



EASTERN PROVINCE BIODIVERSITY PROFILE AND CONSERVATION ACTION PLAN



MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES
BIODIVERSITY SECRETARIAT

EASTERN PROVINCE BIODIVERSITY PROFILE AND CONSERVATION ACTION PLAN



Thangamuthu Jayasingam

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Message from the Hon. Minister

Sri Lanka is a small island with rich biological diversity and high level of endemism. Biodiversity of the country is unique and hence it has universal value. Nevertheless, it is currently under threat from ever increasing human interferences. Due to this extraordinary endemism and also high level of threat the country is considered as one of the global biodiversity hotspots.

Biodiversity conservation is not a new phenomenon to Sri Lanka. From ancient times Sri Lankans have had close relations with flora and fauna and they were very much concerned about their conservation and protection for the benefit of future generation. As we all know the world's first recorded sanctuary, 'Mihintale' is located in Sri Lanka.

Sri Lanka has adopted a positive approach in formulating new policies and strategies towards conserving its biological wealth. We have signed and ratified the Convention on Biological Diversity (CBD) and are already in the process of implementing relevant provisions. I am proud to say that Sri Lanka is one of the very first countries that prepared Biodiversity Conservation Strategy and Action Plan.

Nevertheless, we are facing severe problems in conserving our biological diversity. As outlined in the 2007 Red List of Threatened Fauna and Flora of Sri Lanka, the rate of biodiversity loss in Sri Lanka is increasing rapidly as can be seen in other countries in the world.

Therefore, we need to act now to reduce the biodiversity loss or hold the extinction of endangered species. I believe these Provincial Biodiversity Conservation Profiles and Action Plans are a key strategy to achieve this objective. Biodiversity issues are not concentrated to a particular locality of the country but are distributed in various provinces of the country in different scales.

I strongly believe that this document would be an excellent guide with immense value to all stakeholders who are working on conservation and sustainable use of biodiversity.

Patali Champika Ranawaka

Minister of Environment & Natural Resources

Message from the Secretary

Sri Lanka has signed and ratified the ‘Convention on Biological Diversity’ and is obliged to implement the relevant provisions of the Convention. This Ministry has developed the “Strategy for the Conservation and Sustainable use of Biological Diversity” as early as in 1994 by way of implementing Article 6 of the Convention. This was followed by the development of the ‘Biodiversity Framework Action Plan’ in 1998. In 1997, Sri Lanka finalized the preparation of complete Biodiversity Conservation Action Plan (BCAP) with the development of the “Addendum to the Biodiversity Conservation Framework Action Plan”.

A consultative approach was followed in the preparation of this addendum. During the addendum preparatory process a series of workshops were held by the Ministry with relevant Provincial Administrations and all other relevant stakeholders of the province to discuss draft recommendations and they were revised when and where necessary. At these workshops it was highlighted that the addendum recommendations were focused on national level and adequate attention was not paid to provincial issues. As a solution to this issue, it was decided to develop Biodiversity Profiles and Conservation Action Plans (BPCAP) at provincial level. The Component C of the Protected Area Management and Wildlife Conservation Project of the Ministry provided necessary financial assistance.

The Ministry considers that the preparation of BPCAP at provincial level is a unique exercise as it is one of the first such activities done in the world. This Ministry has ensured that all stakeholders of the relevant province were involved in the preparatory process. Thus we can be happy that this unique exercise produced a document through the collective efforts of all stakeholders for the conservation of biodiversity at provincial level. I strongly believe that the final product is very comprehensive and meets the needs of the Eastern Province.

M A R D Jayatilake

Secretary

Ministry of Environment & Natural Resources

Acknowledgements

- I have compiled this document from much of my experience over the past 25 years in the province, working at the Eastern University and with/for many agencies in different capacities, participating in many discussions at work or leisure. I thank everyone and every organization who had at one time or other contributed to my knowledgebase and understanding of the biodiversity of the east which I have compiled to best of my knowledge.
- I appreciate the confidence of the Biodiversity Secretariat in granting me this assignment and their patience to respect my delay. Special thanks to Gamini who trusted in me. I acknowledge the immense support of Lathika Hapuarachchi and Saranga Jayasundara through out the study.
- I am grateful to the Eastern University which had provided me facilities and provided all assistance whatever possible, over the past three decades.
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- I am deeply grateful to my family, wife and the two kids for the understanding of long absence, physically and mentally from them, for this and this type of work over many years...

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Sri Lanka is an island in the Indian ocean having latitude and longitude between 5-9° north of the equator and 79-81° east. It shares a typical tropical climate with high temperature, humidity and rainfall. Geologically, having been a part of the Gondwanaland which later separated from Indian subcontinent, but yet, sharing the continental shelf of the Deccan plate with it. With a 66,090 sq km of area and maximum breadth of 225

km and length of 450 km, it accommodates a variation of climate that accommodates a range of ecosystems from bonsai forest and cloud forest in the highlands to tropical rain forests, salt marsh, mangroves and sea grasses on the coastal belt.

Eastern Province is made of three administrative districts on the eastern coast of the country sharing 16% of the area of the country. It shares a great wealth of natural resources; approximately 25% of the coast, 25% of lagoons, 28% mangroves, 31% fresh marshes and 5% dunes of the country. It has about 55% of natural vegetation cover against the 28% in the country (Jayasingam,2004).

Socially it shares nearly 1.5 million people(7 % of the population) comprising of all different ethnic groups which make it a mosaic of land and the people, whose composition are given below in Table 1.

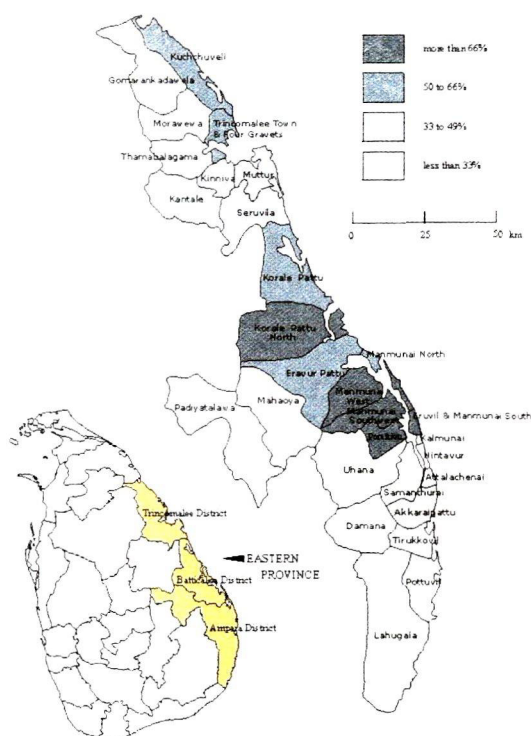


Fig 1: Administrative boundaries of Eastern Province

Table 1: Population distribution (approximate) in Eastern Province in 2001

District/2001	Sinhala	Tamil	Muslim	Others	
Ampara	33.33	18.76	41.56	0.32	589,344
Batticaloa	0.16	74.38	24.38	0.48	517,878
Trincomalee	26.5	33.4	40.2	0.27	330,981
Eastern	320,304	605,164	501,460	5275	1,438,202
Province	22%	42%	34%	0.3%	100%

(Statistical Information 2005, North east Provincial Council)

The urban population is relatively less in the province making only 22% and relatively Trincomalee has a higher urban population and Ampara higher rural population (Table 2). It is evident that the population densities have increased considerably from 1981 to 2001, with Ampara having the highest increase and Trincomalee the lowest.

Table 2: Status of Population in 1981 given in thousands (000). The densities of population (per sq km) is also given in 1981 and 2001.

	Population ('000)			Density (per sq km)		
	URBAN	RURAL	Total			
	1981	1981	1981	1981	2001	Change
Ampara	53.6	335.2	388.8	86	140	65%
Batticaloa	79.5	251.3	330.9	134	186	39%
Trincomalee	83.2	173.5	256.8	98	134	37%
Eastern Province	216.3	760	976.5			
	22%	78%	100%			

(Statistical Information 2005, North East Provincial Council)

Tsunami of December 2004, had a mega impact on the province, beyond the thousands of people killed in the incident and any thousands that were displaced, in terms of changing and damaging the Natural ecosystems in the province, mostly that of the coast.



Fig 2: Impact of Tsunami Dec. 2004

It is noted that the natural systems are recovering naturally and with assistance form various organisations that had enhanced the process or facilitated planting of species mostly in the coastal regions. The Tsunami affected the whole east coast and the zone is also a cyclone prone zone as given in Figure below (United Nations University, 2007)

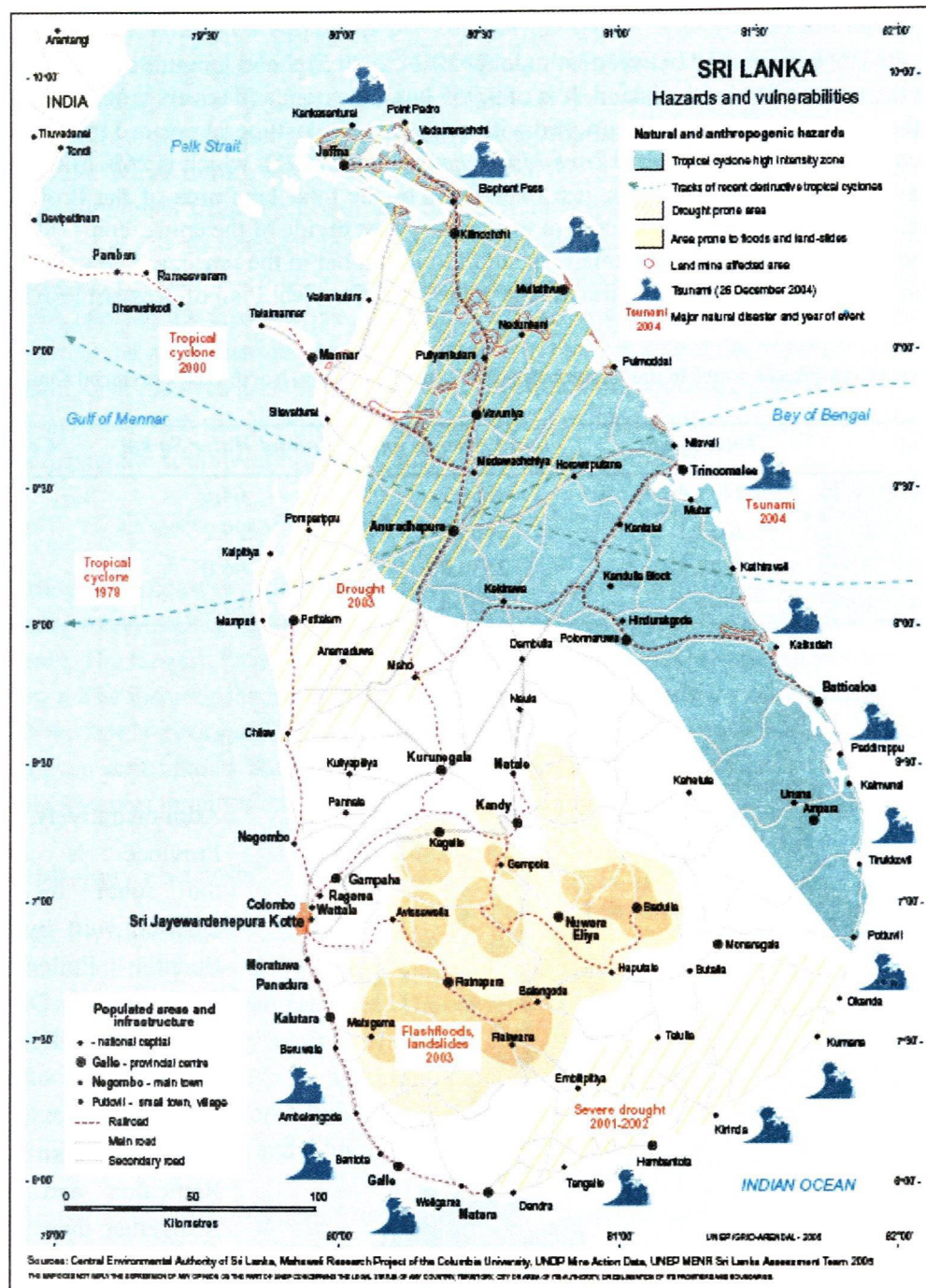


Fig 3: Natural hazards and vulnerable areas in Sri Lanka

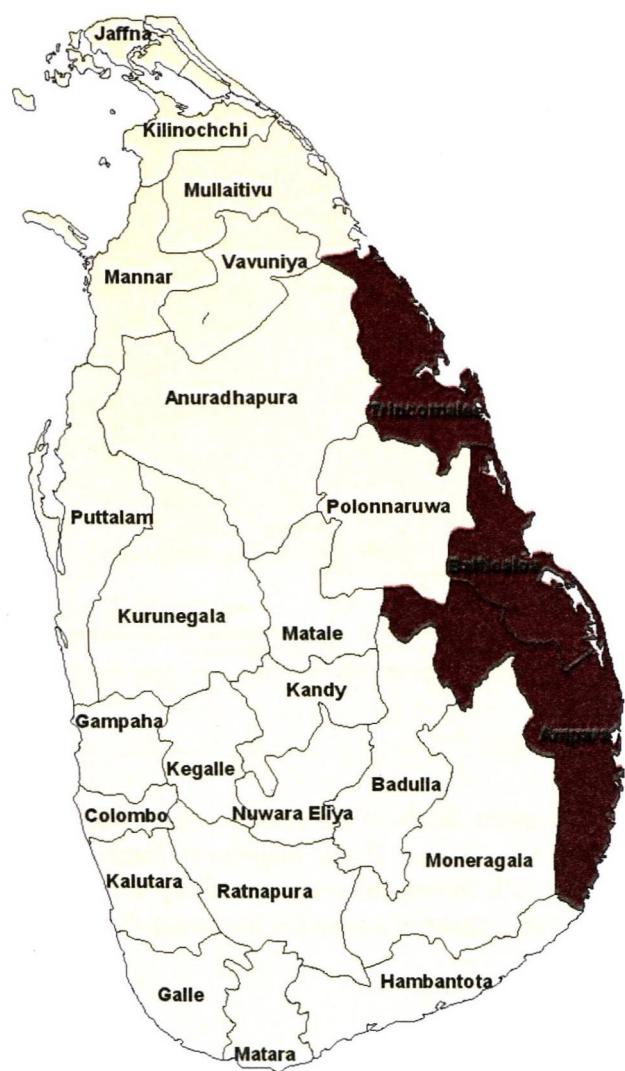
It is the purpose of this document to collate the various facets of the eastern province and document as a profile to illustrate the diversity and distribution of resources. It also engages in identifying the potential that exists of such for use and development of such biological resources along with conservation and sustainable management. It also aims to provide a basic plan of action for furthering the conservation.

2 BIO GEOGRAPHICAL, PHYSICAL AND EDAPHIC FEATURES

The Eastern Province is situated between latitude 60 30' N to 90 5' N and longitude 810 00' E to 820 00' E, and occupies the eastern part of the island. It is of 9,965 km2 in extent and covers around 16.0% of the total land area of the island. the Province is enriched with a 420 km of coastline (Ampara 110 km, Batticaloa 100 km and Trincomalee 210 km – (*Coastal Zone Management Plan, 1997*), which is 26% of the total coastline of the country, and, water bodies cover just over 8.5% of the total land area of the Province. Series of Lagoons from Kokilai to Kumana interlaces to form a east west divide of the entire coast. Maximum length of Eastern Province is 286 km from Kumana in south to Pulmodai in the north, and, the maximum breadth is 89 km from Ulhitiya in the west to Kirankulam in the East(Physical Plan of Eastern Province, 2004) .

Table 3: The extent of land and water in the Eastern Province- Statistical Data, North East Provincial Council 2005

District	Total sq km	Land Area sq km	Inland Water Sq km	Coastline km
Ampara	4431.4	4366.7	64.6	110
Batticaloa	2633.1	2403.9	229.2	100
Trincomalee	2728.8	2630.8	96.0	210
Eastern Province	9793.3	9401.4	389.8	420



Administratively, Eastern Province is bordered in the south by Hambantota District, west by Moneragala, Badulla, Pollonnaruwa and Anuradhapura Districts, North by Mullativu District and east by sea (Bay of Bengal). At present the province comprises of three districts Ampara, Batticaloa and Trincomalee. Altogether there are forty five (45) D.S. Divisions (Batticaloa 14, Trincomalee 11 and Ampara 20) and One Thousand Nine Hundred and Eighty Six (1986) Grama Niladhari Divisions(GN divisions), which are the lower most administrative units of the country.

Fig 4: Map of Administrative boundaries in Sri Lanka

2.1 Climate

The entire eastern coast is located within the dry zone of Sri Lanka, which has a hot and humid tropical climate. The mean annual temperature is 30° C, although typically this ranges from 18° C on cooler nights during the rainy seasons, to 38° C during the rare day in the hot summer months. The province receives about 1000-1500 mm of rainfall per annum, primarily from the northeast monsoons (about 60%), during October to February. Winds during this period originate from the Indo-Asian landmass, unlike the southwest monsoon, which originates from the ocean and brings relatively little precipitation (Swan, 1980). Inter-monsoonal convectional rains account for the most of the balance, although some rain falls during the southwest monsoons. Rainfall distribution, rather than the total, is most important in determining the climate and environment. Most of the province has a dry spell of three months, but Trincomalee district has a much longer dry spell than the other districts. At the same time the southern end of the province is close to the arid zone of the country and receives less than 1000 mm of precipitation. Winds are generally moderate, ranging from 7–15 km per hour with the evening winds being stronger. The *kachan* – a dry wind that blows after shedding rains during the southwest monsoon, July/Aug – is much stronger.

2.2 Geology

Geologically, the eastern coast is varied. The bedrock of the Eastern Province is predominantly Precambrian, usually consisting of crystalline rocks unaffected by volcanic activity and mountain building for more than 500 million years. The Eastern Province has two main series of geological strata, namely the Highland- and the Vijayan series. The former contains highly metamorphosed rocks consisting of sandstones, limestone and clays of which the last is distinguished by the presence of aluminium-rich minerals such as sillimanite and garnet. The Vijayan series flanks the Highland series, but is distinct as it consists of igneous metamorphic rocks, including gneisses, granites and migmatites. These contain relatively few minerals (Swan, 1980).

2.3 Geomorphology and soils

Geomorphologically the Eastern Province is located in the third peneplain, which is coastal and flat, mostly below and altitude of 50 meters above mean sea level, although some areas may rise up to 300 meters. There are few rock outcroppings in the province. The cliffs in the coastal zone of Trincomalee are unique in this respect. Soils are mostly sandy regosols and recent beach and dune sands, with areas of riverine alluvial soils. In the interior there are reddish brown earths and their derivatives. In most places there is an east-west division by the water bodies (lagoons) from Kokkilai to Kumana: reddish-brown earths occur to the west of the lagoons, while sandy regosols and alluvial soils occur to the east.

The continental shelf around the Eastern Province is around 80 meters wide on average and has a depth of more than 60 m. However, submarine canyons are found in Trincomalee and Punnaikudah (nearly 15 km north of Batticaloa along the coast) that are much deeper (often up to several hundred meters) close to the shore. Out of the five canyons found in the country only Punnaikudah is not associated with an estuary or river. The coastline has many coral reefs. Fringing reef from Trincomalee to Kalmunai and off shore reefs (e.g. Pigeon island) and barrier reefs. More details of the corals are less known for the eastern coast, even though recent study by NARA (National Aquatic Resources Agency) indicated that the corals of Pigeon Island are alive and have not been affected by the recent trends of bleaching found in many parts of the island (Rajasuriya, 1999). Tsunami also had large amounts of corals, broken pieces and large boulders, brought to shores in the eastern coast signifying the presence and the destruction of such in the process.

