MANGROVES OF SRI LANKA

LEONARD PINTO

NATURAL RESOURCES, ENERGY & SCIENCE AUTHORITY OF SRI LANKA

MANGROVES OF SRI LANKA

LEONARD PINTO F.S.C.

B.Sc. M. Phil. Ph. D.

Natural Resources, Energy & Science Authority of Sri Lanka

page	error	correction
7 & 8	viviperous	viviparous
8	synonymn	synonym
10	persistant	persistent
15	*aggalocha*	*agallocha*
15	dioceius	dioecious
16	*molluccensis*	*moluccensis*
19	veination	venation
20	*Heretiera*	*Heritiera*
28	*Uca dussumieri*	*Uca vocans*

A PUBLICATION OF THE
NATURAL RESOURCES ENERGY AND SCIENCE AUTHORITY
OF
SRI LANKA

1986

ISBN : 955 — 590 — 002 — 7

Photographs by W.D. Nandasiri
Illustrations by R.P. Dissanayake

PRINTED IN SRI LANKA BY THE NATURAL RESOURCES, ENERGY & SCIENCE AUTHORITY OF SRI LANKA, COLOMBO.

CONTENTS

FOREWORD

The mangroves in Sri Lanka are small in extent and fast decreasing. It is appropriate, at this time, to emphasize the conservation and rational management of our mangroves. The publication of this small book titled 'Mangroves of Sri Lanka' is timely.

This book gives, (in very simple form), most of the information about our mangroves. It is written mainly for the general public to disseminate scientific information to a large segment of the society so that they will be aware of the less known resources of our country.

Having worked in the mangroves of Sri Lanka for half a decade and in the mangroves of the Philippines for the same period, the author has wide experience in this field. The descriptions are critical and concise. The photographs are colourful and attractive.

I am sure this book will serve the purpose for which it was written. It is also a pioneer in a different type of publication, with the general public and the student of science as its user.

Dr. R.P. Jayewardene

Director-General

NARESA.

PREFACE

This book is written mainly for the general public. The objective of the book is, for everyone to know what mangroves are and appreciate their value and significance. Since pictures can give quick information than descriptions, mangrove plants are identified pictorially. However for the critical student more information is available.

Identification of animals is generally difficult and often needs microscopic examination. However in this book the identification of animals is superficial to help the layman to identify the animal with spot checks. This section is not good enough for the critical biology student.

Once plants and animals are identified it is natural that one should know where they are found and what are their uses. The subsequent chapters deal with these topics. The last chapter emphasizes the importance and significance of the mangroves of Sri Lanka and the need for conserving them.

Though not very exhaustive, it is expected that this book will help the students, teachers, planners and the general public.

I am also thankful to all those who helped in the production of this book. The production was initiated by Dr. R.P. Jayewardene, the Director General of NARESA. Dr. S. Liyanage coordinated the work. Mr. G. Felician and Mr. A. Ranasinghe Ptg. Supdt. of NARESA press, worked fast to produce the book in a short period of time. Mrs. R.P. Dissanayake helped with illustrations and Mr. W.D. Nandasiri helped with photography. Without their help the completion of this book would not have been possible.

Leonard Pinto
Open University of Sri Lanka

1. WHAT ARE MANGROVES

A few decades ago all marsh lands were considered to be wastelands that should be filled up for development. But today we know that all marsh lands are not the same. Mangrove habitat is one such marsh land found in coastal area, with unique characters differing in structure and function from the freshwater swamps and peat bogs. The greatest contribution of mangroves to our well-being is that they enhance the marine food production by supplying nutrients to the lagoons and near shore and by serving as nursery grounds for crustaceans and fish.

The etymology of the word is not very clear. But there is evidence to accept that it is derived from the Malay word manggi-manggi which is the name given to the red mangrove. The word mangroves refers to the species of plants growing on the shores of lagoons with special adaptations to saline conditions. In common usage we refer to different species of mangroves as red mangrove (*Rhizophora* spp.) and honey mangrove (*Avicennia* spp.). Sometimes the word mangroves is also used to mean a community as in the case of mangroves of Negombo or mangroves of Kala oya. In recent times, the term mangal has been used to denote the mangrove community and mangrove to mean the species. But authors have not always adhered to this terminology.

The mangrove ecosystem is defined as the intertidal and supra tidal zone of muddy shores in bays, lagoons and estuaries dominated by highly adapted woody halophytes, associated with continuous water courses, swamps and backwaters, together with their populations of plants and animals. The mangrove ecosystem is composed of two main parts, the terrestrial component and the aquatic component. The aquatic part is also composed of marine and freshwater components. The ecosystem is described as highly productive, very fragile and resourceful. It is also designated as an energy subsidized ecosystem since the tidal currents do much work in distributing the nutrients.

The mangrove ecosystem which has emerged as a result of merging of contrasting habitats is unique. In response to the demands of this unique environment, organisms have developed interesting adaptations. These adaptations are clearly seen in a number of mangrove plants belonging to different families.

Although there is plenty of water, the salt conditions of the environment makes it difficult for the plants to use it. Almost all the mangrove plants have developed a thick cuticle to conserve water. Some of them such as the mangrove holly (*Acanthus ilicifolius*) and the honey mangrove (*Avicennia* spp.) are capable of taking in salt water and secreting salt through their salt secreting glands (Fig. 1).

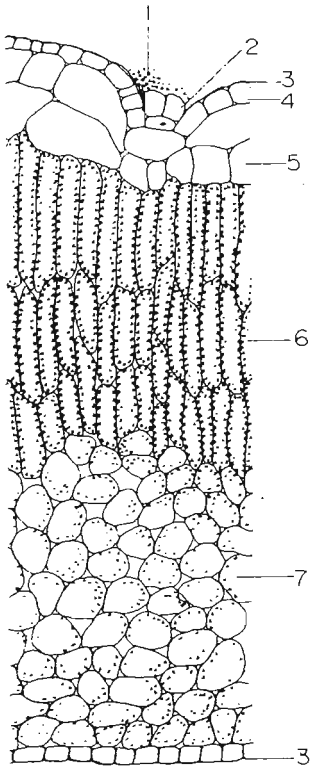


Fig. 1. T.S. *Acanthus ilicifolius* leaf

1 – salt crystals
2 – salt secreting gland
3 – cuticle
4 – epidermis
5 – water storage tissue
6 – palisade parenchyma
7 – spongy parenchyma

Fig. 2. Knee roots of *Bruguiera* and pneumatophores of *Avicennia.*

The ebb and flow of the current washes off the substratum and makes it difficult for an ordinary plant to establish on soil. But the common red mangrove (*Rhizophora* spp.) has developed prop roots to support the plant.

Mangroves also live in a soil poor in oxygen. Soil oxygen is necessary for the respiration of roots. As an adaptation to live in anaerobic condition, specialized roots known as pneumatophores grow above the soil. In *Avicennia* spp. they are pencil like and in *Sonneratia* spp. they are stumpy. For the same purpose *Bruquiera* spp. have knee roots (Fig. 2).

The harsh conditions of the mangrove environment has made it difficult for the development of young plants. An adaptation known as viviparity has developed, where the seeds grow to

juvenilhood while still on the mother plant. Once released from the mother plant they get attached to the mud with their spike-like hypocotyl. This adaptation is seen in most mangrove plants such as in the species of *Rhizophora*, *Bruquiera*, and *Ceriops*.

A typical mangrove plant has most of these adaptation. Some species such as *Avicennia* are adapted to live in more saline conditions whereas *Nypa fruticans* occurs in less saline conditions. Further away from the typical mangrove vegetation are species that occur even under non-saline conditions. These are often referred to as mangrove associates.

