Jurnal Hutan Tropika *(Tropical Forest Journal)* *e-ISSN: 2656-9736 / p-ISSN: 1693-7643*
Vol. XV No.1, June 2020. Hal (Page): 1-7

STRUCTURE AND COMPOSITION OF FLORAL AT MANGROVE FOREST IN PITAS SABAH MALAYSIA

Andy R. Mojiol[1], Audrey Eliseus[1] and Wahyudi Wahyudi[2]
[1]*Forestry Complex, Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia.*
[2]*Department of Forestry, Faculty of Agriculture, University of Palangka Raya, Palangka Raya, Indonesia*

**Author for correspondence. Email: andy@ums.edu.my*

ABSTRACT

The aim of the study was to determined and record mangrove species composition and diversity at Pitas mangrove forest, Sabah. Mangroves forest occurs in waterlogged, salty soils of sheltered tropical and subtropical shores. It usually found along the coastlines throughout the world, usually between 25º N longitude and 25º S latitude. This study was conducted in Pitas district (N $06^0$43', E $117^0$4') which is located at the northern tip of Sabah, Malaysia. Whereas, Pitas district has an approximately 38,564 ha of the mangrove area. In this study, the mangrove location covered an area ranges from Malawali island (N $07^0$2.023', E $117^0$16.883'), Tobo island (N $07^0$01.070', E $117^0$19.008'), Layak-layak island (N $06^0$56.587', E $117^0$14.323'), Mapan-mapan (N $06^0$51.608', E $117^0$14.861'), and Jambongan island (N $06^0$45.016', E $117^0$25.816'). The random sampling method was done with simple plots sizes of 20m x 20m to determine the species' biodiversity, composition and structure. As a result, 13 mangrove species have been identified in all study locations namely known as *Sonneratia caseolaris, Ceriops tagal, Bruguiera gymnorhiza, Rhizophora mucronata, Aegiceras corniculatum, Avicennia marina, Rhizophora apiculata, Sonneratia alba, Bruguiera cylindrica, Lumnitzera littorea, Pemphis acidula, Scyphiphora hydrophyllacea,* and *Scaevola taccada.* The result shows that the Shannon –Wiener biodiversity index (H') at the island and disturbed mangrove areas is less diverse (H' below than 1.5) compared to the undisturbed mainland areas with (H'=1.95). *Sonneratia caseolaris* is the dominant mangrove species in the island with the highest value of Important Value Index (IVI) with 144.77% compared to all species in the study location. These areas show the importance of ecological aspects within the forest ecosystem. Therefore, the protection and conservation of this mangrove in this area is a necessity.

Keywords: Mangrove, species composition, diversity, Important Value Index (IVI), island, mainland, disturbed, Pitas Sabah

INTRODUCTION

Mangroves area occurs in the waterlogged, salty soils of sheltered tropical and subtropical shores. Mangrove swamps are found along tropical and subtropical coastlines throughout the world, usually between 25º N and 25º S latitude. Mangrove ecosystems are

estimated to cover 181,000 km² worldwide (Spalding *et al.,* 1997). Mangroves are divided into two groups – the Old World mangrove swamps and the New World and West African mangrove swamps. An estimated 68 species of mangroves exist, and their distribution is thought to be related to continental drift in the long term and possibly to transport by primitive humans in the short term (Mitsch, 1993).

According to Giesen, *et al*., (2007) the Southeast Asian mangroves generally occur in five zones. There are one on the highly exposed seaward side that is inundated during all high tides; less dynamic exposed seaward sides, which is inundated by all high tides; a central and well-developed mangrove inundated by normal high tides; a landward/freshwater-influenced zone (the back-, hind- or rear mangrove) inundated by spring tides, and a zone occurring along brackish to almost fresh streams and/or occasionally inundated by exceptionally high tides.

Mangrove trees provide timber for construction and fishing poles (Mojiol *et al*., 2016). Unsawn poles of *Rhizophora* species are the most common extraction product because this species is easily harvested manually and has a short crop-rotation period in managed forests (Ng & Sivasothi, 2002). Mangrove trees also provide fuelwood and charcoal (Ashton & Macintosh, 2002) by *Rhizophora* species due to its high calorific value meaning that they produce more heat for the same weight (Ng & Sivasothi, 2002).

