

Full Length Research Paper

Assessment of Tree Diversity and Resource Use Pattern in Bath Putu Forest, Itanagar, Arunachal Pradesh

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Abstract

Arunachal Pradesh is an important part of Himalaya. The state is well known for its rich plant diversity and the unique cultural diversity. It is considered to be luxuriant in floral diversity and has been recognized as the 25th biodiversity hotspot in the world. It is also among the 200 globally important ecoregion. The present study deals with the assessment of tree diversity and resource use pattern of Bath Putu Forest, Itanagar, and Arunachal Pradesh. Three communities were identified i.e. *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed; *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed and *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed with 14 number of species. *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed community had maximum tree density (900.00 Ind ha⁻¹). Species diversity (*H'*) of trees was highest in *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed (2.11). The recorded species are being used as medicine, wild edible/food, fodder, fuel, timber, dye, handicrafts, religious, ornament and various other uses.

Keywords: Himalaya, Arunachal Pradesh, Tree Diversity, Resource use, Conservation

Introduction

Arunachal Pradesh in the eastern Himalaya is among the 200 globally important eco-regions. About 90% of Indian species is found in the Himalayan region among which 85% is found in the Arunachal Himalaya (Paul et al., 2005). The state is well known for its rich biodiversity and the unique cultural diversity. The whole North-East area is well recognized as one of the 'Mega Biodiversity Hot Spot' regions of the world. There are 4117 species of flowering plants belonging to 1295 genera and 192 families of flowering plants from the state as against about 17,500 species in 247 families and 2984 genera in India (Chowdhrey et al., 1996). Besides this, the unique cultural diversity has given it the great significance. The ethnic communities retain their natural resources for a long time through their own traditional management institutions. They have been regulating their own customary laws, rules and regulations for the natural resource management. The state is inhabited by 26 major tribal groups belonging to different social and distinctive cultures. Tribal economy is connected intimately with forests. Forests are the good source of edible roots, fruits, honey, tubers, leaves, vegetables, juice and fish etc. Their knowledge of medicinal herbs and plants around them takes care of their health problems. Other activities like hunting, shifting cultivation and forest based handicrafts including basket making and mat making are dependable on the forests. Forests are the rich repository of good forage for their domestic animals. Materials for house construction viz. timber, bamboo, variety of leaves for thatching the canes, for fixing and binding the poles are collected from the forest. Fuel wood is not only used for cooking but also for lighting and warmth (Singh, 1995).

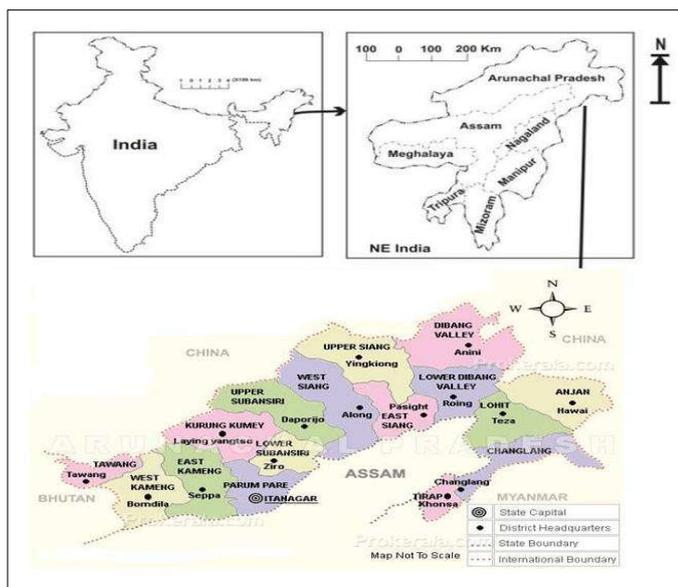
The state is the mega biodiversity hotspot and has rich floral diversity. A large area of the forested area of the state is very remote, dense and inaccessible. Therefore, it is still not fully explored and lots of plant species has to be identified and documented. Keeping in view the fact the present work was carried out to explore more the diversity of Arunachal Pradesh. The present work is also a necessary step towards biodiversity conservation and management.

