Wildlife Conservation should consider declaring the Vidattaltivu mangrove habitat also as a sanctuary. One hundred and twenty eight faunal species have been recorded from the area and among them are 106 bird species. Information on other fauna is scanty.

Mannar DSD: A total of 133 faunal species have been recorded from Mannar Island. However, migratory off-shore birds could not be studied as the sandy islands in Adam's Bridge were inaccessible. Species composition of fauna was 69 birds, 22 reptiles, 20 mammals, 4 amphibians, 12 butterflies, and six dragonflies. The feral donkey population in the Mannar Island is in good condition and three colour morphs were observed. This may be due to the fact that the ancient Arab sailors, who introduced them to the island, brought different subspecies, from time to time, from different parts of the Middle East and African countries. There is potential to develop the bird watching activities in the Palmyra mixed scrub and mud flats around the island.

#### ✦ **Uses of and threats to biodiversity**

##### **Potential uses**

The biodiversity-rich ecosystems in the area provide valuable ecosystem services such as provisioning (food, water, fuel wood), regulating (prevention of soil erosion, flood control), cultural (recreation, spiritual value, sense of place) and supporting (soil formation, nutrient cycling, oxygen from photosynthesis). These services also support the livelihoods and sustainability of communities in the area. Coastal habitats, especially mangroves, protect coastal areas from wind, floods, saline water intrusion and coastal erosion. The coastal vegetation provide habitats for migratory species, nursery and breeding grounds for coastal and marine life.

Wild relatives of economically important crops such as *Vigna* spp. and *Momordica* spp. were also recorded from the GoM coastal belt. Such valuable resources, useful for future crop development, have not been inventoried yet.

The pristine habitats of the GoM have potential for sustainable eco-tourism development activities. Bar Reef Marine Sanctuary, Wilpattu National Park, Vankalai Ramsar Site and Gaint's Tank Sanctuary are the major wildlife attractions in the GoM. Several high biodiversity hotspots such as Gulf of Mannar Reef, Vankalai Reef, Arippu Reef, Silvatturai Reef and Vidattaltivu Lagoon are also future tourist attractions.

##### **Possible threats**

Compared to other coastal areas of Sri Lanka, threats to biodiversity in the coastal habitats of the study area have been few, largely due to the war situation during the last few decades. However, the following concerns and possible threats should be noted:

- The vegetation in many areas is degraded due to human interventions. Specifically, expansion of settlements, new fish landing sites and sand mining are of concern.
- Rapid colonization by the invasive species, *Prosopis juliflora* is one of the foremost threats to the coastal vegetation, especially scrubland and other coastal habitats, including paddy areas, except perhaps the sand dunes.
- Uncontrolled grazing by goats, cattle and donkeys is a matter of concern.
- In future, elephant-human conflict may be expected in some areas with the resettlements and expansion of agricultural lands.
- Proposed development activities must give adequate consideration to biodiversity conservation aspects. Of particular concern is the possible increase of firewood collection by people in the resettlements, illegal logging for timber, and extensive land clearing for agriculture.

### 3.6 Agriculture

Agriculture, a major economic sector of the Mannar District, is expanding in parallel to the rapid resettlement programme. Rice is the main crop covering 9.6% of the land area, followed by perennial crops and highland crops. Of the 20,700 families in the district, more than 75% (16,331 families) are engaged in agriculture.

With peace returning, the survey found that abandoned paddy lands are being prepared for cultivation in the next season. According to the local community, about 70-80% of the paddy lands are being prepared for cultivation and 60% of the irrigation infrastructure has been renovated by the government so far.

Crop selection is based on both soil type and availability of water. Table 3.6 gives the soil types and their distribution in Mannar District (which could be read together with Fig. 3.2); Table 3.7 shows the agro-ecological zones, soil types and land use in Mannar District; and Table 3.8 shows the cultivated extent of crops, by DSD, in Mannar District.

**Table 3.6: Distribution of soil types in Mannar District**

Soil type	Distribution
Alluvial soils	Mantai West and Musali DSDs
Grumosols	Mainly in Mantai West DSD covering the rice bowl area
Red Yellow Latosols	Nanaddan and Musali DSDs
Reddish Brown Earths & Low Humic Grey soils	Madu Division
Regosols	Mannar Islands
Solodized Solonetz	Low lying coastal regions in Nanaddan, Musali and Mantai West DSDs

**Table 3.7: Agro-ecological zones, soil types, and agricultural land use in the Mannar District**

Agro-ecological Zone	DSDs Covered by AEZ	Soil Type	Main Agricultural Land Use
DL3	Mannar, Musali, Mantai West	Red Yellow Latosol: very high permeability and low erosion Regosol: mineral soils in unconsolidated materials Underlying fresh water	Forest areas  Perennial crops such as coconut, cashew and fruits such as mango
DL4	Nanaddan, Mantai West, Musali	Grumosols : ponded alluvial clay with slackwater deposits of prior river systems  Alluvial: alluvial deposits on flat flood plains, finely textured clay  Solodized Solonetz: high sodium content and dense, clay-rich subsoil in coastal flood planes	Irrigated rice  Unirrigated areas under livestock
DL3	Mannar, Musali, Mantai West	Red Yellow Latosol: very high permeability and low erosion Regosol: mineral soils in unconsolidated materials Underlying fresh water	Forest areas  Coconut, cashew and fruits such as mango
DL4	Nanaddan, Mantai West, Musali	Grumosols : ponded alluvial clay with slackwater deposits of prior river systems  Alluvial: alluvial deposits on flat flood plains, finely textured clay  Solodized Solonetz: high sodium content and dense, clay-rich subsoil in coastal flood planes	Irrigated rice  Unirrigated areas under livestock

**Table 3.8: Cultivated extent of crops, by DSD, in Mannar District**

Type of Crop		Cultivated Extent in ha			
		Mannar Town	Nanaddan	Musali	Mantai West
Rice	In Major irrigation systems	1,775	4,742	2,280	4,150
	In Minor irrigation systems		25	225	1,400
	In Rain fed systems	100	125	330	535
Highland crops		1,589	189	352	804
Perennial crops	Cashew	200	-	1,768	-
	Coconut	2,010	134	175	71
	Palmyra	3,360	1,700	220	680
		9,034	6,915	5,350	7,640

Source: Statistical Hand Book 2009, Mannar District Secretariat.

### **Rice cultivation**

The main crop in Mannar District is Rice; Nanaddan, Musali and Mantai West DSDs are the major production areas. Rice is cultivated mainly in Alluvial and Grumosol soils under both irrigated and rain fed systems, and covers 9.0% and 0.6% of the land area, respectively. Generally, all paddy lands are cultivated in the Maha season but only 5% during Yala as irrigation water is insufficient.

### **Irrigation**

Small tanks (243), medium tanks (20), and a major irrigation system provide water for rice cultivation in Mannar District. The small and medium tanks are rain water storage tanks connected to a cascade system (Fig. 3.13).

In addition to irrigation, these small and medium tanks enhance the microclimate and provide many socio-economic benefits; water for bathing, washing, and recreation. They are also a source of fish providing much-needed proteins and others products such as lotus roots.

Three tanks, namely Giant's tank, Viyadikulam tank and Akaththimurippu tank feed the major irrigation system. Giant's tank has a water surface area of 200 ha and a capacity of 3,885 ha meters. It has 162 feeder tanks and irrigates paddy lands in Nanaddan, Mantai West and Mannar town DSDs. The smaller tanks Viyadikulam and Akaththimurippu tanks, with six feeder tanks each, irrigate paddy lands in Musali DS Division. These tanks are entirely dependent on water from the perennial river, Malwathu Oya. Malwathu Oya, which brings water from outside the GoM region, flows through the North Central Province, its catchment area.

This major irrigation system provides water to irrigate about 2,550 ha of paddy land in the Mannar District. Some paddy lands in Mannar are irrigated by medium tanks (Table 3.9) and small tanks (Table 3.10). In addition to the above irrigation options, river banks (Table 3.11) are also cultivated using water from the river.

Tank bed cultivation is carried out during the off season (Yala) to use whatever water is available in the tanks. It is a practice that is allowed by the government authorities and has been practised for a considerable time to generate some off season income.



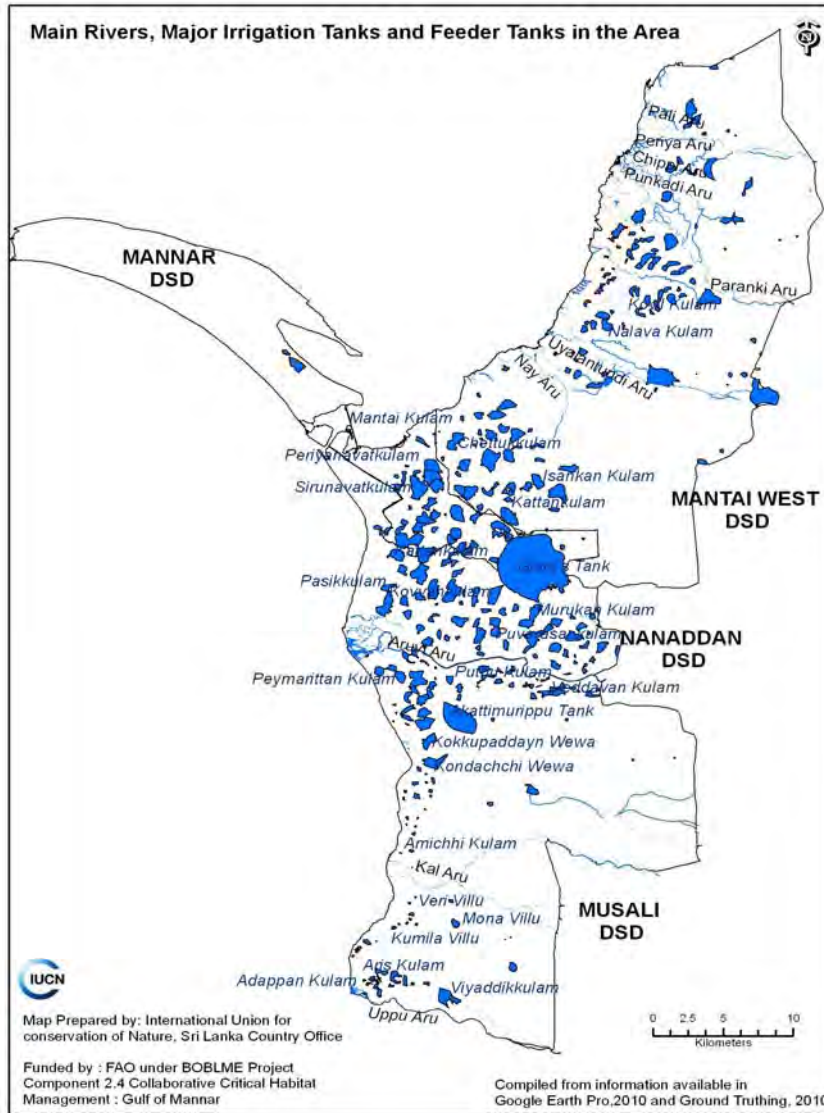


Fig. 3.13: Major irrigation tanks and feeder tanks in Mannar District

Table 3.9: Medium sized tanks in Mantai West and Madhu DSDs

DS Division	Tank
Mantai West	Periyamadhu tank
	Welimaruthamuni tank
	Kurei tank
	Adampankulam tank
Madhu	Periya Pandivirichchan tank
	Thechanamaruthamadu tank
	Maruthamadu anicut

Source: Statistical Hand Book 2009, Mannar District Secretariat.

**Table 3.10: Number of small sized tanks, by DSD, in Mannar District**

DS Division	Number of Tanks
Mannar town	3
Nanaddan	59
Musali	40
Mantai West	141
Total	243

Source: Statistical Hand Book 2009, Mannar District Secretariat.

**Table 3.11: Rice cultivation on riverbanks**

River	DS/AGA Division	Catchment Area in km <sup>2</sup>	Cultivated Extent in ha	River Flow Duration in Months
Aruvi Aru	Musali and Nanaddan	2,944	12,432	9
Modaragama aru	Musali	931	495	9
Kal aru	Musali	209	-	3
Nay aru	Mantai West	560	1821	4
Pali aru	Mantai West	450	-	6
Parangi aru	Mantai West	832	214	6
Chippi aru	Mantai West	66	-	4

Source: Statistical Hand Book 2009, Mannar District Secretariat

### ***Paddy production and productivity***

The paddy land served by the cluster of tanks in Nanaddan, Musali and Mantai West DSDs is referred to as the Rice Bowl of Sri Lanka (Fig. 3.14). These paddy fields are fertile and produce high yields (Table 3.12). The survey revealed that on account of the high soil fertility, fertilizer use is well below the recommended level (only 2/3 of the recommended amount). Several 3, 3 ½, and 4 month rice varieties are cultivated. The common varieties are BG 300, 304, 305 and 406. Salt tolerant varieties such as BW 400, AT 354 and 353 are cultivated in the high salinity lands. The traditional varieties such as Attakariya and improved high yielding varieties such as BG 407 are also cultivated. There are 11 rice mills but currently only three mills are in operation.

**Table 3.12: Rice yield under different farming systems**

Farming System	Yield
Irrigated paddy with dry seeding	5,600 kg/ha/season
Irrigated paddy with wet seeding	7,000 kg/ha/season
Rain fed cultivation	3,600 kg /ha/season

Source: Office of Department of Agriculture, Mannar

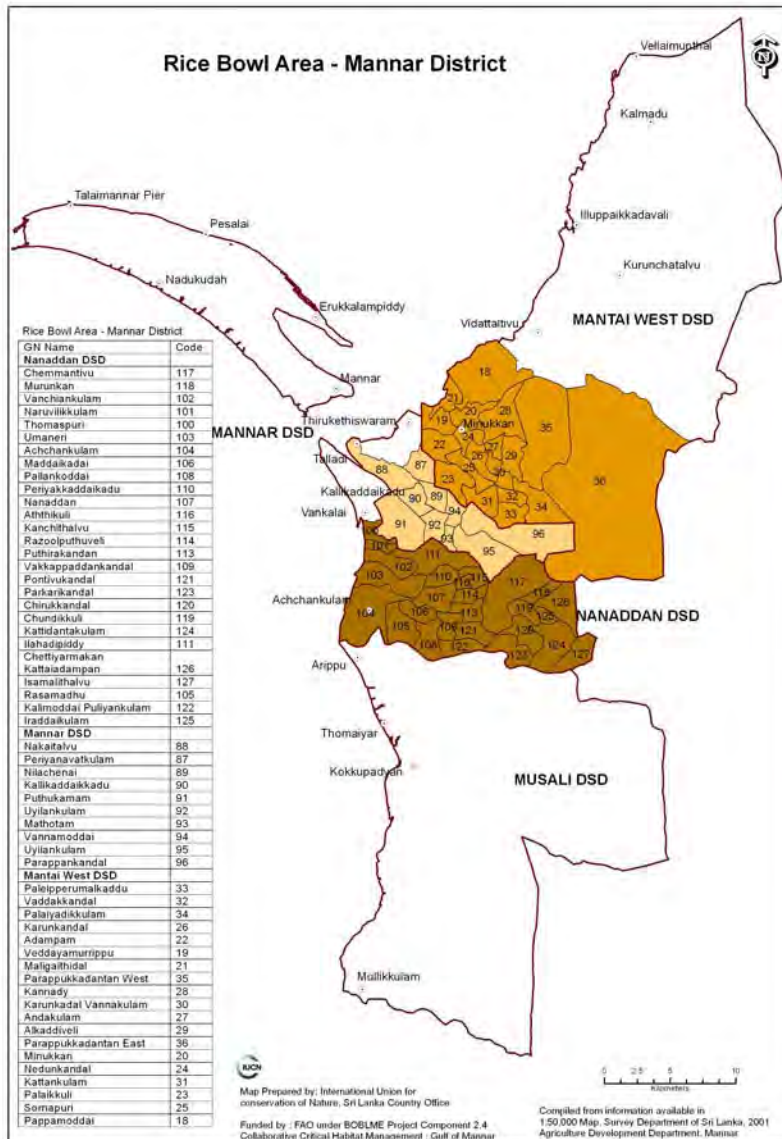


Fig. 3.14: Grama Niladhari Divisions comprising the rice bowl of Sri Lanka

### Highland and perennial crops

About 2 % of the land in Mantai West, Musali and Nanaddan is under highland crops (field crops and vegetables). Although suitable land is available for expansion of highland crops, the limiting factor is water. The use of ground water for irrigation is minimal in these areas as the water is saline. Currently there are 110 tube wells used exclusively for cultivation.

About 5% of the land is under perennial crops. Palmyra, coconut, cashew and mango are the main perennial crops. Coconut is cultivated on a plantation scale in the Mannar Island and in other areas, as well as in home gardens. Perennial crop produce is mainly sold as raw products. Sizeable industries based on perennial crop produce were not found; only very small scale cottage industries using Palmyra and coconut by-products.

### Home gardens

About 200 ha of land in Mannar District are under home gardens at present (Table 3.13). Home gardens mainly have coconut, fruit plants such as mango, papaw, guava, pomegranate, wood apple, lime and banana etc. Almost every home garden has a well grown coconut palm. Home garden vegetable cultivation is actively pursued in the Maha season but not so in the Yala season as water is scarce.

**Table 3.13: Homegardening in the Mannar District in 2008**

DS Division	Number of Homegardens	Area (ha)
Mannar town	1585	110
Nanaddan	987	60.5
Musali	-	-
Mantai West	510	31.5
Total		202

Source: Statistical Hand Book 2009, Mannar District Secretariat.

### Livestock

The abundance of flat or slightly undulating land in the area offers much scope for rearing livestock. Cattle, buffalo, goats and poultry are the main livestock. Cattle, buffalo and goats are reared under extensive systems of management with open-range ranching. Cattle are reared for both meat and milk production. Majority of the cattle are local breeds and milk production is low (1.5-2.0 l/cow/day). Crossbred Friesian, Jersey and Sahival are also available. Milk collection and marketing facilities are almost non-existent and therefore milk is usually consumed locally. Majority of the farmer families have livestock integrated with crops in their homesteads. Livestock statistics are given in Tables 3.14, 3.15 and 3.16.

**Table 3.14: Livestock population in Mannar District in 2009**

DS Division	Neat Cattle				Buffalo				Goat	
	Milk Cows	Other Cows	Bulls	Calves	Milk Cows	Other Cows	Bulls	Calves	Males	Females
Mannar Town	2,500	1,950	850	3,700	150	170	90	150	1,600	4,300
Nanaddan	2,871	2,429	1,444	1,593	196	90	43	35	2,200	1,200
Musali	1,500	1,800	600	2,100	--	--	--	--	600	150
Mantai West	1,750	2,100	700	2,450	100	120	40	140	80	20
Total	8,621	8,279	3,594	9,843	446	380	173	325	4,480	5,670

Source. DS Mannar

**Table 3.15: Livestock population in Mannar District in 2009**

DS Division	Poultry					Ducks	Sheep	Pigs	Rabbits	Guinea Fowl
	Cock Birds	Laying Hens	Hens	Chicks	Broilers					
Mannar Town	10,000	8,560	5,800	25,000	13,000	1,450	70	250	65	450
Nanaddan	7,400	9,200	--	--	1,000	1,700	--	25	--	60
Musali	720	1,440	1,440	3,600	--	30	--	--	--	--
Mantai West	150	300	300	750		12	--	--	--	--
Total	18,270	19,500	7,540	29,350	14,000	3,192	70	275	65	510

Source : DVS Office Mannar

**Table 3.16: Milk collection in Mannar District in 2009**

DS Division	2008 [ Litres ]	2009 [ Litres ]
Mannar Town	28,205	29,510
Nanaddan	343,577	509,350
Musali	information not available	Information not available
Mantai West	Information not available	Information not available

Source : DVS Office Mannar.

### ***Agricultural extension***

Extension and technical support for crop cultivation: Agricultural extension and technical support for cultivation are delivered mainly by the Provincial Department of Agriculture at Mannar.

Agricultural inputs and services: The Department of Agrarian Development is mainly responsible for the supply of agricultural inputs such as subsidized fertilizer, agricultural equipment, agro-chemicals etc. This department also services subsidy programmes for crops other than paddy, attends to small tank rehabilitation and operation, and resolves land conflicts in accordance with the provisions of the Agrarian Services Act.

Veterinary services: There is a Mannar District Veterinary Office and two divisional offices in the Mannar and Mantai West Divisional Secretariats. There are five Veterinary Divisions under the Department of Animal Production and Health in the area covered by the two divisional offices. The services include: disease control and vaccinations, breeding (artificial insemination), and extension. Inadequate staff is a major problem affecting veterinary services in the area.

### ***Farmer organizations***

There are a number of registered farmer organizations, and livestock cooperative societies in the Mannar District (Table 3.17). Some of these organisations were not active during the separatist war and are in need of support for reorganisation and revitalisation.

**Table 3.17: Registered farmer organizations in Mannar District**

DS Division	No. of Farmer Organizations	No. of Members	No. of Farmer Families
Mannar town	13	684	2,635
Nanaddan	38	1,903	4,450
Musali	6	130	540
Mantai West	28	873	6,496
Total	85	3590	14,121

Source: Statistical Hand Book 2009, Mannar District Secretariat.

### ***Issues relating to agriculture***

The people displaced during the internal conflict are being resettled in the area. Resettlement is being done mainly in Mantai West and Musali DSDs. The following constraints and proposals require attention:

Irrigation development: Water has become the critical factor for agriculture in the area. Although the land is available, the cropping intensity is low. Only about 5% of the cultivable land is cultivated in the Yala season due to scarcity of water. The main objective of the sector development plan is to increase cropping intensity and production during the Yala season. There are two development proposals that are under discussion to increase the irrigation capacity in the area.

- Augmentation of Giant's tank bund and thereby increasing its capacity to store more water during the rainy season. This proposal has not been approved by the Environment Committee of the Provincial Government as augmentation will inundate part of the forest in the Giant's tank catchment area.
- Another proposal is being discussed to build an irrigation tank to supply 30 ha m of water to the area with the water from Malwathu Oya .

Irrigation services: Three different state agencies are involved in irrigation water management in the Mannar District.

The Irrigation Department (Central government), based in Murunkan, is responsible for the management of the major irrigation schemes. All maintenance and management decisions are taken by this department in consultation with other agencies including farmer organizations.

The medium sized tanks are under the administrative purview of the Irrigation Department (Provincial government) and the maintenance and water management decisions are taken in consultation of other agencies and farmer representatives.

The small sized tanks are under the purview of the Department of Agrarian Development. Maintenance of the small tanks is funded by the government and carried out with the participation of farmer organizations who contribute some labour.

However, these state agencies formulate their development plans separately and coordination was found to be wanting. At present they coordinate mainly in regard to water allocation decisions.

Institutions: In the agriculture sector there are many agencies involved in performing different functions. However, people feel that they are not adequately consulted in decision-making. This may be due to the dearth of well functioning community organizations.



Inter-agency coordination in arriving at decisions affecting the communities is not functioning well (e.g. allocation of irrigation water). The agencies also suffer from a shortage of staff, technical capacities, opportunities for interaction with counterparts in other areas and exposure to modern tools and methods.

Expansion of agricultural areas, and increased use of agrochemicals: The war displaced families are returning after about 20 to 25 years, in large numbers, and there is a great demand for land than ever before. With the ongoing resettlements, lands are being cleared for cultivation and for settlement. During the survey, the forest areas in Musali and Mantai West DSDs were being cleared for settlements and cultivation. Most of these lands are adjoining estuaries, lagoons, river banks and catchment areas of the tank system in the area, and there is a likelihood of erosion and siltation of tanks.

The current level of water pollution due to agricultural practices is low. The restricted supply of nitrogenous fertilizer due to security concerns and the low level of cultivation are the main reasons. However, resettlement and potential increase in the area under cultivation, fertilizers being freely available, and the likely increase in the use of agrochemicals may result in increased water pollution.

Expansion of tank bed cultivation: The traditional tank bed cultivation in Mannar, which was somewhat limited due to the war situation, is expanding with resettlements. There is a tendency for extensive land clearing in tank beds and reservations for cultivation. These lands can be cultivated in both Yala and Maha seasons; hence more sought after.

Livelihood issues: Each farming family owns about 2-5 acres of paddy land and an upland home garden. While their income is mainly from paddy cultivation almost all farmers own livestock. Cattle and goats are reared for milk and meat for additional income during the off season. Only a few farmers practice coastal fishing for supplementary income but almost all farmers fish in the tanks.

Although paddy yields are relatively high the price of paddy at Rs 15 per kg is low. Nor has it been possible to sell the entire harvest due to a shortage of buyers. In the past, paddy could not be transported to other parts of the country; marketing linkages are now being established after the war. Rice processing mills operating in the area is becoming insufficient as more lands previous abandoned are being brought under paddy. It is likely that new mills will be established soon.

Low-lying marshy flood plains provide forage for livestock, control floods, and absorb excess irrigation water. These functions could be affected if post-conflict developments lead to land use changes in the low lying coastal areas .

Most agricultural communities are faced with seasonal unemployment and hence very low incomes during the Yala season (off season). This is a major problem that needs to be resolved. Livestock is the only option available at present as an income source during the off season.

Invasive species: During the study, the spread of invasive plants such as Water hyacinth (*Eichhornia crassipes*) and Cat's tail (*Typha angustifolia*) in small irrigation tanks was observed. Spread of these species will enhance siltation and reduce tank capacity, and increase maintenance costs.

Soil salinization: A potential problem in the paddy lands in coastal regions is soil salinization due to coastal water intrusion. The Irrigation Department has observed salt water intrusion in the coastal areas. This can be aggravated due to development activities (infrastructure, industries and tourism etc.) and construction of structures disturbing drainage pathways.

### 3.7 Fisheries

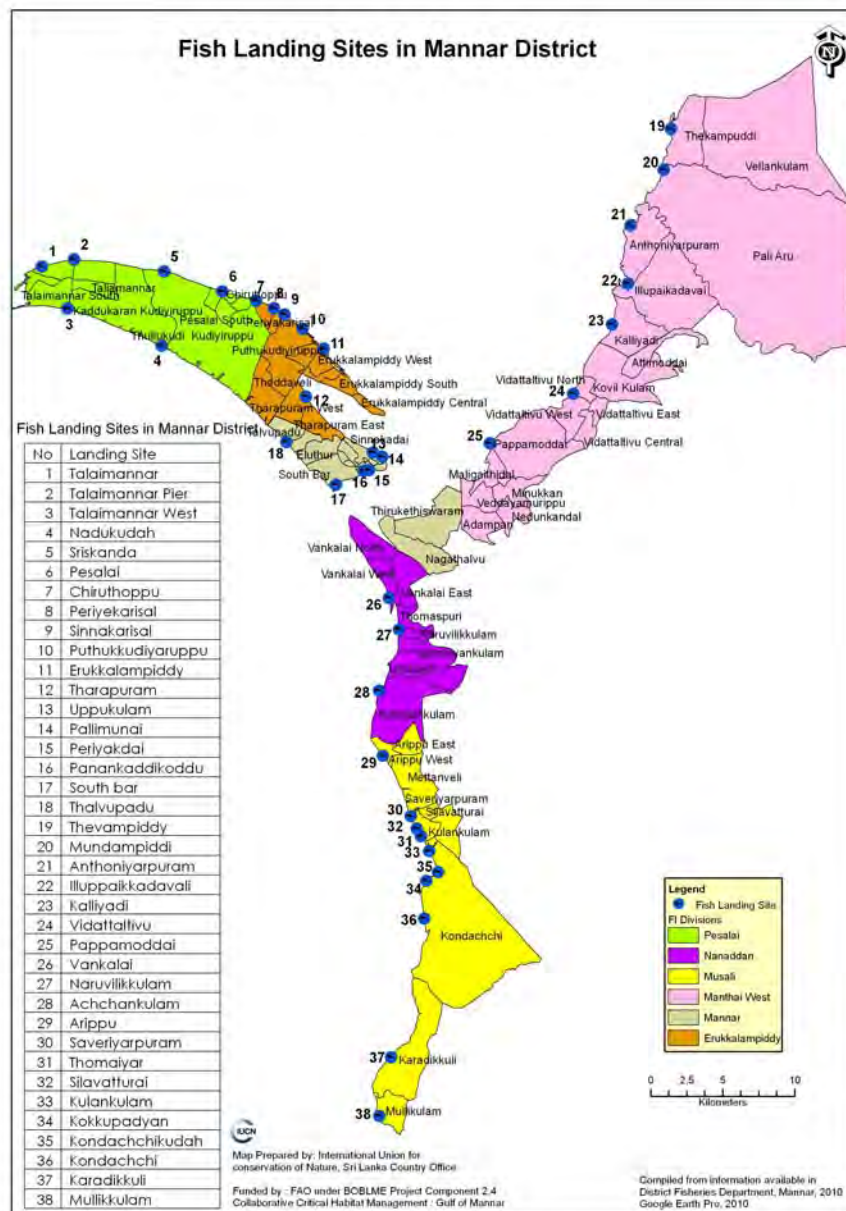
The Gulf of Mannar is an ecosystem with high biodiversity; hence it is rich in fishery resources. Fishing is a major contributor to the economy of Mannar District with 38% of its population involved in fishery. The marine fishing area in the district stretches southwards from Thavenpidy to Mullikulam, and westwards from Periyakadai to Talaimannar. Mannar is an important supplier of fresh and dried fish.

The three-decades-long civil disturbance in the country had a major impact on the fishery, as fisher families had been displaced for security reasons. The situation was compounded by restricted fishing hours, limitation of fishing grounds and restrictions on the capacity of outboard engines. With the dawn of peace in May 2009, life is rapidly moving towards normalcy and the fishery is picking up at a remarkable speed.

Mannar District is comprised of six Fisheries Inspector Divisions (FID) covering 38 fishing villages (Table 3.18). These 38 villages have 50 landing sites (Fig. 3.15).

**Table 3.18: Fisheries inspector divisions in Mannar District**

DS Division	FI Division	Fishing Village	No: of Fishing Villages
Mannar	Pesalai	Thalaimannar West, Thalaimannar Pier, Thalaimannar Station, Nadukkudah, Sriskanda; Pesalai	6
	Erukkalampiddy	Siruthoppu; Periyekarisal; Sinnakarisal; Puthukkudiyiruppu; Erukkalampiddy; Tharapuram	6
	Mannar	Pallimunai, Panankaddikooddu Thalvupadu, South Bar; Periyakadai, Uppukulam	6
Nanaddan	Nanaddan	Vankalai; Naruvilikkulam; Achankulam	3
Musali	Silavatturai	Arippu; Saveriyar Puram; Thomaiyar; Silavatturai; Kulankulam; Kokkupadayan; Kondachchi; Kondachikudah; Karadykuli; Mullikulam	10
Mantai West	Vidattaltivu	Pappamoodai; Vidatalative; Kalliady; Illuppaikadavai; Anthoniyar Puram; Monrampiddy; Thevenpidy	7
Total	6		38



**Fig. 3.15: Fish landing sites in Mannar District**

The latest information on fisher population, fisheries societies, fishing crafts and gear utilized, fish catch statistics, dry fish production, etc. were gathered for this study from District profiles, the Assistant Director, Department of Fisheries and Aquatic Resources (ADF), Mannar, and several Fisheries Inspectors. This was followed by visits to 14 landing sites (Fig. 3.15). A Fisheries Co-operative Society is responsible for all operational aspects at each landing site.

A brief questionnaire was prepared for information collection, and it was administered through one-to-one interviews with the President /Secretary or a member/s of the respective Fisheries Co-operative Society at the landing site. The landing sites/fishing villages surveyed and the societies whose members were interviewed are given in Table 3.19.

**Table 3.19: Fishing villages/Landing sites surveyed and the Fisheries Co-operative Societies (FCS) whose members were interviewed**

DS Division	FI Division	Landing Site/Fishing Village	Fisheries Co-operative Society	
Mannar	Pesalai	Thalaimannar Pier	Thalaimannar Pier FCS (Member)	
		Nadukkudah	Naval Officer (on behalf of Nadukkudah FCS)	
		Pesalai	Kattaspathiri Fishing Crew (Former Pesalai Fishing Society) (Member)	
	Erukkalampiddy	Erukkalampiddy	Fishermen's Samurthi Society	
	Mannar	Mannar	Pallimunai	St. Lucia FCS (President)
			Panankaddikooddu	Panankaddikooddu FCS (Member)
Periyakadai			Periyakadai Fishermen Co-operation Ltd. (Member)	
Nanaddan	Nanaddan	Vankalai	St. Anthony's FCS, Vankalaipadu (Secretary and a member)	
		Naruvilikkulam	St. Mary's FCS (Member)	
		Achankulam	St. Joseph FCS (Member)	
Musali	Silavatturai	Arippu	Arippu Maria FCS (Member)	
		Silavatturai	Silavatturai FCS (Secretary and a member)	
		Kondachikudah	Kondachikudah Sithyvinayakar FCS (Member)	
Mantai West	Vidattaltivu	Pappamoodai	St. Sinthathuraimatha FCS (President)	

Basic information on the marine fishery in the Mannar District is presented in Table 3.20

**Table 3.20: Basic data on the marine fishery in Mannar District (August 2010)**

Description	Number
Number of fishing villages	38
Number of fish landing sites	50
Fishing households	7,813
Fishing population	28,852
Active fishermen	7,547
Membership of FCSs	8,076
Total number of fishing crafts	2,223
Total catch (kg) in July, 2010	551,503

Source: Assistant Director of Fisheries, Mannar

Although much of the catch is from the sea, lagoon fishery is also practised to a certain extent. Allied activities linked to the fishery are dry fish production (currently on a medium scale) and marketing.

### **Fisher population**

As at August 2010, 28,852 people in the Mannar district, belonging to 7,813 families, are dependent on the marine fishery sector. Of these 7,547 are listed as active fishers. A large number of fishermen from the adjacent Puttalam District too are engaged in fishing in the GoM.

The number of fishing households and active fishers in Mannar District over the period 1972 to 2010 are given in Table 3.21. It reveals the large scale movements of people since 1996, in and out of the

district, in response to the war situation. The numbers in 2010, after the dawn of peace are the highest on record.

**Table 3.21: Number of fishing households and active fishers in Mannar District, 1972–2010**

	1972	1989	1996	1999	2004	2008	2010
Fishing households	2,093	5,127	6,000	4,175	7,300	5,810	7,813
Active fishers	2,848	5,684	5,900	4,593	5,400	5,960	7,547

Sources: Assistant Director of Fisheries, Mannar; Ministry of Fisheries & Aquatic Resources (MFAR)

**Table 3.22: Fishing population in Mannar District by FI Divisions, as at August 2010**

DS Division	FI Division	Fishing Families	Fishing Population	Active Fishermen	Membership of FCSs
Mannar	Pesalai	2,275	8,440	1,550	2,511
	Mannar	2,241	8,475	2,224	2,406
	Erukkalampiddy	806	2,824	925	927
Nanaddan	Nanaddan	1,027	3,768	1,090	683
Musali	Silavatturai *	583	2,421	862	476
Mantai West	Vidattaltivu	881	2,904	896	1,073
Total		7,813	28,852	7,547	8,076

\* Data of Karadykuli and Mullikulam fishing villages are not included as their fishing families have been displaced.  
Source: Assistant Director of Fisheries, Mannar

The breakdown of the fishing population in the Mannar District in August 2010, by FI Divisions, is given in Table 3.22. The number of active fishermen is highest in Mannar DSD; lowest in Musali and Mantai West DSDs. This may well be related to Mannar DSD being much less affected than Musali and Mantai West DSDs, which were badly affected by the civil unrest.

The number of active fishers in inland and aquaculture sectors in 2009 was 440 (Ministry of Fisheries and Aquatic Resources, 2009); data for 2010 is not available.

### **Fishing boats**

Several types of fishing boats are used in GoM. These include inboard engine multi day boats (IMUL), inboard engine 1day boats (1DAY), out-board engine fibre reinforced plastic boats (OFRP), motorized traditional boats (MTRB), non-motorized traditional boats (NTRB) and non-motorized beach seine boats (NBSB). There were 2,223 registered boats in the Mannar District as at August 2010 (Office of ADF, Mannar).

A census carried out by the Ministry of Fisheries and Aquatic Resources (MFAR) established there were 2,315 fishing boats in Mannar District in 2006 (Table 3.23). This represents a 27% increase over the number of boats available before the December 2004 Tsunami, no doubt an outcome of the Tsunami relief programmes. The number of boats in 2010 was 4% less than that in 2006, which may be ascribed to damage during the civil unrest.

**Table 3.23: Number of fishing boats available in the Mannar District before and after the 2004 Tsunami, and after the civil unrest**

Type of Boat	Number of Boats in Mannar District		
	Before December 2004 Tsunami	In 2006	In 2010 (post civil unrest)
IMUL	01	-	09
1DAY	63	51	85
OFRP	1,108	1,657	1575
MTRB (Vallam)	76	173	112
NTRB (Theppam)	570	428	442
NBSB	na	06	44
Total	1,818	2,315	2,223

Sources: Ministry of Fisheries and Aquatic Resources and Assistant Director of Fisheries, Mannar

A DSD-wise comparison of the number of boats available in 2006 and 2010 (Table 3.24) shows a decline in Nanaddan and Mantai West DSDs and an increase in Mannar and Musali DSDs. In 2010, OFRP boats are being used in all four DSDs; IMUL and 1DAY boats are used only in Mannar DSD. MTRB are confined to Mannar and Mantai West DSDs and NTRB are used in all except Nanaddan DSD.

Further analysis of the 2010 data revealed that all nine IMUL and 85 1DAY boats are operating from Pesalai FID while OFRPs are used in all FIDs in Mannar District.

The number of fishing crafts operated in inland waters in the Mannar District in 2006 was 40, which is 0.6% of the total number of crafts in the 25 Inland and aquaculture districts/sectors in Sri Lanka. Although the number for 2009 remained at 40, owing to the increase in number of crafts in the country, the percentage dropped to 0.5% (Ministry of Fisheries and Aquatic Resources, 2009).

**Table 3.24: Type and number of fishing boats in 2006 and 2010, by DSDs, in Mannar District**

DSD	IMUL		1DAY		OFRP		MTRB		NTRB	
	2006	2010	2006	2010	2006	2010	2006	2010	2006	2010
Mannar	0	9	51	85	947	1050	74	73	265	342
Nanaddan	0	0	0	0	321	223	0	0	2	0
Musali	0	0	0	0	210	229	0	1	22	90
Mantai West	0	0	0	0	136	59	99	38	130	10

Source: Mannar Statistics Book, 2010

### **Fishing season**

The main fishing season for fin-fish in Mannar District is generally from October to April.

### **Fishing gear and methods**

The landing site survey revealed that trawling is practised exclusively in Pesalai FID of Mannar DSD, while gill nets, drift nets, crab nets and bottom set nets are used in all four DSDs. Multi hooks targeting cuttlefish are used in Mannar DSD (Pallimunai and Vankalai), and beach seine fishery is mostly carried out in Mannar DSD (3 centres each at Vankalai, Thalaimannar Pier, Nadukudah, and 2 centres each at Pallimunai and Panankaddikoodu).

More than 200 stake nets (*Ja-kotu*) were observed in Mantai West DSD (Pappamoddai) while 100-200 are operated from the Mannar DSD (Erukkalampiddy, Pallimunai and Panankaddikoodu).



In addition to the above, brush piles targeting squids and cuttlefish are used in Silavatturai (Silavatturai FID), Periyakadai (Mannar FID) and Vankalai (Nanaddan FID). Sea cucumber, oysters and gastropods (eg. conch) are caught by skin diving/hand picking.

Encircling nets (Surukku nets and Laila nets), Moxi nets and push nets and other harmful fishing methods such as dynamiting and harpooning were banned island-wide long ago but has not been enforced in the Mannar District. However, with effect from 3 October, 2010 fisheries authorities are making a special effort to enforce these regulations in the Mannar District as well. Nevertheless, interviews revealed that dynamiting is taking place in Pesalai and Surukku nets are operated in Pappamoddi.

A wide variety of fishing gear is used in Mannar District; compatible gear and fishing craft combinations are:

IMUL (Trawlers)	-	Trawling nets
OFRP	-	18 ply gill nets with 1" and 2.25" eye sizes, hook and line with different types of hooks (eg: multi-hook for cuttlefish).
MTRB (Vallam)	-	4 ply (3 ½") drift nets, stake nets ( <i>ja-kotu</i> ), crab nets, bottom set nets
NTRB (Theppam)	-	4 ply (2 ¼ to 2 1/2") drift nets
NBSB	-	Beach seine nets

### **Composition of the fish catch**

The composition of the fish catch at the different landing sites surveyed did not vary much. Some notes on the composition of the fish catch are given below.

#### Marine sector

The total catch of fin-fish, crustaceans, echinoderms and chanks in Mannar district for 2008 and 2009 was 5,735 MT and 6,528 MT, respectively.

According to fin-fish catch data for July 2010, *Ilisha spp.* dominated the catch (64,400 kg) followed by *Hilsa kelee* (Kelee shad/seriya - 52,390 kg), carangids (51,195 kg), rock fish (38,690 kg) and rays (21,255 kg). Other fin-fish varieties totalled 155,840 kg.

Of the crustaceans and echinoderm varieties, 65,280 kg of sea crabs (*Portunus pelagicus*/blue swimming crab), 28,750 kg of squids and cuttlefish, 19,720 kg of prawns (*Penaeus spp.*) and 5,420 kg of sea cucumber had been harvested during July 2010 (*Assistant Director of Fisheries, Mannar, personal communication*).

The fish production for July in 2008, 2009 and 2010 are 397,932, 594,559 and 551,503 kg respectively showing a slight decline in July 2010.

Prices of fish are more or less the same at all landing sites surveyed. Seer fish is sold at Rs 400-500/kg, queen fish/kattava (*Scomberoides spp*) at Rs 500/kg, carangids at Rs 350/kg, sea cat-fish/anguluwa (*Arius spp*) at Rs 150/kg, *Mugil spp.* (godeya) at Rs 400/kg, pony fish/ karalla (*Leiognathus* and *Secutor spp*) at Rs 100-150/kg and *Sardinella spp.* at Rs 60/kg.

### Inland fishery

*Oreochromis* spp (Tilapia), *Ophiocephalus striatus/Channa striatus* (Striped snake-head/ Lulla), freshwater *Macrobrachium* spp. (prawns) and mud crabs dominate the inland catch. The inland and aquaculture production from 1998 to 2009 is given in Table 3.25.

**Table 3.25: Inland and aquaculture production, Mannar District**

Year	1998	2000	2005	2006	2007	2008	2009
Quantity (MT)	140	228	NA	NA	40	32	180

Source: Ministry of Fisheries and Aquatic Resources, 2009

### **Dry fish production**

Dry fish production takes place at *wadis* (drying centres) located close to landing sites. Landing site survey revealed sea catfish, rock fish, *Scomberoides commersonianus* (Tanlang queenfish/kattawa), rays, *Stongylura leiura* (banded needlefish/habareliya), *Secutor insidiator* (Pugnose ponyfish/karalla) as the dominant species. The highest price is fetched by Tanlang queenfish/kattawa (Rs 350–700/kg). Rock fish/godaya (*Liza* spp, *Mugil cephalus*) is sold at Rs 400/kg and banded needlefish/habareliya, sea catfish and Pugnose ponyfish/karalla are sold at Rs 300, Rs 150 and Rs 100 per kg respectively.

Of the landing sites/fishing villages surveyed, Mannar DSD has the highest number of dry fish centres; Pallimunai has 15 centres and Panankaddikoodu and Periyakadai fishing villages that share a common landing area have three centres; and Talaimannar Pier is reported to have 20 centres.

In Nanaddan DSD, Vankalai fishing village has 10 centres while Kondachikudah, and Arippe in Musali DSD has one and five centres respectively.

Total dry fish production in Mannar District in July 2010 was 59,245 kg, with the highest production from Nanaddan FID (20,250 kg), followed by FIDs of Pesalai (17,100 kg), Vidattaltivu (9,925 kg), Silavatturai (6,620 kg) and Mannar (5,350 kg). Carangids, *Sardinella* spp. and rock fish were the dominant varieties produced in July with 14,525 kg, 12,640 kg and 6,640 kg, respectively (*Assistant Director of Fisheries, Mannar, personal communication*).

In many of the places visited fish was being dried under unhygienic conditions with crows and dogs having free access to the drying areas.

Bulk of the salt requirement for dry fish is purchased from Mantai Salt Ltd in Mannar and the prices range from Rs. 800-900 per 50 kg. Dry fish centres in Pallimunai also purchase salt from Puttalam at Rs. 700 per 50 kg.

### **Ice plants**

There are three ice plants in Mannar districts. A block ice plant in Pesalai owned by Akila Transport turns out 300, 50 kg-blocks a day. The plant in Thavulpadu, in Thalaimannar, produces flake ice and is managed by two FCSs. The third ice plant, a 5 MT flake ice plant donated by Oxfam is under construction in Pallimunai.

The ice factory managed by the Ceylon Fisheries Corporation in Mannar is currently out of operation. During the glut period fish buyers bring their own supply of ice as the ice production in Mannar is insufficient to meet the increased demand. Ice produced in Mannar is sold at Rs. 190/= a block and flake ice at Rs. 5/kg.

## Salt production

Salt production was a major industry in Mannar, and it still is. Until 1989, the Mannar Saltern located in Mantai West produced between 3,500 and 4,000 MT of salt per year. Since then, its production has decreased dramatically to about 1,250 MT per year. Currently the Mantai Salt Ltd supplies salt to fishing communities for dry fish production, to the ice factory at Pesalai, and to Multi-Purpose Co-operative Societies and the private sector for consumption.

## Special fisheries in GoM

### Sea cucumber fishery

Sea cucumber fishery is a lucrative business in the Mannar district where the processed product is exported to Singapore, Thailand, China and Hong Kong. October to April is the season for collecting sea cucumber. Of the sixteen species of sea cucumber found in the northwestern region, *Holothuria scabra* and *H. spinifera* are restricted to the Mannar area (Dissanayake & Wijeyeratne, 2007). Among the species collected in Mannar, *Holothuria scabra* (sand cucumber/fish) is rated at three star level fetching the highest price followed by *Stichopus choronotus* (green fish) with a two star rating. *Holothuria spinifera* (brown fish), *Stichopus herrmanni* (curry fish) and *Holothuria atra* (lolly fish) are rated at one star level (*Personal communication with traders*).

Sea cucumber is landed at eight of the 14 landing sites surveyed: Pallimunai, Periyakadai, Panankaddikooddu and Erukkalampiddy in Mannar DSD; Vankalai and Naruvilikkulam in Nanaddan DSD; and Silavatturai and Arippe in Musali DSD.

Total sea cucumber production in July 2010 was 5,420 kg made up of 2300 kg from FIDs of Mannar DSD; 100 kg from Vankalai FID of Nanaddan DSD; and 3,020 kg from Silavatturai FID of Musali DSD (*Assistant Director of Fisheries, Mannar, personal communication*).

There are three processing centres for sea cucumber in Mannar owned by three dealers. About 40 people are employed at each centre. Once cleaned, boiled and dried beche-de-mer is once again graded and packed for export.

Beche-de-mer Grade 1 fetches Rs. 15,000 per kg while Grade 5 fetches Rs. 7,000 per kg. One kg of Grade 1 beche-de-mer contains about 15-20 pieces, and Grade 5 contains about 70-100 pieces.

### Crab fishery

Crabs fetch high prices. Sea crab (*Portunus pelagicus*/blue swimming crab) is caught using nylon nets while mud crabs are caught in traps. The catch is brought to collection centres where crabs are packed in rigid boxes with ice and sold to dealers. The Periyakada collection centre draws buyers mainly from Colombo and Kandy. The market is for export and for tourist hotels.

Grading and pricing of crabs are based on their weight, as follows:

Grade 1 -	> 1 kg	= Rs 1,800/kg
Grade 2 -	800 g – 1 kg	= Rs 1,200/kg
Grade 3 -	500 – 800 g	= Rs 800/kg
Grade 4 -	350 – 500 g	= Rs 600/kg

Grade 1 to 4 crabs should have both pincers intact. Crabs with one or both pincers missing are priced at Rs 150/kg.

### Gastropod fishery

*Conch shell collection:* Of the 14 sites surveyed fishermen in Vankalai in Nanaddan DSD and Silavatturai (in Musali DSD division, collect conch shells by skin diving. This is generally an unregulated activity with very little or no supervision on the size of specimens collected.

### Bivalve fishery

*Oyster fishery:* Of the sites surveyed, oyster fishery took place only at Arippuveddukulum in Arippu FID (Musali DSD). Here oysters (*Pinctata radiate*) are hand picked, piled up on the shore and burnt using firewood. Once the shells open up, the flesh is scooped out and sold at the rate of Rs. 150/= a *chundu* (equivalent of a cigarette tin).

Piles of oyster shells were polluting the shore and attracting dogs and crows. These shells could be used to produce lime for the construction industry or a calcium supplement for poultry.

### **Marketing**

Fish is purchased at the landing sites by local dealers and also by buyers from Colombo, Anuradhapura, Vavuniya, Dambulla, Matale, Kandy, etc. The cooler trucks used to transport fish are checked and sealed by the Sri Lanka Navy before they leave the landing site.

The only fish canning factory in the district, located at Pesalai, has closed down. This leaves the fishermen at the mercy of the buyers from the cities and prices plummet unreasonably during the glut period. Since storage facilities are inadequate, fish is either sold at very low prices as fresh fish or sold locally for drying. According to fisherman interviewed, there is no demand for frozen small fish.

### **Fish prices - some indicative data collected randomly during the survey**

The following information on the transactions related to small pelagic fish is indicative of the fish trading and income generation pattern in the coastal areas of Mannar district. The information was elicited from fishers, middle-men and fish buyers and vendors at several fish landing sites in Pesalai, Talaimannar Pier, Mannar town and Vankalai.