The aims of the study are to determine and record the type of mangrove species, biodiversity, tree composition and distribution found at Pitas, Sabah. We also identify the important value index (IVI) of mangrove species in all the study areas.

MATERIALS AND METHODS

Survey area

This preliminary study was focused on the district of Pitas (N 06⁰43', E 117⁰ 4') which is located at the northern tip of Sabah. This expedition has covered Pulau Malawali (N 07⁰2.023', E 117⁰16.883'), Tobo island (N 07⁰1.070', E 117⁰19.008'), Pulau Layak-layak (N 06⁰56.587', E 117⁰ 14.323'), Mapan-mapan (N 06⁰51.608', E 117⁰14.861'), and Jambongan (N 06⁰ 45.016', E 117⁰25.816'). Pitas have approximately 38, 564 ha of mangrove area.

Sampling inventory

To determine and record of species composition and analyze trees stand and vegetation structure of mangrove areas in Pitas, this study has been used stand inventory. Two simple plots with 20 x 20m were established in each site to investigate the species composition, density and structure of stand mangroves in Pitas. Diameter at breast height (DBH), height and number of individuals of the species present were recorded for all trees ≥2:5 cm DBH in each subplot. The data obtained from this study were analysed using the biodiversity indicator (Shannon-diversity index (H'), Important Value Index (IVI) and the logarithmic inverse J-shape to see the stand structure of mangrove in those sampled areas.

RESULTS & DISCUSSION

Species composition of mangrove

There are a total of 75 mangrove trees surveyed at the island, 59 of mangrove trees at mainland, and 132 at disturbed mangrove forest in Pitas during this

expedition. Figure 1 shows the results of mangrove species that have been found on island, mainland and disturbed mangrove forests.

Figure 1 shows the islands in Pitas are dominated by *Sonneratia caseolaris* with 43 individuals. *Rhizophora mucronata* is the second highest with 23 individuals and followed by *Avicennia marina* with 5 individuals.

data usually falls between 1.5 and 3.5 and rarely surpasses 4. The result shows that the H' value at the island and disturbed mangrove forest is less than 1.5 and can be assumed as less diverse. This is because the number of mangrove species surveyed is less than 9 species. Magurran (2005) noted to get the best value of index diversity species, the species represent should be more or equal to 8 species.

