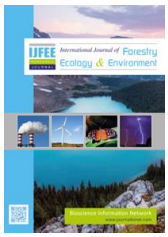
Published with Open Access at Journal BiNET
Vol. 01, Issue 01: 21-27
International Journal of Forestry, Ecology and Environment
Journal Home: https://www.journalbinet.com/ijfee-journal.html



Floral distribution, abundance and diversity of mangroves in Sangupiddy, Kilinochchi, the northern coast of Sri Lanka

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Article received: 19.03.20; Revised: 30.03.20; First published online: 15 April 2020.

ABSTRACT

Sri Lanka, a precious little tropical island in the Indian Ocean harbors a remarkable amount of mangrove habitats scattered along the coastal zone of the country, yet confined to narrow strips since the country has low tidal amplitude. However, most of the researches has given importance to the mangroves of the wet zone of the country. Although neglected, Northern Province shares about 16% of the total mangrove extent of the country. The research aimed to identify the floral distribution of mangroves in Sangupiddy of the Northern Province, Sri Lanka. Mangrove vegetation was surveyed with 5m belt transects laid perpendicular to the shoreline and across the water – land gradient. True mangrove species in each transect were identified and counted. The quantitative data has been used to compute the Shannon diversity index (H), Simpson Index (D) and Shannon Evenness (E), which were used to compare the diversity of the sites, sampled. Two true mangrove species of two families were identified at the site. Highest Shannon diversity index (H = 0.27) and the lowest Simpson index value (D = 0.72) was observed in 2nd transect. Since the place is used for fishing and tourism, pollution and human interaction can degrade the environmental quality of the mangrove habitats. Actions should be taken for conservation of existing patch and replenishment of new mangroves.

Key Words: Mangroves, Diversity, Zonation, Pollution and Replenishment

Cite Article: Arulnayagam, A. (2020). Floral distribution, abundance and diversity of mangroves in Sangupiddy, Kilinochchi, the northern coast of Sri Lanka. International Journal of Forestry, Ecology and Environment, 01(01), 21-27.
Crossref: https://doi.org/10.18801/ijfee.010120.03

I. Introduction

The term "mangrove" used to define both the plants that occur in the tidal forest and to describe the community itself. Mangroves are halophytes occurring in the brackish environments but are restricted to the intertidal zone, which belongs to the tropical and sub-tropical coastlines. They are congregations of faunal community, often occupying the land-sea margin (Amarasinghe and Perera, 2017). Mangroves are architecturally simple ecosystems but also have developed exceptional adaptations; such as viviparous embryos, physiological mechanisms and aerial roots to survive through the high salinity (Alongi, 2012). The uniqueness of mangrove ecosystems lies as they are

capable of tolerating salty waters, constant inundation, and unfavorable conditions for seed germination (Amarasinghe and Perera, 2017).

Mangroves provide a quite higher range of services to humanity and the environment. They provide essential food and fuel services, nursery grounds for aquatic fauna, coastal protection (against pollution, Tsunami, and storms), sequesters carbon and other sediments (Alongi, 2012), primary production, pollution abatement and recreation (Prasanna, Ranawana and Jayasuriya, 2019). It has been recognized as a highly productive wetland system. They are also being emphasized in sustaining the adjoining intertidal ecosystems. In terms of climate change mitigation, they play an important role in maintaining a balance of the atmospheric carbon dioxide via noteworthy quantities of carbon cycling and photosynthesis. Hence, these are unique and highly productive ecosystems, which deliver immense ecological and economical services. They are important in sustaining related faunal, floral as well as human lives. Mangroves in most of the lagoons are highly productive, but extremely vulnerable habitats confined to intertidal zones of coastal environments including especially lagoons. They have special adaptations to harsh environmental conditions and mangrove habitats are considered biodiversity hotspots (Katupotha, 2016).

Significantly stated as "The pearl of the Indian Ocean", Sri Lanka is situated between latitudes 5.55' and 9.51' North and longitude 79.41' and 81.54 East in the Indian Ocean. It is found to the South of the Indian Subcontinent. The tropical island extents about 65,610 sq. km and is astoundingly varied and with a continental shelf of 44,250 sq. km. The country has a coastline of roughly 1600 km in length with a cover of 158,016 ha (Prasanna et al., 2019) of brackish water zone. Therefore, Sri Lanka enjoys a wide range of coastal ecosystems such as coral reefs, mangrove forests, lagoons and estuaries, mudflats, sand dunes and beaches. Since the tidal range of Sri Lanka is small, ranging from mean low water spring -37 cm to mean high water spring +40 cm (Katupotha, 2016) in relation to the mean sea level, the mangroves in are limited to narrow belts bordering the lagoons and estuaries thus showing a patchy distribution. Edirisinghe *et al.,* 2012 stated that the extent of mangroves in Sri Lanka is about 15, 670 ha which is less than 0.03% of the total area and 0.2% of the total forest area (Karunathilake, 2003; Prasanna et al., 2019).