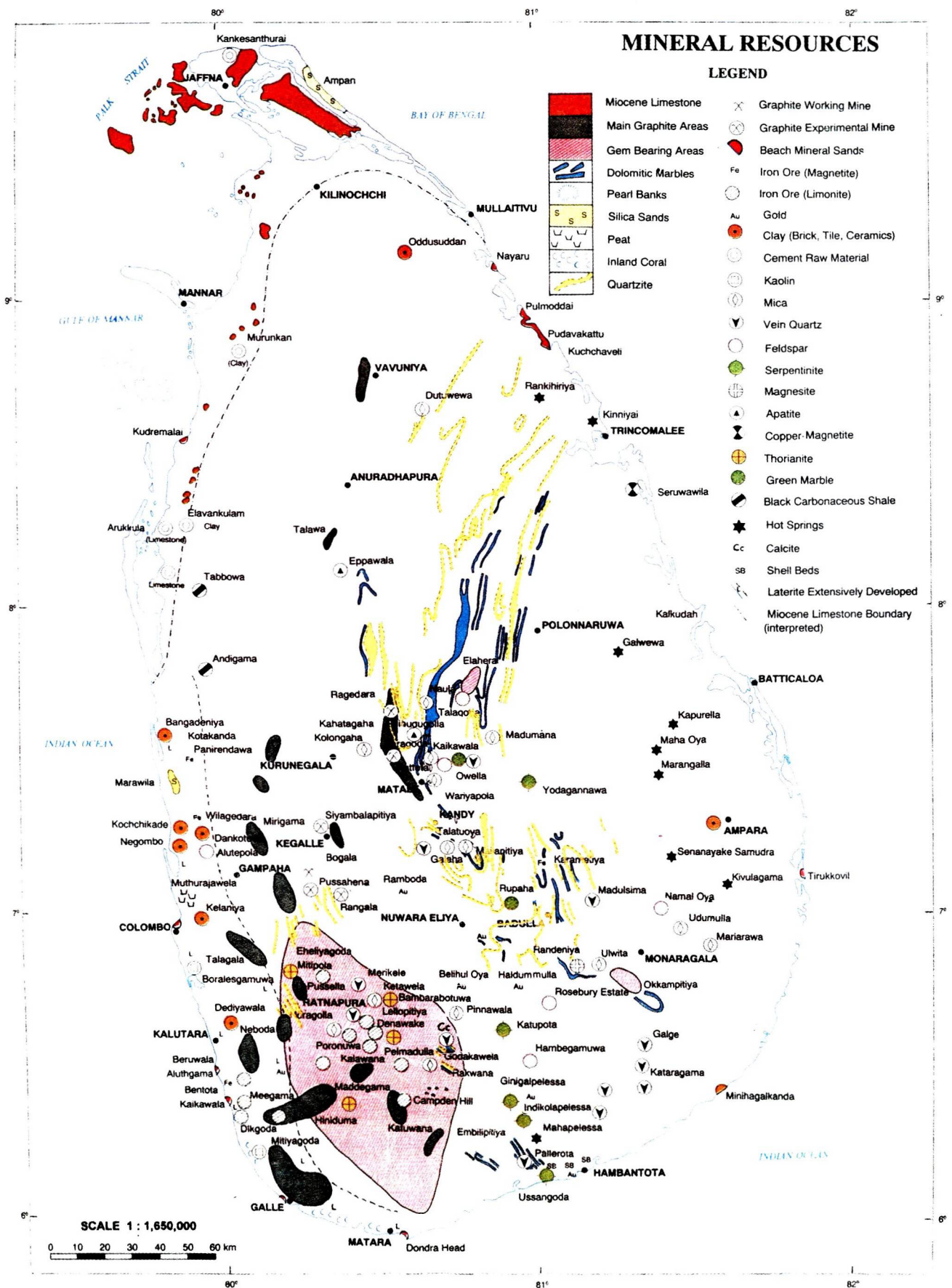


Fig 5: Geology of Sri Lanka

Source : Adopted from Arjuna's Atlas of Sri Lanka, 1997

2.4 Bio eco-regions:

Biogeographically the country had been classified into Bio eco-region following the initiative from Wijesinghe et al.(1993). East primarily shares the regions 2 (dry zone – dry mixed evergreen forests), 8 (mineral sands from Mullaithevu-Kathiraweli), 9 (Kathiraweli to Panama- eastern lagoon system). It also shares with that of 1 (arid zone) and 10(Tangalle to Panama –wildlife habitats).

Region 8. Kathiraweli to Mullaithevu Coral reef and rocky habitat, mangrove habitat, lagoons and estuarine systems and Mineral sands. Large marine mammals. Important for fisheries.

Region 9. Panama to Kathiraweli- near shore coral reefs, The great little basses reefs, mangroves associated with lagoo systems,multiple lagoons and estuarine systems. Important for fisheries and has minimal human interference

Except for the coastal belt the entire east is classified as dry mixed evergreen forest or region 2 which is incorrect which does unjust to the diversity of the natural vegetation in the province, within a superficially monotonous landscape.

2.5 Land Use

The Land use of the eastern province is given below. It is important to note that 55% is found as natural landscapes with forest and scrub land being the main components. Agriculture takes 22%, settlements 7% and water bodies 9% (man made around 5%) as the key components of the land use patterns. In effect around 77% of the cover is green most of the year in the province, even though it is a part of the dry zone of the country.

* the variations noted in figures given in different tables signifies the need for a calibrating study to fix numbers giving the methodology.

Table 4: Land cover of the Eastern Province

Main land uses	Land Use Category	Extent (ha)	Extent of main groups (ha)	% of all category
Human Settlements	Built up Area (Commercial & Residential	3211		0.32%
	Home sted Residential	69763	72975	7.00%
Agriculture	Paddy	176816		17.74%
	Chena	13415		1.35%
	Coconut	5775		0.58%
	Other Plantation	31931	227936	3.20%
	Forest	291005		29.20%
Natural Landscape	Marsh	13203		1.32%
	Grassland	873		0.09%
	Scrub	250275	555356	25.12%
Roads	Main Road	2456		0.25%
	Minor Road	2942		0.30%
	Other Roads	18054	23452	1.81%
Rocks and Quarries	Quarry	33		0.00%
	Rock	18366	18400	1.84%
Sand and Beaches	Sand or Beach	3766	3766	0.38%
Irrigation Tanks & Canals	Tank with Bund	38		0.00%
	Tank with Bund - Abandoned	4748		0.48%
	Tank with Bund - Working	29490		2.96%
	Bund	2477		0.25%
	Canals - Wide	723		0.07%
	Ela	9283		0.93%
	Reservoirs	7994	54752	0.80%
	Water Hole	1335		0.13%
	Lagoon	35624		3.58%
Other Water Bodies	Lakes	268		0.03%
	River	2586	39813	0.26%
TOTAL		996449	996449	100%

3 ECOSYSTEM PROFILE

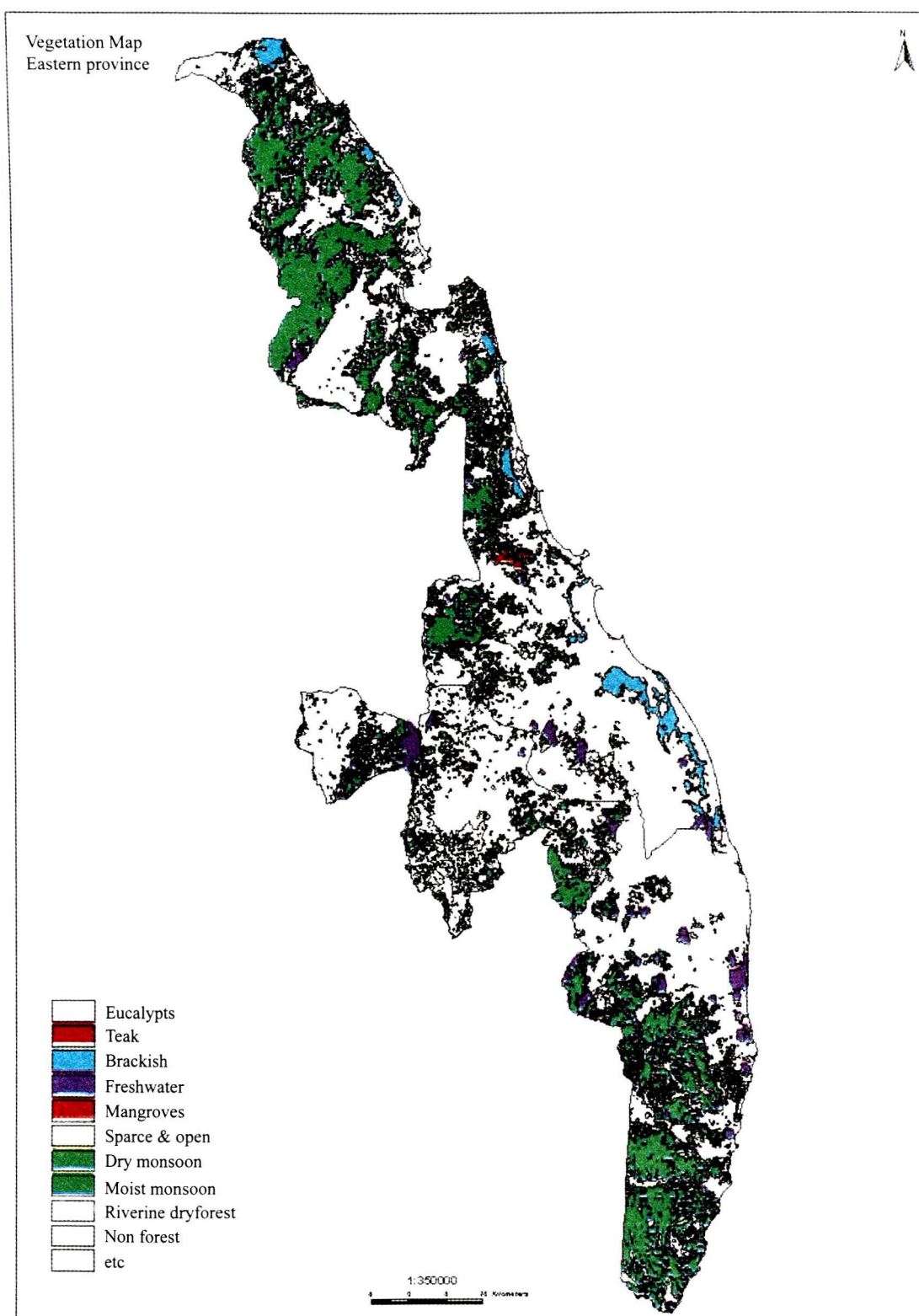


Fig 6: Vegetation map of Eastern Province

3.1 Major ecosystems

Classification of ecosystems, natural and man made, is always a difficult task as they may not fit into our defined categories as they blend into others, defying the classification. For convenience we classify the ecosystems as land ecosystems (which has forest ecosystems and wetlands as the main components) and the coastal marine ecosystems. The forest ecosystems include forest as well as grasslands.

3.1.1 Forest ecosystems

Ecosystems do not follow anthropogenic classification or boundaries which needs to be understood. The classifications are generalized descriptions of assemblages and the boundaries too are based of relative abundance of one against the other. In reality what you would witness is the continuum of ecosystems distributed in a mosaic. Therefore when confronted with terminology such as sparse and open forest, non forest, savannah, grassland one needs to be able to visualize the differences.

Forest is where trees are the major forms of vegetation. Grassland on the other end and has no trees. Savannahs are in between with a mixture of both. A shrub forests would be morphologically closer to the grassland, but with perennial shrubs/thickets and the open forest would be closer to the forest with a sparse canopy. Some of these in the drier areas, specially the shrub forest, may be a thorn forest in nature by the composition of increased thorny species.

The open forest may be natural or may be as a result of a secondary succession following anthropogenic disturbance/perturbations. Most of chena land would be transformed into such in time.

Table 5.1: Distribution of Forest ecosystems in Ampara District (area in Ha)

Forest Type	Number of Patches	Total Area (ha)	Minimum Area (ha)	Maximum Area (ha)	Standard Deviation (ha)
Brackish and salt water	11	439.36	0.49	153.11	52.81
Dry Monsoon forest	293	67921.18	0.27	29490.04	1998.58
Eucalypts	2	61.03	16.91	44.12	19.24
Fresh water	218	19894.45	0.21	4181.08	360.03
Mangroves	33	299	0.18	88.76	17.04
Moist Monsoon forest	674	44074.98	0.10	7866.01	445.39
Non- forest	1967	67475.77	0.10	26221.66	639.38
Riverine dry forest	109	7534.49	0.39	2019.08	219.55
Sparce and open forest	593	227198.03	0.15	190397.61	7830.65
Teak	176	4572.38	0.84	251.51	38.82

Table 5.2: Distribution of Forest ecosystems in Batticaloa District (area in Ha)

Forest Type	Number of Patches	Average Area (ha)	Total Area (ha)	Minimum Area (ha)	Maximum Area (ha)	Standard Deviation (ha)
Brackish and salt water	34	56.18	1910.43	0.28	1373.65	234.02
Dry Monsoon forest	203	82.03	16653.26	0.28	6364.39	482.64
Fresh water	98	50.97	4995.74	0.10	1021.30	153.85
Mangroves	127	13.04	1656.38	0.29	192.80	28.81
Moist Monsoon forest	185	70.23	12994.08	0.16	8438.84	623.48
Non- forest	288	80.05	23054.81	0.12	11330.90	711.95
Sparce and open forest	191	57.79	11039.01	0.65	3000.33	225.00
Teak	41	97.63	4002.84	2.81	3039.31	472.24

Table 5.3: Distribution of Forest ecosystems in Trincomalee District (area in Ha)

Forest Type	Number of Patches	Average Area (ha)	Total Area (ha)	Minimum Area (ha)	Maximum Area (ha)	Standard Deviation (ha)
Brackish and salt water	41	1045.82	42878.65	1.35	35443.34	5529.59
Dry Monsoon forest	383	80.37	30783.23	0.10	3161.71	340.99
Eucalypts	4	38.02	152.10	7.03	62.08	23.02
Fresh water	184	31.12	5726.27	0.24	1118.13	101.92
Mangroves	74	18.03	1334.62	0.57	663.53	76.88
Moist Monsoon forest	1	39.85	3.98	3.98	3.98	0
Non- forest	614	101.29	62192.22	0.94	35075.28	1438.68
Riverine dry forest	13	140.28	1823.65	0.21	1141.81	312.40
Sparce and open forest	344	336.09	115616.71	0.19	63951.83	3773.16
Teak	13	25.97	337.67	0.93	98.85	31.48

Source: Digital Maps, Department of Forestry - 2003

3.1.1.1 Tropical Dry Mixed Evergreen Forest (Dry Monsoon Forest)

Tropical dry mixed evergreen forests are the most abundant in the country, covering the entire dry zone with the exception of the Jaffna peninsula is the predominant vegetation of the Eastern Province. It has a mean annual temperature of about 29° C and rainfall of around 1000-1500 mm. Most of the precipitation is during the North East monsoons from October to February and have a marked dry spell between May – August. Topographically the entire dry zone is in the third peneplain, flat lowland of the country not exceeding 300 m elevation, although the terrain is undulating in many places. Rock outcrops are also found in many places. The rock out crops also have distinct vegetation with *Ficus mollis* (wal aralu), *Crateva adansonii* (lunu warana,mavilanku), and *Sterculia foetida* (telambu, kattu thengai) as the frequent tree components.

Characteristically it has a sparse canopy of about 20-25 m in height, a sub canopy of about 10-15 m and a well developed shrub/herb layer. The major trees of the vegetation has a deciduous component with *Chloroxylon swietenia* (burutha, muhtirai), *Vitex pinnata* (milla, kattamanakku), *Berrya cordifolia* (hal milla, savandal), *Pityranthe verrucosa*, *Cassia fistula* (ehela,thiru kondrai) and an evergreen component of *Manilkara hexandra* (palu, yakada maran), *Diospyros ebenum* (kaluwara, karunkai), *Alseodaphne semecarpifolia* (we veraniya) and *Drypetes sepiaria* (weera, veerai). *Dimorphocalyx glabellus* (weli weanna) and, *Diaspyros ovalifolia* form the sub canopy layer. *Derris scandens* is a common liana and *Glycosmis pentaphylla* (dodam pana), *Croton laccifer* (keppetiyaya), *Barleria* spp. form the herb/shrub layer.

The vegetation does not have high endemism as in the rain forest. But it harbors one of the largest elephant populations in Asia for the given area.

The flora is very diverse producing many of the valuable timber species. The distinctive large mammal fauna includes leopard, bear, elephant, deer, sambhur etc. Most of the forests are protected as national parks, sanctuaries or reserves viz. Gal oya national park, Somawathiya, Hurulu Forest reserve, Madhuru Oya etc which are in the eastern province or associated with it.

Chena cultivation, encroachment, felling of timber and, poaching are serious issues which also have contributed to the marginalisation of these lands into unproductive barren lands, infested only with weedy species in many places.

3.1.1.2 Tropical Moist Evergreen Forest (Moist Monsoon Forest)

Very small areas of the eastern province really has this forests. These are more closer to the borders of the intermediate zone. The forests that borders the Ampara- Moneragala borders of Nilgala region around Senanayake Samudra have these forests in place.

Tropical moist evergreen forests are found in between the Tropical rain forest in the lowland wet zone and the tropical dry mixed evergreen forest in the dry zone. Therefore this forest can also be considered as a transitional or ecotone forest.

This forest type is widespread in intermediate zone at or below 900 m elevation. The main species are *Mangifera zeylanica* (etamba, kaatu maa), *Pometia pinnata* (gal mora), *Artocarpus nobilis* (wal del, kattu erapila), *Filicium decipiens* (pihimbiya, chitra vembu), *Semecarpus* (badulla,) sp., *Pagiantha dichotoma* (divi kaduru), and *Annamirta cocculus* (titta wel). They also have *Dimocarpus longan* (mora, nurai), *Vitex pinnata* (milla), *Haldina cordifoila* (kolon, manchal kadambu) etc. as the deciduous component.

3.1.1.3 Tropical Savannahs

Savannahs are grasslands/woodlands with scattered, characteristic trees among the tall grasslands of the dry/Intermediate zone. They may be of two types, low altitude savannahs found at altitudes below 300 m and high altitude savannahs found between 300-500 m altitudes, having rainfall below 1400 mm or around 1400-2000 mm respectively. The Eastern Province has only the low altitude savannahs. Some refer to savannahs as Talawas colloquially but the lowland wet zone grasslands are called Talawa technically (Pemadasa, 1987).

Periodic burning is a process faced by the savannahs. They have characteristic trees which are fire resistant. The question of origin of savannahs is un-answered as to whether it is anthropogenic in nature controlled by fire or natural due to soil conditions and events inclusive of fire. Fire also causes loss of vegetation followed by soil erosion, leading to exposed rocks in many places.

The savannahs have two layers with scattered trees dispersed in the grasslands forming a 10-15 m stratum. Characteristic vegetation of the higher elevation Savannahs include trees of *Careya arborea* (kahata), *Phyllanthus emblica* (nelli), *Terminalia bellirica* (bulu) with grasses *Themeda triandra*, *Cymbopogon polyneuros*, *Heteropogon triticeus*, citronella grass, *Panicum maximum*. The low altitude savannahs of the Eastern province include *Terminalia bellirica*, *Terminalia chebula* (aralu), *Phyllanthus emblica*, *Careya arborea*, *Anogeissus latifolius* (devu) with grasses *Aristida setacea*, *Cymbopogon nardus*, *Imperata cylindrica* (iluk) and *Themeda triandra*. Recently Savannah with *Cycas* sp. Dominance has been described at the borders of Ampara District (Nilagala Report, DWC 2007).

Low altitude savannahs are found around Bibile, Moneragala, Digamadulla, Mahiyangana etc., while the high altitude savannahs are common around the UVA basin.

Population pressure threatens these as others and burning for grazing is a common feature during the periods of May-August and the new growth begins in November with the rains.

3.1.1.4 Damana Grasslands

Extensive grasslands which cover most of the dry zone are called the Damana grasslands. They may vary in their structure from place to place based on the rainfall, temperature and soil characters. However, they share common features. Extensive damana grasslands are found in Yala, Wilpattu, Maduru Oya, Batticaloa, Amparai, Anuradahapura etc. They form the grazing pastures for most of the wildlife and cattle of the dry zone and hence become an important ecosystem in the country. Often found with scattered trees but has shorter grasses than the Savannahs including *Bauhinia racemosa*, *Ixora coccinea*, It is also common to find *Limonia acidissima*, *Zizyphus eramini* sp., etc in these grasslands. Termite mounds are common in these ecosystems and makes available a colonizing space for the vegetation. Grazing pressure creates thickets of vegetation amidst these grasslands, which are characteristic to these fire affected grasslands.

Cymbopogon nardus, *Aristida*, *Imperata cylindrica*, *Themeda tremula*, *T. Triandra*, *Brachiaria* sp., *Eragrostis* sp., *Ischemum* sp. etc. are common in these grassland.

Heavy grazing pressure, frequent fires, increasing soil erosions and population pressure are turning these grasslands into barren lands.

3.1.1.5 Villu Grasslands

Villus cover a total area of 12,500 ha. Often they are cut-off former river bends. Many of the larger “Villus” are located in the Mahaweli floodplain in the East. A typical example is the inter-connected Handapan and Pendiya Villus (796 ha) which is the largest of the entire Mahaweli Villu system which is in the borders of eastern Province. Trikonamadu, Verugal has smaller villus along the Mahaweli. Vil, Kokku - vil, in Ampara and Batticaloa the usage for wetlands.

They are wetlands which have water throughout the year by floods/rains. Villu grasslands possess distinct vegetation and also form a special link to the wildlife in that area, especially to the avifaunal population.

They are part of the livelihood of the local population, providing fish and prawns most of the year.

Succulent grasses of *Iseilema taxum*, *Paspalidium flavum* and tree species of *Vitex leucoxylon*, *Nauclea orientalis* are common. *Calamus*, cane is a common shrub in the fringes.

Mahaweli diversion has had significant impact on the hydrology of the villu in that region. Human encroached in some of the areas have led to the altering of the entire ecology of the region.

3.1.1.6 Riverine vegetation

Riverine vegetation are that borders the river systems. It is also called Gallery forests or River bank vegetation and is unique as it is richer than the neighbouring vegetation of the site and often taller and greener and easily located in aerial photographs and satellite images. It is also recognizable in the field from long distances. They share characteristic species which differ in the wet zone and dry zone. Wet zone has *Mesua thwaitesii* (na, nakai), bamboos, *Madhuca longifolia* (mi), and the dry zone has *Terminalia arjuna* (kumbuk), *Garcinia* sp., *Diospyros* sp., *Polyalthia* sp., *Madhuca* sp., bamboos may also be found in the dry zone.

