PHYTODIVERSITY (ANGIOSPERMS AND GYMNOSPERMS) IN UMPHYRNAI PRIVATE FOREST OF EAST KHASI HILLS DISTRICT, MEGHALAYA(delete .)

Abstract

A study was carried out at Umphyrnai village (1,578 m) in the East Khasi Hills District of Meghalaya to identify and assess the angiosperm and gymnosperm diversity during 2021-2022, located at an elevation of. A total of 187 unique trees from 17 (correct the figure) different species have been identified. 4 gymnosperm species and 13 (correct the figure) angiosperm species were identified among them. The trees (delete: were discovered to) belong to 9 different families. The most dominant gymnosperm species was found to be *Pinus kesiya*, and the most dominant angiosperm species (delete: was discovered) appeared to be *Alnus nepalensis*. *Pinus kesiya* has the highest IVI.

Key words: Angiosperms, gymnosperms, diversity, Umphyrnai, private forests.

Introduction

Include only the study area-specific (**Umphyrnai** village private forest) data, ecological significance, ground truth and interpreting references than repeating the well known and already published general information of the state. Particularly the first two paras should be modified with novel site-specific information to correlate the diversity. State (i) the local name of private forests (for example, Ri-Kynti, etc.); (ii) whether the studied forests are plantations by origin or matured stock, give details including present valuation; (iii) how many stakeholders (individuals/families or clans or joint clans) are involved including the tribal with classified land holdings and male-female break up; (iv) whether there is any sacred grove within this area under special protection; (v) village private forest management system, rules and regulations or conventions; (vi) role of such forest in the stakeholders' livelihood.

Positioned in the North Eastern part of the country, Meghalaya covers an area of 1,429 (Source? Clarify whether it is the geographical area, i.e. 22,429 sq.km.) sq. km, which is 0.68 of the geographical area of the country. The State lies between 24 ° 58'N and 26 ° 07'N latitude and 89 ° 48' E to 92 ° 51' E longitude and is framed by Assam in the north and east

and shares a transnational boundary with Bangladesh in the south and west. The State has three distinct regions, videlicet, Garo Hills, Khasi Hills, and Jaintia Hills.

The state, owing to the different ecological conditions similar to wide variation in downfall, temperature, altitude as well as soil conditions, supports luxuriant growth of different types of foliage, viz., tropical evergreen, tropical semi-evergreen, tropical wet and dry deciduous, tropical broad-leaved hill forest, tropical pine forest, temperate forest, and champaigns **(Champion and Seth 1968; Rao and Hajra 1986)- not found under reference.**

According to ISFR, 2021 (include in reference), Meghalaya has 8,389 square kilometers of unclassified forest. These sorts of forests are often tiny in size and are spread within the village boundaries. They are handled and used in accordance with the owner's needs and desires. These forests are generally kept in order to produce wood. According to Tiwari, B.K et al. (2010)(not found in reference), private forests in Meghalaya are the primary source of 76,870 m3 of timber valued at INR 284.5 million (USD 5.7 million) taken from Meghalaya's forests per year. Owners of poorly supplied private forests frequently transfer them to other land uses (for example, agriculture or charcoal burning).

Many private forests are secondary forests or pine (*Pinus kesiya*) plantations. In some cases, the owners have converted these forests into agricultural land, agroforests or home gardens. While collection of forest products by people other than the owners' family members is strictly prohibited, in few cases the owners allow fellow villagers to extract dead and fallen wood, and NTFPs (write full form when first mentioned) for their personal use.

Methods and Materials:

Study Area

The research was conducted in private forest lands (total recorded area) in Umphyrnai village, in Mawryngkneng Block in East Khasi Hills District, at a height of 1,578 m, during the years 2021-2022. The study area's geographic coordinates are 25.5359°N and 91.9590°E.

