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A study on the habitat characteristics of Moths in some selected sites of Barpeta District, Assam, India

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Abstract

In the study conducted in the Barpeta district, a comprehensive assessment of the local flora was carried out, identifying a total of 113 tree species from 43 different families. The average species richness among the tree species within moth habitats was found to be S= 43.5±7.05. Notably, sites 2, 3, 4, 8, and 16 exhibited the highest tree species diversity with S= 60, S= 58, S= 46, S= 46, and S= 48, respectively. Several dominant tree species were identified throughout the study sites, including *Tectona grandis* L.f., *Linnea grandis* A. Rish., *Dalbergia sissoo* Roxb., *Artocarpus heterophyllus* Lamk., *Bombax ceiba* L., *Lagerstroemia reginae* Roxb., *Michelia champaca* L., *Sterospermum chelonoides* (L.) DC., *Mangifera indica* L., *Toona ciliata* M. Roem., *Albizzia procera* (Roxb.) Benth, *Erythrina indica* Lamk., *Syzygium cumini* (L.) Skeels, *Premna bengalensis* Cl., *Melia azedarach* L., *Eucalyptus maculata* Hook, *Trewia nodiflora* L., *Vitex peduncularis* Wall.ex Schuer., *Spondias pinnata* (L.f.) Kurz., and *Vitex altissima* L. Additionally, the study identified a total of 62 shrub species from 28 families across the study area, with an average species richness of S=19.5± 5.27. Sites 3, 4, 9, 10, 15, and 16 were found to exhibit the highest diversity of shrub species. Furthermore, 75 herb species from 38 families were identified across the study area, with an average species richness of S=54.19±34.09. Sites 9, 4, 16, 6, and 14 showed significant diversity in herb species.

The study also highlighted the most preferred food/host plants used by the Arctiidae, Geometridae, and Sphingidae moth families, with these plants belonging to various families such as Poaceae, Moraceae, Solanaceae, Rubiaceae, Oleaceae, and Verbenaceae. This research provides valuable insights into the rich biodiversity of the Barpeta district and the plant species that play a crucial role in supporting local moth populations.

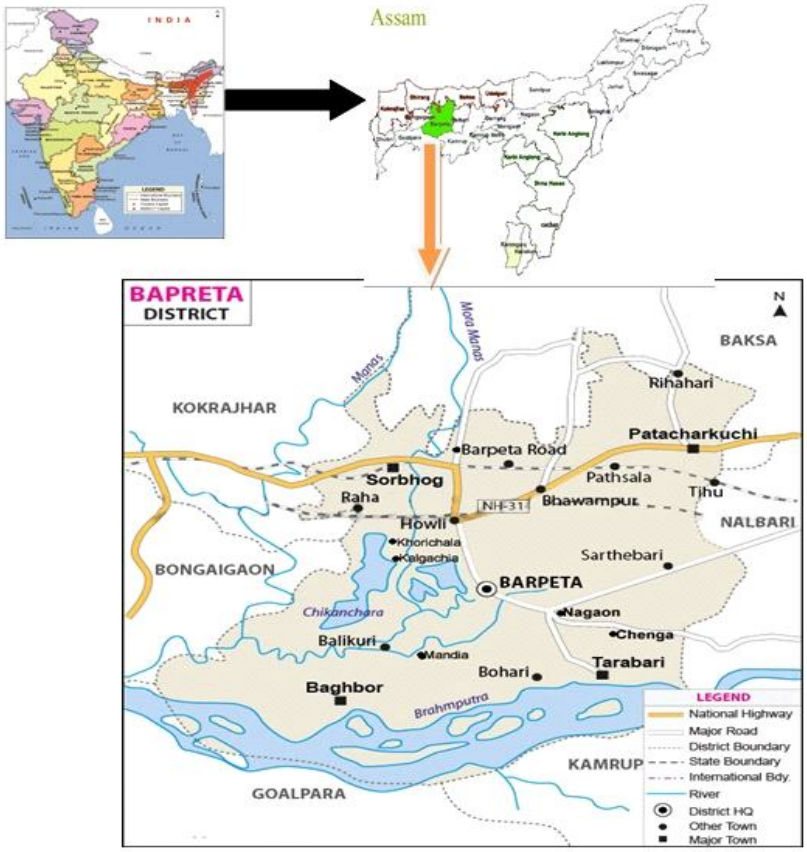
Key words : Habitat characteristics, Moths, Barpeta District, Assam, India.

