MANGROVE VEGETATION DIVERSITY IN TWO VILLAGES OF KYAUKTAN TOWNSHIP, YANGON REGION

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Abstract

Mangrove forest vegetation analyses were carried out from December 2022 to September 2023 at Kayin Chaung (KC) and Kalartan (Shwe Pyi Thit, SPT) Villages, Kyauktan Township, Yangon Region. A total of 36 quadrats (10 × 10) m^2 were established at two different sites (11 quadrats in Kayin Chaung Village and 25 quadrats in Kalartan Village). A total of 23 species belong to 22 genera of 14 families were recorded in Kayin Chaung Village and 20 species belong to 19 genera of 14 families were recorded in Kalartan Village. Species diversity, species richness and evenness were calculated by Shannon-Wiener and Simpson's indices. The quantitative analysis of species richness showed that the species richness in Kayin Chaung Village (23.83) was higher than that of Kalartan Village (20.92). The results of species diversity showed that Kayin Chaung Village was relatively diverse (H = 2.90, D = 0.93) than Kalartan Village (H = 2.55, D = 0.90). As a result of Shannon-Wiener evenness, the plant species in Kayin Chaung Village (E = 0.92) was more evenly distributed than Kalartan Village (E = 0.85). The Important Value Index (IVI) for tree species was determined by the sum of relative density, relative frequency and relative dominance by using the methods of Curtis. According to the IVI value, the ecologically successful species were *Sonneratia caseolaris* (L.) Engl. (La-mu) and *Sonneratia apetala* Banks (Kan-pa-la) in both of the villages.

Keywords: Diversity, mangrove forest, Kyauktan Township

Introduction

Mangrove forests, also called mangrove swamps, mangrove thickets or mangals, are productive wetlands that occur in coastal intertidal zones (Tue *et al*., 2012; Luo Ling and Gu Ji Dong, 2018). Mangrove forests grow mainly at tropical and subtropical latitudes because mangroves cannot withstand freezing temperatures. There are about 80 different species of mangroves, all of which grow in areas with low-oxygen soil, where slow moving waters allow fine sediments to accumulate (National Ocean Service, NOAA, 2021).

Myanmar is the largest country in mainland Southeast Asia, with a continuous coastline of almost 3,000 km, extending along the Bay of Bengal and Andaman Sea. Yangon is located in the southern part of the country in the east bank of the Yangon or Hlaing River (eastern mouth of the Ayeyarwady River), 40 km (25 mi) north of the Gulf Martaban of the Andaman Sea. Kyauktan Township is situated in the lowermost part of Myanmar, existing in the southern part of Yangon. In this research, Kayin Chaung Village (latitude 16º 34′ 31.980″ N longitude 96º 24′ 27.350″ E) and Kalartan Village (latitude 16º 29′ 29.537″ N longitude 96º 24′ 53.011″ E) are selected which are located in Kyauktan Township, Yangon Region.

In Kayin Chaung and Kalartan Villages, local communities live simply by depending on mangrove forests and their associated resources such as fire wood, coal, medicinal plants, marine products, food and shelter, etc. Therefore, the mangrove forests can assume their rightful importance for social, cultural, economic, and environmental contributions they make to the lives of all who depend on them.

The objective of the present research is to serve the source of information for the management of mangrove vegetation to ensure the conditions and sustainability of the ecosystem.

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Furthermore, mangrove vegetation analysis such as species diversity, species richness, evenness, density, frequency, and abundance can be applied to the monitoring of habitat and conservation management of mangrove forests in Kayin Chaung Village and Kalartan Village, Kyauktan Township, Yangon Region.

Materials and Methods

Study Area

Kyauktan Township is located at the lowermost part of Myanmar, existing in the southern part of Yangon. Kuauktan Township is also included in the Mottama Gulf coastline. In this study, Kayin Chaung Village and Kalartan Village were selected which were included in Kyauktan Township, Yangon region. The household and population of the study area was shown in Table 1 and the location map of the study area was shown in Figure 1.