- *Sardinella* sp was sold by the fishers at Rs 40 per kg at the fish landing site during the glut period. Generally, one boat brings in about 1,000-1,500 kg of fish per trip.
- At the beach, the money lenders to the fishers (the first set of middlemen) purchase the fishers' entire catch for immediate re-sale, keeping a commission (profit) of Rs. 5 per kg. This translates into an income of about Rs. 5,000 from each boat. A money lender usually finances 10 to 15 boats and earns more Rs. 50,000 a day. The middlemen deal with a network with fish buyers/vendors from other parts of the country.
- The fish bought at the landing site for Rs 45 per kg is transported to the cities in the south and sold to wholesalers/retailers at Rs. 85 per kg. A 2500 kg load of fish is transported per trip generating an income of Rs. 100,000 per trip. After meeting the transport costs of about Rs 30,000-35,000 the middleman earns a profit of about Rs.70,000 per trip.
- The consumer usually pays Rs.100-120 per kg for this variety of fish.

This informal system has been practiced for a long time and all connected parties are accustomed to the process. In this system the risks are borne entirely by the fishers who are never certain of their catch, and consequently their income. If the catch is small there is a risk of buyers not coming to the landing sites

Uncertainty faced by fishers can be overcome somewhat by providing storage facilities, strengthening organizational structures such as Fisher Co-operative Societies to participate in marketing fish and by providing fish drying and other processing facilities. These steps will help to raise the income of fishermen.

With the existing fish marketing system the bulk of the profits go to various middlemen, not the fishers. The helpless fishers have no option but to continue being subservient to the middle men, who make the least investment.

### **Fisheries in GoM – some issues**

#### (i) Destructive fishing practices

The following destructive fishing practices which will impact on the fishery resources were observed during the study:

- Dynamiting – legally banned but still taking place between Pallimunai to Thavulpadu
- Monofilament nets (*Thangus*) – were being used in almost every landing site, but re-enforcement of the ban from 3 October 2010 is in place
- Brush piles and multi hook artificial bait for cuttlefish were being used in 2 of the 14 landing sites surveyed: Pallimunai and Vankalai
- Surukku nets – banned from 3 October 2010, but still being used in some areas (eg. Pappamoddai in Mantai West DSD)
- SCUBA diving to collect sea cucumber and conch – banned in GoM but fishermen from Kalpitiya still collect these from Silavatturai in Musali DSD.
- Trawling – This is presently limited to Pesalai in Mannar DSD

#### (ii) Uncontrolled exploitation

Collection of holothurians (sea cucumber), gastropods (conch) and bivalves (oysters) without permits or without conforming to the conditions of the permit, especially on recommended sizes.

#### (iii) Marketing

Currently, fish marketing is not well organised, and the middlemen make unjust profits at the expense of the fishermen. The Fisheries Cooperative Societies need to be strengthened to take on a more proactive role and facilitate fishers to market their catch.

The supply of ice for preserving fish is inadequate. Many buyers resort to bringing ice from their home towns. However, this position is expected to improve when the existing ice plants maximize their production.

#### (iv) Processing

Current processing facilities are inadequate. Fish drying is being carried out under unhygienic conditions. Here again, the Fisheries Cooperative Societies should arrange training on better fish processing techniques.

#### (v) Poaching by Indian fishermen

There is an ongoing feud between fishermen of Sri Lanka and India. There are allegations and counter-allegations, and the Government will have to step in to address this issue. Fishermen in Mannar claim that large fleets of Indian fishing boats are poaching in Sri Lankan waters and thereby reducing their catch.

(vi) By-catch

Currently, the by-catch is discarded in an indiscriminate manner, causing significant pollution of the beach and attracting dogs, cats and birds, which also visit the fish drying areas. Often, faecal matter can be found in fish drying areas. Proper disposal of by-catch, perhaps using it for preparing fish meal, is necessary.

### 3.8 Archaeological and Cultural Significance of the Gulf of Mannar

Sri Lanka's Gulf of Mannar coast is its closest territory to South India. Proximity to the Indian mainland, made this coastal area important for external and internal trade since the ancient Silk Road. Before that, during the Pleistocene period, three million to ten thousand years BP (before present), a land bridge is believed to have been in place several times and facilitated the migration of large mammals, and also prehistoric humans to the island. Fig. 3.16 is a map indicating the archaeologically and culturally important sites in the coastal DSDs of Mannar District (see also Annex 4). The archaeological findings can be divided in to five main categories fossils beds, prehistoric settlements, proto-historic settlements, pre-colonial monuments (3 BC to 16 AD), and colonial monuments (1600 AD to 1900 AD).

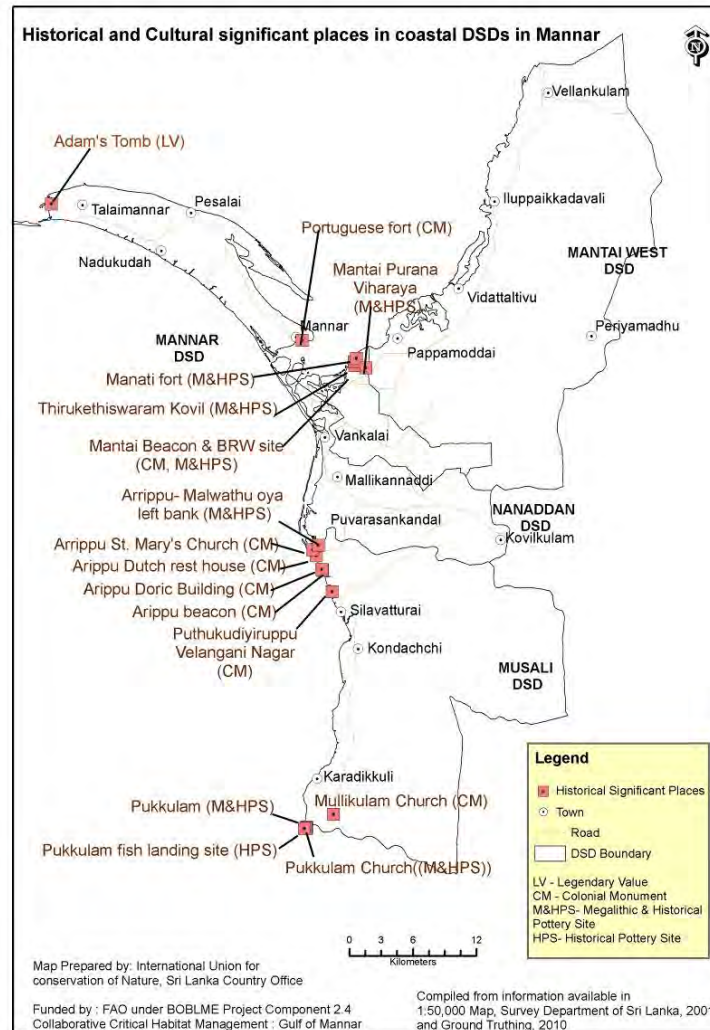


Fig. 3.16: Historical and cultural significant places in coastal DSDs in Mannar District



### ***Fossils beds***

The Miocene (28-8 million years ago) limestone underlying this region is rich with marine invertebrate and vertebrate fossils (Cooray, 1968). Largest Miocene fossil deposits in Vanathavillu DSD and Aruvakkalu have been commercially exploited since 1970s. However, the Miocene fauna in these deposits have been hardly studied. Excavated cement quarry sites along the Aruvakkalu mount provide good opportunities to observe fossilized invertebrates and vertebrates. The famous Anakallu fossil site is also situated bordering the lagoon but is presently eroded. Twenty-four vertebrate species which belong to cartilaginous fishes, bony fishes, marine reptiles, and marine mammals had been recorded from a single location at Anakallu beach at Aruvakkalu. Invertebrates such as annelids, gastropods, corals and echinoderms had been recorded from Anakallu and several Miocene deposits along the Gulf of Mannar coastal belt (Deraniyagala, 1955; Goonatilake, 2001).

Miocene invertebrate and vertebrate fossils are exposed along the coast of Uchchamunai, and Karativu Island. Most of these sites are exposed to the lagoon beach and are continually eroding. Palugahaturai and Kudiramalai also have fossils of the Miocene period. As these sites are in the Wilpattu National Park, it will be well preserved for future studies.

Kal Aru river bed near the old Mannar-Puttalam road causeway has exposed a Miocene bed which can be easily recognized. The fossilized corals will provide more information about this site.

In 1958, Deraniyagala recorded a submerged forest from Puttalam Lagoon, which has been dated to the Pleistocene period.

### ***Prehistoric settlements***

Pleistocene deposits mainly consist of eroded red soil mixed gravel overlaid with Miocene limestone (Cooray, 2003). The gravel deposits, locally known as “Vembu”, have a unique vegetation structure. This type of habitat can be seen in Aruvakkalu, Pomparippu, Wilpattu, Kudiramalai, Mullikulam, and Arippu areas. The gravel beds contain Quartz and Chertstone implements which belong to Palaeolithic and Mesolithic cultures (Deraniyagala, 1972, Goonatilake, 2006). It is believed that these implements have been used by the first humans who migrated over the land bridge (Adam’s Bridge) during the Pleistocene period.

Shell middens mixed with Microlithic Quartz tools have also been observed in the Anakallu area of Puttalam Lagoon. Carbon dating has shown these deposits to be older than 3058-2854 years BP (Deraniyagala, 1990). Shell middens and quartz tools were also observed along the coastal belt of Silavaturai, and Arippu during the survey but more excavations are required to determine their period. Several shell deposits were also observed within the Mannar Island and further studies are needed to understand their origin.

### ***Proto-historic settlements***

Evidence of Megalithic Iron Age culture (proto historic human activities) is also found near the Gangevadiya, bank of Pomparippu Ara, Pomparippuva, Palugahaturai, Mantai and Pukkulam areas (Carswell & Prickett, 1984; Goonatilake, 2006). Black and red ware pottery fragments, iron slags and urn burials have been discovered in the above sites. Comparative analysis of human teeth from Pomparippu burials and present and past human populations in South Asia, clearly indicate that the Pomparippu settlers possessed dental traits more akin to Sinhalese and the Austro-Asiatic people of Eastern and Northeastern India than to Tamils, Veddahs or the more primitive prehistoric Mesolithic man (Balangoda Man) in Sri Lanka (Hawkey, 2002). The Pomparippu dwellers (who probably lived around 500-1000 BC) followed the Iron Age burial custom of burying their dead in large clay vessels (Begley, 1981).

During the survey, fragments of Black and Red Ware (BRW) pottery were found on the left bank of Malwathu Oya near Arrippu; presumably washed down from the upstream area.

### **Pre-colonial monuments (3 BC to 16 AD)**

Pearls from the coast of Thalaimannar, Arrippu, and Silavaturai coral reefs, chanks, and war elephants from the adjacent inland forests were exported through the main Matota port (present Mantai) during the early Anuradhapura Kingdom to Polonnaruwa Kingdom. Mantai port was used by sea-borne forces of the South Indian and European invaders (Nicholas, 1963).

Ancient Matota port and fort are mentioned in the earliest Sinhala chronicles and inscriptions, *Mahavoḻi*, *Mahapuḻu*, *Mahavuḻu*, *Mahatutoḻa*, *Mahapaḻana* and *Mātoḻa*; *Mātōḻḻam* in Tamil, and *Moduttu* in Ptolemy's map. Mathota is now a truly buried city, its ruins lying in a great mound near present *Mantai* from which rises the present Hindu temple of *Tirukēśvaram* (Nicholas, 1963). During the present survey, ruined moats around the mound were observed but most of the area is covered by scrub vegetation. Archaeological excavations at the Māntai Fort have been made by archaeologists since late 1880s. The first excavation was done by Mr. WJS Boake in 1887, followed by AM Horcart (1925-28), RH de Silva (1940), Shanmugam (1950), Sidney H Caplan (1957), KB Codrington (1965), and John Carswell and Martha Prickett (1980). In 1950 and 1951, S Sanmuganathan's detailed excavations revealed a 4 m wide road passing through the east gate to a Buddhist shrine of a later period (Weerasinghe, 1989). These excavations revealed a 4 m x 4 m *Asanagaraya* with a 2 m high Standing Buddha statue belonging to 4<sup>th</sup> century AD. An Awalokitheshwara Bodhisathwa statue mentioned in inscriptions, was also found in the site and a Stupa was situated at Mantai. Later, this Buddha statue had been brought to Anuradhapura Museum (Mathew, 1981, Kulasinghe, 2005, Weerasinghe, 1989, Sansoni 1977, Sirisoma, 1980). Later excavations during the 1980s revealed the prehistoric Mesolithic tools, Megalithic artifacts (BRW with iron slags) and evidence of trading during the historical period of gems, pearls, porcelain ware, various types of potteries, coins including Roman and Chinese coins, and grains such as barley, millet, gram, and pepper (Carswell & Prickett, 1984; Kajale, 1990; Kulasinghe, 2005). Several inscriptions from the Anuradapura period were discovered from Mantai sites which revealed the trade and cultural aspects of Mantai in ancient times. An inscription which belongs to the period of Kassapa IV (898-914 AD) discovered from Mantai, states *that officers in charge of Mahaputu and those who reside at the following Vihara shall not enter Nā-vehera* (literary references to *Nāga* or *Nāgamahā Vihara*) and *Rakavehera*, which were situated at Mantai (Paranavitana, 1933, Ranawella, 2001). According to the Mahāvamsa, King Moggallana II (614-619) built the chetiya (pagoda) in the *Rakkha vihāra* and King Vijayabāhu I (1055-1110) restored the *Rakkhacetiypabbata Vihāra* (Geiger 1960). This Pillar inscription, once kept in the Mannar Kachcheri (GA office), was recently brought to the Archaeological Department Museum at Vavuniya.

Some archaeological monuments (part of a Buddha statue, Bodisathva statue, a fragment of Pillar inscriptions, and a number of stone pillars), presently at *Matota Rajamaha Viharaya* (temple built by a king), had been found when constructing the road to the Tirukēśvaram Kovil. This road connects the Kovil and Pooneryn road and it passes by the Mantai *Viharaya* (temple). The Buddha statue has been dated to 4 AD and the Bodhisathva statue is believed to be 8 AD, and the 12<sup>th</sup> century inscription mentions a grant made to the temple. The stupa mound of these monuments can be seen near the Calvary grotto which was built near the Pooneryn road. This stupa mound was unearthed by treasure hunters and its bricks have been used to construct recent structures at the site (Jinapriya, 2010).

The Hindu temple at Mantai mentioned in the early chronicles as well as in inscriptions found outside the Mannar District, is believed to have been destroyed by the Portuguese in 1540 (Kulasinghe, 2005). The existing Tirukēśvaram Kovil was built in 1903 by Arumuka Navalar in the Ancient Mantai Fort where the ancient Buddhist vihara was located; the original location of the ancient Hindu temple is unknown (Duraisawamy, 2003; Sansoni, 1977).

King Dhatusena (455-473 AD) built the Pasanagama Tank near Mantai, and later King Parakramabahu I renovated it (Geiger, 1960). This tank is now identified as the Panankamam Tank in West Mantai by Nicholas in 1963.

Kalpitiya was earlier known as *Antharpara Samudda* (land between oceans) where the *Antharparasamudda Vihara* is located (Dammakusala, 2005). The ruined site in Thaliadiwellankaran village at Kurunnapitiya is believed to be the ancient *Antharparasamudda Viharaya* (Bandara, 2005; Silva, 2002). Ptolemy's map also correctly locates this site as *Amisimandu*, which is a Greek version of *Antharparasamudda*. During the late Anuradhapura period Kalpitiya was called *Kalpitikuli* (Nicholas, 1963).

The river mouth of Modaragan Ara is known as "Magana Nakara" in chronicles as well as in inscriptions (Codrington, 1920). This is also marked in Ptolemy's map as "Margan". During the survey, a large quantity of pottery fragments, iron slags, and pillars were observed around the Pukkulam area on the left bank of Modaragan Ara. These are assumed to be the remains of ancient townships.

According to ancient chronicles, *Villi Vihara* was built by King Suba (68 AD) near Uruvela (Geiger, 1960). A site called "*Veli Vehera*" near the Pomparippu urn burial site has been identified as the ancient *Villi Viharaya* by using inscriptions discovered from this site (Paranavithana, 1956). This inscription has helped to identify the present Pomparippu area as ancient Uruvela, which had been founded by a minister of the King Vijaya (500 BC). Uruvela also functioned as a port for pearl fishery. During the construction work of Ruwanweli stupa, pearls were supplied from this port town (Geiger, 1960). The coastal bay of Kollankanaththa near Pomparippu is believed to be the ancient Uruwela port. The native African baobab trees (*Adansonia digitata*) found near Pomparippu Ara left bank are believed to have been brought by Arabian sailors who arrived in Uruvela port (Goonatilake, 2007).

Malvila is a place name found in the 17<sup>th</sup> century chronicle called "Nampotha". *Malvila Rajamaha Viharaya* had been renovated by King Kirthi Sri Rajasinghe during his reign of the Kandyan Kingdom. The ruins at Malvila in the Vanathavillu DSD have been identified as a *Rajamaha Viharaya* (Nicholas, 1963; Bandara, 2005).

Very few archaeologically significant places have been recorded along the Nanaddan DSD coastal belt but deeper inland there is the ancient Giant's Tank (earlier known as Manawatta Tank), built by King Dhatusena (455-474 AD) and later renovated by King Parakramabahu I (Geiger, 1960; Nicholas, 1963). Giant's Tank stores rain water as well as water from Malwathu Oya diverted at the anicut built at Alawakka (Kulasinghe, 2005; Nicholas, 1963). In the delta of the Malwathu Oya, west of Giant's Tank, is a series of ancient minor irrigation systems that date back to pre-Vijayan periods when Mantota, the mainland of Mannar, was a well-known emporium. It would appear that the mouth of Malwathu Oya was not where it is found today (Fernando, 1979).

Ruins of Megalithic and historic settlement sites along the coast of Pesalai and Thalaimannar have been recorded by Weerasinghe (1989). According to the Mahavamsa, King Parakramabahu I (1164-1197 AD) built a Fortress in Pesalai (Geiger, 1960). However this site could not be traced during the IUCN survey. Thalaimannar is Thalakori in Ptolemy's maps. According to the chronicles *Thalaguru Viharaya* is situated somewhere in the Mannar Island (Geiger, 1960). There are around 40 baobab trees in the Mannar DSD.

### **Colonial monuments (1600 AD to 1900 AD)**

Cultural facets of the Gulf of Mannar changed as the rulers changed: Portuguese, Dutch and British administrations. Christianity spread throughout the communities and transformed Buddhist and Hindu traditional cultural and religious life styles. A number of churches had been built during this colonial

period and are seen to this day but with modifications that have changed their original historical appearance.

During the Portuguese period the people of Kalpitya had been converted to Christianity. The Dutch rulers built a fort in the Dutch Bay in 1606 due to its significance for trade and defence. A Dutch church with a graveyard is also present in the Kalpitiya Peninsula (Chetty, 1834). The Portuguese forts at Mannar and Kalpitiya are relatively well preserved forts in the region. However immediate action is needed to maintain these and prevent future deterioration. The ancient Portuguese Fort at Arippu is totally destroyed; only the foundation of the two bastions can be traced near the so-called Dutch rest house.

The Doric building, known as such due to its Doric columns, had been built for the first British Governor, Frederick North in 1805 as his residence at Arrippu, to oversee tax collection from the pearl fishery. Afterwards, this building had been abandoned (Wisumperuma, 2005). Ruins of this building are erroneously identified as Alliranai Kottai by some local people and even in the Archaeological Department publications (Kulasinghe, 2005). Presently, the remnants are very much eroded due to wind and sea wave action.

During the colonial periods, several beacons and churches had been constructed along the coastal belt. The churches at Mullikulum and Arippu have lost their historical visual identity due to recent renovations. A beacon of the colonial period is situated to the east of Thirukitheswaram Kovil. Similar beacons can be seen in Kudiramalai and Aruvakkalu hills.

### **Legends**

There are a number of legends connected with Adam's Bridge and adjacent landmarks. Rama and Ravana, Vijaya-Kuveni, the Mukkuwas, and Allirani are some of the legends.

Kudiramalai (Horse Mountain) near Thambapanni beach is known as the place where Prince Vijaya landed. The reddish sandy beach in the vicinity is the main supportive evidence for the Thambapanni legend (Saparamadu, 2006). Ptolemy located this place as *Hiporous*, meaning Horse Mountain. The foundation of the Horse statue can still be seen at Kudiramalai Point. A sub-cylindrical long tomb which belongs to the legendary Mukkawas is also found near the beach at the Kudiramalai Point (Brohier, 1929; Chetty, 1834; Goonatilake, 2006; Ranasinghe, 1998).

Arippu is also connected with Vijaya-Kuveni and Allirani legends. Arippu and Modaragan Ara coastal belt have been identified by several scholars as the landing site of Prince Vijaya in 500 BC.

Adam's Bridge is connected with the Ramayanaya, and according to legend the bridge was built by Lord Hanuman to facilitate the march of King Rama's army to Lankapura. According to another legend, two domes near Urumalai beach where the land bridge connects with Mannar Island were believed to be the Dome of Adam. These domes are similar to the Mukkaru *Sohon* (=headstone in a cemetery) or Mukkara dome at Kudiramalai Point. Adam's dome is now a religious place for Muslims of the country.

### **Issues**

(i) Preservation of important sites:

Action is needed for the preservation of archaeologically and culturally significant sites in the Mannar district.

(ii) Awareness on archaeologically and culturally significant sites

Even the people in Mannar are not well informed about the archaeologically and culturally significant sites in Mannar. Outreach materials on these sites are lacking. Action is needed to produce outreach materials depicting the important archaeologically and culturally significant sites in Mannar.

### **3.9 Some Development and Environmental Issues**

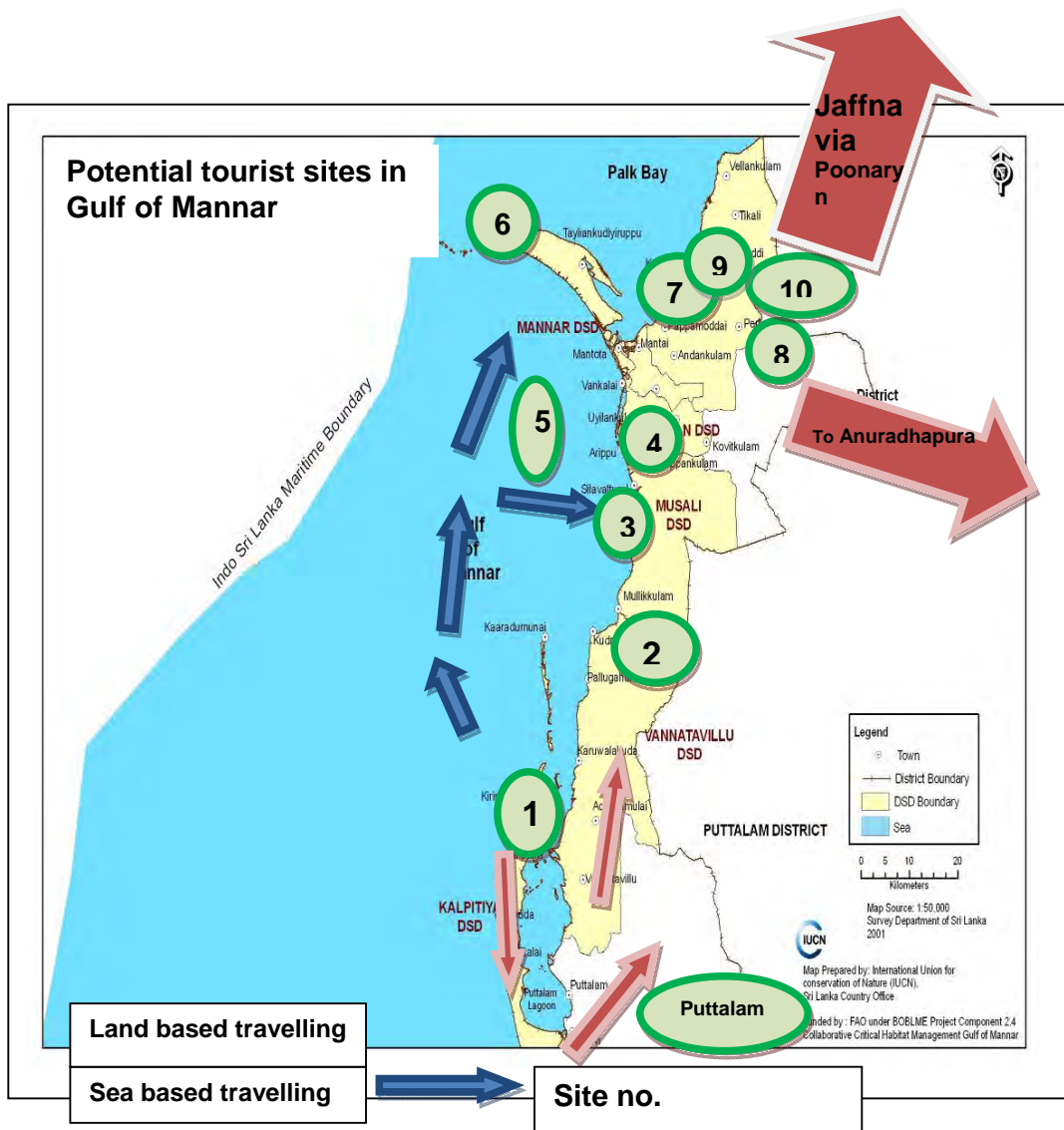
The Mannar area is fast developing. Rapid expansion of cities and settlements, physical modification of lands and coastal landscapes are taking place. Fresh water requirements for the population is an issue and needs attention. Every effort should be made to ensure that environmental safeguards are built into these development efforts.

#### **Tourism**

Mannar area has the potential for introducing “eco-cultural tourism”. An attractive option is to transport tourists by sea as against the traditional road transport, which is time consuming.

Sand bars, river deltas, lagoons and estuaries with mudflats, coastal wetlands with extensive mangrove patches and finally salt marshes are a few of the natural resources with tourism potential. Possible recreational activities include diving, whale watching and bird watching. The coral reefs in the Kalpitiya bar reef and off the coasts of Silavaturai, Arippu and Vankalai would be attractive sites for underwater exploration. Game fishing and water sports can be introduced.

The Vankalai bird sanctuary is a potential site for bird watchers. As for religious and archaeological attractions, there are a number of places including the Madhu Church, which currently draws a large number of local visitors. Fig. 3.17 depicts about 10 potential touristic sites in the area.



1. Kalpitiya Bar reef and coastal habitat
2. Willpattu National Park and other terrestrial and coastal habitats
3. Silavaturai, Arippu, Coastal wetlands and archaeological sites
4. Vankalai Bird Sanctuary and beach
5. Silavaturai, Arippu and Vankalai coral reefs, undiscovered live corals
6. Talaimannar Pier, Adam Bridge, several archeologically sites and Pesalai fishery harbour
7. Mannar Port and Mantai port
8. Madhu Church, religious sites
9. Vidattaltivu lagoon and extensive coastal habitat with mangroves
10. Mantai forest reserves and coastal wetlands with extensive mudflats with birds watching.

Fig. 3.17: Potential tourist sites in Gulf of Mannar



## Rapid expansion of cities and settlements

The study identified the following 15 main population clusters in the Puttalam and Mannar Districts:

Puttalam District	Mannar District
1. Kalpitiya Islands (Kalpitiya DSD)	1. Talaimannar (Mannar DSD)
2. Kalpitiya Town (Kalpitiya DSD)	2. Pesalai (Mannar DSD)
3. Puttalam Town (Puttalam DSD)	3. Erukkilampiddy Mannar (Mannar DSD)
4. Karathive (Vanathavillu DSD)	4. Mantota (Mannar Town) (Mantai West DSD)
5. Eluwankulama (Vanathavillu DSD)	5. Vidattativu (Mantai West DSD)
	6. Vankalai (Nanaddan DSD)
	7. Nanaddan Town (Nanaddan DSD)
	8. Arrippu (Musali DSD)
	9. Silavaturai (Musali DSD)
	10. Mullikkulam (Musali DSD)

Cities in the Mannar District are growing faster than those in Puttalam and the fishing, agriculture, commerce, health and education sectors need attention. Manthota and Vidattativu of Mantai West DSD are expanding rapidly. Manthota is a population centre recognized as a port with a historical and archaeological background. Vankalai and Nannaddan are the key clusters in the Nanaddan DSD. Vankalai is a major fishing centre in the area. Arrippu, Silavaturai and Mullikkulam urban centres, in Musali DSD, are growing with the support of the local community and on account of the national resettlement programmes. Silavaturai and Arrippu have potential for tourism development.

In the current context of sustainable use of GoM resources the ongoing resettlement programme is an important issue (see Fig. 3.18). A matter of concern is that some settlements border environmentally sensitive areas. Settlements entail forest clearance. Whilst it is acknowledged that some clearances are needed, there is an urgent need to consider environmental impacts.

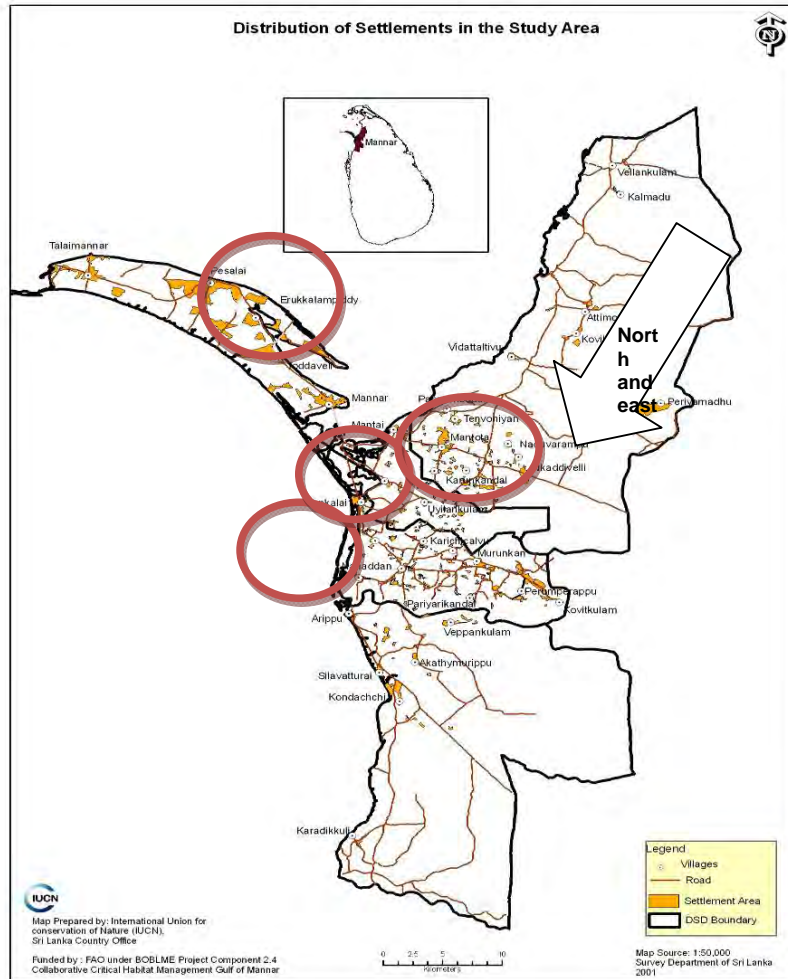


Fig. 3.18: Distribution of settlements in Mannar District

### Solid waste management

Pollution of the coastal areas of the GoM due to the mismanagement of solid waste is a growing issue. There are six local authorities - five *Pradeshhiya Sabhas* (PS) and one Urban Council. Much of the areas under their purview are in transition from a rural agrarian self-sustaining way of life into a more urbanised consumer-oriented lifestyle.

Increasing amounts of solid waste that affect both land and water bodies are being generated. Early action is required to institute an effective system to manage this waste. If not, maintaining the integrity of the coastal and marine ecosystems will become a challenge as a significant amount of solid waste end up in the coastal stretch and eventually in the GoM. This will impact adversely on the quality of water, productivity of the lagoon, etc.

### Solid waste generation in study area

Waste generation in the study area has not received much attention. Available data indicate that waste generation is increasing, and is currently estimated at about 17 MT per day, in the study area. At the current level of development this is likely to be doubled by 2015.

There are no proper waste collection and management strategies. About 50% of the waste generated in the area is not collected regularly. The study revealed that the composition of waste varied and included fish offal and parts, non-degradable plastics, polythene, building materials, and a variety of packaging materials.

### **Waste collection**

The study revealed that the local authorities in GoM do not have the required resources, technical capabilities, technology and equipment to address this growing issue of waste management. Fish waste is a significant contributor to coastal water pollution but the authorities have not taken any steps to encourage and support its conversion to fish meal.

Waste collection in most Pradeshiya Sabhas is restricted to the main roads, key institutions, such as main government buildings, markets and religious places, and public places. None of the local authorities collect 100% of the waste; indeed, field observations revealed about 30% collection against the authorities claim of more than 50%. Only the Kalpitiya local authority has a permanent site for dumping waste; however none of the authorities use sanitary waste disposal methods.

Information on waste collection and related aspects in the local authorities in Mannar and Puttalam Districts is given in Table 3.26.

The composition of waste collected by four PSs in Mannar District is shown in Fig. 3.19 - there is a high percentage of non-degradable waste.

Fig. 3.20 shows the main sources from which solid waste is generated in the four PSs. While the relative outputs vary from PS to PS generally, residential waste is the predominant source. Fisheries waste is also considerable and the potential for fish meal production needs to be examined.

The collected waste is being dumped in a haphazard manner in unacceptable places (Fig. 3.21). A considerable amount of waste is being dumped in the coastal waters and beaches, which is of concern for the health and productivity of the GoM.

Table 3.26: Solid waste generation in Mannar and Puttalam Local Authorities (data for 2005)

No.	Local Authority	Extent km <sup>2</sup>	Population	Waste Generation per day MT	Waste Collected per day by the Local Authority as % Generation	Waste collection points					Waste processing or separation		
						Mainroad	Sub Road	Institution	Houses	Market	Yes	No	Yes, %
<u>Mannar</u>													
1	TM Urban Council	29278	45253	2	50-75	D	W			D		x	
2	TM Pradheshiya Sabha			1.5	25-50	D	W			D		x	
3	Mantai West PS	474	19583	1								x	
4	Nanaddan PS	129.25	19020	1.5	25-50	D	D					x	
5	Musali PS	474.20	19583	1.	25-50	D	D					x	
	Sub total			5									
<u>Puttalam</u>													
5	Kalpitiya	65	90143	5	50-75							x	
6	Vanathavillu	710	15200	5								x	
	Sub total			15									

D=Daily, W=Weekly, O=Other, MT – Metric Tons  
Source: Provincial waste generation statistics of 2005.

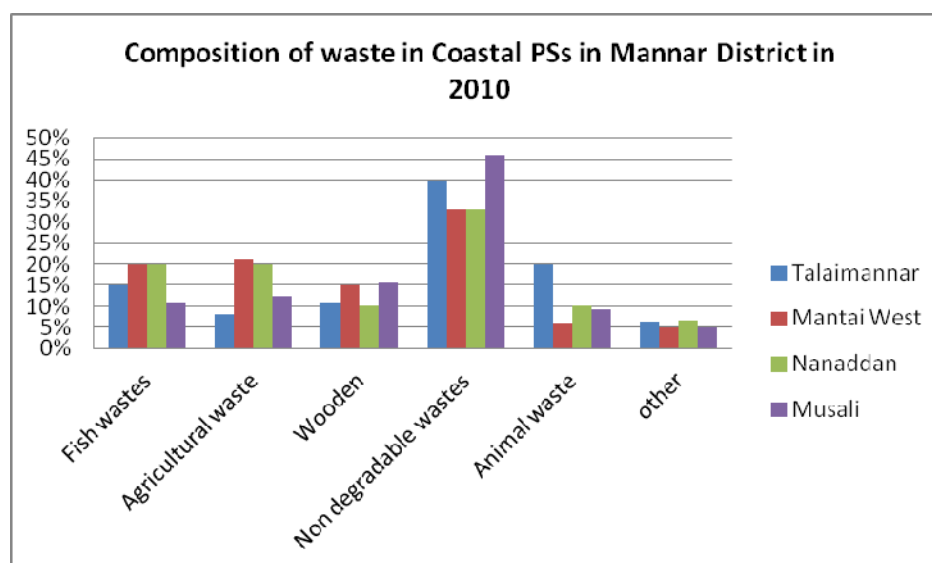


Fig. 3.19: Composition of solid waste in four coastal Pradheshiya Sabhas in Mannar District in 2010

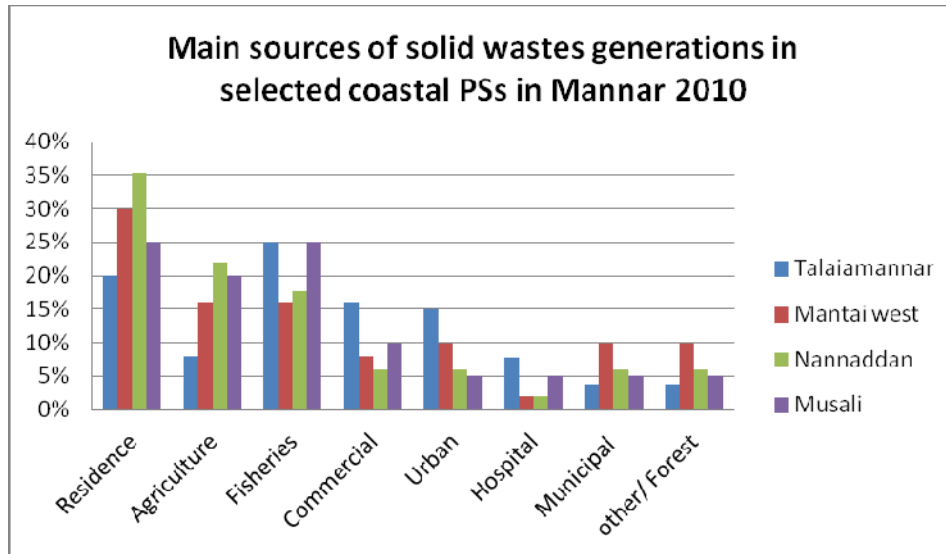


Fig. 3.20: Sources of waste generation in four coastal *Pradheshiya Sabhas* in Mannar District in 2010

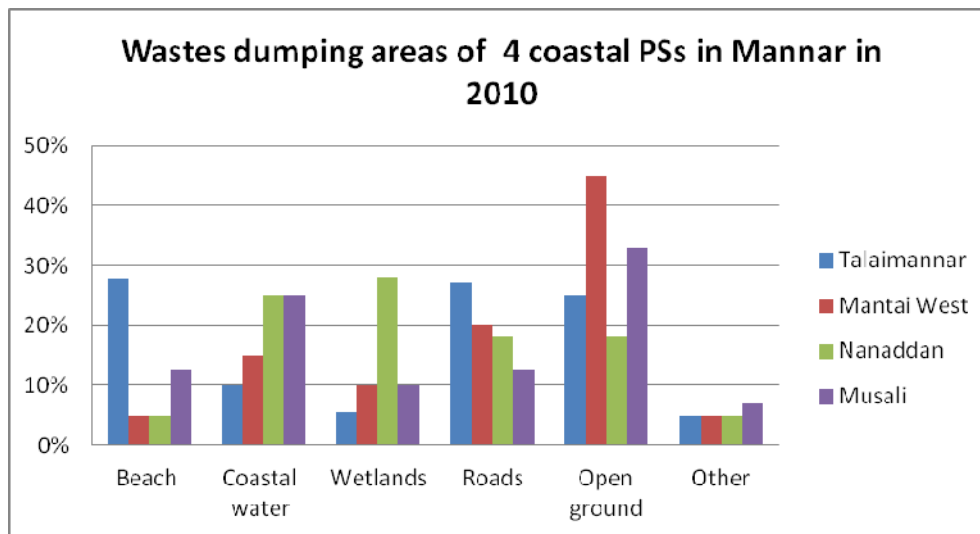


Fig. 3.21: Waste dumping areas in four coastal *Pradheshiya Sabhas* in Mannar District in 2010

### Issues

- (i) Waste generation: Awareness campaigns, with appropriate outreach materials, are required to educate the population in Mannar on reducing waste generation, options for recycling etc.
- (ii) Waste Management: The population is increasing rapidly due to resettlements. Hence, provincial and local level authorities should develop, as a matter of priority, strategies for waste management. The strategy should include options for waste sorting at the source, collection methods, recycling, conversion, etc.

### Alteration of the natural habitat

The development of physical infrastructure such as roads, bridges, culverts, sanitary facilities, buildings, electricity and water supply, and irrigation canals will have an effect on the environment. It is necessary to consider the long term consequences of these interventions for the natural systems. An example is the Mannar causeway under construction. Unless perfectly planned and executed, its construction can alter the natural water movement regimes and thereby change the ecosystem completely. Restriction of water movement from the south towards north will have significant effects.

Another example is the Mannar-Pooneryn road, which runs through a coastal wetland. Without adequate precautions, the natural exchange of water can be affected leading to salinity changes and habitat alteration.

### Issues

#### Development pressures and land use changes:

With the cessation of the war the government seeks to improve infrastructure such as buildings, roads etc., as a matter of urgency. This together with other pressures such as resettlement of communities, limited livelihood opportunities, and seasonal unemployment among farmer communities is likely to increase the demand for land. Potential land use changes and their consequences could be as follows:

- Development of town centres and infrastructure in the coastal region. At present, Mannar town is the only commercial centre especially for the fishery industry
- Tourism development will require more infrastructure in the coastal regions. Silavaturai, presently a fish landing site, is already under consideration for development
- The area has a good potential for aquaculture and salt farms. The likely conversion of land for these industries in the coastal areas can have a direct impact on the coastal ecosystems.
- Improper setting of industries and infrastructure can damage the existing ecosystem and their functions.
- With the resettlements, conflicts and disputes could arise over land and water use in agriculture.



## CHAPTER 4 - DISSEMINATION

The study findings on terrestrial and marine biodiversity, socio-economic status of the communities, and the archaeological sites in the coastal areas of Northwest Sri Lanka, bordering the GoM, were described in the preceding chapters. Dissemination of this information is an important objective of this study. Dissemination is aimed at creating awareness amongst stakeholders, at the local and national levels, on the value of these resources and on approaches for their sustainable use. Enlightened stakeholders is key to sustainable use of natural resources. The findings were disseminated in a number of ways, as set out below.

### 4.1 Training Module for Teachers

The most important project output is the 72-page Teachers' Guide, *Gulf of Mannar and its Environs: A Training Module for Teachers in the Mannar District*, prepared in the Tamil language using information collected from the current and previous studies. Special attention was given to make this document user-friendly.

The draft Module was tested at a workshop, in Mannar, with selected teachers and officials of the Provincial Education Department, on 17 December 2010. Thirty two teachers were trained and provided with electronic copies of the training module and other training materials. These teachers will conduct awareness building programmes for school children in their respective schools. The Teachers' Guide is at Annex 5.

Several staff members of the Education Department were trained to use the module and as resource persons to train more teachers.

IUCN Sri Lanka has received many messages of appreciation for the module. Teachers and other staff of the Education Department say this module will be of immense value in creating awareness of the riches of GoM amongst school children, who will, in turn, carry the message to elders.

A special request was made by the Education Department to train selected Advanced Level students from selected schools to use the Module. It was felt that these students will be very useful resource persons to expand the awareness programmes. However, due to budgetary and time constraints this request could not be met.

### 4.2 Outreach Materials

In developing outreach materials the needs of the target audience and the most effective means of conveying the critical messages were important considerations. Described below are the multimedia presentations, posters and the documentary film produced as outreach materials.

#### *Three multimedia presentations based on the findings of the rapid biodiversity and socio-economic surveys*

- (i) *The Gulf of Mannar and its Environs: richness, issues and sustainable use*

This presentation gives an overall account of the region. The first part provides an introduction to the Gulf of Mannar (GoM): its hydrology, including rivers and other water bodies, population, ethnic composition and livelihoods. The second part presents the findings of the surveys categorized under biodiversity, protected areas, terrestrial habitats, inland wetland habitats, coastal and marine habitats (sand dunes, coral reefs, sea grass

beds, reef fish and other reef dwelling fauna), history and legends, and archaeology.

(ii) *Issues Related to use of GoM Resources*

Issues related to fisheries, agriculture, pollution, invasive alien species, global warming and climate change are dealt with in this presentation.

(iii) *Options for sustainable use of GoM resources*

A presentation to create/enhance awareness on available resources in the GoM, their value and sustainable use; introduction to proper waste management mechanisms; promotion of alternative income generation activities for fisher families, particularly for those engaged in destructive/illegal fishing practices

### **Posters**

Three posters targeting the fisher community on the theme “Save your rich fish resources” and on “Coral reefs of Mannar” were produced in Tamil and were distributed at the workshops held in December 2010. About 400 copies of each poster were handed over to the Assistant Director’s Office of the Fisheries Department, Mannar. These posters are at Annex 6.

### **Documentary**

A 15-minute documentary titled “*Gulf of Mannar and its environs*”, covering the biodiversity, archaeology, fishing issues and threats to the natural resources of Gulf of Mannar was produced in Tamil, with English sub-titles. This was screened at the workshops, and was made available to educational and other authorities for screening at appropriate events.

## **4.3 Awareness Programmes**

IUCN organized a series of awareness programmes in Mannar, as follows:

- (a) A half-day awareness creation workshop for 33 high-level government officials in the Mannar District was held on 11 November, 2010, with the Government Agent in the Chair. The main agencies present were Coast Conservation, Fisheries, Education, Archaeology, and Agriculture Departments, and the Navy.
- (b) A half-day awareness creation workshop for 26 senior officials of the Provincial Education Department, including its district administrators was held on 17 December, 2010.
- (c) A half a day awareness workshop for 32 Advanced Level and Ordinary Level class teachers from the Mannar District was held on 17 December, 2010. The teachers included those teaching science, geography, history and social sciences.
- (d) A one-day awareness programme for 24 members of the Fisheries Cooperative Societies was conducted in Tamil on 18 December, 2010. Eight officials from six Fisheries Inspector Divisions also attended this workshop.

## **4.4 Spatial Maps**

GIS base maps of the study area have been prepared using survey department maps, updated with Google Pro images, and ground-truthing. Attempts have been made to present key findings in the biodiversity assessment and socio-economic assessment on GIS maps to facilitate decision-making. The Government Agent was provided with soft copies of all the maps to be used in planning.

Considering the availability of data and the demand for spatial data for decision-making, the following maps pertaining to the study area were prepared.

- ✦ Sampling sites (20) selected for the rapid biodiversity survey in the Gulf of Mannar and Palk Bay area
- ✦ Areas selected for socio-economic assessment in the Gulf of Mannar
- ✦ Soil types in the Mannar District
- ✦ Agro-ecological zones of Mannar
- ✦ Monthly average temperature of Puttalam and Mannar
- ✦ Monthly potential evapo-transpiration in Mannar and Puttalam
- ✦ Lagoons, estuaries and rivers in GoM
- ✦ Ground water resources
- ✦ Ethnic composition of Mannar and Puttalam Districts
- ✦ Land use pattern of GoM in 2000
- ✦ Land use pattern of GoM in 2010
- ✦ Forest cover in the study area
- ✦ Natural habitats in the Area
- ✦ Mangrove distribution in the Mannar District
- ✦ Major irrigation tanks and feeder tanks in Mannar District
- ✦ Grama Niladhari Divisions comprising the rice bowl of Sri Lanka
- ✦ Fish landing sites in Mannar District
- ✦ Historial and cultural significant places in coastal DSDs in Mannar District
- ✦ Potential tourist sites in Gulf of Mannar
- ✦ Distribution of settlements in Mannar District
- ✦ Composition of solid waste in four coastal *Pradheshiya Sabhas* in Mannar District in 2010
- ✦ Sources of waste generation in four coastal *Pradheshiya Sabhas* in Mannar District in 2010
- ✦ Waste dumping areas in four coastal *Pradheshiya Sabhas* in Mannar District in 2010

## CHAPTER 5 – SUMMARY OF FINDINGS AND RECOMMENDATIONS

The project was welcomed by the relevant state agencies in the area, and received excellent support from the Government Agent, Mannar. The communities and the community organisations too expressed their appreciation and hoped that the findings will be used for the betterment of their lives.

Project activities were completed according to the Activity Plan presented in the concept note except for a few changes, such as:

- Disseminating the biodiversity findings together with socio-economic findings, instead of disseminating the biodiversity findings separately.
- Teacher training programmes were conducted in place of programmes to raise awareness among students, in order to ensure a wider reach in the medium term.
- Presentation of findings at the national level in partnership with BOBLME – this item has been rescheduled to be implemented through BOBLME Sri Lanka national component.

A summary of the study findings are set out below.

### 5.1 Summary of Findings

#### *Biodiversity*

GoM has biodiversity-rich ecosystems that are providing valuable services. These services also support the livelihood and sustainability of communities in the area. Coastal habitats, especially mangroves protect coastal areas from wind, floods, saline water intrusion and coastal erosion. Coastal vegetation provide habitats for migratory species, and nursery and breeding grounds for coastal and marine life.

Compared to other coastal areas of Sri Lanka, threats to biodiversity in the GoM coastal habitats had been few, largely due to the war situation during the last few decades. Forests, inland wetlands, coastal and marine, and agricultural lands are major coastal and terrestrial habitat types found here.

The most common terrestrial natural vegetation types are tropical dry mixed evergreen forest and dry thorny scrubland. Coastal habitats consist of mangroves, salt marsh, sand dunes and beaches as well as inter-tidal habitats including coral reef, algal communities and sea grass beds.

The terrestrial habitats of the GoM possess 12% of the flowering plant species found in Sri Lanka. A total of 583 plant species (in 119 families) were recorded and among them eight species are endemic and 11 species are nationally threatened.

A total of 496 inland faunal species were recorded within the inland coastal habitats of GoM, including 31 endemics, 66 migratory birds, two introduced freshwater fishes and eight domesticated mammals. Among them, 46 species were recognized as nationally threatened.

Economically important crop wild relatives such as *Vigna* spp. and *Momordica* spp. were also recorded from the GoM coastal belt. Such valuable resources, useful for future crop development, have not been inventoried as yet.

The vegetation in many areas is degraded due to human interventions. Of especial concern are the expansion of settlements, new fish landing sites and sand mining.

