MANGROVES IN LGOON ECOSYSTEMS: A NEGLECTED HABITAT IN SRI LANKA

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Abstract.
Mangroves are limited to the coastal ecosystem and are associated with lagoons and estuaries due to high salinity, low oxygen levels, high light intensity, strong winds and periodic inundation by tidal water. Many lagoons, out of 82 lagoons in Sri Lanka, mangroves play an important role on microscopic and mesoscopic fauna and also for coastal inhabitants in the country. The micro relief of the mangrove habitats produces food and shelter, and provides nursery grounds for the birds, fish, reptiles and other crustaceans. Further, they help to preserve the balance of nature.
Different research groups viz., individual scientists and institutional researches provide different figures on the extension of mangrove vegetation in Sri Lanka. However, there is no conformity on total figure. In this study, we try to calculate the exact extent of mangrove vegetation in 82 lagoons with their availability and identified threats. Mangroves in the lagoons of Sri Lanka have been damaged by anthropogenic activities and have also been degraded by (a) changes in freshwater run-off, salinity regime and tidal flow patterns; (b) excessive siltation and discharge of toxic substances; and (c) flowing of polluted water into lagoons, lakes, estuaries and tidal creeks. The depletion and degradation of mangroves have directly and indirectly influence the livelihood of the people, economy of the country and survival of the wildlife. Therefore, an increased public awareness is of utmost importance to promote management and conservation of mangrove habitats for posterity in Sri Lanka.

Keywords: ***Mangrove ecosystem, Lagoons, Tidal water, Overexploitation, Coastal inhabitants, Degradation, Public awareness.***


Replanting at Negombo Lagoon


Replanting at Baththalangunduwa


Replanting at Rekawa (by TCP)

Mangrove forest in Batticaloa Lagoon

INTRODUCTION

The mangrove ecosystem is commonly understood to be made up of a collection of woody and shrub plant species. The true and associate mangroves identified as fringes and patches from the lagoon and river estuary ecosystems. These plants grow in shallow and muddy salt water or brackish waters, such as those along quiet shorelines, lagoons or in estuaries of anaerobic soils found in the intertidal zone, and show their greatest extent and diversity on tropical coasts, especially in Sri Lanka (Figures 1 & 2), and in some subtropical areas, where they rapidly form as mangrove swamps.

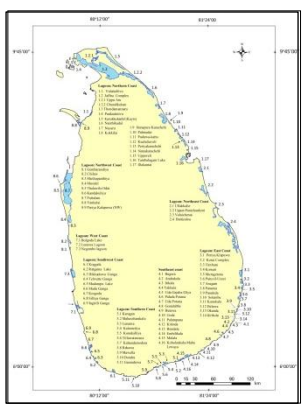

Figure 1. Distribution of coastal lagoons in Sri Lanka, (Silva et al, 2013).

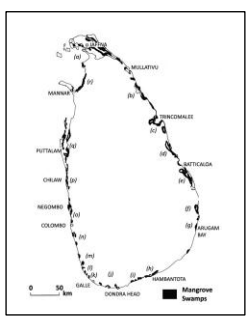

Figure 2. Distribution of mangrove swamps in Sri Lanka: (a) Jaffna Lagoon and Thondamanaru Lagoon complex, (b) Nayaru and Kokkilai Lagoon complex, (c) Trincomalle, Uppaveli and Kodiyar complex, (d) Ullakali Lagoon, (e) Upparu Lagoon, (f) Kalmunai complex and Batticaloa complex, (g) Periya Lagoon, (h) Potuvil area, (i) Walawe Ganga estuary, (j) Nilwala Ganga, Polwatta Ganga and Tudawe Ganga complex, (k) Gin Ganga estuary, (l) Madampe Lake and Madu Ganga complex, (m) Bentota Ganga estuary, (n) Bolgoda Lake and Weras Ganga complex, (o) Kelani Ganga estuary and Muthurajawela area, Pamunugama area and Negombo Lagoon complex, (p) Chilaw Lake, Deduru Oya estuary and Mundal Lake areas, (q) Puttalam Lagoon, Portugal Bay complex (eastern coast of Kalpitiya Peninsula and Kala Oya complex, and (r) Vankalai complex.