Riverine vegetation also contains many up-stream species which are not common to the local vegetation, which have established from propagules of upstream.

Large Riverine vegetations are seen around the Major rivers in the east, viz. Heda oya, Mahaweli and Yan oya. Closer to the estuary these also have large mangrove vegetations fringing the rivers which are also called the 'Riverine mangroves',. Differing from mangroves of lagoon fringes.

Sand mining is a serious problem and causes erosion of the banks in many places. The construction of large dams do also have impacts on these vegetations as the flow patterns of the water changes considerably drying the river banks.

3.1.1.7 Forest Plantations

Large scale Plantations are limited in the Eastern province at present . But large areas had been assigned for plantations in the past whose remnants are still visible. The first successful plantations of Teak was established in Pullumalai along the A5 road 20 km west of Chenkaladi. Most of these plantations were lost during the cyclone in 1978 and was never reestablished. Other plantations include those that were established for the paper factory along the A15 from Oddamawadi to Punanai with bamboo, Eucalyptus and Teak. Teak could still be seen to resprout during the rainy season to be cut and burnt again. In a season of flowering the teak bushes show though slender in appearance have been providing sticks for many years to the firewood cutters of this area. It is a common site along these roads that heaps of these are loaded in the bicycles to be taken to town.

Other plantations of Eucalyptus have been established in Talawai and other stations but have not been maintained much specially after the conflict in this region and many have been utilized by people for various needs. Casuarina plantations have been made in the coast which had prevented TSUNAMI in some location taking some of the beatings e.g Navaladi, Batticaloa.

In terms of landscape the coconut also formed a major cover in the east until 1978 when more than 80% of the trees were destroyed in the cyclone on November 23rd 1978. These areas have not been reestablished for a variety of reasons.

Cashew also has been a plantation more in the Batticaloa district in Vakarai region north of Batticaloa and Pudukudiyriruppu south of Batticaloa, closer to the shores which had been lost due to human activities of burning and cutting for firewood and charcoal production, during the conflict mostly. The remaining too had been heavily affected by the Tsunami of 2004. However one must admit that the crop had become more wild in the shores of the east it is taken partly as a naturalized vegetation in many cases.

3.1. 2 Wetlands

‘Wetlands are defined as areas of marsh, fen, peat land or water whether natural or artificial permanent or temporary with water that is static or flowing fresh or brackish or salt including areas of marine water the depth of which at low tides does not exceed six meters’ under Ramsar Convention which has also been agreed by the National wetland Steering committee. The above definition includes practically all water bodies including puddles after rains and paddy fields. The details are given in the National Wetland directory of Sri Lanka (2006). 62 wetlands have been described in the publication of which 12 are in the eastern province.

In this section only the rivers and streams are considered as natural wetlands and irrigation tanks as man made wetlands. The saline wetlands are considered under the coastal ecosystems. Given the fact that there are no natural lakes in Sri Lanka, all the fresh water irrigation tanks would be man made ecosystems.

3.1.2.1 Rivers and Streams

There are 103 rivers which are listed for the country of which 38 rivers from numbers 31-68 flow through the eastern province to the sea in the Eastern Province including the Mahaweli Ganga. These are shown in the map below. The larger rivers are marked.

Most of the province is in the coastal plain. The rivers and streams drain water from highland and direct it to the sea. Most of them are seasonal and drain only during the rains or short periods after. A few of the rivers drain water from the central highlands and are perennial or at least have water for most of the year viz. Kumbukkan oya, Mahaweli ganga.

Table 06 : Characteristics of River Basins in Eastern Province

Basin No	River Name	Catchment Area	Average Rainfall (mm)	Rainfall Volume in MCM	Discharge Volume to Sea in MCM	Runoff/ Rainfall Ratio
31	Kumbukkan oya	1218	1622	1976	472	24
32	Bagura oya	92	1436	132	37	28
33	Girikula oya	15	1436	22	8	37
34	Helawe ara	51	1436	73	27	37
35	Wila Oya	484	1461	707	254	36
36	Heda Oya	604	1675	1012	394	39
37	Karanda Oya	422	1500	633	253	40
38	Saymena Aru	51	1500	77	27	35
39	Tandiadi Aru	22	1500	33	12	36
40	Kangikadichi Aru	56	1500	84	29	35
41	Rufus Aru	35	1500	53	18	34
42	Pannela Oya	184	1500	276	97	35
43	Ambalam Oya	115	1500	173	66	38
44	Gal Oya	1792	2032	3641	237	7
45	Andella Oya	522	1500	783	278	36
46	Thumpankeni Tank	9	1458	13	4	30
47	Namakada Aru	12	1475	18	5	28
48	Mandipattu Aru	100	1500	150	45	30
49	Pathanthe Aru	100	1500	150	45	30
50	Vett Aru	26	1650	43	12	28
51	Unnichchai Aru	346	1550	536	195	36
52	Mundeni Aru	1280	1750	2240	757	34
53	Miyangolle Ela	225	1450	326	101	31
54	Maduru Oya	1541	1750	2697	226	8
55	Pulliyampota Aru	52	1500	78	23	29
56	Kirimechchi Odai	77	1500	116	35	30
57	Bodigoda Aru	164	1512	248	74	30
58	Mandan Aru	13	1500	20	6	31

(Cont.)

Basin No	River Name	Catchment Area	Average Rainfall (mm)	Rainfall Volume in MCM	Discharge Volume to Sea in MCM	Runoff/Rainfall Ratio
59	Makarachchi Aru	37	1336	49	17	34
60	Mahaweli Ganga	10327	1946	20101	4009	20
61	Kantale Aru	445	1583	704	15	2
62	Panna Oya	69	1585	109	2	2
63	Palampotha Aru	143	1585	227	5	2
64	Pankulam Aru	382	1590	607	13	2
65	Kunchikumban Aru	205	1500	308	7	2
66	Pulankutti Aru	20	1500	30	1	3
67	Yan Oya	1520	1404	2134	132	6
68	Mee Oya	90	1500	135	41	30

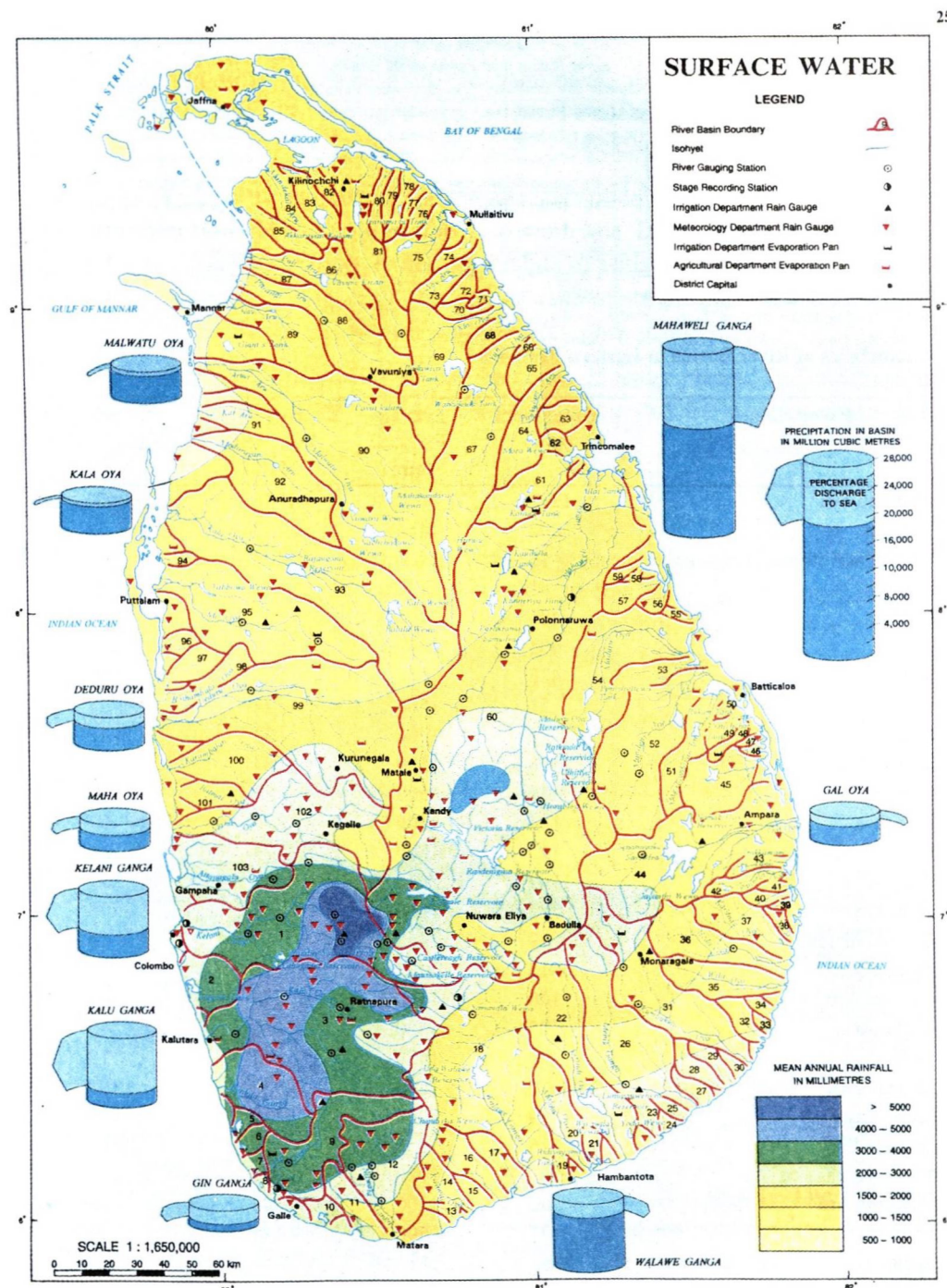


Fig 7: Major Rivers of the Country
Source : Arjuna's Atlas of Sri Lanka

3.1.2.2 Major, Medium and minor Tanks/ Reservoirs

Major, Medium and minor tanks are decided on their irrigable area they command. Major tank commands more than 1500 acres, medium 200-1500 acres and minor tank below 200 acres. The management of the tanks too vary, the minor tanks being managed by the Agrarian Services department and the others by Irrigation department. There are also regulation for management under the provincial irrigation and national irrigation departments.

The numbers of major, medium and minor irrigation tanks and their irrigation potential and catchment area are given in table below. The table also indicates the Major and Medium tanks under National Irrigation which includes Senanayake Samudra in Ampara and Yan oya anicut in Trincomalee.

The important fact is to note that the minor tanks contribute significantly to the cultivation of crops. These are distributed throughout the area and are seasonal and also serve as drinking water to human and cattle.

Table 7 : Number of Irrigation tanks major, medium and minor under provincial and national administration in the Eastern province and the associated catchment and irrigable area.

<i>District</i>	<i>Provincial management</i>			<i>National Management</i>				
	Major+ medium	Irrigable area (Ha)	Catchment Sq km	Minor	Irrigable area(ha)	major+ medium	Irrigable area(ha)	Catchment (sq km)
<i>Ampara</i>	4+6	4836	285.8	348	2488	6+7	61104	222
<i>Batticaloa</i>	2+10	4302	108.4	262	9540	5+5	21498	103
<i>Trincomalee</i>	- +17	2631	203.7	421	7115	7+1	19816	544
EAST		11769			19143		102418	

3.1.3 Coastal & Marine

Coastal and Marine ecosystem are the relatively more abundant and most prominent in the East and they include the Mangroves, salt marshes, Sand dunes and Beaches, sea grass beds, mud flats, corals, grasslands and forests

3.1.3.1 Coastal marine

Table 8: Distribution of coastal marine ecosystems in the Eastern Province.

District	Mangroves	Salt Marshes	Dunes	Beach	Lagoons, Estuaries	Other water bodies	Marshes
Trincomalee	2043	1401	-	671	18317	2180	1129
Batticaloa	1303	2186	-	1489	13682	2365	968
Ampara	100	127	357	1398	7235	1171	894
TOTAL	4346	4857	357	3558	39234	5716	2919
Country Total	12189	23819	7609	11800	158017	18839	9754
Percentage	33%	20%	5%	30%	25%	30%	28%

Source: Coastal Zone Management Plan, 1990 from CCD, 1986

These are the ecosystem that are in the near shore marine areas. Coral reef, sea grasses and sea weeds are deliberately separated to provide more details.

The most prominent Biodiversity of the east lies in its coastal belt which is unique in a sense and also diverse. The other ecosystems would be the forests and grass lands which are of limited interest ecologically. More detailed analysis is therefore presented here.

3.1.3.1.1 Proximal Seas:

The Eastern coast has a narrow continental shelf around it to about 80m and beyond which the waters become deep to about 60m; very deep contours come close to the shores making canyons near Trincomalee and Punnakudah. The areas mostly affected by the Tsunami also do have deep waters closer to the coast viz. Kalmunai, Kalkudah, Vakara, Komari etc., most of which were historically ports of landing. Variety of interesting and important ecosystems/populations are found in these places of which coral reefs, sea grasses and sea weeds would be discussed separately. Large populations of Whales and Dolphins have been witnessed in these waters close to Trincomalee. Collection of large amounts of Sea cucumber (*Holothuria nobilis*-large black, *Holothuria scabra*-large brown, *Actinopyga mauritiana* - small white and black) and shanks in the coasts of Trincomalee (Irakkandi), Batticaloa and Akkaraipattu records the presence of these species populations in these areas; these are often collected by diving 5-15 m deep. In 2001, 10000 specimens of Sea Cucumbers have been collected at Irakkandi. They utilize many divers for this purpose, during the months of April to July. Pulmoddai, Kalkudah and Panama are known for the lobster catch in the proximal sea among the reefs in these areas. Diving for Mussels has also been practiced in Trincomalee bay, diving with masks only. The blue seas are also rich in fish catch where the diversity has been found to be very high.

The moratorium/ ban of deep sea fishing during the conflict had made most of the fishermen restrict them to the shallow proximal seas which may have caused significant depletion of the resources of the proximal seas over time in the past.

3.1.3.1.2 Sea weeds

Sea weeds are lower plants (Algae) that are found in various strata of the sea and may form large carpets in areas. They are mostly found in the shallow waters where light penetrates. Often these are attached to the rocks and reefs in the waters or on substratum itself in cases. There is hardly a total collection of the algae in the country. Recent studies in Ruhuna had concentrated on the sea weeds in the southern and western coast. Eastern coast has plenty of brown algae (*Sargassum*, *Turbinaria* sp) in Trincomalee. There had been collections for export upto 50,000 kg of *Sargassum* per year in Trincomalee in the past. At present collections are made in Kinniya. These species are also found in Kalkudah, Uhanda and in many exposed rocks in the seas. Green algae is more diverse and found in almost the entire coast mostly in places where it is rocky or calcareous in nature. Species of *Caulerpa*, *Ulva*, *Halimeda*, *Enteromorpha*, *Codium* are more common. *Padina* is also found in many places. In Pasikudah it is found in plenty on the ocean floor itself making carpets at times. *Gracilaria* is another genus of algae which had been collected and exported is found in these waters. The species collected is *Gracilaria confervoides*.

The impact of the Tsunami is less known, but judging from the large quantity of the coral rock boulders that were thrown onto the coast of Kirankulam and Kurukkalmadam, by the Tsunami it is fair to assume that the substratum for the Algae would have been disturbed significantly. Further the resultant inflow of debris would have also caused concern to the populations and the system as a whole.

3.1.3.1.3 Sea Grasses

Sea grasses are not grasses in the real sense but look alike in nature, tapery and slender, found in the shallow waters of the sea, bay, estuary or lagoons. These are flowering plants that live in the sea/brackish waters and are also technically referred to as marine angiosperms, which they are. They are a relatively small group of plants and are significant in terms of biodiversity. They are also one of the most productive ecosystems in the world.

Globally, about 12 Genera and 50 species of Sea grasses are recorded. Sri Lanka has 6 Genus of the 7 found in the tropics, and the seventh may also be present (Abeywickrama & Arulgnanam, 1991, Jayasingam 2004), making 12 species in our waters. Recent studies have indicated extensive patches are found in Konesapuri in Trincomalee (10 km north) of *Thalassia* species which show seasonal dynamics. (Mathiventhan, Jayasingam 2004)

Records and observations indicate that *Halophila* and *Thalassia* are common in the east. Most of the sea grasses are found in the shallow bays and lagoons viz. Batticaloa lagoon, Trincomalee cod bay. Abeywickrama documents as follows: *Halophila beccaria* (Batticaloa, rare); *H. decipiens* (very rare, Trincomalee, 1853); *H.*

ovalis (common, Trincomalee, Batticaloa); *Najas gramineae* (common, Trincomalee, Batticaloa); *N.marina* (vary rare, Kalmunai); *Cymodocea serrulata* (rare, Trincomalee); *Syringodium isetifolium* (common, Batticaloa). Eastern Coast shares 60% of the country's species diversity and 80% of Generic diversity, in relation to Sea Grasses. This is even significant globally as 25% of global species diversity and 40% of generic diversity are found in the Eastern Coast.

It is unfortunate that no attempts have been made to update this. Recent compilation was made by Jayasingam(2004), but no fresh collection were made or attempted.

3.1.3.1.4 Coral Reefs



Fig 8: Distribution of coral reef in Sri Lanka

Source : National Atlas of Sri Lanka

Corals are the shelters of the minute flagellate organisms that live in the pores we see in the coral. When the organism die the shelter skeleton piled up on each other forms large reefs. They are one of the most productive enterprises in the entire world and also has one of the highest biodiversity in any given ecosystems having many layers of food chains within it. This includes the coral polyps themselves and the associated crustaceans that thrive in these location and the beautiful coloured fish that roam these ecosystem, Sea anemones which add further colour and many more that live on these themselves.

Coral reefs are found along the entire eastern coast. They are extensive and prominent in Pigeon island, Kalkudah, Salli thevu etc. The coral reefs constitute a variety of species of soft and hard corals including sponges. However most have been damaged or lost owing to human activities in the past. The beautiful reefs of Kalkudah had been lost mostly due to over subscription to ornamental fishing, beach landing etc. Reports of 'crown of thorn' star fish infection was also reported in the 1980s. The Pigeon island had been one that had not been damaged or least damaged by the El-Nino effect unlike the western coast reefs in Hikkaduwa. However recent Tsunami had affected them in one way or the other. Large coral reef boulders that were swept from the sea were littered through the entire coast but was predominantly high near Kirankulam.

Much work has been done on the coral reef ecosystem by the IUCN (Sri Lanka) and NARA.

It is reported that the Coral reefs in Pigeon island have the maximum percentage of live corals which had not been affected by the El-Nino. These are dominated by branching *Acrophora* and fliose *Montipora* species. *Pocillopora*, *Porites* are also common.

Tsunami had damaged coral reefs in almost all places taking boulders to coast, by mere physical force. Almost total destruction was seen in Dutch bay. Large reef fishes as groupers (Serranidae), snappers (Lujanidae), sweetlips (Haemulidae), emperors (Lethrinidae) seemd low while the smaller fish as butterfly fish (Cheatodontidae), gobies (Gobiidae) and wrasses (Labridae) were high in these waters (Rajasuriya, pers comm.) in Trincomalee. The impact of these on the reef fishes have been high, probably due to the loss of habitat.

Lime production also has been a cause of destruction. A study in Pasikudah reports that from six in 1980s it had increased to 108 in 2002. It reported that out of 600 families in these villages 400 were involved in the lime industry and collectively they mined about 155 tonnes per day (Dhramaratnam and Kiruparajah, 2003). The mining was on a 6 km land from Pasikudah as the centre. These kilns are not in operation after the Tsunami.

3.1.3.2 Maritime

Ecosystems close to the sea are called the maritime ecosystems which include primarily the sea shore, sand dunes, mangroves, mud flats and salt marshes.

3.1.3.2.1 Sea Shore

Ecologically, ecotones or boundaries have always had higher biodiversity zones than either side. Sea shore becomes the boundary between land and ocean and varies extensively in morphology and structure and thus shares a great biodiversity within, which is able to tolerate the harshness and the vulnerability of the sea shore environment. The variation of the coast has been given in *Table 1*. Sea shores have large beaches in the east coast which are mostly sandy and white, but also has the pebble beach in places in Trincomalee (foul point) and the rich mineral sand black beach in Pulmoddai and mixture of these in Arugam bay.

8 km coast containing 6million tons of mineral sand contains 70-72% limonite, 8-10% Zircon, 8% rutite and 0.3 % Monazite(Dissanayake, 2000), which is one of the highest concentration of mineral sands in the world.

The form of the beach also varies which transforms into sand dunes in Pottuvil, forest in Ukande, rocky shore in Sankamankandi, Panama and Red rocks, Calcareous rocks in Konesapuri and cliffs in Trincomalee, Pulmoddai etc.

