PHYTOSOCIOLOGICAL STUDIES OF WOODY SPECIES IN SUBTROPICAL FOREST OF MANIPUR, NORTH-EAST INDIA

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ABSTRACT

The present paper aimed to study the diversity of plants in two subtropical forest (natural and protected) of Manipur ($23^{\circ}50'$-$25^{\circ}42'$N latitudes and $92^{\circ}58'$E-$94^{\circ}45'$E longitudes). Phytosociological studies for tree and shrub species were conducted. A total of 79 species belonging to 35 families were recorded. Quantitative features such as Frequency, Density, Basal area, Important Value Index (IVI), Distribution pattern were evaluated. *Schima wallichii* with IVI (68.39), *Lantana camara*, IVI (55.42) were the dominant tree and shrub species of natural forest whereas *Ficus benjamina* with IVI (61.62), *Lantana camara*, IVI (65.06) were the dominant tree and shrub species of protected forest. The IVI values have helped to understand the ecological significance of the vegetation in community structure.

KEYWORDS

Subtropical forest, Phytosociology, Frequency, Density, Important Value Index (IVI).

INTRODUCTION

India has a total land area of 329 million ha of which 43% under cropping and 23% under forest (MOEn 1999). Indian forests ranges from evergreen tropical rain forests in the Andaman and Nicobar Islands, the Western Ghats, and the North-Eastern states to dry alpine scrub in the Himalayas. The Northeastern India harbours not only rich floristic diversity in the difficult terrain, but is also rich in ethnic diversity where the local people have tremendous traditional knowledge to use the natural resources. Tropical forest ecosystems are often referred to as one of the most species diverse terrestrial ecosystems, and generate a variety of natural resources to help sustain the livelihood of local communities (Kumar *et al*. 2006). In the tropical forest lands, shifting cultivation or slash and burn agriculture is practiced widely that affects forest structure, species composition, which resulted in depletion of the biodiversity of forest communities (Ramakrishnan 2003). There is as growing interest in quantifying habitat characteristics like forest structure, floristic composition and species richness in Indian forests (Nirmal Kumar *et al*. **1999**, 2000, 2001, 2002; Yadav and Yadava 2005). Therefore, the present study has been undertaken to assess the plant biodiversity and vegetation analysis of subtropical natural and protected forest of Manipur, Northeast India.

MATERIAL AND METHODS
STUDY AREA

The study was conducted in two subtropical forest of Manipur. Site I (Natural forest) is located at $24^{\circ}52'45''$ N latitude and $93^{\circ}54'51''$ E longitude at Khonghampat within the Langol Reserve Forest, 12 kms from Imphal city at an elevation of 791 m above mean sea level whereas Site II (protected forest, sacred grove) is located at $24^{\circ}46'50''$ N latitude and 9305183 E longitude at Konthoujam village, 11 km west of the Imphal city at an elevation of 781 m above mean sea level. The climate of the study area experiences monsoonal climate with warm moist summer and cool dry winter. The mean maximum temperature varied from 22.5°C (January) to 29.5°C (September) and the mean minimum temperature ranged from 4.97°C (January) to 22.94°C (July). The average annual rainfall is 1,467.5mm.

METHODS

Phytosociological studies was carried out to cover over all spectrum of vegetation by quadrate method. The trees (>31.5 cm GBH) were measured and recorded by random sampling with 10 quadrates of 10 m × 10 m size in each study site. Shrubs were also recorded using 5m × 5m quadrate size respectively. Important community parameters such as frequency, density, abundance, basal area and important value index (IVI) were calculated using standard methods given by Misra (1968) and Muller Dombois and Ellenberg (1974). The ratio of abundance to frequency for different species was determined for eliciting the distribution patterns (Curtis and Cotton 1956).