The animals living in the mangrove area have invaded from land, sea or freshwater. Some of their adaptations are related to the substratum which is muddy. The typical mangrove fish, the mudskipper (*Periophthalmus* sp.) has developed its fins to skip on land and water. Its eyes can be used to see on land and under water and the skin is used as an additional respiratory surface.

The terrestrial crabs are also adapted to live on land for a very long time. When they are on land, the branchial chamber which covers the gills is kept moist and respiration continues. From time to time they go under water to moisten their branchial chamber.

Burrowing habits are common among many mangrove animals. The burrow serves as a place to live, to dine, to breath, to hide and to mate. The mud skipper makes its burrow only during the breeding season. Very interesting prenuptial rituals have been reported for some species of mud skippers.

Crabs have different shapes of burrows. The common grapsid crabs (*Chiromantes* spp.) occur between mangrove roots or in small water holes. The fiddler crabs (*Uca* spp.) have a single burrow which normally ends below the water table. The grapsid crab *Neosermatium malbaricum* that occurs in firm soil has a T-shaped burrow, forming two arms immediately after the entrance. The grapsid crab *Neosermatium smithi* has very complex burrows with a number of side arms. This nocturnal crab is very

active building "castles" above ground during the rainy season. The most complex burrow is found in the mud lobster *Thalassina anomala.* It hardly leaves the burrow and keeps on moving soil to the surface during the nights of the rainy season.

Polychaetes in the mangroves such as *Branchiocapitella singularis* and *Marphysa boradellei* reside in the top soils during the rainy season but penetrate deep in the dry weather.

Some mangrove animals are adapted to live attached to mangrove roots. The oysters (*Crassostrea* spp.) are often found attached to the roots of *Rhizophora* and *Bruguiera* plants. With them a small community composed of gastropods, bivalves, crabs, shrimps, barnacles, isopods, amphipods, polychaetes, sponges and fish exists. Gastropods such as *Littorina scabra* and *Cassidula musterina* occur on mangrove leaves and stems. *Metapograpsus messor* is a grapsid crab capable of climbing mangrove roots.

Although little information is available on the physiology of mangrove animals and plants, they clearly indicate their adaptations to the harsh conditions of the mangrove environment.

The mangrove soils have relatively small soil particles. Particle size less than that of fine sand (less than 0.25 mm) is common. The particle size increases from the shore inwards to the land. The soil is generally acidic, due to the activity of sulphur bacteria. The mangrove soil is generally rich in sodium ion. Calcium and magnesium content is generally higher than that of potassium. Due to the gradients set up by the edaphic factors and the tidal inundation mangrove plants show zonation, in which *Rhizophora* spp. forms a common border along the shore.

Fig. 3. *Rhizophora mucronata*

Fig. 4. *Rhizophora apiculata*

2. HOW TO KNOW THEM

MANGROVE FLORA

Family : Rhizophoraceae
Genus : *Rhizophora*

Sinhala : Kadol
Tamil : Kandal

The local name for the mangroves is derived from the abundant genus *Rhizophora.* There are two species belonging to this genus in Sri Lanka. *R. apiculata* and *R. mucronata.* They normally grow along the muddy shores and have plenty of prop roots and stilt roots. The leaves are thick, and leaves a scar on the stem when they fall.

The flower has 4 sepals and 4 white petals. *R. apiculata* differs from *R. mucronata* in that *R. apiculata* has sessile flowers with short stalks while *R. mucronata* (Fig. 3) has long stalks. This makes the *R. mucronata* viviperous fruits to hang gracefully while the viviperous fruits of *R. apiculata* on the stem are clumsy and are often curved (Fig. 4). The leaf apex of *R. mucronata* is mucronate.

Fig. 5. *Bruguiera gymnorhiza*

Fig. 6. *Bruguiera cylindrica*

Family : Rhizophoraceae

Genus : *Bruguiera*

Sinhala : Malkadol, Sirikanda

There are 3 species of *Bruguiera* in Sri Lanka. They do not have prop roots but knee roots (Fig. 2). Their leaves are leathery in texture like *Rhizophora* spp. They leave scars when their leaves fall. They also have viviperous fruits. But the hypocotyl of the fruit is not so long as in *Rhizophora* spp.

Bruguiera gymnorhiza (Fig. 5) can be easily identified by the red colour of the calyx. There are 12-16 sepals. *B. sexangula* resembles *B. gymnorhiza*, but its calyx is not red. Often it is yellow or orange and there are only 10-12 sepals. The viviperous fruit of *B. cylindrica* looks very much different from the other two species. Its hypocotyl is small and slender. There are only 7-8 green sepals in *B. cylindrica* (Fig. 6). *B. conjugata* is a synonym of *B. gymnorhiza*, *B. eriopetala* is a synonymn of *B. sexangula and B. caryophylloides* is a synonymn of *B. cylindrica.*

Fig. 7. *Ceriops tagal*

Family : Rhizophoraceae
Genus : *Ceriops*

Sinhala : Punkanda, Rathugas
Tamil : Chirukandal

Although in South East Asia they are tall trees, in Sri Lanka they occur as short bushes. They have stilt roots. The leaves are leathery in texture, opposite and wider towards the apex than near the base. Leaf scars occur on the stem. The flowers are small and greenish yellow in colour. There are 5-6 petals and the same number of sepals.

Although two species of *Ceriops* have been reported the common species in Sri Lanka is *C. tagal* (Fig. 7). The flowers of *C. tagal* have short stalks but the flowers of *C. roxburghiana* are without stalks. The petals of *C. tagal* have 3-4 club shaped appendages while the petal apex of *C. roxburghiana* is lacerate. The current name for *C. roxburghiana* is *C. decandra*. *C. candolleana* is a synonym of *C. tagal*.

Fig. 8. *Sonneratia alba*

Family : Sonneratiaceae (Lythraceae)
Genus : *Sonneratia*

Sinhala : Kirilla
Tamil : Kinna

They are small trees. Branches are pendulous carrying dull green foliage. Around the tree are found stumpy pneumatophores. Persistant calyx and style can be seen on the fruit which is a spherical berry. There are 6-9 green sepals and 6 petals. Stamens are numerous.

In Sri Lanka, there are 3 species of *Sonneratia*. *S. apetala* is without petals. *S. alba* has 6 white petals and *S. caseolaris* has 6 red petals. The leaves of *S. alba* are narrow and pointed at the apex, (Fig. 8) while those of *S. caseolaris* are rounded at the apex. In *S. caseolaris* often 2-3 flower buds are found together, but in *S. alba* often flowers occur singly. *S. acida* is probably a synonym of *S. caseolaris*.

Fig. 9. *Avicennia marina*

Family : Avicenniaceae (Verbenaceae) **Sinhala** : Manda, Mada gas

Genus : *Avicennia* **Tamil** : Kanna

They grow in sandy soils and prefers a dry climate. They are trees with plenty of branches or can show a stunted growth when the soil salinity is high. The bark is white in colour. They can be identified by the large number of pencil like pneumatophores around them. The underside of the leaves have a shade of white. The yellow sessile flowers are borne on a panicle. They give an odour like that of bee's honey. Fruit is a capsule. In mature fruits two large cotyledons are present.

In Sri Lanka, there are 2 species of *Avicennia*. In *A. marina* (Fig. 9) the leaf apex is pointed and in *A. officinalis* it is rounded. The fruits of *A. marina* are comparatively smaller than those of *A. officinalis*.

Fig. 10. *Aegiceras corniculatum*

Family : Myrsinaceae
Genus : *Aegiceras*

Sinhala : Heen kadol
Tamil : Vethilikanna

Aegiceras corniculatum (Fig. 10) is the only species found in Sri Lanka. It is a highly branched shrub. The bark is white or brown in colour. The leaves are alternate, leathery, smooth, rounded and sometimes notched at the apex.

