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# A Study of Phytosociology Characteristics of Tree Species Along an Altitudinal Gradient of Khonsa Forest Division Arunachal Pradesh, India

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***Abstract*: The study's goal is to evaluate the phytosociology of several tree species in the Khonsa Forest Division. For the sample plots placed in the forest area underneath the research area, a random sampling design was used. For the calculation of different phyto-sociological attributes 40 identified tree species were found under <800m, 61 species were found under 800-1800m and 39 species were found under >1800m. The total density per hectare at 800m was 141.818 tree/hectare, 800-1800m was 215.360 tree/hectare, and >1800m was 235.926 tree/hectare. The Shannon Weiner's index was 2.390, 2.799, and 2.469 at 800m, 800m to 1800m, and >1800m, respectively. At 800m, 800-1800m, and 1800m, the species evenness of the study area was 0.652, 0.684, and 0.679 respectively. The Simpson index was 0.028, 0.019, and 0.023 at 800m, 800-1800m and >1800m respectively. It was found that at <800 m elevation, the highest IVI was in *Terminalia myriocarpa* (39.891) followed by *Ailanthus integrifolia* (30.085) and least in *Artocarpus chaplasha* (0.155). At elevation 800-1800m the highest IVI was in *Schima wallichi* (23.168) followed by *Altingia excels* (20.429) and least in *Tetrameles nudiflora* (*0.*127). The highest IVI at >1800m was in *Magnolia champaca* (28.893) followed by *Schima wallichi* (27.479) and least in *Eleocarpus floribundus* (0.211).**

***Keywords*: Phytosociology, frequency, density, Important Value Index (IVI), Shannon Weiner's index, Simpson index, species evenness index.**

## 1. Introduction

The study of plant communities, their species relationships within them, and how they form is known as phytosociology. The goal of phytosociology is to create vegetation using an empirical model of the coefficient that describes vegetative units. To characterise the population dynamics of each plant species that exists in a specific community and to comprehend how those species interact with one another within that community, phytosociology is important (Mishra *et al*., 2012). Because it is frequently connected to how communities' function and their capacity for change, species variety is a crucial characteristic of communities (Stachowicz *et al*., 2007; Gamfeldt and Hillebrand, 2008). Diversity measures the likelihood that two randomly chosen members of a community belong to different species. Thus, richness and evenness, two additional community characteristics, have an impact on diversity. A biologically relevant way to assess alpha diversity is species richness, which is typically stated as the number of species per sample unit (Whittaker, 1972). The degree of resemblance in a species' abundance is referred to as evenness. The objective of this study was to evaluate the phytosociological traits of trees in Khonsa Forest Division.

## 2. Materials and Methodology

The study was conducted in Khonsa forest division of Arunachal Pradesh which lies between 27°6'21.45"N to 26°48'25.60"N and 95°21'40.65"E to 95°41'40.43"E. The forest division has two range namely Khonsa and Lazu range. Carto DEM was used to generate the elevation classes using Arc GIS tools. The elevation was categories into four classes that is <800m, 800-1800m, 1800-2400m and >2400m. The field survey was carried out in the two ranges and sampling of the trees was done by random sampling method.

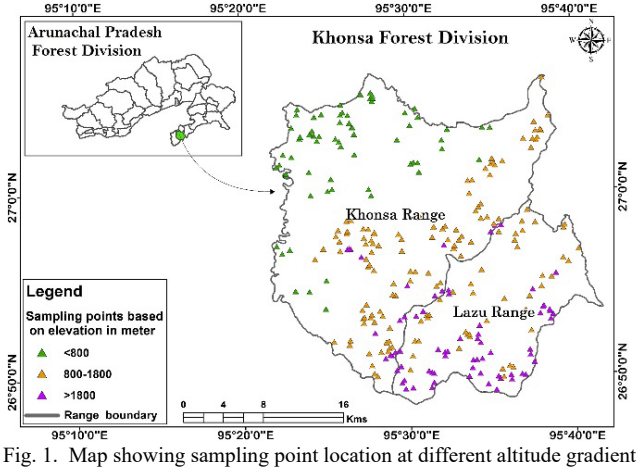

Fig. 1. Map showing sampling point location at different altitude gradient

Keeping in view, the sampling size of each plot was 31.6 m × 31.6 m for trees or woody species (>30 cm GBH) and a total plot of 263 were collected for tree species and individuals. Tree species found in each quadrats were listed, and their girths at breast height (1.37 m) were measured. For each tree species,

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values for frequency, density ($ha^{-1}$), and basal area were calculated. Each species' important value index was calculated by adding its relative density, relative frequency, and relative dominance. The study was also carried to find the diversity, species evenness and dominance indices by using the following formula:

*Diversity index:* The index was computed from the IVI values by using the formula Shannon-Wiener index (Shannon and Wiener 1963) was:

$$H' = -\sum_{i=1}^{n} P_i \, ln \, P_i$$

Where $p_i$ is the proportion of the *i*th species and the number of individuals of all the *i* species (n /N)).

