

## EFFECT OF ANTHROPOGENIC DISTURBANCES ON PLANT DIVERSITY IN TWO DISTRICTS OF GARO HILLS, MEGHALAYA.

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### ABSTRACT

The study was carried out to assess the impact of human disturbance on species diversity of plants and phytosociological attributes of species in different Tropical forests of Garo Hills. The survey has been carried out in two districts of Garo Hills i.e South Garo Hills and South West Garo Hills. In South Garo Hills two forest reserves has been selected i.e. 'Emangre' and 'Dura asim' reserves, whereas from South West Garo Hills, 'Dimagre' and 'Bolgan' reserves have been selected. Therefore, tree species data were collected from 31.62 m<sup>2</sup> in four corners of 0.4 ha sites, randomly from each forest stand. In each plot, all trees ( $\geq 30$ ) diameter at the breast height were identified and measured. For shrubs, saplings and seedling within 5m<sup>2</sup> quadrats were plotted within 31.62 m<sup>2</sup>. The dominant species has been recorded on the basis of Important Value Index (IVI). The *Shorea robusta* (Gaertn.) were the dominant tree species in both the forest reserves of South Garo Hills and *Litsea monopetala* (Roxb.) and *Evodia fraxinifolia* (Hook.) were observed in Dimagre and Bolgan reserves of South West Garo Hills and so on for saplings, seedlings and shrubs. In the forests of South Garo Hills, the basal area in trees, saplings, seedlings and shrubs recorded were ranges from 28.51-46.20 m<sup>2</sup>/ha, 0.010-0.032 m<sup>2</sup>/ha, 0.006-0.211 m<sup>2</sup>/ha and 0.004-0.026 respectively and density were ranges from 540-577.5 individual/ha, 30-465 individual/ha, 365-131.25 individual/ha and 37.5-40 individual/ha respectively. Here, in South West Garo Hills also two forests has been surveyed i.e. Dimagre and Bolgan reserves were value of Basal area in trees, saplings, seedlings and shrubs recorded were ranges from 8.34-10.35 m<sup>2</sup>/ha, 0.011-0.012 m<sup>2</sup>/ha, 0.003-0.005 m<sup>2</sup>/ha and 0.003-0.074 m<sup>2</sup>/ha respectively and density recorded were ranges from 235-270 individual/ha, 30-35 individual/ha, 37.5-40 individual/ha and 37.5-45 individual/ha respectively. The basal area and density has been found to be highest in South Garo Hills as compared to South west Garo Hills. Even the diversity can be seen more in South Garo Hills than South West Garo Hills. The present study reveals that density and basal area is more in undisturbed forests than disturbed forests in 4 different sites of Garo Hills, Meghalaya. The Shannon & Wiener's Index (H') and Simpson index (Cd) were more in undisturbed forests than disturbed forests. In the forests of Garo Hills, in order to prevent the exploitation of forest tree diversity such as extinction of some species, urgent steps should be taken and for such action the NGO's should take initiative and promote the awareness to the local people.

### INTRODUCTION

The 'Garo Hills' is the western most part of Meghalaya. The Garo people mostly depend on the forest for their livelihood, therefore, the forests of Garo hills are decreasing day by day. The human exploitation of old-growth forests has greatly altered forest structure over large areas of the landscape has been recorded in many region of the world. (Thiollay, 1992 and Berg *et al.*, 1994). The destruction or conversion of habitat is the most significant cause of biodiversity loss. The main causes for conversion of forest to agricultural land, overgrazing, shifting cultivation and infrastructure development (roads, buildings, housing etc.). The biological diversity in forests depends on their composition and vertical structure (Puumalainen, 2001) and efforts have been made all over the world to include them in the criteria and indicators of forest biodiversity (Stork *et al.*, 1997). The plant diversity inventories in tropical forests have mostly been concentrated on tree species than other life forms, since tree species diversity is an important aspect of forest ecosystem diversity and also fundamental to total tropical forest biodiversity (Rennols *et al.*, 2000 and Naidu *et al.*, 2014). The effect of human disturbances on species diversity is an issue that has engaged the attention of ecologists both from theoretical and applied standpoints (Stapanian *et al.*, 1997 and Upadhaya *et al.*, 2004). Eriksen, (2007), however, did not