The invasive species, *Prosopis juliflora*, is spreading rapidly. It is one of the foremost threats to coastal vegetation, especially scrubland, and other coastal habitats including paddy areas, except perhaps the sand dunes. The spread of invasive plants such as Water hyacinth (*Eichhornia crassipes*) and Cat's tail (*Typha angustifolia*) in irrigation tanks was also observed. Spread of these species will enhance siltation and reduce tank capacity.

The uncontrolled grazing by goats, cattle and donkeys that goes on is a matter of concern.

In future, elephant-human conflicts may be expected in areas where resettlements and expansion of agricultural lands are taking place.

The development activities proposed need to give adequate consideration to biodiversity conservation. Of particular concern is the possible increase of firewood collection by people in the resettlements, illegal logging for timber, and extensive land clearing for agriculture.

Gulf of Mannar Reef, Vankalai Reef, Arippu Reef, Silvatturai Reef and Vidattaltivu Lagoon which have been identified as environmentally important areas with high biodiversity should receive special consideration and protection.

### **Fisheries**

Fishery is the backbone of the people living around GoM. The fishers need to know well their resource base, and should respect the need for sustainable extraction. During the study, the following destructive fishing practices, which will have an impact on the fishery resources, were observed:

- Dynamiting – although banned it is still taking place from Pallimunai to Thavulpadu.
- Monofilament (*Thangus*) nets – banned but was used in almost every site. The ban has been re-enforced from 3 October 2010.
- Brush piles and multi hook artificial bait for cuttlefish – banned but still being used in two sites (Pallimunai and Vankalai FIDs) of the 14 sites surveyed in the study.
- Surukku nets – banned since 3 October 2010, but still being used in some areas, eg. Pappamoddai in Mantai West DSD
- SCUBA diving for collection of sea cucumber and conch – banned in Gulf of Mannar, but fishermen from Kalpitiya still collect these from Silavatturai in Musali DSD.
- Trawling - presently limited to Pesalai in Mannar DSD.

There is an ongoing feud between the Indian and Sri Lankan fishermen. Indian fishermen use a large number of big trawlers in Sri Lankan waters violating territorial user rights. There are allegations and counter-allegations, and the Governments should address this issue.

Holothurians (sea cucumber), gastropods (conch) and bivalves (oysters) are being collected without permits and without conforming to the recommended sizes. This will affect the sustainability of this sector.

The entire Mannar coast does not have a proper fishing harbour. All fibreglass boats and other smaller boats land on the beach while trawlers and multi-day boats anchor in the sea.

Fish marketing is not well organised; the middle men make unjust profits at the expense of the fishermen.

Ice production is insufficient; many buyers are forced to bring their own ice.

Handling of fish is unsatisfactory resulting in quality deterioration of the catch; wastage is evident.

Processing facilities are poor. Even fish drying was found to be done under unhygienic conditions.

The beach is polluted by the indiscriminately discarded by-catch. This attracts dogs, cats and birds onto the beach; eventually they invade the fish drying areas.

### **Agriculture**

Agriculture is one of the main occupations in the District of Mannar. Considerable areas of paddy land in the district, abandoned due to the conflict, are to be cultivated in the coming season.

The displaced families are returning and there is a great demand for land for cultivation and for settlement; forest areas in Musali Division and Mantai West are being cleared to meet the demand. Most of these lands are adjoining estuaries, lagoons, river banks and catchment areas of the tank system in the area, and there is a likelihood of erosion and consequent siltation of tanks.

A farmer family owns about 2-5 acres of paddy land and an upland home garden. Farmer income is mainly from paddy cultivation. Almost all the farmers own livestock and engage in tank fishing. Cattle and goats are reared for milk and meat.

Paddy is cultivated mainly in the Maha season; a mere 5% of the paddy lands are cultivated in Yala as irrigation water is inadequate. Water is a critical factor for agriculture in the area and there were two development proposals to increase the irrigation capacity.

1. Increasing the capacity of Giant's Tank by raising its bund. As this will inundate some forest in the tank's catchment area the Environment Committee of the Provincial Government has not approved it.
2. Diverting Malwathu Oya water at Thanthirimale and constructing an irrigation tank to supply 30 ha m of water to the area.

Irrigation development and management in the area comes under the purview of three different state agencies - Central Government Irrigation Department (major schemes), Provincial Irrigation Department (medium tanks), and Agrarian Services Department (small tanks). Consultation and coordination among them was poor, except for water allocation decisions.

Many agencies are involved in the agriculture sector, performing different functions. Inter agency coordination in planning is inadequate and lack holistic approach. Their interaction with the communities seems to be inadequate, perhaps due to the dearth of active community organizations. Even the few that are active lack opportunities to participate in decision making and monitoring agriculture related projects.

Paddy yields are relatively high but farmers cannot sell their produce, at a good price, due to a shortage of buyers. Marketing linkages with buyers from outside the district are being re-established after the war. Rice processing mills and storage facilities are inadequate, but new rice mills are likely to be established soon.

Unemployment among farmer communities is high during the Yala season. Livestock is the only option available as an income source during this season.

Tank reservations and the adjacent vegetation are under threat due to land grabbing. In the long term this can affect the ecological balance in the area and consequently the wellbeing of the adjacent communities that rely mainly on the cascading tank system and coastal ecosystem.

The current level of water pollution caused by agricultural practices is low mainly due to the past restrictions that stemmed from security concerns. The likely expansion of agriculture, with fertilizers and agrochemicals freely available, may result in increased soil erosion and water pollution.



The traditional tank bed cultivation in Mannar was somewhat curtailed by the war situation. However, with the ongoing resettlements there are indications that land clearing in tank beds and reservations will escalate.

Soil salinization is another potential problem in the paddy lands in coastal regions due to coastal water intrusion. This can be aggravated by development activities and construction of structures that disturb drainage pathways.

The disruption of marketing channels with the rest of country during the conflict could constrain agricultural expansion.

Agricultural extension services are weak. They lack sufficient staff, technical capacities, and opportunities for interaction with counterparts in other areas and exposure to modern tools and methods. As a result communities lack access to new information on sustainable agricultural practices.

### **Archaeology**

Gulf of Mannar is rich with archaeological monuments and traditional legends. The ancient Mantai port had been developed as the main port of the Anuradhapura period and as the main hub of the ancient trade route where the east and west met.

There are several Miocene fossil (5 to 28 Million years) sites in the region. Among them Uchchamunai and Karativu Island in the Kalpitiya DSD, Aruvakkalu in the Vanathavillu DSD, Palugahaturai, and Kudiramalai in Wilpattu National park are the most important sites.

Many prehistoric human settlements belonging to the Palaeolithic and Mesolithic periods have been found in Aruvakkalu, Kudiramalai and Pomparippu, and around several villu habitats in Wilpattu. Proto-historic and historical monuments including Urn burial grounds have been recorded in Gangevadiya, on the banks of Pomparippu Ara, Pomparippu, Palugahaturai, Pukkulam, Silavaturai, Arippu, Pesalai and Mantai.

During the Anuradhapura period and the Polonnaruwa period Mantai was the main port which played a major role in commercial trade. Other than Mantai port, ancient Tambapanni (Pukkulama), Uruvela (Kollankanatha) and Malwatu Oya estuary also played major roles in the pearl trade with Roman, Arabic and Chinese traders. Baobab trees introduced by Arabian sailors still survive in the Mannar Island and also in the mainland.

Portuguese, Dutch and British monuments such as forts, houses, beacons, survey marks and churches are located at Kalpitiya, Mulikulam, Arippu, Mantai and Mannar Island. The Doric building in Arippu was built for the first British Governor in Sri Lanka.

Many archaeological monuments have been destroyed and some of them have been converted to other uses. The remaining sites are in a vulnerable state and immediate action has to be taken to preserve them.

### **Waste management**

Land-based pollution is the main source of pressure on the GoM resources. Waste generation in the study area has not received much attention. The waste generated is about 17 MT per day, and is increasing.

Proper solid waste management mechanisms are not available in any of the local authorities in GoM area; only the Kalpitiya Pradeshiya Sabha has made some progress. Waste collection is

unsatisfactory; more than 50% of the waste generated is not collected. Considerable amounts of waste is dumped in the coastal waters and beaches, which is of concern to the health and productivity of the GoM.

### *Normalcy and development in the aftermath of the conflict*

The study was witness to several aspects that arise in the aftermath of the conflict, and the needs and wishes of both people and the government on rehabilitation, reconstruction and bringing about normalcy into peoples lives.

In the overall context of GoM resources, the following aspects are relevant.

Government departments: It was evident from discussions with key government officials that their departments were in urgent need of baseline information to facilitate decision-making. Data collection work in the district had been seriously affected due to the civil unrest over the last three decades. The Government Agent and other officials were provided with the spatial maps produced by the project to be used in decision-making.

Administrative systems: Did not function properly during the war, and the shortcomings that piled up over the last three decades need to be addressed. There is a dearth of staff in the state sector institutions at all levels, particularly in the management and technical cadres.

Services: Limited access to drinking water, frequent failures in the power supply, and poor health and sanitation facilities are common problems.

Community Based Organizations (CBOs): They ceased to function during the last few decades. Many of the issues relating fishery, agriculture, etc., could be resolved by effective CBOs with the assistance of political leadership. CBOs can also bring about community harmony. Likewise, business organisations can also help, but they require the support of state agencies, etc., for expansion.

Land use: This is an area that is in need of special attention to maintain the ecological integrity of GoM. Land related issues are growing primarily because of rapid resettlements and conflicting demands for land. Allocations of land for resettlement, development, infrastructure and conservation need to be more systematic. Some important related issues are:

- Land clearance in the upper catchment areas will have a direct effect on the quality of coastal waters of the GoM.
- Low lying marshy flood plains provide forage for livestock, flood control, and the drainage of excess irrigation water. These services will be affected if there are land use changes in the low lying coastal areas.
- There are areas with good potential for aquaculture and salt farms in the coastal areas. If these lands are converted to establish these industries there will be direct impacts on the coastal ecosystems.
- With the resettlements, conflicts and disputes are likely over land and water use in agriculture.
- Land disputes are on the increase; many have lost their deeds due to the conflict.

Infrastructure development: Appropriate environmental safeguards are essential to mitigate the possible negative impacts of the ongoing rapid development. Development of town centres and infrastructure in coastal regions, especially in Mannar town, require careful planning. Improper setting of industries and infrastructure can damage the existing ecosystem and their functions.

Waste management: A growing concern, with serious consequences on the ecological integrity of GoM.

Tourism: An industry with high potential that will provide job opportunities for the people. More infrastructure will be required in coastal regions. Silavaturai,, a fish landing site, is already under consideration for development.

## 5.2 Recommendations

With the ending of the civil unrest a new era has dawned for the people in Mannar. Importantly, people displaced by the civil war are being resettled in Mannar in large numbers, and economic activities are gathering pace. Fishery and agriculture, particularly paddy cultivation, is expected to expand rapidly. Concurrently, the government is on course with its accelerated programme for infrastructure development; indeed new roads and bridges are being built hurriedly.

In this development scenario, the importance of, and need for, environmental safeguards has to be recognized. Some development works are likely to affect environmentally sensitive areas. A special effort is called for to protect GoM resources, which directly support nearly 50% of the Mannar people. Based on the study findings, the following actions are recommended.

### *Natural resources management*

- Prepare a proper inventory of the natural resources of Mannar, and management plans, as required, to address ecosystem management, invasive species and sustainable use of resources.
- Create awareness on the natural resources base of GoM, potential threats and the need for sustainable use of resources among the coastal communities. This should be pursued vigorously with the assistance of the relevant state agencies, who have now received training.
- Use land use planning as a major tool in development planning; strengthen the capacities of relevant officials and incorporate land use planning guidelines and principles in decision making; adopt an integrated approach in making development decisions. Some examples are:
  - Improve knowledge and tools for ecosystem approach
  - Increase knowledge and skills on appraisal tools to address ecosystem issues.
  - Appraisal of development interventions considering ecosystem linkages eg. agricultural development and long term productivity of the entire system
  - Research on ecosystem linkages, collection and use of data in decision making;
- Address land tenure issues.
- Assist in establishing/empowering civil society organizations and facilitate community participation in local decision-making mechanisms. Enhance community awareness and capacities on natural resources management and on environment and agricultural linkages.

### *Fisheries*

- Enforce the laws to stop destructive fishing practices and formalize a partnership between the Navy and the Department of Fisheries for the surveillance and monitoring of fishing practices in the GoM
- Regulate collection of sea cucumber by introducing the closed season concept

- Ascertain and provide the capacities and the wherewithal necessary for handling the fish catch, scientific processing, storage (including availability of ice) and marketing needs. Of particular importance is dry fish production
- Further explore the need for a fishery harbour for Mannar, as fishers are inconvenienced due to lack of one
- Address post-harvest losses of fish, including the feasibility of a fish meal production centre
- Promote systematic aquaculture, which will provide stable and high returns, to reduce excessive extraction of marine resources. Start with pilot scale ventures to test technical and financial feasibility; if successful, provide assistance for expanding aquaculture
- Government should address the issue of Indian fishermen transgressing into Sri Lankan waters
- Strengthen Fisheries Cooperative Societies to take on a more proactive role in providing a suite of services, including capacity building of fishers, fish processing and marketing
- Introduce alternative income generating activities for those directly dependent on GoM resources and thereby reduce the pressure on the resources

### ***Agriculture***

- Provide sufficient water for agriculture. This major challenge should be a priority in the new development plans. Also, introduce efficient water management; reduce water losses in irrigation channels; introduce cultivation practices and appropriate crops that use water efficiently, and harvest rainwater.
- Water management is key to the performance of agriculture sector in the area. Establish inter-agency coordination on water management.
- Maintain the cascading small tank system in good order.
- Introduce off season income opportunities to farmer communities. Promote home gardens and integrated livestock among the farmer communities. Integrated inland fisheries in the cascading small tanks could also be a potential livelihood option.
- Strengthen agricultural extension efforts and introduce new varieties, new cultivation methods and tools, fertiliser use, soil conservation practices to reduce soil erosion, etc. with a perspective on ecosystem principles.
- Establish marketing linkages, marketing infrastructure and industries for value addition such as rice processing mills, etc.

### ***Archaeology and culturally significant sites***

- Undertake a complete archaeological exploration to investigate the historical and archaeological monuments in terrestrial and underwater sites in the Gulf of Mannar area.
- Provide the necessary administrative authority to address issues relating to archaeological sites, in particular for the preservation of archaeologically and culturally significant sites in the Mannar District.
- Produce outreach materials on archaeologically and culturally significant sites in Mannar in order to raise awareness, which is lacking even among the people of Mannar.

### **Waste management**

- Conduct awareness campaigns, with suitable outreach materials, to educate the population in Mannar on reducing waste generation, options for recycling, etc.
- Develop strategies for waste management. This is a priority for the provincial and local level authorities concerned as the population is increasing rapidly with resettlements. The strategy should include options for waste sorting at the source, collection methods, conversion, etc.

### **Other**

- Urgently upgrade and support the administrative systems in the area to ensure the necessary backstopping for rapid development.
- Ensure environmental safeguards to mitigate the impact of the massive ongoing infrastructure development.
- Integrate tourism development into the provincial development plans.
- Support the Government proposal to recognize this area as a UNESCO Biosphere Reserve by providing information generated from this project.

## CHAPTER 6 – NEXT STEPS

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The study was limited to the coastal Divisions of Mannar. The interactions between the Gulf of Mannar and the terrestrial system could not be explored as time and resources were inadequate for the task.

Our efforts at creating awareness generated a great deal of interest amongst the people in Mannar. IUCN has received requests for additional awareness programmes and other assistance as follows:

### **(a) Additional awareness programmes**

Additional awareness building programmes have been requested by security personnel. The security of the Gulf of Mannar is in the hands of the Navy which has a number of camps in the coastal areas to facilitate patrolling. The Navy currently works in partnership with the Department of Fisheries to control illegal fishing activities; yet their technical knowledge on coastal resources is minimal, and the partnership could be strengthened by additional awareness programmes. The three senior officers of the Navy who attended the awareness programme in Mannar requested several other awareness programmes for its staff, as they have not been exposed to information of this nature before.

There is a demand from the Zonal Educational Department to conduct additional programmes, especially for science teachers in the Ordinary Level Classes and for selected students from the Advanced Level Classes. These students will then serve as resource persons in the communities. They have also made a request that we print and distribute the Teachers' Resource Book, prepared under the project. The Education Department is of the view that this book will be very useful in the District, and is prepared to include it as recommended reference material for the schools in the District.

### **(b) Capacity building of the district office of the fisheries department**

The Fisheries Department has a key role to play and have indicated their appreciation for the work done so far, and for providing outreach materials. They are prepared to disseminate information, particularly amongst fishers, but are hampered by the lack of equipment. Essentially, they require a computer and multi-media equipment for mobile awareness programmes, and some capacity building for their junior officers.

### **(c) Other initiatives**

The time is opportune to initiate a discussion on creating a trans-boundary marine protected area for the Gulf of Mannar, covering both Indian and Sri Lankan sides. Perhaps BOBLME, given its regional mandate, would respond positively to this proposal.

The material produced in this project, with some adjustments, could be gainfully used in the north and east of Sri Lanka.



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## Annex 1: IUCN Study Team

Name & Designation	Key Responsibilities
Dr. Ranjith Mahindapala, Country Representative	Overall supervision
Shamen Vidanage, Program Coordinator	Lead Researcher, supervision and team coordination
Kapila Gunarathne, Head, Coastal Livelihood and Policy Unit	Project Manager
Kumudini Ekaratne, Senior Program Officer	Fisheries study and dissemination of findings
Diana De Alwis, Senior Program Officer	Socio -economic survey
Sampath Goonatilake, Assistant Program Officer	Archaeology and terrestrial biodiversity surveys
Dilhari Weragodathenna., GIS Specialist	Preparation of GIS maps
<i>Consultants</i>	
Prof. Ruchira Cumararatunga, Head, Faculty of Fisheries, University of Ruhuna	Team Leader, rapid biodiversity assessment study – Coastal and marine
Dr. Terney Pradeep Kumara, Head, Department of Oceanography, Faculty of Fisheries, University of Ruhuna	Ocean resources survey
Prof. Senevi Epitawatta, Consultant	Technical support to design and conduct Socio-economic survey
Mr. Dilup Chandranimal, Flora Specialist	Flora analysis



## Annex 2. The Checklist of the Flora of Puttalam Lagoon and Mannar Bay Area

Abbreviations:

Plant names: S-Sinhalese; T-Tamil; E-English

Endemic Species are in boldface; Exotic Species are marked with an \*

IAS-Invasive Alien Species, M-Mangrove, MA-Mangrove Associate, SG-Seagrass, SM-Salt marshes

CR-Critically Endangered, EN-Endangered, VU-Vulnerable, NT-Near Threatened

Uses: M-Medicinal Plant; F-Food plant

Lower Plants				Uses	Puttalam	Mannar Bay	Nanaddan	Musalai	Manthai West	Mannar Town
1	Gracilariaceae	<i>Gracilaria spp</i>			X	X	X			
2	Azollaceae	<i>Azolla pinnata</i>			X					
3	Marsileaceae	<i>Marsilea minuta</i>	Dwarf water clover (E)		X	X				
4	Pteridaceae	<i>Acrostichum aureum</i> <sup>MA</sup>	Karan-koku (S)	M,F	X					
5	Salviniaceae	<i>Salvinia molesta</i> <sup>*IAS</sup>	Salvinia (S)		X	X				
Flowering Plants										
No	Family	Species	Local name		X					
1	Acanthaceae	<i>Acanthus ilicifolius</i> <sup>MA</sup>	Ikili (S) Sea Holly (E)	M	X					
2	Acanthaceae	<i>Asystasia gangetica</i>	Puruk (S) Peypatchotti (T) Chinese Violet (S)	M	X					
3	Acanthaceae	<i>Barleria prionitis</i>	Katu-karandu (S) Varamulle (T) Yellow Hedge Barleria (E)	M	X					
4	Acanthaceae	<i>Blepharis maderaspatensis</i>	Samadana (S) Creeping Blepharis (E)		X					
5	Acanthaceae	<i>Dipteracanthus prostratus</i>	Nil-puruk (S)		X	X				
6	Acanthaceae	<i>Elytraria acaulis</i>		M	X	X				
7	Acanthaceae	<i>Hygrophila ringens</i>	Nil-puruk (S)		X					
8	Acanthaceae	<i>Hygrophila schulli</i>	Neeramulliya, Katu-ikiriya (S) Niramulli (T) Marsh Barbel (E)	M,F	X	X				
9	Acanthaceae	<i>Justicia adhatoda</i>	Adhatoda, Agal Adara (S) Adhatodai (T) Malabar Nut (E)	M	X	X				
10	Acanthaceae	<i>Justicia betonica</i>	Sudu-puruk (S) White Shrimp Plant (E)	M	X					
11	Acanthaceae	<i>Pseuderanthemum carruttersii</i> <sup>*</sup>	False Eranthemum (S)		X	X				
12	Acanthaceae	<i>Ruellia tuberosa</i> <sup>*</sup>	Wayside Tuberose (E)		X	X				
13	Acanthaceae	<i>Rungia repens</i>	Sulu-nayi (S) Creeping Rungia (E)	M		X				
14	Acanthaceae	<i>Justicia procumbens</i>	Mayani (S) Ottu-pillu (T) Common Small Justicia (E)	M	X	X				
15	Acanthaceae	<i>Stenosiphonium cordifolium</i> VU	Bu-nelu (S) Nelu (T)		X	X		X		

16	Aizoaceae	<i>Sesuvium portulacastrum</i> <sup>SM</sup>	Maha-sarana (S) Vankiruvilai (T) Seaside Purslane (E)		X	X	x	X	X	
17	Aizoaceae	<i>Trianthema decandra</i>	Maha-sarana (S) Charania (T)	M	X	X	X			X
18	Aizoaceae	<i>Trianthema portulacastrum</i>	Heen-sarana (S) Trianthema (E)	M,F	X	X				X
19	Alliaceae	<i>Allium cepa</i> *	Loonu (S)	M,F	X					
20	Aloaceae	<i>Aloe vera</i> *	Komarika (S) Kattalai (T)	M,F	X	X	X		X	X
21	Amaranthaceae	<i>Achyranthes aspera</i>	Gas-karal-heba (S) Nayururi (T) Prickly Chaff-flower (E)	M,F	X	X				
22	Amaranthaceae	<i>Aerva lanata</i>	Pol-pala (S) Kanpuli (T) Eerva (E)	M,F	X	X				X
23	Amaranthaceae	<i>Allmania nudiflora</i>	Kumatiya (S)			X				
24	Amaranthaceae	<i>Alternanthera paronychioides</i> *			X	X				
25	Amaranthaceae	<i>Alternanthera sessilis</i>	Mukunu-wenna (S) Ponankani (T) Sessile Joyweed (E)	M,F	X	X				
26	Amaranthaceae	<i>Amaranthus lividus</i> *	Thampala (S)	F	X					X
27	Amaranthaceae	<i>Amaranthus spinosus</i>	Katu-tampala (S) Mudkirai (T) Spiny Amaranth (E)	M,F	X					
28	Amaranthaceae	<i>Amaranthus viridis</i>	Kura-thampala (S) Araikkirai (T) Slender Amaranth (E)	M,F	X	X				
29	Amaranthaceae	<i>Celosia argentea</i>	Kiri-handa (S) Silver Spiked Cockscomb (E)	F	X					
30	Amaranthaceae	<i>Gomphrena celosioides</i> *	Prostrate Globe Amaranth (E)		X	X	X			
31	Amaranthaceae	<i>Nothosaerva brachiata</i>	Tampala (S) Chirupilai (T)	F	X					
32	Amaryllidaceae	<i>Crinum asiaticum</i>	Tolabol (S) Vishumungil (T) Giant Crinum (E)	M	X					
33	Amaryllidaceae	<i>Crinum defixum</i>	Heen-tolabo (S)	M	X	X	X			X
34	Amaryllidaceae	<i>Crinum latifolium</i>	Goda Manel (S) Pink-striped Trumpet Lily (E)	M	X	X				
35	Amaryllidaceae	<i>Pancratium biflorum</i>				X		X		
36	Anacardiaceae	<i>Anacardium occidentale</i> *	Caju (S) Montin-kai (T) Cashew Nut (E)	M,F	X	X				
37	Anacardiaceae	<i>Lannea coromandelica</i>	Hik (S) Odi (T)	M	X	X				
38	Anacardiaceae	<i>Mangifera indica</i> *	Amba (S) Ma, Manga (T) Mango (E)	M,F	X	X	x			X
39	Anacardiaceae	<i>Spondias pinnata</i>	Amberella (S) Ampallai (T) Hog Plum (E)	M,F	X	X				
40	Annonaceae	<i>Annona glabra</i> <sup>IAS</sup>	Wel-atta (S)	F	X					
41	Annonaceae	<i>Annona muricata</i> *	Katu-anoda (S) Sitha (T) Soursop (E)	M,F	X					
42	Annonaceae	<i>Miliusa indica</i>	Kekili-messa (S)		X					
43	Annonaceae	<i>Polyalthia korinti</i>	Ul-kenda, Mi-wenna (S) Uluvintai (T)		X					
44	Annonaceae	<i>Polyalthia longifolia</i>	I-petta (S) Assathi (T)	M	X	X				X
45	Apiaceae	<i>Centella asiatica</i>	Gotukola (S) Vallarai (T) Indian Pennywort (E)	M,F	X	X				
46	Apocynaceae	<i>Carissa grandiflora</i> *	Damson (S) Damson (T) Natal Plum (E)	F	X					
47	Apocynaceae	<i>Carissa spinarum</i>	Heen-karamba (S) Chiru-kula (T)	M,F	X	X				
48	Apocynaceae	<i>Catharanthus roseus</i> *	Mini-mal (S) Pattippu (T) Madagascar Periwinkle (E)	M	X	X				

49	Apocynaceae	<i>Ichnocarpus frutescens</i>	Gerandi-wel (S)	M	X	X				
50	Apocynaceae	<i>Nerium oleander</i> *	Kaneru (S) Alari (T) Oleander (E)	M	X	X				
51	Apocynaceae	<i>Plumeria obtusa</i> *	Araliya (S) Temple Tree (E)	M	X	X				
52	Apocynaceae	<i>Plumeria rubra</i> *	Araliya (S) Temple Tree, Frangipani (E)	M	X	X				
53	Apocynaceae	<i>Tabernaemontana divaricata</i> *	Wathu-sudda (S) Nandi-battai (T) Grape Jasmine (E)		X	X				
54	Apocynaceae	<i>Thevetia peruviana</i> *	Kaneru (S) Yellow Oleander (E)		X	X				
55	Aponogetonaceae	<i>Aponogeton natans</i>	Kekatiya (S) Koddi (T)	F	X	X			X	
56	Araceae	<i>Pistia stratiotes</i> * <sup>JAS</sup>	Diya-gowa, Diya-paradel (S) Water Lettuce (E)	M	X					
57	Arecaceae	<i>Areca catechu</i>	Puwak (S) Pakku (T) Arecanut (E)	M		X				
58	Arecaceae	<i>Borassus flabellifer</i> *	Tal (S) Panai (T) Palmyrah (E)	M,F	X	x	X	X	X	X
59	Arecaceae	<i>Calamus rivalis</i> VU	Ela-wewel (S)		X					
60	Arecaceae	<i>Cocos nucifera</i>	Pol, Thambili (S) Thengai (T) Coconut, King coconut (E)	M,F	X	X	X			X
61	Arecaceae	<i>Phoenix dactylifera</i> *	Rata-indi (S) Perichchambalam (T) Date Palm (E)	F	X	X				X
62	Arecaceae	<i>Phoenix pusilla</i> <sup>MA</sup>	Indi (S) Inchu (T)	M,F	X		X		X	X
63	Aristolochiaceae	<i>Aristolochia indica</i>	Sapsanda (S) Isuru (T) Indian Birthwort (E)	M	X					
64	Asclepiadaceae	<i>Calotropis gigantea</i>	Wara (S) Errukalai (T) Giant Milkweed (E)	M	X	X	X	x		X
65	Asclepiadaceae	<i>Leptadenia reticulata</i>	Pala (T)	M	X					
66	Asclepiadaceae	<i>Oxystelma esculentum</i>	Usepale (S) Kulappulai (T)	M	X					
67	Asclepiadaceae	<i>Pentatropis capensis</i>			X					
68	Asclepiadaceae	<i>Pergularia daemia</i>	Mada-hangu (S) Uttamakam (T)	M	X	X	X			
69	Asclepiadaceae	<i>Sarcostemma brunonianum</i>	Muwa-kiriya (S)	M	X	X		X		
70	Asclepiadaceae	<i>Secamone emetica</i>		M	X					
71	Asclepiadaceae	<i>Tylophora indica</i>	Mundu-Bin-Nuga (S) Nancharapanchan (T) Wild Ipecacuanha (E)	M	X					
72	Asclepiadaceae	<i>Tylophora tenuissima</i>			X	X			X	
73	Asclepiadaceae	<i>Wattakaka volubilis</i>	Anguna (S) Kodi-palai (T)	F	X	X	X			
74	Asperagaceae	<i>Asparagus racemosus</i>	Hatawariya (S) Chattavari (T)	M,F	X	X	X	X	X	X
75	Asteraceae	<i>Acanthospermum hispidum</i> *	Katu-nerenchi (S) Bristly Stabur (E)		X	X				
76	Asteraceae	<i>Ageratum conyzoides</i> *	Hulan-tala (S) Pumpillu (T) White Weed (S)	M	X	X				
77	Asteraceae	<i>Blumea obliqua</i>	Muda-mahana (S) Nara-karamba (T)		X					
78	Asteraceae	<i>Chromolaena odorata</i> <sup>JAS</sup>	Podisinghomaran (S) Devil Weed (E)	M	X	X				
79	Asteraceae	<i>Eclipta prostrata</i>	Kikirindi (S) Kaikечи (T) Marsh Daisy (E)	M	X	x				
80	Asteraceae	<i>Emilia sonchifolia</i>	Kadupara (S)	M	X					
81	Asteraceae	<i>Launaea sarmentosa</i>		M	X	X		X		
82	Asteraceae	<i>Mikania cordata</i> <sup>JAS</sup>	Loka-palu (S) Tuni-kodi (T) Mile-a-minute (E)	M	X	X				
83	Asteraceae	<i>Sphaeranthus africanus</i>	Vel-mudda (S) African globethistle (E)	M	X					

84	Asteraceae	<i>Tridax procumbens</i> *	Kurunegala Daisy (E) Wasu sudu (S)		X	x				
85	Asteraceae	<i>Vernonia cinerea</i>	Monarakudumbiya (S) Chitiviyaarchenkalainir(T)	M,F	X	X				X
86	Asteraceae	<i>Vernonia zeylanica</i>	Pupula (S) Kuppailay (T)	M	X	X			X	
87	Asteraceae	<i>Xanthium indicum</i> <sup>AS</sup>	Uru kossa (S) Rough Cocklebur (E)	M	X	X	X	X		
88	Avicenniaceae	<i>Avicennia marina</i> <sup>M</sup>	Manda (S) Kanna (T) Grey Mangrove (E)		X	X	X	X	X	
89	Avicenniaceae	<i>Avicennia officinalis</i> <sup>M</sup>	Manda (S) Kanna (T) White Mangrove (E)	M	X	X				
90	Basellaceae	<i>Basella alba</i>	Nivithi (S) Pasalai (T) Malabar Spinach (E)	M,F	X					
91	Bignoniaceae	<i>Dolichandrone spathacea</i> <sup>MA</sup>	Diya-danga (S) Vil-padri (T) Mangrove Trumpet Tree (E)	M	X					
92	Bignoniaceae	<i>Stereospermum colais</i>	Dunu-madala (S) Padri (T)		X					
93	Bignoniaceae	<i>Tecoma stans</i> *	Kalani-tissa (S) Yellow Elder (E)		X	X				
94	Bombacaceae	<i>Adansonia digitata</i> *	Ali-gaha (S) Papparappuli (T) Baobab (E)			X				X
95	Bombacaceae	<i>Bombax ceiba</i>	Katu-imbul (S) Kaddu-olaga (T) Cotton Tree (E)			X		X		
96	Bombacaceae	<i>Ceiba pentandra</i>	Pulun-imbul (S) Silk cotton Tree (E)	M	X					
97	Boraginaceae	<i>Carmona retusa</i>	Heen-tambala (S) Pakkuvetti (T)	M	X					
98	Boraginaceae	<i>Coldenia procumbens</i>	Chirupaddi (S)		X					
99	Boraginaceae	<i>Cordia curassavica</i> *			X					
100	Boraginaceae	<i>Cordia dichotoma</i>	Lolu (S) Naruvilli (T)	M,F	X	X				
101	Boraginaceae	<i>Cordia sinensis</i>			X					
102	Boraginaceae	<i>Cordia subcordata</i>			X					
103	Boraginaceae	<i>Heliotropium indicum</i>	Et-honda, Dimi-biya (S) Tedkodukku (T) Indian Turnsole (E)	M	X	X				
104	Boraginaceae	<i>Trichodesma indicum</i>	Kavil-tumpai (T) Indian Borage (E)			X				
105	Boraginaceae	<i>Trichodesma zeylanicum</i>	Camel Bush (E)	M	X					
106	Cactaceae	<i>Cereus peruvianus</i>			X					
107	Cactaceae	<i>Opuntia cochenillifera</i>	Velvet Opuntia (E)		X					
108	Cactaceae	<i>Opuntia sp</i>		F	X	X	X	X		X
109	Cactaceae	<i>Trichocereus pachanoi</i>			X					
110	Capparaceae	<i>Cadaba fruticosa</i>	Vili (T)		X	X				
111	Capparaceae	<i>Cadaba trifoliata</i>	Oothi-perali (T)	M	X	X				
112	Capparaceae	<i>Capparis divaricata</i>	Torikei (S)		X	X	X			X
113	Capparaceae	<i>Capparis grandis</i>	Mudkondai (T)			X				
114	Capparaceae	<i>Capparis moonii</i>	Rudanti (S)		X					
115	Capparaceae	<i>Capparis rotundifolia</i>	Karunchurai (T)		X	X				
116	Capparaceae	<i>Capparis sepiaria</i>	Hora-balal Wel (S) Karuchurai (T)		X				X	
117	Capparaceae	<i>Capparis zeylanica</i>	Sudu-welangiriya (S) Vennachchi (T) Ceylon Caper (E)	M	X	X				
118	Capparaceae	<i>Cleome chelidonii</i>	Wal-aba (S)			X				

119	Capparaceae	<i>Cleome gynandra</i>	Wela (S) Tayirvalai (T) Whiskered Spider Flower (E)	M		X				
120	Capparaceae	<i>Cleome viscosa</i>	Wal-aba, Ranmanissa (S) Yellow Spider Flower (E)	M		X				X
121	Capparaceae	<i>Crateva adansonii</i>	Lunu-warana (S) Navala (T)	M	X	X	X	X		
122	Capparaceae	<i>Maerua arenaria</i>			X	X				
123	Caricaceae	<i>Carica papaya</i> *	Gas-labu, Papol (S) Pappali (T) Pawpaw (E)	M,F	X	X				
124	Caryophyllaceae	<i>Polycarpaea corymbosa</i>	Old Man's Cap (E)	M	X					
125	Casuarinaceae	<i>Casuarina equisetifolia</i> *	Kasa (S) Chavakku (T) Whistling Pine (E)		X	X				X
126	Celastraceae	<i>Cassine glauca</i>	Neralu (S) Perunpiyari (T)		X	X				
127	Celastraceae	<i>Maytenus emarginata</i>			X	X				
128	Celastraceae	<i>Pleurostylia opposita</i>	Panakka (S) Chiru Piyari (T)		X					
129	Chenopodiaceae	<i>Atriplex repens</i> <sup>SM</sup>	Elichchevi (T)	F	X	X	x	x		
130	Chenopodiaceae	<i>Halosarcia indica</i> <sup>SM</sup>	Kotanai (T)	M	X	X	X	X	X	
131	Chenopodiaceae	<i>Salicornia brachiata</i> <sup>SM</sup>		M	X	X	X	X		
132	Chenopodiaceae	<i>Suaeda maritima</i> <sup>SM,MA</sup>	Umari (T)	F	X	X	X	X	X	X
133	Chenopodiaceae	<i>Suaeda monoica</i> <sup>SM</sup>		M	X	X	X		X	X
134	Chenopodiaceae	<i>Suaeda vermiculata</i> <sup>SM</sup>	Umari (T) Wormleaf Saltwort (E)		X	X	X		X	X
135	Clusiaceae	<i>Calophyllum inophyllum</i> <sup>MA</sup>	Domba (S) Dommakottai (T) Alexandrian Laurel (E)	M	X					
136	Colchicaceae	<i>Gloriosa superba</i>	Niyangala (S) Kartikai (T)	M	X	X				X
137	Combretaceae	<i>Lumnitzera racemosa</i> <sup>M</sup>	Beriya (S) Tipparuthin (T) Black Mangrove (E)	M	X	X	X	X	X	
138	Combretaceae	<i>Quisqualis indica</i> *	Rangoon Creeper (E)		X	X				
139	Combretaceae	<i>Terminalia arjuna</i>	Kumbuk (S) Marutu (T)	M	X	X		X		
140	Combretaceae	<i>Terminalia bellirica</i>	Bulu (S) Ahdan-koddai (T) Myrabalans (E)	M	X					
141	Combretaceae	<i>Terminalia catappa</i> *	Kottamba (S) Country Almond (E)	M,F	X	X				X
142	Commelinaceae	<i>Commelina benghalensis</i>	Diya-meneriya (S) Garden Commelina (E)		X	X				
143	Commelinaceae	<i>Commelina diffusa</i>	Gira-pala (S)	M,F	X	X				
144	Commelinaceae	<i>Cyanotis obtusa</i>			X					
145	Commelinaceae	<i>Murdannia spirata</i>			X					
146	Connaraceae	<i>Connarus monocarpus</i>	Radaliya (S) Chettupulukodi (T)	M	X	X				
147	Convolvulaceae	<i>Cuscuta chinensis</i>	Aga-mula-neti-wel (S) Dodder (E)	M	X					
148	Convolvulaceae	<i>Evolvulus alsinoides</i>	Visnu-kranti (S) Vichnu-kiranti (T)	M	X	X				
149	Convolvulaceae	<i>Evolvulus nummularius</i> *			X					
150	Convolvulaceae	<i>Ipomoea aquatica</i>	Kankun (S) Water Spinach (E)	M,F	X	X				
151	Convolvulaceae	<i>Ipomoea batatas</i> *	Batala (S) Vel-kelengu (T) Sweet Potato (E)	F	X					
152	Convolvulaceae	<i>Ipomoea obscura</i>	Tel-kola (S) Lesser Glory (E)	M	X	X				
153	Convolvulaceae	<i>Ipomoea pes-caprae</i>	Mudu-bin-thamburu (S) Adapukodi (T) Goat's Foot Glory (E)	M	X	X		X	X	

154	Convolvulaceae	<i>Ipomoea sepiaria</i>	Rasa-tel-kola (S) Tali (T)		X	X				
155	Convolvulaceae	<i>Ipomoea violacea</i>			X					
156	Convolvulaceae	<i>Merremia emarginata</i>				X				
157	Convolvulaceae	<i>Merremia tridentata</i>	Heen-madu (S) Mudiyakuntal (T) African Morning vine (E)	M	X	X				
158	Crassulaceae	<i>Kalanchoe pinnata</i> *	Akkapana (S)	M,F	X	X				X
159	Cucurbitaceae	<i>Benincasa hispida</i>	Alupuhul (S) Puchini (T) Ash Pumpkin (E)	M,F	X	X				
160	Cucurbitaceae	<i>Citrullus lanatus</i> *	Komadu (S) Water Melon (S)	M,F	X	X				
161	Cucurbitaceae	<i>Coccinia grandis</i>	Kowakka (S) Kovvai (T) Ivy Gourd (E)	M,F	X	X	X		X	X
162	Cucurbitaceae	<i>Cucumis melo</i>	Heen kekiri (S) Metukku (T)	M,F	X	X				X
163	Cucurbitaceae	<i>Cucumis sativus</i>	Pipingha (S) Cucumber (E)	M,F	X	X				
164	Cucurbitaceae	<i>Cucurbita maxima</i> *	Wattakka (S) Pumpkin Gourd (E)	M	X					
165	Cucurbitaceae	<i>Diplocyclos palmatus</i>	Pasengilla (S) Red-striped Cucumber (E)	M	X	X				
166	Cucurbitaceae	<i>Gynopetalum scabrum</i>			X					
167	Cucurbitaceae	<i>Lagenaria siceraria</i> *	Diya-labu (S) Churai (T) Bottle Gourd (E)	M,F	X					
168	Cucurbitaceae	<i>Luffa acutangula</i> *	Vetakolu (S) Peypichukka (T)	M,F	X	X				
169	Cucurbitaceae	<i>Luffa cylindrical</i> *	Niyan Vetakolu (S) Pikku (T)	M,F	X	X				
170	Cucurbitaceae	<i>Momordica charantia</i>	Batu-karavila (S) Pakal (T) Bitter Gourd (E)	M,F	X	X				X
171	Cucurbitaceae	<i>Momordica dioica</i>	Thumba-karavila (S) Tumpai (T)	M,F	X	X				
172	Cucurbitaceae	<i>Mukia maderaspatana</i>	Gon-kekiri (S) Mochumochukkai (T) Rough Bryony (E)		X	X				
173	Cucurbitaceae	<i>Trichosanthes anguina</i> *	Pathola (S) Podivilangi (T) Snake Gourd (E)	M,F	X	X				
174	Cymodoceaceae	<i>Cymadocea rotundata</i> <sup>SG</sup>	Round-tipped seagrass		X	X				X
175	Cymodoceaceae	<i>Cymadocea serrulata</i> <sup>SG</sup>			X	X	X			
176	Cymodoceaceae	<i>Halodule uninervis</i> <sup>SG</sup>	Narrow leaf Seagrass (E)		X	X				
177	Cymodoceaceae	<i>Syringodium isoetifolium</i> <sup>SG</sup>			X	X	X			X
178	Cyperaceae	<i>Bulbostylis barbata</i>	Uru-hiri (S)		X					
179	Cyperaceae	<i>Cyperus arenarius</i>	Mudu-kalanduru (S)		X					
180	Cyperaceae	<i>Cyperus corymbosus</i>	Gal-ehi (S)		X					
181	Cyperaceae	<i>Cyperus javanicus</i>	Ramba (S) Irampai (T)		X					
182	Cyperaceae	<i>Cyperus pilosus</i>			X					
183	Cyperaceae	<i>Cyperus rotundus</i>	Kalanduru (S) Korai (T)	M	X	X	X			
184	Cyperaceae	<i>Cyperus stoloniferus</i>		M	X					
185	Cyperaceae	<i>Eleocharis actangula</i>			X	X				
186	Cyperaceae	<i>Eleocharis dulcis</i>	Boru-pan (S)		X	X				
187	Cyperaceae	<i>Fimbristylis cymosa</i>			X					
188	Cyperaceae	<i>Fimbristylis dichotoma</i>			X					
189	Cyperaceae	<i>Fimbristylis ferruginea</i>			X					
190	Cyperaceae	<i>Fimbristylis miliacea</i>	Mudu-hal-pan (S)		X					



191	Cyperaceae	<i>Fuirena ciliaris</i>			X					
192	Cyperaceae	<i>Pycreus polystachyos</i>			X					
193	Cyperaceae	<i>Pycreus pumilus</i>	Go-hiri (S)		X					
194	Cyperaceae	<i>Schoenoplectus supinus</i>			X					
195	Dioscoreaceae	<i>Dioscorea oppositifolia</i>	Hiritala (S)	M,F	X					
196	Dioscoreaceae	<i>Dioscorea sp</i>			X	X		X		
197	Dioscoreaceae	<i>Dioscorea tomentosa</i>	Uyala (S)		X					
198	Dracaenaceae	<i>Dracaena fragrans*</i>	Fragrant Dracaena (E)		X	X				
199	Dracaenaceae	<i>Sansevieria zeylanica</i>	Niyanda (S) Maral (T) Bow-string Hemp (E)	M	X	X				X
200	Ebenaceae	<i>Diospyros ebenum</i> EN	Kalu-wara (S) Karunkali (T) Ebony (E)	M	X	X		X		
201	Ebenaceae	<i>Diospyros malabarica</i>	Thimbiri (S) Panichchai (T) Gaub Persimmon (E)	M	X	X		X	X	
202	Ebenaceae	<i>Diospyros montana</i>	Katukanni (T)		X					
203	Ebenaceae	<i>Diospyros ovalifolia</i>	Kunumella (S) Vedukkanari (T)		X					
204	Ebenaceae	<i>Maba buxifolia</i>	Jabara (S)	F	X	X				X
205	Eriocaulaceae	<i>Eriocaulon quinquangulare</i>	Heen-kokmota (S)		X					
206	Erythroxylaceae	<i>Erythroxylum monogynum</i>	Devadaram (S) Chemanatti (T)	M	X	X		X		
207	Euphorbiaceae	<i>Acalypha indica</i>	Kuppameniya (S) Kuppameni (T) Indian Copperleaf (E)	M,F	X	X				
208	Euphorbiaceae	<i>Acalypha lanceolata</i>	Nettle-leaf Acalypha (E)	M,F	X					
209	Euphorbiaceae	<i>Breynia retusa</i>	Wa (S)	M	X	X				
210	Euphorbiaceae	<i>Croton aromaticus</i>	Wel-keppitiya (S) Teppaddi (T)	M	X	X				
211	Euphorbiaceae	<i>Croton bonplandianus *</i>	Mal-miris (S) Kolvinge (E)		X	x				X
212	Euphorbiaceae	<i>Croton hirtus*</i>	Gan-veda, Val-tippili (S)		X	X				
213	Euphorbiaceae	<i>Croton laccifer</i>	Gas-keppetiyi(S)Teppaddi(T)	M	X	X				
214	Euphorbiaceae	<i>Croton officinalis</i>			X					
215	Euphorbiaceae	<i>Drypetes sepiaria</i>	Wira (S) Virai (T)	M,F	X	X		X		
216	Euphorbiaceae	<i>Euphorbia antiquorum</i>	Daluk (S) Chatura Kalli (T) Spurge Cactus (E)	M		X	x	X	X	
217	Euphorbiaceae	<i>Euphorbia hirta</i>	Bu-dada-kiriya (S) Palavi (T) Common Spurge (E)	M	X	X				
218	Euphorbiaceae	<i>Euphorbia indica</i>	Ela-dada-kiriya (S) Hypericum leaf Spurge (E)	M	X					
219	Euphorbiaceae	<i>Euphorbia rosea</i>	Mudu-dada-kiriya (S)	M	X					
220	Euphorbiaceae	<i>Euphorbia thymifolia</i>	Bin-dada-kiriya (S) Chittirapalavi (T) Thyme-leaf Spurge (E)	M	X	X				
221	Euphorbiaceae	<i>Euphorbia tirucalli</i>	Nawa-handi (S) Kalli (T) Milk Hedge (E)	M	X	X				
222	Euphorbiaceae	<i>Excoecaria agallocha<sup>M</sup></i>	Tela-kiriya (S) Tilai (T) Blind-your-eye (E)	M	X	X	x	X	X	
223	Euphorbiaceae	<i>Flueggea leucopyrus</i>	Hen-katu-pila (S) Mudpulanti (T)		X	X		X	X	X
224	Euphorbiaceae	<i>Jatropha curcas*</i>	Rata Enderu (S) Kaddamanakku (T)	M	X	X				

			Physic Nut (E)							
225	Euphorbiaceae	<i>Jatropha glandulifera</i> EN	Atalai (T)			X	X	X		X
226	Euphorbiaceae	<i>Jatropha gossypifolia</i> *	Bellyache Bush (E)	M	X	X			X	X
227	Euphorbiaceae	<i>Mallotus eriocarpus</i>	Vel-kepetiya (S) Maratini (T)		X					
228	Euphorbiaceae	<i>Manihot esculenta</i> *	Maiokka, Manyokka (S) Cassava, Manioc (E)	F	X	X				
229	Euphorbiaceae	<i>Manihot glaziovii</i> *	Gas-manyokka (S) Ceara Rubber (E)		X	X				X
230	Euphorbiaceae	<i>Mischodon zeylanicus</i>	Tammanna (S) Tampanai (T)		X	X		X	X	
231	Euphorbiaceae	<i>Phyllanthus acidus</i> *	Japan nell i(S)	F	X	X				X
232	Euphorbiaceae	<i>Phyllanthus amarus</i>	Pita-wakka (S) Kikaunelli (T) Carry Me Seed (E)	M	X					
233	Euphorbiaceae	<i>Phyllanthus debilis</i>	Kulhainelli (T)			X				
234	Euphorbiaceae	<i>Phyllanthus maderaspatensis</i>		M	X	X				X
235	Euphorbiaceae	<i>Phyllanthus polyphyllus</i>	Kuratiya (S)		X	X			X	
236	Euphorbiaceae	<i>Phyllanthus reticulatus</i>	Wel-kayila (S) Mipullanti (T)	M	X	X				
237	Euphorbiaceae	<i>Phyllanthus urinaria</i>	Rat-pita-wakka (S) Kilkaynelli (T)	M	X	X				
238	Euphorbiaceae	<i>Ricinus communis</i>	Endaru (S) Chittamanakku (T) Castor Oil Plant (E)	M,F	X	X				
239	Euphorbiaceae	<i>Sapium insigne</i>	Tel-kaduru (S) Tilai (T)	M	X	X		X		
240	Euphorbiaceae	<i>Sauropus bacciformis</i>	Bin-delung, et-pitawakka (S)		X	X	X			
241	Euphorbiaceae	<i>Tragia plukenetii</i> EN	Wal-kahambiliya (S)							
242	Euphorbiaceae	<i>Tragia hispida</i> NT	Wal-kahambiliya (S)	M	X	X				
243	Fabaceae	<i>Abrus precatorius</i>	Olinda (S) Kundu-mani (T) Crab's eyes (E)	M	X	X				
244	Fabaceae	<i>Acacia auriculiformis</i> *	Earleaf Acacia (E)		X	X				X
245	Fabaceae	<i>Acacia caesia</i>	Hinguru-wel( S)		X	X				
246	Fabaceae	<i>Acacia catechu</i>	Catechu Tree (E)	M		X		X		
247	Fabaceae	<i>Acacia eburnea</i>	Kukul-katu (S) Kaluda i(T) Cockspur Thorn(E)		X	X	X			X
248	Fabaceae	<i>Acacia ferruginea</i> *	Velvelam (T)		X	X				
249	Fabaceae	<i>Acacia leucophloea</i>	Maha Andara (S) Velvalayam (T)		X	X	x	X	X	X
250	Fabaceae	<i>Acacia nilotica</i> *	Karuvel (T)		X					
251	Fabaceae	<i>Acacia panifrons</i>	Odai (T) Jungle Nail (E)			X	x			X
252	Fabaceae	<i>Acacia pennata</i>	Goda-hinguru (S)		X					
253	Fabaceae	<i>Adenanthera pavonina</i>	Madatiya (T) Anaikuntumani (T) Red Sandalwood (E)	M,F	X	X				
254	Fabaceae	<i>Aeschynomene indica</i>	Diya-siyambala (S) Indian Jointvetch (E)		X	X			X	
255	Fabaceae	<i>Aeschynomene villosa</i> *	Diyasiyambala (S) Thornless Mimosa (E)		X					
256	Fabaceae	<i>Albizia amara</i>	Thuringi (T)	M	X	X				
257	Fabaceae	<i>Albizia amara</i>	Thuringi (T)		X	X				X
258	Fabaceae	<i>Alysicarpus vaginalis</i>	Aswenna (S) Kuthiraivali (T) Alice Clover (E)	M	X	X				
259	Fabaceae	<i>Arachis hypogaea</i> *	Ratakaju (S) Nella-kadalai (T)	F	X	X				