The criteria of the diversity index are classified into:

H' ≤ 1 is low diversity, 1 < H' ≤ 3 is moderate diversity and H' ≥ 3 is high diversity.

*Species evenness index:* It provides information on the number of individuals of each species present in a community and is calculable using the formula.

$$E = \frac{H'}{Ln(S)}$$

Where E is the evenness index, H' is the diversity index, S is the number of species found.

The evenness ranges from 0-1 and based on Kreb (1989), evenness is categorized as:

E ≤ 0.5 is depressed community, 0.5 <E ≤ 0.75 is unstable community and E ≥ 0.75 is stable community.

*Dominance index:* The dominance was measured by Simpson's index (Simpson 1949) using the formula:

$$C = -\sum_{i=1}^{n} {P_i}^2$$

Where $p_i$ is the same as for the Shannon–Wiener information function.

The dominance ranges from 0-1 as categorized below:

D ≤ 0.5 is low dominance, 0.5 < D ≤ 0.75 is moderate dominance and D ≥ 0.75 is high dominance.

## 3. Results and Discussion

The phyto-sociological assessment of the different elevation classes has been carried out by taking into account of a total of 291 sampling points while each of them bearing an area of 0.1 ha. For the calculation of different phyto-sociological attributes the tree species under different elevation classes were taken. A total of 40, 61 and 39 species were found at <800m, 800-1800m and >1800m respectively. The Shannon Weiner's index was 2.390, 2.799, and 2.469 at 800m, 800m to 1800m, and >1800m, respectively, according to Table 1. In the study done by Saikai *et al*. (2017) the Shannon-Wiener diversity value was 4.64 which was higher than the present study. The study area has a moderate diversity index as per the criteria given by Ulfah *et al.* (2019). The total density per hectare at 800m was 141.818 tree/hectare, 800-1800m was 215.360 tree/hectare, and >1800m was 235.926 tree/hectare. Yumnam and Ronald (2022) found that the primary forest's total tree density was 395.75 stems per hectare, and the secondary forest's total tree density was 425 stems per hectare. The Simpson index was 0.028, 0.019, and 0.023 at 800m, 800-1800m and >1800m respectively. In the study it was found that the area has a low diversity as per Ulfah *et al.* (2019). Saikai *et al*. (2017) reported the concentration of dominance for trees was 0.02 which was less than the present study conducted. The Shannon Weiner's Index of primary and secondary temperate broadleaf forest of Indian Himalayas, according to Yumnam and Ronald (2022), was 3.10 and 3.21, respectively. Primary forest and Secondary forest each had a Simpson's index value of 0.05 and 0.04, respectively. At 800m, 800-1800m, and 1800m, the species evenness of the study area was 0.652, 0.684, and 0.679 respectively, indicating that the community was unstable at all elevation classes. The requirements for an unstable community, according to Ulfah et al. 2019, should be 0.5 - 0.75. From the Table 2, it was found that at <800 m elevation, the highest IVI was in *Terminalia myriocarpa* (39.891) followed by *Ailanthus integrifolia* (30.085) and least in *Artocarpus chaplasha* (0.155). From Table 3, at elevation 800-1800m the highest IVI was in *Schima wallichi* (23.168) followed by *Altingia excels* (20.429) and least in *Tetrameles nudiflora* (*0.*127). From Table 4, the highest IVI was in *Magnolia champaca* (28.893) followed by *Schima wallichi* (27.479) and least in *Eleocarpus floribundus* (*0.*211). Geelani *et al.* (2018) found in the study that *Picea smithiana* had the most dominance among trees with an IVI value of (130.60), followed by *Pinus wallichiana* (55.44), *Aesculus indica* (29.91), *Cedrus deodara* (27.09), *Abies pindrow* (19.48), and *Juglans regia* (19.40), while *Ulmus wallichiana* had the lowest IVI (18.08).