Mangroves are of two types; true mangroves and mangrove associates. True mangrove species are associated to brackish water areas whilst mangrove associates can grow either in similar or aquatic environment with saline soil (Subasinghe, 2015). According to IUCN, twenty-one true mangrove species and approximately twenty-three mangrove associate species have been recorded in Sri Lanka (Prasanna et al., 2019). However, the species richness of the mangrove species is being notably decreasing with time due to the destruction of mangrove forests and exposure to various anthropogenic pressures. Efforts should be carried out to minimize deforestation and to promote the reforestation of mangroves.

Jaffna Peninsula is an area in the Northern Province, Sri Lanka with a shoreline of 403 km and comprises 17 lagoons that cover nearly 804 sq. km (Katupotha, 2016). Mangrove ecosystems in Jaffna are distributed in small, uneven patches. This area comprises of a mangrove patch of about 2505 ha covering areas of Thondamanar, Chundikulam and Jaffna lagoon. The Northern part of the island tends to be hot and dry in the dry season (February to September) and moderately cool and moist in the wet season (October to January). The area experiences an average temperature of about 28^0 to 30^0 all around the year and an annual rainfall of less than 1250 mm. relative humidity fluctuates from 70% during the day to 90% at night (Katupotha, 2016). Due to these reasons, mangrove diversity is not that rich as in the other parts of the island, but they have a wide distribution throughout the province. Despite the climatic conditions, the freshwater influx is low making the brackish water in certain areas to be highly saline. The objective of this study was to determine the distribution, abundance and diversity of true mangrove species and mangrove associates in the Sangupiddy area of the Northern Province of Sri Lanka.

II. Materials and Methods

Study Sites

Five points were located in the coastal stretch of Sangupiddy Bridge, which runs along the Navatkuli – Karaitivu - Mannar Highway, which connects Sangupiddy, Kilinochchi with Karaitivu via Jaffna. The bridge runs across the Jaffna lagoon. The mangrove ecosystems were scattered near the bridge and are located in the Northern coastal belt of the country. All the study sites are located in the dry zone of Sri Lanka (Figure 01). The survey was done in December 2019.

Figure 01: Map of the study site

Table 01. Study locations and number of quadrats studies in each location

Sampling point	GPS Location	No. of quadrats
Point 1	9°34'55.07 N, 80°12'1.30 E	3
Point 2	9°34'54.31 N, 80°12'1.18 E	5
Point 3	9°34'53.33 N, 80°12'1.02 E	6
Point 4	9°34'52.27 N, 80°12'1.07 E	5
Point 5	9°34'51.09 N, 80°12'0.92 E	4

Vegetation sampling

Mangrove vegetation was sampled using the transect method. Species richness and density data were collected from 10m wide belt transects. Transects were randomly laid in the mangrove vegetation perpendicular to the shoreline (five transects) (Table 01) across the water-land gradient. The length of the transects varied depending on the density of the mangrove patches. About 10% of the area of each point was sampled. Each transect was divided into 5m x 5m subplots for convenience of sampling. Total areas of 22, 600 sq. feet were surveyed. Within each transect, true mangrove species were identified and counted.

Data Analysis

Quantitative data were used to calculate diversity indices based on species richness (Margalef Index, D_{Mg}) and proportional abundance (Shannon Index H') (Prasanna et al., 2019). Species dominance was estimated using Simpson index (D) and Shannon Evenness (E) (Jayatissa et al., 2002) was computed. The indices were used to explain the distribution and abundance of mangroves in the selected site. All the data analysis were done with MS Excel 2010 version and SPSS 17.0

III. Results

Species distribution

Surprisingly, only two true mangrove species, *Avicennia marina* and *Brugueira cylindrical* were identified in the study site (Figure 02). *Brugueira cylindrica* was common and seen in higher numbers at all the points that have been sampled. Other than that, *Avicennia marina* was the least abundant to be recorded at the sites sampled (Table 02). It was observed that *Avicennia marina* occupied the insides of the shores while *Brugueira cylindrica* has been found throughout the region, from the shoreline towards the estuary fringe (Figure 03). Further, it was observed that the mangroves were relatively shorter, more like mangrove shrubs than those tall trees found in the wet zones of the island.