			Earth Nut, Groundnut, Peanut (E)							
260	Fabaceae	<i>Atylosia scarabaecoides</i>	Wal-kollu (S)		X	X				
261	Fabaceae	<i>Bauhinia racemosa</i>	Maila (S) Atti (T)	M	X	X		X	X	X
262	Fabaceae	<i>Bauhinia tomentosa</i>	Kaha-pethan (S) Tiruvathi (T) Bell-bauhinia (E)	M,F	X	X		X		
263	Fabaceae	<i>Caesalpinia bonduc</i> <sup>MA</sup>	Kumburu-wel (S) Punaikkaichchi(T) Grey Nicker (E)	M	X	X	x	X		
264	Fabaceae	<i>Caesalpinia crista</i>	Diya-wawuletiya (S) Woodgossip Caesalpinia (E)		X					
265	Fabaceae	<i>Caesalpinia pulcherrima</i> *	Monara-mal (S) Peacock Flower (E)		X					
266	Fabaceae	<i>Canavalia cathartica</i>	Wild Bean (E)		X	X				
267	Fabaceae	<i>Canavalia rosea</i>	Mudu-awara (S)		X	X				
268	Fabaceae	<i>Cassia alata</i> *	Rata-tora (S) Candle Bush (E)	M,F	X	X			X	X
269	Fabaceae	<i>Cassia auriculata</i>	Rana-wara (S) Avarai (T) Matara Tea (E)	M,F	X	X	x	X	X	X
270	Fabaceae	<i>Cassia fistula</i> *	Ehela (S) Kavani (T) Indian Laburnum (E)	M,F	X	X		X		
271	Fabaceae	<i>Cassia occidentalis</i>	Peni-tora (S) Ponnantakarai (T) Coffee-senna (E)	M,F	X	X				
272	Fabaceae	<i>Cassia roxburghii</i>	Ratu-Wa (S)		X	X				X
273	Fabaceae	<i>Cassia tora</i>	Peti-tora (S) Vaddutakarai (T) Pot Cassia (E)	M,F	X	X				
274	Fabaceae	<i>Chamaecrista kleinii</i>	Bin-siyambala (S)			X				
275	Fabaceae	<i>Clitoria ternatea</i>	Katarodu-wel (S) Karuttappu (T)	M	X	X				
276	Fabaceae	<i>Crotalaria hebecarpa</i>	Bu-gota-kola (S)		X					
277	Fabaceae	<i>Crotalaria laburnifolia</i>	Yak-bariye (S) Rattle-box (E)		X	X				
278	Fabaceae	<i>Crotalaria pallida</i>	Andanaheriya (S) Smooth Rattle Box (E)		X					
279	Fabaceae	<i>Crotalaria verrucosa</i>	Yak-bariye (S) Kilukiluppai (T) Blue Andana (E)	M	X	X				
280	Fabaceae	<i>Cynometra iripa</i> <sup>MA</sup> CR	Opulu (S) Attukaddupulli (T)		X					
281	Fabaceae	<i>Delonix regia</i>	Mal-mara (S) Mayaram (T) Flame Tree (E)		X					X
282	Fabaceae	<i>Derris parviflora</i>	Sudu-Kala-wel (S)		X					
283	Fabaceae	<i>Derris scandens</i>	Bo-kala-wel (S) Tekil (T) Forest Beanstalk (E)		X	X	X			
284	Fabaceae	<i>Derris trifoliata</i> <sup>MA</sup>	Kala-wel (S) Tilankoddi (T)		X	X				
285	Fabaceae	<i>Desmodium heterophyllum</i>	Maha undu piyali, Et-undupiyali (S) Spanish Clover (E)	M	X	X				
286	Fabaceae	<i>Desmodium triflorum</i>	Heen-undupiyali (S) Narankodi (T) Creeping Tick Trefoil (E)	M	X	X				
287	Fabaceae	<i>Dichrostachys cinerea</i>	Katu-Andara (S) Vindattai (T) Sickie Bush (E)	M	X	X	x	X	X	
288	Fabaceae	<i>Erythrina variegata</i>	Erabadu (S) Mullu-murukku (T) Coral Tree (E)	M,F	X	X	X			X
289	Fabaceae	<i>Gliricidia sepium</i>	Kona (S) Kona (T) Mexican Lilac (E)		X	X				

290	Fabaceae	<i>Indigofera colutea</i>			X						
291	Fabaceae	<i>Indigofera linnaei</i>	Bin-avari (S) Cheppunerenchi (T)		X						
292	Fabaceae	<i>Indigofera oblongifolia</i>	Kuttukarasmatti (T)	M	X	X	X	X	X	X	X
293	Fabaceae	<i>Indigofera tinctoria</i>	Nil-awari (S) Nilam (T) Indigo (E)	M	X	X					X
294	Fabaceae	<i>Leucaena leucocephala</i> <sup>AS</sup>	Ipil-ipil (S) Tangavai (T) Ipil-ipil (E) Wild Tamarind (E)		X	X	X	X			
295	Fabaceae	<i>Macroptilium lathyroides</i> *	Wild Bushbean (E)			X					
296	Fabaceae	<i>Mimosa pudica</i> *	Nidi kumba (S) Tottal-vadi (T) Sensitive Plant (E)	M,F	X	X					
297	Fabaceae	<i>Neptunia oleracea</i>	Diya-nidikumba (S) Water Mimosa (E)			X				X	
298	Fabaceae	<i>Parkinsonia aculeata</i> *	Mulvakai (T) Mexican Palo-verde (E)		X						
299	Fabaceae	<i>Peltophorum pterocarpum</i>	Kaha-mara (S) Iya-vakai (T) Yellow Flame (E)		X	X					
300	Fabaceae	<i>Pithecellobium dulce</i> *	Andara (S) Kodaikaapulli (T) Madras Thorn (E)			X					
301	Fabaceae	<i>Pongamia pinnata</i>	Magul-karanda (S) Poona (T) Mullikulam Tree (E)	M	X	X					X
302	Fabaceae	<i>Prosopis juliflora</i> <sup>AS</sup>	Kalapu-andara (S) Mesquite (E)	F	X	X	X	X	X	X	X
303	Fabaceae	<i>Psophocarpus tetragonolobus</i> *	Dara-dambala (S) Winged Bean (E)	F	X	X					
304	Fabaceae	<i>Samanea saman</i> *	Mara (S) Rain Tree (E)		X	X					
305	Fabaceae	<i>Sesbania bispinosa</i>			X	X					
306	Fabaceae	<i>Sesbania grandiflora</i>	Kathuru-murunga (S) Akatti (T) Agati (E)	M,F	X	X					X
307	Fabaceae	<i>Tamarindus indica</i> *	Siyambala (S) Puli (T) Indian Date, Tamarind (E)	M,F	X	X		X			
308	Fabaceae	<i>Tephrosia purpurea</i>	Gam-pila (S) Kavilai (T) Common Tephrosia (E)	M	X	X	X				X
309	Fabaceae	<i>Tephrosia villosa</i>	Bu-pila (S) Hoarypea (E)	M	X	X					
310	Fabaceae	<i>Vigna marina</i>	Karal-li-me (S) Kodippayaru (T) Field Bean (E)	M	X						
311	Fabaceae	<i>Vigna mungo</i> *	Mun (S) Ulundu (T) Black Gram (E)	M	X	X					
312	Fabaceae	<i>Vigna radiata</i> *	Bu-me-mun (S) Chirupparatu (T) Mung Bean (E)	M	X						
313	Fabaceae	<i>Vigna trilobata</i>	Munwenna, Bin-me (S) Navippayaru (T)		X	X		X			X
314	Fabaceae	<i>Vigna unguiculata</i> *	Me-karal (S) Kodip-payam (T) Cowpea (E)		X						
315	Flacourtiaceae	<i>Flacourtia indica</i>	Uguressa (S) Katukali (T)	F	X						
316	Flagellariaceae	<i>Flagellaria indica</i>	Goyi-wel (S)	M	X						
317	Gentianaceae	<i>Enicostema axillare</i>	Vellakuru (T)	M	X	X		X			
318	Goodeniaceae	<i>Scaevola plumieri</i>	Heen takkada (S)		X						
319	Goodeniaceae	<i>Scaevola taccada</i>	Takkada (S) Half-flower (E)		X	X					
320	Hernandiaceae	<i>Gyrocarpus americanus</i>	Diya-labu-gas (S) Tanakku (T)		X	X					

321	Hippocrateaceae	<i>Salacia oblonga</i>	Himbutu (S) Chundan (T)	M,F	X					
322	Hippocrateaceae	<i>Salacia reticulata</i>	Kotala Himbutu (S)	M	X					
323	Hyacinthaceae	<i>Scilla hyacinthina</i>				X		X		
324	Hydrocharitaceae	<i>Enhalus acoroides</i> <sup>SG</sup>	Waattala (S)	F	X	X			X	
325	Hydrocharitaceae	<i>Halophila decipiens</i> <sup>SG</sup>			X					
326	Hydrocharitaceae	<i>Halophila ovalis</i> <sup>SG</sup>			X					
327	Hydrocharitaceae	<i>Thalassia hemprichii</i> <sup>SG</sup>	Chatelai (T)		X	X				X
328	Hypoxidaceae	<i>Curculigo trichocarpa</i>	Maha-bin-tal (S)			X		X		
329	Lamiaceae	<i>Hyptis suaveolens</i> *			X	X				
330	Lamiaceae	<i>Leonotis nepetiifolia</i>	Maha-yak-wanassa (S) Kasitumpai (T)	M	X	X				
331	Lamiaceae	<i>Leucas zeylanica</i>	Gata-tumba (S) Mudi-tumpai (T)	M,F	X	X				
332	Lamiaceae	<i>Ocimum americanum</i>	Heen-tala (S) Kanchankorai (T) Hoary Basil (E)	M	X	X				
333	Lamiaceae	<i>Ocimum tenuiflorum</i>	Maduru-tala (S) Sacred Basil (E)	M	X	X				
334	Lamiaceae	<i>Orthosiphon thymiflorus</i>		M		X				
335	Lamiaceae	<i>Platostoma menthoides</i>			X					
336	Lecythidaceae	<i>Berringtonia acutangula</i>	Ela-midella (S) Adampu (T)	M	X	X		X		
337	Linaceae	<i>Hugonia mystax</i>	Bu-getiya (S) Motirakanni (T)	M	X	X		X		
338	Loganiaceae	<i>Spigelia anthelmia</i> *	Wormbush (E)		X					
339	Loganiaceae	<i>Strychnos benthamii</i>			X					
340	Loganiaceae	<i>Strychnos nux-vomica</i>	Goda-kaduru (S) Eddi (T) Nux Vomica (E)	M	X	X				
341	Loganiaceae	<i>Strychnos potatorum</i>	Ingini (S) Tetta (T) Clearing Nut (E)	M	X	X				
342	Loranthaceae	<i>Dendrophthoe falcata</i>	Pilila (S)	M	X	X	X			
343	Loranthaceae	<i>Dendrophthoe ligulata</i> VU			X	X		X	X	
344	Loranthaceae	<i>Taxillus cuneatus</i> VU			X					
345	Lythraceae	<i>Lawsonia inermis</i>	Maruthondi (T) Mignonette Tree (E)		X	X				X
346	Lythraceae	<i>Pemphis acidula</i> <sup>MA</sup>	Mudu-wara (S) Kiri-maram (S)		X	X	x			
347	Malvaceae	<i>Abelmoschus esculentus</i> *	Bandakka (S) Vandakkay (T) Lady's Finger (E)	F	X	X				
348	Malvaceae	<i>Abelmoschus sp</i>			X					
349	Malvaceae	<i>Abutilon hirtum</i>	Vaddatutti (T)	M	X	X	X	X		
350	Malvaceae	<i>Abutilon indicum</i>	Anoda (S) Peruntulli (T)	M	X	X				X
351	Malvaceae	<i>Abutilon pannosum</i>				X				
352	Malvaceae	<i>Gossypium arboreum</i> *	Kapu (S) Cotton (E)	M	X	X				
353	Malvaceae	<i>Gossypium hirsutum</i> *			X					
354	Malvaceae	<i>Hibiscus eriocarpus</i>	Kapukinissa (S) Parutti (T)		X	X				
355	Malvaceae	<i>Hibiscus micranthus</i>	Bebila (S) Perumaddi (T)	M	X	X				
356	Malvaceae	<i>Hibiscus rosa-sinensis</i> *	Sapaththu mal, Wada (S) Shoeflower (E)	M	X	X				X
357	Malvaceae	<i>Hibiscus tiliaceus</i> <sup>MA</sup>	Beli-patta (S) Artia, Nir-paratthi (T)	M	X	X				X

358	Malvaceae	<i>Hibiscus vitifolius</i>	Maha-epala (S) Vaddattutti (T) Tropical Rose-mallow (E)	M	X	X	X	X		X
359	Malvaceae	<i>Malvastrum coromandelianum</i>	False mallow (E)			X				
360	Malvaceae	<i>Pavonia odorata</i>		M	X					
361	Malvaceae	<i>Sida acuta</i>	Gas-bevila (S) Vaddatiruppi (T) Common Sida (E)	M	X	X				
362	Malvaceae	<i>Sida cordata</i>	Bevila (S) Palampadu (T) Heartleaf Fanpetals (E)		X	X				
363	Malvaceae	<i>Sida cordifolia</i>	Wal-bevila (S) Chevakanpudu (T)	M	X	X				
364	Malvaceae	<i>Sida mysorensis</i>	Siriwadi-bavila (S)	M	X				X	
365	Malvaceae	<i>Sida rhombifolia</i>	Kotikan-bevila (S) Paddy's Lucerne (E)	M		X				
366	Malvaceae	<i>Thespesia populnea</i> <sup>MA</sup>	Suriya (S) Kavarachu, Puvarachu (T) Tulip Tree (E)	M	X	X	X	X	X	X
367	Martyniaceae	<i>Martynia annua</i> *	Naga Darani (S) Naga-tail (T) Tiger's Claws (E)		X	X				
368	Melastomataceae	<i>Memecylon capitellatum</i>	Weli-kaha (S) Katti-kaya (T)	M	X	X				
369	Melastomataceae	<i>Memecylon umbellatum</i>	Kora-kaha (S) Kaya (T) Blue mist (E)	M	X	X				
370	Meliaceae	<i>Azadirachta indica</i>	Kohomba (S) Vembu (T) Neem (E)	M	X	X	X	X	X	X
371	Meliaceae	<i>Cipadessa baccifera</i>	Hal-bembiya (S) Pulippan-cheddi (T)		X	X				
372	Meliaceae	<i>Melia azedarach</i>	Kiri-kohomba (S) Malvi-vembu (T) Bead Tree (E)	M	X	X				
373	Meliaceae	<i>Walsura trifoliolata</i>	Kirikon (S) Chadavakku (T)	M	X	X		X	X	
374	Meliaceae	<i>Xylocarpus granatum</i> <sup>M</sup>	Mutti-kadol (S) Kandal Anga (T)	M	X					
375	Meliaceae	<i>Xylocarpus rumphii</i> <sup>MA</sup>	Mudu Delum, Koon-talan (S)	M	X					
376	Menispermaceae	<i>Cassampelos pareira</i>	Diya-mitta (S) Appatta (T) Abuta (E)	M	X					
377	Menispermaceae	<i>Tinospora cordifolia</i>	Rasa-kinda (S) Chintil (T)	M	X	X				X
378	Menyanthaceae	<i>Nymphoides hydrophylla</i>	Heen-ambala, Heen-olu (S)		X					
379	Molluginaceae	<i>Gisekia pharnaceoides</i>	Atthiripala (S) Manalkirai (T)			X				
380	Molluginaceae	<i>Glinus lotoides</i>	Hairy Carpet Weed (E)			X				
381	Molluginaceae	<i>Glinus oppositifolia</i>	Henn-ala (S) Kachchantirai (T)	M,F	X					
382	Molluginaceae	<i>Mollugo cerviana</i>	Udetta (S) Pat-padakam (T) Threadstem Carpet Weed (E)	M	X					
383	Molluginaceae	<i>Mollugo pentaphylla</i>	Mollugo (E)	M,F	X	X				
384	Moraceae	<i>Artocarpus heterophyllus</i>	Kos (S) Pila (T) Jak (E)	M,F	X					
385	Moraceae	<i>Ficus amplissima</i>	Ela-nuga (S) Kalatti (T)		X	X	X		X	X
386	Moraceae	<i>Ficus benghalensis</i>	Maha-nuga (S) Arla (T) Banyan (E)	M	X	X	X	X	X	X
387	Moraceae	<i>Ficus hispida</i>	Kota-dimbula (S)	M	X	X	x			
388	Moraceae	<i>Ficus mollis</i>	Wal-aralu (S)		X					
389	Moraceae	<i>Ficus racemosa</i>	Attikka (S) Atti (T)	M,F	X	X				
390	Moraceae	<i>Ficus religiosa</i>	Bo (S) Arachu (T) Bo-Tree (E)	M	X	X				



391	Moraceae	<i>Strelbus asper</i>	Gata-netul (S) Patpirai (T) Crooked Rough-bush (E)	M	X	X		X	X	
392	Moringaceae	<i>Moringa oleifera</i> *	Murunga (S) Murungamaram (T) Horse Radish Tree (E)	M,F	X	X				X
393	Musaceae	<i>Musa x.paradisiaca</i> *	Kesel (S) Valippalam (T) Banana (E)	M,F	X	X				
394	Myrsinaceae	<i>Aegiceras corniculata</i> <sup>M</sup>	Avari-Kadol, Heen-kadol (S) Vitlikanna (T) River Mangrove (E)		X	X				
395	Myrtaceae	<i>Eucalyptus sp</i> *			X					
396	Myrtaceae	<i>Psidium guajava</i> *	Pera (S) Guava (E)	M,F	X	X				X
397	Myrtaceae	<i>Syzygium cumini</i>	Madan, Maha-dan (S) Naval, Perunaval (T) Java Plum (E)	M,F	X	X		X		X
398	Najadaceae	<i>Najas minor</i>			X					
399	Nelumbonaceae	<i>Nelumbo nucifera</i>	Nelum (S) Tamarai (T) Lotus (E)	M,F	X	X				
400	Nyctaginaceae	<i>Boerhavia diffusa</i>	Pita-sudu-pala (S) Karichcharanai (T)	M,F	X	X				
401	Nyctaginaceae	<i>Bougainvillea spectabilis</i> *	Bougainvillea (E)		X	X				
402	Nyctaginaceae	<i>Pisonia grandis</i>	Wathabanga, Lechchakotta (S) Chandi (T) Lettuce Tree (E)	M,F	X					
403	Nymphaeaceae	<i>Nymphaea nouchali</i>	Manel (S) Common Water Lily (E)	M,F	X	X				
404	Nymphaeaceae	<i>Nymphaea pubescens</i>	Ela-olu (S) Red Water Lily (E)	M		X				
405	Ochnaceae	<i>Gomphia serrata</i>	Bo-kara( S) Katharai (T)			X		X		
406	Ochnaceae	<i>Ochna obtusata</i>	Mal-keru (S) Chilanti (T)	M	X	X		X		X
407	Oleaceae	<i>Jasminum angustifolium</i>	Wal-pichcha (S) Wild Jasmine (E)	M	X	X				
408	Oleaceae	<i>Jasminum auriculatum</i>			X			X		
409	Oleaceae	<i>Jasminum grandiflorum</i> *	Saman-pichcha (S)	M	X					
410	Oleaceae	<i>Jasminum rotterianum</i>			X					
411	Onagraceae	<i>Ludwigia adscendens</i>	Beru-diyaniilla (S) Creeping Water Primrose (E)		X					
412	Onagraceae	<i>Ludwigia perennis</i>			X					
413	Orchidaceae	<i>Vanda spathulata</i>				X			X	
414	Orchidaceae	<i>Vanda tessellata</i> VU	Rassana (S) Anuradhapura Orchid (E)	M	X	X				
415	Oxalidaceae	<i>Biophytum nervifolium</i>	Gas-nidikumba (S)	M	X	X				
416	Oxalidaceae	<i>Oxalia barrelieri</i> *	Barrelier's Woodsorrel (E)		X	X				
417	Pandanaceae	<i>Pandanus odoratissimus</i> <sup>MA</sup>	Mudu-keyiya (S) Talai (T) Screw Pine (E)		X	X				X
418	Passifloraceae	<i>Adenia wightiana</i>				X				
419	Passifloraceae	<i>Passiflora edulis</i> *	Wal-dodan (S) Passion Fruit Vine (E)	F	X	X				
420	Passifloraceae	<i>Passiflora foetida</i> *	Delbatu (S) Kodimathulai (T) Common Passion Flower (E)		X	X				X
421	Pedaliaceae	<i>Pedaliium murex</i>	Et-nerenchi (S) Anai-nerinchi (T) Common Pedalium (E)	M	X	X				X
422	Pedaliaceae	<i>Sasamum indicum</i> *	Tel-tala (S) Ella (T) Gingelly (E)	M,F	X	X				

423	Pedaliaceae	<i>Sesamum radiatum</i>			X	X				
424	Periplocaceae	<i>Cryptostegia grandiflora</i> *	Rubber Vine (E)		X					
425	Periplocaceae	<i>Hemidesmus indicus</i>	Heen-Iramusu (S) Nannari (T) Indian Sarsaparilla (E)	M,F	X	X				
426	Plumbaginaceae	<i>Plumbago zeylanica</i>	Ela-netul (S) Ceylon Leadwort (E)	M	X					
427	Poaceae	<i>Alloteropsis cimicina</i>	Budeni-tana (S) Unni-pul (T)		X					
428	Poaceae	<i>Aristida setacea</i>	Et-tuttiri (S)		X					
429	Poaceae	<i>Bambusa bambos</i>	Kaha-una (S) Mungil (T) Spiny Bamboo (E)	M,F	X					
430	Poaceae	<i>Chloris barbata</i>	Mayuru-tana (S) Kandai-pul (T)		X					
431	Poaceae	<i>Chrysopogon aciculatus</i>	Tuttiri (S) Ottu-pul (T) Love Grass (E)	M	X					
432	Poaceae	<i>Cynodon dactylon</i>	Ruha (S) Arugam-pillu (T) Bermuda Grass (E)	M	X	X				
433	Poaceae	<i>Dactyloctenium aegyptium</i>	Bela-thana, Putu-tana (S)	M	X	X				
434	Poaceae	<i>Echinochloa colona</i>	Gira-tana (S) Adipul (T)	F	X	X				
435	Poaceae	<i>Eleusine indica</i>	Bela-tana (S)		X					
436	Poaceae	<i>Eragrostis ciliaris</i>			X					
437	Poaceae	<i>Eragrostis viscosa</i>			X					
438	Poaceae	<i>Heteropogon contortus</i>	I-tana (S)	M	X					
439	Poaceae	<i>Hygroryza aristata</i>	Go-jabba, Beru-tana (S)	M	X					
440	Poaceae	<i>Imperata cylindrica</i> <sup>AS</sup>	Iluk (S) Varli-pillu (T)	M	X	X				
441	Poaceae	<i>Ischaemum ciliare</i>	Rat-tana (S)		X					
442	Poaceae	<i>Leptochloa neesii</i>			X					
443	Poaceae	<i>Oryza sativa</i>	Wi (S) Paddy (E)	M,F	X	X				
444	Poaceae	<i>Panicum repens</i>	Etoru (S) Inji-pul (T)	M	X	X				
445	Poaceae	<i>Panicum sumatrense</i> *	Heen-meneri (S) Shamai (T)		X	X				
446	Poaceae	<i>Panicum maximum</i> <sup>AS</sup>	Rata-tana (S) Guinea Grass (E)		X	X				
447	Poaceae	<i>Paspalum distichum</i>			X					
448	Poaceae	<i>Saccharum officinarum</i> *	Uk (S) Karumbu (T) Sugar-cane (E)	M,F	X	X				X
449	Poaceae	<i>Setaria barbata</i>			X					
450	Poaceae	<i>Spinifex littoreus</i>	Maha-ravana-ravula (S) Ravanan-meesai (T)		X	X		X		X
451	Poaceae	<i>Sporobolus virginicus</i>	Mudu-etora (S)		X	X				
452	Poaceae	<i>Zea mays</i> *	Bada-iringu (S) Makka-cholam (T) Maize (E)	F	X	X				
453	Poaceae	<i>Zoysia matrella</i>			X					
454	Polygalaceae	<i>Polygala chinensis</i>	Cinese Milkwort (E)	M	X					
455	Polygonaceae	<i>Persicaria attenuata</i>	Sudu-kimbul-wenna (S) Water martweed (E)		X	X				
456	Polygonaceae	<i>Persicaria glabra</i>	Pink-rod (E)			X				
457	Pontederiaceae	<i>Eichhornia crassipes</i> <sup>AS</sup>	Japan-jabara (S) Water Hyacinth (E)		X	X				
458	Pontederiaceae	<i>Monochoria vaginalis</i>	Diya-habarala (S) Pickerel Weed (E)	M,F	X	X				
459	Portulacaceae	<i>Portulaca grandiflora</i>	Common Rose Moss (E)		X					

460	Portulacaceae	<i>Portulaca oleracea</i>	Genda-kola (S) Sun-plant (E) Pulikkirai (T)	M	X	X				X
461	Portulacaceae	<i>Portulaca quadrifida</i>	Heen-genda-kola (S) Chiken Weed (E)	M,F	X					
462	Potamogetonaceae	<i>Potamogeton sp</i> <sup>SG</sup>			X					
463	Potamogetonaceae	<i>Ruppia maritima</i> <sup>SG</sup>			X					
464	Punicaceae	<i>Punica granatum</i> *	Delum (S) Madalai (T) Pomegranate (E)	M,F	X	X				X
465	Rhamnaceae	<i>Colubrina asiatica</i>	Tel-hiriya (S) Mayirmanikkam (T)	M	X	X				
466	Rhamnaceae	<i>Scutia myrtina</i>	Tudari (T)		X	X		X		
467	Rhamnaceae	<i>Ziziphus mauritiana</i>	Debera, Masan (S) Ilantai (T) Indian Jujube (E)	M	X	X			X	X
468	Rhamnaceae	<i>Ziziphus oenoplia</i>	Heen-eramiya (S) Churai (E)	M	X	X				
469	Rhamnaceae	<i>Ziziphus xylopyrus</i>	Kakuru, Masan (S) Nari-ilantai (T)		X	X				
470	Rhizophoraceae	<i>Bruguiera cylindrica</i> <sup>M</sup>	Mal-kadol (S)		X					
471	Rhizophoraceae	<i>Bruguiera gymnorhiza</i> <sup>M</sup>	Mal-kadol (S) Mangrove (E)		X					
472	Rhizophoraceae	<i>Ceriops tagal</i> <sup>M</sup>	Pun-kanda (S) Chiru-kanal (T)		X	X	x	X		
473	Rhizophoraceae	<i>Rhizophora apiculata</i> <sup>M</sup>	Maha-Kadol (S) Kandal (T)		X					
474	Rhizophoraceae	<i>Rhizophora mucronata</i> <sup>M</sup>	Maha-kadol (S) Kandal (T) Asiatic Mangrove (E)		X	X	x		X	X
475	Rubiaceae	<i>Benkara malabarica</i>	Pudan (S)		X					
476	Rubiaceae	<i>Canthium coromandelicum</i>	Kara (S) Karai (T) Spring Randia (E)	F	X	X		X		X
477	Rubiaceae	<i>Cantunaregam spinosa</i>	Kukuruman (S) Karai (T) False Guava (E)		X	X		X	X	
478	Rubiaceae	<i>Guettarda speciosa</i>	Nil-pichcha (S) Panir (T)			X				
479	Rubiaceae	<i>Hydrophylax maritima</i>	Mudu-geta-kola (S) East Indian Waterbluet (E)		X	X				
480	Rubiaceae	<i>Ixora coccinea</i>	Ratambala (S) Vedchi (T) Jungle Flame (E)	M	X	X				
481	Rubiaceae	<i>Ixora pavetta</i>	Maha-ratambala (S) Kanmuttankirai (T) Torch Tree (E)		X	X				
482	Rubiaceae	<i>Mitragyna parvifolia</i>	Halamba (S)		X	X			X	
483	Rubiaceae	<i>Morinda citrifolia</i>	Ahu (S) Manchavanna (T) Great Morinda (E)	M	X					
484	Rubiaceae	<i>Morinda coreia</i>	Ahu (S) Manchavanna (T)		X	X		X		
485	Rubiaceae	<i>Nauclea orientalis</i>	Bakmi (S) Atuvangi (T)	M,F	X	X				
486	Rubiaceae	<i>Oldenlandia biflora</i>	Thirapala (S)	M	X					
487	Rubiaceae	<i>Oldenlandia herbacea</i>		M	X					
488	Rubiaceae	<i>Oldenlandia umbellata</i>	Saya (S) Chaya (T) Chay-root (E)	M	X					
489	Rubiaceae	<i>Pavetta indica</i>	Pavatta (S) Pavddai (T)	M	X	X		X		
490	Rubiaceae	<i>Psilanthus wightianus</i> CR	Kaddumallikai (T)			X				
491	Rubiaceae	<i>Psydrax dicoccos</i>	Panakarawa (S) Vatchikuran (T) Ceylon Box Wood (E)		X	X				
492	Rubiaceae	<i>Scyphiphora hydrophyllacea</i> <sup>MA</sup> CR	Keera Kadol (S) Black Mangrove (E)		X					
493	Rubiaceae	<i>Spermacoce articularis</i>			X					

494	Rubiaceae	<i>Spermacoce hispida</i>	Heen-geta-kola (S) Nattaichchuri (T)		X					
495	Rubiaceae	<i>Tarenna asiatica</i>	Tarana (S) Karanai (T)	M	X	X				
496	Rutaceae	<i>Aegle marmelos*</i>	Beli (S) Vilvam (T) Bael Fruit (E)	M,F	X	X				
497	Rutaceae	<i>Atalantia ceylanica</i>	Yakinaran (S) Pey-kuruntu (T)	M	X	X				
498	Rutaceae	<i>Atalantia racemosa</i>			X					
499	Rutaceae	<i>Chloroxylon swietenia</i>	Buruta (S) Muritai (T) Satinwood (E)	M	X	X		X		
500	Rutaceae	<i>Citrus aurantifolia*</i>	Dehi (S) Desi-kai (T) True Lime (E)	M	X	X				
501	Rutaceae	<i>Citrus aurantium*</i>	Ambul Dodan (S) Narankai (T) Sour Orange (E)	M,F	X	X				
502	Rutaceae	<i>Citrus limon*</i>	Lemon (E)	F	X	X				
503	Rutaceae	<i>Citrus sinensis*</i>	Peni Dodan (S) Sweet Orange (E)	F	X	X				
504	Rutaceae	<i>Clausena indica</i>	Migon-karapincha (S) Pannai (T)	M	X					
505	Rutaceae	<i>Glycosmis mauritiana</i>	Dodan-pana (S) Kula-pannai (T)		X	X				
506	Rutaceae	<i>Glycosmis pentaphylla</i>	Dodan-pana (S) Kula-pannai (T)	M		X				
507	Rutaceae	<i>Limonia acidissima</i>	Divul (S) Mayaladikkuruntu, Vilatti (T) Wood-apple (E)	F	X	X		X		
508	Rutaceae	<i>Micromelum minutum</i>	Wal-karapincha (S) Kakaipalai (T)	M	X	X				
509	Rutaceae	<i>Murraya koenigii</i>	Karapincha (S) Karivempu (T) Curry-leaf (E)	M,F	X	X				X
510	Rutaceae	<i>Murraya paniculata</i>	Etteriya (S) Orange Jassamine (E)		X					
511	Rutaceae	<i>Paramignya monophylla</i>	Wellangiriya (S)		X					
512	Rutaceae	<i>Toddalia asiatica</i>	Kudu-miris (S) Kandai (T)	M	X	X		X		
513	Salvadoraceae	<i>Azima tetracantha</i>	Ichanku (T) Needle Bush (E)	M	X	X	x	X	X	
514	Salvadoraceae	<i>Salvadora persica</i>	Malithan (S) Uvay (T)	M	X	X	X	X	X	X
515	Santalaceae	<i>Santalum album*</i>	Sudu-handun (S) Sandal Maram (T) Sandalwood (E)	M	X					
516	Sapindaceae	<i>Allophylus cobbe</i>	Kobbe (S) Amarai (T)	M	X	X				
517	Sapindaceae	<i>Cardiospermum halicacabum</i>	Wal-penela (S) Ballon Vine (E)	M,F	X	X				
518	Sapindaceae	<i>Dodonaea viscosa</i>	Eta-werella (S) Virali (T)	M	X	X			X	X
519	Sapindaceae	<i>Filicium decipiens</i>	Pehimbiya (S) Chitteraivempu (T)		X					
520	Sapindaceae	<i>Lepisanthes tetraphylla</i>	Dambu (S) Nekota (T)		X	X	x	X		
521	Sapindaceae	<i>Schleichera oleosa</i>	Kon (S) Kula (T) Ceylon Oak (E)	M,F	X	X				
522	Sapotaceae	<i>Madhuca longifolia</i>	Mee (S) Illupai (T) Mousey Mi (E)	M,F	X	X	x			X
523	Sapotaceae	<i>Manilkara hexandra</i>	Palu (S) Palai (T)	M,F	X	X	x	X	X	
524	Scrophulariaceae	<i>Bacopa monnieri</i>	Lunu-wila (S) Water Hyssop (E)	M,F	X	X				X
525	Scrophulariaceae	<i>Centranthera indica</i>	Dutu-satutu (S)	M	X	X				
526	Scrophulariaceae	<i>Dopatrium nudicaule</i>	Bin-sawan (S) Horsefly's Eye (E)		X					
527	Scrophulariaceae	<i>Lindernia crustacea</i>			X					
528	Scrophulariaceae	<i>Lindernia pusilla</i>			X					
529	Scrophulariaceae	<i>Lindernia rotundifolia</i>			X					

530	Scrophulariaceae	<i>Scoparia dulcis</i> *	Wal-kottamalli (S) Sweet Broom Weed (E)	M,F	X	X				
531	Solanaceae	<i>Capsicum annuum</i> *	Miris (E) Chilli (E)	M,F	X	X				
532	Solanaceae	<i>Capsicum frutescens</i> *	Kochi (S) Bird Pepper (E)	F	X	X				
533	Solanaceae	<i>Datura metel</i>	Attana (S) Venumattai (T) Devil's Trumpet (E)	M	X	X	x			
534	Solanaceae	<i>Lycopersicon esculentum</i> *	Takkali (S) Tomato (E)	F	X	X				
535	Solanaceae	<i>Physalia angulata</i> *	Cutleaf Groundcherry (E)		X					
536	Solanaceae	<i>Solanum macrocarpon</i> *	Wam-batu (S)	F	X	X				
537	Solanaceae	<i>Solanum melongena</i> *	Thalana-batu/Ela-batu (S) Vaddu (T) Egg Plant (E)	M,F	X	X				
538	Solanaceae	<i>Solanum torvum</i>	Gona-batu (S) Turkey Berry (E)	F	X					
539	Solanaceae	<i>Solanum trilobatum</i>	Wel-tibbatu (S) Tuttuvalai (T)	M,F	X	X	X			X
540	Solanaceae	<i>Solanum virginianum</i>	Katu-wel-batu (S) Kandan-kattai (T)	M	X	X				X
541	Sonneratiaceae	<i>Sonneratia alba</i> <sup>M</sup>	Sudu-Kirala( S) Kinnai (T)		X	X	x	X		
542	Sterculiaceae	<i>Heritiera littoralis</i> <sup>M</sup>	Attoona (S) Chonmuntiri (S) Boat-shaped Mangrove (E)		X					
543	Sterculiaceae	<i>Melochia corchorifolia</i>	Gal-kura (S) Chcolate weed (E)		X					
544	Sterculiaceae	<i>Pterospermum suberifolium</i>	Velang (S) Taddaemarum (T) Fishing Rod Tree (E)		X	X				
545	Sterculiaceae	<i>Waltheria indica</i>	Punnikki (T) Sleepy Morning (E)		X					
546	Tamaricaceae	<i>Tamarix indica</i> <sup>MA</sup>	Karai (T) Tamarisk (E)		X	X		X	X	
547	Tiliaceae	<i>Berrya cordifolia</i>	Hal-milla (S) Chvandalai (T) Trincomalee Wood (E)		X	X				
548	Tiliaceae	<i>Cochorus aestuans</i> *			X	X				
549	Tiliaceae	<i>Grewia carpinifolia</i>			X	X				
550	Tiliaceae	<i>Grewia damine</i>	Daminiya (S) Cadachi (T)	M		X				
551	Tiliaceae	<i>Grewia helicterifolia</i>	Bora-damaniya (S) Taviddai (T)		X	X				
552	Tiliaceae	<i>Grewia orientalis</i>	Wel-mediya (S) Taviddai (T)	F	X	X				
553	Tiliaceae	<i>Grewia tanax</i>	Achu (T)		X					X
554	Tiliaceae	<i>Muntingia calabura</i> *	Jam (S) Jam Tree (E)		X	X				
555	Tiliaceae	<i>Triumfetta sp</i>			X	X				
556	Turneraceae	<i>Turnera ulmifolia</i> *	Twelve o'clock Flower (E)		X					X
557	Typhaceae	<i>Typha angustifolia</i> <sup>AS</sup>	Hambu pan (S) Cat-tail (E)		X	X	X			
558	Ulmaceae	<i>Trema orientalis</i>	Gadumba (S) Charcoal Tree (E)		X					
559	Verbenaceae	<i>Clerodendrum inerme</i> <sup>MA</sup>	Bu-renda (S) Dangamkuppi (T) Common Hedge Bower (E)	M	X	X	x	X	X	
560	Verbenaceae	<i>Clerodendrum phlomidis</i>	Gas Pinna (S) Talu-dala (T)		X	X		X		
561	Verbenaceae	<i>Gmelina asiatica</i>	Heen-Demata (S) Kumil (T) Asiatic Beechberry (E)	M	X	X			X	
562	Verbenaceae	<i>Lantana camara</i> <sup>AS</sup>	Hinguru, Ganda-pana (S)	M,F	X	X			X	X





## Annex 3: Checklist of the Fauna of the Gulf of Mannar Region

Legends and abbreviations used in the text:

<b>BrR</b>	Breeding Resident
<b>WV</b>	Winter Visitor
<b>WVa</b>	Winter Vagrant
<b>Va</b>	Vagrant
<b>SU</b>	Status Unknown
<b>SV</b>	Summer Visitor
<b>PM</b>	Passage Migrant
<b>R</b>	Resident
<b>UWV</b>	Uncertain Winter Visitor
<b>UBr</b>	Uncertain Breeding Resident
<b>Pro: endemic</b>	Proposed endemic
<b>CR</b>	Critically Endangered
<b>EN</b>	Endangered
<b>VU</b>	Vulnerable
<b>NT</b>	Near Threatened
<b>DD</b>	Data Deficient
<b>KAL</b>	Kalpitiya DSD
<b>VAN</b>	Vanathavillu DSD
<b>MUS</b>	Musali DSD
<b>NAN</b>	Nanaddan DSD
<b>MAW</b>	Mantai-west DSD
<b>MAN</b>	Mannar DSD
<b>SpS</b>	Species status
<b>CoS</b>	Conservation Status

### Dragonfly checklist

	Scientific Name	English Name	SpS	CoS	KAL	VAN	MUS	NAN	MAW	MAN
<b>Family - Lestidae</b>										
1	<i>Lestes elatus</i>	White-tipped Spreadwing	Indigenous		0	0	0	0	0	1
<b>Family - Coenagrionidae</b>										
2	<i>Ischnura aurora</i>	Dawn Bluetail	Indigenous		0	0	0	0	0	1
3	<i>Pseudagrion malabaricum</i>	Malabar Sprite	Indigenous		0	1	0	0	0	0
<b>Family - Platycnemididae</b>										
4	<i>Copera marginipes</i>	Yellow Featherleg	Indigenous		0	1	0	0	0	0
<b>Family - Aeshnidae</b>										
5	<i>Gynacantha dravida</i>	Indian Duskhawker	Indigenous		0	1	0	0	0	0
<b>Family - Libellulidae</b>										
6	<i>Orthetrum sabina</i>	Green Skimmer	Indigenous		0	1	0	0	0	0
7	<i>Bradinopyga geminata</i>	Indian Rockdweller	Indigenous		0	0	0	0	0	1
8	<i>Diplacodes trivialis</i>	Blue Percher	Indigenous		0	0	0	0	0	1
9	<i>Neurothemis intermedia</i>	Paddyfield Parasol	Indigenous		0	1	0	0	0	0
10	<i>Rhodothemis rufa</i>	Spine-legged Redbolt	Indigenous		0	1	0	0	0	0
11	<i>Trithemis aurora</i>	Crimson Dropwing	Indigenous		0	1	0	0	0	0
12	<i>Rhyothemis variegata</i>	Variegated Flutter	Indigenous		0	1	0	0	0	0
13	<i>Pantala flavescens</i>	Wandering Glider	Indigenous		1	1	1	1	1	1
14	<i>Tramea limbata</i>	Sociable Glider	Indigenous		0	0	0	0	0	1
	TOTAL				1	9	1	1	1	6
Sources - IUCN Field Survey October 2010										

### Butterfly checklist

	Scientific Name	English Name	Sinhala Name	SpS	CoS	KAL	VAN	MUS	NAN	MAW	MAN
<b>Family - Papilionidae</b>											
1	<i>Pachliopta hector</i>	Crimson Rose	Maha rosa papilia	Indigenous		1	1	1	1	1	1
2	<i>Pachliopta aristolochiae</i>	Common Rose	Podu rosa papilia	Indigenous		1	1	0	0	0	0
3	<i>Papilio crino</i>	Banded Peacock	Monara papilia	Indigenous		1	1	0	0	0	0
4	<i>Papilio domoleus</i>	Lime Butterfly	Kaha papilia	Indigenous		1	1	0	0	0	1
5	<i>Papilio polytes</i>	Common Mormon	Kalu papilia	Indigenous		1	1	0	0	0	0
6	<i>Papilio polymnestor</i>	Blue Mormon	Maha nilaya	Indigenous		1	1	0	0	0	0

7	<i>Graphium doson</i>	Common Jay	Podu papilia	Indigenous		1	1	0	0	0	0
8	<i>Graphium agamemnon</i>	Green Jay / Tailed Jay	Kola papilia	Indigenous		1	1	0	0	0	0
<b>Family - Pieridae</b>											
9	<i>Leptosia nina</i>	Psyche	Kalu-thith sudda	Indigenous		1	1	0	0	0	0
10	<i>Delias eucharis</i>	Jezebel	Podu Maha-sudda	Indigenous		1	1	0	0	0	0
11	<i>Belenois aurota</i>	Pioneer	Thambiliwan sudana	Indigenous		0	1	0	0	0	0
12	<i>Cepora nerissa</i>	Common Gull	Podu Punduru-sudana	Indigenous		1	1	0	0	0	0
13	<i>Appias libythea</i>	Striped Albatross	Iri sudana	Indigenous	NT	1	1	0	0	0	0
14	<i>Ixias marianne</i>	White Orange Tip	Sudu maha sudana	Indigenous		0	1	0	0	0	0
15	<i>Ixias pyrene</i>	Yellow Orange Tip	Kaha maha sudana	Indigenous		1	1	0	0	0	0
16	<i>Hebomoia glaucippe</i>	Great Orange Tip	Yoda sudana	Indigenous		0	1	0	0	0	0
17	<i>Catopsilia pyranthe</i>	Mottled Emigrant	Thith-piya piyasariya	Indigenous		1	1	0	1	1	1
18	<i>Catopsilia pomona</i>	Lemon Emigrant	Kaha piyasariya	Indigenous		1	1	0	1	1	1
19	<i>Colotis amata</i>	Small Salmon Arab	Punchi rosa sudana	Indigenous	NT	1	1	1	0	0	1
20	<i>Colotis fausta</i>	Large Salmon Arab	Maha rosa sudana	Indigenous	VU	0	1	1	0	0	0
21	<i>Colotis danae</i>	Crimson Tip	Rathu-thudu sudda	Indigenous	NT	0	1	1	0	0	0
22	<i>Colotis aurora</i>	Plain Orange Tip	Podu tembiliwan sudana	Indigenous	VU	0	1	0	0	0	0
23	<i>Colotis etrida</i>	Little Orange Tip	Heen sudana	Indigenous	NT	1	1	0	0	0	0
24	<i>Eurema brigitta</i>	Small Grass Yellow	Punchi kahakolaya	Indigenous		0	1	0	0	0	0
25	<i>Eurema hecabe</i>	Common Grass Yellow	Maha kahakolaya	Indigenous		1	1	0	0	0	0
<b>Family - Nymphalidae</b>											
26	<i>Tirumala limniace</i>	Blue Tiger	Podu nil-kotithiya	Indigenous		1	1	0	0	0	0
27	<i>Tirumala septentrionis</i>	Dark Blue Tiger	Anduruwan nil-kotithiya	Indigenous	NT	0	1	0	0	0	0
28	<i>Parantica aglea</i>	Glassy Tiger	Suduwan nil-kotithiya	Indigenous		1	1	0	0	0	0
29	<i>Danaus chrysippus</i>	Plain Tiger	Podu koti-thambiliya	Indigenous		1	1	0	0	0	1
30	<i>Danaus genutia</i>	Common Tiger	Iri Koti-thambiliya	Indigenous		1	1	0	0	0	0
31	<i>Euploea core</i>	Common Crow	Podu kaka-kotithiyaya	Indigenous		1	1	0	0	0	0
32	<i>Euploea sylvester</i>	Double-banded Crow	De-iri kaka-kotithiya	Indigenous		0	1	1	0	0	1
33	<i>Ariadne ariadne</i>	Angled Castor	Ruthu pathan-sariya	Indigenous		1	1	0	0	0	0
34	<i>Byblia ilithyia</i>	Joker	Kawataya	Indigenous	NT	0	1	0	0	0	0
35	<i>Phalantha phantha</i>	Leopard	Podu thith-thambiliya	Indigenous		0	1	0	0	0	1
36	<i>Junonia lemonias</i>	Lemon Pansy	Dumburuwan alankarikya	Indigenous		1	1	0	0	0	0

37	<i>Junonia atlites</i>	Grey Pansy	Aluwan alankarikya	Indigenous		0	1	0	0	0	0
38	<i>Junonia iphita</i>	Chocolate Soldier	Podu alankarikya	Indigenous		1	1	0	0	0	0
39	<i>Junonia almana</i>	Peacock Pansy	Monera alankarikya	Indigenous		1	1	0	0	0	0
40	<i>Hypolimnas bolina</i>	Great Eggfly	Maha alankarikya	Indigenous		0	0	0	0	0	1
41	<i>Hypolimnas misippus</i>	Danaid Eggfly	Kela Alankarikya	Indigenous		0	0	0	0	0	1
42	<i>Neptis hylas</i>	Common Sailor	Gomara selaruwa	Indigenous		1	1	0	0	0	0
43	<i>Dophla evelina</i>	Redspot Duke	Rathu-thith Kumaraya	Indigenous		0	1	0	0	0	0
44	<i>Acraea violae</i>	Tawny Costor	Thambily panduru-boraluwa	Indigenous		1	1	0	0	0	0
45	<i>Melanitis leda</i>	Common Evening Brown	Podu dumburuwa	Indigenous		0	1	0	0	0	0
46	<i>Orsotriaena medus</i>	Nigger	Maha-iri panduru-dumburuwa	Indigenous		0	1	0	0	0	0
47	<i>Mycalesis perseus</i>	Common Bushbrown	Podu panduru-dumburuwa	Indigenous		0	1	0	0	0	0
48	<i>Nissanga patnia</i>	Gladeye Bushbrown	Visithuru panduru-dumburuwa	Indigenous		0	1	0	0	0	0
49	<i>Ypthima ceylonica</i>	White Four Ring	Podu heen-dumburuwa	Indigenous		1	1	0	0	0	0
50	<i>Elymnias hypermnestra</i>	Common Palmfly	Podu thal-dumburuwa	Indigenous		1	1	0	0	0	0
<b>Family - Lycaenidae</b>											
51	<i>Arhopala amantes</i>	Large Oakblue	Maha gas-nilaya	Indigenous		0	1	0	0	0	0
52	<i>Azonus jesous</i>	African Babul Blue	Apricanu neelaya	Indigenous		0	1	0	0	0	0
53	<i>Azonus ubaldus</i>	Bright Babul Blue	Punchi neelaya	Indigenous	CR	0	1	0	0	0	0
54	<i>Castalius rosimon</i>	Common Pierrot	Podu Mal-nilaya	Indigenous		0	1	0	1	0	0
55	<i>Catochrysops strabo</i>	Forget-me-not	Kela Mal-nilaya	Indigenous		1	1	0	0	0	0
56	<i>Chilades lajus</i>	Lime Blue	Podu Panu-nilaya	Indigenous		0	1	0	0	0	0
57	<i>Chilades pandava</i>	Plains Cupid	Lanka Panu-nilaya	Indigenous		0	1	0	0	0	0
58	<i>Chilades parrhasius</i>	Small Cupid	Punchi Panu-nilaya	Indigenous	VU	1	1	0	0	0	0
59	<i>Curetis thetis</i>	Indian Sunbeam	Maha hiru-nilaya	Indigenous		0	1	0	0	0	0
60	<i>Deudorix epijarbas</i>	Cornelian	Podu Kirana-nilaya	Indigenous	VU	0	1	0	0	0	0
61	<i>Euchrysops cnejus</i>	Gram Blue	Maha Panu-nilaya	Indigenous		1	1	0	0	0	0
62	<i>Freyeria trochilus</i>	Grass Jewel	Ran Thruna-nilaya	Indigenous		1	1	0	0	0	0
63	<i>Jamides celeno</i>	Common Cerulean	Podu Seru-nilaya	Indigenous		0	1	0	0	0	0
64	<i>Lampides boeticus</i>	Pea Blue	Maha Iri Mal-nilaya	Indigenous		0	1	0	0	0	1
65	<i>Megisba malaya</i>	Malayan	Podu Dumburu-nilaya	Indigenous		0	1	0	0	0	0
66	<i>Rathinda amor</i>	Monkey Puzzle	Visituru vanduru nilaya	Indigenous		0	1	0	0	0	0