The inflorescence is an umbel. The white flowers are fragrant and borne on slender stalks. The clayx has 5 sepals which are twisted to the left and overlapping to the right. There are 5 petals and 5 stamens, inserted in the corolla tube. The fruit is curved and shows viviparity.

Fig. 11. *Acanthus ilicifolius*

Family : Acanthaceae
Genus : *Acanthus*

Sinhala : Ikili, Katu-ikili, Mulli
Tamil : Mulli

Acanthus ilicifolius is the only mangrove species present in Sri Lanka (Fig. 11). It is a creeper or a shrub with small prop roots and thorny leaves. The leaves are opposite and have very short petioles. Often spines are found at the leaf base.

Sessile flowers are borne on spikes and are surrounded by 2 bracts and a bracteole. The flowers are purple. Calyx has 4 sepals. Fruit is a capsule.

White flowered *A. ebracteatus* has not been reported in Sri Lanka.

Fig. 12. *Lumnitzera racemosa*

Family : Combretaceae
Genus : *Lumnitzera*

Sinhala : Bariya
Tamil : Tipparethai

Lumnitzera racemosa (Fig. 12) is the only species of mangrove *Lumnitzera* described so far for Sri Lanka. It is a shrub or a small tree, evergreen with smooth purplish bark. The leaves are fleshy, apex is rounded and notched. The leaf base is pointed and the petiole is very short. Leaves are spirally arranged.

Small sessile white flowers are arranged on a spike. Calyx is green with 5 sepals. Petals are white and 5 in number. There are 5-10 white stamens. The fruit is woody, green, oblong and narrow at both ends, crowned by persistent calyx and with a single seed.

Scarlet flowered *L. littorea* has not been reported in Sri Lanka.

Fig. 13. *Excoecaria aggalocha*

Family : Euphorbiaceae
Genus : *Excoecaria*

Sinhala : Thelakiriya, Thela
Tamil : Thilla

E. aggalocha (Fig. 13) is a small tree growing on firm mud or sand. The bark is light grey and broadly checked with dark streaks. It is dioceious. Its latex is believed to be very poisonous. The leaves are oval, acute at base, accuminate, crenate and alternatively arranged. The mature leaves are red in colour. The male flowers are found on spikes which grow singly in the axils of leaves. Female flowers occur as spikes on branches and are few in number. Flowers are very small. There are 3 sepals, 3 stamens and no petals.

Fig. 14. *Xylocarpus granatum*

Family : Meliaceae
Genus : *Xylocarpus*

Sinhala : Mutti kadol
Tamil : Somuntheri, Kadal manga

This is a small tree with dark brown petiole and bark. Leaves alternate and are pinnate. These compound large leaves have 1-3 pairs of leaflets. They are articulated, margin entire and apex retuse.

Flowers are borne on long flowering branches, and are large. Calyx has 4 sepals. 4 petals are rounded and their edges are overlapping. The large spherical fruit has a corky leathery covering which usually splits into 4 pieces as the fruit dries.

In Sri Lanka, there are 2 species of *Xylocarpus*. The fruit of *X. granatum* (Fig.14) is 17-25 cm in diameter whereas the fruit of *X. molluccensis* is about the size of a small orage. The fruit of *X. granatum* is light coloured, globose and smooth while that of *X. molluccensis* is dark brown, compressed and wrinkled.

Fig. 15. *Clerodendron inerme*

Family : Verbenaceae
Genus : *Clerodendron*

Sinhala : Wal gurenda, Gowinda
Tamil : Pinchi, Pinari, Pichuvilathi

Clerodendron inerme (Fig. 15) is a much branched small shrub with a pale brown bark. The leaves are small and oval in shape.

White flowers occur on a cyme. Stamen and style are exerted.

Fig. 16. *Nypa fruticans*

Family : Palmae
Genus : *Nypa*

Sinhala : Gin pol

Nypa fruticans is the only palm growing naturally in the mangroves (Fig. 16). It occurs along the tidal rivers. It has a stout, subterranean rhizome and the leaves are erect with long petioles. The inflorescence is very characteristic with large globose fruiting head. The fruit is a fibrous drupe and it takes about 4 months for the fruit to ripen.

Fig. 17. *Acrostichum aureum*

Family : Pteridaceae (Polypodiaceae)
Genus : *Acrostichum*

Sinhala : Karen koku
Tamil : Minni

Acrostichum aureum is the only fern growing in our mangroves (Fig. 17). Some times it is found in freshwater marshes too. Rhizome is erect and stout. Leaves are pinnate and leathery. Veination is reticulate. Sori are found along the veins and are ex-indusiate.

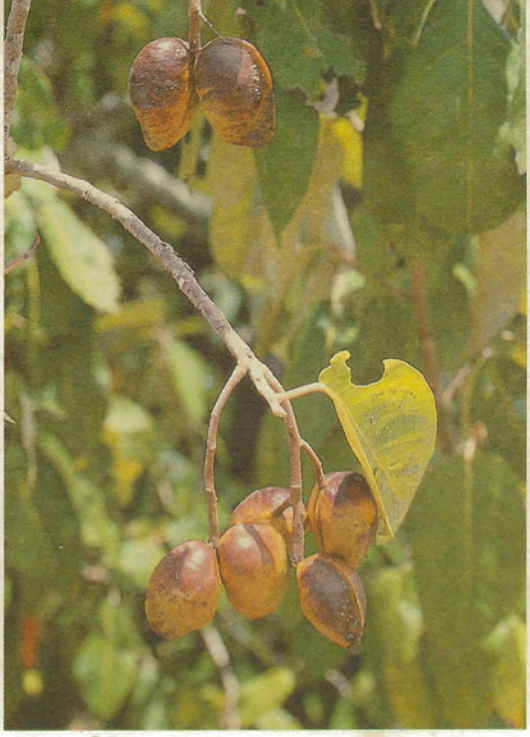


Fig. 18. *Heretiera littoralis*

Family : Sterculiaceae
Genus : *Heretiera*

Sinhala : Etuna
Tamil : Chomuntiri

Heretiera littoralis is a tree, normally found away from the shore (Fig. 18). Some times it occurs around freshwater streams. The bark is longitudinally furrowed. Young parts may bear peltate scales. The leaves are green on the upper surface and silvery below. The flowering branches are borne in the axils of leaves and are hairy. The flowers are unisexual, yellowish green and bell shaped. The flower has no petals. Calyx has 5 sepals. Fruit is hard and woody with a keel.

Fig. 19. *Dolichandrone spathacea*

Family : Bignoniaceae
Genus : *Dolichandrone*

Sinhala : Diya danga
Tamil : Mankulanchi, Vilpadri

Dolichandrone spathacea is a tree with high branches (Fig. 19). Leaf scars are prominent on the stem and the leaves are glossy. Leaflets of 7-13 are found with short stalks.

3-4 flowers occur in a cluster. These white flowers have a long corolla tube. The fruit is a follicle about a foot long. There are many seeds within the corky testa.

Fig. 20. *Cerbera manghas*

Family : Apocynaceae
Genus : *Cerbera*

Sinhala : Gon Kaduru
Tamil : Nachchukkai

Cerbera manghas (Fig. 20) is found in mangroves, fresh water marshes and rice fields. They are trees with prominent leaf scars. Leaves are linear, lanceolate and are alternatively arranged. Flowers are large and white in colour. Corolla has 5 petals. Calyx tube has 5 sepals. Fruit is smooth and rounded. It is a fibrous drupe.