Table 1
Community characteristics of Khonsa forest division at different elevation classes

| Attributes | Elevation classes in meters | | |
|---|---|---|---|
| | <800 | 800-1800 | >1800 |
| No. of sampling points | 85 | 125 | 81 |
| No. of species found | 39 | 60 | 38 |
| Diversity index (H') | 2.390 | 2.799 | 2.469 |
| Species evenness (E) | 0.652 | 0.684 | 0.679 |
| Dominance index (C) | 0.028 | 0.019 | 0.023 |
| Density per hectare | 141.818 | 215.360 | 235.926 |

Table 2
Phyto-sociology characteristics of tree species of Khonsa forest division at <800 elevation class

| Botanical name | Frequency | Density | Dominance | Relative frequency | Relative dominance | Relative density | IVI |
|---|---|---|---|---|---|---|---|
| *Adina oligocephala* | 0.018 | 0.018 | 0.002 | 0.385 | 0.185 | 0.128 | 0.698 |
| *Ailanthus integrifolia* | 0.436 | 1.527 | 0.101 | 9.231 | 10.085 | 10.769 | 30.085 |
| *Albizia procera* | 0.127 | 0.218 | 0.018 | 2.692 | 1.849 | 1.538 | 6.080 |
| *Alstonia scholaris* | 0.055 | 0.164 | 0.010 | 1.154 | 1.002 | 1.154 | 3.310 |
| *Altingia excelsa* | 0.109 | 0.200 | 0.031 | 2.308 | 3.092 | 1.410 | 6.810 |
| *Amoora wallichii* | 0.091 | 0.218 | 0.009 | 1.923 | 0.907 | 1.538 | 4.369 |
| *Anthocephalus cadamba* | 0.055 | 0.164 | 0.011 | 1.154 | 1.118 | 1.154 | 3.426 |
| *Aporusa roxburghii* | 0.236 | 0.600 | 0.048 | 5.000 | 4.779 | 4.231 | 14.010 |
| *Artocarpus chaplasha* | 0.000 | 0.018 | 0.000 | 0.000 | 0.026 | 0.128 | 0.155 |
| *Baccaurea ramiflora* | 0.000 | 0.018 | 0.000 | 0.000 | 0.029 | 0.128 | 0.158 |
| *Balakata baccata* | 0.182 | 0.436 | 0.056 | 3.846 | 5.583 | 3.077 | 12.506 |
| *Bischofia javanica* | 0.036 | 0.055 | 0.005 | 0.769 | 0.539 | 0.385 | 1.693 |
| *Canarium strictum* | 0.236 | 0.800 | 0.051 | 5.000 | 5.092 | 5.641 | 15.733 |
| *Carallia brachiara* | 0.055 | 0.218 | 0.012 | 1.154 | 1.234 | 1.538 | 3.926 |
| *Celtris australis* | 0.127 | 0.236 | 0.009 | 2.692 | 0.934 | 1.667 | 5.293 |
| *Choerospondias axillaris* | 0.018 | 0.055 | 0.001 | 0.385 | 0.065 | 0.385 | 0.834 |