The coastal vegetation varies vastly in these habitats. Most of the beaches have *Spinifex*, and *Ipomoea* as creepers along the coast, that stabilizes the beaches. Tsunami completely removed them or covered them to regenerate only after about 4 months time. Shrubs include *Vitex negundo*, *Scaveola* species, *Pemphus* and *Clerodendron*. *Crinum zeylanica* was recorded in Oluvil and *Scaveola* sp. in Sangamankandi, both are rare species.

The large number of crustaceans shuttle in this zone surfing with waters. Small crabs, mollusks and large population of birds are found in this zone specially in flat coast where the tide reversals are seen (Trincomalee bay); cliffs have Gulls and Turns seen in Sangamankandi and Panama.

Sea Turtles are frequent visitors to these coasts for laying eggs. Vakara, Verugal areas have reported Sea Turtles. Komari area also has recorded Sea Turtles which also get trapped into the fishing nets and are drawn to coast. Out of the eight endangered species in the world Sri Lanka has recorded five species. The species distribution on the eastern coast is not well established.

Sea shore is not considered as an ecosystem by many, but it is. The stabilization of the sea shore is fundamental to prevent erosion, which the creeping plants do. The sea shore ecosystem is often damaged by the beaching of boats, spilling of oil and other pollution, dumping of wastes into the coastal waters etc. Removal of sand is a major issue that destabilizes the sea shore.

3.1.3.2.2 Sand dunes

Sand dunes are created by wind action on small grains of sand which are carried with wind and accumulate at points and the points grow, stabilized often by vegetation. Sand dunes are an ecosystem ignored and threatened in the global scene.



Fig 9: Sand dunes in Ampara District

Dunes are found in Manalkadu (near Point Pedro) in the North, Mannar, Putalam and along the East and the South East coast. A total of 7606 hectares are known of which 357 acres are in the East (LHI). Large coastal dunes are found near Pottuvil, Panama (shown in Figure) area in Ampara which are above 25 m in height and spread for many kilometers with a maximum width of about 500 m. They form sand towers near the coast. These are some of the tallest dunes close to the sea in the world; in fact these arise almost from the sea.

Species found in the sand dunes include *Syzygium* sp., *Azadirachta* sp., and *Calotropis gigantia*. The trees grow with the dune and are checked by the wind as seen clearly in the field. They are only about a meter higher than the sand dune, but if they are dug they would be as tall as the dune. They serve as hosts to a range of birds in this vicinity.

Tsunami had washed parts of the dune away in many places, specially in those that were destabilized by cutting of trees (Arugam bay). In places these have also had a funnelling effect where the water sped through the gaps between two dunes near Arugam bay. But the dunes have saved many villages that were covered from the coast (Green assessment, 2005).

Many areas have been found to be colonized by people and Coconut have been introduced in these areas. Dumping of wastes and removal of sand is seen in these places which make these susceptible ecosystem more vulnerable.

3.1.3.2.3 Salt Marshes

Salt marshes are those that are inundated with sea water/brackish water at sometime in history, and face a high extreme temperature which causes higher evaporation resulting in high salinity areas even to the point of salt deposition. Large areas are found in Batticaloa and Trincomalee. Very characteristic species thrive in these areas including *Salicornia*, *Arthrocnemum*, *Sueda* species, and *Portulaca* species which have xerophytic characteristics. They are found in Sathurukondan, Vakara, Trincomalee and Thambalagamum. Most of these have been converted to alternative uses and have become rare in the eastern coast. These species colonise a very hostile environment and make it productive and share a biodiversity that is unique. Tsunami waters had also entered areas of salt marshes, but the impact had been minimal.

The areas of salt marshes have been cleared for various uses in the past and during the conflict. This is an ecosystem that occupies a harsh environment and makes it productive. Destruction of these would lead to salt depositions and spray of such during the drier months with the wind into interior land salinising those too, inclusive of water bodies.

3.1.3.2.4 Mangroves

Mangroves is a specific ecosystem that thrive in the intertidal zone in bays, lagoons, and estuaries and are able to meet the harshness of the environment of saline soils, soft substratum, extreme temperatures etc. They fringe the lagoons and are known to be the hatcheries and nurseries of the lagoons. They are very productive and also fragile. 17 million hectares are found in the world and is reported that about 35% had been lost since 1980 with 2.1% being lost each year (Valiela et al 2001) emphasizes its vulnerability and importance, globally. 16-20 Families make this Mangrove species composition of about 50-75 species worldwide (Tomlinson, 1986).



Fig 10: Mangroves area

The extent of the mangroves are given in Table 8. The exact figures have been varying with different study. Recent Coastal Zone Management Plan(2003) indicates that the total mangroves in the country is less than 5000 hectares. It is reported that 39% had been lost 1986 and 2002. Nallarajah and Jayasingam(2001) find 321 hectares lost by 2001 which is only 16%, and relatively better than the national average.

East has between 28-40 percent of the mangroves in the country. The total number of species of mangroves is between 20-25 true mangroves and the equivalent amount of mangrove associates.

Eastern coast has about 17-19 species of the mangroves listed and as many associates. CZMP,2003 quotes 40 species with 25 true mangrove species. A details assessment of the discrepancies are given by Jayatissa et al., (2002).

The diversity is very high given the fact that the entire world has about 75 species and we have about 17 (23%) in an area of about 3000 hectares, insignificant percentage (3000/17 million).

Table 9: Mangrove area in Eastern Province

District	Mangrove Area, in hectares		
	CCD (1997)	Lanka Hydraulic Institute (1986)	CRMP (2003)
Trincomalee	1421	2043	<2000?
Batticaloa	1491	1303 (1525*)	<1200*?
Ampara	292	100	<100?
Subtotal for three project districts	3274	3446	?<3000
% of total	40%	28%	?
Total in Sri Lanka	8187	12189	<5000

* Nallarajah & Jayasingam (2001) state that 321 ha had been cleared by 2001.

Recent publications from Forest department, Batticaloa indicates the presence of *Xylocarpus* in Batticaloa which had been long missing. Species which are common are *Rhizophora*, *Brugueira*, *Lumnitzera*, *Avicinnia*, *Sonneratia* and *Excoecaria*. The mangrove fern *Achrosticum* and *Acanthus illicifolis* are also common. *Cerbera manghas* is a common associate in most places. *Dolichandron* is found in Mattakkali, Batticaloa.

Table 10: Size distribution of Mangrove patches in the eastern Coast

District	Area	Units	<5	<10	<20	<100	>100
Trincomalee	1489	147	101	14	18	11	3
Batticaloa	1421	210	150	31	11	20	
Ampara	292	36	24	7	1	4	
E-coast	3202	393	275	52	30	35	3

The size class of the mangroves in *Table 10*, indicate the shallowness of their sustainability. Most of the mangroves are in patches which are less than 5 hectares in extent, which probably borders lagoons and other waters. Only large patches of mangroves are in Trincomalee which exceeds 100 hectares in extent. Unless plans are provided to manage these the chances of these disappearing is high. Nallarasa and Jayasingam(2001) have reported that 301 hectares have been lost from Batticaloa over the past decade, which is about 16% and it is a serious concern.

Mangrove ecosystem is dynamic and rich, It has a very rich faunal component mostly of the arthropods. Fauna includes fin fish, shell fish, fiddler crabs, grapsid crab, portunid crab, Ocypodid crab, Shrimps (*Penaeus monodon*, *P.semisulcatus*), mud lobster, mud skipper etc. Also known are the Marsh crocodile(*Crocodylus palustris*) and mangrove snake (*Geochelone elegans*). 65 avifaunal species were recorded in Sathurkondan (Dharmaretnam et al , 1994), a mangrove marsh in Batticaloa. The author on 28th October 2005, had recorded 23 Painted Storks in Sathurukondan at about 11.30 a.m.

Tsunami has had a great impact on this ecosystem. The Tsunami had easily and preferably travelled into the lagoons and openings in the coast which have been the areas occupied by the mangroves. Mangroves have been physically damaged, at least the front lines in many places. Much more of the of the understorey and saplings have been affected. Considering this as a natural event of evolution we could expect it to revive itself. But unfortunately Mangroves were destroyed in many places prior to Tsunami by cutting it for firewood, security etc, on which was the impact of Tsunami. The Mangroves in protected areas too had been affected but to a lesser extent. Panama, Batticaloa, Nasivanthevu, Vakara, Mattakkali(Trinco), Kinniya, Mutur had been affected.

Mangroves have had no care taker in the system. Forest department or the coast conservation department does not take in charge of these if not with in their limits and thereby these had dwindled in extent. The

services they provide by protection of surges are only witnessed after Tsunami, but they continue to do these during floods and other surges. A fragile ecosystem whose loss would cause heavy on the lagoon productivity as these are the nutrition banks for them.

3.1.3.3 Littoral Vegetation

Littoral vegetation refers to another transition zone where the shrub line paves way to the tree line/forest. But these may not be evident in all places as one would transform to the other without really having a boundary. Littoral vegetation in the east coast is made of *Azadirachta*, *Anacadium occidentale*, *Borassus*, *Calotropis*, *Syzygium*, *Manilkara* etc. However when the human habitation reaches these areas these are replaced by home gardens and plantations of their choice and Coconut has become one of the more prominent tree crop in these zones. These serve as soil stabilizers and also as wind belts for the salt spray from the coast.

Most of the littoral vegetation were affected by the Tsunami, physically or physiologically. It was noted that most were removed or killed by salinity, immersed under the wave. However fascinating is the fate of the Palmyrah. The tree which stood the cyclone in 1978 in the East, completely lost face for Tsunami. Large trees, which stood erect dried up dead. We have no explanation to date. The only possible explanation is the vulnerability of the apical bud to salinity. Most of the Neem and mango trees which dried up, a percentage of them were able to regrow. Cashew which grew wild too was totally lost to Tsunami as they dried up, mostly.

3.1.3.3.1 Coastal Forests :

Forests are considered as climax vegetation of an environment. In another sense that connotes a stable environment. It is therefore not a type of vegetation that would be expected in an environment like a coast which is a transient environment. However forest are found in proximity of the coast either when sheltered by the dunes or by elevated from the coast by way of cliff. Various terminology is used for forests in the dry zone. The terminology used here is Open and sparse forest(similar to Thorn forest) , Dry zone evergreen monsoon forest, Moist monsoonal forest (Dry mixed evergreen forest) to keep up with the forest department classification. Typical dry zone forests, dry mixed evergreen forests, are found south of Panama, sheltered by the dunes. Though having the thorny species it is also rich with Palu, weera, satin, madan and kohomba(neem). These can be very close to the sea itself. Open areas where the grasslands are found have Phoenix in plenty. Riverine forests have Kumbuk in common. Ampara has a high percentage of riverine forests.

The moist forests are also found north of Trincomalee, 6th mile post as it is elevated in from the shore. Further north of Irakkakandy forests are found but this is more of the drier forest. The composition between these is more important as individual tree species of importance may be found in this vegetation, too. The area between the Verugal river and the Uppar is another area where large tracts of forests have been found. This is one of the best areas for honey collection in the East.

Sangamankandy and Kathraweli have a different type of Rock outcrop vegetation which has Ficus species in the prime vegetation.

These forests support a large sector of wildlife specially large mammals as Leopard, Bears, Elephants, Deer and Sambur.

Forests had less damage during the Tsunami, and in most cases the ground layer and shrubs were washed away.

These forests are under heavy threat at present, from illegal timber traders and those who are requesting land for further expansion.

3.1.3.3.2 Grasslands:

Coastal grasslands are those that pave the ground of the coastal lagoons and pods during the dry period and provide grazing ground to the cattle and wildlife. These are shallow waterholes that fill during the wet season and provide for various strata of animal population. Rich birdlife is found in these grasslands which

are seasonal water bodies. The dung of the grazing animals nourish the waters during the wet period and facilitate lush growth in the summer.

3.1.3.4 Coastal Water Bodies

3.1.3.4. 1 Coastal Lagoons:

These are perhaps the most striking and the most important of the ecosystems in the eastern coast which really link all together. There are about 47 identified in toto of which most are really seasonal and very small. Larger ones would be the major lagoons Batticaloa, Uppar, Panichernkerni, Karachi, Akkaraipattu etc. Important water bodies are cited in Table 12 as modified from the EPCCDP report.

The country has about 158,017 hectares of Brackish water bodies of which about 39,234 are in the east., which is about 25% of the country. Of the 41 wetlands described in the Asian Wetlands Directory 31 are coastal and east has 12 of which 9 are coastal which is 30% of the wetlands(National Environmental Atlas, 2005).

Table 11: Distribution of Saline and Brackish waters in the East Coast(extracted form the Forestry map of Sri Lanka)

District	Area(ha)	Units	<5	<10	<20	<50	<100	<500	>500
Trincomalee	9264	69	20	11	11	12	5	7	3
Batticaloa	18850	66	55	2	3	1			4
Ampara	1531	12	2	1	3	2	1	1	1
E-Coast	29645	147	77	14	17	15	6	8	8

Lagoons are water bodies that open seasonally or periodically to the sea and shows exchange of fresh and sea water and is brackish in nature and the levels of salinity varies with seasons and distance from the bar mouth, the opening if the lagoon.

A series of lagoons decorate the eastern coast from Kokilai in the North to Kumbukkan oya in the south. They are productive in terms of fish, shrimp and crab catch and also host a large biodiversity within and around them. Often their shores are lined with mangroves increasing the biodiversity. However colonization of people in the recent past has affected the shores in many ways and caused decline in the ecosystem, both in quantity and quality.

Lagoons have become part of the community in many places, that they are livelihood providers to large sector of fishermen in the community, they provide transport of persons and material, provide food (fish and shrimp), poles (mangroves) and unfortunately serve as dump yards too. They also play a role in the religious and cultural activities and also share leisure activities with the community. Most of the lagoons are under utilized except for the purpose of fishing which is stated to be over exploited in many places specially following the conflict which sets limits to fishing in the sea.

3.1.3.4.2 Estuaries:

Estuaries are the point/area where the running waters of the river or streams reach the sea. Often these areas show a mixing of water and as all other ecotones these are also productive and exhibit very fertile grounds for growth. Luxurious growths of riverine vegetation are seen in these areas and also mangroves in the vicinity of these estuary. Mahaweli, Heada oya, Gal oya and Yan oya estuaries show large riverine vegetation the most in the Ampara district. Some time the distinction between the lagoon and estuary is masked. Batticaloa estuary is claimed as a estuary as many rivers really shed their waters into this lagoon which then connects to sea to empty them. Many estuaries and lagoons are mixed in usage, Batticaloa lagoon is an 'estuary' by definition.

3.1.3.4.3 Marshes and Villus and Thonas

Fresh water marshes, tend to be associated to depressions, water holes which are seasonally filled during the rains and the ground is more clayey and does not drain the water easily. These share common species as reeds (*Typha* sp.), Lotus (*Nelumbo* sp.), lilies etc during the wet season. They become very important for birdlife as they often breed in these marshes. Periodic mixing of brackish water may make them saline in nature, slightly at times, but does not become salt marshes which are entirely different. These marshes exist side by side to mangroves in Batticaloa.

Villus are special marshes which are in the flood plains of the large rivers which are filled during the flooding of the river and sustain the water for long thereafter. Mahaweli river, Verugal aru (branch of mahaweli) form many villus close to their shores. They share a unique biodiversity and dynamics as a system.

Thonas are similar to the Villus but which get periodically inundated by the sea water which may be each year or in many years time. They have a specific combination of biodiversity and the marsh crocodile is a specific rarity. (Mathyventhan and Jayasingam 2003).

All of the wetlands and marshes had the same fate of being inundated by the Tsunami waters which made it more saline than usual. Further debris and waste ended up in these waters brought by the Tsunami and by people following Tsunami which had made these vulnerable, specially the shallow smaller wetlands. These serve as the water holes for the birds and animals during the dry season and the next season may have shortages. No study is known to look into this effects.

3.1.3.5 Coastal agriculture

Coastal agriculture includes the plantations of Coconut, Cashew, Casuarina, Palmyrah and the vegetable cultivation of Onions, Chillies, Brinjal and Beetles in the coast. Paddy cultivation is also practiced along the coast, in few places.

Plantations except Coconut were affected significantly by Tsunami. Casuarina had the next least. Cashew and Palmyrah suffered mostly.

These were affected by the Tsunami directly as the crops were damaged and also salinisation of the soils and water ground had prevented them from cultivating immediately. It took many monsoon rains for the leaching of the salinity.

Paddy too suffered when inundated with the saline water and sand deposits. Some of these impacts may have been reduced over time by the washing by the monsoonal rains of the following seasons.

Table 12: Important Coastal Ecosystems of Eastern Province¹

Sites (N-S)	Description / Importance / Status
Kokkilai Lagoon*	Northernmost lagoon spanning border with Northern Province
Palvakki Lagoon	Small lagoon with extensive mangroves
Periya Karachchi *	Small lagoon providing habitat for fish and other aquatic organisms, and resting areas for migratory birds
Sinna Karachchi*	Small lagoon providing habitat for fish and resting areas for migratory birds
Pirate's Cove	Coral reef area near Kuchchaveli and Podawakattu, reportedly exploited for aquarium fish collection; potential special area management (SAM) site
Pigeon Island	Terrestrial wildlife sanctuary; fringing coral reefs
Uppuveli (backwaters)	Brackishwater lagoon
Trincomalee Bay	diverse resources and high economic importance; potential special area management (SAM) site ²
Tambalagam Bay	Inner brackishwater lagoon of Trincomalee Bay
Ullackkalie Lagoon*	Medium-sized lagoon providing habitat for fish and resting areas for migratory birds
Panichankeni (Uppar) Lagoon*	Medium-sized lagoon providing habitat for fish and resting areas for migratory birds
Vandeloos Bay, Elephant Point, Thenadi Bay	Open coastal area; fringing coral reefs
Passikudah-Kalkudah Bay	Open coastal area; fringing coral reefs; potential tourism area; potential special area management (SAM) site
Batticaloa Lagoon *	Second largest brackishwater lagoon system in Sri Lanka; rich source of biodiversity with mangroves, seagrass beds, fisheries resources; proposed site for Special Area Management (SAM) ³
Periya Lagoon	Medium-sized lagoon providing habitat for fish and resting areas for migratory birds
Thandiadi Lagoon	Brackishwater lagoon
Komari Lagoon	Small lagoon providing habitat for fish and resting areas for migratory birds
Paladi-Pottuvil Lagoon	Small lagoon system providing habitat for fish and resting areas for migratory birds
Arugam Lagoon*	Small lagoon providing habitat for fish and resting areas for migratory birds; empties into Arugam Bay
Arugam Bay	Embayment; potential special area management (SAM) site; wide sand beach and nearshore coral reefs; area utilized for tourism
Pottuvil-Panama Dunes	Coastal sand dunes; potential special area management (SAM) site
Panama Lagoon	Small lagoon providing habitat for fish and resting areas for migratory birds
Kunukala Lagoon	Brackishwater lagoon
Helawe Lagoon	Small lagoon providing important habitat for migratory birds
Okanda Lagoon	Small lagoon providing habitat for fish and resting areas for migratory birds
Bagura Lagoon	Small lagoon providing habitat for fish and resting areas for migratory birds
Yakkala Lagoon	Small lagoon providing habitat for fish and resting areas for migratory birds
Kumana Villu	Mangrove and wetland area of botanical interest in Yala East National Park, providing habitat for birds and wildlife

¹ Adapted from information in Samarakoon (March 2000).

² As described in CZMP 1997

³ In CZMP 1997

- * Listed in the most important 41 lagoons in the Asian wetland directory
- Further wetlands have been described in the national wetland directory (2007)
- Adopted from EPCEDP document

4 UNIQUE AND INTERNATIONAL IMPORTANT ECOSYSTEMS

4.1 Introduction

Biodiversity is considered at different levels in terms of ecosystem biodiversity, species biodiversity and genetic biodiversity. Some is so obvious that they could be readily recognized but others may not be so, like different varieties or breeds. However the importance in terms of biodiversity also varies depending on the rarity, uniqueness and also representativeness which varies between different considerations. For example, MAB programme would be more inclined to consider representativeness rather than the uniqueness of the habitat. Therefore it is important for us to take stock of our diversity under different headings. It is however unfortunate that there is limited information on the details of the biodiversity and their distribution unlike in reference to eastern province in some other province, which is a major drawback.



Fig 11: Pigeon Island, Shallow reefs in Pool

Sri Lanka is a hot spot in the world in relation to Biodiversity, mostly due to the significance of the Tropical Rain forests, which accommodates many rare and endemic species. But the richness of the east lies in the interwoven ecosystems creating a mace of biodiversity, extensive and unique in its own value. This is more so true of the coastal ecosystem which has a interwoven system of lagoons from Kokkilai to Kumbukkan oya, 420 km in length in toto, providing a blend of the ecosystems described earlier. The significance of the East in terms of diversity and their significance Nationally and Globally are given below.

4.1.1 Global and National significance

Globally about 50% of the population are found closer to the coast, which as a result threatens the costal ecosystems. Tropical islands usually have a higher biodiversity due to geological and geographical isolation. Sri Lanka is an Island of 65000 sq km, in the Indian ocean with no land mass to its south, thus has a high biodiversity. It also has a coast line of about 1750 km including lagoons and estuaries and most of them are in good conditions. Eastern province has 420 km of coast (25%) of the country and also a high diversity which has been affected by the recent Tsunami in 2004.