Methodology

To assess the plant species diversity, a total of 36 quadrats (10 × 10) m^2 with 11 quadrats in Kayin Chaung Village and 25 quadrats in Kalartan Village were established. Inside each quadrat, all trees with at least 5 cm girth at breast height (GBH) were identified and measured the trunk diameter (cm) and total height (m). The location (latitude and longitude) of each study point was recorded by using a Global Positioning System (GPS). Water salinity of the study points were measured by using the hand refractometer (REF 201/211/201 bp). Soil samples were collected from the soil depth of 0 - 30 cm below the soil surface. They were tested in the soil laboratory of the Department of Agriculture (Land Use) Yezin in Nay Pyi Daw, Myanmar for the soil analysis of soil texture, soil pH, organic matter and nutrient contents (N, P, K).

Plant specimens were collected, pressed, dried and identified with the help of available references and Myanmar names were recorded by Hundley and Chit Ko Ko (1987) and Kress *et al*. (2003).

Jackknife estimate of species richness

The number of species in a community is referred to as its species richness. Species richness is widely used in ecology as a measure of species diversity (Baumgärtner, 2005). Jackknife estimate was adopted in order to estimate the species richness per study area. According to the Heltshe and Forrester (1983), the formula for Jackknife estimate of species richness is:

$$\hat{S} = S + \left(\frac{n-1}{n}\right)^{k}$$

Where,

$\hat{S}$ = Jackknife estimate of species richness

S = Observed total number of species in “n” sample plots

n = Total number of plot sample

k = Number of unique species

Measurement of plant species diversity and evenness

Plants species diversity

Species diversity is the number of different species in a particular area (species richness) weighed by some measure of abundance such as number of individuals or biomass. Two commonly used measurements are Shannon’s index and Simpson’s index. Shannon-Wiener diversity index

places more weight on the rare species while Simpson's diversity index emphasizes on the common species (Weidelt, 2000).

Shannon-Wiener Index

$$H = -\sum_{i=1}^{S} (P_i)\,(\log_2 P_i)$$

Where,

H = Shannon-Wiener index of species diversity
S = Number of species
P_i = Proportion of total sample belonging to the i^{th} species

Simpson's Index

$$D = 1 - \sum_{i=1}^{S} (P_i)^2$$

Where,

D = Simpson's index of species diversity
S = Number of species
P_i = Proportion of individual of i^{th} species in the community

Evenness (E)

Another measure of species diversity is the species evenness, which is the relative abundance with which each species is represented in an area. Species evenness is a diversity index, a measure of biodiversity which quantifies how equal the communities are numerically. Shannon-Wiener function (1963) is the most meaningful measure of evenness as follows:

$$E = \frac{H}{H_{max}}$$

$$H_{max} = \log_2 S$$

Where,

E = Evenness (Range 0-1)
H = Index of species diversity
S = Number of species
H_{max} = Species diversity under conditions of maximal equitability

Coefficient of similarity

Coefficient of similarity is generally used as a mean of comparing stands from floristic point of view (Lamprecht, 1989). The study sites were composed by means of similarity coefficient calculated using Sorenson's index of similarity. The index is used as a mean for comparing the floristic similarity between two forests. The formula is as follows:

$$Ks = \frac{2c}{a+b} \times 100$$

Where,

Ks = Coefficient of similarity
a = Number of species in one stand
b = Number of species in the other stand
c = Number of species common to both stand

Evaluation of density, relative density, frequency, relative frequency, mean basal aera and relative dominance

Forest vegetation and methods for determining tree height and cover were quantitatively analyzed for density, relative density, frequency, relative frequency, dominance, relative dominance, and important value index for each tree species that were used for description of vegetation structure are as follows:

$$\text{Density (D)} = \frac{\text{No. of individuals of the species in all the sample plots}}{\text{Total no. of sample plots studied}}$$

$$\text{Relative Density (R. D)} = \frac{\text{No. of individuals of the species}}{\text{No. of individuals of all the species}} \times 100$$

$$\text{Frequency (F)} = \frac{\text{No. of sample plots in which the species occur}}{\text{Total no. of plots sampled}}$$

$$\text{Relative Frequency (R. F)} = \frac{\text{No. of occurrences of the species}}{\text{No. of occurrences of all the species}} \times 100$$

$$\text{Mean Basal Area (MBA)} = \frac{\text{Total basal area}}{\text{Number of trees}}$$

$$\text{Relative Dominance (R. Dm)} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all the species}} \times 100$$

$$\text{IVI} = \text{R. D} + \text{R. F} + \text{R. Dm}$$

The Important Value Index (IVI) of any species in a community ranges between 0 and 300. Values of IVI help in understanding the ecological significance of the species in the respective vegetation type (Lutz, 1928-1930).