| *Chukrassia tabularis* | 0.236 | 0.691 | 0.057 | 5.000 | 5.705 | 4.872 | 15.577 |
| *Cryptocarya amygdalina* | 0.109 | 0.200 | 0.006 | 2.308 | 0.618 | 1.410 | 4.336 |
| *Cyclostemon assamica* | 0.091 | 0.255 | 0.010 | 1.923 | 0.980 | 1.795 | 4.698 |
| *Dillenia indica* | 0.164 | 0.382 | 0.011 | 3.462 | 1.088 | 2.692 | 7.242 |
| *Dipterocarpus macrocarpus* | 0.273 | 1.455 | 0.114 | 5.769 | 11.448 | 10.256 | 27.474 |
| *Duabanga grandiflora* | 0.218 | 0.600 | 0.036 | 4.615 | 3.597 | 4.231 | 12.443 |
| *Dysoxylum binectiferum* | 0.018 | 0.018 | 0.000 | 0.385 | 0.028 | 0.128 | 0.541 |
| *Dysoxylum procerum* | 0.109 | 0.200 | 0.014 | 2.308 | 1.430 | 1.410 | 5.148 |
| *Endospermum chinensis* | 0.127 | 0.400 | 0.018 | 2.692 | 1.849 | 2.821 | 7.362 |
| *Ficus racemosa* | 0.164 | 0.582 | 0.046 | 3.462 | 4.564 | 4.103 | 12.128 |
| *Garuga pinnata* | 0.091 | 0.091 | 0.001 | 1.923 | 0.088 | 0.641 | 2.652 |
| *Heteropanax fragrans* | 0.036 | 0.073 | 0.004 | 0.769 | 0.376 | 0.513 | 1.658 |
| *Kydia calycina* | 0.145 | 0.418 | 0.016 | 3.077 | 1.635 | 2.949 | 7.660 |
| *Lannea coromandelica* | 0.091 | 0.145 | 0.007 | 1.923 | 0.733 | 1.026 | 3.681 |
| *Macaranga denticulata* | 0.036 | 0.182 | 0.007 | 0.769 | 0.741 | 1.282 | 2.792 |
| *Mesua ferrea* | 0.036 | 0.073 | 0.003 | 0.769 | 0.333 | 0.513 | 1.616 |
| *Phoeba cathia* | 0.055 | 0.109 | 0.001 | 1.154 | 0.132 | 0.769 | 2.055 |
| *Phoebe goalparensis* | 0.036 | 0.073 | 0.003 | 0.769 | 0.282 | 0.513 | 1.564 |
| *Pterospermum acerifolium* | 0.055 | 0.055 | 0.003 | 1.154 | 0.279 | 0.385 | 1.817 |
| *Schima wallichi* | 0.164 | 0.436 | 0.020 | 3.462 | 2.010 | 3.077 | 8.549 |
| *Shorea assamica* | 0.273 | 0.909 | 0.061 | 5.769 | 6.093 | 6.410 | 18.272 |
| *Sterculia villosa* | 0.036 | 0.073 | 0.005 | 0.769 | 0.477 | 0.513 | 1.759 |
| *Terminalia myriocarpa* | 0.382 | 1.818 | 0.190 | 8.077 | 18.993 | 12.821 | 39.891 |
| **Total** | 4.727 | 14.182 | 1.000 | 100.000 | 100.000 | 100.000 | 300.000 |

