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Ecological Studies of Tree Vegetation of Ramshai Forest Range, Gorumara National Park, India

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Abstract

Ecological studies are the measure of biodiversity status of any vegetation. Knowledge of ecological composition, diversity of tree species and dominant communities of the ecosystem is the basis of planning and implementation of biodiversity conservation management. To fulfil this requirement the study was carried out at Ramshai forest of Jalpaiguri District, West Bengal, India. The study provided the composition of tree communities and the status of biodiversity of these trees. The article mainly focused on the diversity and ecology of the tree vegetation of the forest range.A total of 21 established tree species belonging to 17 families were recorded. The present studies were made to evaluate the Frequency, Density, Basal Area and Importance Value Index along with some community indices.

Keywords: Biodiversity, Quadrate, Phytosociology, Dominance, Co-doinance, Basal area, IVI.

Introduction

Forests are the greatest resources among the ecosystems that support life throughout the globe. The forest ecosystems are the most rich terrestrial ecosystems which are characterized by the high species diversity and species richnesss. These ecosystems are distinguished from all other terrestrial ecosystems by a very high level of biodiversity. Now a days biodiversity is declining seriously on a global scale, which also reveals the importance of conservation planning. Except protected areas and reserve forests, scientific studies on biodiversity of special habitats in India are meager like the other areas of the world. Furthermore, extensive surveys of biodiversity have been conducted only for a few taxonomic groups and ecosystem types. The situation is the same in Ramshai range of Gorumara National Park. Only preliminary information on the biodiversity patterns of plant groups are available in this forest range. Such a lack of study significantly hinders the assessment of the value of existing species, their current status and threats which might facilitate their long term conservation[1]. As a result a considerable number of species may currently be under threat of local extinction. From the ecological point of view, eliminating or decreasing forest ecosystem has severe negative effect on other ecosystems[2]. The present investigation has been conducted to assess the status of biodiversity of tree species in Ramshai Forest Range.

For the evaluation of the status several phytosociological and quantitative parameters were determined. Such quantitative description of plant patterns provides a clear view to look at the interaction between the plants as well as between the plant and environment. It can also provide a clear cut evidence about the status of biodiversity[3].

Materials and Methods

Description of Study Site: Ramshai Forest is the southern part of Gorumara National Park. This range is about 18 km far from Maynaguri, a block of District Jalpaiguri of state West Bengal. The range covers 1316.14 Ha area. The forest range has two forest beats namely Ramsai beat and Kalaati beat. Both the beats are rich in biodiversity. Ramsai beat covers 321.09 Ha and within this 115.33 ha area is the biodiversity working circle. Kalamati beat covers 825.82 Ha and within this 224.50 ha area is the biodiversity working circle. Some areas of both beats is riverine and some parts are recommended for Sal plantation. The study was performed in biodiversity circle including riverine circles. The climatic conditions in the forest range are suitable for the growth and development of tree species. The average temperature during winter season ranges within 10˚C-21˚C and within 24˚C-30˚C during the summer season. The forest receives an average rainfall of 300-380 cm during rainy season. Lying in the foot hill region of Himalayas, the forest comprises of grassland and tall trees and includes a number of ferns, mosses and other plant groups. Numerous tropical orchids are also found here. It is also rich in birds, insects and other faunal communities. The total biodiversity circle of this forest range is 508.61 Ha. Based on the information obtained from Range officer, the area was classified into ten sites, five from each of Ramshai beat and Kalamati beat.

The use of local name of each forest site was adopted from the knowledge of Forest guards. As the different topographical and altitudinal variations controls the types and levels of disturbance on the vegetation and biodiversity, thus biodiversity status in each of these ten forest sites were also found different. For identification, tree species found within each sampling plot were

photographed and recorded by their vernacular names (adopted from Forest Guards, Range Officer and local people). The scientific names were determined by using various books, articles and internet sources[4-6].