RESULT AND DISCUSSION

A total of 29 trees and 14 shrubs species belonging to 26 families were recorded from site I (natural forest). Among families, Fabaceae (5 species), Anacardeaceae, Lamiaceae, Malvaceae, Phyllanthaceae (3 species) each were the most diverse family. Fagaceae, Lauraceae, Moraceae, Meliaceae, Rubiaceae were observed with 2 species each and the remaining are monospecific. Among tree species, *Lithocarpus fenestratus* exhibited highest density (230 ind ha^{-1}) and frequency (70%). Species like *Dipterocarpus turbinatus*, *Ficus religiosa*, *Toona ciliate* exhibited **minimum** density (10 ind ha^{-1}) and frequency (10%) each. Considering IVI as an indication of dominance, *Schima wallichi* dominated with IVI (68.39) and *Spondias macrophylla* exhibited the minimum IVI (2.32). Maximum value of basal cover (4.72 m^2 $100m^2$) was recorded by *Schima wallichi* and minimum by *Spondias macrophylla* (0.01 m^2 $100m^2$). Most of the species showed clumped distribution pattern while some species like *Albizzia lebbeck*, *Bombax cieba*, *Celtis australis*, *Pinus kesiya* etc exhibited random distribution pattern.

Among shrubs, *Lantana camara* was recorded with maximum density (80 ind ha^{-1}), frequency (60%) and IVI (55.42) whereas species like *Osbekia stellata*, *Adinosaeme stipulate*, *Crotalaria saltiana* exhibited minimum density (20 ind ha^{-1}), frequency (20%) and IVI (11.60), (12.25), (12.46) etc. Maximum of the shrub species showed random distribution pattern while Antidesma species and *Lantana camara* showed regular distribution pattern (Table 1).

Phytosociological analysis of site II (protected forest) was shown in Table 2. 27 trees and 9 shrubs species belonging to 25 families were recorded. Miliaceae with 4 species, Moraceae and Verbenaceae with 3 species each was observed as the most diverse family. Families with 2 species each were Apocynaceae, Combretaceae, Euphorbiaceae and Myrtaceae where as the remaining are represented by one species each. Among the tree species *Ficus benjamina* was recorded with maximum density (110 ind ha^{-1}), frequency (70%), basal cover (4.52m^2 100 m^2) and IVI (61.62). The minimum density (20 ind ha^{-1}) and IVI (4.52) was recorded by *Syzygium jambos*. *Artocarpus lakoocha*, *Celtis limorensis*, *Parkia roxburghii* are some of the species which recorded with minimum frequency, *Aquilaria agallocha* with minimum basal cover (0.018 m^2 $100m^2$). Clumped distribution pattern showed by maximum number of species. For shrubs, maximum density (100 ind ha^{-1}), frequency (60%), basal cover (0.024 cm^2 25 m^{-2}) and IVI (65.06) was recorded by *Lantana camara*. Minimum basal cover (0.005 cm^2 25 m^{-2}) and IVI (18.03) was exhibited by *Datura stramonium*. Random distribution pattern was recorded maximum among the shrub species. Dominance diversity curve of both site I and II was reflected in Fig. (1) and Fig. (2).

The total number of 79 species recorded from both the study site I and II was found to be lower than the number of species reported by several workers in the different tropical forests [Choudhury *et al*. 2000 (85 species); Fox *et al*. 1997 (94 species); Kadavul and Parthasarathy 1999 (89 species); Khera et al. 2001 (92 species)] whereas Pande (1999) reported 52 species which was closer to the value found in the present

study. The differences in IVI of both sites may be due to the change in the surrounding conditions and the anthropogenic activities around the sites (Elawad, Alawia A and Ismail M. Ismail, 2015). Occurance of clumped distribution pattern of the tree species has also been reported by several workers (Greig-Smith, 1957 and Bharali *et al*., 2011).

Random distribution pattern in shrub species may be due to the environment in which these plant species grow in homogenous and has many factors acting on the population (Das *et al*. 2012 and Ewersia 1980). Density of trees and shrubs are closer to the value reported by Srinivasa *et al*. (2013).