Table 3
Phyto-sociology characteristics of tree species of Khonsa forest division at 800-1800 elevation class

| Botanical name | Frequency | Density | Dominance | Relative frequency | Relative dominance | Relative density | IVI |
|---|---|---|---|---|---|---|---|
| *Aesculus assamica* | 0.016 | 0.040 | 0.002 | 0.166 | 0.246 | 0.186 | 0.598 |
| *Aglaia spectabilis* | 0.168 | 0.296 | 0.008 | 1.746 | 0.805 | 1.374 | 3.925 |
| *Ailanthus excelsa* | 0.304 | 0.720 | 0.041 | 3.159 | 4.127 | 3.343 | 10.629 |
| *Ailanthus integrifolia* | 0.248 | 0.528 | 0.027 | 2.577 | 2.697 | 2.452 | 7.726 |
| *Alnus nepalensis* | 0.088 | 0.168 | 0.006 | 0.914 | 0.581 | 0.780 | 2.275 |
| *Altingia excelsa* | 0.536 | 1.416 | 0.083 | 5.569 | 8.285 | 6.575 | 20.429 |
| *Amoora wallichii* | 0.312 | 0.848 | 0.040 | 3.242 | 3.967 | 3.938 | 11.146 |
| *Anthocephalus kadamba* | 0.016 | 0.016 | 0.000 | 0.166 | 0.040 | 0.074 | 0.280 |
| *Baccaurea ramiflora* | 0.352 | 0.696 | 0.022 | 3.658 | 2.207 | 3.232 | 9.097 |
| *Balakata baccata* | 0.104 | 0.352 | 0.020 | 1.081 | 1.985 | 1.634 | 4.700 |
| *Bischofia javanica* | 0.360 | 1.000 | 0.043 | 3.741 | 4.275 | 4.643 | 12.659 |
| *Calophyllum polyanthum* | 0.024 | 0.024 | 0.001 | 0.249 | 0.078 | 0.111 | 0.439 |
| *Camellia sp* | 0.016 | 0.048 | 0.002 | 0.166 | 0.186 | 0.223 | 0.576 |
| *Canarium strictum* | 0.168 | 0.424 | 0.025 | 1.746 | 2.549 | 1.969 | 6.264 |
| *Carallia brachiara* | 0.016 | 0.016 | 0.000 | 0.166 | 0.040 | 0.074 | 0.280 |
| *Castanopsis indica* | 0.360 | 0.920 | 0.050 | 3.741 | 4.951 | 4.272 | 12.963 |
| *Choerospondias axillaris* | 0.072 | 0.160 | 0.008 | 0.748 | 0.836 | 0.743 | 2.327 |
| *Chukrassia tabularis* | 0.296 | 0.576 | 0.032 | 3.076 | 3.161 | 2.675 | 8.911 |
| *Cinnamomum glaucescens* | 0.368 | 0.968 | 0.044 | 3.824 | 4.360 | 4.495 | 12.678 |
| *Cinnamomum verum* | 0.472 | 1.016 | 0.028 | 4.904 | 2.818 | 4.718 | 12.440 |
| *Dysoxylum binectiferum* | 0.064 | 0.064 | 0.002 | 0.665 | 0.174 | 0.297 | 1.136 |
| *Dysoxylum hamiltonii* | 0.080 | 0.144 | 0.008 | 0.831 | 0.847 | 0.669 | 2.347 |
| *Dysoxylum procerum* | 0.400 | 0.648 | 0.035 | 4.156 | 3.505 | 3.009 | 10.670 |
| *Eleocarpus floribundus* | 0.144 | 0.288 | 0.008 | 1.496 | 0.825 | 1.337 | 3.659 |