Methodology: For phytosociological studies in Ramsai range, the quadrate methods were used. In each forest beat five quadrates laid down for trees. The sizes of quadrates for trees were 10 m. sq. Basal area was calculated from the perimeter which was measured at a breast height[6].

Data Analysis Techniques: To analyse the level of diversity in tree vegetation several phytosociological parameters like frequency, Relative frequency, density and Relative density etc., were calculated[6-8]. Then IVI of trees were made to determine the dominant species of the forest. Dominance is a significant indicator of species composition in a forest ecosystem[9,10]. The dominance of any species refers to its relative value or importance in its habitat[3]. Or in other language it is the measure of the degree of influence of the species on the ecosystem. To asses the over all impact of a species Importance Value Index was determined by adding Relative frequency, Relative density and Relative Basal Area[8,11].

Frequency (%): Frequency refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage. It is calculated by the equation:

$$\text{Frequency } (\%) = \frac{\text{No. of plot in which the species is present}}{\text{Total No. of plots sampled}} \times 100$$

Density: Density refers to the expression of the numerical strength of a species. It is calculated by the equation:

$$\text{Density} = \frac{\text{No. individuals of the species}}{\text{Total No. of plots sampled}}$$

Relative Frequency (%): Relative Frequency is the degree of dispersion of individual species in an area in relation to the number of all the species occurred.

$$\text{Relative Frequency } (\%) = \frac{\text{Frequency of the species}}{\text{Frequency of all the species}} \times 100$$

Relative Density (%): Relative Density is the measure of numerical strength of a speies in respect to the total number of individual of all the species. It can be determined by the equation.

$$\text{Relative Density} = \frac{\text{Density of the species}}{\text{Density of all the species}}$$

Relative Dominance (%): Dominance is the parameter which is determined by the value of basal area. For the comparative analysis Relative dominance is determined. It is the coverage value of a species with respect to the sum of coverage of the rest of the species in the area.

$$\text{Basal Area} = \frac{(\text{Circumference at breast height})^2}{12.56}$$

$$\text{Relative dominance or Relative Basala Area} = \frac{\text{Basal Area of the species}}{\text{Basal Area of all the species}}$$

Importance Value Index: Importance Value Index is used to determine the over all impact of each species in the community structure.It is calculated by the addition of the percentage values of the relative frequency, relative density and relative dominance (Relative Basala Area).