PURPOSE AND SIGNIFICANCE

Ecological conditions and multiple uses of mangroves in Sri Lanka are overexploitation by traditional users than commercial users. Destructive action resulting from activities generally unrelated use of mangrove swamps is commercial timber harvesting; conversion of mangrove areas for aqua- culture, especially for prawn farms; agriculture, saltpans and urban development. The applications of agrochemicals at agroecological zones have caused damage to mangrove habitats (Katupotha, 2016).

Mangrove swamps cover by trees or shrubs that have the common trait ot growing in shallow and muddy salt or brackish waters and provide excellent nesting and feeding grounds. These habitats constitute a reservoir and a refuge for a variety of marine and brackish fish, invertebrates, and birds. Based on field evidence and other scientist researchs, it is possible to identify 31 true mangrove species from sixteen families and 10 mangrove associates from 9 families. True mangrove and associate species the lagoons and estuaries located in different climetic zones.

ADAPTATIONS OF MANGROVES

Mangroves have had to physically adapt their leaves, their roots and their reproductive methods in order to survive in a harsh, dynamic environment of soft, low oxygen soils and varying salinity.

1. The mangroves have special leaves to help adapt to the environment. For example:
2. The leaves are evergreen due to the rainfall, tropical climate and constant temperatures all year round.
3. Due to high temperature present, the surafaces are thick and leathery, preventing excess water loss through transpiration.
4. To limit the amount of water lost through leaves, the can restrict the opening of the stomata.
5. They also vary the orientation of their leaves to avoid the harsh midday sun and so reduce evaporation from the leaves.
6. A red mangrove in captivity only grows if its leaves are misted with fresh water several times a week, simulating the frequent tropical rainstorms.
7. These leaves have drip tips to allow excess rainwater to be able to drain or flow off quickly, preventing harmful bacteria from growing on it.

Drip Tips

To help adapt to the saline water, these leaves have a few tricks up thier sleeves.
Example:

- A red mangroves exclude salt by having significantly impermeable roots which acts as an ultra-filtration mechanism to exclude sodium salts from the rest of the plant, effectively reducing 90%-97% of the salt.
- Salt which does accumulate in the shoot concentrates in old leaves which the plant then sheds.
- Red mangroves can also store salt in cell vacuoles.
- White mangroves can secrete salts directly through two salt glands at each leaf base which are then removed by environmental factors, such as wind or rain.

Flowers & Fruits

Each of these mangroves have special characteristics added to the fruits and plants to help increase survival of offspring.

1.The Bruguiera have bight-cloured flowers to attract insects to help pollinate the flowers to become fruits.
2.The Avicennia have fruits that are buoyant which can thus, be carried away by the water to another location where they will take root.
3.Mangrove seeds are also buoyantand suited to water dispersal.
4.Once germinated, the seedling grows either within the fruit or out through the fruit to form a propagule (a ready-to-go seedling) which can produce its own food via photosynthesis. Once mature, it will drop into the water. Mangrove habitats with its variety of sub-habitats are a source of forest products such as food and beverages, timber, firewood, tannin, wax, honey, etc., and provide suitable environmental conditions for aquaculture and opportunities for tourism.


Bruguiera flowers


Avicennia fruits


Cerbera manghas

Propagules can survive desiccation and remain dormant for over a year before arriving in a suitable environment. Once a propagule is ready to root, its density changes so that the elongated shape now floats vertically rather than horizontally whereby it is more likely to lodge in the mud and root.

METHODOLOGY

Islandwide field observations, formal and informal discussions with the inhabitants and officials were carried out within the period since 1993 infrequently up to 2016. The reconnaissance phase of the study was useful to highlight the nature of the environmental problems and the degradation of mangrove species. Both published and unpublished data have also been mentioned where relevant in the study.