Table 3 (Contd.)

| Botanical name | Frequency | Density | Dominance | Relative frequency | Relative dominance | Relative density | IVI |
|---|---|---|---|---|---|---|---|
| *Ficus nervosa* | 0.024 | 0.024 | 0.001 | 0.249 | 0.078 | 0.111 | 0.439 |
| *Garcinia* | 0.048 | 0.112 | 0.003 | 0.499 | 0.281 | 0.520 | 1.299 |
| *Garuga pinnata* | 0.256 | 0.544 | 0.022 | 2.660 | 2.219 | 2.526 | 7.406 |
| *Gironniers sp* | 0.056 | 0.080 | 0.004 | 0.582 | 0.378 | 0.371 | 1.332 |
| *Glochiodon sp* | 0.032 | 0.048 | 0.001 | 0.333 | 0.130 | 0.223 | 0.685 |
| *Ilex dipyrena* | 0.008 | 0.016 | 0.000 | 0.083 | 0.038 | 0.074 | 0.196 |
| *Juglas regia* | 0.104 | 0.240 | 0.012 | 1.081 | 1.227 | 1.114 | 3.422 |
| *Kayea assamica* | 0.104 | 0.208 | 0.005 | 1.081 | 0.532 | 0.966 | 2.578 |
| *Kydia calycina* | 0.168 | 0.400 | 0.019 | 1.746 | 1.947 | 1.857 | 5.550 |
| *Lanea coromandelica* | 0.408 | 1.072 | 0.056 | 4.239 | 5.561 | 4.978 | 14.778 |
| *Litsea panamonja* | 0.128 | 0.184 | 0.008 | 1.330 | 0.777 | 0.854 | 2.961 |
| *Lophopetalum fimbriatum* | 0.104 | 0.232 | 0.008 | 1.081 | 0.847 | 1.077 | 3.005 |
| *Macaranga denticulata* | 0.016 | 0.016 | 0.000 | 0.166 | 0.032 | 0.074 | 0.272 |
| *Machilus globusa* | 0.040 | 0.064 | 0.002 | 0.416 | 0.201 | 0.297 | 0.914 |
| *Magnolia champaca* | 0.432 | 0.952 | 0.052 | 4.489 | 5.176 | 4.421 | 14.085 |
| *Magnolia griffithii* | 0.152 | 0.264 | 0.014 | 1.579 | 1.386 | 1.226 | 4.191 |
| *Magnolia pterocarpa* | 0.128 | 0.248 | 0.006 | 1.330 | 0.583 | 1.152 | 3.065 |
| *Michelia champaca* | 0.096 | 0.144 | 0.010 | 0.998 | 0.975 | 0.669 | 2.641 |
| *Morus laevigata* | 0.016 | 0.032 | 0.001 | 0.166 | 0.063 | 0.149 | 0.378 |
| *Morus macroura* | 0.248 | 0.552 | 0.028 | 2.577 | 2.762 | 2.563 | 7.902 |
| *Myrica esculenta* | 0.008 | 0.008 | 0.000 | 0.083 | 0.035 | 0.037 | 0.155 |
| *Phoeba cathia* | 0.384 | 0.768 | 0.047 | 3.990 | 4.682 | 3.566 | 12.238 |
| *Phoebe goalparensis* | 0.008 | 0.016 | 0.001 | 0.083 | 0.145 | 0.074 | 0.303 |
| *Podocarpus neriifolius* | 0.192 | 0.536 | 0.016 | 1.995 | 1.625 | 2.489 | 6.109 |
| *Quercus sp* | 0.008 | 0.016 | 0.000 | 0.083 | 0.038 | 0.074 | 0.196 |
| *Schima khasiana* | 0.080 | 0.280 | 0.010 | 0.831 | 1.034 | 1.300 | 3.166 |
| *Schima wallichi* | 0.696 | 1.864 | 0.073 | 7.232 | 7.281 | 8.655 | 23.168 |
| *Spondias pinata* | 0.168 | 0.232 | 0.010 | 1.746 | 0.951 | 1.077 | 3.773 |
| *Sterculia villosa* | 0.096 | 0.128 | 0.003 | 0.998 | 0.349 | 0.594 | 1.941 |
| *Sterospermum chelonoides* | 0.112 | 0.176 | 0.006 | 1.164 | 0.643 | 0.817 | 2.624 |
| *Talauma phellocarpa* | 0.008 | 0.008 | 0.000 | 0.083 | 0.038 | 0.037 | 0.159 |
| *Terminalia bellerica* | 0.008 | 0.008 | 0.000 | 0.083 | 0.038 | 0.037 | 0.159 |
| *Terminalia chebula* | 0.080 | 0.168 | 0.009 | 0.831 | 0.896 | 0.780 | 2.507 |
| *Terminalia myriocarpa* | 0.216 | 0.512 | 0.035 | 2.244 | 3.503 | 2.377 | 8.124 |
| *Tetrameles nudiflora* | 0.008 | 0.008 | 0.000 | 0.083 | 0.007 | 0.037 | 0.127 |
| **Total** | 9.624 | 21.536 | 1.000 | 100.000 | 100.000 | 100.000 | 300.000 |