Species distribution by frequency class

Each tree species was grouped into five frequency classes based on Raunkiaer's law of frequency. The frequency classes are A, B, C, D, and E according to Raunkiaer's frequency spectrum by Raunkiaer (1934). The law also known as the law of homogeneity and frequency class A represents the species that are rare (r), class B that are seldom present (s), class C that are often

present (o), class D that are mostly present (m), and class E that are constantly present (c). Frequency class A to E were suggested by Raunkiaer's from 0 to 100.

Table 1 Household and population of study area

No.	Village name	Household	Male	Female	Total population
1	Kayin Chaung	247	835	782	1617
2	Kalartan (Shwe Pyi Thit)	167	387	357	744

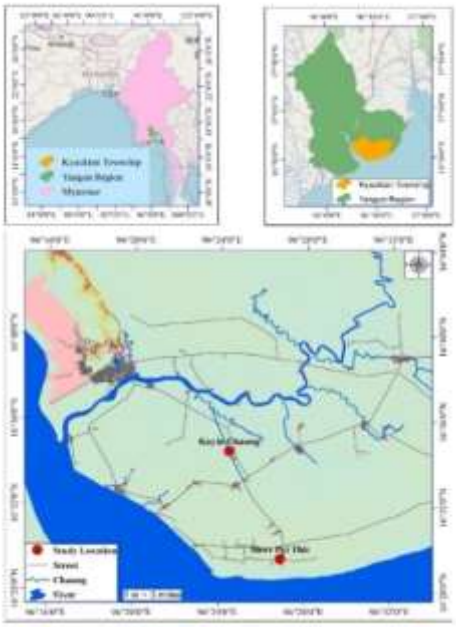

Figure 1. Location map of the study area

Results

The number of family, genera and species of trees which were found in Kayin Chaung Village were 23 species belong to 22 genera and 14 families. There were 20 species belong to 19 genera and 14 families found in Kalartan Village as shown in Table 2.

The species richness is commonly expressed as the number of species per unit area, which is also mentioned as the species density. According to the results, Jackknife estimate of species richness in Kayin Chaung Village and Kalartan Village were 23.83 and 20.92 respectively as shown in Table 3. Among the two study areas, Kayin Chaung Village had higher species richness than Kalartan Village.

Among the different measurement of species diversity indices, Shannon-Wiener Index (H), Simpson's Index (D) and Shannon-Wiener Evenness (E) were used because these indices do not only take taxa richness into account but also depend on relative distribution of individuals. It was observed that the values of Shannon-Wiener Index (H) and Simpson's Index (D) of Kayin Chaung Village were (H = 2.90, D = 0.93) and those that of the values in Kalartan Village were (H = 2.55, D = 0.90). So, it was considered that Kayin Chaung Village was relatively diverse than Kalartan Village.

Shannon-Wiener function is the most widely used index of species diversity because it incorporates both species richness and abundance (E). According to Krebs (1999), 'E' means "Equitability or Evenness" and varies between 0 and 1. A higher value E indicates the presence of many species in approximately equal quantities. As a result of Shannon-Wiener Evenness (E), Kayin Chaung Village was more evenly distributed with the value of 0.92 than that of Kalartan Village with the value of 0.85.

The floristic compositions of two different sites were composed by means of similarity coefficient calculated by using Sorenson's index of similarity. Sorenson's index (1948) is based on the presence or absence of species. If both stands are floristically identical, the coefficient of similarity (Ks) value is 100 and if they are completely different, the value of Ks is zero (0). Sorenson's similarity index (i.e., based on the number of common species) indicated that species composition had 74.42% similarity between Kayin Chaung Village and Kalartan Village, referring that the species composition had moderate floristic similarity.