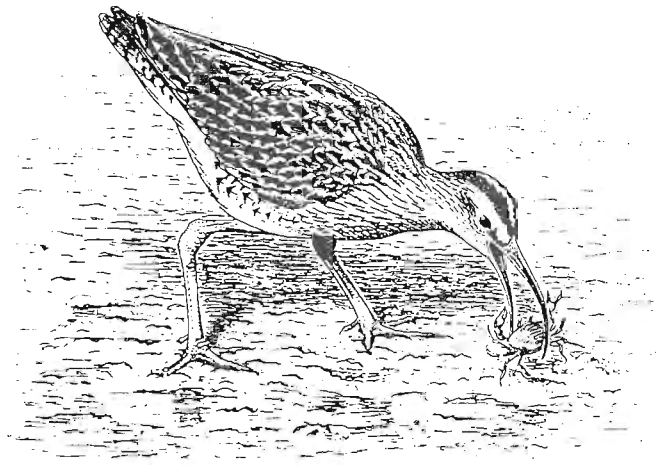
Fig. 21. *Derris scandens*

Family : Leguminoseae
Genus : *Derris*

Sinhala : Kala wel
Tamil : Tekil

Derris scandens (Fig. 21) is a creeper common in the mangrove vegetation. The leaves are oblong, lanceolate, acute at base and emarginate at apex.

White flowers are borne on a slender peduncle. *D. uliginosa* has pink flowers.



MANGROVE FAUNA

There are many species of mangrove animals than plants. Unlike plants some of them are microscopic and difficult to identify. There are animals like the fish that go to the mangroves with the tide but reside in the lagoon. The following short account is about the abundant macroscopic mangrove animals. Identifications are not exhaustive and aimed at identifying the species quickly in the field. For more detailed scientific identifications the reader is advised to refer to keys of different animal groups. No account is given on the birds and the fishes of the lagoon. For birds, the reader is advised to refer to "A guide to the birds of Ceylon" by G.M. Henry and for the fishes to refer to "the marine and fresh water fishes of Ceylon" by S.E. Munro.

Fig. 22. Portunid and ocypodid crabs

Phylum : Arthropoda
Class : Crustacea
Order : Decapoda
Sub order : Brachyura

There are a number of crabs that frequent the mangroves during the high tide and others reside in the mangroves or the intertidal region. Fig. 22 shows the crabs of the family Portunidae and family Ocypodidae.

Family : *Portunidae*

Portunid crabs (Fig. 22; 1-3) are swimming crabs and their last pair of legs is modified for this purpose. These crabs have a characteristic shape of the shell (carapace); anterior and posterior borders are parallel while the lateral margins are angled.

Thalamita crenata S. Kaberiya (Fig. 22.1)

This crab resembles the mud crab, but generally it is not sold in the market. The colour of the carapace is like that of the mud crab. But there are 2 clear horizontal lines and a 3rd

broken lines on the carapace. The spines on the antero-lateral border are less than 8. Often there are only 5 spines along the antero-lateral border. Spines are almost equal in size. The claw is heavily built and black at the tip. They do not grow to a large size.

Portunus pelagicus (Fig. 22.2) S. Sinnakkali

Sea crab can be identified by the beautiful colour patterns on its carapace. Carapace and legs are often mottled with green, yellow and sometimes blue colour. The last spine on the antero-lateral border is very long extending laterally. The claw is thin and longer than that of *Scylla serrata*. It is also known as *Neptunus pelagicus*.

Scylla serrata (Fig. 22.3) S. Kalapu kakuluwa, Kadol kakuluwa

Mud crab or the mangrove crab is the most expensive of all the crabs. Although often found in the lagoon it frequents the mangroves, and sometimes are found in deep burrows in the swamp. It can be easily identified by the dark green colour of the shell. Some of them acquire a deep red colour in the claws and is believed to be due to their association with the mangroves. The antero-lateral border (the space between the eye and the legs) has 8 spines of equal size, excluding the one bordering the eye.

Family : *Ocypodidae*

Fiddler crabs are found in the sandy intertidal region.Their last pair of legs is not modified for swimming and they live in burrows. In the male one leg is modified to form an enlarged claw. In the female thereis no such modification. The males keep on waving the large claw, probably to attract the female. Their carapace is rectangular in shape and eyes are stalked.

Macrophthalmus depressus (Fig. 22.4)

This ocypodid is found in the mud flats adjoining the mangroves. Its carapace is very much broader than long. The carapace is dull green in colour and has depressions on it. Eye stalks are very long. Often when they are submerged, they keep their eyes above the water level.

Uca lactea (Fig. 22.5)

This fiddler crab can be identified by the shape of the large claw. The upper margin of the claw is convex and the inner margin is almost smooth with few tubercles. There is a single space when the claw is closed. The claw is white or pink in colour. The carapace may be blue-black, purple or sometimes with white horizontal lines. There are a number of sub species of *U. lactea.*

Uca dussumieri (Fig. 22.6)

This fiddler crab grows to a larger size than the former. The claws are yellow in colour and when closed 2 cavities can be seen. The internal border of the claw is rough.

Fig. 23. Grapsid crabs

Family : *Grapsidae*

Neosermatium malbaricum (Fig. 23.1)

This is a shy crab and it is active in the evening. It burrows in firm soil. The burrow is T-shaped with 2 arms. The carapace is purple in colour, and somewhat rounded on the lateral walls and dorsally. A U-shaped depression is found on the carapace. There are spines on the anterolateral margins. When the claw is closed, a large cavity can be seen between them. In *Neosermatium* species, the male abdomen with telson is remarkably elongated.

Metapograpsus messor (Fig. 23.2)

This crab is found among the mangrove roots. Its carapace is flat and the lateral margins are straight. There is a broad, curved depression extending from one lateral wall to the other. The carapace is mottled with olive green and purple colours. The claws are small.

Chiromantes indiarum (Fig. 23.3)

All the members of the genus *Chiromantes* have the following characters. There are 2 anterolateral teeth behind the eye. The carapace is almost a square. The upper surface of the palm of the cheliped has 2-3 transverse pectinate crests.

C. indiarum lives in water holes in the mangroves. It can be identified in the field from its black colour of the carapace and its rough surface.

Chiromantes bidens (Fig. 23.4)

C. bidens generally prefers sandy soils. It can be identified by the colour of the carapace and the limbs which are mottled with yellow and black colours.

Chiromantes darwinensis (Fig. 23.5)