see consensus on the role played by human in density reduction of economic tree species in particular and land management in general. But, it appeared from some studies that anthropogenic disturbances, particularly burning, increases tree species richness (Kennard, 2002; Gould *et al.*, 2002) while other views are opposite (King *et al.*, 1997; Kalacska *et al.*, 2004). Attua *et al.* (2013) emphasized on the necessity of a quantitative assessment towards understanding the extent of role played by the human and other ecological factors in the spatial distribution of trees in nature. Majority of the studies so far addressing this management gap have focused on the neighboring forest (Asase *at et.*, 2007 and Addo-Fordjour *et al.*, 2009) and belongs to tropical grass land ecotypes (Asase *et al.*, 2009; Asase and Tetteh, 2010; Tom-Dery *et al.*, 2012). Trees diversity is vital to tropical forest biodiversity, because tree provide homes and resources to a wide variety of plant and animal species (Huang *et al.*, 2003).

Tree species diversity and spatial distribution in tropical forest are therefore, mostly influenced by biogeography, as well as day to day requirements and disturbances (Huang *et al.*, 2003). Considering the above facts an effort was made to study the effect of human disturbances on the plant diversity of the Garo Hill Districts of Meghalaya.

### MATERIALS AND METHODS

The survey has been done in two district of Garo Hills i.e. South Garo Hills which lies between 90.55° E and 25.36° N, South West Garo range which lies between 90.17° E and 25.39° N. From each district two reserves have been selected, which were ‘Emangre’ and ‘Dura asim’ reserves in South Garo Hills, while ‘Dimagre’ and ‘Bolgan’ reserves in South West Garo Hills .



A. Emangre reserve



B. Dura asim reserve



C. Dimagre reserve



D. Bolgan reserve

Plate 1. The four study sites in two districts of Garo Hills.

In each forest, a 250 m × 250 m site was selected following ISRO-GBP/NCP-VCP (Singh and Dadhwal 2009). Four quadrats of 0.1 ha size (31.62 m × 31.62 m) was laid in four different forests of Garo Hills. The plot size of 0.1 ha was based on earlier surveys carried out by state forest department and Forest Survey of India. CBH of all trees (≥ 10 cm CBH) within the 0.1 plot were recorded and some plant specimens were collected to prepare herbarium. The seedlings, saplings and shrubs were sampled by laying a 5 m x 5 m quadrat in each 0.1 ha plot. For herb species a 1 m x 1 m quadrat was laid in each 5 m x 5 m quadrat.

### Plant species identification

All the plant species was identified with the help of 'Flora of Assam' (Kanjilal, 1934–1940), 'Assam Flora' (Chowdhury *et al.*, 2005) and the herbarium of the Botanical Survey of India, Shillong.

### Phytosociological analysis

The phytosociological data was quantitatively analysed for density, frequency, basal area, relative density, relative frequency, relative dominance and Important Value Index following Curtis and McIntosh (1950), Phillips (1959) and Diversity index was calculated following Shannon & Wiener (1963) as follows

$$H = - \sum_{i=1}^s p_i \ln p_i$$

Where,  $p_i$  is the proportion of individuals of  $i$ th species and total number of individuals of all species.

The concentration of dominance was calculated following Simpson (1949) as follows-

$$Cd = \sum_{i=1}^s (p_i)^2$$

Where  $p_i$  is the proportion of individuals of  $i$ th species and total number of individuals of all species.

## RESULTS AND DISCUSSION

The important value index (IVI) of the tree species, sapling species, seedling species and shrub species of the four reserved forests being studied are presented as bar diagram in figures 1, 2, 3 and 4 respectively. On the basis of IVI, the dominant tree species found was *Shorea robusta* (Gaertn.) and the numbers of recorded to be the highest, in both the reserves of South Garo Hills. While in South West Garo Hills, different species of trees *i.e.* *Litsea monopetala*(L.) in Dimagre reserve and *Evodia fraxinifolia* (Hook.) in Bolgan reserve were found to be dominant.

