Species Diversity and Forest Stand Structure of Neik-bein-na Protected Area in Pyay Township, Bago Region

May Zon Thunn[1], Lwin Lwin Mar[2], Aye Myat Thuzar[3]

Abstract

The present study was carried out to investigate the species diversity of Neik-bein-na protected area, Pyay Township during December 2022 to January 2023 by laying 6 quadrats (50 m x 50 m) following systematic unaligned sampling method. Species diversity was computed by Shannon-Wiener (1963) and Simpson indices (1949). Importance Value Index (IVI) was calculated in the sum of relative density, relative frequency and relative dominance (Curtis and McIntosh, 1950). A total of 35 species belonging to 31 genera, 27 families in site 1, 41 species belonging to 35 genera, 24 families in site 2 and 32 species belonging to 28 genera, 23 families in site 3 were recorded. In the present study, site 3 (H = 4.20, D = 0.92, E = 0.84) were slightly higher than site 1 (H = 4.01, D = 0.91, E = 0.78) and site 2 (H = 4.05, D = 0.90, E = 0.76). In all study sites, site 3 would still be the most diverse than the others. Quantitative analysis of diversity and tree species recorded from present study may provide baseline information for formulating conservation and management strategies of the present forest.

Introduction

Forest ecosystems are important because they act as reserviors of biodiversity, timber, medicinal plants, oxygen are play a critical role in watershed protection. (Richards 1996). Quantitative floristic sampling provides the necessary content for planning and long-term biodiversity conservation. (Phillip et al., 2003). Information of the species composition of a forest is essential for its wise management in terms of economic value, regeneration potential and ultimately may be leading to conservation of biological diversity (Verma *et al*. 1999).Plant diversity inventories in tropical forest have mostly been concentrated on tree species than other life forms, because tree species diversity is an important aspect of forest ecosystem diversity and also fundamental to total tropical forest biodiversity (Rennols and Laumonier, 2000). Biodiversity is the relationship between species and their pattern of richness (Young & Swiacki, 2006).

Tree species composition as an ecosystem, is a habitat for biodiversity representing the very foundation of human existence as it produces goods and services for the most fundamental human needs. For instance, forest trees provide resources like food, traditional medicine, energy, timber, shade, clear air, fresh water, fuel wood and habitats for other organisms. (FAO, 2016). The Importance Value Index (IVI) shows the complete or overall picture of ecological importance of the species in a community. (Ripu & Shiv, 2004). A stand is defined as a contiguous group of trees relatively uniform in age-class distribution, composition and structure, and growing on a site of sufficiently uniform quality that is a distinguishable unit from adjoining areas or stands (Helms 1998).

[1] Ma, M.Sc student, Department of Botany, Pyay University,
[2] Dr, Lecturer, Department of Botany, Pyay University,
[3] Daw, Demonstrator, Department of Botany, Pyay University.

Methodology

Study area

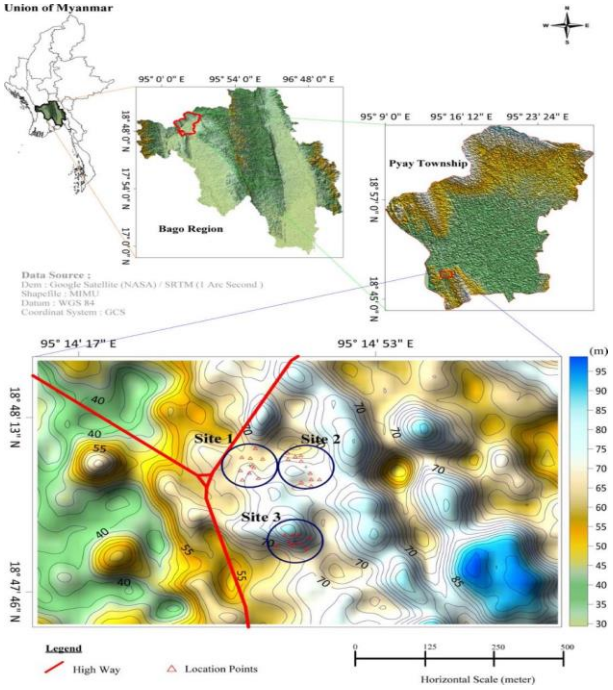

Fig. 1. Location map of the study area and study sites

The Bago Region (West) lies mostly in the Ayeywardy embayment, and partly in western Bago Yoma. Generally, PyayTownship is a flat lowland area. It is situated in the transitional zone between the hot dry zone of central Myanmar in the north and the wet deltaic zone in the south. It lies between north latitudes 18° 45′ and 18° 52′ and also between east longitudes 95° 12′ and 95° 17′. The total area of Pyay City is 13.31 square miles (34.34 square kilometer or 8521 acres.) The site 1 is occupied 3.13 ha (7.74 Acres) altitude between N 18° 48.073′ to N 18° 48.107′ & E 95° 14.607′ to E 95° 14.631′ , elevation ranges between 69 m to 94 m.