The coastal belt of Eastern coast with 420km in length and 2 km in width, making 800 km². The mosaic of the inter twined ecosystems increase the diversity in toto. 25% of the country's coast is in the east. Though

relatively insignificant in terms of extent, the number of ecosystems are significant, given the size of the coast, practically all the tropical ecosystems.

Sea Grasses

They are very productive ecosystems in shallow seas and lagoons in the world. The world has 12 genera and 50 species of which 7 genera are in the tropics. 6 Genera and 12 species found in the Sri Lanka of which 5 genera and 8 species are found in the east. This amounts to 60% of the country's species diversity and 80% generic diversity (5/6) in the east. This also amounts to 25% of the global diversity (12/50) in an insignificant size of coast, which is 40% Generic diversity of the globe (5/12)

Reefs

Coral reefs have been very significant in the east specially as those that were not affected by the El nino, at Pigeon Island. But a considerable fraction was affected by the Tsunami and the debris that accumulated in the coast thereafter.

Salt Marshes

They are very productive ecosystems and support large number of bird population. Special flora are found here with *Arthrocnemum*, *Salicornia*, *Sueda*, *Cynodon* species. Saltmarsh ecosystem studied in Mannar had recorded 56 species which is high diversity. 3724 hectares of salt marshes are in the east which is 16% of the country's (23819 hectares) diversity. This also supports a large bird population and is also a threatened/ endangered ecosystem of the world.

Sand dunes

They are found across the globe. The Sand dunes found at Pottuvil is less in extent but has a height of 25-30 m and perhaps one of the largest in the world rising as a wall on the coastal waters. Panama dunes are extensive but less in height 15-20m. 357 hectares of dunes are in the Eastern province which is 5% of the country (7606 ha). These dunes have protected the villages adjacent to it during the Tsunami in 2004. This is also an endangered ecosystem of the world, grossly neglected.

Beaches

Beaches in the Eastern coast are wide and mostly sandy and white. Black mineral sands are found at Pulmoddai and Pottuvil and other sites along the coast. Pulmoddai has one of the richest mineral soils in the world. A 8 km coast (north of Trincomalee) is known to have 6 million tons of mineral sand containing 70-72 % limonite, 8-10% zircon, 8% rutite and 0.3% monazite. (Dissanayake, 2000). Mineral sands of less concentration are found in Pottuvil.

The Beach is also known to provide nesting for sea turtles which are endangered. Sea Turtles are found to nest in these coasts at Pottuvil, Kumana, Vakarai etc. Out of the 8 species in the world 5 are found to nest in Sri Lanka. The exact species and distribution in the east is not known. But the citing are significant.

Mangroves

They are very productive, fragile and diverse ecosystem and threatened in the world. 17 million hectares are in the world at present of which 35% had been lost since 1980 at the rate of loss of 2.1% per year. (Valielael, 2000.). They are made of 16-20 Families with 50-75 specialised plant species (Tomlinson, 1986).

Sri Lanka has around 7000 hectares (CRMP, 2004) of which the Eastern province has about 3659 hectares (NEP Statistical information 2005). Sri Lanka has 20-25 species of true mangroves and 20-30 associates. East has about 17 true mangroves and 13 associate species. East has about 50% of the country's mangroves in extent and 65 % (17/25-29) of species diversity. 33% (17/50) of global species diversity is found in the a negligible area (3659/17million hectares) in the east coast.

Coastal Lagoons/ Estuaries

These are significant ecosystems that harbour the mangroves in their shores; host a variety of species of shrimp, fish etc as biodiversity; share sea grass beds and also provides a habit for a range of Phytoplanktons

and zooplanktons. East has 39,234 hectares of the country's 158,017 hectares in 29 major lagoons/estuaries along its coastline.

Brackish water system

25% of the country's brackish water system is found in the east. Of the 41 wetlands described in the Asian Wetlands Directory (31 are coastal) from Sri Lanka, 12 are in the East of which nine are in the Eastern Coast. These serve as roosting and breeding sites for the birds. Kumana is considered as one of the most important sites for Bird life nationally and internationally. Thenady Bay, North of Batticaloa has been recommended by the Ceylon Bird Club to be declared as a sanctuary. These support a Large range of Migratory birds as the southern end of the landmass. The avifauna arrive from various countries in the western, Eastern and Andaman routes (Phillips). These are also the breeding site for many bird species as Pelican. Many globally important birds are found to nest in these marshes.

Marsh crocodile is found in these lagoons, which is a threatened species. Mahaweli floodplains which runs into Trincomalee recorded 250 species of residents and 75 migrants. It also supports Larger mammals population, some endangered. Most of the endangered mammals of the country are present in this zone in the east.

Birds:

450 species of birds have been listed with 110 migrant species in the country. Large numbers of migrants and residents have been found in the east. 65 species were recorded in Batticaloa (Sathurukondan), 1995, among them 12 were migratory and among the residents 24.5% were endemic (Dharmaretnam); 57 species were recorded in 2001 in the eastern coast mostly south of Ampara in two days indicating the high diversity.

Records indicate rare and important migrant species in the past included flamingos, spoon bills, Black neck stork, Blackwing stilt, Pelicans, Painted Storks etc.

Mammals:

The east also support Larger animals at water holes, feeder ground etc. which includes Leopard, Bear, Elephant, Deer, Sambar etc.

Forests:

The East has 57% of its area covered with Natural vegetation compared to the 28% of the country. Most of the Forests are Monsoonal Semi-evergreen Forests with *Drypetes sepiaria*, *Chloroxylon switenia* and *Manilkara hexanadra* as the dominant species, which are becoming rare. These forests extend close to the coast and provide space for movement of larger animals.

Large portion of the country's dry zone forests are found along the east coast. Many large timber species are fast becoming rare.

These forests are also threatened by development and fragmentation. They house large population of wildlife. Many protected areas are found in the east and though all of them are not in the coast they are linked to the coastal forests. More than 2000 number of elephants are found in the East including the Mahaweli basins.

Biodiversity

a) Endemicity and rarity

- 24 species of endemic plants are found in the east and of which one is extinct, 7 are threatened and 8 are highly threatened.
- Sri Lanka has 3368 species of angiosperms with about 890 endemics (27%), but most of the diversity is in the wet zone with the moist low country having 60% and Montane zone having 50% endemics. Dry Zone (East) has only 10% endemics.
- Though not endemic the dry zone has vast numbers of timber species and medicinal plants which are becoming rare at present.

Endemics are prestige as it is only found in this country. The threaten status suggests its vulnerability of becoming extinct if not cared for. 228 endemics and 252 non endemics are threatened. 25 species of endemics is found in the east and is high, as the dry zone has low numbers of endemics (10.4%) unlike the wet zone (50%)

Endemic plants are of global importance for biodiversity. Threatened endemics become very important globally, if it is lost it has no replacement.

Monsoonal forests are threatened in the globe. Sri Lankan Monsoon forests are considered as a Biogeographic province by Udwardy (1975)

b. Crop wild relatives:

These are species which are wild species whose relative is a crop plant.

65 species of crop wild relative are found in the east. These are only from preliminary investigations and the numbers are expected to increase significantly. (The East has not totally been surveyed and these numbers are expected to rise significantly)

This provides for better genetic diversity and evolution over time. Cross Breeding may provide for better characters.

Globally this is important as it represents a gene pool which could potentially be used for improvement of economic crops.

c. Threatened species

Number of species of birds, Reptiles and mammals are given as 10, 9, 11 species respectively.

These constitute major proportion of the threatened species of the entire dry zone which is more than 60% of the country.

The Globally threatened species and Nationally threatened species are important.

d. Whales and Dolphins:

Coastal waters are known to have a large score of Dolphins and Whales mostly cited off Trincomalee. More than 28 species existing our coastal waters.

Important for biodiversity and for ecotourism development. Plan for a floating hotel was made in the 1970s as the sighting was frequent and in plenty.

Many threatened species are found in these waters.

e. Singing fish of Batticaloa

Records have indicated this as true verified by national and international scientists. However the reason still is being debated or not confirmed. This is very characteristics of Batticaloa as it is called “ the land of the singing fish”. Such rare phenomena are globally interesting.

Singing fish of Batticaloa lagoon is legendary, where on Full moon nights people have heard melodies over decades. Verifications have not finalised the issue, but various options have been highlighted or suggested from investigations. This is a potentially interesting phenomena as Batticaloa is termed as the ‘land of the singing fish’.

The Singing Fish of Batticaloa Jonclas also dived into the waters of lady manning drive, from the third span. When summing up his conclusion , Jonclas was of the opinion that the croaks were uttered by one kind of fish or more for example the catfish or the silver bream of the tiger fish all found in the deep at or near the bed of the lagoon. The other more pleasant sound he thought, were produced by nocturnal glass fishes(ambassis) which were in evidence at the level in which we heard them. A few years later a Japanese team of experts who made some investigation in 1961 identified the fish as *GUCHI*, the Japanese name for this variety of fish common in their waters. The embassy later gave the name as white croker, *Argyrosomus argentatus*

SVO Somanader 1967

f. Medicinal Plants :

The dry zone as in the Eastern Coastal belt has a large number of species which are used as source for herbal medicines. Recently large removals of these plants for export as well as for sale has threatened these species which are neither endemic nor threatened otherwise.

Destruction of ecosystem by over collection has caused concern.

The loss of potential biological resources which may be utilised in the search of new drugs in future. The unplanned large collections could make them a 'threatened' category from 'abundant' in a few years.

g. Invasive Species:

Many invasive species which have invaded our ecosystems and are causing reduction of biodiversity.

eg: Salvinia Water hyacinth

Parthenium Carp

Ipil ipil

This had caused loss of species in many places and found to alter ecosystems. The ecosystem and species diversity, the latter more specifically has caused concern.

Loss of biodiversity as a whole is a serious concern. In fact many international agencies are at present concerned with controlling invasive species.

World Heritage site/MAB sites

The province does not have a world heritage site. But it encompasses an International Man and Biosphere reserve Hurulu Forest (along A6 near Habarana) which is a significant site for the Monsoon forests of the world.

International important wetlands

41 International important wetlands have been recognized in the country and 12 of them are in the east which makes 22% of the total.

Coral reef

Coral reef is a recognized and a globally endangered ecosystem. East is rich in its coral reefs spreading from Trincomalee to Akkaraipattu in the south. This has facilitated ornamental fish divers and sea cucumber collectors to be focused in this province.

The coral reef in the Nilaveli area (Pigeon Island) which is also a National Park at present were some of the few which were not affected by the El nino bleaching a few years ago in the asian region.

Swamps-villus and thonas

Fresh water marshes are limited in the province However two specilised eco systems. Villus and Thonas are found along the flood plains and the coast respectively.

Villus are wetlands in the flood plains which retain water long after the river dries/receeds and forms a prominent source of water for wildlife during this period. The vegetation is succulent and different from the neighbourhood and harbours/attracts a large population of birdlife and elephants in particular. Mahaweli flood plains have some of the best villus in the country.

Thonas are marshes close to the coast which had been associated with the incoming sea water in the past but separated from it at present and continues as a partly 'saline' marsh mostly maintained by the perhaps evaporation and sea sprays and thus does have a unique vegetation on its own. These are very common in the east mostly in Ampara and Batticaloa districts.(Mathyventhan and jayasingam)

Managed ecosystems (Man made ecosystems)

Managed ecosystems are the man made ecosystems that have been managed, some over centuries. Paddy field are the best examples of such which is extensive in the east and is also associated with a rich irrigation history. Plantations of coconut had a bright history of the past where most of the Ampara and Batticaloa coast had extensive estates which gave way to the increasing populations demand for housing and other needs.. The remaining was taken by the cyclone in 1978 which uprooted or damages almost 80% of the coconut . The ecosystem has not reached that extent yet, owing to the conflict in the area.

Teak was also a major and one of the best plantations in the country near Pullumaali which again was totally lost in 1978, never to be started again. Plantations of Bamboo and teak along the Oddamawadi-Welikande road also had not been able to survive their impacts of the conflict. The Teak resprouts each year to be cut/burnt again. The Bamboo is not seen now at all.

Road sides

Road sides are dominated by the weeds of the dry zone mostly, Sida sp is one of the predominant one with Tephrosia sp. However Pennisetum and Panicum maximum had found their ways to areas in Trincomalee Batticaloa and Ampara. Another one which is spreading in Trincomalee is Parthenium though not very common is found along road sides.

Large Rain trees were landmarks of many towns specially in the east, which had been lost during the expansion of road ways and also cut for security. Most popular trees of the road side plantations are Samanea saman (vakai, mara gas), Ficus, Nauclea(vammi). Recent plantations have Sterculia (kaatu thengai) and Terminalia (marutham, kumbuk) by the road sides.

5 DIVERSITY AND CONSERVATION

5.1 Floral Biodiversity :

Sri Lanka has 3368 species of which 890 are endemic(27%), but most of the diversity is in the wet zone; the moist low country having 60% and the montane zone having 50% endemics. Dry zone where the entire Eastern province is located has only about 10% endemics. However the region has vast number of timber species, medicinal plants and other economic plants which are all threatened by the expansion of habitation. The monsoonal forest ecosystem (Udwardy , 1975) which is the predominant vegetation type itself is globally threatened as an ecosystem. It is recorded that 228 endemics as well as 258 non endemics are threatened in the country showing the pressure on the biodiversity.

The east coast has about 25 endemics as listed in Table 12. The Crop wild relatives and their place of occurrence are given in the table.

Table 13: Crop wild relatives –List in the Eastern Province

1	Amaranthaceae	1	<i>Amaranthus spinosus</i>	Trincomalee
1	Amaranthaceae	2	<i>Aerva lanata</i>	Kantalai
1	Amaranthaceae	2	<i>Aerva lanata</i>	Mutur
1	Amaranthaceae	2	<i>Aerva lanata</i>	Nilaveli
1	Amaranthaceae	3	<i>Allmania nodiflora</i>	Nilaveli
1	Amaranthaceae	3	<i>Allmania nodiflora</i>	Kantalai
1	Amaranthaceae	3	<i>Allmania nodiflora</i>	Batticaloa
1	Amaranthaceae	4	<i>Celosia argentea</i>	Kantalai
1	Amaranthaceae	4	<i>Celosia argentea</i>	Trincomalee
2	Annonaceae	5	<i>Polyalthea korinti</i>	Inginiyagala
2	Annonaceae	5	<i>Polyalthea korinti</i>	Trincomalee
2	Annonaceae	5	<i>Polyalthea korinti</i>	Kantalai
2	Annonaceae	5	<i>Polyalthea korinti</i>	Panama
3	Anacardiaceae	6	<i>Semecarpus nigroviridis</i>	Batticaloa
3	Anacardiaceae	7	<i>Mangifera zeylanica</i>	Inginiyagala
3	Anacardiaceae	7	<i>Mangifera zeylanica</i>	Kalkudah
4	Apocynaceae	8	<i>Carissa spinarum</i>	Batticaloe
5	Clusiaceae	9	<i>G. spicta</i>	Ampara
5	Clusiaceae	9	<i>G. spicta</i>	Kalkudah
5	Clusiaceae	9	<i>G. spicta</i>	Lahugala
6	Convolvulaceae	10	<i>I.pescaprea</i>	Kalkudah
6	Convolvulaceae	10	<i>I.pescaprea</i>	Trincomalee
6	Convolvulaceae	11	<i>I. pestigris</i>	Kantalai
6	Convolvulaceae	11	<i>I. pestigris</i>	Chenkaladi
6	Convolvulaceae	12	<i>I.sepiaria</i>	Chenkaladi
6	Convolvulaceae	12	<i>I.sepiaria</i>	Baticaloe
7	Cucurbitaceae	13	<i>Coccinia grandis</i>	Kerativu
7	Cucurbitaceae	14	<i>M.madaraspatana</i>	Siyambalanduwa
7	Cucurbitaceae	14	<i>M.madaraspatana</i>	Niliveli
7	Cucurbitaceae	15	<i>M. dioica</i>	Westminster Abbey
8	Dioscoreaceae	16	<i>D. oppositifolia</i>	Westminster Abbey
8	Dioscoreaceae	16	<i>D. oppositifolia</i>	Batticaloa
8	Dioscoreaceae	17	<i>D. tomentosa</i>	Kantalai
9	Euphorbiaceae	18	<i>Drypetes sepiaria</i>	Inginiyagala
9	Euphorbiaceae	19	<i>Phyllanthus amarus</i>	Uppuveli
9	Euphorbiaceae	20	<i>P.polyphyllus</i>	Kantalai

9	Euphorbiaceae	20	<i>P.polyphyllus</i>	Pottuvil
9	Euphorbiaceae	20	<i>P.polyphyllus</i>	Batticaloe
9	Euphorbiaceae	21	<i>P.reticulates</i>	Kumana
9	Euphorbiaceae	21	<i>P.reticulates</i>	Valachchanai
9	Euphorbiaceae	22	<i>P. rotundifolius</i>	Batticaloe
9	Euphorbiaceae	22	<i>P. rotundifolius</i>	Pottuvil
9	Euphorbiaceae	22	<i>P. rotundifolius</i>	Panama
9	Euphorbiaceae	22	<i>P. rotundifolius</i>	Kumana
9	Euphorbiaceae	22	<i>P. rotundifolius</i>	Mutur
9	Euphorbiaceae	23	<i>P. simplex</i>	Nilaveli
9	Euphorbiaceae	24	<i>P. urinaria</i>	Kalkudah
9	Euphorbiaceae	24	<i>P. urinaria</i>	Batticaloa
10	Fabaceae	25	<i>Cassia occidentalis</i>	Trincomalee
10	Fabaceae	26	<i>C.rosea</i>	Pottuvil
10	Fabaceae	26	<i>C.rosea</i>	Arugam Bay
10	Fabaceae	26	<i>C.rosea</i>	Batticaloe
10	Fabaceae	26	<i>C.rosea</i>	Mankeni
10	Fabaceae	27	<i>C. cathartica</i>	chenkaladi
10	Fabaceae	28	<i>Cynometra iripa</i>	Trincomalee
10	Fabaceae	29	<i>C. zeylanica</i>	Uraniya
10	Fabaceae	29	<i>C. zeylanica</i>	Nilgala
10	Fabaceae	30	<i>Dolichos trilobus</i>	Kalkudah
10	Fabaceae	31	<i>S. sericea</i>	Pankulam
10	Fabaceae	32	<i>Vigna marina</i>	Pottuvil
10	Fabaceae	33	<i>V.triobata</i>	Arugam Bay
10	Fabaceae	33	<i>V.triobata</i>	Kalkudah
10	Fabaceae	33	<i>V.triobata</i>	Batticaloe
10	Fabaceae	34	<i>V. aradicola</i>	Ampara
10	Fabaceae	34	<i>V. aradicola</i>	Batticaloe
11	Lamiaceae	35	<i>Leucas zeylanica</i>	Kalkudah
12	Malvaceae	36	<i>Hibiscus eriocarpus</i>	Arugam Bay
12	Malvaceae	36	<i>Hibiscus eriocarpus</i>	Kantalai
12	Malvaceae	36	<i>Hibiscus eriocarpus</i>	Ampara
12	Malvaceae	37	<i>Hibiscus furcatus</i>	Wadinagala
12	Malvaceae	38	<i>Hibiscus lobatus</i>	Mutur
12	Malvaceae	39	<i>H.tiliaceus</i>	Batticaloa
12	Malvaceae	39	<i>H.tiliaceus</i>	Trincomalee
13	Marcileaceae	40	<i>Marcilea quadrifolia</i>	Mutur
14	Moraceae	41	<i>Ficus amplissima</i>	Kantalai
14	Moraceae	42	<i>Ficus arnotiana</i>	Arugam Bay
14	Moraceae	43	<i>Ficus benghalensis var.benghalensis</i>	Batticaloa
14	Moraceae	44	<i>F.microcarpa</i>	Periyakulam
14	Moraceae	45	<i>F.mollis</i>	Arugam Bay
15	Nyctaginaceae	46	<i>Boerhavia diffusa</i>	Batticaloa
16	Pandanceae	47	<i>P. odoratissimus</i>	Kalkudah
16	Pandanceae	48	<i>Sesamum prostratum</i>	Panama
17	Poaceae	49	<i>Oryza elchingeri</i>	Siyambalanduwa
17	Poaceae	49	<i>Oryza elchingeri</i>	Kuchchaveli
17	Poaceae	50	<i>O. rufipogon</i>	Trincomalee
17	Poaceae	50	<i>O. rufipogon</i>	Batticaloa
17	Poaceae	51	<i>P.repens</i>	Batticaloa
17	Poaceae	51	<i>P.repens</i>	Trincomalee