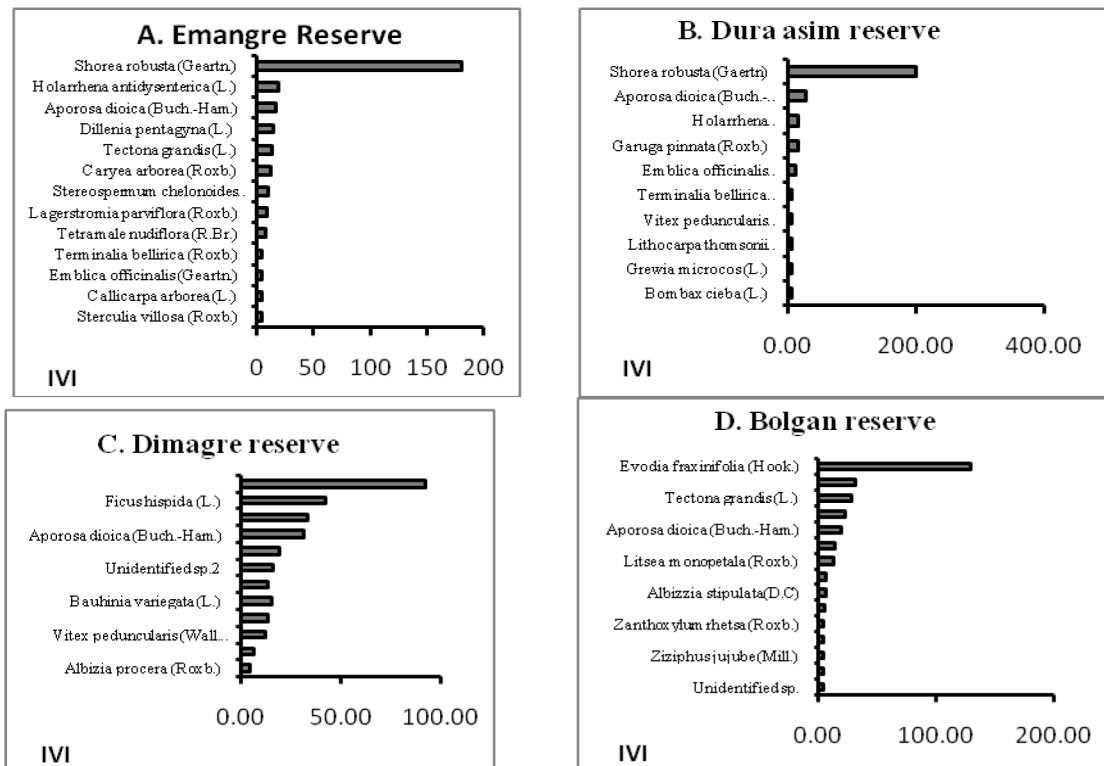


Fig1. The Important value index (IVI) of tree species in the tropical forests of Garo Hills, Meghalaya.

In Dimagre reserve two tree species were unidentified species and one in Bolgan reserve respectively. *Aporosa dioica* (Buch.-Ham.) and *Litsea monopetala* (L.) were the highest dominating sapling species in Emangre and Dura asim reserves of South Garo Hills whereas in South West Garo Hills, the Dimagre reserve and Bolgan reserve were dominated by Unidentified species along with *Aporosa dioica* (Buch.-Ham.) respectively. In South Garo Hills, the Emangre reserve, one unidentified species has been recorded. In South West Garo Hills, one unidentified species has also been recorded in both the reserves and so on in seedling species; the unidentified species has been recorded. The seedling species, *Shorea robusta* (Gaertn.) had dominated in both the reserves of South Garo Hills, whereas in Dimagre and Bolgan reserves the unidentified species and *Dalbergia stipulacea* (Roxb.) were the dominant species respectively. Lastly, in case of shrubs species, *Clerodendrum inornatum* (L.) and *Phlogacanthus thyrsoiflorus* (Nees.) were the dominant species in Emangre and Dura asim reserves of South Garo Hills respectively, whereas in Dimagre and Bolgan reserve *Urena lobata* (L.) was dominant in both the reserves of South West Garo Hills. The dominance of *Shorea robusta* (Gaertn.) in South Garo Hills forests can be due to remoteness from the human populations and difficult situation of transportation, the people cannot reach easily to disturb. This situation in fact protect the forest of those locations as compared to the forests of South West Garo Hills situating near the township and thickly populated location. The timber and economic value of *Shorea robusta* (Gaertn.) plant is also another attraction for the miscreants' for towards destruction of the *S. robusta* (Gaertn.) plantations.