67	<i>Spalgis epeus</i>	Apefly	Wanduru nilaya	Indigenous		0	1	0	0	0	0
68	<i>Spindasis ictis</i>	Ceylon Silverline	Lanka Ridee-nilaya	Indigenous	NT	0	1	0	0	0	0
69	<i>Spindasis vulcanus</i>	Common Silverline	Podu Ridee-nilaya	Indigenous		0	1	0	0	0	0
70	<i>Syntarucus plinius</i>	Zebra Blue	Raja Iri-Neelaya	Indigenous		0	1	0	0	0	0
71	<i>Tajuria cippus</i>	Peacock Royal	Monara Raja-nilaya	Indigenous		0	1	0	0	0	0
72	<i>Talicauda nyseus</i>	Red Pierrot	Rathu Panduru-nilaya	Indigenous		0	1	0	0	0	0
73	<i>Zesius chrysomallus</i>	Redspot	Rathu-thith gas-nilaya	Indigenous		0	1	0	0	0	0
74	<i>Zizeeria karsandra</i>	Dark Grass Blue	Anduruwan Thrurna-nilaya	Indigenous		0	1	0	0	0	0
75	<i>Zizina otis</i>	Lesser Grass Blue	Podu Thrurna-nilaya	Indigenous		1	1	0	0	0	0
76	<i>Zizula hylax</i>	Tiny Grass Blue	Punchi Thrurna-nilaya	Indigenous		0	1	0	0	0	0
<b>Family - Hesperidae</b>											
77	<i>Ampittia dioscorides</i>	Bush Hopper		Indigenous		0	1	0	0	0	0
78	<i>Caprona ransonnettii</i>	Golden Angle		Indigenous		0	1	0	0	0	0
79	<i>Hasora taminatus</i>	White-banded Awl		Indigenous	NT	0	1	0	0	0	0
80	<i>Iambrix salsala</i>	Chestnut Bob		Indigenous		0	1	0	0	0	0
81	<i>Spalia galba</i>	Indian Skipper		Indigenous		0	1	0	0	0	0
82	<i>Suastus gremius</i>	Indian Palm Bob		Indigenous		1	1	0	0	0	0
83	<i>Taractrocera maevius</i>	Common Grass Dart		Indigenous		0	1	0	0	0	0
84	<i>Telicota colon</i>	Pale Palmdart		Indigenous		1	1	0	0	0	1
	TOTAL					38	82	5	4	3	12
Sources - IUCN Field Survey 2010; Weeratunga, 2010; IUCN Sri Lanka, 2010											

#### Freshwater fish checklist

	Scientific Name	English Name	Sinhala Name	SpS	CoS	KAL	VAN	MUS	NAN	MAW	MAN
<b>Family - Anguillidae</b>											
1	<i>Anguilla bicolor</i>	Level-finned eel	Kalu aandha	Indigenous	NT	0	1	0	0	0	0
2	<i>Anguilla nebulosa</i>	Long- finned eel	Pol mal aandha	Indigenous	VU	0	1	0	0	0	0
<b>Family - Cyprinidae</b>											
3	<i>Amblypharyngodon melettinus</i>	Silver Carplet	Soraya	Indigenous		0	1	0	0	0	0
4	<i>Devario malabaricus</i>	Giant Danio	Dankola Sayala	Indigenous		0	1	0	0	0	0
5	<i>Labuca lankensis</i>	Lanka Labuca	Lanka karaedaya	Endemic		0	1	0	0	0	0
6	<i>Puntius bimaculatus</i>	Redside Barb	Ipili Kadaya	Indigenous		0	1	0	0	0	0
7	<i>Puntius chola</i>	Swamp Barb	Kota Pethiya	Indigenous		0	1	0	0	0	0

8	<i>Puntius dorsalis</i>	Longsnouted Barb	Bimtholla	Indigenous		0	1	0	0	0	0
9	<i>Puntius melanomaculatus</i>	Tic-tac-toe Barb	Depulliya	Endemic		0	1	0	0	0	0
10	<i>Puntius sarana</i>	Olive Barb	Mas Pethiya	Indigenous		0	1	0	0	0	0
11	<i>Puntius singhala</i>	Filamented Barb	Dankola Pethiya	Endemic		0	1	0	0	0	0
12	<i>Puntius vittatus</i>	Silver Barb	Bandi Titteya	Indigenous		0	1	0	0	0	0
13	<i>Rasbora microcephalus</i>	Carverii Rasbora	Caveri Randiya	Indigenous		0	1	0	0	0	0
14	<i>Rasboroides atukorali</i>	Horadandia	Horadandiya	Indigenous	NT	0	1	0	0	0	0
<b>Family - Cobitidae</b>											
15	<i>Lepidocephalichthys thermalis</i>	Common Spiny Loach	Thith Ahirawa	Indigenous		0	1	0	0	0	0
<b>Family - Bagridae</b>											
16	<i>Mystus seengtee</i>	Gangetic Mystus		Indigenous	DD	0	1	0	0	0	0
17	<i>Mystus gulio</i>	Long-whiskered Catfish	Mana ankutta	Indigenous		0	1	0	0	0	0
18	<i>Mystus vittatus</i>	Striped Dwarf Catfish	Iri ankutta	Indigenous		0	1	0	0	0	0
<b>Family - Claridae</b>											
19	<i>Clarias brachysoma</i>	Walking Catfish	Magura	Endemic		0	1	0	0	0	0
<b>Family - Siluridae</b>											
20	<i>Ompok bimaculatus</i>	Butter Catfish	Walapoththa	Indigenous		0	1	0	0	0	0
21	<i>Wallago attu</i>	Shark Catfish	Walaya	Indigenous	VU	0	1	0	0	0	0
<b>Family - Heteropneustidae</b>											
22	<i>Heteropneustes fossilis</i>	Stinging Catfish	Hunga	Indigenous		0	1	0	0	0	0
<b>Family - Oryziidae</b>											
23	<i>Orizias cf. dancena</i>	Blue Eye	Handi handaya	Endemic	DD	0	1	0	0	0	0
<b>Family - Aplocheilidae</b>											
24	<i>Aplocheilus parvus</i>	Dwarf Panchax	Kalapu handeya	Indigenous		0	1	0	0	0	0
<b>Family - Cichlidae</b>											
25	<i>Etoplus suratensis</i>	Pearl Spot	Koraliya	Indigenous		0	1	0	0	0	0
26	<i>Oreochromis mosambicus</i>	Tilapia	Tilapia	Exotic		0	1	0	0	0	0
<b>Family - Gobiidae</b>											
27	<i>Awaous melanocephalus</i>	Scribbled Goby	Bali Weligouva	Indigenous		0	1	0	0	0	0
28	<i>Glossogobius giuris</i>	Bar Eyed Goby	Maha gan weligouva	Indigenous		0	1	0	0	0	0
<b>Family - Belontiidae</b>											

29	<i>Pseudosphromenus cupanus</i>	Spiketailed Paradisefish	Pulutta	Indigenous		0	1	0	0	0	0
30	<i>Trichogaster pectoralis</i>	Snakeskin Gourami	Vel gurami	Exotic		0	1	0	0	0	0
<b>Family - Anabantidae</b>											
31	<i>Anabas testudineus</i>	Climbing Perch	Kavaiya	Indigenous		0	1	0	0	0	0
<b>Family - Hemiramphidaedae</b>											
32	<i>Hyporhamphus limbatus</i>	Congaturi Halfbeak	Morella	brakish		0	1	0	0	0	0
<b>Family - Mastacembelidae</b>											
33	<i>Mastacembelus armatus</i>	Marbled Spiny Eel	Gan theliya	Indigenous		0	1	0	0	0	0
<b>Family - Channidae</b>											
34	<i>Channa ara</i>	Giant Snakehead	Gan ara	Endemic	VU	0	1	0	0	0	0
35	<i>Channa punctata</i>	Spotted Snakehead	Mada Kanaya	Indigenous		0	1	0	0	0	0
36	<i>Channa striata</i>	Murrel	Loola	Indigenous		0	1	0	0	0	0
	TOTAL					0	36	0	0	0	0
Sources - IUCN Field survey October 2010; Weeratunga, 2010; IUCN Sri Lanka, 2010											

#### Amphibians checklist

	Scientific Name	English Name	Sinhala Name	SpS	CoS	KAL	VAN	MUS	NAN	MAW	MAN
<b>Family - Bufonidae</b>											
1	<i>Bufo atukoralei</i>	Atukorale's Dwarf Toad	Atukoralage kuru gemba	Endemic		0	1	0	0	0	0
2	<i>Bufo scaber</i>	Ferguson's Toad	Fergusonge gemba	Indigenous		0	1	0	0	0	0
3	<i>Duttaphrynus melanostictus</i>	Common House Toad	Sulaba ge gemba	Indigenous		1	1	0	0	0	0
<b>Family - Microhylidae</b>											
4	<i>Kaloula taprobanica</i>	Common Bull Frog	Visituru ratu madiya	Indigenous		0	1	0	0	0	0
5	<i>Microhyla ornata</i>	Ornate Narrow Mouth Frog	Visituru muwa patu madiya	Indigenous		1	1	1	1	0	0
6	<i>Microhyla rubra</i>	Red Narrow Mouth Frog	Ratu muwa patu madiya	Indigenous		0	1	0	0	1	0
7	<i>Ramanella variegata</i>	White-bellied Pugsnout Frog	Bada-sudu mottahomba madiya	Indigenous		1	1	0	0	0	0
8	<i>Uperodon systoma</i>	Balloon Frog	Balun madiya	Indigenous		0	1	0	0	0	0
<b>Family - Dicroglossidae</b>											
9	<i>Euphyctis cyanophlyctis</i>	Skipper Frog	Utpatana madiya	Indigenous		0	1	1	1	1	1
10	<i>Euphyctis hexadactylus</i>	Six-toe Green Frog	Sayangili pala madiya	Indigenous		1	1	0	0	0	1



11	<i>Fejervarya limnocharis</i>	Common Paddyfield Frog	Sulaba vel madiya	Indigenous		1	1	1	1	0	1
12	<i>Hoplobatrachus crassus</i>	Jerdon's Bull Frog	Jerdonge hala madiya	Indigenous		0	0	1	1	0	1
13	<i>Sphaerotheca breviceps</i>	Banded Sand Frog	Tunhiri vali madiya	Indigenous		0	1	0	0	0	0
14	<i>Sphaerotheca rolandae</i>	Marbled Sand Frog	Lapavan vali madiya	Indigenous		0	1	0	0	0	0
<b>Family - Rhacophoridae</b>											
15	<i>Polypedates cruciger</i>	Common Hourglass Tree Frog	Sulaba pahimbu gas madiya	Endemic		0	1	0	0	0	0
16	<i>Polypedates maculatus</i>	Spotted Tree Frog	Pulli gas madiya	Indigenous		1	1	0	0	0	0
<b>Family - Ranidae</b>											
17	<i>Hylarana gracilis</i>	Sri Lanka Wood Frog	Lanka bandi madiya	Endemic		0	1	0	0	0	0
	TOTAL					6	16	4	4	2	4
Sources - IUCN Field Survey October 2010; Weeratunga, 2010; IUCN Sri Lanka, 2010											

#### Reptile checklist

	Scientific Name	English Name	Sinhala Name	SpS	CoS	KAL	VAN	MUS	NAN	MAW	MAN
<b>Family - Crocodylidae</b>											
1	<i>Crocodylus palustris</i>	Mugger Crocodile	Hala kimbula	Indigenous		0	1	0	1	0	0
<b>Family - Bataguridae</b>											
2	<i>Melanochelys trijuga</i>	Parker's Black Turtle	Parkerge gal ibba	Indigenous	NT	1	1	0	0	0	1
<b>Family - Cheloniidae</b>											
3	<i>Chelonia mydas</i>	Green Turtle	Gal kasbaeva	Indigenous	EN*	1	1	0	0	0	0
4	<i>Eretmochelys imbricata</i>	Hawksbill Sea Turtle	Pothu kasbaeva / Leli kasbaeva	Indigenous	CR*	1	1	0	0	0	0
5	<i>Lepidochelys olivacea</i>	Olive Ridley Sea Turtle	Batu kasbaeva	Indigenous	EN*	1	1	0	0	0	0
<b>Family - Testudinidae</b>											
6	<i>Geochelone elegans</i>	Indian Star Tortoise	Mevara ibba	Indigenous	VU	1	1	1	1	0	0
<b>Family - Trionychidae</b>											
7	<i>Lissemys punctata</i>	Flapshell Turtle	Kiri ibba	Indigenous	VU	0	1	1	0	0	0
<b>Family - Agamidae</b>											
8	<i>Calotes calotes</i>	Green Garden Lizard	Pala katussa	Indigenous		1	1	0	0	0	0
9	<i>Calotes ceylonensis</i>	Painted Lip Lizard	Thola-visituru katussa	Endemic	VU	0	1	0	0	0	0
10	<i>Calotes versicolor</i>	Common Garden Lizard	Gara katussa	Indigenous		1	1	1	1	1	1
11	<i>Otocryptis nigrisigma</i>	Black Spotted Kangaroo	Wiyali Pinum katussa	Endemic		0	1	0	0	0	0

		Lizard									
12	<i>Sitana ponticeriana</i>	Fanthroat Lizard	Pulina talikatussa	Indigenous		1	1	1	1	1	1
<b>Family - Chameleoniae</b>											
13	<i>Chamaeleo zeylanicus</i>	Sri Lankan Chameleon	Bodilima / Bodiliya	Indigenous	NT	0	1	0	0	0	0
<b>Family - Gekkonidae</b>											
14	<i>Geckoella yakhuna</i>	Blotch Bowfinger Gecko	Lapavan vakaniyahuna	Endemic		0	1	0	0	0	0
15	<i>Gehyra mutilata</i>	Four-claw Gecko	Caturanguli huna	Indigenous		1	1	0	0	0	0
16	<i>Hemidactylus brookii</i>	Spotted House Gecko	Pulli gehuna	Indigenous		1	1	0	0	0	0
17	<i>Hemidactylus depressus</i>	Kandyan Gecko	Hali gehuna	Endemic		0	1	0	0	0	0
18	<i>Hemidactylus frenatus</i>	Common House Gecko	Sulaba gehuna	Indigenous		1	1	0	0	0	0
19	<i>Hemidactylus leschenaultii</i>	Bark Gecko / Sycamore Gecko	Kimbul huna	Indigenous		1	1	0	0	0	1
20	<i>Hemidactylus triedrus</i>	Termite Hill Gecko	Humbas huna	Indigenous		1	1	0	0	0	0
21	<i>Lepidodactylus lugubris</i>	Scaly-finger Gecko	Salkapa huna	Indigenous	EN	0	1	0	0	0	0
<b>Family - Scincidae</b>											
22	<i>Dasia halianus</i>	Haly's Tree Skink	Helige rukhiraluva	Indigenous	NT	0	1	0	0	0	0
23	<i>Eutropis carinata</i>	Common Skink	Sulaba hikanala	Indigenous		0	1	0	0	0	0
24	<i>Eutropis macularia</i>	Bronzegreen Little Skink	Pingu hikanala	Indigenous		0	1	0	0	0	0
25	<i>Eutropis tammanna</i>	Tamanna Skink	Tammanna hikanala	Endemic		0	1	0	0	0	0
26	<i>Lankascincus fallax</i>	Common Lanka Skink	Sulaba lakhiraluva	Endemic		0	1	0	0	0	0
27	<i>Lygosoma punctatus</i>	Dotted Skink	Tit hiraluhikanala	Indigenous		1	1	0	0	0	0
<b>Family - Varanidae</b>											
28	<i>Varanus bengalensis</i>	Land Monitor	Talagoya	Indigenous		1	1	1	1	1	1
29	<i>Varanus salvator</i>	Water Monitor	Kabaragoya	Indigenous		1	1	0	0	0	0
<b>Family - Acrochordidae</b>											
30	<i>Acrochordus granulatus</i>	Wart Snake	Diya goya/Redi naya	Indigenous	EN	1	1	0	0	1	1
<b>Family - Boidae</b>											
31	<i>Gongylophis conica</i>	Sand Boa	Vali pimbura, kota pimbura	Indigenous	VU	0	1	0	0	0	0
32	<i>Python molurus</i>	Indian Python	Pimbura	Indigenous		1	1	1	1	0	1
<b>Family - Colubridae</b>											
33	<i>Ahaetulla nasuta</i>	Green Vine Snake	Ahaetulla	Indigenous		0	1	0	0	0	0
34	<i>Ahaetulla pulverulenta</i>	Brown Vine Snake	Henakandaya	Indigenous	NT	0	1	0	0	0	0

35	<i>Amphiesma stolatum</i>	Buff Striped Keelback	Aharukuka	Indigenous		0	1	0	0	0	0
36	<i>Atretium schistosum</i>	The Olive Keelback Watersnake	Diyawarna.	Indigenous		0	1	0	0	0	0
37	<i>Balanophis ceylonensis</i>	Sri Lanka Keelback	Nihaluwa	Endemic		0	1	0	0	0	0
38	<i>Boiga forsteni</i>	Forsten's Cat Snake	Naga mapila	Indigenous		0	1	0	0	0	1
39	<i>Boiga trigonatus</i>	Gamma Cat Snake	Ran mapila	Indigenous		0	1	0	0	0	0
40	<i>Cerberus rynchops</i>	Dog-faced Water Snake	Kuna diya kaluwa.	Indigenous	VU	1	1	0	0	0	1
41	<i>Chrysopelea taprobanica</i>	Striped Flying Snake	Dangara danda	Endemic	VU	0	1	0	0	0	0
42	<i>Coeloganthus helena</i>	Trinket Snake	Katakaluwa	Indigenous		0	1	0	0	0	0
43	<i>Dendrelaphis bifrenalis</i>	Boulenger's Bronze-back	Pandura haldanda	Indigenous		0	1	0	0	0	0
44	<i>Dendrelaphis tristis</i>	Front Spot Bronze-back	Handa haldanda	Indigenous		0	1	0	0	0	0
45	<i>Dryocalamus nympha</i>	Bridal Snake	Geta Radanakaya	Indigenous	NT	0	1	0	0	0	0
46	<i>Gerarda prevostianus</i>	Gerard's Water Snake	Prevostge diyabariya	Indigenous	CR	1	0	0	0	0	0
47	<i>Liopeltis calamaria</i>	Reed Snake	Punbariya.	Indigenous	VU	0	1	0	0	0	0
48	<i>Lycodon aulicus</i>	Wolf Snake, House Snake	Alu radanakaya	Indigenous		0	1	0	0	0	0
49	<i>Lycodon osmanhilli</i>	Flowery Wolf Snake	Mal radanakaya	Endemic		0	1	0	0	0	0
50	<i>Oligodon arnensis</i>	Common Kukri Snake	Arani dath ketiya	Indigenous		0	1	0	0	0	0
51	<i>Oligodon taeniolata</i>	Variiegated Kukri Snake	Wairi dattketiya	Indigenous		0	1	0	0	0	0
52	<i>Ptyas mucosa</i>	Rat Snake	Gerandiya.	Indigenous		1	1	0	0	0	0
<b>Family - Natricidae</b>											
53	<i>Xenochrophis cf. piscator</i>	Checkered Keelback	Diya bariya	Endemic		0	1	0	0	0	0
<b>Family - Elapidae</b>											
54	<i>Bungarus caeruleus</i>	The Common Krait	Thel karawala	Indigenous		0	1	0	0	0	0
55	<i>Calliophis melanurus</i>	Sri Lanka Coral Snake	Depath kaluwa	Indigenous	NT	0	1	0	0	0	0
56	<i>Naja naja</i>	Indian Cobra	Naya	Indigenous		1	1	0	0	1	1
<b>Family - Hydrophidae</b>											
57	<i>Astrotia stokesii</i>	Stoke's Sea Snake	Maha valakkadiya	Indigenous		0	0	0	0	0	1
58	<i>Enhydrina schistosa</i>	Hook Nose Sea Snake	Valakkadiya	Indigenous		1	1	0	0	0	1
59	<i>Hydrophis cyanocinctus</i>	The Chitul	Wairan muhudunaya	Indigenous		0	0	0	0	0	1
60	<i>Hydrophis ornatus</i>	Gray's Sea Snake	Grayge muhudu naya	Indigenous		1	0	0	0	0	1
61	<i>Hydrophis spiralis</i>	Narrow Banded Sea Snake	Sihin mudhu naya	Indigenous		1	0	0	0	0	1

62	<i>Hydrophis stricticollis</i>	Guenther's Sea Snake	Guntherge muhudunaya	Indigenous		1	0	0	0	0	1
63	<i>Kerilia jerdonii</i>	Jerdon's Sea Snake	Jerdonge muhudu naya	Indigenous		0	0	0	0	0	1
64	<i>Lapemis curtus</i>	Shaw's Sea Snake	Shawge kuda muhudunaya	Indigenous		1	0	0	0	0	1
65	<i>Pelamis platurus</i>	Yellow-bellied Sea Snake	Badakaha muhudu naya	Indigenous		0	0	0	0	0	1
66	<i>Praescutata viperina</i>	Viperine Sea Snake	Polon muhudunaya	Indigenous		0	0	0	0	0	1
<b>Family - Viperidae</b>											
67	<i>Daboia russelii</i>	Russell's Viper	Tith polonga.	Indigenous		0	1	0	0	0	1
68	<i>Echis carinatus</i>	Saw-scaled Viper	Vali polonga	Indigenous	VU	0	1	0	0	1	1
69	<i>Hypnale hypnale</i>	The Merrem's Hump Nose Viper	Polon thelissa	Indigenous		0	1	0	0	0	0
TOTAL						27	59	6	6	6	22
Sources - IUCN Field Survey October 2010; Weeratunga, 2010; IUCN Sri Lanka, 2010; Somaweera, 2006											

#### Bird Checklist

	Scientific Name	English Name	Sinhala Name	SpS	CoS	KAL	VAN	MUS	NAN	MAW	MAN
<b>Family - Phasianidae</b>											
1	<i>Francolinus pondicerianus</i>	Grey Francolin	Alu Ussawatuva	BrR	NT	0	1	1	1	1	1
2	<i>Coturnix chinensis</i>	Blue-breasted Quail	Nil Piriwatuwa	BrR		0	1	0	0	0	0
3	<i>Gallus lafayetii</i>	Sri Lanka Junglefowl	Sri Lanka Wali-kukula	Endemic		0	1	0	0	0	0
4	<i>Pavo cristatus</i>	Indian Peafowl	Monora	BrR		0	1	1	1	0	1
<b>Family - Anatidae</b>											
5	<i>Dendrocygna javanica</i>	Lesser Whistling-duck	Heen Thamba-seruwa	BrR		0	1	1	1	0	0
6	<i>Nettapus coromandelianus</i>	Cotton Pygmy-goose	Mal-seruwa	BrR		0	0	1	0	0	0
7	<i>Anas strepera</i>	Gadwall	Alu tharava	Va		0	0	0	0	1	0
8	<i>Anas penelope</i>	Eurasian Wigeon	Rankiralu tharava	VRWV		0	0	0	0	1	0
9	<i>Anas poecilorhyncha</i>	Spot-billed Duck	Thith-hota tharava	WV/BrR?	CR	0	0	0	0	1	0
10	<i>Anas clypeata</i>	Northern Shoveler	Path-thudu tharava	UCWV		0	0	0	0	1	0
11	<i>Anas acuta</i>	Northern Pintail	Ulpenda tharava	VCWV		0	0	1	0	1	0
12	<i>Anas querquedula</i>	Garganey	Bemmasudu tharava	VCWV		0	1	0	0	1	0
13	<i>Anas crecca</i>	Common Teal	Podu Tharava	RWV		0	0	0	0	1	
<b>Family - Turnicidae</b>											
14	<i>Turnix suscitator</i>	Barred Buttonquail	Bola Watuuruwa	BrR		1	1	1	0	1	0

<b>Family - Picidae</b>											
15	<i>Dendrocopus nanus</i>	Brown-capped Pygmy Woodpecker	Bora Esasi Gomara-karela	BrR	NT	0	1	0	0	0	0
16	<i>Dinopium benghalense</i>	Black-rumped Flameback	Rath-karela	BrR		1	1	1	1	1	1
17	<i>Chrysocolaptes festivus</i>	White-naped Woodpecker	Kahapita Maha-karela	BrR	VU	0	1	0	0	0	0
<b>Family - Ramphastidae</b>											
18	<i>Megalaima zeylanica</i>	Brown-headed Barbet	Polos Kottoruwa	BrR		1	1	1	0	0	1
19	<i>Megalaima rubricapilla</i>	Crimson-fronted Barbet	Rathmhunath Kottoruwa	Pro:endemic		0	1	0	0	0	0
20	<i>Megalaima haemacephala</i>	Coppersmith Barbet	Rathlaye Kottoruwa	BrR		0	0	0	0	0	1
<b>Family - Bucerotidae</b>											
21	<i>Ocyroceros gingalensis</i>	Sri Lanka Grey Hornbill	Sri Lanka Alu Kandaththa	Endemic		0	1	0	0	0	0
22	<i>Anthracoceros coronatus</i>	Malabar Pied Hornbill	Poru-Kandaththa	BrR	NT	0	1	0	0	0	0
<b>Family - Upupidae</b>											
23	<i>Upupa epops</i>	Common Hoopoe	Podu Poroluwa	BrR	NT	0	1	0	0	1	0
<b>Family - Coraciidae</b>											
24	<i>Coracias benghalensis</i>	Indian Roller	Dumbonna	BrR		1	1	1	1	1	1
<b>Family - Alcedinidae</b>											
25	<i>Alcedo atthis</i>	Common Kingfisher	Mal Pilihuduwa	BrR		1	1	0	0	1	1
26	<i>Pelargopsis capensis</i>	Stork-billed Kingfisher	Manathudu Madi-pilihuduwa	BrR		1	1	1	0	0	0
27	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	Layasudu Madi-pilihuduwa	BrR		1	1	1	1	1	1
28	<i>Ceryle rudis</i>	Pied Kingfisher	Gomara-pilihuduwa	BrR		1	1	1	0	1	1
<b>Family - Meropidae</b>											
29	<i>Merops orientalis</i>	Green Bee-eater	Punchi Binguharaya	BrR		1	1	1	0	1	0
30	<i>Merops philippinus</i>	Blue-tailed Bee-eater	Nilpenda Binguharaya	WV		1	1	1	1	1	1
<b>Family - Cuculidae</b>											
31	<i>Clamator jacobinus</i>	Pied Cuckoo	Gomara Kondakoha	BrR		1	1	1	0	1	1
32	<i>Cuculus micropterus</i>	Indian Cuckoo	Indu Kookilaya	SU		0	1	0	0	0	0
33	<i>Surniculus lugubris</i>	Drongo Cuckoo	Kawudukoha	BrR	VU	0	1	0	0	1	0
34	<i>Eudynamis scolopacea</i>	Asian Koel	Kowula	BrR		1	1	1	0	0	1
35	<i>Phaenicophaeus viridirostris</i>	Blue-faced Malkoha	Wathanil Malkoha	BrR		1	1	1	0	0	1
36	<i>Centropus sinensis</i>	Greater Coucal	Ati-kukula	BrR		1	1	1	1	1	1
<b>Family - Psittacidae</b>											

37	<i>Psittacula eupatria</i>	Alexandrine Parakeet	Labu Girawa	BrR		1	1	0	0	0	0
38	<i>Psittacula krameri</i>	Rose-ringed Parakeet	Rana Girawa	BrR		1	1	1	0	1	1
<b>Family - Apodidae</b>											
39	<i>Collocalia unicolor</i>	Indian Swiftlet	Indu Upa-thurithaya	BrR	NT	0	1	0	0	0	0
40	<i>Cypsiurus balasensis</i>	Asian Palm Swift	Asiaa Thal-thurithaya	BrR		1	1	1	1	1	1
41	<i>Apus affinis</i>	House Swift	Punchi Thurithaya	BrR		0	1	0	0	0	0
<b>Family - Hemiprocidae</b>											
42	<i>Hemiprocne coronata</i>	Crested Treeswift	Silu Ruk-thurithaya	BrR		1	1	1	0	0	0
<b>Family - Strigidae</b>											
43	<i>Ketupa zeylonensis</i>	Brown Fish Owl	Bora Kewul-bakamoona	BrR		0	1	0	0	0	0
<b>Family - Podargidae</b>											
44	<i>Batrachostomus moniliger</i>	Frogmouth	Madi-muhuna	BrR	NT	0	1	0	0	0	0
<b>Family - Caprimulgidae</b>											
45	<i>Caprimulgus atripennis</i>	Jerdon's Nightjar	Jerdon Bimbassa	BrR		0	0	1	0	0	0
46	<i>Caprimulgus asiaticus</i>	Common Nightjar	Indu Bimbassa	BrR		0	0	1	0	0	0
<b>Family - Columbidae</b>											
47	<i>Columba livia</i>	Feral Pigeon	Podu Paraviya	BrR		1	1	1	1	1	1
48	<i>Streptopelia chinensis</i>	Spotted Dove	Alu Kobeiyya	BrR		1	1	1	1	1	1
49	<i>Chalcophaps indica</i>	Emerald Dove	Neela-Kobeiyya	BrR		0	1	0	0	0	0
50	<i>Treron bicincta</i>	Orange-breasted Green Pigeon	Laya-ran Batagoya	BrR		0	1	0	0	0	0
51	<i>Treron pompadora</i>	Pompadoru Green Pigeon	Pompadoru Batagoya	Pro:endemic		0	1	0	0	0	0
52	<i>Ducula aenea</i>	Green Imperial Pigeon	Neela Mahagoya	BrR		0	1	0	0	0	0
<b>Family - Rallidae</b>											
53	<i>Amauornis phoenicurus</i>	White-breasted Waterhen	Laya-sudu Korawakka	BrR		1	1	0	0	0	1
54	<i>Gallinula chloropus</i>	Common Moorhen	Podu Gallinuwa	BrR		0	1	0	0	0	0
55	<i>Fulica atra</i>	Common Coot	Podu Kithala	BrR		0	1	0	0	0	0
<b>Family - Scolopacidae</b>											
56	<i>Gallinago stenura</i>	Pintail Snipe	Ulpenda Kaswatuwa	WV		1	0	0	0	0	0
57	<i>Limosa limosa</i>	Black-tailed Godwit	Kalu-penda Gohuduwiththa	WV		1	0	0	0	1	0
58	<i>Limosa lapponica</i>	Bar-tailed Godwit	Waira-penda Gohuduwiththa	WV		0	0	0	0	1	0
59	<i>Numenius phaeopus</i>	Whimbrel	Wimburali Kalikaya	WV		1	1	0	0	1	0
60	<i>Numenius arquata</i>	Eurasian Curlew	Eurasiya Kalikaya	WV		1	0	0	0	1	1

61	<i>Tringa totanus</i>	Common Redshank	Podu Rathpa Silibilla	WV		1	1	0	0	1	1
62	<i>Tringa stagnatilis</i>	Marsh Sandpiper	Waguru Silibilla	WV		1	0	0	0	1	0
63	<i>Tringa nebularia</i>	Common Greenshank	Podu Palapa Silibilla	WV		1	0	0	0	1	0
64	<i>Tringa ochropus</i>	Green Sandpiper	Kola Silibilla	WV		1	0	0	0	0	1
65	<i>Tringa glareola</i>	Wood Sandpiper	Wana Silibilla	WV		1	0	0	0	1	0
66	<i>Xenus cinereus</i>	Terek Sandpiper	Terek Silinna	WV		1	0	0	0	1	0
67	<i>Actitis hypoleucos</i>	Common Sandpiper	Podu Siliththa	WV		1	1	0	0	1	1
68	<i>Arenaria interpres</i>	Ruddy Turnstone	Rath Galperaliya	WV		1	0	0	0	1	0
69	<i>Calidris tenuirostris</i>	Great Knot	Mahanott Hinna	WVa		0	0	0	0	1	0
70	<i>Calidris canutus</i>	Red Knot	Rathu Not Hinna	WV		0	0	0	0	1	0
71	<i>Calidris alba</i>	Sanderling	Wali Hinna	WV		0	0	0	0	1	0
72	<i>Calidris minuta</i>	Little Stint	Punchi Hinna	WV		1	0	0	0	1	1
73	<i>Calidris temminckii</i>	Temminck's Stint	Temminck Hinna	WV		0	0	0	0	1	0
74	<i>Calidris ferruginea</i>	Curlew Sandpiper	Kalika Hinna	WV		1	0	0	0	1	0
75	<i>Limicola falcinellus</i>	Broad-billed Sandpiper	Mathudu-hinna	WV		0	0	0	0	1	0
76	<i>Philomachus pugnax</i>	Ruff	Lowichchiya	WV		0	0	0	0	1	0
77	<i>Phalaropus lobatus</i>	Red-necked Phalarope	Rathgela Diyawatuwa	WV		0	0	0	0	1	0
<b>Family - Rostratulidae</b>											
78	<i>Rostratula benghalensis</i>	Greater Painted Snipe	Raja Ulu-kaswatuwa	BrR		0	0	0	0	1	0
<b>Family - Jacanidae</b>											
79	<i>Hydrophasianus chirurgus</i>	Pheasant-tailed Jacana	Savul-penda Diyasaana	BrR		0	1	0	0	0	0
<b>Family - Burhinidae</b>											
80	<i>Burhinus oedicnemus</i>	Eurasian Thick-knee	Golu-kiraluwa	BrR	NT	1	1	0	0	1	0
81	<i>Esacus recurvirostris</i>	Great Thick-knee	Gal-kiraluwa	BrR	NT	0	1	0	0	1	0
<b>Family - Haematopodida</b>											
82	<i>Haematopus ostralegus</i>	Eurasian Oystercatcher	Eurasia Bolugulla	WV		0	0	0	0	1	1
<b>Family - Recurvirostridae</b>											
83	<i>Himantopus himantopus</i>	Black-winged Stilt	Kalupiya Ipalpawa	BrR		1	1	1	1	1	1
84	<i>Recurvirostra avosetta</i>	Pied Avocet	Gomara Avasatha	WV		0	0	0	0	1	0
<b>Family - Charadriidae</b>											
85	<i>Pluvialis fulva</i>	Pacific Golden Plover	Sethkara Ran Maha-oleviya	WV		0	1	1	0	1	1
86	<i>Pluvialis squatarola</i>	Grey Plover	Alu Maha-oleviya	WV		0	0	0	0	1	0



87	<i>Charadrius hiaticula</i>	Common Ringed Plover	Loku Mala Oleviya	WV		1	1	0	0	1	0
88	<i>Charadrius dubius</i>	Little Ringed Plover	Punchi Mala Oleviya	BrR & WV		1	1	1	0	1	1
89	<i>Charadrius alexandrinus</i>	Kentish Plover	Kenti Oleviya	BrR & WV		1	1	0	0	1	1
90	<i>Charadrius mongolus</i>	Lesser Sand Plover	Heen Wali Oleviya	WV		1	1	0	0	1	0
91	<i>Charadrius leschenaultii</i>	Greater Sand Plover	Raja Wali Oleviya	WV		0	0	0	0	1	0
92	<i>Charadrius asiaticus</i>	Caspian Plover	Caspia Oleviya	WV		0	0	0	0	1	0
93	<i>Vanellus malabaricus</i>	Yellow-wattled Lapwing	Kaha-yatimal Kirella	BrR		0	1	1	1	0	1
94	<i>Vanellus indicus</i>	Red-wattled Lapwing	Rath-yatimal Kirella	BrR		1	1	0	1	0	1
<b>Family - Dromadidae</b>											
95	<i>Dromas ardeola</i>	Crab Plover	Kakulu-oleviya	SU		0	0	0	0	1	0
<b>Family - Glareolidae</b>											
96	<i>Glareola pratincola</i>	Collared Pratincole	Karapati Javasariya	WV		0	0	0	0	1	0
97	<i>Glareola maldivarum</i>	Oriental Pratincole	Peradigu Javasariya	BrR	EN	0	0	0	0	1	0
98	<i>Glareola lactea</i>	Small Pratincole	Small Pratincole	BrR	VU	0	0	0	0	1	0
<b>Family - Laridae</b>											
99	<i>Larus cachinnans</i>	Heuglin's Gull	Heuglin Galuviya	WV		0	0	0	0	1	0
100	<i>Larus brunnicephalus</i>	Brown-headed Gull	Bora-hisa Galuviya	WV		0	0	0	0	1	0
101	<i>Larus ridibundus</i>	Black-headed Gull	Kalu-his Galuviya	WV		0	0	0	1	1	1
102	<i>Sterna nilotica</i>	Gull-billed Tern	Galuthudu Sayurulihiniya	WV		0	0	0	0	0	1
103	<i>Sterna caspia</i>	Caspian Tern	Caspia Muhudulihiniya	WV		0	0	0	0	1	1
104	<i>Sterna bengalensis</i>	Lesser Crested Tern	Heen Konda Muhudulihiniya	WV		0	1	0	0	0	1
105	<i>Sterna bergii</i>	Great Crested Tern	Maha Konda Muhudulihiniya	BrR		0	0	0	0	1	1
106	<i>Sterna sandvicensis</i>	Sandwich Tern	Sandwich Muhudulihiniya	WV		0	0	0	0	1	0
107	<i>Sterna dougallii</i>	Roseate Tern	Arunu Muhudulihiniya	SV/BrR		0	0	0	0	1	0
108	<i>Sterna hirundo</i>	Common Tern	Podu Muhudulihiniya	WV/Ubr	DD	0	0	0	0	1	0
109	<i>Sterna albifrons</i>	Little Tern	Punchi Muhudulihiniya	BrR		1	1	1	1	1	1
110	<i>Sterna saundersi</i>	Saunders's Tern	Saunders Muhudulihiniya	BrR	CR	0	0	0	0	1	0
111	<i>Chlidonias hybrida</i>	Whiskered Tern	Alupiya Kangul-lihiniya	WV		1	1	1	1	1	0
112	<i>Chlidonias leucopterus</i>	White-winged Tern	Sudupiya Kangul-lihiniya	WV		0	1	0	0	1	0
113	<i>Anous stolidus</i>	Brown Noddy	Bora Nidilihiniya	Va		0	0	0	0	1	0
<b>Family - Accipitridae</b>											
114	<i>Pernis ptilorhynchus</i>	Oriental Honey-buzzard	Silu Bambarakussa	BrR/WV/Va		0	1	0	0	0	0

115	<i>Elanus caeruleus</i>	Black-wing Kite	Kaluuris Pathannkussa	BrR	NT	0	1	0	0	0	0
116	<i>Milvus migrans</i>	Black Kite	Bora Parakussa	BrR	DD	0	0	0	0	0	1
117	<i>Haliastur indus</i>	Brahminy Kite	Bamunu Piyakussa	BrR		1	1	1	1	1	1
118	<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	Kusa-ali Muhudukussa	BrR		1	1	1	0	0	0
119	<i>Ichthyophaga ichthyaetus</i>	Grey-headed Fish Eagle	Alu-his Masukussa	BrR		1	1	1	0	0	0
120	<i>Spilornis cheela</i>	Crested Serpent Eagle	Silu Sarapakussa	BrR		0	1	1	1	0	0
121	<i>Circus aeruginosus</i>	Western Marsh Harrier	Waguru Harikussa	WV		0	0	0	0	0	0
122	<i>Circus macrourus</i>	Pallid Harrier	Sudumali Harikussa	WV		0	1	0	0	0	1
123	<i>Accipiter badius</i>	Shikra	Kurulugoya	BrR		1	1	0	0	0	0
124	<i>Accipiter virgatus</i>	Besra	Besra Kurulugoya	BrR	VU	0	1	0	0	0	0
125	<i>Hieraaetus kienerii</i>	Rufous-bellied Eagle	Kusarath Rajaaliya	BrR	NT	0	0	1	0	0	0
126	<i>Spizaetus cirrhatous</i>	Changeable Hawk Eagle	Perali Kondakussa	BrR		0	1	1	0	0	0
<b>Family - Podicipedidae</b>											
127	<i>Tachybaptus ruficollis</i>	Little Grebe	Punchi Gembithuruwa	BrR		0	1	0	0	1	1
<b>Family - Anhingidae</b>											
128	<i>Anhinga melanogaster</i>	Oriental Darter	Abikava	BrR		0	1	0	0	1	1
<b>Family - Phalacrocoracidae</b>											
129	<i>Phalacrocorax niger</i>	Little Cormorant	Punchi Diyakava	BrR		1	1	1	1	1	1
130	<i>Phalacrocorax fuscicollis</i>	Indian Cormorant	Indu Diyakava	BrR		1	1	0	0	1	1
<b>Family - Ardeidae</b>											
131	<i>Egretta garzetta</i>	Little Egret	Punchi Anu-koka	BrR		1	1	1	1	1	1
132	<i>Ardea cinerea</i>	Grey Heron	Alu Koka	BrR		1	1	0	0	1	0
133	<i>Ardea purpurea</i>	Purple Heron	Karawal Koka	BrR		1	1	0	0	1	1
134	<i>Casmerodius albus</i>	Great Egret	Sudu maha-koka	BrR		1	1	0	1	1	1
135	<i>Mesophoyx intermedia</i>	Intermediate Egret	Sudu Madi-koka	BrR		1	1	0	1	1	1
136	<i>Bubulcus ibis</i>	Cattle Egret	Geri-koka	BrR		1	1	0	1	0	0
137	<i>Ardeola grayii</i>	Indian Pond Heron	Kana-koka	BrR		1	1	0	0	0	0
138	<i>Butorides striatus</i>	Straited Heron	Pala-koka	BrR		1	1	0	0	0	1
139	<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	Ra kana-koka	BrR		1	1	0	0	0	1
140	<i>Ixobrychus flavicollis</i>	Black Bittern	Kalu Mati-koka	BrR		0	1	0	0	0	0
<b>Family - Phoenicopteridae</b>											

141	<i>Phoenicopterus roseus</i>	Greater Flamingo	Raja Siyakkaraya	WV		0	0	0	0	1	0
<b>Family - Threskiornithidae</b>											
142	<i>Plegadis falcinellus</i>	Glossy Ibis	Silutu Dathuduwa	WV		0	0	0	0	1	0
143	<i>Threskiornis melanocephalus</i>	Black-headed Ibis	Hisakalu Dakaththa	BrR		1	1	1	1	1	0
144	<i>Platalea leucorodia</i>	Eurasian Spoonbill	Handialawa	BrR		1	1	0	0	1	0
<b>Family - Pelecanidae</b>											
145	<i>Pelecanus philippensis</i>	Spot-billed Pelican	Thithhota Pasthuduwa	BrR		0	1	1	0	1	0
<b>Family - Ciconiidae</b>											
146	<i>Mycteria leucocephala</i>	Painted Stork	Lathuwakiya	BrR		0	1	0	0	1	0
147	<i>Anastomus oscitans</i>	Asian Openbill	Vivarathuduwa	BrR		0	1	1	1	1	0
148	<i>Ciconia episcopus</i>	Woolly-necked Stork	Padili Manawa	BrR	NT	0	1	1	0	0	0
149	<i>Leptoptilos javanicus</i>	Lesser Adjutant	Heen Bahuru-manawa	BrR	VU	0	1	0	0	0	0
<b>Family - Pittidae</b>											
150	<i>Pitta brachyura</i>	Indian Pitta	Avichchiya	WV		0	1	0	0	0	0
<b>Family - Chloropseidae</b>											
151	<i>Chloropsis jerdoni</i>	Blue-winged Leafbird	Nilpiya Kolarisiya	BrR		0	1	1	0	0	0
<b>Family - Laniidae</b>											
152	<i>Lanius cristatus</i>	Brown Shrike	Bora Sabariththa	WV		0	0	1	0	0	0
153	<i>Lanius schach</i>	Long-tailed Shrike	Dikpenda Sabariththa	BrR		0	1	1	1	0	0
<b>Family - Artamidae</b>											
154	<i>Artamus fuscus</i>	Ashy Woodswallow	Alu Wanalihiniya	BrR		1	1	1	1	1	0
<b>Family - Oriolidae</b>											
155	<i>Oriolus xanthornus</i>	Black-hooded Oriole	Kahakurulla	BrR		1	1	0	0	0	1
<b>Family - Dicruidae</b>											
156	<i>Dicrurus macrocercus</i>	Black Drongo	Kalu Kawuda	BrR		0	1	1	1	1	1
157	<i>Dicrurus caeruleus</i>	White-bellied Drongo	Kawuda	BrR		1	1	0	0	0	0
158	<i>Dicrurus paradiseus</i>	Great Racket-tailed Drongo	Maha Kawuda	BrR	NT	0	1		0	0	0
<b>Family - Rhipiduridae</b>											
159	<i>Rhipidura aureola</i>	White-browed Fantail	Bama-sudu Pawanpenda	BrR		0	1	0	0	0	0
<b>Family - Monarchidae</b>											

160	<i>Hypothymis azurea</i>	Black-naped Monarch	Kalu-gelasi Radamara	BrR		0	1	0	0	0	0
161	<i>Terpsiphone paradisi</i>	Asian Paradise Flycatcher	Asia Rahanmara	BrR/WV		0	1	0	0	0	0
<b>Family - Corvidae</b>											
162	<i>Corvus splendens</i>	House Crow	Kolamba Kaputa	BrR		1	1	1	1	1	1
163	<i>Corvus leuallantii</i>	Large-billed Crow	Kalu Kaputa	BrR		1	0	0	0	0	0
<b>Family - Campephagidae</b>											
164	<i>Coracina melanoptera</i>	Black-headed Cuckooshrike	Kalu-his Kovul-saratiththa	BrR		0	1	0	0	0	0
165	<i>Pericrocotus cinnamomeus</i>	Small Minivet	Punchi Miniviththa	BrR		0	1	0	0	0	0
166	<i>Coracina macei</i>	Large Cuckooshrike	Maha Kovul-saratiththa	BrR		0	1	0	0	0	0
167	<i>Tephrodornis pondicerianus</i>	Common Woodshrike	Podu Wana-saratiththa	Pro:endemic		0	1	0	0	0	0
168	<i>Hemipus picatus</i>	Bar-winged Flycatcher-shrike	Wairapiya Masi-saratiththa	BrR		0	1	0	0	0	0
<b>Family - Aegithinidae</b>											
169	<i>Aegithina tiphia</i>	Common Iora	Podu Iorawa	BrR		1	1	1	0	0	0
<b>Family - Muscipapidae</b>											
170	<i>Cyornis tickelliae</i>	Tickell's Blue Flycatcher	Tickel Nil-masimara	BrR		0	1	0	0	0	0
171	<i>Copsychus saularis</i>	Oriental Magpie Robin	Polkichcha	BrR		1	1		0	0	1
172	<i>Copsychus malabaricus</i>	White-rumped Shama	Wana Polkichcha	BrR		0	1	1	0	0	0
173	<i>Saxicoloides fulicata</i>	Indian Robin	Indu Kalukichcha	BrR		1	1	0	0	0	1
<b>Family - Sturnidae</b>											
174	<i>Sturnus pagodarum</i>	Brahminy Starling	Bamunu Sharikawa	WVa		0	1	0	0	0	0
175	<i>Acridotheres tristis</i>	Common Myna	Mayna	BrR		1	1	1	1	1	1
<b>Family - Sittidae</b>											
176	<i>Sitta frontalis</i>	Velvet-fronted Nuthatch	Villuda Nalal Yatikuriththa	BrR	NT	0	1	0	0	0	0
<b>Family - Hirundinidae</b>											
177	<i>Hirundo rustica</i>	Barn Swallow	Atu Wahilihiniya	BrR		1	1	1	1	1	1
178	<i>Hirundo daurica</i>	Red-rumped Swallow	Nithamba rathu Wahilihiniya	Pro:endemic	NT	1	1		0	0	0
<b>Family - Pycnonotidae</b>											
179	<i>Pycnonotus melanicterus</i>	Black-crested Bulbul	Kalu Hisasi Kondaya	Pro:endemic		0	1	0	0	0	0
180	<i>Pycnonotus cafer</i>	Red-vented Bulbul	Kondaya	BrR		1	1	1	1	1	1