The results of quantitative analysis of study area, relative density, relative frequency, relative dominance and ranking of ecological significance by Important Value Index (IVI) of tree species in Kayin Chaung Village and Kalartan Village were given in Tables 4 - 5.

The Important Value Index (IVI) of the species was determined by the sum of relative density, relative frequency and relative dominance. Kayin Chaung Village was dominated by *Sonneratia apetala* Banks (IVI = 57.29%), followed by *Sonneratia caseolaris* (L.) Engl. (IVI = 55.85%) and *Ziziphus mauritiana* Lam. (IVI = 16.63%). Kalartan Village was dominated by *Sonneratia caseolaris* (L.) Engl. (IVI = 88.73%), followed by *Sonneratia apetala* Banks (IVI = 39.12%) and *Derris trifoliata* Lour. (IVI = 20.56%).

The horizontal structures of the study area were shown in Tables 6 - 7. In Kayin Chaung Village, *Sonneratia apetala* Banks species were observed to be the biggest tree (≥ 116 cm GBH) which was 1.24% of the total species (Table 6). There were six species in lower class (5 - 15 cm GBH) which were 18.12% of the total species. In Kalartan Village, two species, *Sonneratia apetala* Banks and *Sonneratia caseolaris* (L.) Engl. were to be the biggest trees (≥ 116 cm) which were 1.15% of the total species (Table 7). There were eight species in lower class (5 - 15 cm GBH) which were 60.44% of the total species.

Stratification or vertical structure of the community determines the different growth forms. In Kayin Chaung Village, thirteen species (50.79% of total individuals) were found in the height class of < 2 m. Two species, *Sonneratia apetala* Banks and *Sonneratia caseolaris* (L.) Engl., were found in the height class of ≥ 8 m (4.56% of total individuals) as shown in Table 8. In Kalartan Village, thirteen species (55.40% of total individuals) were found in the height class of < 2 m; two species *Sonneratia apetala* Banks and *Sonneratia caseolaris* (L.) Engl were found in the height class of ≥ 8 m (2.29% of total individuals) as shown in Table 8.

According to the Raunkiaer (1934), five frequency classes of species frequency distribution found in the study area was shown in Table 9. The frequency gives an approximate indication of homogeneity or heterogeneity of a stand. In the present study area, high distribution values were found in higher frequency classes C, D, and E whereas low distribution values were found in lower frequency classes A and B. It indicated that the study area had a high degree of floristic homogeneity.

According to the results of weather data, the study area is influenced by tropical monsoon climate with high temperature and abundant rainfall and characterized by seasons: summer, rainy and winter. Generally, March, April and May of 2020 and 2021; and March and April of 2022 were recorded as having maximum temperatures (between 36.2ºC and 39.1ºC). Also, the study area received maximum rainfall during June (671 mm) in 2020; during June (819 mm) in 2021; and during August (796 mm) in 2022. (Source: Department of Meteorology and Hydrology, Kaba Aye Station, Yangon Region).

The structure and nutrient contents of soil is important, particularly for plants. According to the results of soil analysis, the soil texture of both Kayin Chaung Village and Kalartan Village was clay loam. The nitrogen content of both of the villages was low. The phosphorus content of both of the villages was medium and the potassium content of both Kayin Chaung Village and Kalartan Village was high as shown in Table 10.

Salinity of water is strongly related to the distance from the sea, topography, tidal action and the rain. It is an important factor that affects the rate of growth, survival, height and distribution of mangrove ecosystems (Tri, 1999). The salinity percentage of Kayin Chaung Village (between 1.0% - 2.0%) is lower than that of Kalartan Village (between 8.0% - 9.0%) by using the hand refractometer (REF 201/211/201 bp).