C. darwinensis also prefers the water holes like *C. indiarum*. Its carapace is smooth and purple to red in colour.

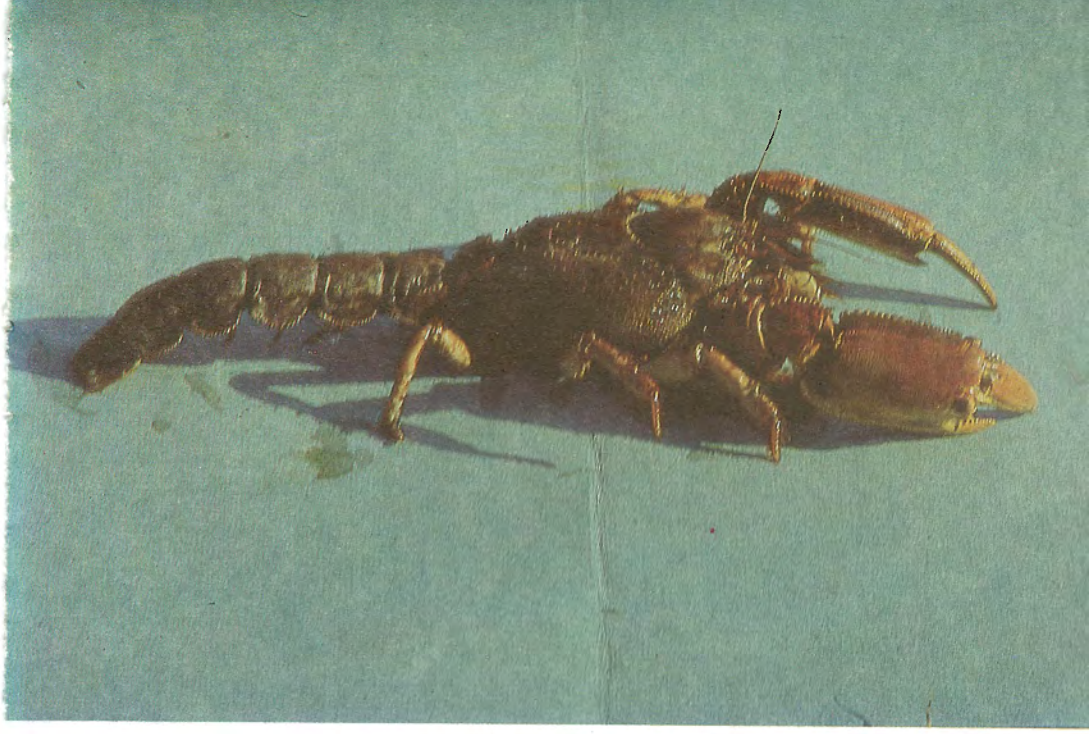


Fig. 24. Mud lobster

Phylum : Arthropoda
Class : Crustacea

Order : Decapoda
Sub order : Macrura

Burrowing macruran

Thalassina anomala (Fig. 24)

Mud lobster is unique to mangrove environment. It lives in burrows and hardly leaves the burrow. Their mounds can be seen in the mangroves. Its Cephalothorax is large and the abdominal appendages are poorly modified. The claws of the first walking leg is used to carry mud.

Swimming macrurans

Shrimps and prawns that swim in the lagoon frequent the mangroves especially for feeding. These macrurans are classified into two major tribes, namely Penaeidea and Caridea.

Fig. 25. Prawns

Tribe : Penaeida
Family : Penaeidae

In penaeid prawns the pleura (scaly covering) of the first abdominal segment overlaps the pleura of the second and so on in sequence. There are 3 pairs of chaelate (clawed) legs. To this family belongs the genera *Penaeus* and *Metapenaeus. Penaeus* has spines on either side of the rostrum, but *Metapenaeus* has spines only on the dorsal side of the rostrum. *Penaeus* is more commercially important than *Metapenaeus.*

Penaeus indicus

Banana prawn or white prawn (S. Kiriissa) (Fig. 25.3) is the common prawn of the lagoons and it can be identified by the characteristic curvature of the rostrum. It differs from the tiger prawn *Penaeus monodon* (S. Kalissa) since it has no dark bands on the abdomen. *P. monodon* is rare in the lagoons. *P. semisulcatus* (S. Kurutiissa) is also found in the lagoon and it can be identified by the bands on the tentacles.

Metapenaeus dobsoni (S. Malissa) (Fig. 25.4)

These are smaller in size than *Penaeus species. Metapenaeus dobsoni* is the common species with spines on the dorsal side of the evenly extending rostrum. In *M. monoceros* the rostrum is crested.

Tribe : Caridea

Caridean prawns (S. bandissa) can be identified by the overlapping pleura of the 2nd abdominal segment over the adjacent segments. There are various species of carideans in the waters around the mangroves (Fig. 25. 1, 2 & 5). Their females normally carry eggs.

In family palaemonidae is the commercially important species of *Macrobrachium*. Normally they prefer less saline water. Palaemonids can be identified by the first two pairs of walking legs which are long and clawed. All *Macrobrachium* species can be separated from the other Palaemonids by the position of the second antennal spine on the carapace which is placed posterior to the first. Commercially important *M. rosenbergii* has 11 or more ventral teeth in the rostrum and the tip of the telson projects beyond the 2 spines.

Another common family of very little commercial importance is alpheidae. These snapping shrimps have the 1st walking leg on one side enlarged with a strong claw. They make noise by snapping this claw. Some times they make shallow burrows around the shores.

Fig. 26. Molluscs

Phylum : Mollusca
Class : Gastropoda

A number of mangrove gastrodes are shown in Fig. 26 (1 & 4, 5, 6, 7). Besides these *Pleuroploca trapezium* and *Faunus ater* also have been collected from the lagoons.

Telescopium telescopium (Fig. 26.1) (S. Uri)

Largest of all the mangrove gastropods is found in the mangrove forest floor. The shell is heavy with a long spire and many whorls. A prominent anterior canal runs down the shell aperture. Each whorl has about 4 annuli.

Nerita polita (Fig. 26.4)

This gastropod is found attached to mangrove roots. Its spire is suppressed and the shell aperture is large. There are clear teeth on the inner lip and the outer lip is heavy. A large operculum is present.

Cerithidea cingulata (Fig. 26.5) (S. Uri)

This member of the family potamididae is abundant on the mud flats adjoining the mangroves. It is about 3 times smaller in size than *T. telescopium.* When the tide recedes, they cover the shell aperture with an operculum. The outer lip is soft and the anterior canal is not very conspicuous. *C. quadrata* is also common in the mangroves, but occurs in the shade.

Littorina scabra (Fig. 26.6)

This member of the family littorinidae is found on the leaves of mangrove plants. The spire is short and the base is broad. Aperture is large. Markings are found on the whorls.

Cassidula musterina (Fig. 26.7)

Occurs on the ground and occasionally on the plants. Some of them are brown and others have white and brown bands. Outer lip is broad and indented close to the upper end. Inner lip has 2-3 teeth. There is no distinct anterior canal.

Phylum : Mollusca

Class : Lamellibranchiata (Bivalvia)

The common bivalves of the mangroves are shown in Fig. 26.2 - 3 and Fig. 27. *Gaffrarium tumidum*, *Perna* spp., *Pinna bicolor* and *Marcia* sp. also occur in the lagoons and they are not shown in these figures.

Geloina coaxans (Fig. 26.2) (S. Matti)

These clams are found in the lagoon bed. They grow to a large size. Umbo is situated in the mid line dividing the anterior and posterior parts of the shell. Cardinal teeth are wide apart. Posterior laterial tooth is small. Outside of the shell is rough, black or dark brown in colour with annulations. It peels off easily.

Meretrix casta (Fig. 26.3) (S. Matti)

These clams are found in the lagoon bed. These clams are smaller than *G. coaxans.* Umbo is situated aneterior to the middle of the shell. Cardinal teeth are situated close to each other at the upper end. Lateral tooth is long. Outside of the shell is smooth, light brown and does not peel off easily.

Fig. 27. Oysters on roots

Saccostrea spp. (Fig. 27) (S. Kawati)

Oysters are often found on mangrove roots. In our mangroves *Saccostrea* and *Crassostrea* are common. *Saccostrea* shells have furrowed margins and can be identified by the dentate margins near the umbo. *Crassostrea* shells are long and comparatively large. The border is even and there is an eccentrically situated black scar on the inside of the shell *C. madrasensis* shell is shallow while *C. cucullata* shell has a deep cup.

Fig. 28. Mud skipper

Phylum : Chordata
Class : Actinopterygii
Order : Perciformes
Family : Gobiidae
Genus : *Periophthalmus* (Fig. 28)

The mud skipper can be easily identified by its protruding eyes and the modified fins. It can use its fins to skip, swim and perch. It is said that *P. koelreuteri* makes double turret burrows while the burrow of *P. sobrinus* is simple. In their appearance they look similar.

3. WHERE ARE THEY FOUND

Mangroves are halophytes: That is, they need saline conditions for their growth. Hence they are distributed along the coast of Sri Lanka. They are restricted to estuaries, lagoons and river mouths.