IVI= Relative Frequency + Relative Density + Relative dominance

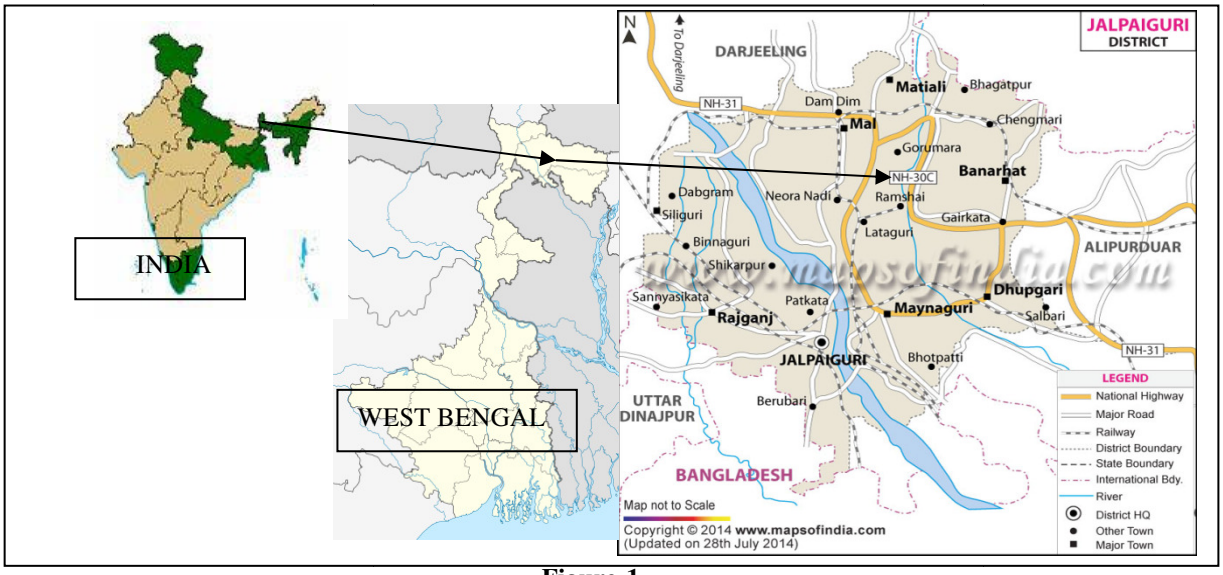

Figure-1
Map of study site - Ramsai Forest Range (irdindia.in)

Table-1
Value for the different phytosociological parameters measured for different tree species of Ramshai forest range

Name of The Plant	Family	A	D	Fr (%)	BA	R D	RF	RBA	IVI
Shorea robusta Gaertn. f.	Dipterocarpaceae	2.80	2.80	100	4825.83	12.5	10.2	25.95	48.65
Schima wallichii (DC.)Koth.	Theaceae	4.22	3.80	90	810.29	16.96	9.18	4.35	30.49
Syzygium cumini (Linn.) Skeels	Myrtaceae	1.33	0.40	10	392.53	1.78	1.02	2.11	4.91
Toona ciliata Roem.	Meliaceae	1.00	0.20	20	1819.78	0.89	2.04	9.78	12.71
Dillenia pentagyna Roxb.	Dilleniaceae	1.71	1.20	70	684.91	5.35	7.14	3.68	16.17
Lagerstromia perviflora Roxb.	Lythraceae	2.00	1.20	60	1199.73	5.35	6.12	6.45	17.92
Albizia procera (Roxb.) Benth. gum	Fabaceae	1.00	0.10	10	64.66	0.44	1.02	0.34	1.8
Anthocephalus cadamba Miq.	Rubiaceae	1.50	0.30	30	247.72	1.33	3.06	1.33	5.72
Careya arborea Roxb.	Lecythidaceae	2.16	1.30	60	210.32	5.8	6.12	1.13	13.05
Wrightia tomentosa Roem.& Schult.	Apocynaceae	3.25	2.60	80	676.20	11.6	8.16	3.63	23.39
Amoora spectabilis Miq	Meliaceae	1.50	0.60	40	171.14	2.67	4.08	0.92	7.67
Amoora walichii King.	Meliaceae	1.80	1.00	50	1391.95	4.46	5.1	7.48	17.04
Lagerstromia speciosa (L.) Pers.	Lythraceae	2.00	0.20	10	33.16	0.89	1.02	0.17	2.08
Terminalia alata Heyne ex Roth.	Combretaceae	2.25	0.90	40	595.39	4.01	4.08	3.2	11.29
Bischofia javanica Blume	Phyllanthaceae	2.66	1.60	60	473.49	7.14	6.12	2.54	15.8
Terminalia bellerica (Gaetn.)Roxb.	Combretaceae	2.20	1.10	50	554.26	4.91	5.1	2.98	12.99
Sterculia villosa Roxb.	Sterculiaceae	2.00	0.20	10	2436.30	0.89	1.02	13.1	15.01
Persea fructifera Kosterm	Lauraceae	1.25	0.50	40	170.15	2.23	4.08	0.91	7.22
Premna mucronata Roxb.	Verbenaceae	1.50	0.03	30	678.76	1.33	3.06	3.65	8.04
Altingia excelsa Noronha	Hamamelidaceae	1.75	0.70	40	718.55	3.12	4.08	3.86	11.06
Terminalia tomentosa Roth.	Combretaceae	1.75	1.40	80	435.62	6.25	8.16	2.34	16.75