181	<i>Pycnonotus luteolus</i>	White-browed Bulbul	Bamasudu Kondaya	BrR		1	1	1	1	1	1
<b>Family - Cisticolidae</b>											
182	<i>Cisticola juncidis</i>	Zitting Cisticola	Iri Pawansariya	BrR		1	1	1	0	0	0
183	<i>Prinia hodgsonii</i>	Grey-breasted Prinia	Grey-breasted Prinia	BrR		0	0	1	0	0	0
184	<i>Prinia sylvatica</i>	Jungle Prinia	Wana Priniya	BrR		0	1	0	0	0	0
185	<i>Prinia socialis</i>	Ashy Prinia	Alu Priniya	BrR		1	1	1	0	0	1
186	<i>Prinia inornata</i>	Plain Prinia	Sarala Priniya	BrR		1	1	1	1	0	0
<b>Family - Zosteropidae</b>											
187	<i>Zosterops palpebrosus</i>	Oriental White-eye	Peradigu Sithasiya	BrR		1	1	0	0	0	0
<b>Family - Sylviidae</b>											
188	<i>Orthotomus sutorius</i>	Common Tailorbird	Battichcha	BrR		1	1	1	1	1	1
189	<i>Phylloscopus trochiloides</i>	Greenish Warbler	Kola Gassraviya	WV		1	1	0	0	0	0
<b>Family - Timalidae</b>											
190	<i>Pellorneum fuscicapillum</i>	Sri Lanka Brown-capped Babbler	Sri Lanka Boraga-demalichcha	Endemic	NT	0	1	0	0	0	0
191	<i>Dumetia hyperythra</i>	Tawny-bellied Babbler	Kusakaha Landu-demalichcha	BrR	NT	0	1	0	0	0	0
192	<i>Rhopocichla atriceps</i>	Dark-fronted Babbler	Wathanduru Panduru-demalichcha	BrR		0	1	0	0	0	0
193	<i>Turdoides affinis</i>	Yellow-billed Babbler	Demalichcha	BrR		1	1	1	1	1	1
<b>Family - Alaudidae</b>											
194	<i>Mirafra affinis</i>	Rufous-winged Bushlark	Rathpiya Akul-thulikawa	BrR		1	1	1	1	0	0
195	<i>Eremopterix grisea</i>	Ashy-crowned Sparrow Lark	Kirulalu Gekurulu-thulikawa	BrR		1	1	1	1	0	1
196	<i>Alauda gulgula</i>	Oriental Skylark	Peradigu Ahas Thulikawa	BrR		0	1	0	0	0	0
<b>Family - Dicaeidae</b>											
197	<i>Dicaeum erythrorhynchos</i>	Pale-billed Flowerpecker	Lathudu Pililichcha	BrR		1	1	1	1	1	1
<b>Family - Nectariniidae</b>											
198	<i>Nectarina zeylonica</i>	Purple-rumped Sunbird	Nithamba Dam Sutikka	BrR		1	1	1	1	1	1
199	<i>Nectarina asiatica</i>	Purple Sunbird	Dam Sutikka	BrR		1	1	1	1	1	1
200	<i>Nectarina lotenia</i>	Loten's Sunbird	Lotenge Sutikka	BrR		1	1	0	0	0	0
<b>Family - Passeridae</b>											
201	<i>Passer domesticus</i>	House Sparrow	Gekurulla	BrR		1	1	0	0	0	1
<b>Family - Motacillidae</b>											

202	<i>Anthus richardi</i>	Richard's Pipit	Richard Varatichcha	WV		0	1	0	0	0	0
203	<i>Anthus rufulus</i>	Paddyfield Pipit	Keth Varatichcha	BrR		1	1	1	1	1	1
<b>Family - Estrididae</b>											
204	<i>Lonchura striata</i>	White-rumped Munia	Nithamba Sudu Weekurulla	BrR		0	1	0	0	0	0
205	<i>Lonchura punctulata</i>	Scaly-breasted Munia	Laya Kayuru Weekurulla	BrR		1	1	1	1	1	1
	TOTAL					90	147	68	44	106	69
Sources - IUCN Field Survey 2010; Weeratunga, 2010; IUCN, 2010; Siriwardena, 2003; Bambaradeniya et al. 2005a; Bambaradeniya et al., 2005b											

### Mammal checklist

	Scientific Name	English Name	Sinhala Name	SpS	CoS	KAL	VAN	MUS	NAN	MAW	MAN
<b>Family - Manidae</b>											
1	<i>Manis crassicaudata</i>	Pangolin	Kabellewa	Indigenous	NT	0	1	0	0	0	0
<b>Family - Emballonuridae</b>											
2	<i>Taphozous melanopogon</i>	Sheath-tailed Bat	Ravukalu Kepulum- vavula	Indigenous		0	1	0	0	0	0
<b>Family - Hipposideridae</b>											
3	<i>Hipposideros galeritus</i>	Dekhan Leaf-nosed Bat	Kesdiga Pathnehe-vavula	Indigenous	EN	0	1	0	0	0	0
4	<i>Hipposideros speoris</i>	Schneider's leaf-nosed Bat	Kesketi Pathnehe-vavula	Indigenous		0	1	0	0	0	0
<b>Family - Pteropodidae</b>											
5	<i>Cynopterus sphinx</i>	Short-nosed Fruit Bat	Thala-vavula	Indigenous		0	1	0	0	0	0
6	<i>Pteropus giganteus</i>	Flying Fox	Ma-vavula	Indigenous		0	1	0	0	0	0
<b>Family - Vespertilionidae</b>											
7	<i>Kerivoula picta</i>	Painted Bat	Visithuru Kehel-vavula	Indigenous	EN	0	1	0	0	0	0
8	<i>Pipistrellus coromandra</i>	Indian Pipistrel	Indu Koseta-vavula	Indigenous		1	1	1	1	1	1
<b>Family - Cercopithecidae</b>											
9	<i>Macaca sinica</i>	Sri Lanka Toque Monkey	Sri Lanka Rilawa	Endemic	NT	0	1	0	0	0	0
10	<i>Semnopithecus priam</i>	Grey Langur	Eli-wdura	Indigenous	NT	1	1	1	1	1	1
11	<i>Semnopithecus vetulus</i>	Purple-faced Leaf Monkey	Sri Lanka Kalu-wandura	Endemic	VU	0	1	0	0	0	0
<b>Family - Lorisidae</b>											
12	<i>Loris lydekkerianus</i>	Grey Slender Loris	Alu Unahapuluwa	Indigenous	NT	0	1	0	0	0	0
<b>Family - Canidae</b>											
13	<i>Canis aureus</i>	Jackal	Nariya / Hiwala	Indigenous		0	1	0	0	0	0

14	<i>Canis familiaris</i>	Domestic Dog	Balla	Domestic		1	1	1	1	1	1
<b>Family - Felidae</b>											
15	<i>Felis chaus</i>	Jungle Cat	Wal Balala	Indigenous	VU	0	1	0	0	0	0
16	<i>Felis catus</i>	Domestic Cat	Balala/ Pusa	Domestic		1	1	1	1	1	1
17	<i>Panthera pardus</i>	Leopard	Kotiya/ Diviya	Indigenous	VU	0	1	0	0	0	0
18	<i>Prionailurus rubiginosus</i>	Rusty-spotted Cat	Kola Diviya / Balal Diviya	Indigenous	EN	0	1	0	0	0	0
19	<i>Prionailurus viverrinus</i>	Fishing Cat	Handun Diviya	Indigenous	VU	0	1	0	0	0	0
<b>Family - Herpestidae</b>											
20	<i>Herpestes brachyurus</i>	Brown Mongoose	Bora Mugatiya	Indigenous		1	1	0	0	0	0
21	<i>Herpestes edwardsii</i>	Grey Mongoose	Alu Mugatiya	Indigenous		1	1	1	1	0	0
22	<i>Herpestes smithii</i>	Black-tipped Mongoose	Rath Mugatiya	Indigenous		0	1	0	0	0	0
<b>Family - Mustelidae</b>											
23	<i>Lutra lutra</i>	Otter	Diya-balla	Indigenous	VU	0	1	0	0	0	0
<b>Family - Ursidae</b>											
24	<i>Melursus ursinus</i>	Sloth Bear	Walaha	Indigenous	EN	0	1	0	0	0	0
<b>Family - Viverridae</b>											
25	<i>Paradoxurus hermaphoditus</i>	Palm Civet	Uguduwa	Indigenous		0	1	0	0	0	0
26	<i>Paradoxurus stenocephalus</i>	Golden Dryzone Palm Civet	Sri Lanka Ran Hothambuwa	Endemic		0	1	0	0	0	0
27	<i>Viverricula indica</i>	Ring-tailed Civet	Urulewa	Indigenous		0	1	0	0	0	0
<b>Family - Elephantidae</b>											
28	<i>Elephas maximus</i>	Elephant	Etha / Aliya	Indigenous	VU	0	1	1	0	0	0
<b>Family - Bovidae</b>											
29	<i>Bubalus arnee</i>	Wild Buffalo	Kulu Haraka	Indigenous	VU	0	1	0	0	0	0
30	<i>Bubalus bubalis</i>	Domestic Water Buffalo	Mee Haraka	Feral/ domestic		1	1	0	0	0	0
31	<i>Bos indicus</i>	Domestic Cattle	Sinhala Elaharak	Feral/ domestic		1	1	1	1	1	1
32	<i>Capra hircus</i>	Domestic Goat	Eluva	Domestic		1	1	1	1	1	1
<b>Family - Cervidae</b>											
33	<i>Axis axis</i>	Spotted Deer	Tith Muwa	Indigenous		0	1	1	0	0	0
34	<i>Cervus unicolor</i>	Sambur	Gōna	Indigenous		0	1	0	0	0	0
35	<i>Muntiacus muntjak</i>	Barking Deer	Olu Muwa / Weli Muwa	Indigenous		0	1	1	0	0	0
<b>Family - Suidae</b>											



36	<i>Sus scrofa</i>	Wild Boar	Wal Ura	Indigenous		0	1	1	0	0	0
37	<i>Sus domesticus</i>	Domestic Pig	Gam Ura	Domestic		1	1	0	0	0	0
<b>Family - Tragulidae</b>											
38	<i>Moschiola meminna</i>	Sri Lanka Mouse-deer	Sri Lanka Meminna	Endemic		0	1	1	1	0	0
<b>Family - Equidae</b>											
39	<i>Equus asinus</i>	Donkey	Buruwa	Feral/ domestic		1	1	0	0	0	1
40	<i>Equus caballus</i>	Mannar Ponies	Diweldiwa Poniya	Feral/ domestic		1	1	0	0	0	1
<b>Family - Hystricidae</b>											
41	<i>Hystrix indica</i>	Porcupine	Ittewa	Indigenous		1	1	1	0	1	0
<b>Family - Muridae</b>											
42	<i>Bandicota indica</i>	Malabar Bandicoot	Uru-miya	Indigenous		1	1	0	0	0	0
43	<i>Golunda ellioti</i>	Bush Rat	Panduru-miya	Indigenous		0	1	0	0	0	0
44	<i>Millardia meltada</i>	Soft-furred Field Rat	Kesmudu Keth-miya	Indigenous		0	1	0	0	0	0
45	<i>Mus booduga</i>	Field Mouse	Wel Heen-miya	Indigenous		0	1	0	0	0	0
46	<i>Rattus rattus</i>	Common Rat	Podu Ge Miya	Indigenous		1	1	0	0	0	0
47	<i>Vandeleuria oleracea</i>	Long-tailed Tree Mouse	Gas-miya	Indigenous		0	1	0	0	0	0
48	<i>Tatera indica</i>	Antelope Rat	Weli-miya	Indigenous		1	1	1	1	1	1
<b>Family - Sciuridae</b>											
49	<i>Funambulus palmarum</i>	Palm Squirrel	Leena	Indigenous		1	1	1	1	1	1
50	<i>Ratufa macroura</i>	Giant Squirrel	Dandu-leena	Indigenous	VU	0	1	1	0	0	0
<b>Family - Leporidae</b>											
51	<i>Lepus nigricollis</i>	Black-naped Hare	Wal Hawa	Indigenous		1	1	1	1	1	1
<b>Family - Balaenopteridae</b>											
52	<i>Balaenoptera edeni</i>	Bryde's Whale	Brydige thalmaha	Marine		0	0	0	0	0	1
53	<i>Megaptera novaeangliae</i>	Humpback Whale	Molli thalmaha	Marine	VU	0	0	0	0	0	1
54	<i>Balaenoptera acutorostrata</i>	Mink Whale	Minki thalmaha	Marine		1	1	0	0	0	1
55	<i>Balaenoptera musculus</i>	Blue Whale	Nil thalmaha	Marine	EN	1	1	0	0	0	1
<b>Family - Delphinidae</b>											
56	<i>Delphinus delphis</i>	Common Dolphin	Sulaba mulla	Marine		1	1	0	0	0	1
57	<i>Peponocephala electra</i>	Melon-headed Dolphin	Puhulolu thalmaha	Marine		1	1	0	0	0	1
58	<i>Pseudorca crassidens</i>	False Killer Whale	Boru minimaru thalmaha	Marine		1	1	0	0	0	1

59	<i>Sousa chinensis</i>	Indo-Pacific Dolphin	Kabara mulla	Marine		0	0	1	0	0	0
60	<i>Stenella attenuata</i>	Pantropical Spotted Dolphin	Wairam mulla	Marine		1	1	0	0	0	0
61	<i>Stenella longirostris</i>	Spinner Dolphin	Sannali mulla	Marine		0	0	1	0	0	0
62	<i>Tursiops truncatus</i>	Bottlenos Dolphin	Digasubu mulla	Marine		1	1	0	0	0	1
<b>Family -Physeteridae</b>											
63	<i>Physter macrocephalus</i>	Sperm Whale	Manda thalmaha	Marine	VU	0	0	0	0	0	1
<b>Family - Dugongidae</b>											
64	<i>Dugong dugon</i>	Common Dugong	Muhudu ura	Marine	VU	1	0	0	0	0	0
	TOTAL					26	58	19	11	10	20
Sources - IUCN Field Survey October 2010; Weeratunga, 2010; IUCN Sri Lanka, 2010; De Silva, 1987; Bambaradeniya et al., 2007.											

#### Annex 4: Archaeological Monuments and Historic Sites in the Gulf of Mannar

No	DS Division	Village	Monument / Historic site	Site description	FOS	PR H	PO H	PEC	COL	N Latitudes	E Longitudes
	<b>District: Puttalam</b>										
1	Kalpitiya	Kalpitiya	Dutch Fort	Built on Kalpitiya Lagoon waterfront where an old Portuguese period Jesuit church stood. Four-sided rampart of coral stone, with two bastions, two half bastions, and a flat bastion on the eastern front. Year 1676 is marked above the brick-built arch.					X	08° 14' 08.48"	79° 45' 58.95"
2	Kalpitiya	Kalpitiya	Dutch Church	300 m from lagoon. Built during Dutch occupation					X	08° 14' 06.44"	79° 45' 49.34"
3	Kalpitiya	Kuringnanpitiya	Adivellankaran ruins	Identified as a Antharparasamudda Vihara built during the Anuradhapura period				X			
4	Kalpitiya	Kalpitiya	Dutch St Peters Church	Tomb of Johanna Hester van Minnen dated 27 April, 1741					X	08° 14' 06.44"	79° 45' 49.34"
5				Tomb of Benjamina Hannecop dated 28 May, 1686					X	08° 14' 06.44"	79° 45' 49.34"
6				Tomb of Henry Dawson Skinner Templer dated 21 March, 1832					X	08° 14' 06.44"	79° 45' 49.34"
7				Tomb of Sophia Mooraart dated 27 April, 1838					X	08° 14' 06.44"	79° 45' 49.34"
8	Kalpitiya	Sinnakudirippu	Hajjjar Yeh. Alavudeen Mosque	4 km inland from the sea. Built in 1800					X		
9	Kalpitiya	Kuringnanpitiya	Mohideen Yehu Alawuddeen Mosque	700 m inland from the sea. Built in 1800					X		

10	Kalpitiya	Mudalipali	St. Anne's Church, Talawila	Adjacent to beach. Very old popular catholic church. Believed to have originated in 17th century during the Portuguese occupation. The present church was built circa 1885.					X	08° 06' 44.94"	79° 42' 12.10"
11	Kalpitiya	Uchchamunai	Miocene bed	Exposed to lagoon beach	X					08° 15' 24.35"	79° 44' 56.40"
12	Kalpitiya	Karativ island	Miocene bed	Exposed to lagoon beach	X					08° 25' 12.41"	79° 48' 14.64"
13	Puttalam	Puttalam	Old Burial Ground	Tomb of James Greer Edge dated 4th March, 1880					X	08° 14' 06.44"	79° 45' 49.34"
14	Vanathavillu	Saliyapura	Malvila ruins	Ruins of ancient monastery of the Anuradhapura period. This site was mentioned in the "Nampotha" written during the Kandy period.				X			
15	Vanathavillu	Iluvankulama	Aruvakkalu	Miocene invertebrate fossils	X					08° 17' 00.08"	79° 50' 33.08"
16	Vanathavillu	Iluvankulama	Aruvakkalu	Shell midden at coconut plantation belonging to Holcim Lanka Ltd.		X	X			08° 14' 42.32"	79° 48' 45.21"
17	Vanathavillu	Iluvankulama	Aruvakkalu	Prehistoric open settlement where stone tools were discovered.		X				08° 15' 23.24"	79° 50' 47.98"
18	Vanathavillu	Iluvankulama	Aruvakkalu	Survey Base point at the top of the Aruvakkalu hill. Also used as a beacon					X	08° 16' 30.10"	79° 49' 47.9"
19	Vanathavillu	Iluvankulama	Arnakallu	Miocene vertebrate fossils. Fossils of corals, gastropods and marine vertebrates have been discovered.	X					08° 16' 59.59"	79° 49' 30.24"
20	Vanathavillu	Iluvankulama	Gangewadiya	Black & Red Ware (BRW) and iron slags have been discovered in and around the village premises			X	X		08° 17' 34.87"	79° 50' 18.84"
21	Vanathavillu	Iluvankulama	Monaravillu	BRW and iron slags found in the mounds near villu			X	X		08° 17.487'	79° 51.542'

22	Vanathavillu	Iluvankulama	Nelum Wewa	BRW pottery and bead site			X	X		08° 16.902 ' 79° 52.728'
23	Vanathavillu	Pomparippu	Pomparippu	Urn burial and BRW site			X	X		08° 18' 13.40" 79° 53' 15.80"
24	Vanathavillu	Pomparippu	Pomparippu ara	BRW pottery and bead site			X	X		08° 19.437 ' 79° 51.131'
25	Vanathavillu	Pomparippu	Pomparippu ara	Baobab tree and BRW site			X	X		08° 19' 25.60" 79° 50' 42.90"
26	Vanathavillu	Pomparippu	Pomparippu ara	BRW pottery and bead site			X	X		08° 19.269 ' 79° 51.236'
27	Vanathavillu	Pomparippu	Pallivasal Kulam	Stone pillars near water hole				X		08° 19.677 ' 79° 52.727'
28	Vanathavillu	Pomparippu	Vali Vehera	Stupa, Pillars, Inscriptions, coins				X		08° 18.800 ' 79° 54.200'
29	Vanathavillu	Pomparippu	Kollankanaththa	Ancient port. Site discovered in 1922 and excavated in 1932. Terracotta ringed well, various types of pottery including BRW, and numerous conch-shells belonging to megalithic pottery typology of Anuradhapura gedige were found. Site is known to be the ancient Uruvela port.			X	X		08° 26' 24.69" 79° 50' 56.40"
30	Vanathavillu	Pomparippu	Uruvela	Pre Christian settlement founded by King Vijaya's minister or a brother-in-law of King Panduwasudeva.				X		08° 18' 16.5" 79° 53' 15.8"
31	Vanathavillu	Pukkulam	Palugahatura	BRW pottery and bead site			X	X		08° 28' 28.0" 79° 51' 44.28"
32	Vanathavillu	Pukkulam	Kudiramalai point	Miocene fossils	X					08° 32' 18.14" 79° 52' 23.43"
33				Pleistocene fossils and red soil deposits	X					08° 32' 18.74" 79° 52' 22.20"
34				Mukkaru dome which is linked with Mukkaru legends				?	?	08° 32' 23.13" 79° 52' 28.29"

35				Ruins of an elliptical image house with damaged figures found in the vicinity of Kudiramalai point; believed to belong to latter part of the Anuradhapura period. Brohier identifies the location as "Hipparus" recorded in Pliny's map.				X		08° 32' 24.73"	79° 52' 27.93"
36	Vanathavillu	Pukkulam	Kudiramalai hill	Survey Base point situated few meters south of the Kudiramalai point.					X		
37	Vanathavillu	Pukkulam	Periya Villu	Ancient tank				X		08° 27' 11.25"	79° 52' 52.35"
38	Vanathavillu	Pukkulam	Left bank of the Modaragan Ara estuary	Pukkulam, opposite Mullikulama, at the estuary of Modaragan Ara inside the Wilpattu National Park. There are pearl oyster shells mixed with BRW embedded in coastal ridges. This place has been identified as Ancient Magana city mentioned in inscriptions and several chronicles.			X	X		08° 33.701'	79° 55.320'
	<b>District: Mannar</b>										
39	Musali	Arippu	Arippu	The Doric. Built by Frederic North, the first British Governor, in 1802-4, as the 'Governor's Residence' at Arrippu. It was known as 'The Doric' due to its ancient Greek Doric columns. The two-storied mansion has partly collapsed.					X	08° 46.864'	79° 56.060'
40	Musali	Arippu	Arippu, Beacon	Survey Base point; also used as a beacon					X	08° 46.814'	79° 56.094'
41	Musali	Arippu	Pudukuriiruppu -Velangani Nagar	Cemetery belonging to the colonial period, now abandoned					X	08° 45.709'	79° 56.599'

42	Musali	Arippu	Dutch Fort at Arrippu and the Rest House compound	Located few meters inland from Arrippu shore. Robert Knox and another British prisoner escaped from this fort in 1679 AD. Roughly similar in style to the fort at Elephant Pass. Parts of the bastions and probably the eastern rampart are still to be seen. The ruined building was used as a bungalow, during the British period, for the supervisor of the pearl fishery and as a Rest House.					X	08° 47.554'	79° 55.783'
43				Tomb of Charles Lays dated 14 April, 1878. He died of sunstroke at Marichchikaddi and was buried at Arrippu Rest House premises.							
44	Musali	Arippu	Tambapanni Port	According to Dipavamsa it is on the southern bank of the Aruvi ara (Malwathu Oya) which is in the vicinity of modern Arrippu.				X		08° 33.625'	79° 55.197'
45	Musali	Arippu	St. Mary's Church	100 m inland from the sea near the Malwathu Oya estuary left bank. Built in 1894					X	08° 47.846'	79° 55.600'
46	Musali	Arippu	Megalithic site	Near Malwathu Oya left bank			X	X		08° 48.087'	79° 55.880'
47	Musali	Mullikulama	Compound of Roman Catholic Church at Mullikulama	Tomb of John Gerrit Freywer, dated 5 May, 1836					X		
48	Musali	Marichchikaddi	Kal Ara	Near the causeway on Puttalam-Mannar road. Miocene fossils can be traced in the river bed and banks	X					08° 38.484'	79° 57.684'



49	Nanaddan	Vankalai	Ancient settlement	Near the coast. Ancient settlement from which large quantities of indigenous, Islamic and Chinese ceramics were unearthed in 1979.				X			
50	Nanaddan		Giant's Tank	Earlier known as Manawatta Tank built by King Dhatusena (455-474 AD) and renovated by King Parakramabahu I. It was renovated again during the British period				X		08° 51' 52.80"	80° 01' 53.29"
51	Manthai West	Manthai	Matota Rajamaha Viharaya	Stone pillars, fragments of Buddha statues, a Bodhisathva image and an inscription were found here. The Buddha statue has been dated to 4th century AD; the Bodhisathva statue is believed to be from the 8th century AD; and the 12th century inscription records a donation to the temple.				X		08° 57.739'	79° 55.143'
52	Manthai West	Manthai	Matota Port and Fort (present Mantai)	Ancient Fort, 625 m from the sea. Matota is now a truly buried city, its ruins lying under the great mound, near present Mantai, from which rises the present Hindu temple of Tirukēśvaram. Ruined moats around the mound can be traced. Archaeological monuments discovered at the site have been deposited in Archaeological museums				X		08° 57.631'	79° 57.819'

53	Manthai West	Manthai	Manthai Tirukēśvaram Kovil	Ancient Hindu Kovil, 450 m from sea, originated in early historic period. Present construction was after 1872.					X	08° 57.466'	79° 57.716'
54	Manthai West	Manthai	Koholavali Tank	Also called Kehala, constructed by Vasabha (65-109AD). Near Manthai but precise site not identified as yet.				X			
55	Manthai West	Manthai	Dutch Church	Ruins of old Dutch Church is recorded in maps. Difficult to trace the exact site now.					X		
56	Manthai West	Manthai	St. Sebastian's Church	Founded in 1847					X		
57	Manthai West	Manthai	Olaitoduwai division-Portuguese Church	Ruins of a church					X		
58	Manthai West	Manthai	Beacon	1.2 km from the sea. Near Thrikitheshwaram					X	08° 57.255'	79° 57.748'
59	Mannar	Mannar	Mannar Fort	Portuguese Fort built at the tip of the Mannar Island. Initially erected by the Portuguese in 1560 AD.					X	09° 58.549	79° 54.987'
60				Church					X	09° 58.549	79° 54.987'
61				Tomb of Maria de Lacerda (16th century)					X	09° 58.549	79° 54.987'
62				Tomb of Anna van Heuel, dated December 12, 1687					X	09° 58.549	79° 54.987'
63				Tomb of Henrietta van der Parra, dated May 26, 1697					X	09° 58.549	79° 54.987'
64				Tomb of Lamberi van Buren, dated March 12, 169?					X	09° 58.549	79° 54.987'
65				Tomb of Susanna Bout, dated Feb 6, 1701					X	09° 58.549	79° 54.987'
66				Tomb of Johana van der Spar, dated Feb 23, 1740					X	09° 58.549	79° 54.987'

67				Tomb of Jonnes Christians van der Spar, dated May 28, 1775					X	09° 58.549	79° 54.987'
68				Tomb of Magdalena Raket, dated Oct 21, 1744					X	09° 58.549	79° 54.987'
69				Tomb of Abraham Roos, dated March 1, 1744					X	09° 58.549	79° 54.987'
70				Tomb of Pierre de Salve, dated March 2, 1750					X	09° 58.549	79° 54.987'
71				Tomb of Jacob Henderik Vogelaar, dated April 1752					X	09° 58.549	79° 54.987'
72				Tomb of Erasmus Hansz, dated April 5, 17??					X	09° 58.549	79° 54.987'
73	Mannar	Mannar	Old burial ground at the present Mannar stadium	The cemetery was converted into a stadium during the 1970s. Several old tombstones are built in to the stadium wall.					X		
74	Mannar	Pier Village	Lighthouse	Within the Navy base. Built in 1815.					X	09° 06' 25.86"	79° 43' 50.38"
75	Mannar	Urumalai	Adam's dome	Similar to Mukkaru dome at Kudiramalai.					X	09° 05.470'	79° 42.082'
76	Mannar	Pesalai	Ancient settlement	1.4 km inland from the sea between Pesalai and Talaimannar. Buried settlement, perhaps a town. Mounds and surface remains extend a little inland from the shore, but part of the settlement seems to be submerged by the sea.				X			
77	Mannar	Mannar	Historic Baobab tree	Baobab tree at Pallemunai. It was declared as an ancient monument under the Antiquities Ordinance of 28-01-1955.					X	08° 58' 54.02"	79° 55' 23.34"
78	Mannar	Tharapuram	Shell midden	Shell midden located on a sand dune	X	X?				09° 01.229'	79° 52.550'



Annex 5

# The Gulf of Mannar and its Environs

A Training module for Teachers in the Mannar District



**A Training Module for Teachers in the Mannar District  
on  
the Natural Wealth and Socio-economic Conditions of the  
Gulf of Mannar**

Compiled by Dr Sriyanie Miththapala based on

1. Report of the Rapid Biodiversity Survey of Mannar Biosphere, conducted by University of Ruhuna

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## Chapter 1 - Gulf of Mannar: The Setting

### 1.1 Where is the Gulf of Mannar?

The **Gulf of Mannar** lies between the south-eastern tip of India and the north-western coast of Sri Lanka.



Fig 1.1 - Location of the Gulf of Mannar

Between India and Sri Lanka lies a chain of limestone islands covered with sand, as well as sand islands, stretching from India's Pamban Island (also known as Rameshwaram island) to Sri Lanka's Mannar island. This chain of islands is called **Adam's Bridge** in English, *Ātham Pālam* in Tamil and *Rama Sethu* in Malayalam. The name Adam's Bridge was given by a British mapmaker, and referred to legend that said that Adam (the first man in Christianity and Islam) crossed from India to Sri Lanka along this bridge to reach Adam's Peak in the central part of Sri Lanka. The Indian name *Rama Sethu* refers to the Indian legend *Ramayanaya*: the bridge is supposed to have been built for the Indian Prince Rama to cross from India to Sri Lanka to rescue his wife Sita from Ravana, the king of Sri Lanka ([http://en.wikipedia.org/wiki/Gulf\\_of\\_Mannar](http://en.wikipedia.org/wiki/Gulf_of_Mannar)). *Sethu* means bridge.

Evidence from the past shows that Adam's Bridge once connected India and Sri Lanka but now there is sea between the limestone and sand islands. The sea level in the past was much lower, therefore, there was a connection. Wave currents move the sand so that some sand islands disappear during certain parts of the year. According to historical records, people walked across Adam's Bridge up until the 15<sup>th</sup> century, until a bad storm broke up the chain. However, even now much of Adam's Bridge can be waded across.

Adam's Bridge is 30 km long. The sea in this area is very shallow (1.5 to 3.5 m only), with sand shifting and resettling with wave currents.



Adam's Bridge starts from Pamban island in Tamil Nadu, India (connected to the mainland by a man-made bridge) and ends at Mannar island in Sri Lanka. Mannar island is connected to the mainland by a causeway – which is a road raised over water with a few culverts underneath to allow some water to pass under. ("Mannar" = Minara – a place of worship).

To the northeast of Adam's Bridge is the **Palk Bay** which leads to **Palk Strait**. Although they are narrow, ships can move pass through straits. Palk Strait is named after the British governor James Palk.

([http://en.wikipedia.org/wiki/Gulf\\_of\\_Mannar](http://en.wikipedia.org/wiki/Gulf_of_Mannar)).

To the southwest of Adam's Bridge is the **Gulf of Mannar**. The Gulf of Mannar is a shallow area of water connected to Lakshadweep Sea, which is part of the Indian Ocean in which the tip of India, Sri Lanka and the Maldives are found.

A **bay** is a body of water that is partly enclosed by land.

A **strait** is a narrow channel of water that separates two deeper areas of water

A **gulf** is larger than a bay, and is also a body of sea that is partly enclosed by land.

## 1.2 The climate in the Gulf of Mannar

The rainfall and the shape of the surface of the land dictate Sri Lanka's climate.

In the centre of the island are high hills, surrounded by less high hills. Below this is the large area of mostly flat land.

Sri Lanka is a tropical island where the temperature does not vary much. However, rainfall varies greatly. The island receives its rain from two monsoons, the southwest and the northeast monsoon. The southwest monsoon comes from the direction of the Bay of Bengal, from May to September. The water vapour bearing winds cool as they rise above the central hills, and fall down as rain on the side of the hills that face the wind. During this period, the rest of the island remains more or less without rainfall.

Meanwhile, the northeast monsoon, blowing overland from India, snakes round the central hills to bring rain to the whole island from November to March. This means that the part of the island southwest of the hill is wet through most of the year, while the rest of the country has a dry spell. Because of this combination of both the shape of the surface of the land and rainfall, we are able to tell apart different climatic zones in the island. For the purpose of this module, we will use the Wet Zone, the Dry Zone, the Intermediate Zone and the Arid Zone. The Arid Zone receives only about 650 mm of rain every year, and suffers a long dry period for nearly three quarters of the year.

Much of the coastline near Mannar District lies in the Arid zone and the Dry Zone.



Climatic Zone	Average Rainfall	Remarks
Wet Zone	2,000 mm – 5, 000 mm	The upcountry wet zone generally receives rain throughout the year. The low country wet zone is likely to have about 5 -6 months without rain.
Intermediate Zone	1,100 mm – 2,000 mm	<ul style="list-style-type: none"> <li>The up country Intermediate Zone receives better rainfall than the rest of the Intermediate Zone.</li> <li>Some parts of the Mid Country Intermediate Zone may have about 6 months without rain.</li> <li>The Low Country Intermediate Zone may have about 6 months without rain.</li> </ul>
Dry Zone	700 mm – 1,000 mm	The Dry Zone receives rain only for about 3-4 months, mainly from the northeast monsoon. The rest of the year is dry.
Arid Zone	About 650 mm	The Arid Zone receives limited rain only for about three months. The lowest rainfall is in Hambantota. The rainfall in Mannar, Jaffna and parts of Kilinochchi district is also low (in the region of about 700 mm).

Adapted from Agro-ecological Map; Panabokke & Kannangara (1996)

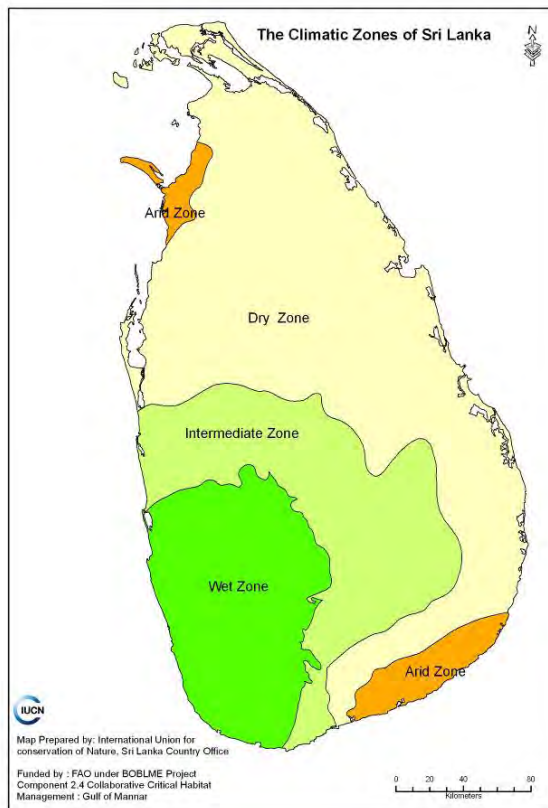


Figure 1.2 - The climatic zones of Sri Lanka

The monsoons that so greatly control the climate in Sri Lanka, are also extremely important for the waters of Palk Strait, Palk Bay and the Gulf of Mannar.

Even though the size and depth of Adam's Bridge seem small, this chain plays a very important role in controlling the amount of water that moves between the Bay of Bengal (east of India) and the Arabian Sea (west of India). Because Adam's Bridge is small, it does not allow the daily tide to move across it. As a result, the tides in the Gulf of Mannar and the tides in Palk Bay are very different: there is almost a twelve-hour difference in the tides, although they are close together. Because of this, there are huge differences in the water levels on either side of Adam's Bridge, driving strong currents through the gaps between the islands. These currents change direction as the tide changes.

During the southwest monsoon, strong winds blow large quantities of water from the Gulf of Mannar to Palk Bay, sending warmer, more salty water into Palk Bay. During the northeast monsoon, the opposite happens: cool, less salty water is moved to the Gulf of Mannar.

Animals and plants in the Gulf of Mannar and Palk Bay will be adapted to these differences in water levels, changing warmth of water and changing saltiness. The importance of these peculiarities in the area will become clear later on in this module.

### 1.3 Rivers and Lagoons in area

Draining into the Gulf of Mannar and Palk Strait are several rivers. From India

- The **Thambarapani River** starts 1,500 m above sea level in the Western Ghats of India and flows eastwards, out into the Gulf of Mannar.
- The **Vagai River**, also originating in the Western Ghats of India, drains into the Palk Strait.

In Sri Lanka, draining into the Gulf of Mannar are

- **Aruvi Aru,**
- **Kal Aru** and
- **Moderagam Aru.**

Draining into Palk Bay are two more rivers:

- **Nay Aru** and
- **Parangi Aru.**

Along the coastline are two small lagoons:

- **Periya Kalapu** and
- **Vidattaltivu Lagoon.**

**Tides** are the rise and fall of sea levels caused by the combined effects of the gravity exerted by the Moon and the Sun as well as the rotation of the Earth. Many coastal areas go through a high tide (when the sea level is high) and low tide (when the sea level is low) once a day, usually with a time difference of 12 hours. Areas close together – for example Colombo and Negombo, go through high and low tides around the same time.

A **lagoon** is a body of shallow water separated from the sea by some form of barrier at least during part of the year. This is usually a barrier formed by a strip of beach.

An **estuary** is also a body of sea water partly enclosed from the sea, but connected to sea through out the year which has one or more rivers flowing into it.

The Puttalam estuary has three rivers flowing into it: **Mi Oya, Kala oya** and **Moongili Aru.**

There is also one large estuary: the **Puttalam estuary** (many call it **Puttalam lagoon**).

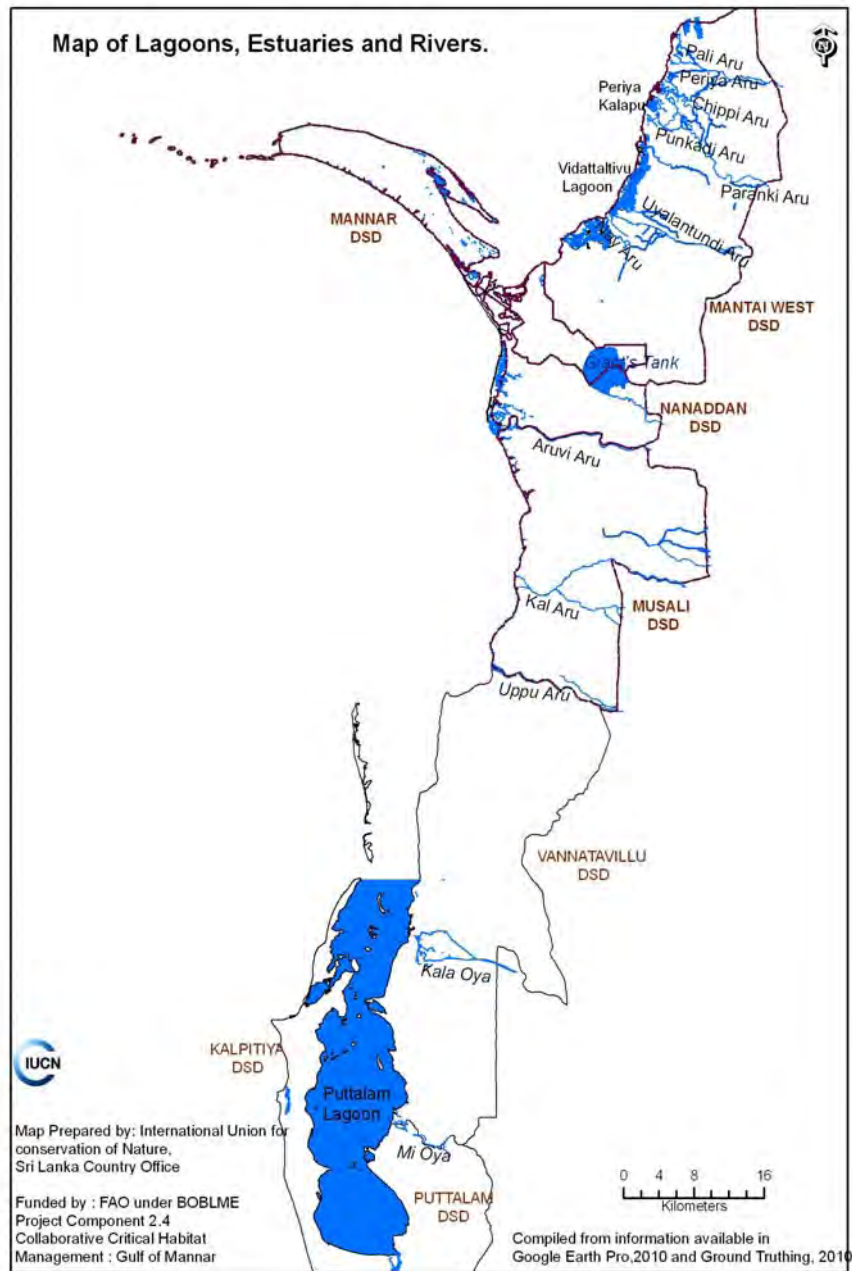


Figure 1.3 - Water bodies in the area

## 1.4 The Sri Lankan coastline in the region of the Gulf of Mannar

Several divisional secretariat divisions of both Districts of Puttalam and Mannar line the coastline along the Gulf of Mannar and part of Palk Strait.

These are

- Kalpitiya and
- Vanathavillu in the Puttalam District
- and
- Mannar Town
- Manthai West
- Nananddan
- Musali in the Mannar District

- Below the national level of administration are provinces. Below the provincial layer of administration are **districts**.
- **Divisional secretariat divisions** are subdivisions of a district.

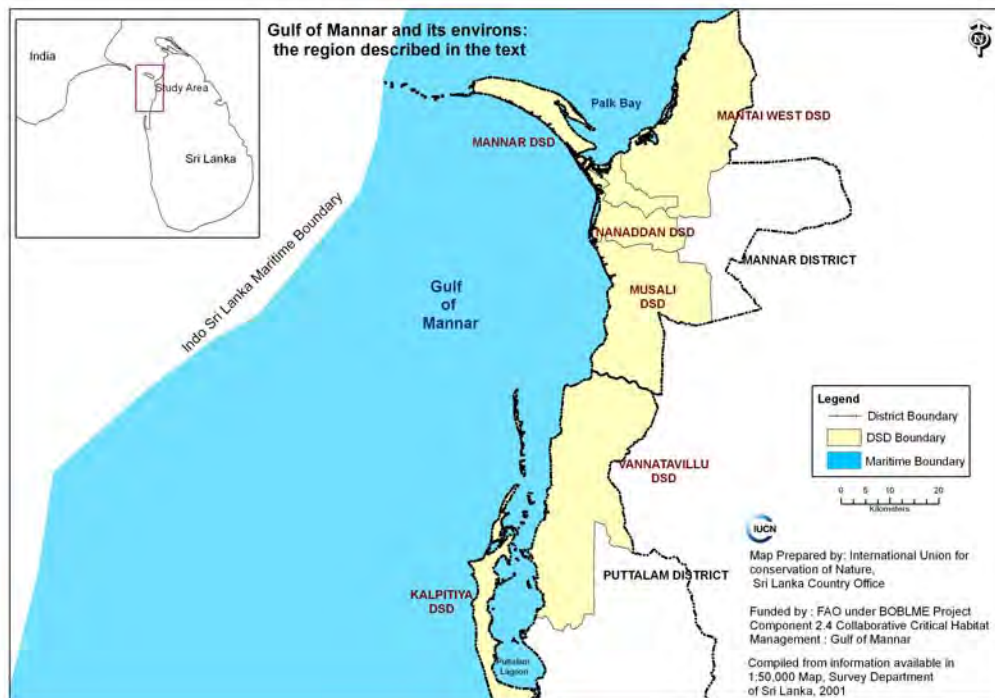


Figure 1.4 - Administrative divisions along the Sri Lankan coastline in the region of the Gulf of Mannar and Palk Strait

## 1.5 The people of the area

According to latest statistics, there are about 412,000 people living in the divisional secretariat divisions shown in Fig. 4. The highest number of persons per square kilometre (**population density**) is seen in Kalpitiya (524 persons per km<sup>2</sup>) and the next highest density is in Mannar, with 238 persons per km<sup>2</sup>. Mantai West has only 12 persons per km<sup>2</sup>.

The majority of the population here is Sri Lankan Tamil (51.3%), but there are also Muslims (26.1%), Indian Tamils (13.0%), Sinhalese (8.2%) and others (1.4%). However, these proportions and the actual number of people in the region are both changing because there are ongoing resettlements after the civil disturbances.

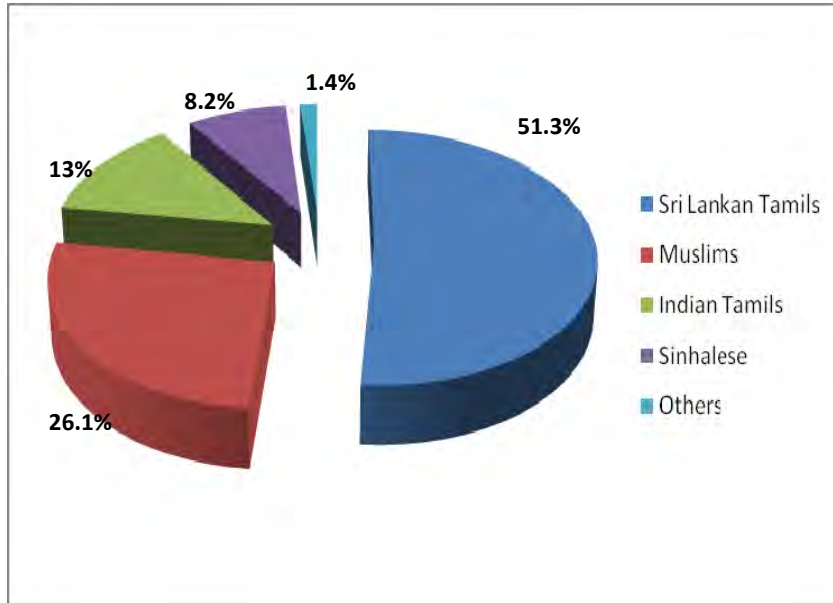


Figure 1.5 - People of the area



Figure 1.6 - Coconut plantation



Figure1. 7 - Fisheries



## 1.6 What do the people of Mannar do?

- ➔ Most of the people in Mannar are farmers. There are 16,331 farmers in the Mannar district (Statistical Hand book Mannar District, 2009). Paddy, highland crops and plantation crops such as coconut, cashew and Palmyrah are the main crops cultivated in Mannar.
- ➔ There are 7,547 active fishermen in Mannar.
- ➔ Salt production (Olaithoduval & Vankalai) and goat rearing (Tharapuram) are also common.

### Summary of Chapter 1

- The Gulf of Mannar lies between the southeastern tip of India and the northwestern coast of Sri Lanka.
- Between India and Sri Lanka lies a chain of limestone islands covered with sand, as well as sand islands, called Adam's Bridge.
- To the northeast of Adam's Bridge is the Palk Bay, which leads to Palk Strait.
- To the southwest of Adam's Bridge is the Gulf of Mannar.
- The coastal region of the Mannar district and Palk Strait lies in the Dry Zone of Sri Lanka, and part of it, in the Arid Zone.
- Adam's Bridge controls the amount of water exchanged between the Gulf of Mannar and Palk Strait.
- The tides in the Gulf of Mannar and the tides in Palk Bay are very different: there is almost a twelve-hour difference in the tides, although they are close together. As a result there are huge difference in water speeds in both areas.
- During the southwest monsoon, strong winds blow large quantities of water from the Gulf of Mannar to Palk Bay, sending warmer, more salty water into Palk Bay. During the northeast monsoon, the opposite happens: cool, less salty water is moved to the Gulf of Mannar.
- Draining into the Palk Strait and Gulf of Mannar are several rivers: the Thambarapani and Vagai Rivers from India; and Aruvi Aru, Kal Aru, Moderagam Aru, Nay Aru and Prangi Aru.
- Along the Sri Lanka coast lining the region of the Gulf of Mannar, are Periya Kalapu and Vidattalitivu Lagoons and the Puttalam estuary. Three more rivers - Mi oya, Kala oya and Moongili Aru – drain into the Puttalam estuary.
- Along the coastline are two divisional secretariat divisions in Puttalam District: Kalpitiya and Vanathavillu; and four in the Mannar District: Mannar Town, Mantai West, Nanaddan and Musali.
- There are 412,040 people in the area, with the highest population density in Kalpitiya (524 persons per km<sup>2</sup>), the next highest in Mannar, with 238 persons per km<sup>2</sup>) and the lowest density is in Mantai West with only 12 persons per km<sup>2</sup>.
- The majority of the population is Sri Lankan Tamil (51.3%), but there are also Muslims (26.1%), Indian Tamils (13.0%), Sinhalese (8.2%) and others (1.4%).
- Most of the people in Mannar are farmers. There are 16,331 farmers in Mannar and nearly 7,500 fishermen.

## Chapter 2 - The Natural Wealth of the Area

The Gulf of Mannar region is rich with animals, plants and habitats. Studies on the plants and animals of the area have been carried out separately – both in India and Sri Lanka.

### 2.1 Habitats and protected areas:

#### 2.1.1 Protected areas:

Studies from India show that the Gulf of Mannar has more than 3,000 different kinds of animals and plants and many different kinds of habitats).

Because of this, the Indian Government declared the area as a **protected area**.

**Protected areas** are areas which are protected from development and other human activities for their environmental, cultural or archaeological value.

The protected area is specifically a **Biosphere Reserve**, extending over 10,500 km<sup>2</sup>. Within this area are 21 islands. Within this reserve is the **Gulf of Mannar Marine National Park** extending over 560 km<sup>2</sup>. There are many different habitats, including coral reefs, mangroves and seagrasses (See below for an explanation). Visiting the 21 islands are 168 kinds birds that migrate from afar, 5 kinds of marine turtles, 450 different kinds of fish, 79 kinds of shellfish, 100 different kinds of sponges, 260 kinds of molluscs (relatives of snails) and 100 kinds of echinoderms (sea stars, sand dollars, sea cucumbers and their relatives) .

A **Biosphere Reserve** is a part of an international network of preserved areas chosen by the United Nations Educational, Scientific and Cultural Organization (UNESCO). These areas are based on a model where there is a large central area where complete protection is given to the habitat. This is surrounded by an area when non damaging human activities are allowed.

On the Sri Lankan side, are three sanctuaries:

**Giant's Tank, Vankalai Bird Sanctuary and Bar Reef Marine Sanctuary** and a National Park : Wilpattu National Park.

A **national park** is an area belonging to the government, set aside for the protection of animals, plants and habitat, where people are allowed to visit to see and enjoy these without damaging them.