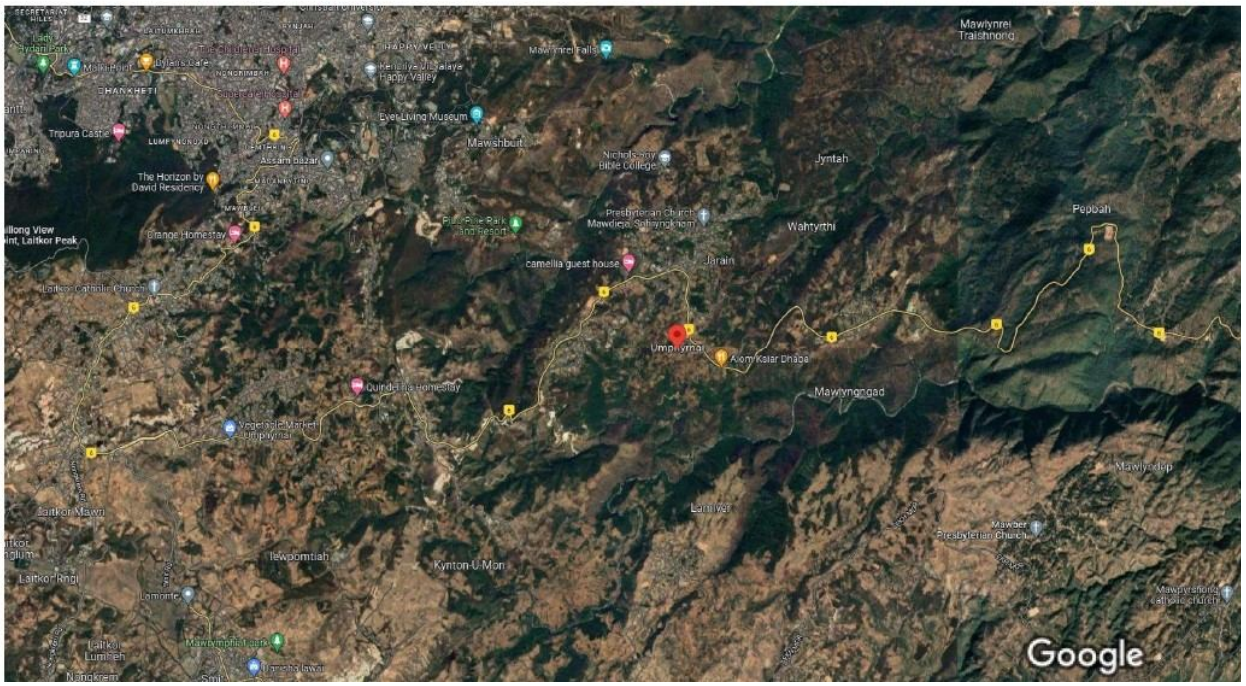

Fig 1: Location map of the Study Area (digitised map may be used).

[Only give physical features of the village like total number of households- 502; total population of 2,997 people (2011)- male 1,461, female 1,536; tribal population 2,980- male 1,449, female 1,531; estimated population in 2021-2022= 3,357; total workers- 1,214 out of which men 760 and women 454; Total cultivators 299 (men 176 and women 123; 394 agricultural labour (men 255 and women 139)]

Climate The South-West monsoon, which originates in the Bay of Bengal, has a direct influence on the climate of Meghalaya. Depending on altitude and elevation, the climate differs from eastern to western sections of the state. The area's climate is classified into four seasons: winter (December-February), spring (March-May), rainy (June-August), and autumn (September-November). The average maximum and lowest temperatures in June and July are 22°C and 8°C, respectively (January-February)(Delete the para).

Methodology:

Standardized belt transects survey (Mention whether consisting of continuous belt, or series of quadrat or stratified sampling? Give details and reasons for preferring the same. These sites may be shown in a field map):

The forest was divided into four square sample plots, each measuring 20×20m. All of the species found in these plots were recorded. Each angiosperm or gymnosperm tree's botanical description was documented independently in each of these plots. All tree species were identified and recorded with the assistance of informed individuals (name the expert/s assisted in the field along with institution). The phytodiversity of the study region was calculated by adding all of the species found in all of the plots. The diameter at breast height of trees in each plot was measured at 1.37 m (reference?)(What is used to measure accurately and precisely- tape/meter stick or what?).