The Eastern Himalaya represents one of the world's 34 biodiversity hotspots, renowned for its rich species diversity and endemism[24]. Situated at the confluence of the Indo-Malayan, Indo-Chinese, and Indian biogeographical realms, this region stands out for its unique ability to host a wide range of habitat types, thus supporting a diverse biota characterized by a high degree of endemism. Remarkably, a significant portion of its plant diversity remains intact[32]. However, the mounting human population in this area has led to severe anthropogenic pressures on its vegetation, including deforestation, grazing, tree branch cutting, and slash-and-burn practices for shifting cultivation[27]. These disturbances are continuous, with the extraction of biomass from forests occurring without allowing sufficient recovery time. Consequently, these activities have led to a gradual decline in habitat structure and a loss of biodiversity. Forest diversity plays a crucial role in sustaining livelihoods in the northeastern region, but the surge in population over recent decades has triggered extensive exploitation of its natural flora and fauna, resulting in habitat degradation.

Moths, belonging to the Lepidoptera order, are predominantly phytophagous, with their larval stages feeding on plant tissues and the adult moths primarily subsisting on nectar. Moths often exhibit monophagous or oligophagous feeding habits, meaning their abundance hinges on the presence of suitable food plants or host plants[22]. While moths can be found in diverse habitats, their peak numbers and diversity are typically observed in forested regions. Woody plants, shrubs, and trees make up the majority of host plants utilized by moth caterpillars, making moths economically significant as primary herbivores in forest ecosystems. Moths exhibit a wide array of habits and adapt to various conditions. Many herbivorous insects, such as macromoths, have a strong association with a single species or genus as their host plant[8]. Given their dependence on specific host plants, the abundance and distribution of macromoth species may mirror that of their host plants.

Herbivorous insects are known to exhibit heightened sensitivity to deforestation and subsequent forest regeneration, owing to their close functional ties with the vegetation they inhabit. The abundance and quality of host plants exert substantial influence over the spatial and temporal variations in herbivorous insect populations[25,44]. This is because host plants serve as both habitat and sustenance for herbivorous insects, and plant structure can influence the distribution of these insects[17], with the potential to interact with nutritional quality[40].

Moths serve as an intriguing model group for studying the effects of habitat changes due to their rich species diversity, herbivorous larval stages, accessibility of adult moths for standardized sampling, and the availability of substantial taxonomic knowledge for the majority of tropical samples[15,20]. Studies conducted in lowland habitats in other tropical regions have suggested that Arctiidae moths may even thrive in response to anthropogenic habitat disturbance, likely due to the broad dietary preferences exhibited by the larvae of many arctiid species[16,21,38]. While numerous studies have explored the diversity of tropical butterflies in response to habitat disturbance, moths, particularly the nocturnal species, also serve as suitable indicators for comprehending



Map-1: Map of Barpeta district showing sampling sites.

and monitoring the effects of habitat changes[1,2,6,15,20,33,39,45]. The present study deals with the habitat characteristics (*i.e.* vegetation composition, diversity, richness) of Moths in some selected sites of Barpeta Disctrict of Assam.

Study area :

The Barpeta district is located in Lower Brahmaputra valley with the total geographical area of the district is about 2243.96 Sq. KM. (https://barpeta.assam.gov.in), which is 4.21% of the total area of the state and 16.05% of the Lower Brahmaputra Valley Zone. It is bounded by Chirang District (B.T.A.D.) on its North and the mighty Brahmaputra on its South. The districts of Nalbari and Bongaigaon are situated in its eastern and western side respectively. The District lies between latitude 26°51' North - 26°49' North and longitude 90°39' East - 91°17' East (Map-1). It has almost flat topography with gentle slope towards the south *i.e.* the general Topography of the Barpeta district varies from low-lying plains to highland having small-hillocks in the South-West-corner of the District, namely Baghbar, Fulora and Chatala. The river Brahmaputra flows from east to west across the Southern

part of the district. The tributaries of this river that flows through the District are Beki, Manah, Pohumara, Kaldia, Palla, Nakhanda, Marachaulkhowa and Bhelengi flowing from North to South. Rivers Pohumara and Kaldiajoins near Barpeta town to form river Nakhanda whereas Palla and Beki join with Nakhanda to form Chaulkhowariver. The Soil of Barpeta District may be classified as Sandy, Sandy-loamy and forest-soils. The vegetation of the Barpeta district is of mixed evergreen and semi evergreen types.