17	Poaceae	51	<i>P.repens</i>	Inginiyagala
17	Poaceae	52	<i>Paspalum distichum</i>	Trincomalee
17	Poaceae	52	<i>Paspalum distichum</i>	Potana Oya
17	Poaceae	53	<i>S. spontaneum</i>	Pottuvil
17	Poaceae	53	<i>S. spontaneum</i>	Inginiyagala
17	Poaceae	54	<i>Brachiaria distachya</i>	Batticaloa
17	Poaceae	55	<i>B.remota var.lanceolata</i>	Trincomalee
17	Poaceae	56	<i>B.raptans</i>	Trincomalee
17	Poaceae	56	<i>B.raptans</i>	Batticaloa
17	Poaceae	56	<i>B.raptans</i>	Kantalai
17	Poaceae	57	<i>D.bicornis</i>	Kantalai
17	Poaceae	57	<i>D.bicornis</i>	Inginiyagala
17	Poaceae	57	<i>D.bicornis</i>	Trincomalee
17	Poaceae	58	<i>D. ciliaris</i>	Siyambalanduwa
17	Poaceae	58	<i>D. ciliaris</i>	Trincomalee
17	Poaceae	58	<i>D. ciliaris</i>	Amparai
17	Poaceae	58	<i>D. ciliaris</i>	Inginiyagala
17	Poaceae	59	<i>D.longiflora</i>	Kantalai
17	Poaceae	60	<i>Echinochloa stagnina</i>	Trincomalee
17	Poaceae	60	<i>Echinochloa stagnina</i>	Amparai
17	Poaceae	61	<i>E.ciliaris</i>	Kalmunai
17	Poaceae	62	<i>E.gangetica</i>	Senanayaka
				Samudraya
				Sanctuary
17	Poaceae	62	<i>E.gangetica</i>	Inginiyagala
17	Poaceae	62	<i>E.gangetica</i>	Batticaloa
17	Poaceae	63	<i>E.japonica</i>	Batticaloa
17	Poaceae	63	<i>E.japonica</i>	Pankulam
17	Poaceae	63	<i>E.japonica</i>	Kantalai
17	Poaceae	63	<i>E.japonica</i>	Trincomalee
17	Poaceae	64	<i>E.nutans</i>	Valachchenai
17	Poaceae	64	<i>E.nutans</i>	Trincomalee
17	Poaceae	65	<i>E.riparia</i>	Pottuvil
17	Poaceae	66	<i>E.unioides</i>	Valachchenai
17	Poaceae	67	<i>E.viscosa</i>	Kantalai
17	Poaceae	67	<i>E.viscosa</i>	Kalkudah
17	Poaceae	67	<i>E.viscosa</i>	Trincomalee
17	Poaceae	67	<i>E.viscosa</i>	Batticaloa
18	Rubiaceae	68	<i>Murraya gleniei</i>	Trincomalee
18	Rubiaceae	68	<i>Murraya gleniei</i>	Mutur
19	Sapindaceae	69	<i>Glenia unijuga</i>	Trincomalee
19	Sapindaceae	69	<i>Glenia unijuga</i>	Batticaloa
20	Sapotaceae	70	<i>Manilkara hexandra</i>	Valachchenai
20	Sapotaceae	70	<i>Manilkara hexandra</i>	Pottuvil
20	Sapotaceae	70	<i>Manilkara hexandra</i>	Panama
21	Solanaceae	71	<i>S.trolobatum</i>	Pottuvil
22	Vitaceae	72	<i>Cayratia pedata</i>	Trincomalee
22	Vitaceae	73	<i>C.quadrangularis</i>	Batticaloa
22	Vitaceae	74	<i>C.vitiginea</i>	Kalkudah
22	Vitaceae	74	<i>C.vitiginea</i>	Ampara
22	Vitaceae	74	<i>C.vitiginea</i>	Panama
22	Vitaceae	74	<i>C.vitiginea</i>	Trincomalee

Table 14: The endemic plants of the eastern province and their status

	Family	Scientific Name	Conservation Status
1	Acanthaceae	<i>Brillantaisia thwaitesii</i>	
2	Anacardiaceae	<i>Camptosperma zeylanicum</i>	
3	Anacardiaceae	<i>Mangifera pseudoindica</i>	Extinct
4	Anacardiaceae	<i>Mangifera zeylanica</i>	TR- Threatened
5	Anacardiaceae	<i>Semecarpus nigro-viridis</i>	TR- Threatened
6	Araceae	<i>Cryptocoryne nevillii</i>	HT- Highly threatened
7	Clusiaceae	<i>Calophyllum calaba</i>	TR- Threatened
8	Cyperaceae	<i>Scleria multilacunosa</i>	HT ** - Not recorded after 1900
9	Ebenaceae	<i>Diospyros nummularifolia</i>	HT- Highly threatened
10	Eriocaulaceae	<i>Eriocaulon thysanoccephalum</i>	
11	Euphorbiaceae	<i>Eriocaulon walkeri</i>	HT- Highly threatened
12	Euphorbiaceae	<i>Mallotus eriocarpus</i>	
13	Fabaceae	<i>Sophora violacea</i>	
14	Lamiaceae	<i>Anisochilus velutinus</i>	
15	Orchidaceae	<i>Habenaria dichopetala</i>	TR- Threatened
16	Orchidaceae	<i>Thrixspermum pugionifolium</i>	TR- Threatened
17	Rubiaceae	<i>Gardenia fosbergii</i>	
18	Rutaceae	<i>Murraya gleniei</i>	
19	Rutaceae	<i>Zanthoxylum caudatum</i>	HT- Highly threatened
20	Sapindaceae	<i>Dimocarpus gardneri</i>	HT- Highly threatened
21	Sapindaceae	<i>Allophylus zeylanicus</i>	TR- Threatened
22	Sapindaceae	<i>Gleniea unjuga</i>	TR- Threatened
23	Tiliaceae	<i>Triumfetta glabra</i>	HT- Highly threatened
24	Viscaceae	<i>Notothixos floccosus</i>	HT- Highly threatened
25	Dipterocarpaceae	<i>Vatica obscura</i>	HT- Last recorded in Trincomalee

5.2 Faunal biodiversity

The extensive lands of the East provides a habit for large mammals in numbers, which is further facilitated by the large number of protected areas. Large mammals mostly include Elephants, deer, leopard, bear and sambhur. The lagoon systems provide a habitat for variety of reptiles, crustaceans and fish species and these populations this in turn attracts/justifies a large number of bird species, residents and migrants alike.

Table 15 gives the Threatened species in the Eastern province from the IUCN lists of threatened species. This is significantly high for the sector of the dry zone.

Table 15: Eastern Coast- Threatened species recorded in the coastal Habitats (National List, IUCN 1999; Global List, IUCN, 2004)

Common name	Name	Status	Habitat
Reptiles			
Marsh Crocodile	<i>Crocodylus palustris</i>	NT,GT	Mangrove, Marsh
Salt watercrocodile	<i>Crocodylus porosus</i>	NT	Mangrove, marsh, esturies
Softshelled Terrapin	<i>Lissemys punctuata</i>	NT	Marshes, villus
Hard shelled terrapin	<i>Melanochelys trijuga</i>	NT	Marshges, mangroves, swamps, villus
Star tortoise	<i>Geochelone elegans</i>	NT	Scrbland

GreenTurtle	<i>Chelonia mydas</i>	GT	Beach
Oliveridley	<i>Lepidochelys olivaceae</i>	GT	Beach,coralreefs
SandBoa	<i>Eryx Conicus</i>	NT	Sanddunes
IndianPython	<i>Python molurus</i>	NT	Mangrove swamp,Coastalforests

Birds

Black neck stork	<i>Ephippiorrhynchus asiaticus</i>	NT	Marsh, Mangroves
Spot Billied Pelican	<i>Pelicanus Phillipensis</i>	GT,NT	Marshes, Lagoons, Esturies
Oriental darter	<i>Anhinga melanogaster</i>	NT	Esturies, Lagoons
Lesser Adjutant Stork	<i>Leptoptilus javanicus</i>	NT, GT	Marshes, mangroves
Great Stone Plover	<i>Esacus recurvirostris</i>	NT	Salt Marsh, Tank beds, sand dunes
Yellow Wattled lapwing	<i>Vanellus malabaricus</i>	NT	Salt Marshes, tank beds
Spoon Billied Sand piper	<i>Eurynorrhynchus pygeus</i>	GT	Marshes, Mud flats
Grey Headed fish eagle	<i>Ichhyophaga ichthyaetus</i>	NT	Marshes, mangrove
Painted Stork	<i>Mycteria leucocephala</i>	NT	Marshes, Mangroves
Black-headed Ibis	<i>Threskiornis melanocephalus</i>	NT	Marshes, mangroves, Mud flats

Mammals

Elephant	<i>Elephas maximus</i>	NT,GT	Villus, Coastal Scrubland, Marshes
Fishing Cat	<i>Prionailurus viverrinus</i>	NT,GT	Villus, Marshes, Mangrove
Eurasian Otter	<i>Lutra lutra</i>	NT	Villus, Marshes, Mangroves
Rusty spotted Cat	<i>Felis rubiginosa</i>	NT	Coastal Forest/scrubland
Toque macaque	<i>Macaca sinica</i>	GT	Coastal Scrubland,Forest
Grissled Giant Squirrel	<i>Ratufa macroura</i>	GT	Coastal scrubland, forest
Pangolin	<i>Manis crassicaudata</i>	NT	
Common or Hanuman Langur	<i>Semnopithecus entellus</i>	NT	Coastal forest, Scrubland
Sloth Bear	<i>Melursus ursinus</i>	NT	Coastal forest, scrubland
Leopard	<i>Panthera pardus</i>	GT,NT	Coastal forest, Scrubland
Dugong	<i>Dugong Dugon</i>	NT	Sea

- Many species of Dolphins and Whales are also recorded in the Eastern Coast

Eastern coastal waters too have been known for large scores of Dolphins and Whales often cited off Trincomalee. 28 species have been cited in Sri Lankan waters, the exact numbers and species in the Eastern coast is not determined, but the frequent citing of Blue whale has been recorded. The recent conflict and the associated sea battles also would be a deterrent for these species and for the science of it.

Birds

Large number of migratory birds move to these areas during winter/rainy seasons from Europe. They not only visit the protected areas but areas of noted significance Sathurukondan, Rugam tank, Rottai tank, Thandiyadi etc. which have shown high diversity of Birds. Study of Sathurukondan in 1995 had recorded 65 species among which 12 were migrants and of the residents 25% were endemics. (Dhramaretnam et al) . 57 Species were recorded in Ampara in two days alone. Records indicate rare and important migrant species in the east including Black neck stork, Flamingos, Spoon Bills, Blackwing stilt, Painted Stalks etc. Many birds are known to also have breeding sites in this region e.g Kumana, Sathurukondan, Kokkilai etc.

Mangrove fauna

In the lagoon in addition to the mangrove flora, fauna we have the shell fish, fin fish. *Penaeus monodon*, *P. semisulcatus*, *P. indicus*, *Saccostrea cuculata*, *Crassostrea madrasensis*, *Tilapia* sp, *Mystus* sp, *Aerius* sp, *Tachysurus* sp, *Leognathus* sp, *Etroplus* sp, grapsid crab (*Neoserratium malbaricum*), Ocypodid crabs (*Macrophthalmus depressus* and fiddler crabs), Portunid crabs (*Scylla serrata*) etc found among the catch of the fishermen. At Paalameenmadu the mangrove ecosystem contains different species such as *Excoecaria*, *Acrostichum*, *Lumnitzera*, *Rhizopora*. The associated fauna are as follows *Penaeus monodon*, *P. semisulcatus*, *P. indicus*, *Saccostrea cuculata*, *Crassostrea madrasensis*, *Tilapia* sp, *Mystus* sp, *Aerius* sp, *Tachysurus* sp, *Leognathus* sp, *Etroplus* sp, grapsid crab (*Neoserratium malbaricum*), Ocypodid crabs (*Macrophthalmus depressus* and fiddler crabs), Portunid crabs (*Scylla serrata*), mud skipper (*Periopthalmus* sp) In Vaharai next to the Upparu lagoon (Vahari lagoon) an extensive mangrove patch was damaged after the tsunami which was a rich diversified environment with species such as *Lumnitzera racemosa*, *Avicennia* and *Rhizopora*. Where the fin fish and shell fishes are similar to that of the Batticaloa lagoon in addition the followings could also be seen, mud lobster (*Thalassina anomala*), mud skipper (*Periopthalmus* sp). Apart from the above mentioned fauna, the hepatofauna such as *Crocodylus palustis*, *Geochelone elegans*, non poisonous snake (mangrove snake).

Endemic and Threatened species in the Eastern Sector

During 1953 along with the introduction of omnivorous cichlids (*Oreochromis* sp, and *Tilapia* sp) in inland freshwater systems changes the existing natural ecological balances in the ecosystem, resulting in the loss of some endemic species such as minor cyprinids *Puntius* sp such as *P. nigrofasciatus*, *P. dorsalis*, *Labeo* sp such as *L. dussumieri* and *Danio* sp. (Vinobaba personnel observation in Unnichai and Rugam tank in 2004). *Heteropneustes* sp such as *H. fossilis* and sometimes doubtedly there may be *H. microps* (which is endemic) were found in the tank at lower prevalences. In the past the fishermen caught larger *Siganus lineatus* from the Batticaloa lagoon, but at present the habitat degradation loss of feeding grounds with sea grasses (such as *Enhaluse*, *Thalassia* sp), untreated shrimp farm effluents entering the lagoon use of illegal fishing gears such as monofilament gill nets, and usage of smaller mesh sized gill net usage may not facilitate such growth.

Apart from the above mentioned fauna, the herpatofauna such as *Crocodylus palustis* was found in the Batticaloa lagoon in 1999 at Sathurukondan (Vinobaba, personnel observation), *Geochelone elegans* distributed throughout the eastern province, *Eretmochelys imbricata* (Hawksbill turtle) reached Kaluwankerny for egg laying at the sandy beach (fishermen statement) and endemic non poisonous snake (mangrove snake) found in the Batticaloa lagoon.

Fish mortalities at the Batticaloa lagoon from 1989

There has been serious out breaks of severe ulcerative condition of the wild fish in 1989 after heavy monsoon rains. Since then the Batticaloa lagoon based fishery was severely affected by unknown ulcerative disease after the rainfall each year (Vinobaba and George, 1996). The ulcerative condition affects the fishermen's socio- economic status by lowering the market value for fish during the disease season (Vinobaba and Vinobaba, 1999).

The mass mortalities of fish were observed in 2002, during this out break where not only the fin fish but the elasmobranches also died. This may be due to the security net barrier across the lagoon closer to the military camp. When the lagoon maintains continuity with the ocean via bar mouth, it used to pave migration of stocks to and from the lagoon. Skates entered into the deeper part of the lagoon and these cannot return to the sea barrier and due to the osmotic imbalances along with higher residential time inside the lagoon may the death of those organisms. Apart from the deaths the nitrate, phosphate concentration of the lagoon water was very high mostly around eutrophic state, when the mass mortalities were observed during 2002. Since it related mostly to the water quality condition other ecologically significant organisms among mollusks, invertebrates, and other fish kinds also died during the same period.

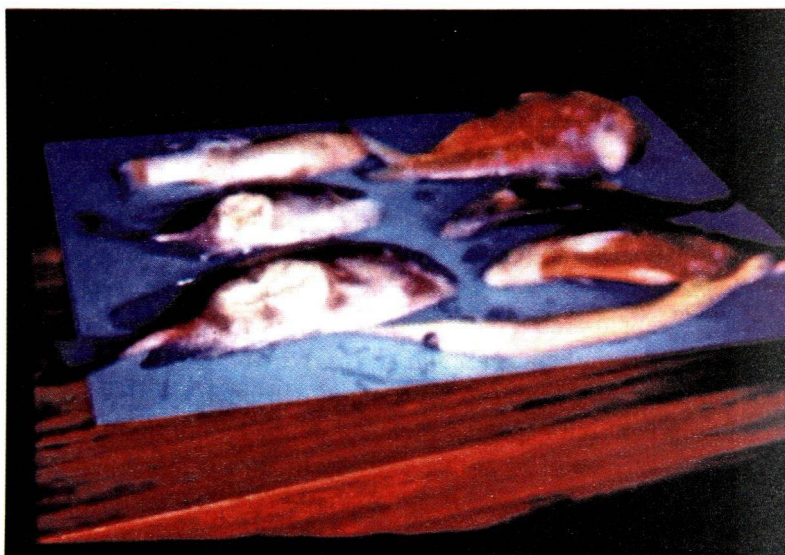


Fig 12 : The fish with the ulcers on its body surface
(Vinobaba, 2006)

5.3 Threats to Biodiversity

Biodiversity may be threatened by many events internationally or as a consequence. It is important to be conscious of the impact of various activities of the development process to avoid any negative impacts. It is thus very important to realize the threats to Biodiversity in advance.

5.3.1 Erosion

Sea erosion has been mentioned in many places but we have little positive evidence of such in the province except Kinniya, Mutur, Batticaloa (navaladi), and Salapaai aru. Many quote the event of the cyclone which had eroded the coast which is a special event and nothing could be done on that ground against the nature's heist. Seasonal erosion and accretion is found in many places which is acceptable in a strong monsoonal climate where the coast is rough during seasons takes away sand and deposits them back in other seasons.

Kinniya and Mutur flank the Mahaweli estuary at Koodiyar bay and are shallow blue waters. A valid question is whether the Mahaweli project which dammed the river had caused reduction in the material brought by the rivers which left less for the dispersal in the shore and therefore the Kinniya and Mutur erosion have been manifested? But that should only be a fact after 1970s when the Mahaweli scheme began. But these erosions are stated to have been there prior to that. The other possible explanation is that of the canyon in the estuary which prevents the redistribution of the shore material but rather takes it away into the depth. In which case this would have been continued through ages which have been aggravated in the recent past.

It must be borne in mind a whole range of events can add to erosion or destabilization of the coast. Population pressure is a major cause where either by construction close to the coast, dragging of nets and boats to the shore, dumping of wastes in the coastal water etc. damage the natural sea grass beds which are common in these shallow waters which in turn protects from the action. It is more possible that the anthropogenic actions contribute to the increase in the erosion. Further cyclones have been recorded in early twentieth century and in 1964 and in 1978 which may have disturbed the reefs in the ocean which then loses the protective value which may have been there earlier.

The salappai aru may be the defect in the construction which may have not taken the wave action into consideration and unlike the open shore the sand that is deposited may not strengthen the construction. Coastal constructions have shown this all over.

Even in Batticaloa the area is associated with large scale sand mining and bivalve collections. Further the boats are dragged into the shallow lagoon which has a high sea grass population. These may have caused the removal of natural protection which led to erosion.

The education of the public on these matters therefore takes priority on any mitigatory actions in the future at least to arrest the erosions in future. Further it would be important to restrict the collection of bivalves from the lagoon specially by dragging or scraping the bottom. In this concern even fishing with nets close to the shore needs to be restricted as it damages the sea grasses.

The leads to the next question of the landing of the boats. It becomes essential that zonation is made to make available places for landing the boats which minimises the destruction of the sea grass beds.

The same applies to the Lagoon erosion at Eravur and the construction of the wall does not sort out the problem. Walls have been constructed along the edges of the Batticaloa lagoon for the same purpose.

Wave action of the lagoon had increased near Batticaloa at Thannamunai after the removal of the mangroves in that area for security reasons. This is a clear example of the effects of removal of mangroves which was manifested within a year.

5.3.2 Sand mining

This has become a major problem with the development phase where more sand is needed for construction. Sand mining is taking place in inappropriate places. It is vital that the relevant DS divisions make allocation for removal of sand to meet their demand for the year and earmark the sites. In the absence of such zonation it will be impossible to control this. At present, permit systems are applied for removal of sand which is flaunted by many. Sand mining close to the coast contributes to the destabilisation process of the coast and causes health concern by collection of water which promotes breeding of mosquitoes. Gravel mining also has similar effects but more inland. It is important that a coordinated activity is planned for removal of sand or gravel, filling it for other uses by solid waste or other means and to monitor the whole process over time.

This is yet not a major problem except in some special sites.

However mineral mining which had been already agreed with foreign companies have to be well studied, often the damages done may not be easily reverted.

5.3.3 Coral mining

Coral mining has been recorded in many places in the eastern coast from Nilaweli to Akkaraipattu. But at present the process has taken an acute shape in Kalkudah where many large kilns operate. The police had recently arrested many and destroyed the kilns. The fundamental problem remains as the need of an alternative to those involved in this. It is also unclear how much people are aware of the dangers of coral mining. It must be remembered that with so much publicity and trainings and alternatives the west coast has marginally handled this problem. This may ease out if the tourism develops again. Corals are mined at Pudukudiyiruppu (more bivalves are used), or burnt at this location by the road side near Thalankuda. Dragging of nets (madel), beaching of boats contribute to breaking the reefs and corals which needs to be regulated.

5.3.4 Sanitation and health

These have been discussed under the above. An additional factor is the continuing lives in the refugee camps which are crowded poses threat in many ways. The Camps or settlements are found in Trincomalee, Ampara and Batticaloa. Some have been resettled. The problems about refugee settlements is not only the sanitation

and health but the dependency on state supplies which causes a social problem. Also their activities in terms of clearing forests, cutting trees for firewood etc becomes inevitably justified, yet is an issue.

Increase in Mosquitoes have been noted in all three districts but had not really encouraged a coordinated effort to control. Recently Chickengunya swept the districts (an estimate of more than 30% of the families in Batticaloa were affected) yet, failed to have adequate coordinated actions for control. The lack of preemptive and precautionary practices continue as a threat to health in the province.