Climate

The climate of the Neik-bein-na Protected Area has three seasons; extremely hot summer, moist monsoon and cool winter. In Neik-bein-na Protected Area, the greatest rainfall was 267.9 mm and the lowest amount of rainfall was 2 mm in 2022. The monthly mean temperature of study area, 32° C is the highest temperature and the 24.7°C is the lowest temperature in 2022. The relative humidity of Neik-bein-na Protected Area in 2022, the maximum relative humidity was 89% and the minimum relative humidity was 69%.

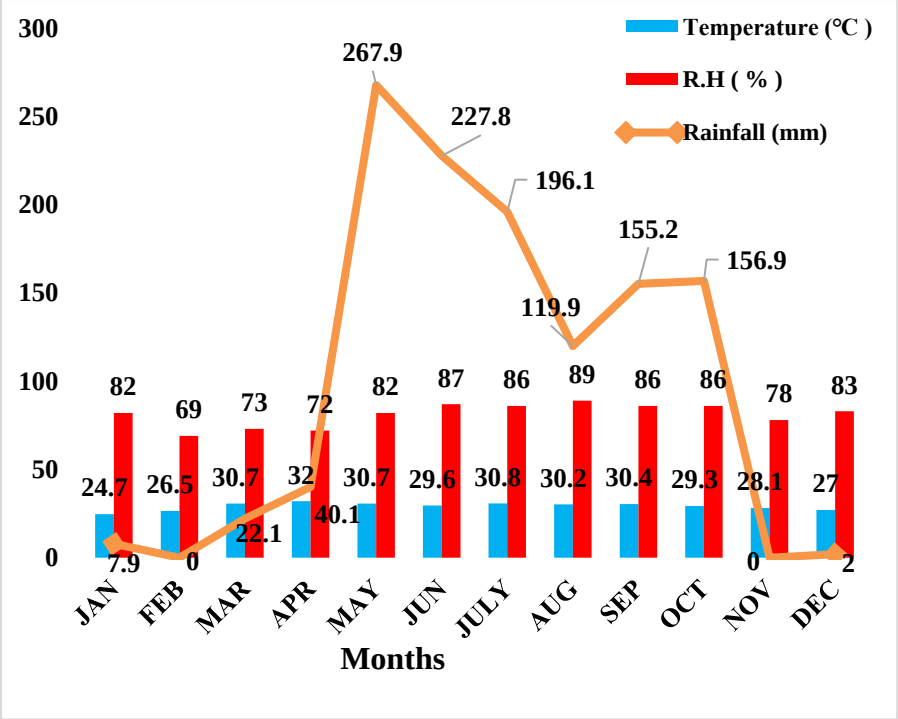

Fig.2 Histogram showing Monthly rainfall, temperature and relative humidity of 2020-2022

Soil

Soil is one of the important factor in abiotic. The soil characteristic of site 1 is loamy sand and pH level is 6.67. In site 2, the soil texture is sandy loam, color is brown-yellow and pH level is 6.23. In site 3, the soil characteristic is sandy loam and pH level is 7.73. In site 3, the pH level is greater than site 1 and site 2 and this study site is base.

No.	Study sites	pH	Texture
1.	Site 1	6.67	Loamy sand
2.	Site 2	6.23	Sandy loam
3.	Site 3	7.73	Sandy loam

Source: Land-used laboratory, Department of Agriculture, Pyay Township, Bago Region

Data collection and species identification

In Neik-bein-na Protected Area, firstly, three different sites were performed for the field investigation. In each sample plot has 50m x 50m and then 10m x10m subplot were subdivided. The information that was recorded from each sample plot includes: height, girth at breast height (GBH) of trees and their local names. Height and girth at breast height (GBH) were measured for any woody plant species with height $\geq$ 2m and GBH $\geq$ 10 cm thick, 1.3m from ground level. The girth at breast height (GBH) was to be measured using a measuring tape as well as height measurements was done by a bamboo stick bearing a graduated scale was used. Plant

specimens were collected and matched by checking "A Checklist of Trees, Shrubs, Herbs and Climber of Myanmar" (Kress *et al.,* 2003) " List of Trees, Shrubs, Herbs, and Principle Climbers, etc." (Hundley, H.G. and Chit Ko Ko. 1961). and website of tropicos and kew science.

Data Analysis

The data were analyzed for species composition, richness, diversity, Important Value Index (IVI). Species diversity was computed by Shannon-Wiener (1963) and Simpson indices (1949). Shannon-Wiener evenness (Shannon-Wiener function 1963), and stand density. Jackknife estimation of species richness (Heltshe & Forrester, 1983). Importance Value Index (IVI) was calculated in the sum of relative density, relative frequency and relative dominance (Curtis and McIntosh, 1950).