Giant's Tank is an important water storage area in the district of Mannar and supplies water to some 160 smaller tanks in the district. This area was declared as a sanctuary to protect this important source of water in an otherwise very dry area.

Vankalai Bird Sanctuary is an important site for migratory birds (see above for definition) and was declared a sanctuary in 2008.

A **sanctuary** in wildlife conservation in Sri Lanka, refers to an area which contains both government and private land, where protection is ensured but various human activities are also allowed.

Bar Reef Marine Sanctuary lies just north of Kalpitiya and has about 150 different kinds of coral and about 280 different kinds of fish.

There is also one national park in this area of Sri Lanka: **Wilpattu National Park**.



Wilpattu has nearly 60 villus (see below for description) and is one of the largest and oldest national parks in Sri Lanka. Some 280 different kinds of vertebrates are found in this Park, including elephants and leopards, and some 600 different kinds of flowering plants.

There are two forest reserves, governed by the Forest Department, called **Neenthavil Forest Reserve** and **Mavillu Forest Reserve**.

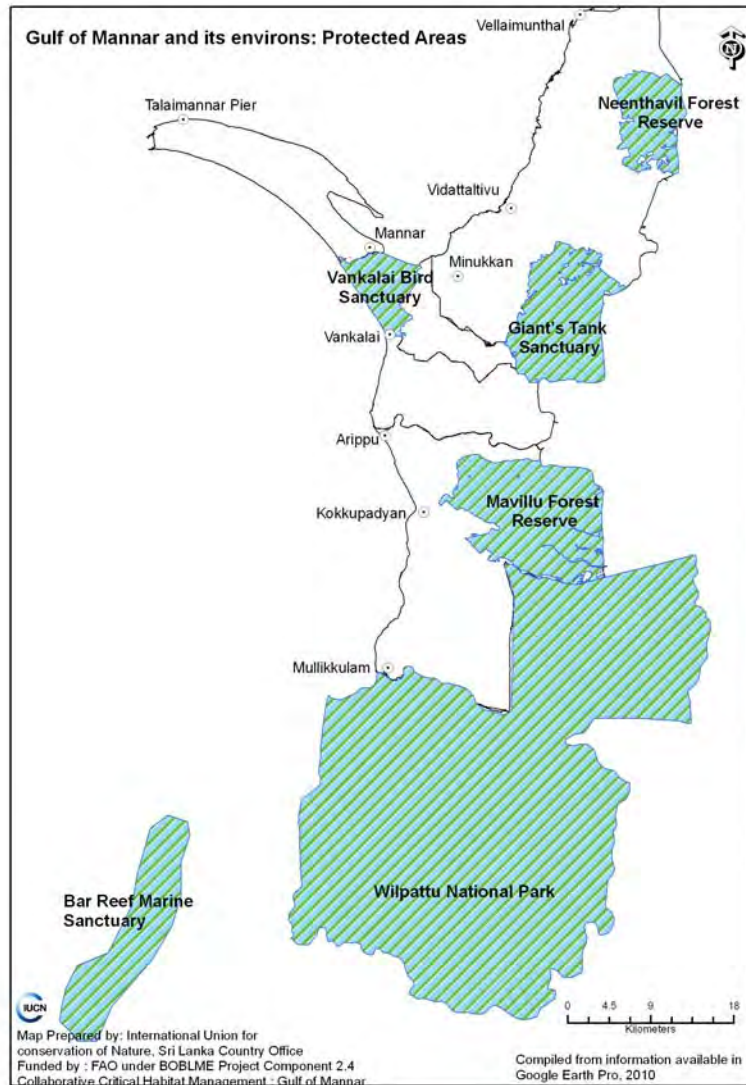


Figure 2.1 - Protected areas in the Gulf of Mannar region

### 2.1.2 Habitats

Studies from Sri Lanka show that in this area there are

1. Forests
2. Inland wetland habitats
3. Coastal habitats and
4. Agricultural land.

Most plants and animal names are quite familiar. We know of elephants, leopards and mangos. But as we know, there are different kinds of trees, coconut and palmyrah, for example, and each has their own common name. But these common names are different in different languages and in different parts of the world. For example, here in Sri Lanka, we call Margosa Kohomba in Sinhalese in the southern part of the country and Arulundi in Tamil in the northern part of the country. In India, these trees are called Neem. If you didn't know this, you would probably think that these were four different kinds of trees.

To avoid this confusion, scientists have special names for plants and animals. Each is given two names, much as you have a first name and a last name. These scientific names are in Latin, so unless you know Latin, it is very hard to make sense of them. However, if you want to look up more information about a particular mammal from another book or the Internet, you must use its scientific name, because this is the same anywhere in the world.

Thus Margosa is known scientifically as *Azadirachta indica*. When these scientific names are printed, they are always printed in italics because they are Latin, not English. So you would print the name as Margosa (*Azadirachta indica*), but when you write this name, you would underline the scientific name thus: Margosa (*Azadirachta indica*).

#### 2.1.2.1 Forests.

In this region, there are two kinds of forests: **Tropical dry-mixed evergreen forests** and **Tropical thorn forests** (scrublands).

**Tropical dry-mixed evergreen forests** – also called **Monsoon forests** - are found in tropical areas that have a long dry season followed by a season of heavy rain. These seasons have a huge impact on these forests, whose plants and animals are adapted to deal with long periods without water. For example, many trees shed their leaves during the dry season.

Tropical dry-mixed evergreen forests can be seen in the Musali area.

Vegetation in Tropical dry-mixed evergreen forests include

- Palai (Sinhala: Palu; Scientific name *Manilkara hexandra*),
- Muthirai (Sinhala: Burutha; Scientific name *Chloroxylon swietenia*)
- Veerai/Veeraimaram (Sinhala: Weera; Scientific name *Drypetes sepiaria*)
- Tampanai (Sinhala: Tammanna; Scientific name: *Mischodon zeylanicus*)
- Chiru piyari (Sinhala: Pannakka; Scientific name: *Pleurostyliia opposite*) and
- Parutti (Sinhala: Kapukinissa; Scientific name: *Hibiscus eriocarpus*) and
- Karanai (Sinhala: Tarana; Scientific name: *Tarenna asiatica*)

Wood is taken from Tropical dry-mixed evergreen forests for use as fuelwood and for many other household purposes.

In Tropical Scrublands, the plants are generally adapted to survive very harsh conditions related to water. Some have small leaves (to avoid water loss through transpiration), others have thorns instead of leaves and yet other trees have water stored in their stems.



Figure 2.2 - Tropical dry-mixed evergreen forests in Musali DS (Sampath Goonatilake)

When **Tropical dry-mixed evergreen forests** are destroyed, often, **Tropical thorn forests** (scrublands) grow in their place. **Tropical thorn forests** also grow in arid areas where the dry season is very long. Plants in thorn forests have to conserve water, so they have small leaves or thorns, to reduce water loss, or store water in fleshy leaves and stems. During the dry season, leaves fall off.

Tropical thorn forests can be seen in Manthai west, Musali and Mannar island.

Vegetation in Tropical scrublands includes

- Inchu (Sinhala: Indi; Scientific name *Phoenix pusilla*)
- Uvay/Vijay (Sinhala: Maliththan; Scientific name *Salvadora persica*);
- Udai/Odai (English: Umbrella Thorn; Scientific name *Acacia planifrons*);
- Kaludai (English: Cockspur Thorn; Scientific name *Acacia eburnea*);
- *Kalli* (English: Milk Hedge; Sinhala: Nawa Handi; Scientific name *Euphorbia tirucalli*)  
and
- *Arugani* (Sinhala: Hiressa; Scientific name *Cissus quadrangularis*).

Wood is taken from Tropical thorn forests for use as fuelwood and for many other household purposes, such as medicines.

In Tropical Scrublands, the plants are generally adapted to survive very harsh conditions related to water. Some have small leaves (to avoid water loss through transpiration), others have thorns instead of leaves and yet others tree have water stored in their stems.



Figure 2.3 - Tropical thorn forests in Wilpattu National Park (Sampath Goonatilake)

#### 2.2.1.2 Inland Wetland Habitats

Several **streams and rivers** drain into the Palk Strait and Gulf of Mannar. These were listed in Section 1.3 and shown in Figure 3. Rivers and streams are bodies of water that move continuously in one direction. At the beginning of the stream the channel is narrow and the water is pure and carries less sediment than downstream, as well as only a few minerals. Many such streams (tributaries of a river) join together to form a larger river.



Figure 2.4 - Kala Oya Causeway (Sampath Goonatilake)



**Villus** are lakes formed because as a result of spreading of underground water to the surface and they also form in low lying area as a result of floods. Villus are important sources of water for many animals during the dry season. They can be seen in Wilpattu, Marichchikaddi to Silavatturai, and in Aruvakkalu.

**Reservoirs** or Tanks were made by Sri Lanka's ancient kings to help store water for agriculture and other human use. Many of these – such as Giant's Tank – are found in the area.



Figure 2. 5 - Giant's Tank during the dry season (Sampath Goonatilake)

#### 2.2.1.3 Coastal and marine habitats

In this region there are also many coastal and marine habitats. They are

1. Mangroves
2. Salt marshes
3. Sand dunes and beaches (including seashore vegetation)
4. Mud flats
5. Sea grass meadows
6. Coral Reefs

#### **Mangroves**

A **mangrove** can either mean a woody plant or a group of plants which live between the sea and the land in areas which are flooded by tides for part of the time. Mangroves are unique because they grow where no other trees can survive – between the ocean and land. In this area, the tide rises and falls daily, and the saltiness of the water changes with this rise and fall of the tide. The soil is soggy with water and therefore, has little oxygen. The soil also moves with the tide. Mangrove plants and animals are especially adapted to this lack of oxygen, movement water and soil and changing saltiness. Many mangroves have roots that stretch out from the main trunk (**stilt roots**) to better attach them to the shifting soil. They also have roots that poke out into the air from the soil, seeking oxygen. These roots are called **breathing roots**.

Mangroves can be seen in Manthai west.

Many different kinds of mangroves can be seen in the region. Among the most common are

- The Grey Mangrove (Tamil: Kannamaram; Scientific name: *Avicennia marina*) without stilt roots but with **pencil-shaped breathing roots**.
- Mangrove (Sinhala: Kadol; Tamil: Kandal; Scientific name: *Rhizophora mucronata*) with many **branching stilt roots** and
- Mangrove Apple (Sinhala: Kirala; Tamil: Kinnai; Scientific name: *Sonneratia alba*) with **peg-like breathing roots**.

Mangroves provide humans with many goods such as food, firewood, fuelwood, timber and medicine, and serve to prevent erosion, filter soil from pollutants and serve as a physical barrier to protect the shoreline.



Figure 2.6 - Mangrove habitat at Palakamunai (Sampath Goonatilake)

### Salt marshes

**Salt marshes** are found near mangroves, and are also adapted to flow – in and out - of the daily tide. Plants that grow in salt marshes are adapted to tolerate water flooding and changes in saltiness.

Salt marshes can be seen in Kaladi, Vankalai, Arrippu, inside the Wilpattu, Ailay at Illuvankulam, inside the Mannar island and in Pallimunai.

In this region, most of the Salt Marshes are covered by non-woody, small plants.. These areas become extremely dry during the very long dry period and lose a lot of water, with the result that the area become very salty. Often, salt can be seen in these habitats during the dry season.

Vegetation in salt marshes includes

- *Umiri* (Scientific name *Suaeda maritima* and *Suaeda vermiculata*).

These habitats are important for many reasons. Hiding among these plants are animals in various stages of life. *Umiri* is used as a leafy vegetable.



Figure 2.7 - Salt marsh at Thaladi (Sampath Goonatilake)

### **Sand dunes and beaches (including seashore vegetation)**

Creepers such as Spinifex (*Spinifex littoreus*) is very common on beaches and Pandanus (*Pandanus odoratissimus*) are seen in some beaches.

In coastal beaches where the tide moves daily, **sand dunes** form where there is enough sand and enough wind. If the beach is large enough, then the surface dries between high tides. This dry sand is blown landwards and deposited above the area where the high tide reaches. Some of this sand collects behind rocks or clumps of seaweed. Here, plants trap the sand from being blown away. The wind then starts eroding sand particles from the windward side and depositing them on the side protected from the wind. Gradually, this action causes the dune to move inland, accumulating more and more sand as it does so.

Plants that are found in sand dunes are usually creepers that hug the ground to avoid being blown away in the wind.

Seashore vegetation is found usually behind sand dunes. Here too vegetation is adapted to high winds, and trees are short and stunted.

Sand dunes can be seen in Nadukudah.

Sand dunes have

- Creepers such as Spinifex (Sinhala: Maha-Ravana ravula; Tamil: Ravanan meesai; Scientific name: *Spinifex littoreus*) and Bermuda Grass (Sinhala: Ruha; Tamil: Arugam Pillu; Scientific name: *Cynodon dactylon*) ; and
- Small trees such as Bell Mimosa (Sinhala: Andara; Tamil: Vindattai; Scientific name: *Dichrostachys cinera*).





Figure 2.8 - Sand dune at Nadukudah (Sampath Goonatilake)

### **Mud flats**

**Mud flats** are areas of exposed mud, found in the area exposed to air during low tide, and flooded by sea water during high tide.

Mud flats can be seen in Vankalai, Vidatalativu and Mantai west.

Thirty six migratory birds settle in the above mud flats on their journey from India to Sri Lanka.

Mud flats cycle nutrients, prevent coastal erosion and are important for animals – especially water birds that migrate.



Figure 2.9 Mud Flat at Palakamunai (Sampath Goonetilleke)

## Seagrass meadows

**Seagrasses** are seed-bearing, flowering, rooted plants which grow under water, only in shallow coastal seas and coastal wetlands. Like grasses on land, they form meadows on the bed of coastal seas.

Seagrass meadows are seen in Adam's Bridge, Talaimannar and Pallimunai.

Many different kinds of seagrasses – such as

- Tape Seagrass (Scientific name: *Enhalus acoroides*),
- Sickle Seagrass (Tamil: *Chatelai*; Scientific name: *Thalassia hemprichii*) and
- Noodle Seagrass (*Syringodium isoetifolium*)

are found in these meadows.

Seagrasses are important as they die out very quickly when there are changes in the environment – for example – from pollution. Therefore they serve to show us that there is damage to the environment. Also many species of fish and other animals live among their leaves. Famous among the animals that live in seagrass meadows is the Dugong or Sea Cow (Sinhala: Muhudu Ura; Tamil: Caddadt-pandri; Scientific name: *Dugong dugon*).

**Indicator species** are plants and animals that cannot tolerate changes in the environment: they die out quickly indicating that the environment is not healthy. Seagrasses die out quickly when the water is cloudy, indicating that all is not well with the environment.



Figure 2.10 Seagrass meadows off Pallimunai (Terney Pradeep Kumara)

## Coral reefs

Corals are two-layered animals that live in groups and are related to jellyfish and sea anemones. Corals are made up of tiny individuals called polyps. Each polyp is like a fluid-filled bag with a ring of tentacles surrounding its mouth, and looks like a tiny anemone.

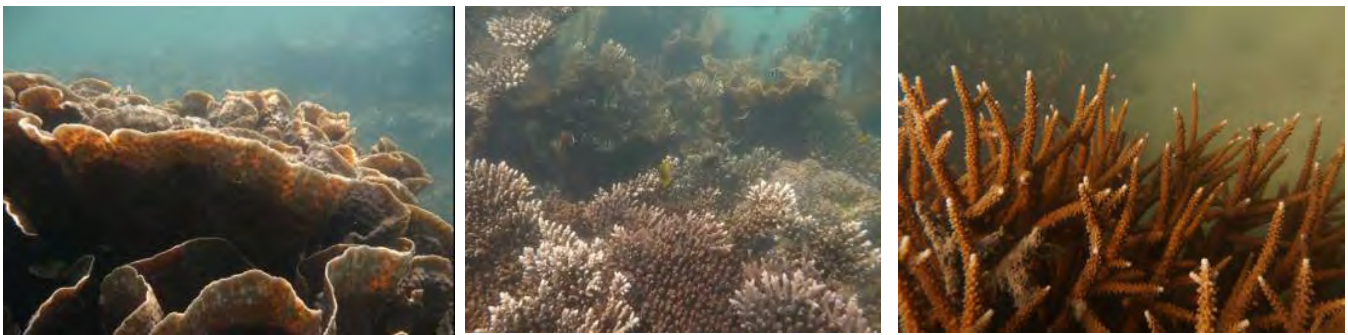
In some corals, the polyp extracts calcium carbonate from the sea and secretes it as a cup of calcium carbonate from the bottom half of its body. When the calcium carbonate cups of many billions of these polyps fuse together, for many thousand years, they form **coral reefs**. Coral reefs are found in shallow seas. In the Bar Reef area, Mannar (off Pallimunai), south west of Mannar Island, Arippu, Silavatturai, Vankalai and near Thomaiyar and Kokkupadyan.

Nearly 50 different kinds of corals have been found in the region, including

- Staghorn Coral (Scientific name: *Acropora cytherea*)
- Encrusting Pore Coral (Scientific name: *Montipora aequituberculata*) and
- Stony Coral (Scientific name: *Porites cylindrica*).

Also found are 42 different kinds of coral reef fish, with Damsel Fish as the most common.

Coral reefs are extremely important as they provide many services to humans. Nearly 500 million people depend - directly and indirectly – on coral reefs to catch fish and shell fish to eat, for medicines, for their livelihoods as fisherfolk and as popular tourist spots.



**Figure 2.11 Corals in the reef at Silavatturai. *Echinopora lamellosa* (top left), *Acropora hyacinthus* (top middle), *Acropora formosa* (top right) (Terney Pradeep Kumara)**

The map below shows the different habitats of the region for the Sri Lankan coastline.

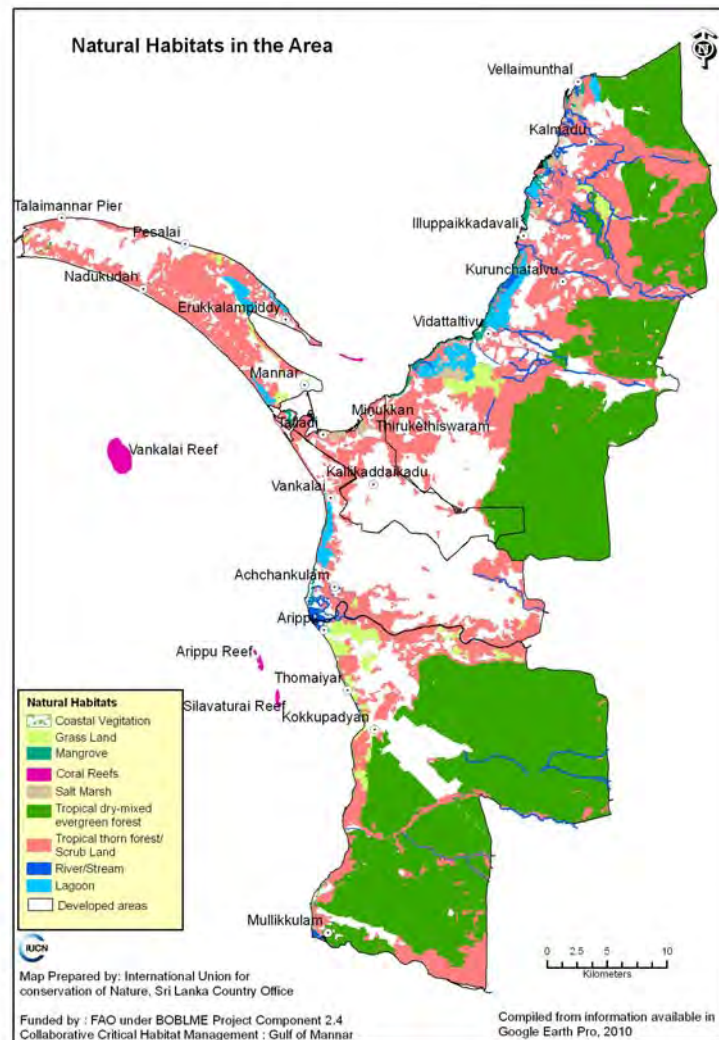


Figure 2.12 Map of the different habitats of the area

## 2.2 Plants of the area

Many plants have been identified in the area. Presented below is a table that shows the number of plants in the area.

Table 2.1 Plants of the area

	Number of different kinds	Number of Endemics	Number native to Sri Lanka	Number introduced into Sri Lanka
Flowering Plants	578	08	459	121
Lower Plants	05	00	04	01

**Flowering plants** have flowers.

Unlike flowering plants, **lower plants** do not have specialised cells and tissues to transport food and water.

**Native plants** are found naturally in Sri Lanka.

**Introduced plants** have been brought into Sri Lanka from another country.

**Endemic plants** are plants found in Sri Lanka and nowhere else in the world.

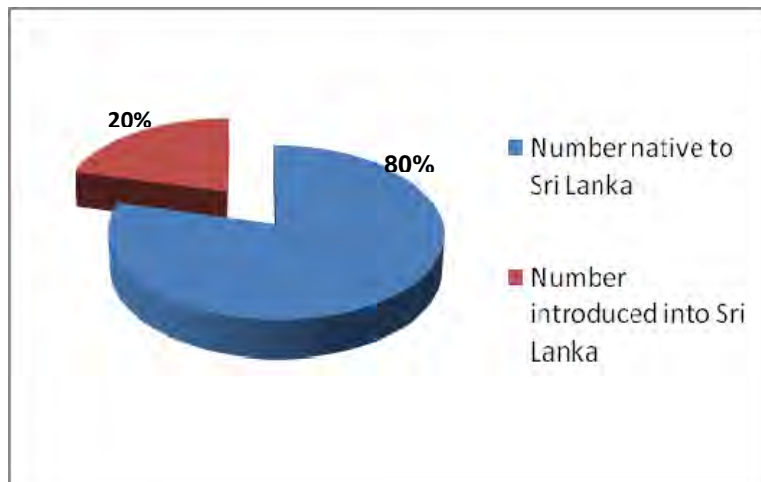


Figure 2.13 Proportion of Introduced (20%) and native plants (80%) in the area



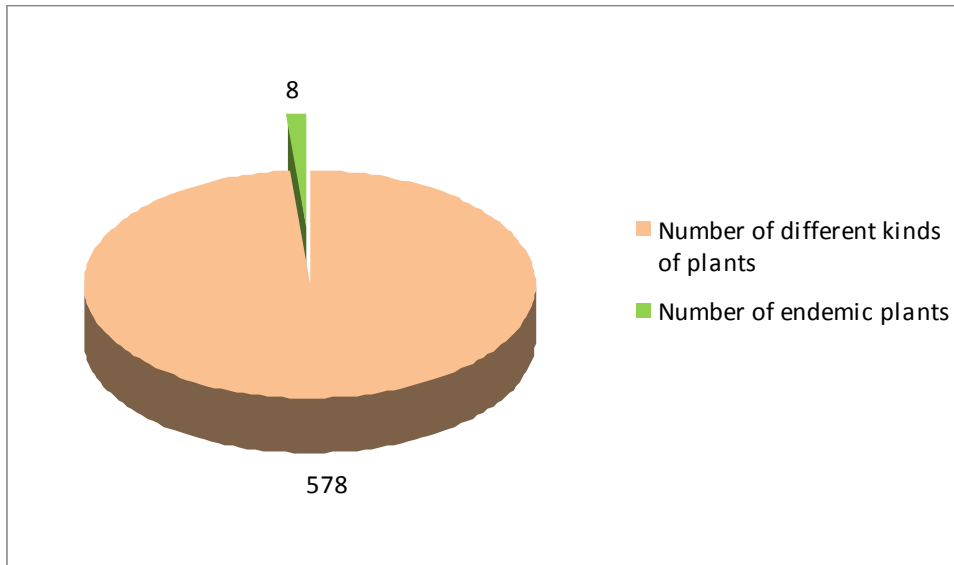


Figure 2.14 Proportion of Endemic flowering plants (1.8%) in the area

Among the endemic species found in this region are Kappilay (Sinhala: Pupula; Scientific name: *Vernonia zeylanica*), and Piyari (Sinhala: Neralu; Scientific name: *Cassine glauca*).

Other common species have been listed under the various habitats.

Special to the area are the Baobab Trees found in Mannar Town Division. There are around 40 of these Baobab trees (*Adansonia digitata*). Native to the African continent, these trees were brought to the island by early Arabian traders around 700 AD.

These trees store water in the enormous trunks (some as much as 19.5 m around the thickest part) as a means of surviving the dry season. They shed their leaves easily to avoid water loss.



Figure 2.15 - Baobab tree in Mannar Town Centre (Kumudini Ekaratne)

### 2.3 Animals of the area

Many species of animals were recorded both on land and in the sea.

Presented below is a table that shows the number of animals in the area.

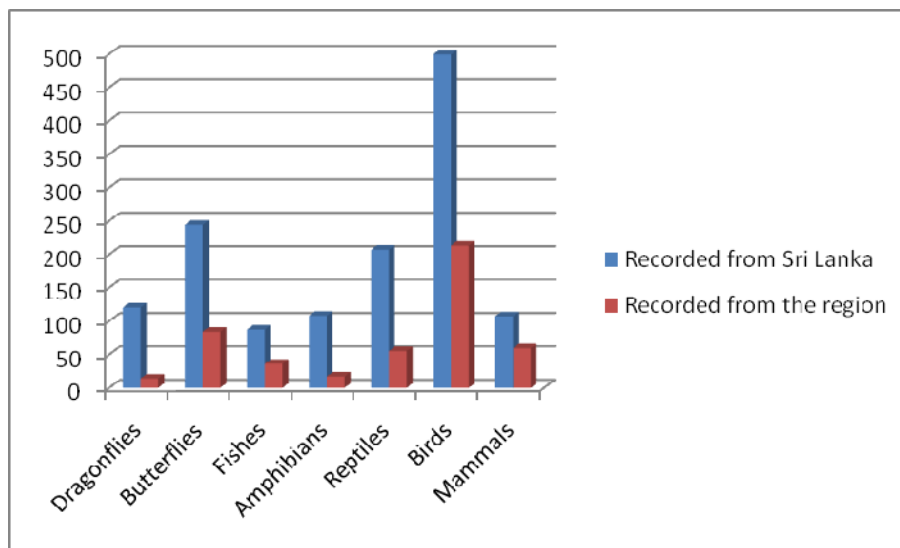
Presented below is a table that shows the different groups of animals in the area.

**Table 2.2 Different group of animals of the area**

Animal Group	Recorded from Sri Lanka		Recorded from the region		
	Total	Endemic	Total	Endemic	Mi/In/Do
Dragonflies	120	51	14	0	0
Butterflies	244	20	84	0	0
Fishes	87	48	36	6	2
Amphibians	108	92	17	3	0
Reptiles	207	117	55	10	0
Birds	499	26	213	3	66
Mammals	107	20	59	4	8
<b>Total</b>	<b>1372</b>	<b>375</b>	<b>478</b>	<b>26</b>	<b>76</b>

Mi: Migratory – animals who travel long distance in search of suitable habitats  
 In: introduced  
 Do: Domestic.

There are also 282 different kinds of ocean living invertebrates, 13 different kinds of reptiles that live in fresh water and in the sea and 13 different kinds of mammals that live in the sea.



**Figure 2.16 Different groups of animals: total in Sri Lanka and in this area**



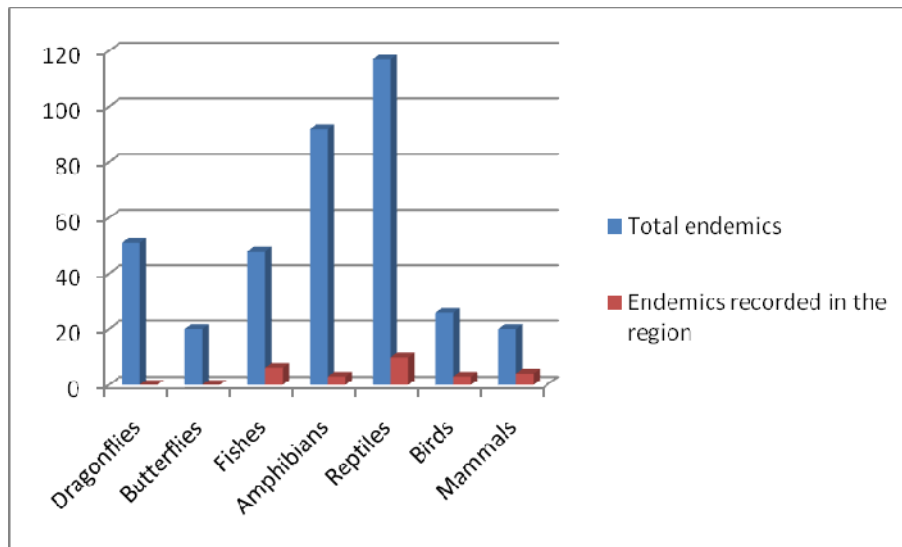


Figure 2.17 Animals: proportion of totals and endemics found in the region

### Birds:

Of the animal groups, birds are the most visible. During the winter, many birds migrate from north India and other cool areas to warmer climates – like Sri Lanka, so that they can continue to feed. There are several routes along which birds travel. The route from India along Rameshwaram Island and Adam's Bridge to Mannar Island is an important one. During the last count of migratory birds, 166,300 individual birds and 66 different kinds of birds were counted in Adam's Bridge, Talaimannar, and Vankalai.

- Greater Flamingos (Sinhala: Raja Seeyakkaraya; Tamil: Pu-narai, Urian; Scientific name: *Phoenicopterus roseus*) can be seen in Talaimannar.

**Birds** are feathered, flying animals who are able to control their internal body temperature.

Among the endemic birds found in the region are

- the Sri Lanka Junglefowl (Sinhala: Welikukula; Tamil: Kattu-koli; Scientific name: *Gallus lafayetii*) and
- the Sri Lanka Grey Hornbill (Sri Lanka: Alu Kandaththa; Tamil Irattai-chondukuruvi; Scientific name: *Ocyrceros gingalensis*).

During the winter, when it is cold and there is little available food, some animals move very long distances from the habitat in which they breed to other countries where it is warmer and there is more food. This is called **migration**.

Nearly 170 of the birds that can be seen in Sri Lanka migrate from various parts of the world including north India

### Mammals:

Seventy two different kinds of mammals are found in the coast lining the region of the Gulf of Mannar and waters in the region.

**Mammals** feed their young with milk produced from special glands. Like birds, they are able to control their internal body temperature.

Among the common mammals of the area are

- the Grey Langur (Sinhala: Eli-wandura; Tamil: Mundi Kurangu; Scientific name: *Semnopithecus priam*);
- Grey Mongoose (Sinhala: Alu Mugatiya; Tamil: Keeri; Scientific name: *Herpestes edwardsii*).

Among the endemic mammals found in the area are

- The Sri Lanka Toque Monkey (Sinhala: Rilawa; Tamil: Kurangu; Scientific name: *Macaca sinica*) and
- The Golden Dry Zone Palm Civet (Sinhala: Ran Hothambuva; Tamil: Maram Nai; Scientific name: *Paradoxurus stenocephalus*).

### Reptiles:

Sixty nine different kinds of reptiles are found in the region and in the waters of the region.

Among the common reptiles are

- Green Garden Lizard (Sinhala: Pala katussa; Tamil: Pachchai Onnan; Scientific name: *Calotes calotes*);
- Land Monitor (Sinhala: Thalagoya; Tamil: Udumbu; Scientific name: *Varanus bengalensis*) and
- Indian Python (Sinhala: Pimbura; Tamil: Periya pambu; Scientific name: *Python molurus*).

**Reptiles** have scaly skins, and generally lay eggs with protective shells. They are dependent on the environment to control their body temperature.

Among the endemic reptiles are

- Common Lanka Skink (Sinhala: Sulaba lakhiraluva; Scientific name: *Lankascincus fallax*).
- Striped flying snake (Sinhala: Dangara danda; Scientific name: *Chrysopelea taprobanica*).

The coastline in this region is important for Hawksbill Turtles (Sinhala: Potthu kasbaeva; Tamil: Alunk amai; Scientific name: *Eretmochelys imbricata*) who come to lay their eggs in the sand.

### Amphibians:

There are few amphibians in this area, as it is very dry. Amphibians need moisture to keep their skins wet.

Among the common amphibians in the area are

- The Ornate Narrow-mouthed Frog (Sinhala: Visituru muwapatu madiya; Scientific name: *Microhyla ornata*) and
- The Skipper Frog (Sinhala: Utpatana madiya; Scientific name: *Euphlyctis cyanophlyctis*).

Adult **amphibians** are air-breathing, insect-eating, animals that live on land, while their young (tadpoles) live in fresh water, breathing oxygen dissolved in water and feeding on plant matter. Amphibian eggs do not have a shell, therefore amphibians need water or very damp conditions for females to lay their eggs near or in water. Frogs and Toads are amphibians.

Among the endemic amphibians are

- The Common Hour-glass Tree Frog (Sinhala: Sulaba pahimbu gas madiya; Scientific name: *Polypedates cruciger*) and
- Sri Lanka Wood Frog (Sinhala: Lanka bandi madiya; Scientific name: *Hylarana gracilis*).

### **Freshwater fish:**

There are thirty six different kinds of freshwater fish in this region. Among the most common are

- Tilapia (Scientific name: *Oreochromis mosambicus*) and
- Blue Eye (Sinhala: Handi titteya; Scientific name: *Orizias dancena*).

Among the endemic fresh water fish are

- Filamented Barb (Sinhala: Damkola pethiya; Scientific name: *Puntius singhala*) and
- Walking Catfish (Sinhala: Magura; Scientific name: *Clarias brachysoma*).

**Fish** are animals who can live only in water and are shaped to move smoothly and fast through water. They breathe oxygen dissolved in water through breathing organs called gills.

There are fish that live in freshwater bodies such as tanks, rivers and villus. These are called **freshwater fish**.

There are fish that live in the sea. These are called **marine fish**. How about lagoons?

### **Marine fish:**

There are 122 different kinds of marine fish caught by fishermen. Eighty of these fish that are caught are important as food for people in the area and 42 are important for ornamental purposes.

Among the most commonly caught food fish are

- White sardinella (Sinhala: Sudaya; Tamil: Thatta-kavalai, Choodai; Scientific name: *Sardinella albella*) and
- Indian Ilisha (Sinhala: As bokka; Tamil: Thattakuthuva; Scientific name: *Ilisha melastoma*).

Special to the area are introduced domestic donkeys, now become wild, called **Mannar Ponies** (Sinhala: Diweldiwa Poniya; Scientific name: *Equus caballus*). These were introduced by Arab traders in the past.

### **Invertebrates:**

Two hundred and eighty two invertebrates were observed in the Gulf of Mannar and Palk Bay.

Among the different kinds of invertebrates collected by fishermen to sell for export are

- **Sea anemones** – soft-bodied, colourful relatives of corals which are very popular for use in aquaria.
- **Seashells**, including Tiger Cowries (Scientific name: *Cypraea tigris*) and Common Spider Conch (Scientific name: *Lambis lambis*) all of which are popular as ornaments and
- **Sea cucumbers** (Sinhala: Muhudu kakiri; Scientific name: mainly different kinds of *Holothuria*) – soft-bodied animals with a leathery skin and long bag-like bodies, who are relatives of sea stars and sea urchins. These are slated, boiled, dried and packaged for export to China and other far eastern countries, where it is valued for food.

- The region is rich with animals, plants and habitats.
- There is a Biosphere reserve on the Indian side of the Gulf of Mannar called the Gulf of Mannar Biosphere reserve. Within this is the Gulf of Mannar National Park.
- On the Sri Lanka side are two sanctuaries: Giant's Tank and Vankalai Bird Sanctuary. There are also two national parks: Wilpattu and Bar Reef Sanctuary.
- In Sri Lanka, there are Forests, Inland wetland habitats, Coastal habitats and Agricultural land.
- There are two different kinds of forests in the area: Tropical Dry-mixed Evergreen Forests and Tropical Scrublands.
- There are several kinds of Inland wetland habitats in the area: streams and rivers, villus and reservoirs.
- In this region there are also many coastal and marine habitats. They are Mangroves, Salt marshes, Sand dunes and beaches (including seashore vegetation), Mud flats, Sea grass meadows and Coral Reefs.
- Five hundred and seventy eight different kinds of flowering plants of which eight are endemic are found in the region.
- Four hundred and seventy eight different kinds of land living animals were found in the region. Of these 26 were endemic to Sri Lanka. There are also 282 different kinds of marine invertebrates in the area, 13 reptiles that live in fresh or sea water and 13 different kinds of mammals that live in the sea.
- Baobab trees and Mannar Ponies are special to the area, having been introduced in the past by Arab traders.

## Chapter 3 - The Archaeological and Cultural Significance of the Gulf of Mannar Region

Because the Gulf of Mannar is so close to India and because Adam's Bridge is so shallow, traders found it easy to come from India to Sri Lanka, across this shallow area. Elephants, pearls and shells were traded among many other things in the past.

This would also have been an easy point of invasion from India.

**Fossils** of animals – such as worms, corals, snails, fish, reptiles and marine mammals - have been found in this region. Fossil deposits have been found in

- Uchchamunai and Karativu Island in the Kalpitiya divisional secretariat division,
- Aruvakkalu in the Wanathawillu divisional secretariat division,
- Kal Aru river bed in the Musali divisional secretariat division,
- Mannar Island; and
- Palugahaturai, and Kudiramalai in Wilpattu National park

**Archaeology** is the scientific study of past cultures and the way people lived, based on the things they left behind.

**Culture** is the shared ways of life learned by a group of people, including their language, religion, technology, and values.

A **fossil** is the prehistoric remains of a plant or animal.

Fossils are usually preserved when they are buried under many layers of sand and mud. After many years and under great pressure the sand and mud become rock. Minerals ooze the fossil replacing the organic matter and creating a duplicate stone.



Figure 3.1 - Aruvakkalu fossil deposit

Many **prehistoric human settlements** have been found in this area, showing stone age tools in:

- Aruvakkalu, Kudiramalai, Pomparippu and around several villu habitats in Wilpattu National park. These tools are believed to belong to people who first migrated across Adam's Bridge when there was a land connection.



**Figure 3.2 - Prehistoric stone tools that were used for cutting and chopping, discovered from Aruvakkalu in Vanathavillu Divisional Secretariat Division.**

Many Proto-historic and Historical monuments can also be seen at Gangevadiya, the banks of Pomparippu Ara, Pomparippu, Palugahaturai and Pukkulam in the Vanatavillu divisional secretariat division,

- Silavaturai and Arippu (also known as Muthuarippu-thurai) in the Musali divisional secretariat division
- Pasalai and Thalaimannar in the Mannar town divisional secretariat division and
- Mantai fort in the Mantai West divisional secretariat division. There are several inscriptions referring to Kings who ruled during the Anuradapura period in this site, showing the importance of this site for trade and culture of that time.
- Several Buddhist and Hindu monasteries which belong to Anuradhapura and later period are also found in the Kalpitiya, Vanathavillu, Musali, Mantai west divisional secretariat divisions.
- Arabian sailors came to the ancient Mantai port for trade and Baobab trees were brought to the island by them.

**Prehistoric period:** the period during which stone tools were used by humans;  
**Proto-historic period:** the period during which humans domesticated animals and started making and using pottery;  
**Historical period:** the period during which there are written records.





**Figure 3.3 - Proto-historic pottery site at Pukkulam**



**Figure 3.4 -The Baobab tree in Mannar island is native to Africa and brought to Mannar Island by Arabian sailors.**



**Figure 3.5. - Fragments of a Buddha statue from Mantai Buddhist monastery.**



**Figure 3.6 - Thirukitheshwaram kovil at Mantai**



During the colonial times, the Portuguese, Dutch and British -spread Christianity through the region, so that churches are easily visible. Colonial monuments such as forts in Mannar and Kalpitiya, a light house in Thalaimannar, a rest house in Arippu and a castle – the Doric Building can also be seen in this area.

### Other archaeological sites and legends:

#### Archaeological sites

1. Hanging bridge (near Kunchikulam- near Madhu)
2. St. Lucia's Church was constructed using lime stones (Pallimunai)
3. Thotaveli Martiens (600 historical Mannar people settled)
4. Karisal Kapan Church (Mannar DSD)
5. Church inside Mannar Fort,
6. Vidathalaithivu – Kalodai Canal constructed during Dutch Period
7. Thottaweli church
8. Buddhist temple Santipuram
9. Erukkalampiddy light house

#### Legends

1. Medicinal plants (Ramayana) Thottadi
2. Ancient shipping canal from mainland to India built by Arunoulda



Figure 3.7 - St. Mary's church, Arippu



Figure 3.8 - First British Governor Cedrik North's circuit bungalow, which was based on Greek Doric architecture. It was later used as a circuit bungalow for government officers .

There are also many **legends** coupled with the region.

- According to **legend**, Adam's Bridge, also known as Rama Sethu in India, was built so that Prince Rama could cross into Sri Lanka, to find his queen Sita, who had been captured by Ravana, the king of Sri Lanka. This legend is still important in south Indian culture.

- It is also believed that Kudiramalai and Pukkulama area (called Thambapanni in ancient times) is where Prince Vijaya of Northern India landed in Sri Lanka in 500BC. Pomparippu area (earlier known as Uruwela) was founded during Vijaya's time in 500BC. This served as a port where the pearl fisheries took place. History records that when Ruwanwelisaya was built, pearls were supplied from Uruwela.
- Another legend says that the Kalpitiya to Arippu area was ruled by the legendary queen Allirasani and her palace was situated in the middle of the Puttalam lagoon. Legend says that her palace was destroyed by an ancient tsunami and formed Kalpitiya lagoon.



**Fig . 3.9 -Thambapanni beach near Kudiramalai and Pukkulama.**



**Figure 3.10 - Kudiramalai point**



**Figure 3.11 - Adam's dome (Sampath Goonatilake)**



**Figure 3.12 - Lighthouse at Talaimannar (Sampath Goonatilake)**



**Figure 3.13 - Beacon at Arippu (Sampath Goonatilake)**



**Figure 3.14 - Mannar Fort (Sampath Goonatilake)**



**Figure 3.15 - Dutch church in Mannar Fort (Sampath Goonatilake)**



**Figure 3.16 - Miocene fossils (Sampath Goonatilake)**





**Figure 3.17 - Grave yard in Arippu (Sampath Goonatilake)**



**Figure 3.18 - Church at Mullikulam (Sampath Goonatilake)**



**Figure 3.19 - Arippu Dutch rest house (Sampath Goonatilake)**



**Figure 3.20 - Mantai beacon (Sampath Goonatilake)**



**Figure 3.21 - Pillar inscription from Mantai (Sampath Goonatilake)**

- Fossils of animals have been found in this region.
- Many prehistoric human settlements have been found in this area, showing stone age tools.
- There are several legends relating to the area, including one that says that Adam's Bridge was built for Rama to cross, so that he could save Sita from Ravana.
- Another legend states that Prince Vijaya landed in Sri Lanka in this area.
- Another legend says that Queen Allirasani ruled in the Kalpitiya area.
- Colonists such as Portuguese, Dutch and British left their mark in the area: there are several forts and churches.

## Chapter 4 - The Importance of the Natural Wealth in the Gulf of Mannar Region.

The Gulf of Mannar and its environs has great natural wealth (See Chapter 2). This wealth provides the people of the area with a range of benefits.

Plants, animals and ecosystems provide humans with a whole range of benefits. They give a range of services (benefits) - such as giving us food and fuel, protecting us from the floods and famines, improve the climate, purifying our waters, clean our soils of poisons and sustaining our lives. Often, ecosystems are quite simply beautiful.

An **ecosystem** has a variety of different kinds of plants, animals and micro-organisms – depending on each other and interacting with each other, in a specific habitat, with a given set of physical variables (for example, temperature, rainfall and soil) to form a natural unit.

A **habitat** is where plants and animals live. It is like their home.

### 4.1 Providing us with food, firewood, shelter and other goods:

#### *Animals:*

It is estimated that nearly 30 million of the poorest human populations in the world depend entirely on coral reefs for their food.

Mangroves are very important because they are nursery grounds for many commercially important fin and shell fish: many larvae and young fish are found in mangroves. It is estimated that up to 80% of global fish catches are directly or indirectly dependent on mangroves.

There are many different kinds of plants and animals that are eaten as food. There are 88 different kinds of fish that are caught in sea of the region. Several prawns and crabs are also popular catches.

Many important fin and shell fish are found living in seagrass meadows. Seagrass meadows, like mangroves, are nursery areas for many finfish and shellfish.

#### *Plants:*

Plants provide many kinds of food:

- Trees such as Vilatti (English: Woodapple; Sinhala: Divul; Scientific name: *Limona acidissima*) and Naval (Sinhala: Madan; Scientific name: *Syzygium cumini*) have **fruit** which can be eaten.
- Pakal (Sinhala: Batu-karavila; Scientific name: *Momordica charantia*) and Paluppakal (Sinhala: Thumba-karavila; Scientific name: *Momordica dioica*) are popular **vegetables**.
- Green leaves of Nirmulli (Sinhala: Neeramulliya; Scientific name: *Hygrophila schulli*), Kodi-palai (Sinhala: Anguna; Scientific name: *Wattakaka volubilis*) and Kovvai (English: Ivy Gourd; Sinhala: Kowakka; Scientific name: *Coccinia grandis*) are used as **leafy vegetables**.

Some plants of the area are used for **medicinal purposes**:

- Avarai (English: Matara Tea; Sinhala: Ranawara; Scientific name: *Cassia auriculata*),
- Vembu (English: Margosa; Sinhala: Kohomba; Scientific name: *Azadirachta indica*) and
- Kappilai (Sinhala: Pupula; Scientific name: *Vernonia zeylanica*), Kattoddi (Sinhala: Sudu-welangiriya; Scientific name: *Capparis zeylanica*) are some examples found in the area.



Figure 4.1 - Medicinal plants – *Aloe vera* (Kumudini Ekaratne)

Some plants provide timber

- Karunkali (English: Ebony; Sinhala: Kaluwara; Scientific name: *Diospyros ebenum*);
- Muritai (English: Satinwood; Sinhala Burutha; Scientific name: *Chloroxylon swietenia*) provide valued timber.

Tropical dry-mixed evergreen forests, tropical scrublands and mangroves are not only sources of food and timber but also of wood for construction and firewood.



Panai Maram (English: Palmyrah; Sinhala: Thal; Scientific name: *Borassus flabellifer*) is a very valuable tree found in the area. It has many uses. The soft inside of young fruits is called nungu and is eaten. The inside of the ripe fruits – pannam palam – is sweet and can be eaten or made into juice. Sweets made from the fruits are called panankai paniarum. The sap of the bunches of flowers is tapped to obtain toddy; fermented toddy yields arrack. Boiling down toddy yields palmyrah jaggery or pannan katti.

Palmyrah roots are boiled and eaten as kotta kelangu and are a good source of starch. The boiled and dried root -called odiel - is powdered and used to make kool - a traditional seafood soup.

Leaves are used for roofing, the leaf stalk for fencing and the trunk for timber.



Figure 4.2 Palmyrah trees (Sampath Goonatilleke)

## 4.2 Protecting the coastline:

Coral Reefs, Sand Dunes and Mangroves serve as physical barriers against beating waves, storms and cyclones. Therefore, they protect the coastline from damage. Undamaged sand dunes were the most effective barrier against tsunami waves that affected the coastal zone of Sri Lanka in 2004.



Figure 4.3 - Sand dunes at Nadukuda (Sampath Goonatilleke)



Figure 4.4 - Mangroves at Palakamunai (Sampath Goonatilleke)

### 4.3 Preventing floods:

In Tropical Dry-mixed Evergreen forests there is always a layer of leaf litter that serves as a sponge to absorb water from falling rain, and to release it slowly into the ground. In doing so, these forests help prevent floods.

The mud in Mangroves also serves to soak up and hold rain water, again preventing floods. Depending on whether they have been damaged or not, mangroves absorb the energy of the ocean waves.

Mud flats, like Mangrove soak up and hold rain water, also preventing floods.

Sand dunes also prevent flooding inland.

### 4.4 Preventing erosion:

In the process of preventing floods, Tropical dry mixed evergreen forests also prevent the soil from washing away – erosion, because of the leaf litter on the ground.

Seagrass meadows hold down the sand at the bottom of shallow seas and therefore stabilise the sea floor.

Mangroves and mud flats, in the process of preventing floods also prevent erosion.

Sand dune vegetation traps sand and prevents it from being blown further inland, and therefore, prevents erosion inland.

### 4.5 Trapping pollutants:

Mangrove roots also function as filters to strain out pollutants that reach the sea from waters inland. Therefore, they help improve the quality of water reaching ecosystems in the sea, in particular, ecosystems such as coral reefs.

Like mangroves, seagrass meadows also act as filters for coastal waters.



Figure 4.5 - Seagrass meadows (Terney Pradeep Kumara)

#### 4.6 Regulating the local climate

Tropical dry mixed evergreen forests and tropical thorn forests play a role in regulating local climate. Because the crowns of their trees form a large area of shelter from the sun, they provide shade to local villages.

#### 4.7 Producing food

Through the process of photosynthesis, green plants and many green algae make their own food, and serve as the base on which most other life on earth is supported. Therefore, they are called **primary producers**. Tropical dry mixed evergreen forests, tropical scrublands, mangroves, coral reefs, seagrass meadows are large areas of primary production and serve to support a large range of animal life within their habitats.

#### 4.8 Trapping carbon dioxide

Through the process of photosynthesis, green plants and algae take in carbon dioxide from the atmosphere and as a by-product of this process, release oxygen into the air. As they breathe, they take in oxygen and release carbon dioxide into the air as we do. However, the net effect is that they absorb more carbon dioxide than they release. Therefore, they are called **carbon sinks**.

Tropical dry mixed evergreen forests, tropical scrublands, mangroves and seagrasses are all carbon sinks. It is estimated that mangroves trap large amounts of carbon, approximately 25.5 million tonnes of carbon every year. A single acre of sea-grass is estimated to produce over nine tonnes of leaves per year. All this provides a huge amount of food for many animals.