TABLE – 1 PHYTOSOCIOLOGICAL ANALYSIS OF TREES AND SHRUBS FROM SITE I (NATURAL FOREST)

TREES

Sl. No.	Name of the species	Family	Density	Basal cover	Abundance	A/F Ratio	IVI	Distribution pattern
1.	*Albizzia lebbeck*	Fabaceae	0.5	0.061	1.25	0.0312	10.15	Rn
2.	*Alnus nepalensis*	Betulaceae	0.2	0.055	1	0.05	4.95	Rn
3.	*Aquilaria agalocha*	Thymelaceae	0.6	0.120	2	0.066	10.10	Cl
4.	*Bixa orellana*	Binaceae	0.2	0.039	1	0.05	4.79	Rn
5.	*Bambax cieba*	Malvaceae	0.2	0.036	1	0.05	4.76	Rn
6.	*Celtis australis*	Cannabaceae	0.2	0.123	1	0.05	5.67	Rn
7.	*Cinnamomum zeylanicum*	Lauraceae	0.4	0.070	1.33	0.044	8.06	Rn
8.	*Derris robusta*	Fabaceae	0.5	0.107	2.5	0.125	7.79	Cl
9.	*Dipterocarpus turbinantus*	Dipterocarpaceae	0.1	0.080	1	0.1	3.15	Cl
10.	*Emblica officinales*	Phyllanthaceae	0.2	0.036	1	0.05	4.76	Rn
11.	*Eucalyptus citriodora*	Myrtaceae	0.2	0.244	1	0.05	6.95	Rn
12.	*Erythrina variegata*	Fabaceae	0.6	0.303	2	0.066	12.04	Cl
13.	*Ficus hispida*	Moraceae	0.2	0.022	2	0.2	3.17	Cl
14.	*Ficus religiosa*	Moraceae	0.1	0.195	1	0.1	4.24	Cl
15.	*Gmelina arborea*	Lamiaceae	0.7	0.122	2.33	0.077	10.88	Cl
16.	*Grevillea robusta*	Proteaceae	0.5	0.249	1.66	0.055	10.71	Rn
17.	*Litsea polyantha*	Lauraceae	0.2	0.019	2	0.2	3.14	Cl
18.	*Lithocarpus fenestrata*	Fagaceae	2.3	0.566	3.28	0.46	33.41	Cl
19.	*Mangifera indica*	Anacardiaceae	0.5	0.384	2.5	0.125	10.71	Cl
20.	*Melia azaderach*	Meliaceae	0.2	0.029	2	0.2	3.25	Cl
21.	*Parkia roxburghii*	Leguminosae	0.3	0.112	1.5	0.075	6.31	Cl
22.	*Pinus kesiya*	Pinaceae	0.6	0.697	1.5	0.037	17.62	Rn
23.	*Quercus serrata*	Fagaceae	1.1	0.760	2.75	0.068	22.08	Cl
24.	*Rhus sucudanea*	Anacardiaceae	0.2	0.026	1	0.05	4.65	Rn
25.	*Schima wallichi*	Theaceae	1.5	4.72	3	0.06	68.39	Cl
26.	*Spondias macrophylla*	Anacardiaceae	0.1	0.013	1	0.1	2.32	Cl
27.	*Tectona grandis*	Lamiaceae	0.4	0.209	2	0.1	8.10	Cl
28.	*Toona ciliate*	Meliaceae	0.1	0.016	1	0.1	2.36	Cl
29.	*Xylosma longifolia*	Salicaceae	0.3	0.034	1.5	0.075	5.49	Cl

SHRUBS

Sl. No.	Name of the species	Family	Density	Basal cover	Abundance	A/F Ratio	IVI	Distribution pattern
1.	*Albemoschus precatorius*	Malvaceae	0.4	0.007	1	0.025	27.03	Rn
2.	*Adenosaeme stipulate*	Rubiaceae	0.2	0.002	1	0.05	12.25	Rn
3.	*Antidesma sps.*	Phyllanthaceae	0.6	0.008	1.2	0.024	34.53	Rg
4.	*Artabotrys hexapetallis*	Annonaceae	0.3	0.010	1	0.033	25.24	Rn
5.	*Bridelia stipularis*	Phyllanthaceae	0.3	0.006	1	0.033	20.77	Rn
6.	*Crotalaria sattiana*	Fabaceae	0.2	0.003	1	0.05	12.46	Rn
7.	*Desmodium laxiflorum*	Fabaceae	0.5	0.005	1.25	0.031	26.79	Rn
8.	*Eupatorium odoratum*	Asteraceae	0.3	0.003	1	0.033	17.40	Rn
9.	*Lantana camara*	Verbenaceae	0.8	0.021	1.33	0.022	55.42	Rg
10.	*Meyna laxiflora*	Rubiaceae	0.2	0.006	1	0.05	16.09	Rn
11.	*Osbekia stellata*	Melastomataceae	0.2	0.002	1	0.05	11.60	Rn
12.	*Plumbago zeylanica*	Plumbaginaceae	0.2	0.003	1	0.05	12.85	Rn
13.	*Urena lobata*	Malvaceae	0.2	0.003	1	0.05	12.82	Rn
14.	*Vitex negundo*	Lamiaceae	0.2	0.005	1	0.05	14.75	Rn