RESULTS AND DISCUSSION

Mangrove flora can be categorized as true mangroves and mangrove associates. True mangrove species grow only in mangrove environment and do not extend into terrestrial plant community, whereas mangroves associates are found within or in the peripheral areas of mangrove wetlands.

Specific leaf area of true mangroves as well as leaf nitrogen concentration on a leaf mass were lower than that of mangrove associates; leaf succulence was, in general, twice as high in true mangroves compared to mangrove associates; true mangroves accumulated 8–9 times more Na and Cl than mangrove associates and the former had K/Na ratios 0.5.

True mangrove species are: *Acanthus ilicifoliu*-Ikill/Mulli **(Acanthaceae)**, *Aegiceras corniculatum*-Heen kadol, (**Myrsinaceae** (or **Primulaceae**), *Avicennia alba*-Manda (**Acanthaceae**), *Avicennia marina*-Manda/Mandagas (**Acanthaceae**) *Avicennia officinalis*-Manda **(Acanthaceae)** *Bruguiera cylindrica*-Mal kadol **(Rhizophoraceae)**, *Bruguiera gymnorrhiza*-M.kadol **(Rhizophoraceae)**, *Bruguiera sexangula* **(Rhizophoraceae)**, *Ceriops decandra* **(Rhizophoraceae)**, *Ceriops tagal*-*Pun kanda* **(Malpighiales)**, *Clerodendron inerme* **(Verbenaceae)**, *Cynometra iripa*-Opalu **(Leguminosae)**, *Excoecaria agallocha*-Tela (**Euphorbiaceae**), *Exoecaria indica* **(Euphorbiaceae)**, *Lumnitzera littorea* (**Combretaceae**) *Lumnitzera racemosa*-Sudu beriya) **(Combretaceae)** *Nypa fruticans*-Gin pol (**Arecaceae**), *Pandanus tectorius*-*Mudu keiya* (**Pandanaceae**), *Pemphis acidula*-Mudu wara (**Lythraceae**), *Premna integrifolia* (Walmidi) **(Verbenaceae)** Rhizophora annamalayana (Hybrid), *Rhizophora apiculata*-Mahakadol (**Rhizophoraceae**), *Rhizophora mucronata*-M.kadol (Rhizophoraceae), *Sonneratia alba*-Sudukadol, Sudu kirala **(Sonneratiaceae)** (Lythraceae), *Scyphiphora hydrophyllacea*-Kalu or Keera kadol **(Rubiaceae)**, *Sonnaratia apetala* **(Sonneratateae)**, *Sonneratia caseolaris*-Kirala (**Lythraceae**), *Sonneratia ovalis* (**Sonneratiaceae**), *Thespesia populnea*, *Xylocarpus granatum*-Mutti Kadol (**Meliaceae**).



Aegiceras corniculatum-**Heen kadol and** *Bruguiera cylindrica* **(True mangroves)**



Nypa fruticans, **a flower and** *Sonneratia caseolaris* **and a fruit (True mangroves)**



Mixed species at Vedithalativu lagoon and Okanda Lagoon (True mangroves)

Associates mangrove species are:
Acrostichum aureum-Karan *(***Pteridaceae),** *Acrostichum speciosum*-Karan **(Pteridaceae),** *Annona glabra* **(Annonaceae),** *Cerbera manghas*-Elakadol **(Apocynaceae),** *Cerbera odollam* **(Apocynaceae),** *Dolichandrone spathacea*-Diya danga **(Bignoniaceae)** *Derris scandens*-Kalawel **(Fabaceae),** *Heritiera littoralis or tiliaceus*-Etuna **(Sterculaceae),** *Morinda citrifolia*-Ahu **(Rubiaceae).**

When compared to their role in countries such as Brazil, Australia, Indonesia, Malaysia, India and Philippines, it appears that mangroves have not played as significant a role in the national economy of Sri Lanka.