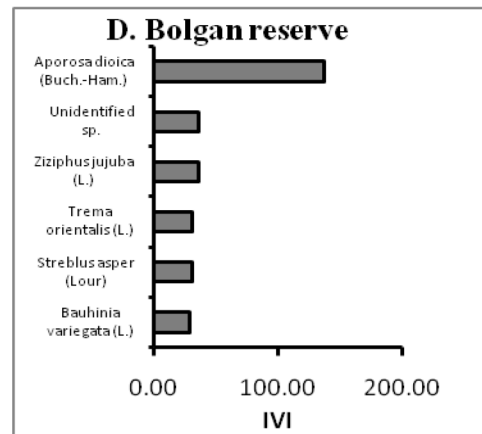
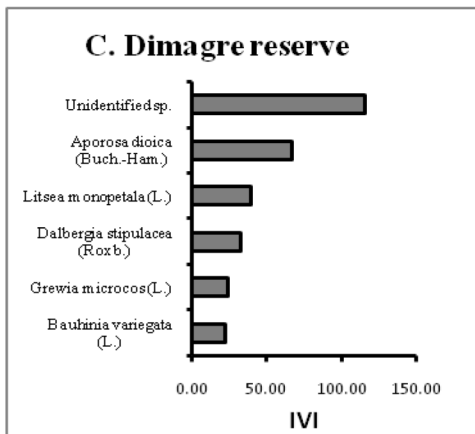
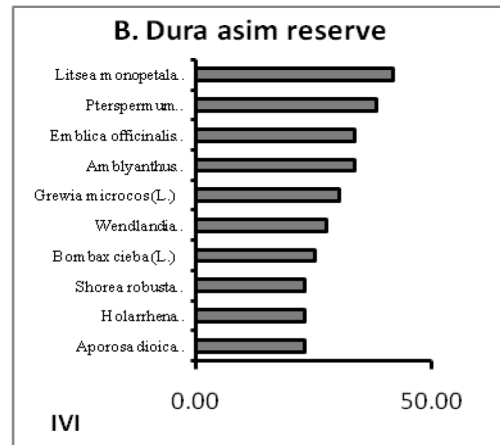
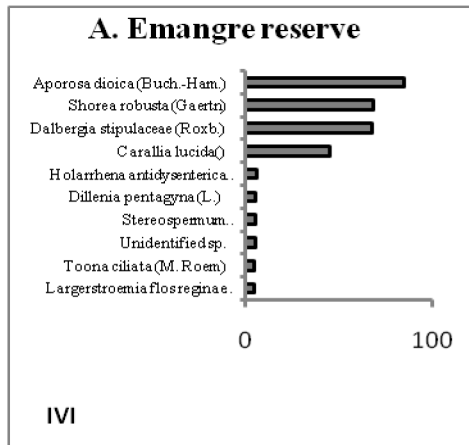
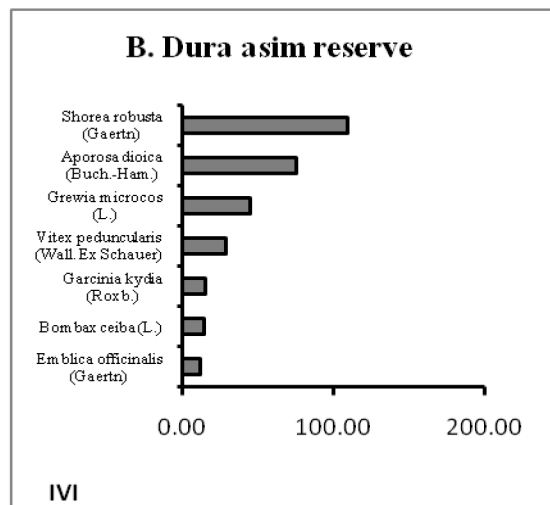
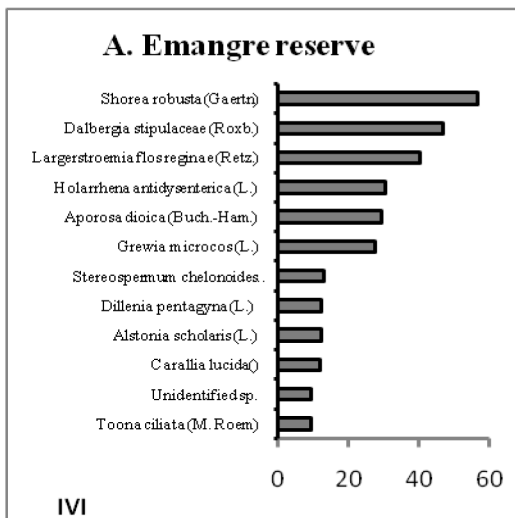