Table 02. Abundance and distribution in selected sites

Family	Species	Point 1	Point 2	Point 3	Point 4	Point 5
Avicenniacea	*Avicinnia marina*	+	+	-	+	+
Rhizophoracea	*Brugueira cylindrica*	++	++	++	++	++
Total no. of sp.	2	2	2	1	2	2

Absent = -, Very rare = +, Very common = ++

Diversity indices

As for the results of the 2t- test the Shannon diversity values of the study site significantly vary from each other (p=0.016). Highest Shannon diversity index (H = 0.27) and the lowest Simpson index value (D = 0.72) was observed in point 2 (Table 03). This point tended to show the highest mangrove diversity and species distribution over all the other points. In contrast least, Shannon diversity index (H = 0.00) and the highest Simpson index value (D=1.00) was observed in point 3, where only one species of mangrove was recorded. Highest evenness value (E = 0.90) and highest dominance value (D_{Mg} = 0.73) were observed in point 2 while the lowest evenness value (E = 0.00) and lowest dominance value (D_{Mg} = 0.00) were observed in point 3.

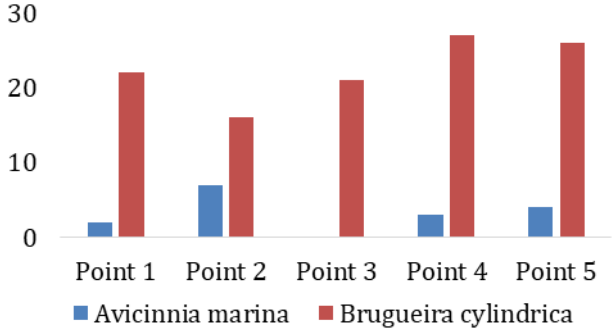

Figure 02. Mangrove distribution in the study site

As explained the Shannon diversity index was in the range of 0.00 – 0.30, whereas the Simpson index was observed in the range of 0.00 – 1.00. The number of total individuals recorded at points 4 and 5 was same. Still they have relatively different Shannon and Simpson index (H = 0.14 and 0.17 and D = 0.79 and 0.77 respectively). The least Shannon diversity index and evenness were recorded in point 3 at 0.00 and 0.00 respectively. This was because of the prevalence of only one species.

Table 03. Diversity indices obtained for the mangroves in the study area

	Point 1	Point 2	Point 3	Point 4	Point 5
No. of species	2	2	1	2	2
No. of individuals	24	23	21	30	30
Shannon diversity index (H)	0.12	0.27	0.00	0.14	0.17
Simpson Index (D)	0.80	0.72	1.00	0.79	0.77
Evenness, E	0.40	0.90	0.00	0.47	0.56
Margalef's index (D_{Mg})	0.72	0.73	0.00	0.68	0.68