A= Abundance, D= Density, Fr= Frequency, BA= Basal Area, RD=Relative Density, RF= Relative Frequency, RBA= Relative Basal Area, IVI= Importance Value Index

Data Processing and Phytosociological Analysis: All the phtosociological data collected from different sources were tabulated and analysed individually. The data collected were used to compute some community indices like,

Species diversity (H'): Species diversity was determined by the Shannon-Weiner Index[12]. It was calculated by the equation,
(H') = - ∑ [(ni / N). ln (ni / N)]
Where ni= IVI of individual species and N= total IVI of all the species[12].

Species dominance (Cd): Species dominance was calculated by the Simpson Index[13]:
$Cd = \Sigma (ni/N)^2$,
Where ni= IVI of individual species and N= total IVI of all the species.

Equitability of evenness (e): Equitability of evenness is the measure of the degree of relative dominance of each species in the habitat. It was determined according to Pielou[14] as:
Evenness (e) = H'/log S
Where: H'= Shannon index, S = number of species.

Species richness (D) :Species richness was calculated by Margalef Index[15] as:
D=(S-1)/ln N.
Where: S = number of species. N= total number of individuals.

Menhinick's index (D_{mm}): Menhinick's index[16] is expressed as D_{mm}=S/ N,
Where: N= Number of individuals in the sample, S= Number of species.

Equitability Index: The Shannon's equitability Index[13] is expressed as
(EH)=H'/Hmax = H'/ln S

Berger-Parker Dominance Index: The Berger-Parker Dominance Index is the measure of numerical importance of the most abundant species. It is determined by the equation
$d=N_{max}/N$.
Where: $N_{max=}$ Number of individuals of the most abundant species, N= Total number of individuals in the site.

Results and Discussion

Observation of this study indicates that *Schima wallichii* (DC.) Koth. had highest density(3.80) and *Shorea robusta* Gaertn. f. had maximum IVI (48.65). Density of *Shorea robusta* Gaertn. f. was recorded as 2.80. *Schima wallichii* (DC.) Koth. had IVI value as 30.49. It is also noted that some other tree species had a good IVI value. These include *Wrightia tomentosa* Roem and Schult. (23.39), *Lagerstromia perviflora* Roxb. (17.92) and *Amoora spectabilis* Miq (17.04). However maximum relative basal growth is recorded for *Shorea robusta* Gaertn. f. and it is 4.35. Relative basal growth is not so good in other tree species of this forest including *Schima wallichii* (DC.) Koth(4.35), *Wrightia tomentosa* Roem. and Schult (3.63) and *Amoora spectabilis* Miq. (0.92). Relative basal area is also found good for *Sterculia villosa* Roxb. (13.1). In this survey it is also recorded that few species had very low IVI and Relative basal area *Albizia procera* has minimum IVI value of 1.80 and relative basal area of 0.34.

To assess the overall status of biodiversity in Ramshai Forest Range, eight diversity indices were used. Shannon and Weiner[12] index represents entropy. It is a diversity index that consider the number of individual species as well as the number of taxa. It ranges from zero to higher value.The communities with only single taxa has the value of zero. Increase of the value of diversity index reveal higher number of taxa in the community. Simpson's dominance Index was also found much less than 1, which showed that the sites were not dominated by single species[18].On the contrary a few species dominate the forest. The primary conclusion is that there is low grazing pressure and moderate human impact on normal distribution of tree species which may cause reduction in tree community in next few decades in the forest ecosystem. Both the Menhinick's Index and Margalef's Index measure richness of species in the ecosystem.