In the forest, vegetation data were quantitatively examined for density, frequency, and abundance (Curtis and McIntosh, 1950 not found in the reference). The total of the relative values was utilized for the Importance Value Index, namely frequency, density, and dominance (Curtis, 1959). The diameter at breast height (Dbh) of the tree was used to calculate the basal area, which was given in Square Meter (m^2). The Shannon-Weiner information index was used to calculate the diversity index (Shannon and Weiner, 1963). Simpson's Index was used to calculate dominance concentration (Simpson, 1949). Pielou's evenness index was used to calculate species' evenness (Pielou, 1969). Margalef's Index of Species Richness was used to calculate species richness (1958).

Quantitative analysis

In each forest community, field data was analysed for abundance, density, and frequency (Curtis and McIntosh, 1950 not found in the reference). The total of the relative values utilised for the important value index, namely frequency, density, and dominance (Curtis, 1959 not found in the reference), (These- delete) are used to express a community's traits. Quantitative traits are analytical in nature and are typically expressed on a 5-point scale. These include characteristics such as frequency, density, quantity, cover, basal area, and so on.

(re-arrange the serial numbers below)

1. Frequency

This term refers to the degree of dispersal of each species in a given area, which is usually stated as a percentage of occurrence. It will be examined by randomly sampling the research region and recording the names of the species that occur in each sampling unit. It is calculated by the following equation:

$$\textbf{Frequency (\%)} = \frac{\text{Number of quadrates in which the species occurred}}{\text{Total number of quadrates}} \times 100$$

1. **Density**

The numerical strength of a species within the community is represented by its density. The diversity of a species is defined by the number of individuals in any given unit area. The degree of competitiveness is indicated by density. It is called by the following formula

$$\textbf{Density} = \frac{\text{Total no. of individuals of a species in all quadrates}}{\text{Total no. of quadrates sampled}} \times 100$$

2. **Abundance**

This is the number of individuals per quadrate of occurrence of any species. It is calculated as follows:

$$\textbf{Abundance} = \frac{\text{Total no. of individuals of a species in all quadrates}}{\text{No. of quadrates in which the species occurred}} \times 100$$

3. **Relative frequency**

The proportion of individual species in an area in relation to the total number of species observed.

$$\textbf{Relative frequency} = \frac{\text{Number of quadrates in which the species occurs}}{\text{Total number of quadrates in which all the species occurred}} \times 100$$

4. **Relative density**

Relative density is the study of numerical strength of a species of a species in relation to the total number of individuals of all the species and can be calculated as:

$$\text{Relative density} = \frac{\text{Total no. of individual of a particular species in all quadrate}}{\text{Total no. of individuals of all species in all quadrates}} \times 100$$

5. **Relative Dominance**

The value of a species' entire basal cover determines its dominance. The coverage value of a species in relation to the total coverage of the other species in the area is known as relative dominance.

$$\text{Relative Dominance} = \frac{\text{Total basal area of a particular species}}{\text{Total basal area of all species}} \times 100$$

6. **Basal Area**

Basal Area is one of the primary determinants of community dominance. The girth of the tree stems at breast height (DBH) at 1.37m above ground level will be used to calculate the basal area.

$$\textbf{Basal Area } (m^2) = \frac{\boldsymbol{\pi} \times (DBH)^2}{4 \times 10000}$$

7. **Importance Value Index (IVI)**

This index is used to determine each species' overall relevance in the community structure. In order to calculate this index, the percentage values of relative frequency, relative density, and relative dominance are added together, and the resulting value is known as the Importance Value Index (IVI) of the species (Curtis, 1959).

IVI = Relative Frequency + Relative Density + Relative Dominance

8. **Species richness**

'Margalef's index of richness (Dmg) **(Magurran, 1988)**

Dmg = (S-1 / In N(close the bracket)

Where, S = Total number of species, N = Number of individuals.

9. **Species diversity**

Shannon and Weiner (1963)

H' = - Σ (Pi In Pi)

Where, Pi = n/N (proportion of each species in the sample**(close the bracket)**

n = Number of individual species

N = Total number of individuals

10. **Evenness Index**

(Pielou, 1975)

E = H'/ln S

Where, H' = Shannon Index Value

ln = Bits per individual

11. **Index of dominance (D)**

Simpson (1949)

$D = \Sigma (n/N)^2$

Where, D = Simpson index of dominance

n = Number of individual species

N = Total number of individuals

Results and Discussion:

The vegetation composition observed in 4 quadrates of 20×20 m size at random locations revealed a total of 187 unique trees representing 17 species (check the list below and correct the figure and calculations done on this basis). Four species of gymnosperms and thirteen species of angiosperms were discovered (the number of angiosperm species should be corrected). The trees were discovered to be members of nine separate families (Table 1). Table 1 lists the species, along with their scientific names, local/common names, and families.