Table 2. Number of families, genera and species of mangrove in study area

Taxonomic Rank	Kayin Chaung Village	Kalartan Village
Family	14	14
Genus	22	19
Species	23	20
Individuals	1337	2666

Table 3. Consolidated details of mangrove species inventory in Kayin Chaung Village and Kalartan Village

Description	**Kayin Chaung Village**	**Kalartan Village**
No. of Sample Plots	11	25
No. of Species	23	20
Individual Species	1337	2666
Unique Species	2	2
Species Richness	23.83	20.92
Shannon-Wiener Diversity Index (H)	2.90	2.55
Simpson's Diversity Index (D)	0.93	0.90
Shannon-Wiener Evenness (E)	0.92	0.85

Table 4. Ranking of Important Value Index (IVI) in Kayin Chaung Village

No.	**Scientific Name**	**R.D (%)**	**R.F (%)**	**R.Dm (%)**	**IVI (%)**
1	*Sonneratia apetala* Banks	3.74	3.17	50.37	57.29
2	*Sonneratia caseolaris* (L.) Engl.	17.28	5.82	32.75	55.85
3	*Ziziphus mauritiana* Lam.	6.36	3.17	7.09	16.63

No.	Scientific Name	R.D (%)	R.F (%)	R.Dm (%)	IVI (%)
4	*Pithecellobium dulce* (Roxb.) Benth.	5.61	4.23	2.83	12.67
5	*Hygrophila phlomoides* Nees	5.91	5.82	0.00	11.73
6	*Hibiscus tiliaceus* L.	6.73	4.76	0.12	11.62
7	*Eupatorium sp.*	5.46	5.82	0.00	11.28
8	*Malachra capitata* (L.) L.	5.09	5.82	0.00	10.91
9	*Derris trifoliata* Lour.	4.86	5.82	0.15	10.83
10	*Mimosa pudica* L.	4.04	5.82	0.00	9.86
11	*Terminalia catappa* L.	3.74	2.12	3.67	9.53
12	*Urena lobata* L.	3.59	5.82	0.00	9.41
13	*Calotropis gigantea* (L.) W.T.Aiton	5.61	3.70	0.08	9.39
14	*Stachytarpheta indica* (L.) Vahl	3.37	5.82	0.00	9.19
15	*Acanthus ilicifolius* L.	3.22	5.82	0.00	9.04
16	*Volkameria inermis* L.	2.99	5.82	0.04	8.85
17	*Ipomoea violacea* L.	3.44	5.29	0.03	8.76
18	*Chromolaena odorata* (L.) R.M. King & H. Robinson	2.92	4.23	0.00	7.15
19	*Hellenia speciosa* (J.Koenig) S.R.Dutta	2.84	4.23	0.00	7.07
20	*Sesbania bispinosa* (Jacq.) W.Wight	1.05	3.17	1.16	5.39
21	*Typha angustifolia* L.	1.72	1.59	0.00	3.31
22	*Samanea saman* (Jacq.) Merr	0.22	1.06	1.27	2.56
23	*Syzygium grande* (Wight) Walp.	0.22	1.06	0.42	1.70
	Total	**100**	**100**	**100**	**300**

R.D = Relative Density; R.F = Relative frequency; R.Dm = Relative Dominance; IVI = Important Value Index

Table 5. Ranking of Important Value Index (IVI) in Kalartan Village

No.	Scientific Name	R.D (%)	R.F(%)	R.Dm(%)	IVI(%)
1	*Sonneratia caseolaris* (L.) Engl.	20.33	9.06	59.34	88.73
2	*Sonneratia apetala* Banks	0.30	1.81	37.01	39.12
3	*Derris trifoliata* Lour.	11.25	8.33	0.97	20.56
4	*Volkameria inermis* L.	10.43	5.80	0.25	16.47
5	*Acanthus ilicifolius* L.	9.75	5.80	0.00	15.55
6	*Ipomoea violacea* L.	6.11	9.06	0.17	15.34
7	*Eupatorium sp.*	7.76	5.80	0.00	13.56
8	*Hygrophila phlomoides* Nees	6.98	4.71	0.00	11.69
9	*Hibiscus tiliaceus* L.	2.18	8.33	1.16	11.67
10	*Urena lobata* L.	5.74	5.80	0.00	11.54
11	*Calotropis gigantea* (L.) W.T.Aiton	2.44	7.25	0.11	9.79
12	*Hyptis brevipes* Poit.	4.28	5.07	0.00	9.35