Conclusion

The paper reflects the phytosociological characters of tree vegetation of Ramshai forest range in Jalpaiguri forest division, West Bengal, India. This study implies the variety of tree species, their distribution and the status of dominance. The vegetation of the Ramshai forest range is composed of mosses, ferns, native grasses, sedges, climbers, shrubs and trees. It is also rich in faunal diversity. Here Diversity index of tree species was found as 2.8169, where as dominance index(Cd) was observed as 0.33937. Both the indices reflect that the forest patch is rich in tree vegetation and tree diversity.The present investigation also revealed some interesting phytosociological findings about the tree vegetation of the forest. The findings have illustrated that most abundant plant species i.e., *Schima wallichii* (DC.) Koth. Lack poper growth (growth of basal area),where as species having highest basal growth i.e., *Shorea robusta* Gaertn. f. are comparatively less abundant.In addition another two species, *Wrightia tomentosa* Roem. and Schult and *Bischofia javanica* Blume are also abuntdant. Another noticeable fact is that IVI of *Wrightia tomentosa* Roem. and Schult is more than the IVI of *Shorea robusta* Gaertn. f..Thus more than one species are dominant in this forest. This finding supports theories of co-dominant succession.

Therefore, the study recommends further research to be carried out to study succession pattern including tree species loss more specifically (i.e. effects of specific species in specific ecosystems such as in forest, grassland and bush-land eco-systems) regeneration ability of the previously disturbed species in this forest range.