Data collection :

Habitat assessment studies were conducted during daylight hours using the Quadrat method, as outlined by Sharma[35]. The aim was to characterize the various habitats within the surveyed areas, with a total of 16 sites (Baghbor, Kalgachia, Khorichala, Mandia, Sorbhog, Howly, Barpeta Road, Jania, Bhawanipur, Patacharkuchi, Rehabari, Pathsala, Bahari, Sarthebari, Nagaon, Chenga) were chosen in Barpeta district where Moth survey was done (Map-1). Throughout the survey, moths belonging to the Arctiidae, Geometridae, and Sphingidae families were observed in all 16 sites within the district. However, it's worth noting that the Sphingidae family was not present in all the plots that were surveyed.

In order to evaluate the habitat's vegetation characteristics across these 16 sites, a comprehensive sampling approach was employed. A total of 64 quadrates, measuring 20m x 20m, were systematically sampled for trees, while 5m x 5m quadrates were utilized for shrubs. Additionally, for herbaceous vegetation, 1m x 1m quadrates were employed in each site within both districts, spaced at 500-meter intervals. Given the relatively low density of trees, the decision was made to use 20m x 20m quadrates in each site within both districts, following the methodology proposed by Braun-Blanquet[4].

In each plot the following data were recorded: (1) Diameter at breast height (DBH) of all trees havinge ≥ 10 cm DBH; (2) Local name of all measured trees, shrubs and herbs (Initially plants were identified by local name with the help of local field assistants) and later on plant species were identified with the help of standard field guide following Hajra and Jain,[12] and Kanjilal *et al.,*[19] and also Dutta and Choudhury[8]; (3) Total no of trees, shrubs and herbs species present in each of the plot; (4) Identification of food trees, shrubs and herbs of moth.

In all the cases, the Density, Frequency and dominance of a particular taxon were calculated. All vegetation characteristics were then averaged for each study site. Measures of species diversity were then added to the analysis; species richness, defined by the no of tree species identified in each study site, Shannon-Wiener diversity index and Simpson diversity index, calculated as described in Ganzhorn[11] and Doughlas[7]. Shannon-Wiener diversity index[34], evenness index[31], Margalef index[23] and Simpson dominance index[36] were calculated by using PAST [13] software to analyse species diversity and dominance in the community.

A total of 113 tree species belonging to 43 families were identified across the study area (16 sites) of Barpeta. The average species

Table-1. Tree species richness and diversity at each study sites of Barpeta district

Study site	Name of the location	GPS point	Species richnes (S)	Sim-pson's index (C)	Shannon-wiener index (H)	Even-ness (J) index	Margalef index
1	Baghbor	26°13'24.32"N, 90°50'59.75"E	43	0.9032	2.62	0.7262	4.786
2	Kalgachia	26°21'48.57"N, 90°52'14.18"E	60	0.8383	2.232	0.6211	3.419
3	Khorichala	26°24'59.68"N, 90°51'59.32"E	58	0.9073	2.591	0.8342	3.694
4	Mandia	26°16'07.83"N, 90°53'40.34"E	46	0.9045	2.153	0.8231	4.44
5	Sorbhog	26°29'34.77"N, 90°53'40.97"E	42	0.8526	2.212	0.7608	2.943
6	Howly	26°25'30.42"N, 90°58'12.93"E	42	0.907	2.489	0.8608	3.478
7	Barpeta road	26°30'15.68"N, 90°58'47.97"E	38	0.9072	2.457	0.8976	3.299
8	Jania	26°19'46.16"N, 90°55'11.75"E	46	0.9348	2.796	0.91	4.44
9	Bhawanipur	26°30'15.68"N, 91°03'03.32"E	40	0.9325	2.838	0.8538	5.151
10	Patacharkuchi	26°30'30.13"N, 91°15'37.46"E,	36	0.9522	3.107	0.9313	6.418
11	Rehabari	26°37'27.03"N, 91°1209'.60"E	42	0.9414	2.909	0.9172	5.302
12	Pathsala	26°30'51.31"N, 91°11'17.88"E	36	0.9248	2.789	0.8136	5.052
13	Bahari	26°16'25.69"N, 291°09'36.21"E	43	0.9248	2.789	0.8136	5.052
14	Sarthebari	26°21'42.46"N, 91°12'58.14"E	36	0.9429	2.948	0.9078	5.581
15	Nagaon	26°18'17.76"N, 91°06'45.55"E	40	0.9575	3.225	0.9318	7.048
16	Chenga	26°17'10.24"N, 91°08'38.37"E	48	0.9245	2.827	0.8046	5.166
		Mean	43.5±7.05				