Table 4
Phyto-sociology characteristics of tree species of Khonsa forest division at >1800 elevation class

| Botanical name | Frequency | Density | Dominance | Relative frequency | Relative dominance | Relative density | IVI |
|---|---|---|---|---|---|---|---|
| *Aesculus assamica* | 0.519 | 0.840 | 0.023 | 4.947 | 3.558 | 2.302 | 10.807 |
| *Aglaia spectabilis* | 0.531 | 1.173 | 0.023 | 5.065 | 4.971 | 2.326 | 12.362 |
| *Ailanthus excelsa* | 0.037 | 0.099 | 0.005 | 0.353 | 0.419 | 0.460 | 1.232 |
| *Alnus nepalensis* | 0.704 | 1.617 | 0.051 | 6.714 | 6.855 | 5.073 | 18.641 |
| *Altingia excelsa* | 0.160 | 0.432 | 0.029 | 1.531 | 1.832 | 2.939 | 6.302 |
| *Amoora wallichii* | 0.148 | 0.358 | 0.017 | 1.413 | 1.518 | 1.666 | 4.597 |
| *Baccaurea ramiflora* | 0.173 | 0.420 | 0.013 | 1.649 | 1.779 | 1.272 | 4.700 |
| *Calophyllum polyanthum* | 0.222 | 0.432 | 0.012 | 2.120 | 1.832 | 1.233 | 5.185 |
| *Camellia sp* | 0.457 | 1.000 | 0.023 | 4.358 | 4.239 | 2.257 | 10.853 |
| *Castanopsis indica* | 0.741 | 1.778 | 0.122 | 7.067 | 7.535 | 12.204 | 26.806 |
| *Chukrassia tabularis* | 0.037 | 0.062 | 0.003 | 0.353 | 0.262 | 0.275 | 0.890 |
| *Cinnamomum glaucescens* | 0.272 | 0.765 | 0.032 | 2.591 | 3.244 | 3.228 | 9.063 |
| *Cinnamomum verum* | 0.333 | 0.605 | 0.014 | 3.180 | 2.564 | 1.429 | 7.173 |
| *Dysoxylum hamiltonii* | 0.148 | 0.210 | 0.013 | 1.413 | 0.890 | 1.305 | 3.608 |
| *Dysoxylum procerum* | 0.037 | 0.037 | 0.002 | 0.353 | 0.157 | 0.161 | 0.672 |
| *Eleocarpus floribundus* | 0.012 | 0.012 | 0.000 | 0.118 | 0.052 | 0.041 | 0.211 |
| *Garcinia* | 0.012 | 0.025 | 0.001 | 0.118 | 0.105 | 0.051 | 0.273 |
| *Garuga pinnata* | 0.037 | 0.062 | 0.002 | 0.353 | 0.262 | 0.236 | 0.851 |
| *Gironniers sp* | 0.012 | 0.025 | 0.001 | 0.118 | 0.105 | 0.050 | 0.273 |
| *Ilex dipyrena* | 0.519 | 1.247 | 0.024 | 4.947 | 5.285 | 2.405 | 12.637 |
| *Juglas regia* | 0.654 | 1.840 | 0.091 | 6.243 | 7.797 | 9.060 | 23.100 |
| *Lanea coromandelica* | 0.284 | 0.778 | 0.048 | 2.709 | 3.297 | 4.839 | 10.845 |
| *Litsea panamonja* | 0.556 | 1.049 | 0.028 | 5.300 | 4.448 | 2.837 | 12.585 |
| *Macropanax dispermus* | 0.259 | 0.543 | 0.014 | 2.473 | 2.302 | 1.385 | 6.161 |
| *Magnolia champaca* | 0.741 | 1.988 | 0.134 | 7.067 | 8.425 | 13.401 | 28.893 |
| *Magnolia griffithii* | 0.235 | 0.370 | 0.023 | 2.238 | 1.570 | 2.330 | 6.138 |
| *Magnolia pterocarpa* | 0.148 | 0.222 | 0.007 | 1.413 | 0.942 | 0.737 | 3.093 |
| *Michelia champaca* | 0.037 | 0.062 | 0.001 | 0.353 | 0.262 | 0.088 | 0.703 |
| *Morus macroura* | 0.296 | 0.642 | 0.036 | 2.827 | 2.721 | 3.554 | 9.102 |

Table 4 (Contd.)

| Botanical name | Frequency | Density | Dominance | Relative frequency | Relative dominance | Relative density | IVI |
|---|---|---|---|---|---|---|---|
| *Schima chinensis* | 0.012 | 0.012 | 0.001 | 0.118 | 0.052 | 0.058 | 0.228 |
| *Schima khasiana* | 0.074 | 0.173 | 0.006 | 0.707 | 0.733 | 0.567 | 2.007 |
| *Schima wallichi* | 0.852 | 2.259 | 0.098 | 8.127 | 9.576 | 9.775 | 27.478 |
| *Sorbus wallichii* | 0.210 | 0.420 | 0.007 | 2.002 | 1.779 | 0.748 | 4.529 |
| *Spondias pinata* | 0.012 | 0.025 | 0.001 | 0.118 | 0.105 | 0.098 | 0.321 |
| **Total** | 10.481 | 23.593 | 1.000 | 100.000 | 100.000 | 100.000 | 300.000 |

## 4. Conclusion

Any species in a community plays a specific role and there is a definite quantitative relationship between abundant and rare species. From the result of the study, it was found that the tree species were mostly found and dominated in the elevation categories of 800-1800 meters where significant number of trees species were found. This area is dominated by *Schima wallichi, Altingia excels*, *Dysoxylum procerum, Terminalia myriocarpa*. Generally low elevation area has more diverse species than higher elevation due to climatic condition or soil characteristics. But in this study, the elevation of less than 800 meter has less diversity than the higher elevation and this would be due to some anthropogenic invention like jhum cultivation. Under this study, it was found that the forest area of the Forest Division is moderately diverse and unstable. The study also revealed that the species evenness and dominance decreases as elevation increases. Therefore, knowledge of phyto-sociological characteristics would help a forester to decide in managing the forest health. More trees can be planted in less diverse area. In area where one species is dominant, mixed species planting can be a good management practices. There are many different tree species in the forest at this altitude that may be helpful in the future. The forest can be sustainably useful to preserve biodiversity and reduce climate change with effective silvicultural methods.

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