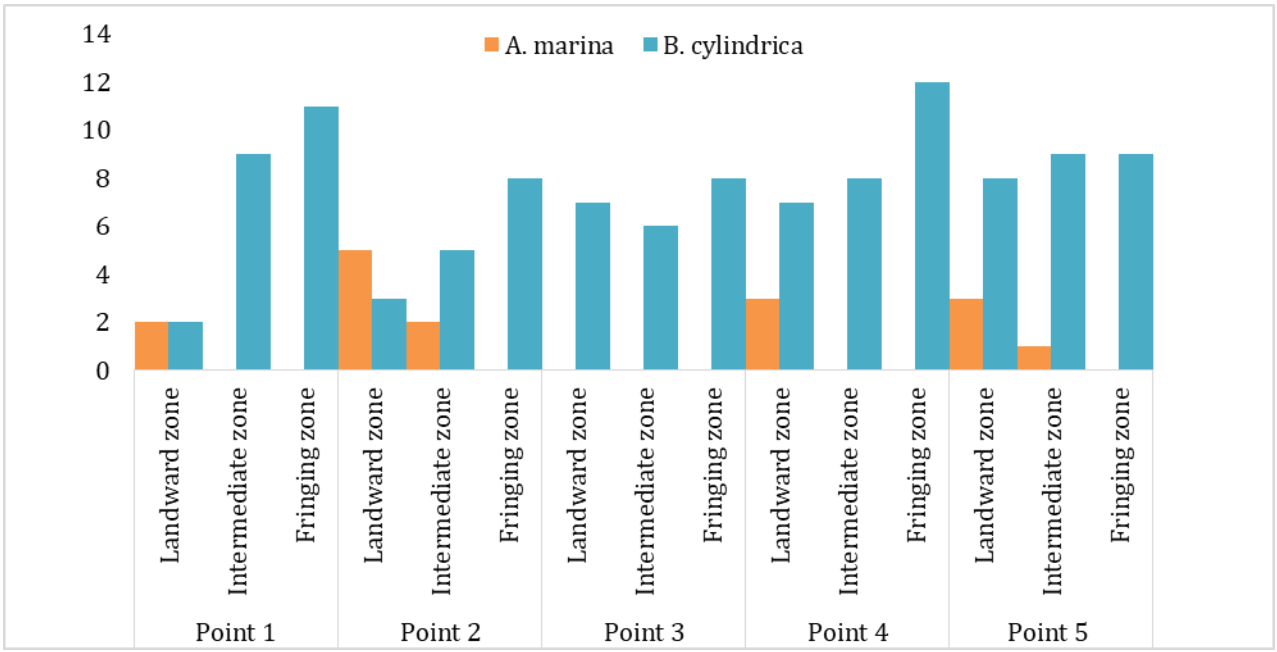

Figure 03. Zonation of the mangroves in the study area

IV. Discussion

In Sri Lanka, mangrove flora is the most studied and well knowledgeable biodiversity. Mangrove flora is of two types; true mangroves and associate mangroves, neither of these are endemic to Sri Lanka (Karunathilake, 2003). In general, true mangrove species are commonly found in all sites, but the floristic composition of the dry zone mangrove forests is different from that of the wet zones. Because of the seasonality of rains and the lower freshwater discharge in the dry zone, the mangrove forests in the dry zone experience relatively higher salinity than mangroves in wet zones which experience much high and evenly distributed annual rainfall and has a high flux of freshwater input (Silva and Silva, 1998)

This research focused on identifying the true mangrove species in the area. According to the study, the mangrove communities in Sangupiddy area were not much diversified. The mangrove communities in the site were a representative of two mangrove families; Avicenniaceae and Rhizophoraceae. Climate and soil texture are two of the major factors affecting the composition and species distribution of mangrove species (Jayatissa, et al., 2002). All the sampling points are sited in the same geographic as well as the same climatic region. However, species distribution showed considerable variances. This may be attributed to differences of mangroves with respect to their hydrology, soil salinity, and other edaphic factors (soil nutrition, texture, bulk density etc.) (Prasanna et al., 2019).

At least 23 species of true mangroves are present in Sri Lanka (Silva and Silva, 1998). The most common species of Sri Lankan mangroves are *Avicennia marina*, *Bruguiera gymnorrhiza*, *Excoecaria agallocha*, *Lumnitzera racemosa*, *Rhizophora mucronata*, *R. apiculata* and *Sonneratia caseolaris*. They can grow under a wide range of soil and hydrological conditions and are widely distributed in Sri Lanka. The common category of mangrove species includes *Aegiceras corniculatum*, *A. officinalis*, *B. cylindrica*, *B. sexangula*, *Ceriops tagal*, *Heritiera littoralis*, *Pemphis acidula*, *Sonneratia alba*, and *Nypa fruticans*. Although these species are widely distributed in Sri Lanka, they are low in abundance. Rare species of mangroves that are few in numbers restricted to a few locations in Sri Lanka include *L. littorea*, *Xylocarpus granatum* and *Scyphiphora hydrophyllacea* (Subasinghe, 2015). The mangrove species identified in the study site falls into the most common and common categories of the above-mentioned list. Since the diversity is not obvious, there was no clear pattern of species diversity change with the climate differences. It should be noted that there are no previous studies mad on this site before.

Considering the usual zonation of mangroves, *Brugueira* occupies the waterfront and *Avicennia marina* is found in the mixed zone towards the inland margin but may extend to the edge of the water as well. (Silva and Silva, 1998). *Brugueira* in Sangupiddy occupied not only the waterfront but also was seen in the mixed as well as landward fringe whereas *Avicennia marina* was observed in the mixed and inland margin (Figure 03). The fishermen use this mangrove patch as a harbor area, for fishing. However, the places seem subjected to various kinds of anthropogenic pressure. Anglers using the mangrove poles and sticks to build fish baits and fishing rods can destroy the small patch spontaneously. Tourists littering the areas were also observed at the site. Plastic wrappers, foil, glass bottles and aluminum tins were observed at the site. They could be a hindrance to the fauna living or visiting the mangrove patch for their survival or migration. There were not any large industries or aquaculture ponds observed near the mangrove patch, thus, there would not be any pollution via the effluents.