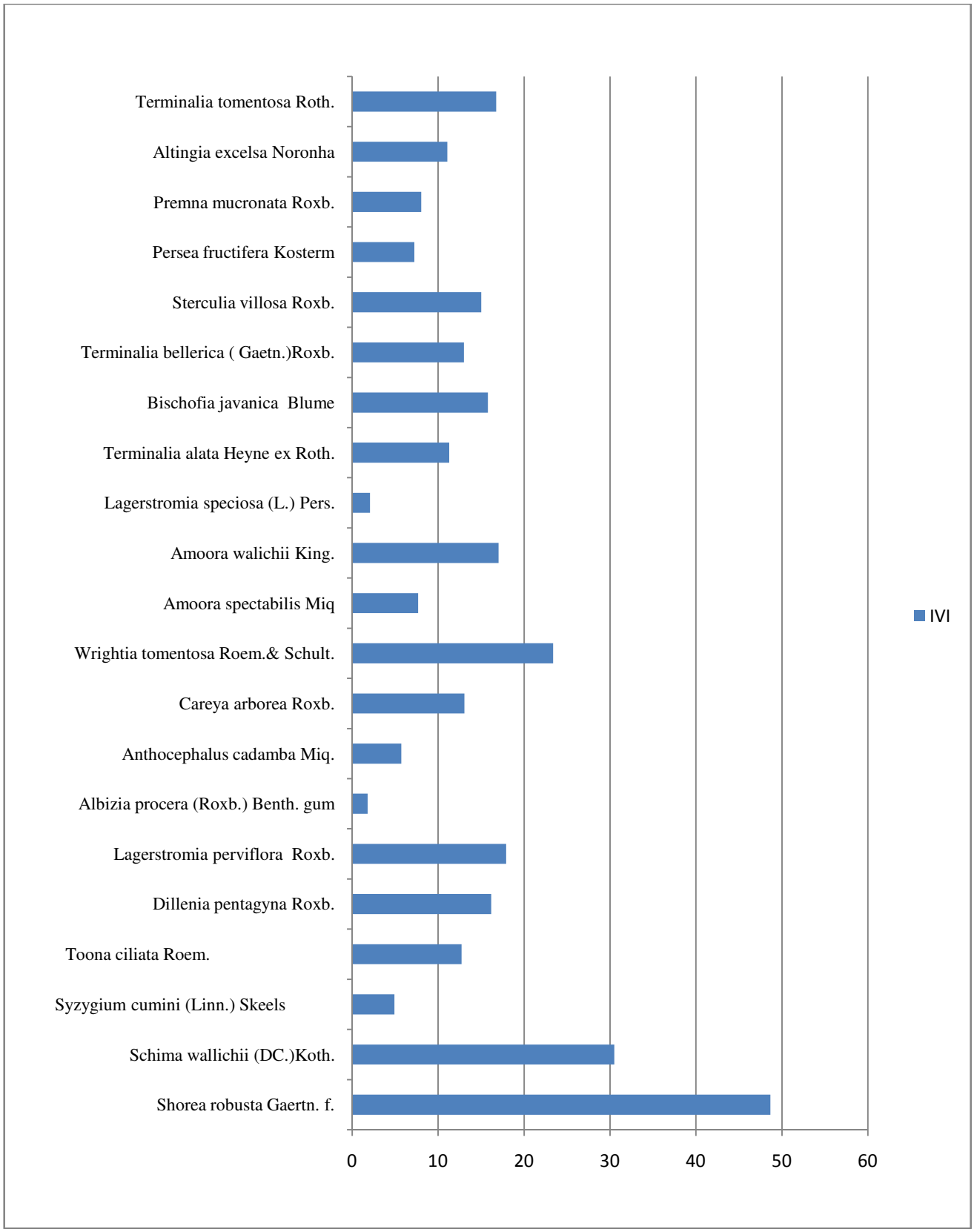

Figure-2
Graphical representation of IVI of tree species in Ramshai range

Table-2
Value for the different community index parameters, measured for different tree species of Ramshai forest range

Sl. No.	Name Of The Plant	Shannon Index (H)	Species dominance	Evenness	A/F index
1	*Shorea robusta* Gaertn. f.	0.2948	0.2948	0.2229	0.028
2	*Schima wallichii* (DC.)Koth.	0.2331	0.0104	0.1763	0.046
3	*Syzygium cumini* (Linn.) Skeels	0.0670	0.0002	0.0506	0.133
4	*Toona ciliata* Roem.	0.1331	0.0017	0.1006	0.050
5	*Dillenia pentagyna* Roxb.	0.1583	0.0029	0.1197	0.024
6	*Lagerstromia perviflora* Roxb.	0.1682	0.0035	0.1272	0.033
7	*Albizia procera* (Roxb.) Benthgum	0.0306	0.00003	0.0231	0.100
8	*Anthocephalus cadamba* Miq.	0.0756	0.0003	0.0571	0.050
9	*Careya arborea* Roxb.	0.1363	0.0019	0.1031	0.036
10	*Wrightia tomentosa* Roem.& Schult.	0.1989	0.0060	0.1989	0.040
11	*Amoora spectabilis* Miq	0.0943	0.0006	0.0713	0.037
12	*Amoora walichii* King.	0.1630	0.0032	0.1232	0.036
13	*Lagerstromia speciosa* (L.) Pers.	0.0343	0.00004	0.0259	0.200
14	*Terminalia alata* Heyne ex Roth.	0.1233	0.0014	0.0932	0.056
15	*Bischofia javanica* Blume	0.1550	0.0027	0.1172	0.044
16	*Terminalia bellerica* (Gaetn.)Roxb.	0.1359	0.0018	0.1028	0.044
17	*Sterculia villosa* Roxb.	0.1497	0.0025	0.1132	0.200
18	*Persea fructifera* Kosterm	0.0895	0.0005	0.0624	0.031
19	*Premna mucronata* Roxb.	0.0969	0.0007	0.0730	0.050
20	Altingia excelsa Noronha	0.1196	0.0012	0.0904	0.043
21	*Terminalia tomentosa* Roth.	0.1595	0.0030	0.1206	0.021

Table-3
Value for different community indices for Ramsai Forest Range

Community indices	Value
Species diversity (H')	2.8169
Species dominance (Cd)	0.33937
Equitability of evenness (e)	2.130
Species richness (d)	3.696
Menhinick's index (D_{mn})	0.0937
Equitability Index	0.925
Berger-Parker Dominance Index	0.169

Figure-3
A study site of Dakhali more (Ramshai Beat)

Figure-4
A study site of Darbesh line (Kalamati Beat)

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