Table 1: Taxonomic status of trees at Umphyrnai Private Forest of East Khasi Hills District.

Sl. No.	Scientific name	Local/Common Name	Family	No. of Individuals

1	*Pinus kesiya*	Dieng Kseh Khasi	Pinaceae	58
2	*Pinus roxburghii*	Dieng Kseh Bilat	Pinaceae	19
3	*Cryptomeria japonica*	Dieng Cedar	Cupressaceae	8
4	***Juniperus*** *japonica*	Juniper	Cupressaceae	5
5	*Alnus nepalensis*	Dieng iong	Betulaceae	23
6	*Alnus glutinosa*	Dieng lieh	Betulaceae	10
7	*Myrica esculenta*	Dieng Sohphie Heh	Myricaceae	4
8	*Rhus chinensis*	Dieng Sohma	Anacardiaceae	15
9	*Schima khasiana*	Dieng ngan	Theaceae	5
10	*Pyrus pashia*	Dieng Sohjhur	Rosaceae	6
11	*Prunus cerasoides*	Dieng Cherry (Jew)	Rosaceae	7
12	*Prunus nepalensis*	Dieng Cherry (Thiang)	Rosaceae	11
13	*Cinnamomum glaucescens* (synonym *Cinnamomum cecicodahne*)	Dieng Pingwait	Lauraceae	7
14	*Quercus serrata*	Jolcham Oak	Fagaceae	1
15	*Acacia dealbata*	Dieng Baibl	Fabaceae	3
16	*Celtis tetrandra*	Nilgiri Elm	Ulmaceae	3
17	*Pyrus calleryana*	Dieng Sohphoh	Rosaceae	1
18	*Pourthiaea arguta*	Sohryngkham	Rosaceae	1

Gymnosperms

Table 1 indicates that out of 90 numbers of gymnospermic tree species found, 4 belonged to *Pinaceae* and *Cupressaceae*. The individual gymnosperms with the maximum number of individuals included *Pinus kesiya* (58), followed by *Pinus roxburghii* (19). The gymnosperms with the least number of occurrences included *Cryptomeria japonica* (8) and *Juniperous phoenica* (5).

Angiosperms

Table 1 shows that from the occurrence of 97 angiospermic trees, 14 species belonging to 7 families- viz., Betulaceae, Myricaceae, Rosaceae, Fabaceae, Fagaceae, Anacardiaceae, and Ulmaceae were recorded. The species with the highest number of occurrence belongs to *Alnus nepalensis* (23), and followed by *Rhus chinensis* (15), whereas the individuals with the least number of occurrence include *Quercus serrata*, *Pyrus calleryana* and *Pourthia arguta* each with one individual only.