There is a view that mangroves formed a continuous belt along the coast some time ago and due to human activities they have been reduced to patches. There is another view according to which, the coastal formation of Sri Lanka is such that mangroves would not have colonized the entire coastal belt due to the bed rock and sand accumulation.

Earlier mangrove extent of Sri Lanka was estimated to be between 3000-4000 ha. But recent investigations show that it was an underestimate and that the extent of mangroves in Sri Lanka is between 6000-7000 ha. This is due to the fact that some workers have considered as mangrove land only the areas occupied by typical mangroves while others have included those areas where mangrove plants occur with their associates or with salt marsh plants.

The distribution of mangroves in Sri Lanka is shown in Fig. 29. The largest mangrove patch is said to occur in Puttalam Lagoon — Dutch Bay — Portugal Bay complex (3385 ha). The second largest is the mangrove patch in Batticaloa (1520 ha) and the third is in Trincomallee (1020 ha). One of the least disturbed mangroves in the west coast is in the Kala Oya estuary north of Puttalam bordering the Wilpattu National Park. One of the most disturbed mangroves in the west coast is in Bentota, probably due to the pressure from tourism. In the east coast, the Mahaweli-Kodiyar Delta in Trincomallee is said to harbour rare species, such as *Ceriops decandra* and *Kandella candel.*

Most species are distributed throughout the island but others have a limited distribution. In the north, north-east and north-west species of *Avicennia* dominate, although it is found

distributed throughout the island. Species of *Rhizophora* is also islandwide, but generally they are restricted to the shores of waterways in the mangroves.

Nypa fruticans occurs in Gin oya north of Negombo and in the South-East coast only. *Xylocarpus granatum*, *Ceriops tagal*, *Dolichandrone spathacea*, *Heretiera littoralis*, *Bruguiera gymnorhiza* and *Acrostichum aureum* do not occur in Jaffna. *X. granatum* is found in Chilaw and Batticaloa. *X. molluccensis* is also found in Batticaloa. All the other species are found distributed throughout the island.

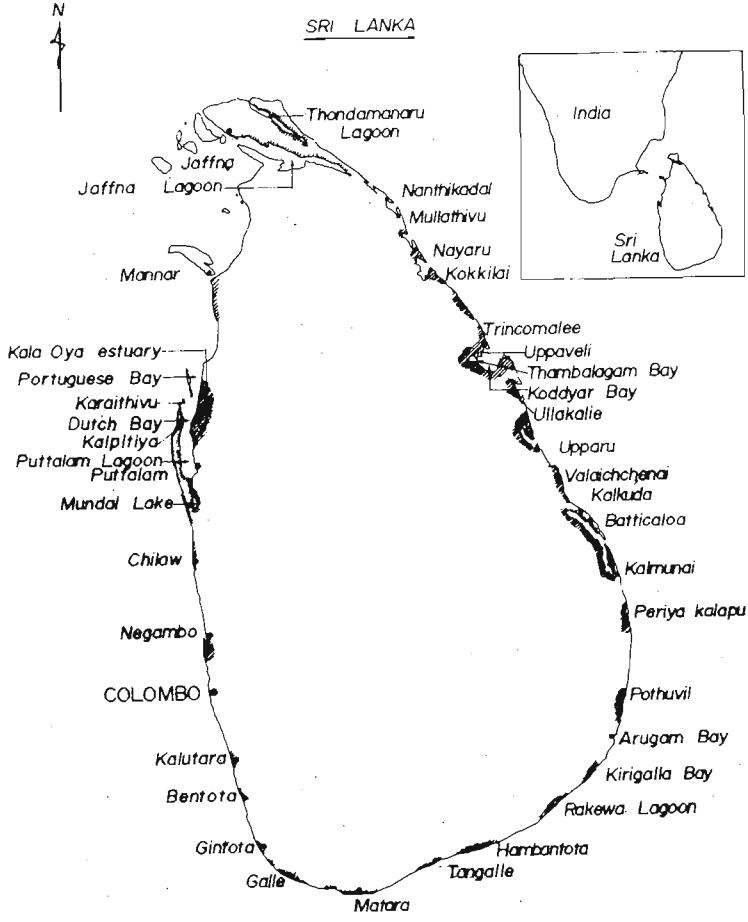


Fig. 29. Distribution of mangroves in Sri Lanka

4. WHAT ARE THEIR USES

For many years the coastal inhabitants have lived close to the mangroves and derived many benefits from them, without totally destroying them. The economic uses normally refer to the things that can be removed from the mangroves and sold for cash. These uses are called extractable uses. Such uses can be derived from the aquatic as well as the terrestrial components of the mangroves.

Food and beverages

Mangrove fringed lagoons are a source of sea food. Fish, crustaceans and molluscs are collected from the lagoons mainly for food.

The tender leaves of *Acrostichum aureum* are used to prepare a vegetable curry. The ripe fruit of *Sonneratia* is used in the preparation of a beverage. Toddy can be tapped from *Nypa fruticans* and converted to alcohol or vinegar.

Firewood and timber

Mangrove wood is used for many purposes. The wood of *Rhizophora* and *Avicennia* are good for fire wood. The charcoal of *Rhizophora* is considered to be of high quality.

Mangrove wood contains a high percentage of tannins and therefore naturally protected from insects. The wood is used for beams and poles in housing construction. *Rhizophora*, *Bruguiera* and *Avicennia* are used in building construction.

The mangrove timber is used in constructing fishing gear and boats. Mangrove wood can last for a long period in water. Hence it is used to make outriggers and poles for fixing nets.

Mangrove wood is also used in making household items such as tool handles and furniture. In the Bentota area *Cerbera manghas* is used for making masks.

Fig. 30. A brush pile

Brush-pile fishery ("mas athu")

This is a fishing method unique to Sri Lanka. The fishermen leave the branches of mangrove plants in the lagoon. After a few weeks when fish have gathered in this "artificial mangrove", the brush pile is encircled with a net, the branches are removed and the fish caught. *Avicennia* branches are preferred for brush piles.

In the Negombo Lagoon there are about 750 brush piles and 80% of the Negombo Lagoon's fishery depends on brush piles.

The fish and crustaceans caught in the brush pile are sold as sea food. In addition, ornamental fish are also caught and they are sold to exporters.

Fig. 31. Products from *Nypa*

Mats and baskets

The leaves of *Nypa fruticans* are used for thatching mats and making baskets (Fig. 31). Unlike in South East Asia, *N. fruticans* is not used for thatching roofs of houses and cabanas.

Tannin

Tannin extracted from *Rhizophora* spp. and *Ceriops tagal* is used to dye nets and sails to give durability to them. Barks are removed, dried, packeted and transported to fishing villages for marketing. Annually about 12,000 kg. of barks are removed from the mangroves.

Lime

The shells of mangrove molluscs are also collected and sent to kilns to convert them to lime. Lorry loads of *Telescopium telescopium* are collected from Kalpitiya weekly. Annually about 150 m tons of cockle and clams and 10 m tons of *T. telescopium* are extracted from the mangroves for lime.

Agriculture

The leaves of mangrove plants especially those of *Avicennia* are used in agriculture as a manure.

Aquaculture

Mangrove areas are good for aquaculture, especially for prawns that need brackish water. Acid sulphate of the mangrove soils, sometimes adversely affect the prawns or fish in the pond.

Animal feed

Cattle and goats feed on mangrove leaves. Perhaps the salt in the leaves make it more palatable to them. Even the thorny *Acanthus ilicifolius* is liked by goats.