No.	Scientific Name	R.D (%)	R.F(%)	R.Dm(%)	IVI(%)
13	*Malachra capitata* (L.) L.	3.98	4.71	0.00	8.69
14	*Acrostichum aureum* L.	3.64	4.35	0.00	7.99
15	*Pithecellobium dulce* (Roxb.) Benth.	0.60	3.99	0.43	5.02
16	*Ziziphus mauritiana* Lam.	0.53	3.26	0.34	4.13
17	*Stachytarpheta indica* (L.) Vahl	1.61	2.17	0.00	3.79
18	*Physalis angulata* L.	1.28	2.17	0.00	3.45
19	*Phoenix paludosa* Roxb.	0.53	1.81	0.06	2.40
20	*Terminalia catappa* L.	0.30	0.72	0.16	1.18
	Total	**100**	**100**	**100**	**300**

R.D = Relative Density; R.F = Relative Frequency; R.Dm = Relative Dominance; IVI = Important Value Index

Table 6. Population density of tree species across GBH class interval in Kayin Chaung Village

GBH (cm)	Total no. of individuals	No. of species	% of total species
5 -15 cm	102	6	18.12
16 - 25 cm	128	5	22.74
26 - 35 cm	124	5	22.02
36 - 45 cm	95	4	16.87
46 - 55 cm	47	5	8.35
56 - 65 cm	6	2	1.07
66 - 75 cm	6	2	1.07
76 - 85 cm	5	2	0.89
86 - 95 cm	15	2	2.66
96 - 105 cm	18	1	3.20
106 - 115 cm	10	1	1.78
≥ 116 cm	7	1	1.24
Total	**563**		**100**

Table 7. Population density of tree species across GBH class interval in Kalartan Village

GBH (cm)	Total no. of individual	No. of species	% of total species
5 -15 cm	472	8	60.44
16 - 25 cm	172	3	22.02
26 - 35 cm	73	1	9.35
36 - 45 cm	32	1	4.10
46 - 55 cm	12	1	1.54
56 - 65 cm	4	1	0.51
66 - 75 cm	4	1	0.51
76 - 85 cm	1	1	0.13
86 - 95 cm	-	-	-
96 - 105 cm	1	1	0.13
106 - 115 cm	1	1	0.13
≥ 116 cm	9	2	1.15
Total	**781**		**100**

Table 8. Population of tree species in vertical structure of Kayin Chaung Village and Kalartan Village

Height Class (m)	Kayin Chaung Village			Kalartan Village		
	NS	NI	TI(%)	NS	NI	TI (%)
<2 m	13	679	50.79	13	1477	55.40
2 – 4 m	10	539	40.31	7	887	33.27
4 – 6 m	1	38	2.84	1	141	5.29
6 – 8 m	1	20	1.50	1	100	3.75
≥8 m	2	61	4.56	2	61	2.29
Total		**1337**	**100**		**2666**	**100**

NS = No. of species; NI = No. of individuals; TI = % of total individuals

Table 9. Species distribution by frequency class in Kayin Chaung Village and Kalartan Village

Frequency Class	Frequency Range	Kayin Chaung Village		Kalartan Village	
		NS	TSD (%)	NS	TSD(%)
A	1 – 20 %	2	8.70	3	15
B	21 – 40 %	2	8.70	3	15
C	41 – 60 %	3	13.04	5	25
D	61 – 80 %	4	17.39	5	25
E	81 – 100 %	12	52.17	4	20
Total		**23**	**100**	**20**	**100**

NS = No. of Species; TSD = % of total species distribution

Table 10. Results of soil interpretation

Sr No.	Sample	pH Soil: Water 1:2.5	Texture	Organic Carbon	Total N	Available Nutrients	
						P	K_2O
1	KC	Moderately Alkaline	Clay Loam	Very Low	Low	Medium	High
2	SPT	Slightly Alkaline	Clay Loam	Very Low	Low	Medium	High

KC = Kayin Chaung; SPT = Shwe Pyi Thit

Source: Department of agriculture (land use) Yezin, Naypyidaw

Discussion and Conclusion

In this part of study, species composition and diversity of Kayin Chaung Village and Kalartan Village were investigated. Two areas were chosen with 11 sample plots in Kayin Chaung Village and 25 sample plots in Kalartan Village. In Kayin Chaung Village, 23 species comprising 22 genera and 14 families and 1337 individuals were recorded; 20 species contributing 19 genera and 14 families and 2666 individuals were represented in Kalartan Village.