#### 4.9 Maintaining soil productivity

Soil supports the growth of plants. Therefore, soil must contain the basic nutrients necessary for plant growth – such as nitrogen, phosphorous and potassium. In natural habitats, these nutrients are cycled among the air, soil and plants. When plants and animals die and decay, this releases nutrients back into the soil.

Decaying organic matter from mangroves is broken down into free nutrients that are washed away to the sea. This makes coastal food webs better, and with it, coastal fisheries.

The same happens in seagrass meadows and in mud flats.

On land, the same process happens in tropical dry mixed evergreen forests and in tropical scrublands.

Different soil types are found in the area. Limestone is common in the coast line from Puttalam to Jaffna, clay in Murukkan and mineral sands such as ilmanite in Pesalai.

#### 4.10 Supporting biodiversity

A large number of different kinds of animals and plants are found in the different habitats that were mentioned in Chapter 2.

These include

Various timber trees such as

- Palai (Sinhala: Palu; Scientific name *Manilkara hexandra*),
- Muthirai (Sinhala: Burutha; Scientific name *Chloroxylon swietenia*) in tropical dry mixed evergreen forests.

Large animals such as

- Elephants (Sinhala: Aliya/atha; Tamil: Yanei; Scientific name: *Elephas maximus*)
- Leopards (Sinhala: diviya; Tamil: Seruthai/Kattu poonai; Scientific name: *Panthera pardus*) in tropical dry mixed evergreen forests, scrublands and

**Biodiversity** is the variety of all life on earth and all life processes. This means that differences among people (genetic diversity); differences among, for example, fish, ferns and frogs (species diversity) and differences among tropical dry mixed evergreen forests, tropical scrublands and mangroves (ecosystem diversity) are all included in under the general term biodiversity. In addition, processes such as photosynthesis and nutrient cycling are also included.



Figure 4.6 - Tusker (*Elephas maximus*)



Figure 4.7 - Leopards (*Panthera pardus kotiya*)

- Blue whales (Sinhala: Nil thalmassa; Tamil: Neelath Thimingilam; Scientific name: *Balaenoptera musculus*); and
- Dugong (Sinhala: Muhudu ura; Tamil: Caddadt pandri; Scientific name: *Dugong dugon*) in the sea around.

Many different kinds of animals come near villus to drink water. These include

- Muggers crocodiles (Sinhala: Hala Kimbula; Tamil: Kulathi Muthalei; Scientific name: *Crocodylus palustris*)
- Golden Jackals (Sinhala: Nariya; Tamil: Kulla narie; Scientific name: *Canis aureus*)
- Wild Boar (Sinhala: Wal Oora; Tamil: Pandri; Scientific name: *Sus scrofa*)

Many different kinds of water birds stop at mud flats while migrating. These include

- Common Sandpipers (Sinhala: Podu Siliththa; Tamil: Kottan; Scientific name: *Actitis hypoleucos*); and
- Common Redshanks (Sinhala: Podu Rathpa Silibilla; Tamil: Malai-kottan; Scientific name *Tringa totanus*).



Figure 4.8 - Common Redshank at Vankalai mud flat

#### 4.11 Supporting traditional livelihoods:

Mangroves, coral reefs and seagrass meadows support traditional fisheries such as kudu (traps) and kraal fisheries.



Figure 4.9 - kraals and traps (Kumudini Ekaratne)

#### 4.12 Providing archaeological and cultural significance

Chapter 3 described the archaeological and cultural significance of the region.

#### 4.13 Providing relaxation and learning

Mangroves and coral reefs help people to learn about the environment.

Beaches are popular for relaxation.

Closed for security reasons during the war, Wipattu National Park has been reopened for visitors since the war was ended, and is a popular place for seeing elephants, leopards and sloth bears (Sinhala: Walaha; Tamil: Karadie; Scientific name: *Melurses ursinus*).

**Ecosystems, therefore, provide humans with a wide range of benefits that ultimately affect their health and well-being. For example, having enough food ensures good health; being protected from bad weather ensures personal security.**

Plants and animals and ecosystems provide humans with a whole range of benefits. Such as

- Providing us with food, firewood, shelter and other goods;
- Protecting the coastline;
- Preventing floods;
- Preventing erosion;
- Trapping pollutants;
- Regulating the local climate;
- Producing their own food;
- Trapping carbon dioxide;
- Maintaining soil productivity;
- Maintain biodiversity;
- Supporting traditional livelihoods;
- Providing archaeological and cultural significance ; and
- Providing relaxation and learning



## Chapter 5 - What is Happening to the Natural Wealth in the Gulf of Mannar Region?

Although the region of the Gulf of Mannar is rich with natural wealth, this natural wealth is also threatened by many human activities. In this chapter, these threats will be discussed in detail.

### 5.1 Overexploitation

Humans simply take too much from their natural environment. Animals and plants need to grow and breed. However, sometimes humans catch (or harvest) these animals and plants before they have had time to breed and grow. When this happens repeatedly, there are not enough to catch the next time. When too much is taken for too long, the end result is that nothing or little is left.

- Perhaps the best example of overexploitation is the **Pearl Fisheries of the Gulf of Mannar**.

The pearl beds (areas where pearl oysters were found) of the Gulf of Mannar are mentioned in historical records as early the 6th century BC. Traders from India, Persia and Arabia fought to own these pearl beds. In 1294, Marco Polo visited the Gulf of Mannar and noted that as many as 500 ships and boats would come during the time of harvest, with divers and traders, all searching for pearls. These traders had to pay 10% of what they earned to the King.

During the colonial times, from the 16th century, the pearl beds belonged to the government, which rented the beds to divers and traders. By 1881, however, the then government noted that although the pearl fisheries that year had been the most successful for 67 year, there were no more supplies of oyster for the next year. By 1924, a law regulating pearl fisheries was established, but it was too late: there were no more pearl oysters.

**Pearls** come from Pearl Oysters.

Oysters are relatives of snails and slugs that live in water. Their bodies are covered by two shells connected by a bit of elastic ligament. Between the shell and the oyster's body is the mantle, which makes the shells. When something small like grain of sand gets between the shell and the mantle, it irritates the oyster, rather like a scratch on the skin. The mantle then produces some liquid to cover up this irritation. So a small blob forms round the grain of sand, and this becomes bigger and bigger, until a pearl is formed.

Pearls are popular jewels. In ancient times, pearls were believed to be special: Indian believed that Gods turned dew into pearls; Persians believed that pearls were a gift from God; and the Chinese believed that pearls were created by the power of the moon.

Pearls are referred to in the Bible, the Koran and the Mahabharata, all praising the purity of pearls.

**Extinction** is a process by which groups of animals or plants die out. When this happens, the world loses that particular animal or plant. For example, dinosaurs became extinct about 65 million years ago. Now, there no longer are any dinosaurs in the world. Although the extinction is a natural process, human have greatly increased the rate of extinction so that extinction is happening extremely fast now, and many animals and plants are becoming extinct as a result of human actions.

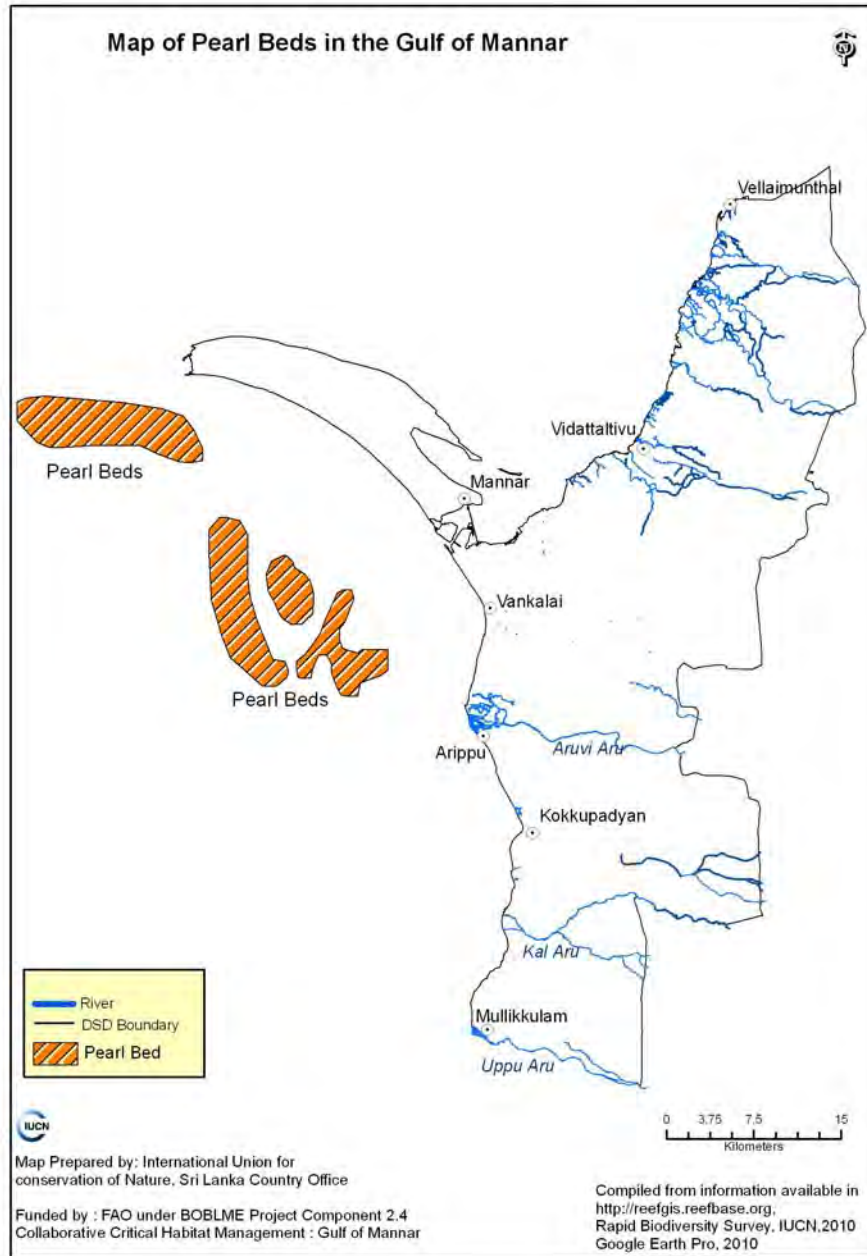


Figure 5.1 - Map of pearl beds

- The other famous example of overexploitation is the **Dugong**. Dugongs are plant-eaters who live entirely in shallow seas. They graze on seagrass meadows underwater in the same way that cattle graze grass on land. In the 19<sup>th</sup> century and early 20<sup>th</sup> century there were plenty of dugongs in the shallow coastal waters from the Gulf of Mannar to Jaffna peninsula. However, over the years, the number decreased rapidly as a result of hunting for its meat. Dugong flesh is considered a delicacy. Now dugongs are rarely sighted in the region. The Dugong is considered **Threatened** with extinction.

IUCN-International Union for the Conservation of Nature is a global organisation that measures whether animals and plants are facing extinction due to various causes. Every year, it produces a Red List that lists all the animals and plants that are threatened with extinction.

Depending on the level of threat, the IUCN Red List notes seven categories. However, in this module, we will concentrate on only three of these categories

- Critically Endangered;
- Endangered; and
- Vulnerable.

The three categories Critically Endangered, Endangered and Vulnerable are grouped as 'Threatened'. In this module, we only use the term **Threatened**.

A short study of the region showed that there were **46 different kinds of Threatened animals**, including butterflies, fish, reptiles, birds and mammals, known to be threatened in Sri Lanka. These are listed in Table 5.1.

**Eleven different kinds of Threatened plants** were also observed in the area. These are listed in Table 5.2.

- **Sea cucumbers** are collected in large numbers every day. These are boiled, salted, dried, packed and sent for export. Many people, including women are involved in this process and therefore, it is an important livelihood. Yet, studies are showing that too many sea cucumbers are being collected, with the result that this fishery could also become like the pearl fishery, unless some care is taken to regulate harvest.
- **Sea anemones, sea urchins and various shells** are being collected for ornamental purposes without any regulation. Again, there may be over-collection.
- **Mussels** are collected on commercial scale in Arippu, Pallimunai and Thavulpadu.

Table 5.1 – Threatened animals in the region

	English name	Sinhala Name	Tamil Name	Scientific Name
<b>Butterflies</b>				
1	Large salmon arab	Maha rosa sudana		<i>Colotis fausta</i>
2	Plain orange tip	Podu tembiliwan sudana		<i>Colotis aurora</i>
3	Bright Babul Blue	Punchi neelaya		<i>Azonus baldus</i>
4	Small Cupid	Punchi Panu-nilaya		<i>Chilades parrhasius</i>
5	Cornelian	Podu Kirana-nilaya		<i>Deudorix epijarbas</i>
<b>Freshwater fishes</b>				
1	Long finned eel	Pol mal aandha		<i>Anguilla nebulosa</i>
2	Shark catfish	Walaya		<i>Wallago attu</i>
3	Giant snakehead	Gan ara		<i>Channa ara</i>
<b>Reptiles</b>				
1	Green turtle	Gal kasbaeva		<i>Chelonia mydas</i>
2	Hawksbill sea turtle	Pothu kasbaeva		<i>Eretmochelys imbricata</i>
3	Olive ridley sea turtle	Batu kasbaeva		<i>Lepidochelys olivacea</i>
4	Indian star tortoise	Mevara ibba		<i>Geochelone elegans</i>
5	Flapshell turtle	Kiri ibba		<i>Lissemys punctata</i>
6	Painted lip lizard	Thola-visituru katussa		<i>Calotes ceylonensis</i>
7	Scaly-finger gecko	Salkapa huna		<i>Lepidodactylus lugubris</i>
8	Wart snake	Diya goya/Redi naya		<i>Acrochordus granulatus</i>
9	Sand boa	Vali pimbura, kota pimbura		<i>Gongylophis conica</i>
10	Dog-faced water snake	Kuna diya kaluwa.		<i>Cerberus rynchops</i>
11	Striped flying snake	Dangara danda		<i>Chrysopelea taprobanica</i>
12	Gerard's water snake	Prevostge diyabariya		<i>Gerarda prevostianus</i>
13	Reed snake	Punbariya.		<i>Liopeltis calamaria</i>
14	Saw scale viper	Vali polonga		<i>Echis carinatus</i>
<b>Birds</b>				
1	Spot-billed Duck	Thith-hota tharava	Tara	<i>Anas poecilorhyncha</i>
2	White-naped Woodpecker	Kahapita Maha-karela	Maram-kotti	<i>Chrysocolaptes festivus</i>
3	Drongo Cuckoo	Kawudukoha	Irattai-valang	<i>Surniculus lugubris</i>
4	Oriental Pratincole	Peradigu Javasariya		<i>Glareola maldivarum</i>
5	Small Pratincole	Punchi Javasariya		<i>Glareola lactea</i>
6	Saunders's Tern	Saunders Muhudulihiniya	Kadal-kuruvi	<i>Sterna saundersi</i>
7	Besra	Besra Kurulugoya	Sinna Valluru	<i>Accipiter virgatus</i>
8	Lesser Adjutant	Heen Bahuru-manawa	Mana, Meva-kokku	<i>Leptoptilos javanicus</i>

Mammals				
1	Dekhan leaf-nosed bat	Kesdiga Pathnehe-vavula	Sinna Vava	<i>Hipposideros galeritus</i>
2	Painted bat	Visithuru Kehel-vavula	Sinna Vava	<i>Kerivoula picta</i>
3	Purple-faced leaf monkey	Sri Lanka Kalu-wandura	Mundi	<i>Semnopithecus vetulus</i>
4	Jungle cat	Wal Balala	Kardup- poonai	<i>Felis chaus</i>
5	Leopard	Kotiya/ Diviya	Sarrugu Pullie	<i>Panthera pardus</i>
6	Rusty-spotted cat	Kola Diviya / Balal Diviya	Kardup- poonai	<i>Prionailurus rubiginosus</i>
7	Fishing cat	Handun Diviya	Koddy-pilli	<i>Prionailurus viverrinus</i>
8	Otter	Diya-balla	Neer-nai	<i>Lutra lutra</i>
9	Sloth bear	Walaha	Karradee	<i>Melursus ursinus</i>
10	Elephant	Etha / Aliya	Anei	<i>Elephas maximus</i>
11	Wild buffalo	Kulu Haraka	Kulu madu	<i>Bubalus arnee</i>
12	Giant squirrel	Dandu-lena	Malai anil	<i>Ratufa macroura</i>
13	Hump backed Whale	Molli thalmaha		<i>Megaptera novaeangliae</i>
14	Blue Whale	Nil thalmaha		<i>Balaenoptera musculus</i>
15	Sperm Whale	Manda thalmaha		<i>Physeter macrocephalus</i>
16	Common Dugong	Muhudu ura		<i>Dugong dugon</i>

Table 5.2 –Threatened plants in the region

	English name	Sinhala Name	Tamil Name	Scientific Name
1		Bu-nelu	Nelu	<i>Stenosiphonium cordifolium</i>
2	Ebony	Kalu-wara	Karunkali	<i>Diospyros ebenum</i>
3			Atalai	<i>Jatropha glandulifera</i>
4		Wal-kahambiliya		<i>Tragia plukenetii</i>
5		Opulu	Attukaddupulli	<i>Cynometra iripa</i>
6				<i>Dendrophthoe ligulata</i>
7				<i>Taxillus cuneatus</i>
8	Anuradhapura Orchid	Rassana		<i>Vanda tessellata</i>
9				<i>Psilanthus wightianus</i>
10				<i>Kaddumallikai</i>
11	Black Mangrove	Keera Kadol		<i>Scyphiphora hydrophyllacea</i>

- When the catch is handled carelessly and handled roughly, the quality of the fish becomes bad, and there is a **lot of wastage**. Usually the whole catch is emptied on to the ground beside the causeway and the prawns and edible fin fish are sorted out. Fish that are not eaten are left on the ground beside the main road. This not only causes waste, but also pollution of the area.

Connected with overexploitation is the way people harvest animals and plants.

Sometimes, fishermen use methods of harvesting which are illegal and damaging to the environment.

- **Using dynamite for fishing.** Dynamite fishing or Blast fishing uses dynamite to stun or kill fish, so that they are easily collected. This type of fishing is banned and illegal because it destroys the entire habitat. However, this type of fishing is still going on from Pallimunai to Thavulpadu area.
- **Using thangus nets.** Thangus nets are made of nylon. Fish cannot see the nets and swim into them, sometimes becoming wounded. This means that fish that are not targeted in a catch and fish that are still growing are also caught in these nets. These nets were banned in October 2010, and people are now stopping use of these nets. However, for some poor fishermen, these are the only nets they have, and they continue to use it.
- **Using brush piles for catching cuttlefish.** In many areas including Pallimunai and Vankalai, fishermen use cut mangrove branches and make brush pile to catch cuttlefish. This is a damaging practice, as it destroys mangroves.
- **Using Surukku nets.** These nets are circular and catch large numbers of fish and even their young.
- **Using SCUBA diving for collection of sea cucumber and conch shells.** Permits are needed for using SCUBA (underwater) gear. No permits have been given in Mannar for the use of SCUBA gear, but businessmen employ fishermen to catch sea cucumbers and conch shells in Silavatturai. The danger is that these SCUBA divers can remain in water for a long time and collect more of these animals, threatening their survival.
- **Using Bottom Trawling Nets.** Bottom trawling nets are dragged along the sea floor by a large boat or fishing trawler. This is highly damaging as it disturbs the bottom of the sea. There are about 85 trawlers in Pesalai and they have been ordered to stop using these nets.
- **Push nets.** Damage sea bottom and destroy benthic fauna

There are other resources being overexploited as well. Sand mining – although illegal – is taking place. When there is sand mining, the coastline becomes eroded. Heavy beach erosion is evident in Musali and Nanaddan Divisions.

River sand mining is taking place in Aruvi aru and Parangi aru resulting salt water intrusion.





Figure 5.2 - Coastal Erosion (Sampath Goonatillake)

- **Illegal fishing in Sri Lankan waters by Indian fishermen is a problem.** This is illegal. Indian fishermen use bigger boats and there are many more too. However, this is now becoming less frequent.

There are many reasons for these animals and plants becoming threatened. Overexploitation is just one of them.

## 5.2 Habitat Destruction

Habitat destruction is the process by which natural habitats are cleared and become unable to support animals and plants. Habitat destruction also results in animals and plants becoming threatened. When habitats are cleared, there is soil erosion. When this soil becomes washed away to a river, the river could become full of sediment - sedimented. Both these results affect humans.

- Large areas of natural habitats are being cleared for settling internally displaced persons, who are returning after the war. This can be seen in the Musali Divisional Secretariat division.
- There are different demands for land: some people want the land for resettlement, others for development, yet others for building infrastructure. There is no complete plan that looks after different needs. Because of this, much of the building that takes place could be haphazard and destroy natural habitats.

## 5.3 Pollution

Pollution makes the air, water and land dirty.

Vehicles and industries that give off gases like carbon dioxide and carbon monoxide pollute the air that we breathe. This is called **air pollution**.

Chemicals that are added to make crops grow faster (fertilisers) or kill pests that eat crops (pesticides) in large quantities pollute water. This is called **water pollution**.

**Solid waste pollution** refers to garbage, refuse or trash that is irresponsibly thrown away, polluting the land.

**Noise pollution** refers to a distressing man-made noise that affects human well-being and animal life. The word 'noise' comes from the Latin word '*nauseas*', meaning seasickness!

The main problems of pollution in the Gulf of Mannar region come from solid waste pollution and water pollution.

Solid waste pollution:

- Fishermen are careless and throw fish that cannot be eaten on the shore, where it rots and smells. Near fish landing sites, this solid waste is quite unpleasant. This is seen in almost every fish landing site.
- There is no proper disposal of solid waste in the area, except in Kalpitiya where a project for recycling wastes has just been begun. In Mannar Town garbage dumping is visible.

Water pollution:

- When farmers cultivate, they add fertilisers and pesticides that pollute rivers and streams. In Kalpitiya, there is a lot of cultivation of vegetables – which are then transported to Colombo. Studies have shown that there is a high level of nitrogen pollution in the ground water of Kalpitiya. In 225 drinking wells tested concentrations of nitrogen higher than what is acceptable for good health were found. This is causing people to fall ill.
- When this polluted water reaches habitats such as mudflats, they become contaminated and less habitat is then available for migrating birds.
- Another problem of pollution arises from cultivation of tank beds during the dry season. When fertilisers and pesticides are added for this cultivation, they can affect the quality of the water when the tank fills during the rains.

## 5.4 Invasive Alien Species

Some plants, like tea, rubber and coconut, are **introduced** into Sri Lanka. Tea, rubber and coconut do not spread aggressively, and remain in the areas they are cultivated.

However some introduced plants – such as

Nayunni (English Lantana; Sinhala: Ganda pana; Scientific name: *Lantana camara*)– will spread aggressively overtaking the areas covered with native plants, causing damage to the habitat. Such plants are called **Invasive Alien Species** (plants in this case). Similarly there are Invasive Alien Species of animals as well. Both invasive alien plants and animals can cause huge damage to the habitat and therefore this affects human well-being.

Note that not all introduced plants and animals are invasive, but that all invasive alien species are introduced.

- Valikkathan/karuvelum (English: Mesquite; Sinhala: Kalapu andara; Scientific name: *Prosopis juliflora*), an invasive alien plant that is rapidly invading all coastal areas and

replacing natural coastal vegetation. This is one of the biggest threats to coastal vegetation.

- In the tanks and rivers of the area, is the Snakeskin Gourami (Sinhala: Vel gurami; *Trichogaster pectoralis*) that has been identified as an invasive alien species. This fish probably competes for food and space.
- *Salvinia* which is considered as an invasive in the Giant's tank.

### 5.5 The Sethusamudram Ship Canal Project and the proposed oil exploration in the Gulf of Mannar

Adam's Bridge is not deep - at most 3 m in depth. Because of this, at present, ships coming along the western coastline of India have to travel right round Sri Lanka in order to reach the eastern coast of India. As far back as 1860, there was a proposal that a canal should be dug across Adam's Bridge to allow ship to pass between India and Sri Lanka, instead of going round. In 2005, the Indian Government began a project to dig a 35 km canal across Adam's Bridge (while removing 48 million cubic meters of dredged material) and another a 54 km stretch across Palk Strait (removing 34.5 million cubic meters of dredged material). This will reduce the distance that ships have to travel by 780 km nearly three days of travel time. However, the Government of India has suspended work on this project.

Sethusamudram is taken from the Sanskrit words *sethu* for bridge and *samudra* for sea. It is the sea between south India and Sri Lanka. It includes the Gulf of Mannar, the Palk Strait, and Adam's Bridge.

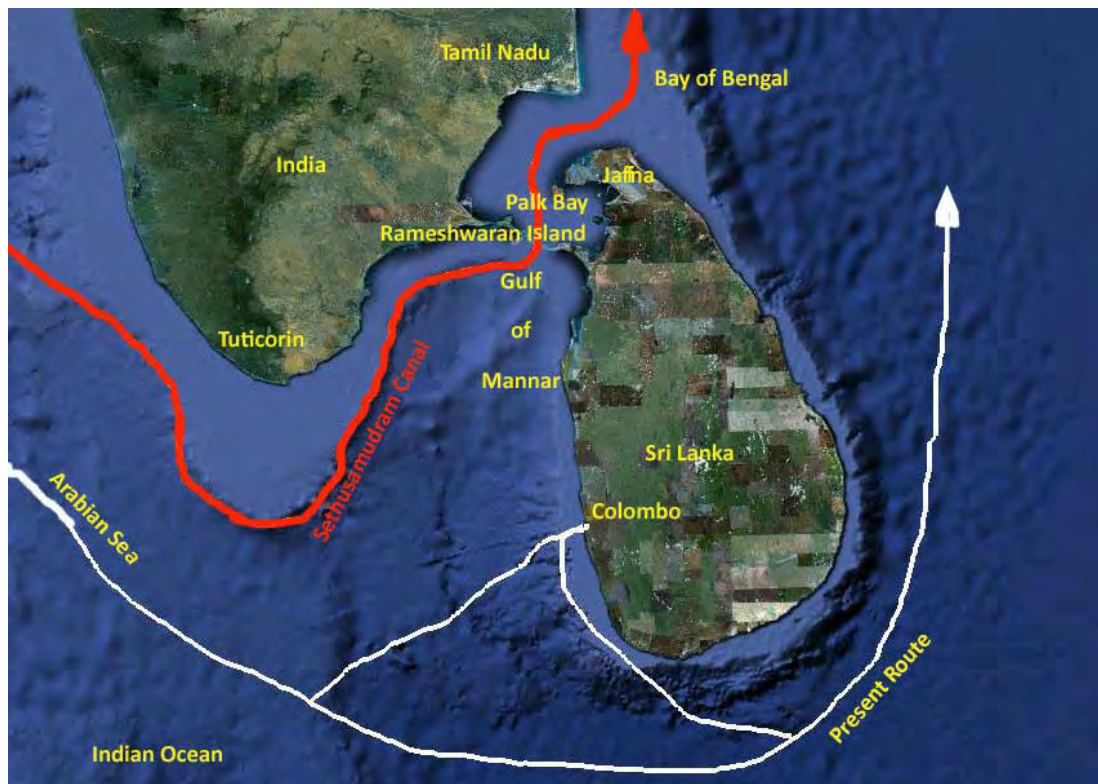


Figure 5.3 The existing and planned shipping routes.

In addition, the Sri Lankan government is likely to begin oil exploration in the Gulf of Mannar. There is a possibility that both these activities may affect the marine and coastal environment. The important considerations are as follows:

- Dredging the canal is likely to disrupt **the normal movement of water** across Adam's Bridge. Digging a deep canal could change the amount of water that is exchanged every season from the Gulf of Mannar to Palk Strait and Palk Strait to the Gulf of Mannar, as well as changing warmth and saltiness in the water moving back and forth. The effects of such changes on marine life and the food web in this area need to be studied carefully. It is to be noted that coral reefs are especially sensitive to even the smallest changes in temperature
- **Changing the depth** of this shallow area of sea could change the amount of sunlight reaching the bottom. **Dredging** could cause cloudiness in the water reducing the amount of sunlight reaching below. Seagrasses and coral reefs – both of which are dependent on sunlight could also die.
- Dredging also affects organisms that live in the water near the mud – **demersal** organisms, as well as organisms that live in the mud – **benthic** organisms.
- **Disposal of dredged materials** needs to be examined scientifically. Sometimes, mud that is excavated may contain toxic materials.
- Other potential issues are **noise pollution** due to dredging (which may affect animals), **pollution** due to shipping accidents and oil exploration, **disturbances** to fishery practices and loss of fishery, particularly conch shell collection.

Both the Sethusamudram canal project and the oil exploration project are likely to have long term, unknown effects on the ecology of the area which calls for adequate precautions to be taken in designing and implementation of the projects.

Ecology is the study of how organisms relate to each other and with their environment.

## 5.6 Climate change

Carbon dioxide and methane - two common gases in air form a layer in the atmosphere and allow sunlight to come in but stop some of the heat generated with that sunlight from going back into the atmosphere. During the last century and this century, too much carbon dioxide and methane has been put into the air. Vehicles and industries add carbon dioxide; collection of solid adds the production of methane. Because of this, more and more heat is being trapped and is warming the Earth. This is called **Global Warming**. Global warming is causing huge changes in the climate and this is called **Climate Change**. One of the impacts of climate change is that glaciers are melting. When glaciers melt, **sea levels rise**. Current sea level rise has happened at an average rate of 1.8 mm per year for the past century.

Coastal areas are the most exposed to sea level rise. Much of the coastline of the region will be threatened by climate change.

- Although the region of the Gulf of Mannar is rich with natural wealth, this natural wealth is also threatened by many human activities.
- Overexploitation is taking too much from the natural environment. The pearl fisheries of Sri Lanka collapsed because of overexploitation. Dugongs have been killed for their meat and are now Threatened with extinction.
- Forty six different kinds of Threatened animals, including butterflies, fish, reptiles, birds and mammals are found in this region.
- Eleven different kinds of Threatened plants were observed in the area.
- Some current practices of collecting sea cucumbers, sea urchins and sea anemones could lead to overexploitation.
- Fishermen waste a lot of fish from their catch.
- Some fishermen use dynamite for fishing, thangus nets, brush piles, surukku nets, and bottom trawling nets which are destructive and illegal.
- Illegal fishing in Sri Lankan waters by Indian fishermen is a problem.
- Habitat destruction is another threat to the environment. Large areas of natural habitats are being cleared for settling internally displaced persons and there are different demands for land.
- Solid waste pollution is a problem in the area as fishermen are careless and throw fish that cannot be eaten on the shore. Also, there is no proper disposal of solid waste in the area.
- When farmers cultivate, they add fertilisers and pesticide that poison rivers and streams. This has affected the ground water in Kalpitiya.
- *Prosopis juliflora*, an invasive alien plant is rapidly invading all coastal areas and replacing natural coastal vegetation. This is one of the biggest threats to coastal vegetation.
- The proposed Sethusamudram Ship Canal Project and oil exploration in the Gulf of Mannar may have adverse effects on the coastal and marine environment of the Gulf, and these initiatives need more scientific studies..
- Coastal areas are the most exposed to sea level rise. Much of the coastline of the region will be threatened by climate change.

## Chapter 6 - What can you do about the Threats to the Environment in the Gulf of Mannar?

The first important lesson everyone has to learn is to become aware of the damage that is being done to the environment around you. In the previous chapters, the natural wealth of the region, its importance to humans and their well-being, the damage that is being done to this wealth, were all discussed.

Now that you know what is going on around you, what can you do about it?

Be conscious of not damaging the environment in your daily activities. Ask yourself,

1. Are you taking too much from the environment?
2. Are you destroying habitats?
3. Are you polluting the air, land and water?
4. Are you bringing in introduced animals and plants that could be invasive?
5. Are you adding to the impacts of climate change?

### 6.1 Are you taking too much from the environment? (Overexploiting the environment)

Take from your environment only what is necessary: you cannot live without food and water, but you can live without shells, turtle shell trinkets, endemic fish in your fish tanks, and exotic plants in your gardens. Every time you collect a shell from the beach, the beach loses that much sand, as the shells will eventually become sand.

Take from your environment only the amount that you need. We take too much and waste too much. If human populations continue to increase as they are now, and if we go on using the environment as we are now, we would need many more earths to supply us with what we need!

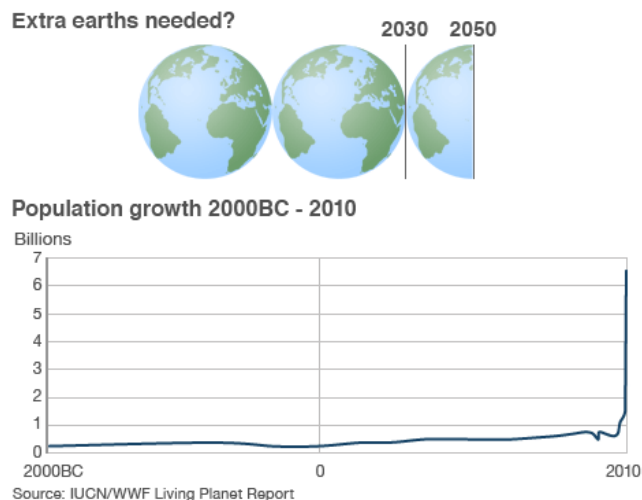


Figure 6.1 - Human Population growth



## 6.2 Are you destroying natural habitats?

- Every time you carelessly uproot a seedling or trample one, you are destroying a tree that is part of an ecosystem. Weeds can certainly cause problems in a garden or on cultivated land, but be careful that you do not destroy plants that are not weeds.
- Always use both sides of paper when writing and drawing,
- Ask your principal and plant a tree in the school yard, every time you see one being cut down somewhere else.
- Ask your principal and plant trees and shrubs in your school that will attract butterflies and birds. In this way, you can create a little natural habitat inside your school!
- Tell people that you know about the benefits you lose when you cut down forests and fill up wetlands (you learned this in Chapter 4).

- Did you know that tropical rainforests, which cover 6-7% of the earth's surface, contain over half of all the different kinds of plants and animals in the world?
- Central America has 50% of its rainforests remaining.
- South America has 70% of its rainforests remaining.
- The Philippines have lost 90% of its rainforests.
- Madagascar has lost 95% of its rainforests.
- Sri Lanka had 84% forest cover in 1881, now it has only 23.88% .

People think that wetlands – salt marshes, mud flats and mangroves – are of no use and are really wastelands, when in fact they are not. Experts agree that nearly 50% of the world's wetlands have been destroyed.

### Grow a butterfly-friendly garden

- Grow nectar plants for adult butterflies. Shrubs such as Ixora (Sinhala: Ratmal/Rathambala; Tamil: Vedchi; Scientific name: *Ixora coccinea*) Mussaenda, Shoe Flowers (Sinhala: Vada mal; Tamil: Shevarathai; Scientific name: *Hibiscus rosa-sinensis*); Blue Snakeweed (Sinhala: Balu nakuta; Tamil: Nayuruvi; Scientific name: *Stachytarpheta jamaicensis*), and Keerai.
- Grow other types of plants for caterpillars to eat. Certain butterflies lay their eggs on certain plants – these are called host plants. Citrus, Erukkalai (Sinhala: Wara Scientific name: *Calotropis gigantea*), Custard Apple (Sinhala: Anona, Sini-aththa; Tamil: Sita pallum/Annamunna; Scientific name: *Annona squamosa*); Passion fruits (Tamil: Koditoddai; Scientific name: *Passiflora caerulea*) and Malla-kulli /Sathai karanchan (Sinhala: Akkapana; Scientific name: *Kalanchoe pinnata*) will provide food for caterpillars.
- Your butterfly garden must have both sunny areas and shady areas.
- Do not use chemical sprays in your garden. Butterflies will die.

Attracting birds is simple. Just grow a Jam Fruit tree (*Muntingia calabura*) in your school garden and many birds will come to eat the fruits.

Every year, more than 1.1 billion trees are cut down for just office use. Each tree on average produces 173 reams of paper. Each ream of paper is equal to roughly 12 pounds of carbon dioxide not removed from the atmosphere, adding to climate change. Each tree cut down reduces the basic food produced on earth and increases floods and erosion.

It takes only 2-3 weeks for a banana skin to decay, but 100-1000 years for a plastic bag to do so. Plastic not only causes waste management problems but also ecological problems. It is reported that, every year, plastic bags kill about 100,000 whales, sea turtles, and other marine animals (many of which are Threatened), often by choking them. Plastic bags resemble edible squid and jellyfish.

### 6.3 Are you polluting the air, land and water?

- Every time you spray chemicals with an aerosol, you are polluting the air. For protection from mosquitoes, try home remedies such as Citronella oil.
- Every time fertilisers are used, these chemicals pollute the water. Persuade your parents to use natural fertilisers – such as cow dung and compost – as far as possible.
- Are you careless with trash? When you eat a toffee, do you just throw the wrapper anywhere? Learn to dispose of your waste responsibly.
- Are you buying unnecessary plastic? When you go to a shop, do you come back with many plastic shopping bags? Instead of using shopping bags, switch to using cloth bags instead.
- If you stop using 10 bags a month, you will save the use of 120 bags a year. If there are four people in your family, you will save the use of 480 bags per year. If you do this for only 10 years, your family will save the use of 48,000 bags. Think of how many you can save the use of in a lifetime and how much a whole town can save.
- Are you keeping the beaches in your area clean? Ask your principal, and try to organise a shramadana to clean one stretch of beach near your school and then make sure that it is kept clean.
- Every time you are careless about solid waste, chemicals or with aerosols, remember that you are polluting the Gulf of Mannar and its environment, that is rich with natural wealth.

Urban and developed areas can produce an enormous amount of solid waste. In Asia, it is estimated that urban areas produce 760,000 tonnes of waste daily, and this is predicted to increase by 2025 to 1.8 million tonnes per day. Sri Lanka is estimated to produce 0.89kg per person per day of municipal solid waste. Apart from looking ugly, solid waste increases the breeding spots of many disease carriers - such as mosquitoes and rats - and therefore, increases the spread of disease. Solid waste can also wash into waterways, causing water pollution and contaminate ground water. It also generates methane, a gas which like carbon dioxide, contributes to global warming.

#### Start a solid waste programme in your school.

Learn to reduce, recycle and reuse materials.

Reduce use of paper (you are using something made from a tree). Reduce the use of plastic.

Reuse paper, bags and bottles without throwing them away.

Recycle glass, tin, paper and plastic.

Have separate bins for paper, tin, glass and wet waste (remnants of food etc.) Teach the school children to use these separate bins for separate items and not to litter the school.

Collect garden waste, eggshells, coffee grinds and tea leaves and start a compost bin or pit. Compost provides good, nutritious natural fertiliser. You can try composting at home too.

## Are you bringing in introduced animals and plants that could be invasive?

You have learned about the dangers of invasive alien species. It is always best to plant native plants in your garden than experiment with introduced species. It is always best to have standard goldfish, guppies and platies in your fish tank than more exotic fish.

## Are you adding to the impacts of climate change?

You can reduce the impacts of climate change by reducing the amount of carbon dioxide emissions – this is called **mitigation**. Whenever we waste electricity or burn things, we are releasing more carbon dioxide into the air. By planting trees we can increase the amount of carbon dioxide absorbed.

Climate change **adaptation** simply means adjusting your life to deal with the effects of climate change: being careful about our use of water, being responsible about solid waste, preventing chemical and air pollution, are all ways of adapting to climate change.

- Am you conscious about reducing energy use  
- do you put out lights and fans when you are not in the room?
- When you cook, do you boil food in a large volume of water in open saucepans or do you use the minimum quantity of water and a closed pan?
- Do you burn trash releasing carbon dioxide into the air? If you learn to reduce, reuse, recycle, then you won't need to burn trash.
- Are you wasting precious water? Are you conscious about reducing use of water? Do you ignore leaking taps? Tell your parents if you see a tap leaking at home or your teacher, in school. Remember that Mannar is located in an area where water is very scarce. It is all the more important, therefore, to be very conscious that you are not wasting a drop.
- Do you leave water running when you brush your teeth? Do you leave water running when you soap yourself when bathing? Or when you wash dishes?
- Are you making an active effort to plant trees?

In Sri Lanka, the net use of electricity doubled between 1992 and 2002.

- Each small leak wastes a lot of water. A leak that fills up a coffee cup in 10 minutes will waste over 11,000 litres of water a year.
- If you leave the water running while brushing your teeth you will waste nearly 19 litres of water – that is enough to fill 80 tea cups

The second important thing you need to do is to persuade other people to change their habits too. Become an agent for the change that is necessary for the environment.

- Start with your school. Tell your classmates what you have learned. If each of them changes his or her habits, you will have 40 children caring for the environment. If each of them tells one more person, you will have 1,600 children caring for your environment.
- Also talk to your family and get them to change their habits in relation to the environment.
- Ask your principal and start a campaign to clean up the environment. Pick an area and have a *shramadana*.

Every mature tree in the tropics absorbs 22kg of carbon dioxide every year, naturally reducing the effects of climate change.

***Every little change counts. Everyone's effort, adding up, can ultimately make a big difference to our environment.***

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## மீனவ வளங்களை எதிர்காளத்திற்காக பாதுகாப்போம்



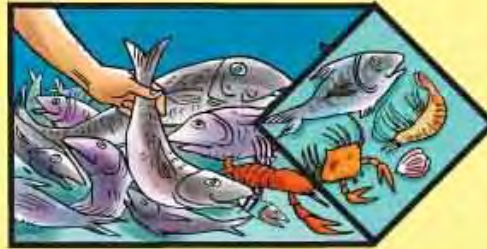
வலைகளில்  
பிடிக்கப்படும்  
சிறிய நண்டுகள்  
கடலுக்குள்  
விடுவிக்கப்பட  
வேண்டும்  
அல்லது  
கொழுக்க  
வைப்பதில்  
பயன்படுத்தப்பட  
வேண்டும்.

குறைந்தளவில் நாவுக்கு ருசியான  
மீன்கள் ஒழுங்கற்ற முறையில்  
ஒதுக்கப்படக்கூடாது. இது  
கடற்கரைகளைக்  
கவர்ச்சிகரமற்றதாக்குகின்றது.....

இவை மீன் உணவு, உரம் போன்ற  
உற்பத்திகளைத் தயாரிப்பதற்கு  
பயன்படுத்தப்பட முடியும்.



சுகாதாரமான  
நிலைமையின் கீழ்  
மீன்பிடியைத் தரம் பிரிக்க வேண்டும்....  
மணல் துணிக்கைகளுடன் மாசடையும்  
போது, அது மீன்களின் தோலைச்  
சேதப்படுத்தி, தரம் குன்றச்செய்வதற்கு  
இட்டுச் செல்லும்.



சாத்தியமான அளவுக்கு தூள்  
பனிக்கட்டியைப் (ஐஸ்)  
பயன்படுத்துங்கள். மீன்களை பெரிய  
துணிக்கைகளிலான பனிக்கட்டி  
நொறுக்கி, குறைந்த விற்பனை  
விலையை விளைவிக்கின்றது.



# மீனவ வளங்களை எதிர்காளத்திற்காக பாதுகாப்போம்

**டைனாமைட் பயன்படுத்தல் - பாதிக்கப்பட்ட மதுமீயில் சகல ஜீவராசிகளையும் பாடுபாடினர் அழிக்கும்.**



**யோக்கர் மீனவர்கள் - ஒரு சில அளவற்ற மீன்களைப் பிடித்ததாக, முருகைக் கற்பாத்தொடரின் பாரிய பகுதிகளை அழிக்கின்றது.**



கடலில் பகுதிகளில் அழகு, நிராடங்களுக்கும் குறுக்கே குறைந்த கண்ணாடிகளைய மீனவர்களைப் பயன்படுத்தல். கனம் பிடுகைத்திறன் வரும் எல்லா மீன்களையும் பிடிப்பதால் மீன் உருகுத் குறைவுகள், ஏராளமான சிறு தொழிலாளிகள் பாதிக்கப்படுவார்கள்.

- தாக்கவீடுகள்**
- சேதமடைந்த மீன்கள் குறைந்த விலைகளையே பெறும்
  - மீன்களினதும், ஏனைய விலங்கினத்தினதும் அடுத்த சந்ததியை அழிக்கின்றது.
  - முருகைக் கற்பாத்தொடர்களையும், சேர்ந்தள்ள விலங்கினத்தையும் அழிக்கின்றது
  - அடிப்பகுதிகளில் வாழ்கின்ற விலங்கினத்தைய பாதிக்கின்றது.

ஏதாவது இந்த தீவிரமடைகின்ற முறைகள் பயன்படுத்துவதை நிங்கள் அலுவலரிடத்தில் தயவுசெய்து மீள்பிடித்தொழில் திணைக்களத்திற்கு அல்லது இலங்கைக் கடற்படைக்கு அறிவிப்புகள்.

**எதிர்காலச் சந்ததிக்கு பெறுமதிவீக்க மீள்பிடித்தொழில் வளங்களுக்கு பாதுகாப்பளிப்புகள்**

**கடந்த காலம்**



**நிகழ்காலம்**



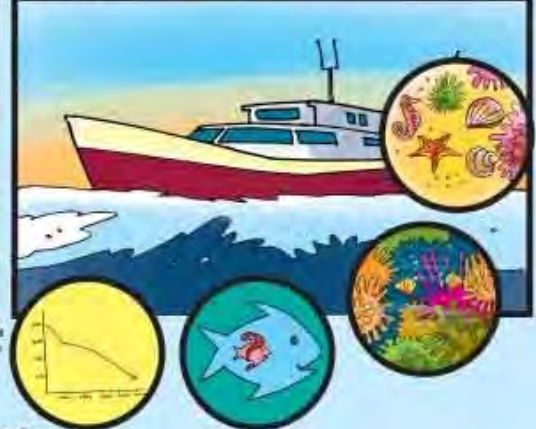
**எதிர்காலம்**



**கற்றி வளைக்கின்ற மீனவர்கள் (உதாரணம்: ஒற்றை மீன்மீன் இறை மீனவர்கள், மீனவ மீனவர்கள், கருக்கு மீனவர்கள்) சகல அளவுகளையும் கொண்டு மீன்களைப் பிடுகின்றனர்... வளரிடம் பருவத்திலானவை உட்பட.**



**கடலடித்தளத்தில் இழுவை மீனவர்களைப் பயன்படுத்தல் கடலின் அடிப்பகுதிகளைக் குடிப்பதால், அடிபுற முழுவியல்முறைமையையும் அழிக்கின்றது.**



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Bay of Bengal Large Marine Ecosystem Project (BOBLME).





# முருகைக் கற்பார்த்தொடர்கள்: ஆழ்கடல் தோட்டங்கள்

## முருகைகள் என்றால் என்ன?

பொலிப் என அறியப்பட்ட சிறிய உயிரினங்குகளால் ஆக்கப்பட்டதே முருகைகள்.

## முருகைக் கற்பார்த்தொடர்கள் எவ்வாறு அமைகின்றன?

அதனைச் சுற்றி கல்சியம் காபனேட் கிண்ணமொன்றை பொலிப்புகள் கட்டியெழுப்புகின்றன.

முருகைக் கூட்டமொன்றை அமைப்பதற்காக இக் கிண்ணங்களின் பெரும்பாலானவை ஒன்றாக ஒட்டிக்கொள்கின்றன. முருகைக் கூட்டங்களினால் முருகைக் கற்பார்த்தொடர்கள் அமைக்கப்படுகின்றன.

## கற்பார்த்தொடர்கள் எவ்வளவு விரைவாக வளர்கின்றன?

அவை விரைவாக வளர்வதில்லை என்பதுடன், சேதத்திலிருந்து மீள்வதற்கு வருடக்கணக்கில் எடுக்கின்றன.



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## மன்னார் விரிதடாவில் நீங்கள் எவ்வாறு முருகைக் கற்பார்த்தொடர்களைக் காணலாம்?

சிலாவத்துறை, அரிப்பு, வங்காலை மற்றும் மன்னார் (பாலமுனைக்கு அப்பால்)

## முருகைக் கற்பார்த்தொடர்களின் பெறுமதி

**பரவலாக்கம்:** பெருமளவு கடலக உயிரினங்குகளுக்கும், அவற்றின் குஞ்சுகளுக்கும் உறைவிடம், உணவுட்டல் மற்றும் வளர்ப்பிடங்கள் ஆகியவற்றை வழங்குகின்றன.

**பாதுகாப்பு:** அலை நடவடிக்கைக்கு எதிராக தடைகளாக செயற்படுவதன் மூலம் எமது கரைகளைப் பாதுகாக்கின்றன.

**உல்லாசப்பயணம்:** கடலோர உல்லாசப்பயணத்திற்கு பிரசித்தமான போக்கிடங்களாக ஆரோக்கியமான கற்பார்த்தொடர்கள் விளங்குகின்றன.

**மீன்பிடித்தொழில்:** துறைமுக மொலாக்கன்கள், சிங்கி இறால்கள் மற்றும் உண்ணத்தக்க கற்பார்த்தொடர் மீன்கள். மீன்வளர்ப்பு வர்க்கத்திற்கு உயிருள்ள மீன்களையும், முள்ளந்தண்டில்லாதவற்றையும் கற்பார்த்தொடர்கள் கொண்டுள்ளன.



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## மீள்வருவனவற்றினால் முருகைக் கற்பார்த்தொடர்கள் சேதமாக்கப்படுகின்றன:

- படகு நங்கூரமிடப்படுதல் அத்துடன் ஆழமற்ற கற்பார்த்தொடர்கள் மீது படகுகளின் செயற்பாடு
- டைனமைற் வெடிவைத்தல்
- மொக்ஸ் வலைகளைப் பயன்படுத்தி மீன்பிடித்தல்
- வேறு பயன்களுக்கு அகற்றப்படுதல்
- மதிக்கப்படுதல்
- வன அழிப்பு மற்றும் பொருத்தமற்ற கமத்தொழில் செயற்பாடுகளிலிருந்து விளைகின்ற மண் அடைதல் (உதாரணம்: சிலாவத்துறையிலும், அரிப்பிலும் உள்ள கற்பார்த்தொடர்கள்)



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## எதிர்காலச் சந்ததிக்கு முருகைகளைப் பாதுகாக்க

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