Fig2. The Important value index (IVI) of sapling species in the tropical forests of Garo Hills, Meghalaya.



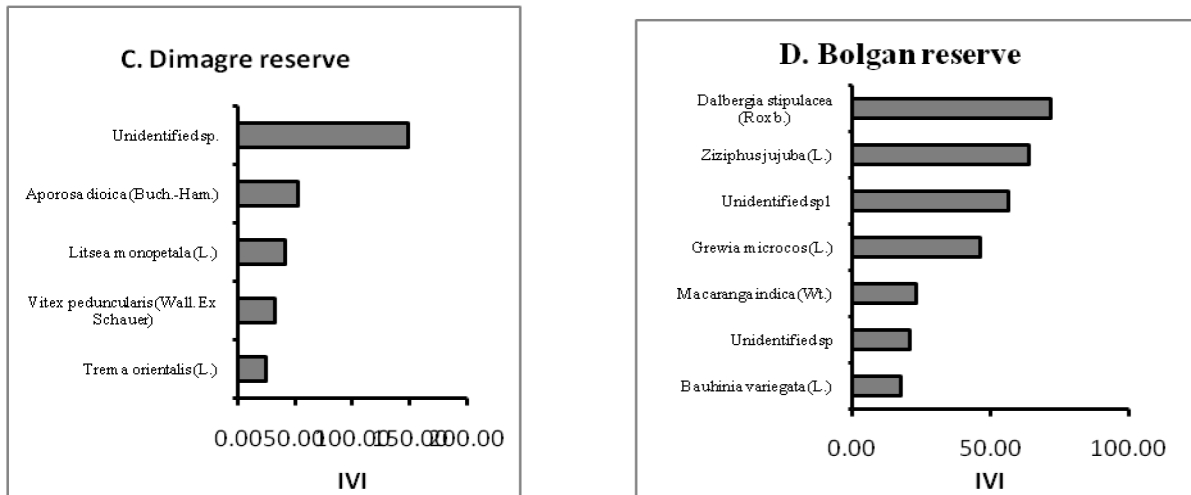
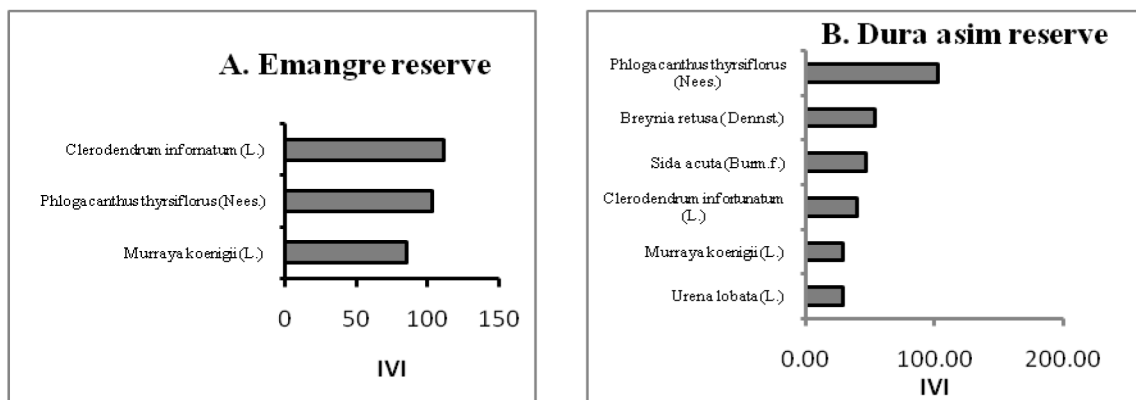