According to the results of Shannon-Wiener index (H) and Simpson's index (D), the diversity value of Kayin Chaung Village was (H = 2.90, D = 0.93) and that of Kalartan Village was (H = 2.55, D = 0.90) respectively. Both of the villages had high diversity but Kayin Chaung Village was relatively higher than Kalartan Village. The Species Evenness or Species Abundance Distribution (SAD) is important in characterizing ecosystems (Paul *et al*., 2005). According to the results of quantitative analysis, the plant species in Kayin Chaung Village (E = 0.92) were more evenly distributed than Kalartan Village (E = 0.85). Species richness is widely used in ecology as a measure of species diversity (Baumgärtner, 2005). According to the results of Jackknife estimate of species richness, the species richness in Kayin Chaung Village (23.83) was higher than Kalartan Village (20.92). Sorenson's index is used as a mean for comparing the floristic similarity between two forests. The result of coefficient of similarity between Kayin Chaung Village and Kalartan Village had 74.42% of similarity. Therefore, these two villages had moderate floristic similarity.

The important value index is imperative to compare the ecological significance of species (Lamprecht, 1989) It indicates the extent of dominance of a species in a structure of a forest stand (Curtis and McIntosh, 1951). It is stated that species with the greatest important value index are the leading dominants of the forests. The highest IVI and two leading dominant species were *Sonneratia apetala* Banks (Kan-pa-la) (IVI = 57.20%) and *Sonnertaia caseolaris* (L.) Engl. (La-mu) (IVI = 55.85%) in Kayin Chaung Village; and *Sonneratia caseolaris* (L.) Engl. (La-mu) (IVI = 88.73%) and *Sonneratia apetala* Banks (Kan-pa-la) (IVI = 39.12%) in Kalartan Village. Therefore, these could be regarded as the representative and ecological indicator species of the study area.

It is important to examine the species distribution of a stand by their GBH classes. The GBH distribution of individuals in the study area showed that most number of trees were belonged to GBH class (16 - 25 cm) (22.74% of total species) in Kayin Chaung Village and GBH class (5 - 15 cm) (60.44% of total species) in Kalartan Village.

The vertical distribution of the study area was distinguished. The individuals of both of the study areas were concentrated in the height class that were found in < 2 m class: 13 species (50.79% of total individuals) in Kayin Chaung Village; and 13 species (55.40% of total individuals) in Kalartan Village.

According to the results of frequency class distribution by Raunkiaer's frequency classes, high distribution values were found in the higher frequency classes C, D and E and low distribution values were found in lower frequency classes A and B, indicating that both of the study areas had high degree of floristic homogeneity.

Mangroves provide a number of valuable ecosystem services that contribute to human well-being. In the present study area, mangroves play a vital role in supporting local and regional communities with ecosystem services, and thus enhancing the livelihoods of communities. Provisioning (e.g., timber, fuel wood and food resources), regulating (e.g., flood, storm and erosion control), habitat (e.g., breeding, spawning and nursery habitat for fish and prawn species), and cultural (e.g., recreation, tourism and cultural heritage) are among these locally and regionally important ecosystem services.

In conclusion, mangrove species diversity of both Kayin Chaung Village and Kalartan Village was carried out. In addition, mangrove vegetation analysis such as species diversity, species richness, evenness, density, frequency and abundance can be applied to the monitoring of

habitat and conservation management of mangrove forests and can also be a source of information to ensure the condition and sustainability of the ecosystem in Kayin Chaung Village and Kalartan Village.

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