A serious health risk was posed after the Tsunami when hundreds of bodies had to be disposed, and many places had mass grave burials. Their consequences on environment is not understood or studied. Another serious issues is the concern of burial grounds which lack space in many districts and also cremation had become difficult owing to lack of wood and the associated expense. Crematoriums in districts may be of importance ecologically and economically.

The major cities in the province need to consider proper sewerage systems for sewage disposal before major outbreak of diseases, which is very likely.

5.3.5 Drainage

Lack of proper drainage is a major environmental concern. Increase of floods in all three districts in the recent years demonstrates the issue vividly. Many of the natural drainage channels have been blocked by legal and illegal constructions, landfills etc. which had primarily contributed to this hazard. Flooding is not only a discomfort but had caused mass displacement, health risk associated with waste dispersal etc. The blocking of drains by solid waste is another major reason which impedes drainage of storm waters. Construction of parapet walls in cities and towns also have severely impeded the surface water flow.

This is another aspect which causes concern. This is partly associated with the solid waste disposal which when done improperly tend to clog the drainage which makes frequent flooding which causes erosion of soil, and health hazards apart from inconveniences. The blocking of the natural drainage channels by legal and illegal means adds to this and indicates improper planning E.g. Walls across natural waterways, bridges.

5.3.6 Clearing of vegetation/forest

Clearing of vegetation and forest destructions have been high over the past few decades in all three districts which have been affected by the armed conflict, due to lack of law enforcement. Clearing for military /security purpose would be considered later. However the fear of traveling to forests had made many to look into the nearby vegetation for their needs. Poles and sticks for Beetle and vegetable cultivation could be seen on bicycles in the mornings near Kaluthawalai. Most of those are poles from the mangroves. Mangroves are taken for poles all over the province. It is cut for firewood even though it releases unpleasant smoke. Much is used for fences and poles and also for fishing cages. Many bicycle loads of poles are seen to be collected from forest each day between oddamawadi and Welikande each day for years.

Much of forest has been cleared for charcoal near Vakarai. Lorry loads of firewood have been seen taken from Okande area.

Firewood collection has become a big business under the security condition. People do not have general access to areas to collect firewood where they may have done in the past which puts pressure on the available and nearby forests. Further many of the fences in the provinces have been removed which had removed their source of firewood and they need alternatives.

More than 70% of the population uses firewood to date. It is therefore important that the need is catered to. Firewood plantations may be a good option and social forestry with people's participation may be another option.

5.3.7 Landfill of marshes

Many marshes and wetlands have been filled for construction of houses and township owing to the demand for land often closer to the urban centres. This had been further augmented by the need for land for Tsunami displaced. However the impacts of this are relatively less studied, except the experience of increased floods.

These include Poompuhar in Batticaloa, Mattikali in Trincomalee and Karavahu area near Kalmunai amidst many others.

The process of filling itself had caused concern in some areas where it had been used as a solid waste land fill of marshes which affects the marshes physically and also pollutes them.

5.3.8 Practices in fishing

Illegal fishing modes practiced causes concerns in many places. Lack of awareness, lack of implementation of regulations are primary reasons. Usage of nets smaller than prescribed tends to remove fry from the lagoon which will deplete the natural resources. Landing of boats, dragging of nets etc had been pointed out earlier.

Another important aspect is the use of dynamite in fishing which destroys fish of all sizes and the environment itself, and sometimes corals and other structures. This is reported from Trincomalee and Kalmunai areas.

Over fishing was also mentioned as a serious cause as many non fishermen had taken to fishing in the lagoon and the numbers were too high, specially in the Batticaloa lagoon. It was also a serious concern that following Tsunami the rehabilitation had provided 'adequate and more' replacements leading to excess boats in the lagoon leading to an 'overfishing' scenario, though not agreed by all.

5.3.9 Security situation

This is one of the most important aspects that affect the environment at present and may be one of the major underlying factors for many other negative impacts.

5.3.9.1 Removal of forests

Forests have been extensively cleared for forming camps and roadside clearance in all districts and they include coastal and interior areas. This leads to soil erosion and proliferation of weeds in this area.

5.3.9.2 Removal of mangroves

Mangroves have been extensively cleared in Batticaloa and Trincomalee as the roads area coastal and mangroves are found along them. This had caused deterioration of the ecosystem which had affected the production of the associated waters and dependant wildlife, mainly birds. In Batticaloa the mangroves have been removed by bulldozers and burnt using oil which will remove the chances of any regeneration.

5.3.9.3 Ploughing of land/ denudation

Ploughing around the camps for various purposes have been done which increase the erosion and often this is associated with burning of the regrowth in future which adds to it and decreases the soil biota and destroys its structure.

5.3.9.4 Shells and Bombs

They have damaged the wildlife heavily. Large animals have been displaced by the threat. Shorelines have been destabilized. Destruction of buildings have formed more rubble. The areas bombed causes such a heat on soil that it destroys the entire biota.

The effect on the seas in Trincomalee is worse. The marine life would have been affected drastically. No reports are available any way.

5.3.9.5 Landmines and Antipersonnel mines

These pose a big problem. Some one gets affected each day in the province. This makes much of the land inaccessible. Just the threat alone has debarred from people moving into these areas. Specially in areas which have been changing hands frequently as vakarai, kattaparichan etc. these pose a real threat.

5.3.9.6 Lack of law implementation

In effect the conflict situation has caused erosion of the legal enforcement. Venison is sold in open market in Batticaloa, Logs are transported through the Oddamawadi Bridge, Corals and lime kilns are set by the road side, various nets are being used in the waters etc. continues with inadequate operation of the law and the lack of personnel in these areas. Wildlife officers have not been able to visit areas of conflict where Elephant problems have been reported.

5.3.9.7 Poaching

This is discusses above

5.3.10 Harvest of marine resources

It is noted that collections of Sea cucumber, Shanks and marine ornamental coral fish are collected in large quantities in Akkaraipattu, Batticaloa, Trincomalee, sammanthurai and Pottuvil. However there are no procedures and checks of these operations. There is also collection of reef fishes which also affect the reefs during collection.

These could really affect the biodiversity as no information is available on the resources potential and the sustainable harvest limitations.

5.3.11 Human- elephant conflict

Reports are few from the province recently. But we are informed that there is elephant activity near Konesapuri near Trincomalee. Elephants are known to raid coconut and Banana plantation near Kuchaweli. Elephants came close to Chenkaladi Junction in 1994. Elephant damages have been reported from Nintavur/Ampara, killed people near Karadiyan aru. Elephants have been seen close to Panama. On the way to Kumana the villagers have been attacked by Elephants recently. The extend of the conflict with elephant is not adequately assessed and addressed.

Elephants have also been killed by guns, electricution (punani), runover by train during these periods.

5.3.12 Sand bar conflict

Opening and closing of the sand bar has been an important concept in people's lives in the coast. Opening facilitates the fishermen and the closure facilitates the farmers in general. However opening has been based on a norm and scheduled in Batticaloa which awaits a height rise in the lagoon before the Irrigation department opens the bar which promoted deep opening which in turn will be open for longer time. But it is known that recently political influences and security forces have opened the bar early which had caused a minimum flow and the bar was formed swiftly. The trend affects the potential of the lagoon as the fry have to arrive from the sea.

People have been found to cut the bar in other smaller places to reduce water levels in the lagoon for fishing.

The unplanned bridges across the lagoons, with limited passages for water flow, have changed the ecology of running waters, changing of the ecology of the waters which had affected the biodiversity and caused increased pollution as seen in Batticaloa, Kallar, Trincomalee etc. It is unfortunate even the most recent constructions have followed the same without any improvement (kallar).

5.3.13 Development, industries

Two Large industries found in these provinces are not in operation at present (Kantalai sugar, Ampara sugar). Paper factory at Valaichenai would be the largest in terms of number of employees which also had shrunk its operations ever since paddy straw was banned as a raw material for paper production owing to its polluting properties. The other major industries would be the Prima Mills and Mitsui cement factory in Trincomalee and the environmental monitoring seems inadequate.

Though not major, there are many small industries in Kattankudi, Maruthmunai etc. specially those involve dyeing whose effluents are sent directly to the lagoon. Most of the large rice mills are near the lagoon or water way (Nintavur, Ootamawadi, Batticaloa, Kinniya) pollutes these waters and also the dumping of the paddy husk close to the lagoon (Akkaraipattu, Oddamawadi) pollutes the lagoon. Study had revealed that paddy husk ash could be used as an alternative to lime for cementing. But unfortunately the research lies in the books and no one had taken it up beyond the thesis.

Recently many shrimp farms have been developed in the Batticaloa and Valaichenai lagoon whose legality has been debated. Small farms have been aggregated to give a mega farm impact, not accounted for by EIA other means. Further they directly send the effluent into the lagoon. The impacts may be less as these are relatively small operations but the need is there to regulate these and make zonation and recommendations so that we do not follow suit with North western province. It is unfortunate that most farms are on the lagoon itself without any setback distances.

5.3.14 Invasive Species:

On a reverse key note these too are of significance as they reduce the true biodiversity of a region. Parthenium is one of the more known species which is having a high distribution in Trincomalee. Other invasive species like Salvinia, Pistia, Ichornia in the water bodies are also known. Species like Pennisetum are invading areas in the east closer to Punanai and Kantalai. There needs to be adequate and scientific planning to ensure that these do not expand further to deteriorate the natural ecosystems.

Further to the Tsunami there had been reports stating of increase in some species in the coast, which may not qualify for invasive species.

5.3.15 Post Tsunami Pollution

The increased diesel boats and associated oil leaks and spills add to this. These also show the lack of implementation issues as we have one of the best laws in relation to the environment in the South Asian region. This is a serious event which is gaining importance more than ever. Specially Post tsunami had made the Coast the dump yard of every thing, which had cause considerable damage to the eco systems. Apart from this domestic sewage and sewerage tends to end up in the coast or shallow coastal waters which are of considerable importance. The internal water bodies also face serious concerns over this.

5.3.16 Post Tsunami Constructions

These are deliberate events which significantly affect the coastal ecosystems. Following the Cease fire agreement many hotels have mushroomed in places without adequate regulations in place e.g Nilaweli, Arugam bay causing much concern. Many were damaged by the Tsunami to be reconstructed again despite regulations.

A new road was constructed to access Arugam bay from Pottuvil across the forests for urgency following Tsunami which had become a welcome route for potential timber traffic.

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6 PROTECTED AREAS ARE DECLARED BY THE STATE FOR RESTRICTED USE AND ACCESS AS APPROPRIATE

These promote In situ conservations by design where the species, population or community has protection in its habitat itself. However there are many aspects that may not make it adequate for larger populations. Specially the size of the conservation area is a factor. Fragmentation of areas often lead to disintegration of the conservation area and reduce the impact.

6.1 Wildlife

There are already many protected areas in the Eastern province as given in the Table 9 below. Some of these spread outside the province itself and link/continue into other provinces viz. Madhuru oya national park, Somawathiya national park, Gal oya national park, Kudumbigala sanctuary, Yala East national Park etc. This provides excellent ground for movement of wildlife, in particular, the larger mammals. The eastern coastal forests and other ecosystems out side the protected areas too provide much room for movement. It is of prime importance that these are identified and linked to assist the sustainability of the wildlife in the province and the country at large.

Table 16: Designated wildlife Protected areas in the eastern province of Sri Lanka

Location	District	Area (ha)	category	Notes
Kokkilai Lagoon Sanctuary	Trincomalee	2995	Sanctuary	One of the oldest sanctuaries in the country
Pigeon Island	Trincomalee	5	National Park	Only the terrestrial part is protected (coral reef is not)
Naval Headworks Sanctuary	Trincomalee	About 12,000	Sanctuary	Area west of Tambalagam Bay
Great Sober Island	Trincomalee	65	Sanctuary	In Trincomalee Bay
Little Sober Island	Trincomalee	5	Sanctuary	In Trincomalee Bay
Seruwilla – Ella Sanctuary	Trincomalee	15,540	Sanctuary	Includes western part of Ullackalie Lagoon
Trikonomadu National Reserve	Batticaloa	About 5,000	Nature Reserve	Includes western shores of Upaar Lagoon
Sagamam (Sakamam) Sanctuary	Ampara	About 600	Sanctuary	West of Periya Kalapuwa Lagoon
Lahugala-Kitulana NP	Ampara	About 1,000	National Park	Along road from Pottuvil west to Lahugala
Kudumbigala Sanctuary	Ampara	4,403	Sanctuary	Extension from Yala East to Okanda
Yala East NP	Ampara	17,864	National Park	Kumana to Kirigala Bay
Galoya	Ampara	25800	National Park	
Gal oya NE	Ampara	12400	Sanctuary	
Gal Oya SE (Buddangala)	Ampara	15200	Sanctuary	
Flood Plains	Trincomalee / Polonnaruwa		National park	
Somawathya	Batticaloa / Polonnaruwa	About 37,645	National Park	
Triconamadu	Batticaloa / Polonnaruwa	About 25,019	Nature Reserve	

6.2 Forest protected areas

Nearly 12% of the land is under the Department of wildlife conservation demarcated as protected areas. Forest department too has many types of forests under protection for various reasons. They have conservation forests, Other state forests, Man and Biosphere reserves etc. under their purview which amounts almost to about a million hectares. Some of the areas under them are the Sinharaja forest and the Hurulu forest of the MAB reserve.

6.3 Ex Situ Conservation

6.3.1 Flora

There are no formal ex- situ conservation in the province as Botanical Gardens and Zoological Gardens. However traditional practices had conserved many species which were maintained in home gardens, fences and temples through history. Much of which had been mostly lost during the conflict. Changing life styles also had contributed to this.

Home garden in the dry zone, including the eastern province, is centered around the well and usually contains Coconut, Arecanut, Lime, Ginger, Turmeric, Banana, papaw etc where water from use flows to these regularly. However this had been reduced by the increased use of electric pumps and delivery system. Arecanut has become rare and also the varieties that were found in the other species. Apart from these the garden also had greens including 'kankun' in these plots.

Live fences were the most common boundary markers between properties which had many common species in them. Many species which were common in these fences have decreased in abundance and are near extinction as fences have given way to the preferred parapet walls. Species like *Jatropha*, *Glyceridia*, *Erythrina*, *Murruya*, *Morinda* are becoming rare as a whole. Many climbers were seen to be on these fences e.g. *Cucurbita* sp, medicinal plants as *Solanum* sp., *Cardiospermum* sp., which have lost their habitat.

Traditional medicinal herbs had been cultivated by practitioners inclusive of *Cannabis*. These species have been preserved only in these gardens.

Trees like *Agelis(vilvam)*, *Callophyllum inophyllum(punnai)*, *Pongamia(vengai)* had been maintained in Hindu temples preferentially protecting them. They have also protected species of *Stenolobium stans*, *Thevetia nerifolia* at the temples. It is interesting that *BOUGENVILLEA* had been a preferred species in the east and is found in many homes, some of it which had grown into trees. Similarly some which had been prominent in the east had been lost over years, which includes *Canna* species. Most of these species have been cultivated from cuttings and root stocks and are able to maintain the genetic diversity to a great level.

6.3.2 Fauna

Ex situ conservation of animals are less common but some temples have reared Pea cocks in their premises. However owing to religious beliefs, as the Vehicle of Lord Murugan, killing of Pea cocks are not practiced in the east, and this may be a reason for the large numbers found at present.

Some temples have had Elephants with them, Eg. *Kaliyamadu* in Batticaloa. But they have not maintained the tradition.

Some of the fish species have found their way to the fish tanks/ wells in the homes where they had been maintained for long while their stocks had depleted in the wild with the reduction of the habitats and pollution.

Large number of herds of cattle/buffaloe, mostly free ranging which had survived in these areas for decades, which in a sense would have a preserved genetic diversity in terms of conservation.

7 CULTURAL AND OTHER RELATED DIVERSITY

7.1 Bio archaeological sites

One could think of the Thonas as Bio Archeological sites in the sense that they represent an event in history which had distanced itself at present except by the remnant, as Thonas. They are lagoons technically.

It is also a fact that the areas between the lagoon and the sea shows many features of representing history, the soil being sandy is one. Further when wells are excavated in these areas the presence of coral debris and shells are striking features which indicate the link to the ocean in the past.

The hot water wells at Kannniya, seven kilometers west of Trincomalee, is one of the most famous hot water wells in the country which has seven wells of different temperatures. This is said to have been created by Rama, in Hindu mythology. Other hot water wells are found near Maha oya.

7.2 Bio cultural aspects

7.2.1 Naming of villages and places

Naming of many villages have been based on trees and vegetation historically but unfortunately the vegetation had been lost and only the names remains at present. A long list is possible in this context.

I have personal experience of VAMMIYADI in Eravur which is the junction where there was a Nauclea (vammi) tree, large which was cut recently and the name remains naked now. The following have basis for their names

Pasikudah – pasi (sea weeds) kudah (bay)
Kandaladi – kandal (mangroves) adi (near by)
Thennamarawadi – Thennamaram(coconut) vadi(hut)
Thumpalai cholai – Thumpalai (Vatica) cholai (garden/grove)
Palayadi thona – Palayadi (next to Palu tree) Thona (mini lagoon)
Palameen madu – palameen (milk fish) madu (ditch)
Eachan thevu – Eachai (Phoenix palm/date) thevu (island)
Mudalai kudah – Mudalai (crocodile) kudah (bay)
Puli paitha kal – Puli (leopard) paintha (sprung) kal (rock)
Mavadi vembu – Mavadi (near mango tree) vembu (margosa tree)
Maha divul wewa – maha (large) divul (wood apple) wewa (tank)
Arasadi – arasu (figus tree), adi (near or foot)
Arugum bay – Bay

In fact most of the villages have a name with reason, which had recently changed having names indicating the origin of the people (if migrated), or names of leaders/politicians.

Kathan, Puliyan, Karadiyan and Kannan have been tribes/tribe leader in the past and their areas are indicated by these names in Batticaloa. (FXC Nadarajah, Personal communication)

Kathan kudi – community of Kathan
Puliyan thevu – Island of Puliyan
Karadiyan aru – River of Karadiyan
Kannan kuda – Bay of Kannan

7.2.2 Use of flora and fauna in culture

- a. Pongal is a Tamil festival where the harvest is celebrated in January (month of Thai). The following day celebration is focused on the cattle which had helped them in the field where they are decorated and pooja are held, called MATTU PONGAL.
- b. The use of Margosa leaves in front of the houses when infected with small pox/ measles serves as a warning to visitors and also an antiseptic in general.
- c. Use of turmeric water by people in the shops and houses is a spray of antiseptic in reality.
- d. Use of Beetle leaves for greeting has been prevalent among the Sinhala community mostly for all occasions. It is also seen in the Tamil community where during invitations are given for wedding or cash transactions during festive season beetle is used. Beetle is also used as an end of meal chewing with Arecanut and lime.
- e. Various flowers are used for the offering to the temples. The most prominent are Lotus, Lily, Jasmine etc.
- f. Plantain palms are used for welcoming at weddings and functions with ripe bunch for good omen. Traditional meals are also served in Plantain leaves or Lotus leaves in temples and functions.
- g. House warming ceremonies are often performed by bringing a COW to the house in concern for prosperity.
- h. Cobra worship is common among Hindus.

7.3 Traditional knowledge profile

People have a good sense of the weather forecast for cultivation. If there is a halo around the Moon it is said that the rains would not be there for the next few days.

People are aware of the poisonous plants and snakes by traditions. For example people would not eat manioc and ginger as it provides a poison in combination.

They are also aware of the poisons used for fish and also fruits that are poisonous. In fact *Cerbera manghas* is called Nachu Kai meaning poison fruit.

7.4 Human ethnical diversity

East has all communities found in the country.

East also has indigenous people as a community in the coasts called Coastal veddhas. Some of their traditions were seen until late 1990s, specially around VAKARI area, but had been lost in the conflict of the day. They had healing ceremonies during Poya days in these villages.

7.5 List of historical, rare memorial trees

Limited number of Botanical or zoological expeditions have been performed in these areas for the past three decades which is really a set back for information and verification.

Species such as *Vatica obscura* which is supposed to be around is not recorded for long periods. Some other interesting plant species are seen which are discussed below.

Branched palm – Batticaloa has this, in front of Vincent Girls High School and a few places. (Manoharam, 2006)

Ficus tree at Koneswaram Temple is found at the edge of the cliff which has a special pooja.

Knox tree at Mutur also considered as special.