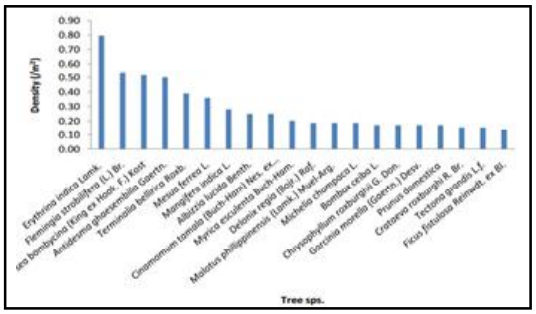


Fig. 1. Density (/m^2) of Top 20 Tree species in moth inhabitated of Barpeta district

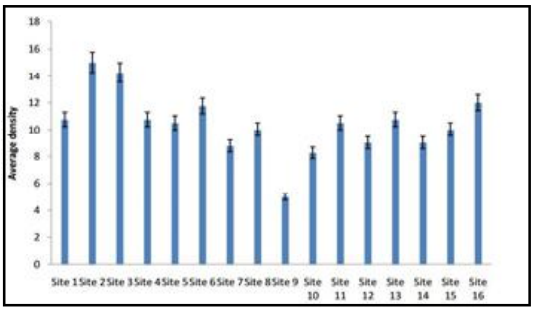


Fig. 2. Site wise Average density and standard deviation of trees in moth inhabitated of Barpeta district

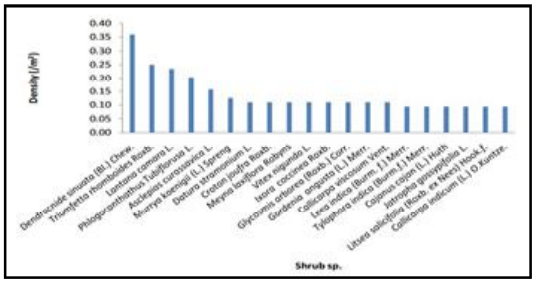


Fig. 3. Density (/m^2) of Top 20 Shrub species in moth inhabitated of Barpeta district

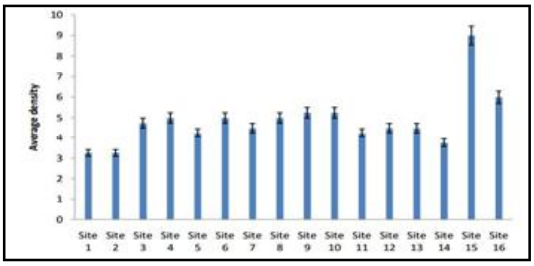


Fig. 4. Site wise Average density and standard deviation of shrubs in moth inhabitated of Barpeta district

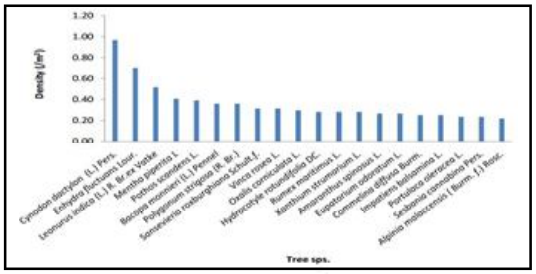


Fig. 5. Density (/m^2) of Top 20 Herb species in moth inhabitated of Barpeta district

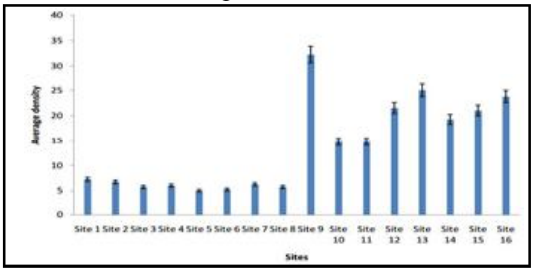


Fig. 6. Site wise Average density and standard deviation of Herbs in moth inhabitated of Barpeta district