Diversity Index

$$H = -\sum_{i=1}^{s} (p_i)(\log_2 p_i)$$

Shannon-Wiener Index (1963)

H= index of species diversity

S= number of species

p_i= proportion of total sample belonging to the ***i*** th species

$$D = -\sum_{i=1}^{s} (p_1)^2$$

Simpson Index (1949)

D= Simpson's index of species diversity

S= number of species

p_i= proportion of individual of *i* species in the community

Evenness (Shannon-Weiner function, 1963)

$$E = \frac{H}{H_{\max}} \text{ * Shannon-Wiener}$$

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

H_{max}= species diversity under conditions of maximal equitability

S = number of species

H = index of species diversity

E = evenness (range 0-1)

Investigation of Importance Value Index (IVI)

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

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

$$\text{Frequency (F)} = \frac{\text{No. of sample plots in which the spp. occurs}}{\text{Total no. of plots samples}}$$

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

$$\text{Mean basal area (MBA)} = \frac{\text{Total basal area}}{\text{No. of tree}}$$

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

(Curtis and McIntosh, 1950)

Results

Table 1. Consolidate detail of tree species in Site 1, Site 2 and Site 3

Description	Site 1	Site 2	Site 3
No. of Sample plots	50	50	50
No. of species	35	41	32
Unique species	9	7	5
Species Richness ($S^{\wedge}$)	35.83	41.87	32.13
Shannon Wiener diversity (H)	4.01	4.05	4.20
Simpson diversity index (D)	0.91	0.90	0.92
Species Evenness (E)	0.78	0.76	0.84
Density (Tree/ha)	736	1154	588
Basal area (m^2)	14.32	14.43	11.02

Table 2. Ranking of importance value index (IVI) in site 1

No.	Scientific Name	R.D (%)	R.F (%)	R.Dm (%)	IVI (%)
1	*Shorea obtusa* Wall.	3.80	5.83	29.12	38.75
2	*Chukrasia tabularis* A.Juss.	13.32	13.11	5.99	32.42
3	*Mitragyna parvifolia* (Roxb.) Korth.	0.28	0.49	27.83	28.57
4	*Xylia xylocarpa* (Roxb.) Taub.	16.85	10.68	0.78	28.30
5	*Millettia brandisiaba* Kurz.	14.67	8.25	0.69	23.63
6	*Lannea coromandelica* (Houtt.) Merr.	11.14	10.19	0.45	21.79
7	*Schleichera oleosa* (Lour.)Merr.	4.89	5.83	1.13	11.85
8	*Oroxylum indicum* (L.) Kurz.	5.71	5.83	0.05	11.58
9	*Bridelia retusa* (L.) Spreng.	3.26	4.85	2.79	10.91
10	*Terminalia pyrifolia* Kz.	1.90	3.39	4.73	10.03
		75.82	68.45	75.36	217.83
	Others	24.18	31.55	26.44	82.17
	Total	100	100	100	300

Table 3. Ranking of importance value index (IVI) in site 2

No.	Scientific Name	R.D (%)	R.F (%)	R.Dm (%)	IVI (%)
1	*Dipterocarpus tuberculatus* Roxb.	7.28	8.38	42.50	58.16
2	*Lannea coromandelica* (Houtt.) Merr.	21.66	12.28	6.79	40.74
3	*Shorea obtusa* Wall.	2.43	3.59	21.26	27.28
4	*Lagerstroemia speciosa* L.Pers	13.86	9.88	0.18	23.93
5	*Haplophragma adenophyllum* (Wall.)Sem.ex Benth and Hook	10.23	6.59	1.28	18.09
6	*Terminalia chebula* Retz.	5.72	6.59	4.88	17.19
7	*Schleichera oleosa* (Lour.)Merr.	4.85	5.69	4.48	15.02
8	*Ficus pomifera* Wall.	6.59	8.08	0.01	14.68
9	*Terminalia alata* B.Heyne and Roth.var.typica CEP	2.08	2.39	3.54	8.01
10	*Millettia brandisiaba* Kurz.	2.94	4.49	0.49	7.92
		77.63	67.96	85.41	231.02
	Others	22.36	32.04	14.59	68.98
	Total	100	100	100	300