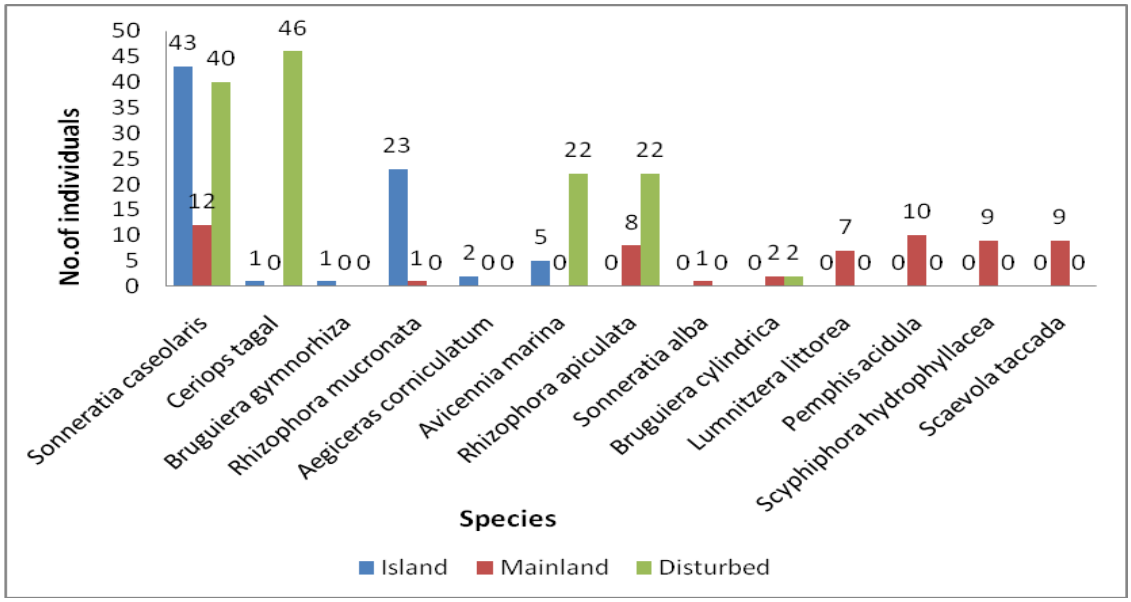


Fig 1: Histogram shows the mangrove tree composition according to study site

The mainland is also dominated by *Sonneratia caseolaris* with 12 individuals and followed by *Pemphis acidula* with 10 individuals. The disturbed mangrove forests in Pitas are dominated by *Ceriops tagal* with 46 individuals. *Sonneratia caseolaris* is the second highest with 40 individuals and followed by *Avicennia marina* and *Rhizophora apiculata* both with 22 individuals.

Species diversity of mangrove

According to Magurran (2005), when H' increase, the diversity increase. The value of the Shannon index obtained from empirical

The species that represent in the island is 6 species while in mainland 9 species and disturbed mangrove forest is only 5 species.

The Shannon Evenness (E) index standardizes the species abundance and its range from near 0, which is means most of the individuals are belong to a few species, until close to 1 which is also means the species are equally abundant. Table 1 shows the species in the mainland and disturbed mangrove forests are equally abundant with Shannon Evenness (E) measure at these both sites is 0.887 and 0.8638. While with Shannon

Evenness (E) measure at the island is 0.599 which is means most of the individuals in the island are belong to a few species.

Table 1: Value of mangrove species diversity according to the indexes

Index / Area	Shannon –Wiener (H')	Shannon Evenness (E)	Simpson's (D)
Island area	1.073	0.599	0.421
Disturbed area	1.3903	0.8638	0.264
Mainland area	1.949	0.887	0.131

The Simpson's Diversity Index (D) is a measure of heavily weighted towards the most abundant species in the sample while being less sensitive to species richness. According to Magurran (2004), the value of D ranges is between 0 and 1 which is the bigger the value of D, the lower the diversity. According to the result above, the diversity of mangrove in the mainland is the highest with 0.131 followed up by a disturbed area with 0.264 and the lowest diversity at the island with 0.421.

Important Value Index (IVI) of Mangrove tree

The Important Value Index (IVI) of mangrove species in the island found that *Sonneratia caseolaris* is the dominant species in the island with the highest value of IVI with 144.77 (Table 2). The second highest value of IVI is *Rhizophora mucronata* with 67.43295. The third highest value of IVI is *Avicennia marina* with 23.72068 and followed up by *Ceriops tagal* with 22.23098, *Bruguiera gymnorhiza* with 21.97874. While the lowest value of IVI is *Aegiceras corniculatum* with 19.86662 which is hardly found in the mainland and disturbed mangrove forests.

While in Table 3 shows that *Rhizophora apiculata* has the highest value of IVI with 73.49465 which also means *Rhizophora apiculata* is the dominant species in the mainland. The second highest value of IVI is *Scaevola taccada* with 42.32337 and followed by *Sonneratia caseolaris* with 41.38044, *Lumnitzera littorea* with 33.37208, *Pemphis acidula* with 33.02404, *Scyphiphora hydrophyllacea* with 30.09179 and *Bruguiera cylindrical* with 17.34484. The lowest value of IVI is

Table 2: Important Value Index (IVI) of mangrove species in island

Island Area	RA	RF	RD	IVI
Sonneratia caseolaris	57.33333	16.66667	70.77005	144.77
Rhizophora mucronata	30.66667	16.66667	20.09962	67.43295
Avicennia marina	6.666667	16.66667	0.387342	23.72068
Ceriops tagal	1.333333	16.66667	4.230979	22.23098
Bruguiera gymnorhiza	1.333333	16.66667	3.978738	21.97874
Aegiceras corniculatum	2.666667	16.66667	0.533282	19.86662
TOTAL	100	100	100	300

Rhizophora mucronata and *Sonneratia alba* both with 14.4844.