Fig3. The Important value index (IVI) of seedling species in the tropical forests of Garo Hills, Meghalaya.

The basal area, density and diversity have been presented for trees, sapling, seedlings and shrubs in tables 1, 2, 3 and 4. In South Garo Hills, two forest reserves has been surveyed i.e. Emangre and Dura asim reserves and the measures of basal area in trees, saplings, seedlings and shrubs have been ranges from 28.51-46.20 m<sup>2</sup>/ha, 0.010-0.032 m<sup>2</sup>/ha, 0.006-0.211 m<sup>2</sup>/ha and 0.004-0.026 respectively and the density ranges was from 540-577.5 individual/ha, 30-465 individual/ha, 365-131.25 individual/ha and 37.5-40 individual/ha respectively. Here, in South West Garo Hills also two forest reserves have been surveyed i.e. Dimagre and Bolgan reserves, and value of Basal area in trees, saplings, seedlings and shrubs recorded were ranging from 8.34-10.35 m<sup>2</sup>/ha, 0.012-0.011 m<sup>2</sup>/ha, 0.003-0.005 m<sup>2</sup>/ha and 0.003-0.074 m<sup>2</sup>/ha respectively. Similarly the density records have shown ranges from 235-270 individual/ha, 30-35 individual/ha, 37.5-40 individual/ha and 37.5-45 individual/ha respectively. The basal area and density has been found to be highest in South Garo Hills as compared to South west Garo Hills. The study reveals that South Garo Hills has a least disturbance as compared to South West Garo Hills. Even the diversity has also been observed high in South Garo Hills as compared to South West Garo Hills. The diversity indices, according to Shannon & Wiener Index (H') and Simpson Index (Cd) varied widely in the trees (Table.1), saplings (Table.2), seedlings (Table.3) and shrubs (Table.4).



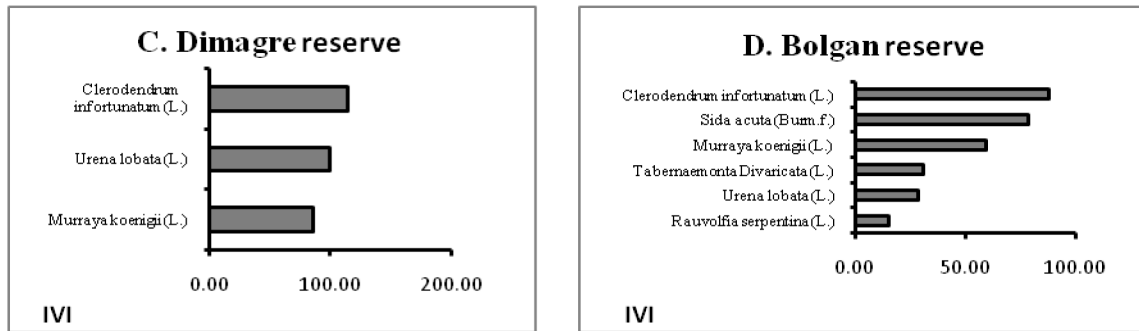


Fig4. The Important value index (IVI) of shrub species in the tropical forests of Garo Hills, Meghalaya.