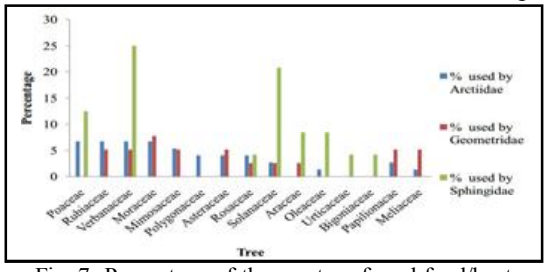


Fig. 7. Percentage of the most preferred food/host plants (top 15 families) used by Aretiidae, Geometridae and Sphingidae family in Barpeta district

richness was found across the tree species of moth habitats are S= 43.5±7.05. The sites 2, 3, 4, 8, and 16 have the highest tree species *i.e.* S= 60, S= 58, S= 46, S=46 and S=48. The dominant tree species all over the study sites of Barpeta district are *Tectona grandis* L.f., *Linnea grandis* A. Rish., *Dalbergia sissoo* Roxb., *Artocarpus heterophyllus* Lamk., *Bombax ceiba* L., *Lagerstroemia reginae* Roxb., *Michelia champaca* L., *Stereospermum chelonoides* (L.) DC., *Mangifera indica* L., *Toona ciliata* M. Roem., *Albizzia procera* (Roxb.) Benth, *Erythrina indica* Lamk., *Syzygium cumini* (L.) Skeels, *Premna benghalensis* Cl., *Melia azedarach* L., *Eucalyptus maculata* Hook, *Trewia nodiflora* L., *Vitex peduncularis* Wall.ex Schuer., *Spondias pinnata* (L.f.) Kurz., and *Vitex altissima* L.

A total of 62 shrub species belonging to 28 families were identified across the study area (16 sites). The average species richness of the shrubs species was found across the habitat are S=19.5± 5.27 and the sites S= 3, S=4, S= 9, S= 10, S=15 and S= 16. A total of 75 herbs species belonging to 38 families were identified across the study area. The average species richness of the herbs species was found across the habitat are S=54.19±34.09 and the sites S= 9, S=4, S= 16, S= 6 and S=14. Most preferred food/host plants used by Arctiidae, Geometridae and Sphingidae Moth family belongs to the Poaceae, Moraceae, Solanaceae, Rubiaceae, Oleaceae, Verbenaceae.

Vegetation is a relatively most important parameter to moth that depends on environmental variables. Vegetation is a group of correlated variables and the plant composition is an influential factor in determining moth composition. This is not surprising because majority of moths (over 98 %) are herbivorous when in the larval stage[37,46]. Presence of adult food sources is considerably less important because adults do not consume a large amount of food;only but take nectar or other liquid to sustain them for about a week, the approximate life span of one moth[46]. Herbivorous insects *i.e.* Lepidoptera are thought to be highly affected to the extinction of plant as they use specific host plant compared to other organisms[9]. In this study moth density was found to correlate with the availibilities of food plants. In this work, the food plants abundance were found to be nearly 50% and 41% of the total plants (including trees, shrubs and herbs) in Barpeta district. This could be due to the moth's wide range of food plants in the study areas. Moths are mainly herbivorous in the study areas. Arctiidae, Geometridae and Sphingidae moths are found to predominantly feed upon the tree species of family Asteraceae, Meliaceae and Solanaceae, Rubiceae, Moraceae and Verbanaceae in the Cachar and Barpeta district respectively. It is due to the heterophagy nature of the moths larvae. Thus, food availability seems to be limiting factor for their survival and distribution. In undisturbed and disturbed Forest of Barak valley, Southern Assam a total of 137 species were documented out of which the main dominant species were *Cynometra polyandra*, *Palaquium polyanthum*, *Tetrameles nudiflora*, *Artocarpus chama*, *Dysoxylum binectariferum*, *Mitragyna rotundifolia*, *Schima wallichi*, *Stereospermum chelonoides*, *Castanopsis purpurella* etc. In the present study, a total of 146 tree 69 species belonging to 50 families, 74 Shrub species belonging to 28 families and 87 herbs

species belonging to 41 families were found.