Table 4 shows that *Sonneratia caseolaris* has the highest value of IVI with 93.82094 and followed by *Ceriops tagal* with 79.38867 as the second highest, *Avicennia marina* with 68.43553 and *Rhizophora apiculata* with 45.52805. The lowest value of IVI is *Bruguiera cylindrica* with 12.8268.

There was also a difference in species composition in all study areas. The IVI index for island mangrove shows that *Sonneratia caseolaris* was the important species with a value of 144.77 for species composition. *R. mucronata* with a value of 72.27 means this two *Rhizophora spp*. dominated the area. This indicates that the virgin mangrove was in Rhizophora zone. Even though *R. apiculata* was the dominant species in converted mangrove with IVI of 88.9 and *R. mucronata* with IVI of 70.4, it is difficult to interpret this area as Rhizophora zone because it had a mixture of other mangrove species. Thus we can conclude that there was a difference in terms of species composition and species diversity in the two different situations, virgin mangrove with low tree diversity and more distinct zonation and converted mangrove with higher diversity but no distinct zonation. This maybe is due to the effect of conversion to other land uses such as land clearing, human settlement, and others as been highlighted by Gilman *et al*., (2008).

Table 3: Important Value Index of mangrove species in mainland

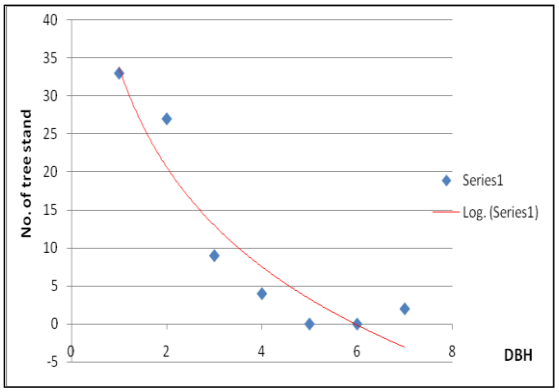
Mainland Area	RA	RF	RD	IVI
Rhizophora apiculata	13.55932	11.11111	48.82422	73.49465
Scaevola taccada	15.25424	11.11111	15.95802	42.32337
Sonneratia caseolaris	20.33898	11.11111	9.930349	41.38044
Lumnitzera littorea	11.86441	11.11111	10.39656	33.37208
Pemphis acidula	16.94915	11.11111	4.963776	33.02404
Scyphiphora hydrophyllacea	15.25424	11.11111	3.726445	30.09179
Bruguiera cylindrica	3.389831	11.11111	2.843903	17.34484
Rhizophora mucronata	1.694915	11.11111	1.678369	14.4844
Sonneratia alba	1.694915	11.11111	1.678369	14.4844
TOTAL	100	100	100	300

Table 4: Important Value Index of mangrove species in the disturbed mangrove forest

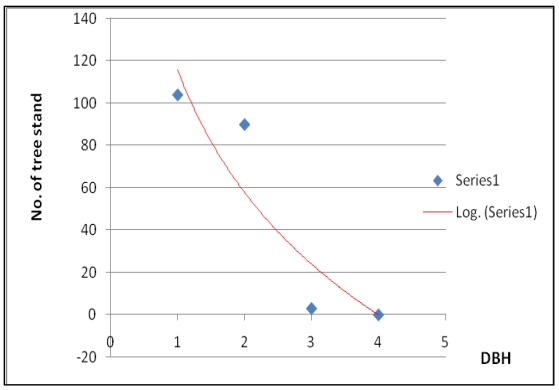
Disturbed Area	RA	RF	RD	IVI
Sonneratia caseolaris	30.30303	22.22222	41.29568	93.82094
Ceriops tagal	34.84848	22.22222	22.31797	79.38867
Avicennia marina	16.66667	22.22222	29.54664	68.43553
Rhizophora apiculata	16.66667	22.22222	6.63916	45.52805
Bruguiera cylindrica	1.515152	11.11111	0.200539	12.8268
TOTAL	100	100	99.99999	300