Sl no.	Name of species	No. of species in each quadrat				Total no. of individuals	Total no. of quadrat in which the species occurred	Total no. of quadrats studied	Basal Area (m^2)	Frequency	Density	Abundance	Relative frequency	Relative density	Relative dominance	IVI
		I	II	III	IV											
1.	*Pinus kesiya*	11	14	11	22	58	4	4	4.045	100	14.5	14.5	7.547	31.01	36.08	74.643
2.	*Pinus roxburghii*	4	5	4	6	19	4	4	1.219	100	4.75	4.75	7.547	10.16	10.87	28.577
3.	*Cryptomeria japonica*	2	2	2	2	8	4	4	0.498	100	2	2	7.547	4.27	4.45	16.275
4.	*Juniperous phoenica*	1	0	4	0	5	2	4	0.318	50	1.25	2.5	3.773	2.67	2.84	9.287
5.	*Alnus nepalensis*	5	7	5	6	23	4	4	1.51	100	5.75	5.75	7.547	12.29	13.5	33.346
6.	*Alnus glutinosa*	2	5	2	1	10	4	4	0.644	100	2.5	2.5	7.547	5.34	5.76	18.654
7.	*Myrica esculenta*	1	0	1	2	4	3	4	0.193	75	1	1.4	5.66	2.13	1.72	9.519
8.	*Rhus chinensis*	4	3	4	4	15	4	4	0.439	100	3.75	3.75	7.547	8.021	3.92	19.488
9.	*Schima khasiana*	1	3	1	0	5	3	4	0.419	75	1.25	1.7	5.66	2.67	3.74	12.074
10.	*Pyrus pashia*	1	2	0	3	6	3	4	0.294	75	1.5	2	5.66	3.208	2.63	11.498
11.	*Prunus cerasoides*	1	3	2	1	7	4	4	0.262	100	1.75	1.75	7.547	3.74	2.34	13.630
12	*Prunus nepalensis*	3	5	2	1	11	4	4	0.678	100	2.75	2.75	7.547	5.882	6.06	19.489
13	*Cinnamomum cecicodahne*	1	2	4	0	7	3	4	0.329	75	1.75	2.4	5.66	3.743	2.94	12.343
14	*Quercus serrata*	1	0	0	0	1	1	4	0.056	25	0.25	1	1.886	0.534	0.5	2.921
15	*Acacia daelbata*	0	1	0	2	3	2	4	0.0143	25	0.75	1.5	3.773	1.604	1.28	6.657
16	*Celtis tetranda*	0	0	2	1	3	2	4	0.099	50	0.75	1.5	3.773	1.604	0.89	6.267
17	*Pyrus calleryana*	0	0	0	1	1	1	4	0.035	25	0.25	1	1.886	0.534	0.32	2.741
18	*Pourthia arqueta*	0	0	1	0	1	1	4	0.022	25	0.25	1	1.886	0.534	0.2	2.621
						187	**53**	**Total?**	**11.21**							**300.03**

Correct scientific names following the corrections made in table 1; recalculate and correct total Basal Area (m^2); IVI: Recalculate and correct the figures.

Table 2: Quantitative analysis of tree species at Umphyrnai Private Forest.

Fig 2: Importance Value Index at Umphyrnai Private Forest.

Correct scientific names following the corrections made in table 1

What does the blue colour represent in figure 2?

Diversity aspects

Various aspects were calculated on the basis of Shannon and Weiner index of species diversity (H'), Margalef's index of richness (Dmg), Pielou index of evenness (E), Simpson index of dominance (D).

Diversity Parameters in Umphyrnai Forest Stand

Table 3 shows that Shannon Weiner diversity index in the study site is greater in Angiosperms (2.30) than that of gymnosperms (0.99) which indicate that the angiosperms are more diverse.

Based on diversity indices values from table **3**, it was concluded that tree species diversity is greater in Angiosperms (2.30) than that of gymnosperms (0.99). Simpson index has been shown to be higher in gymnosperms (0.459) and lower in angiosperms (0.114). Margalef's Species richness is found to be higher in Angiosperms (2.841) and lower in Gymnosperms (0.666). As per dominance index, it was found that- delete Angiosperms (0.885) are found to be higher than that of gymnosperms (0.540).

Table 3: Gymnospermic and Angiospermic tree diversity in Umphyrnai Forest Stand

Sl. No.	Attributes/Parameters	Gymnosperms	Angiosperms
1.	**Shannon-Weiner Diversity**	0.990	2.30
2.	**Simpson index**	0.459	0.114
3.	**Evenness/Equitability Index**	0.712	0.872
4.	**Margalef's Richness Index**	0.666	2.841
5	**Dominance index**	0.540	0.885
6.	**Total no. of individuals**	90	97

Conclusion- This section should include the future prospect of the present stock and challenges to solve.

The results of present study could be concluded as an analysis of angiospermic and gymnospermic tree diversity in the private forest of Umphyrnai village. It was observed that- **delete these sentences**.

In Umphyrnai Private Forest Stand 4 species of gymnosperms and 14 species of angiosperms were recorded- show figures in percentage with Microsoft Support. The maximum frequency, density, abundance, and IVI of gymnosperms were recorded for *Pinus kesiya* and that of angiosperms was recorded for *Alnus nepalensis*. Shannon Weiner diversity index in the study site is greater in Angiosperms (2.30) than that of gymnosperms (0.99) which indicate that the angiosperms are more diverse- **shift this para to results section**.

References: Correct with only those mentioned in the text and delete others.

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