These problems and degradation which clearly threaten mangrove ecosystems have not been taken into consideration at the national level. This paper envisages to reveal different uses, the behavior of the fauna and flora of mangrove habitats, human impact and degradation.

Multiple uses of the mangroves:

- Provide food and shelter for a large and varied group of fishes and shellfish.
- The aerial roots provide shelter for many species of commercial fish and shellfish, particularly in their juvenile and most predators prone stages.
- Provide protection from storm surges and high winds associated with tropical typhoons. This is important in a country that is hit by an average of 20 typhoons a year.
- Provide the bulk of primary production in lagoons and estuaries.
- Serve as protection against soil erosion. Soil erosion and sedimentation causes in the ocean are the number one cause of coral reef degradation.
- Serve as a land builder through soil accretion. Sediment from the land collects among the dense roots building up the land and minimize the coast erosion
- Traps and buffer adjacent estuarine areas against the large changes in up-streams input of nutrients and wastes.
- Trap coastal pollutants, which may otherwise severely damage adjacent marine ecosystems.
- Buffer adjacent flood plains from the damage caused by severe storms, and they reduce the maintenance cost of habours and navigation channels by trapping silt.
- Play an important role as nursery areas for the larva and juvenile stages of many coastal fish and invertebrates including commercial species especially for crustaceans.
- Maintaining and controlling the normal cycles of nitrogen and sulphur.
- Serve as a wildlife sanctuary.
- Offer aesthetic, educational and scientific values

***The trees and shrubs provide protection from storm surges and high winds associated with tropical storms such as typhoons, cyclones or tsunamis* (Katupotha, 2016).**

Over exploitation that has rapidly destroyed and degradated the mangrove ecosystems:

- Rapid urban development (establishment of Free Trade Zones and townships),
- Establishment of anchorages and landing of a large number of fishing craft, including Multi-day boats: e.g. Puttalam, Chilaw, Negombo, Baticaloa, Trincomale and Jaffna lagoons,
- Land reclamation for road construction, settlements and expansion of agriculture,
- Conversion of marginal mangrove lands into shrimp farm ponds in Gembarandidiya, Chilaw, Muthipanthiya and Puttalam lagoons and Mundal Lake; and in addition into salterns in Puttalam lagoon and Mundal Lake, lagoon areas in southeastern area,
- Use as municipal solid waste disposal sites,
- Inflows of inorganic fertilizer, herbicides/weedicides/insecticide runoff from inland agricultural areas (Negombo, Mundal and Puttalam areas; eastern lagoons and Jaffna Lagoon Complex),
- Rapid siltation that is often aggravated by coral mining and aquaculture practices,
- Industrial pollutants and waste disposal.




Use as municipal solid waste disposal sites at Negombo Lagoon and Mouth of the Deduru Oya. Noise pollution and disturbance to fauna/flora the Mawella Lagoon.

CONCLUSION

Mangrove forests are home to a large variety of fish, crab, shrimp, and mollusk species, and they provide good nursery grounds for all including birds. These fisheries form an essential source of food for thousands of tropical coastal communities around the world. Since environmental impacts are an ongoing threat, to successfully restore an ecosystem implies not merely to recreate its former condition, but to strengthen its capacity to adapt to change over time.Mangrove habitats have scientific, educational, aesthetic and commercial values.

Variety of mangrove fauna like crabs, lobsters, prawns and mollusks bring in a considerable amount of foreign exchange. Over the last 4 decades, most of the mangrove species in Sri Lanka have been cleared and water bodies, mainly lagoons reclaimed to construct shrimp farms. As a result mangrove swamps rapidly destroyed and degraded. This destruction is a threat to flora and fauna as well as the livelihood of the people. Thus, it is necessary to manage and conserve the mangrove habitats as a natural heritage to protect the coast from erosion, and to obtain a variety of products from aquatic and terrestrial components. For this purpose, public awareness is needed for the proper use of mangroves.

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