**TABLE – 2 PHYTOSOCIOLOGICAL ANALYSIS OF TREES AND SHRUBS FROM SITE II (PROTECTED FOREST)**

TREES

Sl. No.	Name of the species	Family	Density	Basal cover	Abundance	A/F Ratio	IVI	Distribution pattern
1.	Aegle marmelos	Rutaceae	0.6	0.105	1.5	0.037	10.74	Rn
2.	Albizzia chinensis	Fabaceae	0.5	0.480	1.7	0.055	12.35	Rn
3.	Amoora ruhituka	Meliaceae	0.4	0.347	1.3	0.044	10.31	Rn
4.	Artocarpus lakoocha	Moraceae	0.4	0.051	2	0.1	6.08	Cl
5.	Aquilaria agallocha	Thymelaceae	1.0	0.018	2.5	0.062	12.81	Cl
6.	Bauhinia vareigata	Caesalpinaceae	0.3	0.327	1	0.033	9.39	Rn
7.	Celtis australis	Ulmaceae	0.6	0.164	2	0.066	9.99	Cl
8.	Celtis timorensis	Cannabaceae	0.6	0.221	3	0.15	9.21	Cl
9.	Chukrasea tabularis	Meliaceae	0.4	0.065	2	0.1	6.22	Cl
10.	Cordia grandis	Euphorbiaceae	0.3	0.062	1.5	0.075	5.46	Cl
11.	Delonix regia	Fabaceae	0.4	0.051	2	0.1	6.17	Cl
12.	Eugenia cymosa	Mystaceae	0.4	0.090	2	0.1	6.54	Cl

13.	Ficus benjamina	Moraceae	1.1	4.524	1.57	0.022	61.62	Rg
14.	Ficus glomerata	Moraceae	1	1.102	2	0.04	24.75	Rn
15.	Gmelina arborea	Verbenaceae	0.3	0.035	1.5	0.07	5.20	Cl
16.	Emblica officinalis	Phyllanthaceae	0.5	0.074	1.66	0.055	8.37	Rn
17.	Litsea citrata	Lauraceae	0.3	0.31	1.5	0.075	5.16	Cl
18.	Litsea polyantha	Lauraceae	0.5	0.58	1.66	0.055	8.21	Rn
19.	Mangifera indica	Anacardiaceae	0.7	0.868	2.33	0.077	17.5	Cl
20.	Melia azadirach	Meliaceae	0.4	0.104	2	0.1	6.60	Cl
21.	Oroxylum indicum	Begnoniaceae	0.4	0.048	10.33	0.044	7.38	Rn
22.	Parkia roxburghii	Leguminosae	0.5	0.099	2.5	0.125	7.28	Cl
23.	Quercus graffiti	Fagaceae	0.8	0.762	2.66	0.088	17.29	Cl
24.	Syzygium jambos	Mystaceae	0.2	0.0402	1	0.05	4.52	Rn
25.	Tectona grandis	Verbenaceae	0.3	0.127	1.5	0.075	6.10	Cl
26.	Terminalia chebula	Combrataceae	0.4	0.269	2	0.1	8.22	Cl
27.	Toona ciliata	Meliaceae	0.4	0.097	2	0.1	6.53	Cl