Corks and floats

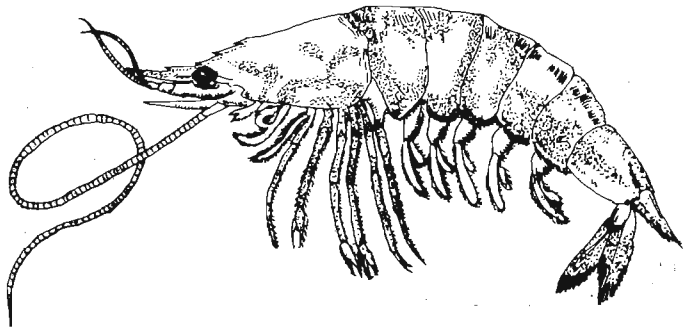
The pneumatophores of *Sonneratia* are porous. Hence they are used as bottle stoppers and floats.

Medicine

Mangrove plants are used as indigenous medicines. *Rhizophora* bark is used to cure fractures. Barks of *Bruguiera* is crushed and used as a poultice on minor cuts. Juice from *Sonneratia* fruit is used for bleeding piles. *Excoecaria* latex is used for skin rashes.

Baits and fish food

Polychaetes especially the large *Marphysa boradellei* (S. Kalandanpanuwa) are dug out of the soil for fish baits. Since they are rich in proteins, there is a demand for polychaetes as fish food. The flesh of *Telescopium telescopium* is also used as fish baits.



5. WHY SHOULD WE SAVE THEM

In the last chapter we saw a number of extractive uses of mangroves. Now let us consider the non-extractive uses of mangroves. These are the benefits we derive without knowing what we are benefiting.

Mangroves are important because of the significant role they play in the coastal fishery industry. They serve as the feeding grounds and the suitable habitat for juveniles of marine fish. They are the nursery grounds for much valued prawns (Fig. 32). It has been shown that prawn catch is less in the parts of lagoons where there are no mangroves.

The nutrients given to the lagoon as detritus from the mangroves is carried away in to the coastal water by the tide. They become the food of microscopic organisms. They are the first steps in a food chain, to end in large fishes of commercial importance.

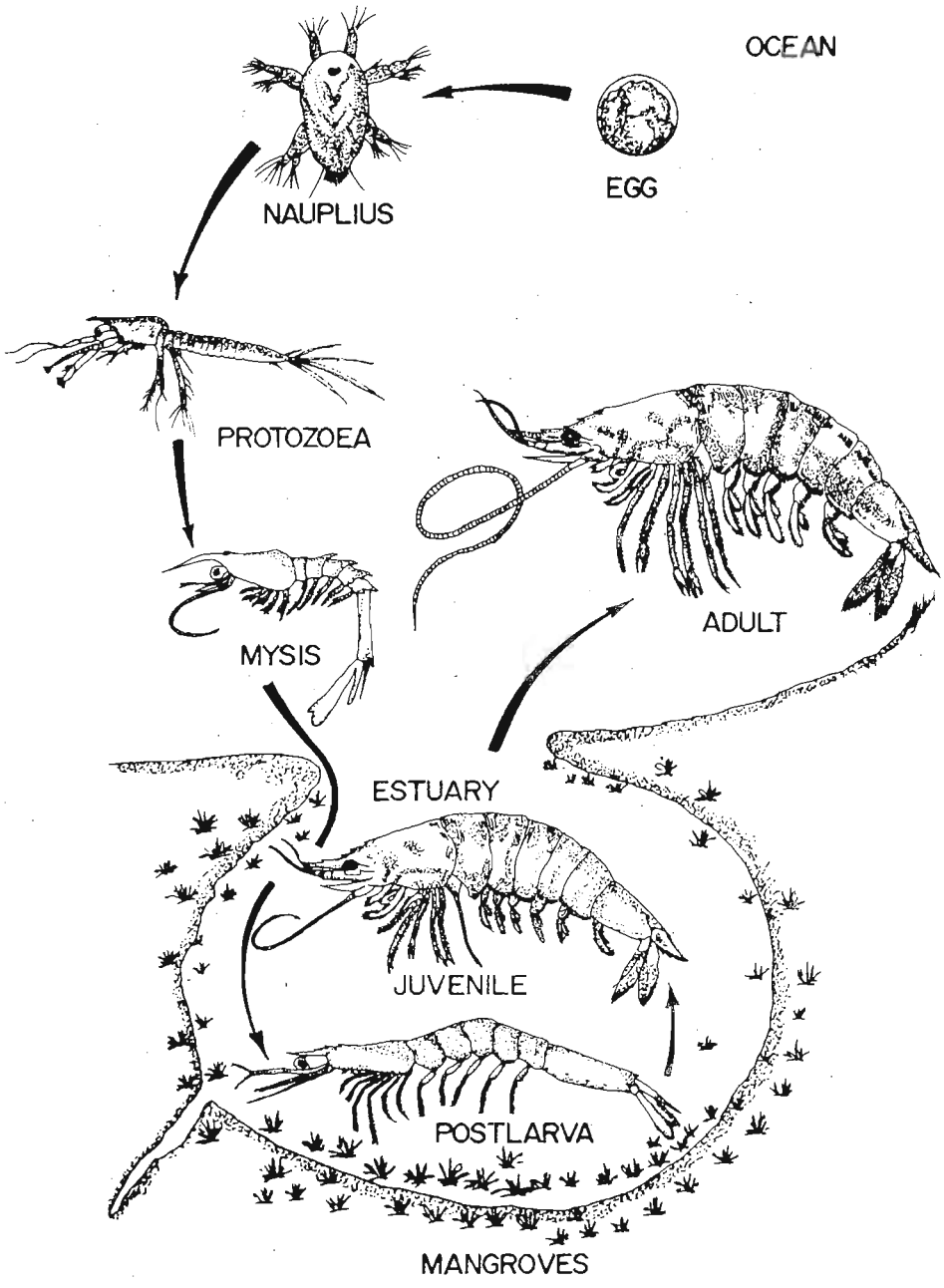


Fig. 32. Life cycle of prawn

Fig. 33. Replanting mangroves

Mangroves protect the shores of estuaries and lagoons against erosion. Sediments get trapped between mangrove roots and help to stabilize the lagoon shore. Thus they reduce siltation of lagoons. In doing so, they also protect the nearby ecosystems such as coral reefs and sea grass beds which are very sensitive to siltation. Mangroves also absorb pollutants. They can keep the level of pollutants in lagoons at a low level.

Mangroves are recreational grounds for fishing and boating. Migratory birds visit the environs of mangroves and the nearby mud flats. Hence they are suitable for bird watching.

Mangrove plants and animals show many adaptations to the environment and species diversity is also high. They are ideal material to study biological phenomena such as adaptation and diversity. Mangroves serve as field laboratories for College and University students and they do visit the mangroves occasionally.

Although mangroves are very useful to man they are fast disappearing. The destructive activities of fishermen in the mangroves affected but little and kept the mangroves in existence for a long time. Some of them are even replanting mangroves in their backyard (Fig. 33). It is unfortunate that some large scale 'development' projects have been undertaken in the mangroves, completely destroying them. The major threats to our mangroves today come from aquaculture and building construction projects.

The extent of mangroves in Sri Lanka is small compared to those of Asian countries (Table 1). This table also shows the small amount of mangrove land as a percentage of the total land area.

COUNTRY	MANGROVE AREA (Ha)	PERCENTAGE OF MANGROVE AREA
Indonesia	3.6×10^6	1.9
Malaysia	6.5×10^5	2.0
Bangladesh	6.3×10^5	4.4
Burma	5.2×10^5	0.76
India	3.6×10^5	0.11
Vietnam	3.2×10^5	0.96
Thailand	3.1×10^5	0.60
Pakistan	2.5×10^5	0.31
Philippines	2.2×10^5	0.70
Sri Lanka	6.3×10^3	0.10
Singapore	1.8×10^3	2.9

Table 1. The extent of mangroves in some Asian countries.