Diameter distribution of mangrove species

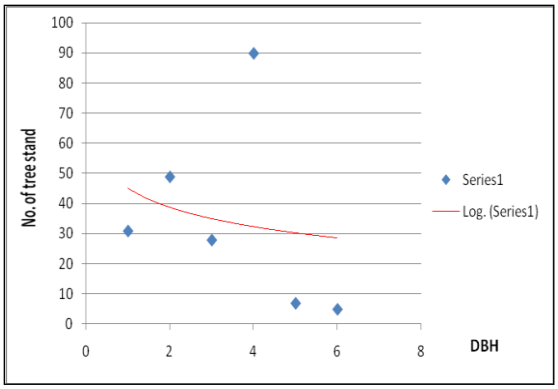
Diameter distribution explain the distribution trees level on the forest based their structure and composition. Figure 2 shows the diameter distribution of mangrove species at the island, mainland and disturbed mangrove forest in Pitas. These three graphs show logarithmic J-shape and these graphs illustrate a normal structure in unaged forest development. Figure 2 shows the distribution of the number of individual tree per diameter class and gives a clear view of the stand structure.



Island



Mainland



Disturbed

Figure 2. The diameter distribution of mangrove species at the island, mainland and disturbed mangrove forest

CONCLUSION & RECOMMENDATIONS

All 15 species of mangrove present on island, mainland and disturbed mangrove forest are *Sonneratia caseolaris*, *Ceriops tagal*, *Bruguiera gymnorhiza*, *Rhizophora mucronata*, *Aegiceras corniculatum*, *Avicennia marina*, *Rhizophora apiculata*, *Sonneratia alba*, *Bruguiera cylindrica*, *Lumnitzera littorea*, *Pemphis acidula*, *Scyphiphora hydrophyllacea*, and *Scaevola taccada.*

The value of mangrove diversity in the mainland is the highest with Shannon-Weiner (H') = 1.949 and Simpson Index (D) = 0.131 compared to disturbed mangrove forest with Shannon-Weiner (H') = 1.3903 and Simpson Index (D) = 0.264 as the second highest. The islands in Pitas has the lowest diversity value with Shannon-Weiner (H') = 1.073 and Simpson Index (D) = 0.421.

Considering the importance of mangrove forests for productive, protective and social functions, steps must be taken in order to take care of the habitat, which includes mangroves inside estuaries and lagoons, by gazetting them as Permanent Forest Reserve (PFR). Meanwhile, stricter local governmental regulations and enforcement protecting mangroves are necessary. Also, the involvement of the local communities in sustainable management and protection of their coastal resource base, including mangrove forests, is essential.

ACKNOWLEDGMENT

The authors would like to express their great appreciation to Sabah Forestry Department Pitas and the communities in Pulau Mandi Darah, Pulau Jambongan, Malawali, and Mapan-Mapan for their permission to conduct study and access into the mangrove areas. This project study was funded by the Fundamental Research Grant (GPS0014-NSNH-1/2009).

REFERENCES

Ashton E.C and Macintosh D.J. 2002. *Preliminary Assessment of the Plant Diversity and Community Ecology of the Sematan Mangrove Forest, Sarawak, Malaysia.* Forest Ecology and Management 166, 111-129.

Giesen, W., Wulffraat, S., Zieren, M., & Scholten, L. (2007). Mangrove guidebook for Southeast Asia. Mangrove guidebook for Southeast Asia.

Gilman, E.L., Ellison, J., Duke, N.C, and Field, C. 2008. *Threats to Mangroves from Climate Change and Adaptation Options: A Review*. Aquatic Botany 89,237–250.

Magurran, E. A., 2005. *Measuring Biological Diversity*. Blackwell Publishing. Australia.

Mitsch J.W and Gosselink G.J., 1993. *Wetlands Second Edition.* Van Nostrand, New York.

Mojiol, A. R., Kodoh, J., Wahab, R., & Majuki, M. (2016). Contribution of non-wood forest product to the local community living near the mangrove forest in Kudat, Sabah. *Journal of Tropical Resources and Sustainable Sciences,* 4(1), 38-41.

Ng, P.K.L. and Sivasothi, N., 2002. *A Guide to the mangroves of the Singapore 1, the Ecosystem and Plant Diversity*. Singapore Science Centre, Singapore.

Spalding M.D., Blasco F. and Field C., 1997. *World Mangrove Atlas. The International Society for Mangrove Ecosystems.* Okinawa Japan.