SHRUBS

1.	Artabotrys hexapetalis	Annonaceae	0.7	0.018	1.75	0.04	45.62	Rn
2.	Adhatoda vasica	Acanthaceae	0.715	0.014	1.25	0.03	37.48	Rn
3.	Blumea balsamfera	Asteraceae	0.14	0.005	1.33	0.04	24.38	Rn
4.	Calatropis glomerata	Apocynaceae	0.13	0.005	1.5	0.07	18.60	Cl
5.	Lantana camara	Verbenaceae	1.0	0.246	1.66	0.02	65.06	Rn
6.	Plumeria rubra	Apocynaceae	0.4	0.016	1.33	0.04	33.65	Rn
7.	Nycthanthes arbotristis	Oleaceae	0.3	0.012	1	0.03	27.98	Rn
8.	Vitex negundo	Lamiaceae	0.5	0.008	1.66	0.05	29.13	Rn
9.	Datura stramonium	Solanaceae	0.3	0.005	1.5	0.07	18.10	Cl
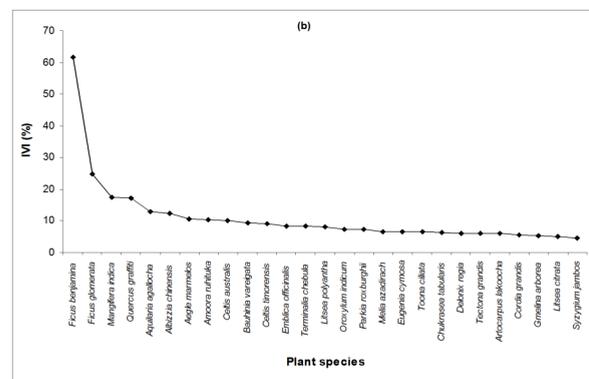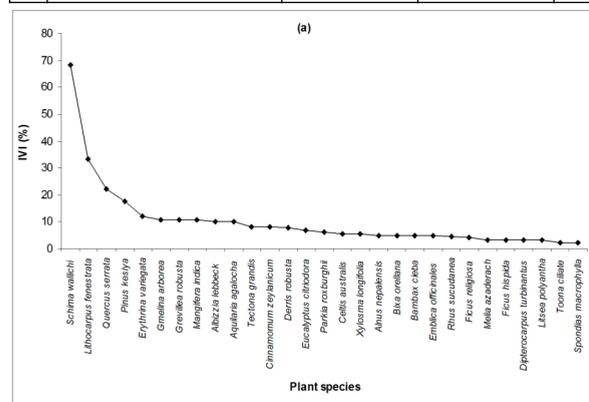
Fig. 1: Dominance-diversity curves for tree layer in Site I(a) and II(b).

Fig. 2: Dominance-diversity curves for shrub layer in Site I(a) and II(b).
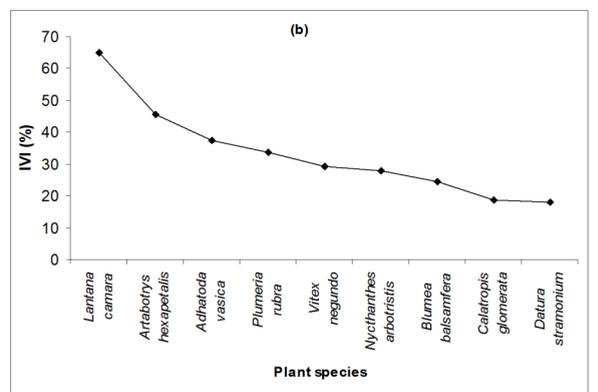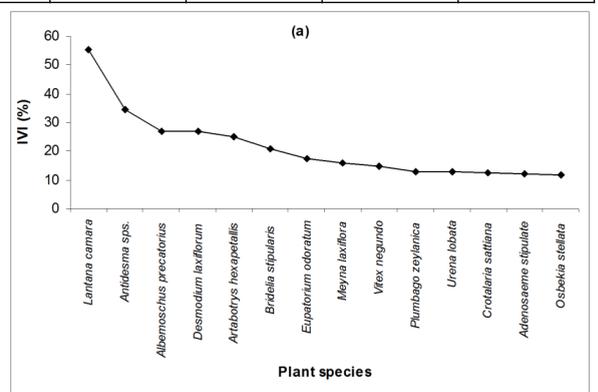
CONCLUSION

The present study revealed the basic information and trends of successful recruitment of potential woody species in the subtropical forests of the state and further implementation of effective conservation measures.

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