Not only the area of mangroves in Sri Lanka is small, the mangrove extent as a percentage of available land is lowest in the region. That means there is plenty of non-mangrove land available for agriculture and development projects. Should we protect the little we have or allow it to be destroyed by mismanagement for ever?

REFERENCES

Abeywickrema, B.A. (1960). Estuarine vegetation of Ceylon. *Proc. Abidjan Symposium on the humid tropics.* UNESCO, pp. 207–210.

Amarasinghe, M.D. (1986). Socio-economic status of the human communities of selected mangrove areas on the West Coast of Sri Lanka (unpublished report). 52 pp.

Amarasinghe, M.D. and Perera, W.K.T. (1984). A preliminary survey of peripheral vegetation communities of Puttalam Lagoon and Dutch Bay. *Proc. 40th SLAAS Ann. Ses.* (abstract).

Arriola, F.J. (1940). A preliminary study of the life history of *Scylla serrata* (Forskal). *Philipp. J. Sc.* 73: 437 – 456.

Aruchelvam, K. (1968). The mangroves. *The Ceylon Forester,* **8** (3 & 4): 59 – 92.

Brown, W.H. and Fisher, A.F. (1928). *Philippine mangrove swamps.* Bull. No. 17, Dept. of Agric. and Nat. Res., Bureau of Forestry, Philippines, 132 pp.

Burukovskii, R.N. (1982). *Key to shrimps and lobsters.* Oxonian Press, New Delhi, 174 pp.

Chhapgar, B.F. (1957). On the marine crabs (Decapoda, Brachyura) of Bombay State. *J. Bombay Nat. Hist. Soc.* 54: 399 – 439, 503 – 549.

Crane, J.C. (1975). *Fiddler crabs of the world* (Ocypodidae: Genus *Uca).* Princeton University Press. New Jersey, 735 pp.

De Fonseka, R.N. and Balasuriya, I. *The mangroves* (In Sinhala). Praja Press, 29 pp.

De Silva, M. (1986). Survey of flora and fauna of mangroves in the West Coast of Sri Lanka. (unpublished report) 14 pp.

De Silva, S.S. (1980). Biology of juvenile mullet: a short review. *Aquaculture*, **19**: 21 – 36.

Dijk, D.K. van (1960). Locomotion and attitudes of the mud skipper *Periophthalmus*, a semi-terrestrial fish. *S. Afr. J. Sci.*, **56** : 158 – 162.

Flueeler, T. (1983). *A mangrove inventory in Eastern Sri Lanka.* A case study of man's pressure on natural resources. ACRS, 13 pp.

Gunawardena, D.C. (1968). *The flowering plants of Ceylon.* Lake House Pub., Ceylon, 268 pp.

Hussain, Z. (1983). Management of mangrove ecosystem in the ESCAP region. ESCAP/SACEP, *Symposium on environmental management of mangroves, coral and island ecosystems in South Asia.* 23 pp.

Jayewardene, R.P. (1985). The mangroves of Sri Lanka. *Bakawan*, **4**: 8 – 10.

Kugathasan, K.S. (1969). *Mangrove vegetation of the lagoon:* Hydrobiological survey of the Thondamannaru Lagoon. Bull. 7, Northern Province Science Teacher's Association.

Macnae, W. (1968). A general account of the fauna and flora of mangrove swamps and forests in the Indo-West Pacific region. *Adv. Mar. Biol.*, **6** : 73 – 270.

Macnae, W. and Fosberg, F.R.(1981). Rhizophoraceae. In: Dassanayake, M.D. and Fosberg, F.R. (eds.). *A revised handbook to the Flora of Ceylon.* Vol. 2, Smithsonian Institute, pp. 487 – 500.

Macnae, W. and Fosberg, F.R. (1981). Sonneratiacea. In: Dassanayake, M.D. and Fosberg, F.R. (eds.). *A revised handbook to the Flora of Ceylon,* Vol. 2, Smithsonian Institute, pp. 450 – 453.

Malley, D.F. (1977). Adaptations of decapod crustaceans to life in mangrove swamps. *Mar. Res. Indonesia,* **18**: 63 – 72.

Martosubroto, P. and Naamin, N. (1977). Relationship between tidal forests (mangroves) and commercial shrimp production in Indonesia. *Mar. Res. Indonesia,* **18**: 81 – 88.

Mohamed, K.H. and Rao, P.V. (1971). Estuarine phase in the life history of the commercial prawns of the west coast of India. *J. Mar. Biol. Ass. India*, **13**: 149 – 161.

Noriega, V.R. (1984). Zonation and subratum preference of mudflat fiddler crabs (Ocypodidae) in the Pagbilao mangrove forest reserve with the first record of interbreeding subspecies of *Uca lactea* in Luzon. B.S. thesis, De La Salle University, Manila, 45 pp.

Serene, R. and Soh, C.L. (1970). New Indo-Pacific genera allied to *Sesarma* Say 1817 (Brachyura, Decapoda, Crustacea) *Treubia*, **27**, (4): 389 – 416.

Soh, C.H. (1978). On a collection of sesarmine crabs (Decapoda, Brachyura, Grapsidae) from Hong Kong. *Memoirs of the H.K. Nat. His. Soc.* No.13, pp. 9 – 22.

Trimen, H. (1974). *A handbook of the flora of Ceylon.* Vol. 2, 391 pp.

Pinto, L. (1980). Some uses of mangroves. *Karmantha.* May pp. 23 – 25.

Pinto, L. (1980). Some ecological aspects of a population of mangrove crabs occurring within the islets of Negombo Lagoon (Sri Lanka). *In: Proc. Asian Symposium on mangrove environment, Research and management*, Kuala Lumpur, August 1980.

Pinto, L. (1982). Distribution and zonation of mangroves in the northern part of the Negombo Lagoon (Sri Lanka). *J. Natn. Sc. Coun. Sri Lanka*, **10**, (2): 245 – 255.

Pinto, L. and Wignarajah, S. (1980). Some ecological aspects of the edible oyster *Crassostrea cucullata* (Born) occurring in association with mangroves in the Negombo Lagoon, Sri Lanka. *Hydrobiologia* **69** (1 – 2): 11 – 20.

Samarakoon, J.I. and Pinto L. (1986). Synthesis report for information on critical habitats in the coastal zone. Workshop on critical habitats in the coastal zone, CCD/USAID/URI, Technical report (draft), 76 pp.

Samarakoon, J.I. and Raphael, Y.I. (1972). On the availability of seed of culturable shrimps in the Negombo Lagoon. In: Pillay, T.V.R. (ed.). *Coastal Aquaculture in the Indo-Pacific region.* Fishing news books, Surrey, pp. 251 – 259.

Wignarajah, S., De Fonseka, R.N. and M. Ponnambalam (1986). Report on mangroves along the South West Coast of Sri Lanka , with special reference to the islets of mangrove in the Bentotal Estuary. (unpublished report). 12 pp.

ACKNOWLEDGEMENTS

I wish to thank Prof. B.A. Abeywickrama for confirming some species of mangrove plants. Late Dr. R. Serene identified the grapsid crabs. Dr. R.W. Ingle, Dr. R.J. Lincoln, Ms. Solene Whybrow and Ms. A. Blake who worked in the British Museum (Natural History) also helped in the confirmation of some animals.

The discussions I had with Mr. W.M. Indrasena, Mr. D.S. Jayakody, Mrs. S. Jayamanne and Dr. (Mrs.) A. de Alwis of NARA were very useful in the production of this book.