The South Garo Hills have more dense forest than South West Garo Hills which may be due to Urbanizations or may be due to increasing population as well as unauthorised occupation of forest land for residential purposes by the local people. Also, deforestation increases due to local people who reside in that area since the people mostly depend on the forest for their livelihood. Moreover, South West Garo Hills is bit nearer to the town i.e. the head-quarter of the Garo Hills than South Garo Hills and the more disturbances in the forest area can be seen due to urbanization and development.

Table 1. Species Diversity and Important vegetational parameters for Tree in different forest.

Location	District	Basal area (m <sup>2</sup> /ha)	Density (individual/ha)	Shannon & wiener Index (H')	Simpson Index (Cd)
Emangre reserve	South Garo Hills	46.2098	540	0.39	3.26
Dura asim reserve	South Garo Hills	28.5183	577.5	0.97	0.58
Dimagre reserve	South West Garo Hills	8.341444	270	1.95	0.20
Bolgan reserve	South West Garo Hills	10.34904	235	1.93	0.24

Table 2. Species Diversity and Important vegetational parameters for Saplings in different forest.

Location	District	Basal area (m <sup>2</sup> /ha)	Density (individual/ha)	Shannon & wiener Index (H')	Simpson Index (Cd)
Emangre reserve	South Garo Hills	0.032	465	1.63	1.27
Dura asim reserve	South Garo Hills	0.010	30	2.25	0.11
Dimagre reserve	South West Garo Hills	0.011	35	1.54	0.27
Bolgan reserve	South West Garo Hills	0.012	30	1.35	0.38

Table 3. Species Diversity and Important vegetational parameters for Seedlings in different forest.

Location	District	Basal area (m <sup>2</sup> /ha)	Density (individual/ha)	Shannon & wiener index (H')	Simpson index (Cd)
Emangre reserve	South Garo Hills	0.211	365	2.79	0.47
Dura asim reserve	South Garo Hills	0.006	131.25	1.61	0.26
Dimagre reserve	South West Garo Hills	0.003	40	1.35	0.32
Bolgan reserve	South West Garo Hills	0.005	37.5	1.75	0.20

Table 4. Species Diversity and Important vegetational parameters for Shrubs in different forest.

Location	District	Basal area (m <sup>2</sup> /ha)	Density (individual/ha)	Shannon & wiener index(H')	Simpson index (Cd)
Emangre reserve	South Garo Hills	0.026	140	0.96	0.18
Dura asim reserve	South Garo Hills	0.004	42.5	1.73	0.19
Dimagre reserve	South West Garo Hills	0.074	37.5	1.085	0.34
Bolgan reserve	South West Garo Hills	0.003	45	1.44	0.27

#### CONCLUSION:

Since tree species diversity of a forest influences in the ecosystem along with the fundamental for total tropical forest biodiversity, in case of plant diversity inventories of the tropical forest, the maximum importance has been given to tree species rather than other life-forms (Naidu *et al.*, 2014). From the general observation it appears that diversity of tree varied from place to place as well as forest to forest, mainly due to variation in biogeography, habitat and disturbance (Sagar *et al.*, 2003). Hence the comparative study of the two sites i.e. forest reserves of the two districts of Garo Hills, reveals that South Garo Hills have denser tree forest as compared to South West Garo Hills which may be due to urbanization or occupation of people for residing. The Dimagre and Bolgan reserve forests of South West Garo Hills are situated nearby to the town areas i.e. headquarter of Garo Hills and the people took advantage of entering and collecting plants easily for fuel-wood, causing heavy damage of the valuable timbers and non-timber forest products. In order to prevent this exploitation of forest tree diversity, leading towards threatening and extinction of some rare species, urgent and appropriate steps need to be taken for protection of the threatened floras and promoting the awareness among the local people towards importance of the biodiversity. Involvement of some active NGOs should be of great help in this effort.

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