Table 4. Ranking of importance value index (IVI) in site 3

No.	Scientific Name	R.D (%)	R.F (%)	R.Dm (%)	IVI (%)
1	*Tectona grandis* L.f.	18.37	13.66	29.69	61.71
2	*Dipterocarpus tuberculatus* Roxb.	8.16	7.10	12.26	27.54
3	*Xylia xylocarpa* (Roxb.) Taub.	8.84	9.84	8.52	27.18
4	*Chukrasia tabularis* A.Juss.	7.48	5.46	3.35	16.29
5	*Strychnos nux-blanda* A.W.Hill.	5.10	6.56	2.68	14.35
6	*Terminalia alata* B.Heyne and Roth.var.typica CEP	3.74	4.92	5.58	14.25
7	*Schleichera oleosa* (Lour.)Merr.	6.46	4.92	1.81	13.18
8	*Oroxylum indicum* (L.) Kurz.	6.46	5.46	0.85	12.78
9	*Millettia brandisiaba* Kurz.	5.11	3.83	3.18	12.11
10	*Lannea coromandelica* (Houtt.) Merr.	4.76	4.92	1.02	10.69
		74.48	66.67	68.93	210.08
	Others	25.52	33.33	31.07	89.92
	Total	100	100	100	300

Table 5. Population density of tree species across gbh class interval in site 1

GBH classes (cm)	No. of species	Tree Density (n ha^{-1})	% of total individual	Basal area (m^2)
10 ≤ 50	25	257	69.84	1.81
51 ≤ 100	19	72	19.56	2.39
101 ≤ 150	8	17	4.62	2.25
151 ≤ 200	4	13	3.53	3.73
200 ≤	3	9	2.45	4.73
Total		368	100	14.32

Table 6. Population density of tree species across gbh class interval in site 2

GBH classes (cm)	No. of species	Tree Density (n ha^{-1})	% of total individual	Basal area (m^2)
10 ≤ 50	40	499	86.48	2.20
51 ≤ 100	13	30	5.20	1.28
101 ≤ 150	9	25	4.33	3.52
151 ≤ 200	4	14	2.43	3.48
200 ≤	3	9	1.56	3.93
Total		577	100	14.43

Table 7. Population density of tree species across gbh class interval in site 3

GBH classes (cm)	No. of species	Tree Density (n ha^{-1})	% of total individual	Basal area (m^2)
10 ≤ 50	26	189	64.29	1.41
51 ≤ 100	17	57	19.39	2.60
101 ≤ 150	10	36	12.24	4.24
151 ≤ 200	7	8	2.72	1.92
200 ≤	3	4	1.36	1.51
Total		294	100	11.69

DISCUSSION AND CONCLUSION

In this area, three different study sites were established to cover the whole area. A total of 35 tree species, 31 genera, 27 families in site 1, 41 tree species, 35 genera, 24 families in site 2 and 32 tree species, 28 genera, 23 families in site 3 were recorded. The most abundant families in the study area are Combretaceae, Rubiaceae, Annonaceae in site 1, Rubiaceae, Bignoniaceae, Combretaceae in site 2 and Bignoniaceae, Combretaceae in site 2 and Bignoniaceae, Combretaceae, Rubiaceae in site 3. Species richness in site 1, 2 and 3 were 35.83, 41.87 and 32.13 respectively by the method of Heltshe, J.F. & Forrester, N.E.1983). Species richness was defined as the number of species on a site, and species diversity, as the number of abundant species (Alatalo, 1981). Therefore, site 2 shows the highest species richness. The diversity indices in site 1 (H = 4.01, D = 0.91, E = 0.78), site 2 (H = 4.05, D = 0.90, E = 0.76) and site 3 (H = 4.20, D = 0.92, E = 0.84) were analyzed by the method of Shannon-Wiener Index (H) and Simpson's Index (D).

Diversity indices are better measure of the species diversity of a forest and more informative than species counts alone. A higher number equals a more diverse community (Weidelt, 2000). Thus, site 3 would still be the most diverse than the site 1

and site 2 .Ecological successful species with the highest Importance Value Index were *Shorea obtuse* Wall. (Thitya) the 38.75% in site 1, and *Dipterocarpus tuberculatus* Roxb. (In) 58.16% in site 2 and *Tectona grandis* L.f.(Kyun) 61.71% in site 3 by Curtis and McIntosh, 1950. So these species could be regarded as the representative and ecologically successful tree species in the study area. The importance value index is imperative to compare the ecological significance of species (Lampercht, 1989).

The highest population of tree species were found in lower class (10 – 50 cm) in site 2 as well as middle class (50 – 100 cm) in site 1 and highest class (101 – 150 cm) in site 3. The height class of $2 \leq 6$ m and $6.1 \leq 10$ m was observed the highest numbers of individuals are 364 and 138 in site 2.

Therefore, ecological study at regular interval is needed to monitor the survival and growth of plant species and habitat conditions. Quantitative analysis of diversity and tree species recorded from present study may provide baseline information for formulating conservation and management strategies of the present forest. The present study gives an understanding of the diversity, pattern of population and regeneration of the tree species of the sanctuary which may help in forest management and conservation of the species.

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