In addition to enhancing the degraded mangroves by removing stresses that caused their decline, restoring areas where mangrove habitat previously existed and creating new mangrove habitat will also contribute to offsetting anticipated reductions in mangrove area and health and increase resistance and resilience to climate change effects (Subasinghe, 2015). Therefore, the findings of this study can be effectively be used in such rehabilitation activities.

V. Conclusion

Avicennia marina and *Brugueira cylindrica* were identified in the study site. The highest diversity was recorded in point 2. Human interference such as fishing and tourism is high in the area. Therefore, systematic attempts should be made to conserve and educate the local people about their significance.

Acknowledgment

I like to thank Mr. Suresh Kirushnathasan for his help and efforts during the survey. I would also like to thank the anonymous reviewers for their valuable remarks.

References

[1]. Alongi, D. M. (2012). Carbon sequestration in mangrove forests. Carbon Management, 3(3), 313–322. https://doi.org/10.4155/cmt.12.20

[2]. Amarasinghe, M. D. and Perera, K. A. R. S. (2017). Historical biogeography of Sri Lankan mangroves. Ceylon Journal of Science, 46(5), 111. https://doi.org/10.4038/cjs.v46i5.7458

[3]. Jayatissa, L. P., Dahdouh-Guebas, and Koedam, N. (2002). A review of the floral composition and distribution of mangroves in Sri Lanka. Botanical Journal of the Linnean Society, 138(1), 29–43. https://doi.org/10.1046/j.1095-8339.2002.00002.x

[4]. Karunathilake, K. M. B. C. (2003). Status of Mangroves in Sri Lanka. Journal of Coastal Development, *7*(1), 5–9. Retrieved from https://www.omicsonline.com/open-access/status-of-mangroves-in-sri-lanka-1410-5217-7-156.pdf

[5]. Katupotha, K. N. J. (2016). Mangroves in Lagoon Ecosystems: a Neglected Habitat in Sri Lanka.

Wildlanka, 4(3), 79–105.
[6]. Prasanna, M. G. M., Ranawana, K. B. and Jayasuriya, K. M. G. G. (2019). Species composition, abundance and diversity of mangroves in selected sites in Amprara District in the east coast of Sri Lanka. Ceylon Journal of Science, 48(2), 169. https://doi.org/10.4038/cjs.v48i2.7621
[7]. Silva, M. De. and Silva, P. K. De. (1998). Status, diversity and conservation of the mangrove forests of Sri Lanka. Journal of South Asian Natural History, 3(1), 79–102.
[8]. Subasinghe, U. (2015). Floral diversity of six mangrove forests along the northwestern coastline of wet, intermediate and dry climate zones of Sri Lanka. Wildlanka, 3(4), 184–194.

HOW TO CITE THIS ARTICLE?

MLA
Arulnayagam, A. "Floral distribution, abundance and diversity of mangroves in Sangupiddy, Kilinochchi, the northern coast of Sri Lanka". International Journal of Forestry, Ecology and Environment, 01(01) (2020): 21-27.

APA
Arulnayagam, A. (2020). Floral distribution, abundance and diversity of mangroves in Sangupiddy, Kilinochchi, the northern coast of Sri Lanka. *International Journal of Forestry, Ecology and Environment*, 01(01), 21-27.

Chicago
Arulnayagam, A. (2020). "Floral distribution, abundance and diversity of mangroves in Sangupiddy, Kilinochchi, the northern coast of Sri Lanka". International Journal of Forestry, Ecology and Environment, 01(01): 21-27.

Harvard
Arulnayagam, A. 2020. Floral distribution, abundance and diversity of mangroves in Sangupiddy, Kilinochchi, the northern coast of Sri Lanka. International Journal of Forestry, Ecology and Environment, 01(01), pp. 21-27.

Vancouver
Arulnayagam, A. Floral distribution, abundance and diversity of mangroves in Sangupiddy, Kilinochchi, the northern coast of Sri Lanka. International Journal of Forestry, Ecology and Environment, 2020 April 01(01): 21-27.