Fig 13 : Knox tree at Muttur
Photo : Anuruddha Thennakoon

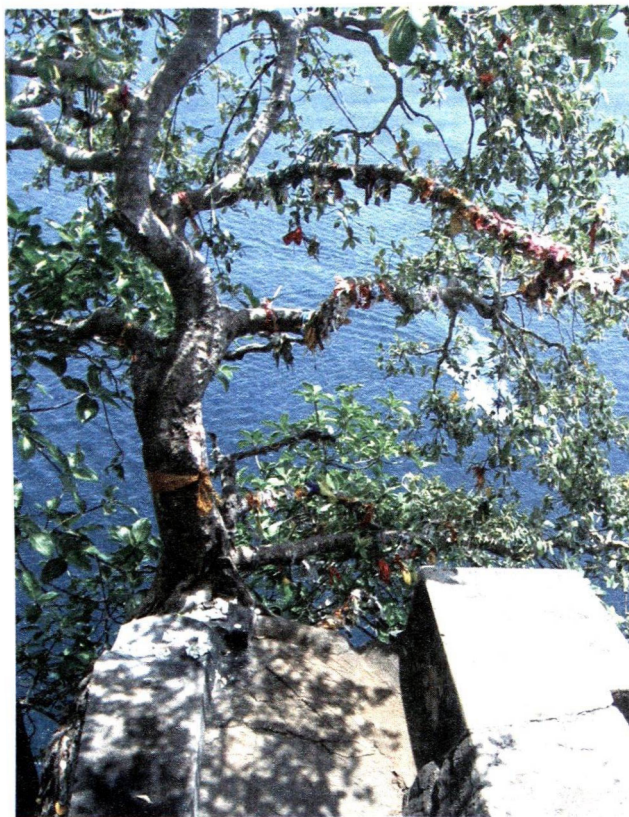


Fig 14 : Ficus tree at Koneshwaram temple.
Photo : Sampath Ranasinghe

8 IMPACT ON BIODIVERSITY

8.1 Human population, trends of change, unemployment

Increase in population, more correctly towards the cities, cause heavy pressure on them and cause severe depletion of the natural resources as mentioned earlier. However the conflict reduced the diversity as more sinhala people left some districts, Batticaloa in particular. Tamils and Muslims have left areas of certain districts. Recently part of the liberated areas have been marked as security zone restricting access to people. A large number of population were displaced and are being resettled at present.

Population increase is also eminent as in Table 2. The conflict had also caused migration of people away from the district specially those who could afford or professionals. Unemployment was high owing to the fact that the fisheries and agriculture were limited in operation, limited by access. However Tsunami of 2004 opened new employment opportunities for skilled and unskilled labour and the rates are one of the highest in the country at present (2007). Opportunity was also created by Homeguards and private security personnel in the past few years.

8.2 Conflict

There are many areas of the east which has experienced Human Elephant Conflict(HEC). This extends from North of Trincomalee to South Ampara as Panama. Western sector of Batticaloa is also known for HEC. Limitation of access had limited operation of law enforcement agencies which had led to increased poaching. Human Elephant conflict had increased in these periods.

8.3 Invasive species

Discussed already

8.4 Negative impacts of biodiversity; snake bites etc.

Always increase of species or bandana cannot be taken as possotive.

Increase of crocodiles have been reported in the Batticaloa Lagoon. More citings have been reported, often.

Snake bite is a common feature in this part of the country specilly those who cultivate Chena clearing Jungles.

The increase in number of dogs is a problem which causes concern with rabies. It is estimated that the country has about 2.5 million dogs in toto.

Increase in Mosquitoes in seen while bed bugs have decreased over the past few years.

The role of invasive species in damaging the natural ecosystem too needs to be seriously considered.

9 BIODIVERSITY RELATED INSTITUTIONAL ASPECTS

9.1 Government institutes: National, provincial, local

Nationally, Biodiversity is primarily handled by Ministry of Environment which may be detailed as Forest Department, Department of Wildlife conservation and Central Environmental Authority. However many more ministries and institutes are involved with Biodiversity related aspects which include Ministry of Aquatic Resources, Ministry of Fisheries, Ministry of Agriculture, Coast Conservation department, Universities and many more. Biodiversity secretariat has been created to coordinate these activities owing to the diversity of the institution that are associated with Biodiversity.

District/ Regional offices of most of these institutions e.g Central environment authority, Forest Department, Department of Wildlife Conservation are available but have been less effective over the past three decades adequately owing to 'conflict situations'. In addition certain subjects which were devolved under the 13th amendment had provided to have provincial institutions which include Agriculture and livestock.

The Local government too has a stake in the biodiversity having access to land and local resources and their management.

East has Government (central), provincial and Local institutions. Often there roles are confused or complicated as there may not be real assignments. However there are no provincial legislations as in the North Central province and the National legislations are in effect. However owing to the conflict there had not been adequate representation facilities or field works for many years and this is one reason of the deterioration of information. However this again may have been a positive aspect of increased wildlife and unspoilt biodiversity.

10 BIODIVERSITY RELATED POLICY AND LEGAL ASPECTS

10.1 National, Regional policies

The absence of an elected Provincial government did not allow any provincial legislation of the North East province (North and East province at present)

Many of the facilities provided to the national agencies are not available to the regional agencies and often they tend to be sidelined, which needs to be rectified. More participatory policy making (not only authorities/personel in Colombo should decide for the regions in particular beyond the broad policies)

There needs to be more categories of conservation areas other than the national categories providing for regional conservation and recreations. Otherwise we will lose everything except the areas protected under forest and wildlife regulations. Some of the small areas may not match the national criteria but are considered important locally and is of significance, which would include small wetlands, forest patches, view points etc.

10.2 Gaps

Very specific ecosystems need to be addressed by very specific terms with authority. The lack of which is seen in the failure of management. Examples are the Lagoon ecosystem and the Mangroves specially in relation to the east. These cut across too many authorities, having no 'absolute control' or interest and makes the subjects afloat. For example, who manages the Batticaloa lagoon? Is it Coast Conservation Department or Fisheries Department or Government Agent or Irrigation department remains a question to be resolved. Similarly who manages the Mangroves of the Country?. Forest Department does most of the work on Mangroves. Are they the custodians of the mangroves and how they relate to the management of the lagoons. Similarly who manages the Villus?

GAPS on information and documentation on the North East is well known. Most of the National plans had been prepared based on the tentative/provisional information. It is vital that the special attention is placed on the east to gather information and document them and amalgamate it into the national documentation with certainty.

National information (authenticity) is vital. It is so frustrating that we are unable to give the coastal length of east precisely based on methodology or quote as the ACCEPTED NORM. Norms would have to be established and formal accepted figures need to be declared.

10.3 National laws, customary laws, implementation difficulties

National Laws are applicable to these regions too, but for the reason of armed conflict over the past three decades implementation had been always an issue, especially in relation to sand mining, poaching and timber trades. However the forest as a whole had been maintained in many areas.

Many of the offices have been placed in areas away from areas of conflict thus making it more difficult and also posting of persons who are unable to speak the local language has also been an issue in implementation and operation. It must also be remembered that officers of some of these offices have lost their life on duty.

Customary laws are some times not written anywhere and when people migrate this makes it more difficult as they merge with each other or evolve appropriately. There had been big fights in regard to burial ground in Batticaloa district as the community expands into isolated areas of burial ground.

Solid waste management lands also cause problems when inadequately addresses the neighbor's issues as the expansion of the communities blend into lands isolated for these purposes long ago.

11 BIO INDUSTRY AND BIO PROSPECTING

The area of the Eastern sector of the marine waters extends to 800km which has tremendous potential.

The marine floor had tremendous resources. Petroleum is one and a major one. Off shore sea mining of sand is an important venture given the future of development and also the need of sand for various infrastructure and highway projects. Given the fact that the coast has a high concentration of rich minerals the opportunity for mining of minerals is not a rare possibility and needs to be investigated.

Coordinated fishing and development of value added industry of this sector is one of the top most priority. Trincomalee has one of the best locations for TUNA catch but the failure to process it at site makes the benefit not reach the local people and also makes the price vulnerable depending on many intermediary agencies.

Tourism for whale watching is another. The potential had been highlighted as far back as 1970s, with potential floating hotels.

The eastern coast has some of the best beaches in the island, which are white and broad with shallow blue water whose potential for tourism inclusive of ecotourism is immense.

Fish monitoring would be a very important technique for future development.

11.1 Medicinal plants / large area of land

Many or most plants found in these regions are used by local people and traditional medical practitioners for cure of various illness. The large number of species found in the area also promotes the potential for medicinal and other dietary remedies, not only at the species levels but at the level of sub species or traits. Medicinal plant cultivation is one great possibility. Search for potential drugs becomes an important potential in the same light, for various diseases.

Venom extraction from snakes is a great possibility. Given the dry climate and the high number of poisonous snakes found in these regions, this could be a viable project.

Livestock including rearing of Deer is a great potential in these areas. Large tracts of dry zone areas are found in all three districts and viable programmes could be initiated. Most of the livestock is free ranging at present with hardly any technical input in terms of increased maintenance or the breed development.

The following are some of the most common raw materials found in the area which could be improved genetically and also efficiently utilized with more value additions as possible. It is also important that a demand supply study is made in relation to each of these resource for effectiveness.

- a. Cane palm – currently harvested from the wild and used for making baskets and trays. This could be developed into plantations and also of better varieties as it has a great demand.
- b. Pandanus - same status as above, mainly used for weaving of mats. These could also be used effectively as bio filters of pollution and also as silt traps close to wetlands. (sedge for weaving)
- c. Fruits (Palu, Veera, Gal siyambala) – More could be obtained from these valuable fruits.
- d. Medicine (Aralu, Bulu, Nelli and others)
- e. Timber (Satin, Palu, Neem, Kon,) – lack of effective harvesting and also lack of proper utilization makes only about 20%-40% of the wood being used effectively. Rest are lost as off cuts, side cuts etc. ending for firewood.
- f. Fish, Crab, Shrimp- This is an area where an industry is in great demand for processing.

Some of the raw material which really has a great value would be

1. paddy husk
2. straw
3. wood shavings and wood pieces
4. organic waste

11.2 List of bio industries in the province

There are few which may be listed under this. The Paper factory which was the main industry using paddy straw ended using the raw material a decade ago and uses other imported pulp and paper as raw material for production.

Saw mills which had increased after tsunami is one industry which needs attention.

Shrimp farm too had been growing after tsunami. Yet the environmental concerns have not been adequately imposed for reasons of poor law enforcement, a part of existing conflict climate.

Limited numbers of Bio gas plants operate in the province and also at very low level.

12 RECOMMENDED ACTION FOR CONSERVATION AND SUSTAINABLE USE OF PROVINCIAL BIODIVERSITY

The real drive for environmental conservation and biodiversity in the country began in the 70s and unfortunately gripped in the conflict the North and the eastern province had been left out of the main stream of development for lack of capacity, institution, access etc. Thus it needs to be recognized that we need to begin from level one for the build up in the east these concepts.

Information and documentation of the biodiversity in the region is a high priority. It is also very important to engage the school children into these activities for the future sustainability and development of these ideas. Translations of many documentations on Sri Lanka and posters produced by various institutes may be good place to start. Dubbing of the films and documentaries produced would be useful to create interest among all stake holders.

Institutional strengthening and capacity building is another area of importance. This would include government, non government and Universities included. More opportunities of training and also field visits locally would enhance the capacity greatly. It is also important that the institutions are devolved to reach the GS levels and arrangements are made for participation of local community in conservation activities.

Devolution of institutional powers to regional and district levels is important if meaningful conservation is to be achieved, which is beyond the rare and the endangered species. The MAB concepts of ecosystem conservation would be a valid phenomena specially in the dry zone especially in the eastern coastal areas which are unique.

A great need is the authority to declare Regional Protected Areas (RPAs) which may be in the province, district or the DS division which gives the people pride and also recognition of the importance. It is difficult to measure all under the National criteria alone.

Basic themes for proposals

- a) Awareness building to the region – schools, public, institutions
- b) Translation of existing local documents and publications
- c) Programmes to document local resources and study on the local resources
- d) Training of regional persons at different levels

13 INSTITUTIONAL ARRANGEMENTS FOR IMPLEMENTATION OF THE ACTION PLAN

It is important to have Biodiversity action committee at Provincial, district and divisional levels that meet regularly. These must also have graded executive powers for implementation and monitoring of events. It is also important that these committees are represented in the planning committees of the appropriate strata. For example the District coordination committee meeting should have representative from the Biodiversity committee.

These committees should also have the necessary institutional structures, office, equipment etc for effective functioning.

These committees should include professionals and practitioners/users along with community leaders for effect. Eastern Province has universities/campuses in each district and their services should be effectively utilized.

The Biodiversity action plan has to be integrated into the Provincial action plans for effectiveness.

Implementation monitoring system

Regular reports of status of the implementation of the action plan would be produced submitted to higher level at each start. It is essential as a prerequisite that these officers are trained in Result based monitoring techniques away from reporting activities alone.

A separate independent mechanism (organization) should also be assigned the periodically monitoring of the plan, which would also serve to assist in training and advising/discussing issues with the committees as relevant.

Periodical public meetings should be held to communicate the results to the stakeholders and interested population for devolving ownership and sustainability of the plans.

Proposed Activities for Biodiversity Action Plan of Eastern Province

The action plans shall be coordinated by the Biodiversity secretariat and shall be in collaboration with departments/institutions of Forestry, Wildlife, Coast conservation, National Botanical and Zoological Gardens, Fisheries, archeology etc. A strong coordination by the Eastern Provincial council and District administration is recommended, for ownership and sustainability. The universities the province should be also included in the planning and managing of plans. Participatory approach of involving the stake holder public is encouraged at all levels. The personnel and services of the province should be utilized as priority in all actions.

14 TENTATIVE ACTION PLAN

	Task	Periods(quarters)									
	Education										
1	Awareness - integrate environment in to school curriculum - Create programmes for awareness campaigns in the society at different levels, from farmers to politicians. - Declare an ENVIRONMENT DAY for the province to highlight the importance - Publicity banners in cities and roads for the purpose	x	x	x	x		x		x		x
2	Translation - Translate related local documents to all three languages as appropriate, including TV programmes, documents and print material - Facilitate training of translators in Environmental subjects - Publication/distribution of such materials	x	x	x	x	x			x		x
3	Document local resources - facilitate study and publication on local resources, distribution and conservation	x	x	x	x	x	x	x	x	x	x
4	Training of staff - Training of Trainers on environmental education for village level awareness - Facilitatiing higher learning on natural, cultural resources including research	x	x	x	x			x			x
5	Public meetings, seminars, workshops, exhibitions, publications of leaflets etc. - This is part of awareness and also dissemination and sertves as base for further planning	x	x	x	x	x	x	x	x	x	x
	Utilization										
6	Development plans - prepare development plans with natural resources perspective at regional, divisional and village levels in consultation with national plans. Ecotourism/ Plant Nurseries - Develop ecotourism as a concept Bio industry - develop industries that would utilize the local resources as much as possible	x		x			x	x			

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The activities are not given in order of priority but the basic surveys, field studies and institution and capacity building would be the starters.

	Activity	Period (months)
Institution building		
1	Assist provincial legislation on environment and the establishment of a Eastern Provincial Environmental Authority	6
2	Train staff of the above to manage the plans in collaboration with other existing mechanisms.	6
Biodiversity evaluations and establishment		
3	Conduct a survey to identify the Bio diversity potential of the province; map the declared protected areas under forestry, wildlife, archaeology etal.	12
4	Assess gaps and facilitate identification of further areas of protection as appropriate; facilitate declaration at GN, DS and GA levels for locally important patches of biodiversity.	6
5	Survey to assess the status of species in the province(threatened, extinct etc) and also the Crop wild relatives and prepare distribution maps for same	12
6	Assess the values of the resources, protected areas in terms of its ecology and services.	12
7	Prepare plans for the biodiversity protection areas in association with the communities in concern, ensuring that they profit from the areas in concern. Identify mechanisms to make it more profitable	12
8	Prepare maps of distribution of Coral reefs, Mangroves, and sea grasses in the province and also estimate their status.	12
9	Identify and document the invasive species in the province and their dynamics and make plans for control of them	12
Management issues and Mitigations		

10	Recognize and identify the issues that conflict with the Conservation interests (given in 5.3.1) 1. sand, clay mining 2. coral mining 3. illicit logging 4. bio extraction ornamental fish, sea cucumber etc. with the number of people engaged and their importance in livelihood. a. Prepare a sand stock and excavation plan b. Promote alternate building material and techniques to reduce use of timber, tile, bricks, sand c. Promote social forestry and community forestry for utility d. Promote establishment of private sector plantation forest for timber usage e. Conduct training programmes for various stakeholders involved in the above f. Investigate and promote alternate sustainable livelihoods to those communities	24
11	Establish a National Mangrove park and a research station at Batticaloa in collaboration with the Eastern University.	24
12	Study the potential for sea weed culture, bi value production and other aqua culture practices as alternative livelihood means.	24
13	Establish Botanical garden, Zoological Garden in the province as appropriate.	18
14	Declare unique landscapes as reserves (similar to MAB reserves)	12
15	Identify areas for Eco tourism and develop plans for associated infrastructure, cottage, trails, activities etc. Local documentation Capacity building to be given to the local members to best utilize the opportunity from eco tourism service provision.	24
16	Establish plant nurseries in districts and promote utility trees in each home garden to increase green cover	3
Awareness, Capacity building		
17	Awareness programme to be conducted at school, village and institution levels for all categories on natural resources and their management importance	6
18	Assess the training needs of the community and establishments in variety of fields from Management to Eco tourism services	6
19	Training to be provided to all staff involved in management of biodiversity to improve performance and better understanding.	6
20	Training to public/legal officers on public litigation and promotion of such in Provincial legislation.	12

15 STRATEGIC ENVIRONMENT ASSESSMENT (SEA) FOR PROVINCIAL BIO DIVERSITY CONSERVATION ACTION PLAN

SEA has been introduced as a preferred alternative to EIA as it provides a pro active approach to environmental sustainability of sectoral planning integrating sectors rather than project specific mitigatory plans

The entire focus /objective of the action plan is to sustain, enhance the biodiversity of the province, provide ownership to the people of the province while making best use of it. This involves a range of activities that includes road development, sand mining, logging, military action, solid waste dumping and covers many sectors and involves all communities as a cross cutting issue. Various activities may have direct impact on the biodiversity (poaching, deforestation) while others would have a long term indirect effects (sand mining, reclamation of marshes).

It may be difficult to draw up a detailed SEA for the proposed Provincial Biodiversity Action Plan (PBAP). The three key sectors of the plan education, utilization and check and balances have been addressed as one unit, which may not be appropriate.

15.1 Education

Most of the public are not familiar with the concept of the biodiversity and its conservation and values. They certainly do not have the knowledge of the impacts of their losses and associated impacts. Recently the Nobel Prize awarded to Al Gore, symbolizes how much the globe recognizes the dissemination of environmental information, even in a developed country. It is to be recognized that it would be the community that could and would be able to sustain the environment, by commitment, rather than by law itself. Specific examples may be cited from Tsunami in Sri Lanka where villagers had completely given up sand mining of sand dunes, cutting of mangroves etc where they had been protected by these during the Tsunami, which is in fact a form of education, the hard way.

The proposed plans have been designed to provide awareness to public, more discussion through seminars and meetings and provide reading material to those who need more. This also would provide ownership of local species and ecosystems which leads to the protection of this diversity. This also would be able to provide capacity building to people to manage various ecosystem related issues in the society at various levels.

It is assumed that the understanding and recognition of the biodiversity and its importance would promote the people at large to develop an 'ownership' of the biodiversity and the 'feeling' to protect it for them and future.

15.2 Utilisation

The Biodiversity is less appreciated and often mismanaged or lost by failure in management or lack of proper utilization. Many of the potential biodiversity whether it is landscape as sea shore or spectacular views as Whales in the ocean or flocks of beautiful birds or the working mechanism of the 'insect trapping plants' have not been best made use by the public for their pleasure or as a means of livelihood.

The set of proposals focus on how the resources could be best obtained sustainably, whether by cultivation of it or harvesting at recognized limits, or how the benefit could be increased by value addition mechanisms etc. It also promotes making industry based on available resources. It also considers aspects of how the non destructive means of ecotourism could provide valuable economy to societies. It provides a local ownership and importance by having protected areas of significance irrespective of its national values, as being not unique. For example a mangrove patch in Batticaloa may be seen locally as the best irrespective of the number of species or the acreage as it is the only patch and may provide a 'nostalgic' sentiment to the local population. The effective management of the biodiversity and systems effectively and economically is emphasized by public private partnership.

The benefits produced to the communities and the recognition associated with the local culture and community would form a significant inducement for the conservation of biodiversity at large.

Development of Ex situ conservation is very important, which would include Botanical and zoological gardens at the outset and lead to gene banks on the longer run. This could be in collaboration with private partnership and also with Universities in the east.

15.3 Check and Balance

Environment had been termed as a cross cutting issue and have been placed in many places without really understanding its impacts. For example Jack of all trades and master of none is an appropriate phrase. Even the drawbacks of the legislations are rarely corrected. The classic example is the need for EIA for a 4 hectares shrimp farm, which is circumvented by two 3.9 hectare farms adjacent to each other by one or two owners. The law survives and the environment suffers, by lack of vision. Many of such applications could be recognized. Lack of monitoring and evaluation of the impacts are key to these errors or omissions. It is also important to recognize the lack of law implementation as a whole which causes significant concern to the Biodiversity at large.

The plan provides for various steps to provide a forum for the discussion of the biodiversity and mechanism for checking the effectiveness of legislations and implementations.

Inclusion of the PBAP in the development forum at various levels would provide at least a discussion around it and increase the chance of considerations. Further appropriate correction to legislations and effective monitoring may provide a better chance for Biodiversity conservation. This would be most effective with EDUCATION already suggested and Utilization.

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