The dominant tree species are *Lagerstroemia reginae* Roxb., *Michelia champaca* L. *Tectona grandis* L.f., *Bombax ceiba* L., *Dalbergia sissoo* Roxb., *Artocarpus lacucha* Buch-Ham., *Artocarpus chama* Buch-Ham, *Artocarpus heterophyllus* Lamk, *Terminalia bellirica* Roxb., *Canarium benghalense* Roxb, *Ficus benghalensis* L, *Shorea robusta* Gaertn, *Syzygium cumini* (L.) Skeels, *Mangifera indica* L, *Gmelina arborea* Roxb, *Aporosa dioica* (Roxb.) Muell, *Vitex altissima* L, *Actinodaphne obovata* (Nees.) BI, *Kayea floribunda* Wall, *Terminalia arjuna* (DC) W. and A. etc. in Barpeta district, a total of 104 tree species belonging to 43 families, 62 shrub species belonging to 28 families and 75 herbs species belonging to 38 families were documented. The dominant tree species of Barpeta district are *Tectona grandis* L.f., *Lannea grandis* A. Rish., *Dalbergia sissoo* Roxb., *Artocarpus heterophyllus* Lamk., *Bombax ceiba* L., *Lagerstroemia reginae* Roxb., *Michelia champaca* L., *Sterospermum chelonoides* (L.) DC., *Mangifera indica* L., *Toona ciliata* M. Roem., *Albizzia procera* (Roxb.) Benth, *Erythrina indica* Lamk. *Syzygium cumini* (L.) Skeels, *Premma benghalensis* Cl., *Melia azedarach* L., *Eucalyptus maculata* Hook, *Trewia nodiflora* L., *Vitex peduncularis* Wall.ex Schuer., *Spondias pinnata* (L.f.) Kurz., and *Vitex altissima* L. The shrubs species which have more density reported in this study are *Melastoma malabathricum* L., *Triumfetta rhomboides* Roxb., *Combretum pilosum, Dendrocnide sinuata* (BI.) Chew., *Glycosmis arborea* (Roxb.) Corr. *Asclepias curassavica* L., *Murrya koenigii* (L.) Spreng, *Oxyceros longiflora* (Lamk.) Yamazaki, *Vitex negundo* L., etc. and in Barpeta district the shrub species which have highest density are *Dendrocnide sinuata* (BI.) Chew., *Triumfetta rhomboides* Roxb., *Lantana camara* L., *Phlogacanhus tubiflorus* L., *Asclepias curassavica* L., *Murraya koenigii* (L.) Spreng, *Datura stramonium* L., *Croton joufra* Roxb., *Meyna laxiflora* Robyns, *Vitex negundo* L. *etc.* In Barpeta district the herbs species which have highest density are *Cynodon dactylon* (L.) *Pers., Enhydra fluctuans* Lour., *Leonurus indica* (L.) R. Br.ex Vatke, *Mentha piperita* L., *Pothos scandens* L., *Bacopa monnieri* (L.) Pennel, *Polygonum strigosa (R. Br.), Sansevieria roxburghiana* Schult.f. *Oxalis corniculata* L., *Hydrocotyle rotundifolia* DC. etc. Young[46] and Fox[10] have reported about the importance of logs on moth population. This is less clear than the reason for the importance of vegetation. Less than one percent of British Lepidoptera consumes dead wood, thus wood is not likely an important food resource as it is not for many beetles, nor does it seem likely that moths need the physical presences of logs for shelter or resting places, as do some animals. During the present study, it was found that moth used both herbs and shrubs species along with the tree species for shelter or resting places as well as food plants.

Tree, shrubs and herbs species during the present study were within range as reported for similar forest in the other regions[3,27,42]. The species richness was comparable with the tropical forest in Luquillo Mountain in Puerto Rico[43]. However, present species richness values were lower than that of the tropical wet evergreen forest (149 species), (74 species) and (87species) and (104 species) (62 species)

and (75 species) 71 of trees, shrubs and herbs found in both Cachar and Barpeta district respectively. Species richness was not uniformly distributed in present study areas. Lower average densities and the related standard deviation of species of different group like trees, shrubs and herbs of disturbed sites (12, 13 and 16) of Cachar district and sites (9, 1, 2, and 5) of Barpeta district were due to the disturbance in those study sites. The disturbance is continuously occurring there and species are not getting sufficient time to recover. In present study the plant species (42-52%) were represented by a few individual only, which is similar to the findings of Thorington *et al*.,[41] for tropical forest in Barro Colorado Island, Panama and Parthasarathy and Karthikeyan[29] for forest of Western Ghats. Tree size class distribution can be used as indicators of changes in population structure and species composition[28]. The tree population structure observed in present study is similar to those reported from the forest at Costa Rica[26], Brazalian Amazon[5], Eastern ghats[18] and subtropical humid of Meghalaya[42]. All the studies reported the dominance of young individuals. In present study maximum trees were found in 25-60 cm girth sized in both the study areas. Absence of higher girth classes in disturbed vegetation indicate that this vegetation were under anthropogenic pressure.

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