Materials and Methods

The Study Area

The present study was carried out in the Bath Potu Forest area of Itanagar, District Papumpare, Arunachal Pradesh. The township of Itanagar is situated at 350 metres above mean sea level. It comes administratively under Papumpare district. The Nishi is the major tribe in Itanagar area. The Bath Potu Forest area is located around 10 km from Itanagar. The area is inhabited by Nyshi tribe. The area is surrounded by lush green forests rich in biological diversity. The inhabitants are dependent on these forests from their daily needs for various purposes. Arunachal Pradesh, the "Land of Rising Sun" is situated in the north-eastern part of India and extends over an area of 83,743 sq. km. It lies between 26^o 28' to 29^o 30' N latitude and 91^o 30' to 97^o 30' E longitude and has borders with Bhutan in the west, China (Tibet) in the north, China and Myanmar in the east and Nagaland, Assam in the south-

east to south. Topography of the state is characteristically rugged. The hill ranges vary in altitude from 100m to above 7000m and are oriented in an east-west direction, gaining height gradually from the south to north (Baishya et al, 2002).



Map 1. Location Map of Study Area

Identification and Selection of Sites and Habitats

A transect was selected along the trail in the Bath Potu Forest of Itanagar, Arunachal Pradesh. Survey was conducted in this transect with altitudinal gradient. The sites were selected on the basis of physical characters and dominance of the vegetation. A total of 03 sites have been selected for the present study. Habitats have been selected on the basis of physical characteristics. Sites having closed canopy with shade were considered as shady habitat, sites with closed canopy with high percent of humus and moisture were considered as moist habitats. The altitude, aspect, slope and other habitat characteristics were noted down in each site.

Survey, Sampling, Identification and Analysis of Data

The field surveys and sampling were carried out within the selected sites. In each site, a plot of 50x50m was laid. Trees have been sampled by randomly placed 10, 10x10m quadrats. The size and number of quadrats was determined following Misra (1968) and Kersaw (1973). For the collection of data from these quadrats standard ecological methods (Grieg-Smith, 1957; Kersaw, 1973; Muller-Dombois & Ellenberge, 1974; Dhar et al., 1997) were followed. Circumference at breast height (Cbh at 1.37m from ground) for each tree individual was recorded. Based on cbh, the tree individuals were considered as tree (cbh \geq 31.5 cm). From each site, samples of each species were collected and identified in the Institute with help of florulas, available literature and by consulting experts in Itanagar. Data analysis has been done following standard ecological methods (Grieg-Smith, 1957; Kersaw, 1973; Muller-Dombois & Ellenberge, 1974 and Dhar et al., 1997). IVI has been calculated as the sum of relative frequency, relative density and relative basal area. The abundance data of different sites were pooled to get community averages in terms of density, total basal area and IVI. Communities were delineated based on the IVI.

Resource use

To collect the useful information about the tree species a knowledgeable person was hired during the survey. Information on the local names, altitudinal range, life forms, part(s) used by the inhabitants, and use values including indigenous knowledge and practices was gathered. From each sampled site, samples of each species were collected and identified in the Institute with help of florulas, available literature and by consulting experts in Itanagar. The information on the indigenous uses of the species is based on primary as well as secondary information.

Results

Site and Habitat Characteristics

In the study area, total 03 sites have been selected. Two sites by shady and one site has been represented by moist habitat respectively. These sites were fall in SW, NE and SE aspect. The slope varied from 35°-45° and boulder percent was negligible as 2% (Table 1).

Community Diversity, Species Diversity and Distribution pattern

A total of three forest communities have been delineated in the Bath Potu Forest of Itanagar, Arunachal Pradesh between 600-650m. Each site is represented by each community. The identified communities are *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed; *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed and *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed. The community types, altitudinal distribution, representation in sites, habitats and major tree associates have been presented in Table 2.

Table 1. Site and habitat characteristics

Site	Habitat Type	Altitude (m)	Location	Aspect	Slope (°)	Boulder%	Dominant Species
1.	Shady	600	N 27°8'290", E 93°33'38"	SW	40	2	<i>Castanopsis</i> sps., <i>Spondias pinnata</i> , <i>Terminalia chebula</i> , <i>Adhatoda zeylanica</i>
2.	Moist	630	N 27°8'288", E 93°33'32"	NE	45	2	<i>Altingia excelsa</i> , <i>Elaeocarpus floribundus</i> , <i>Adhatoda zeylanica</i> , <i>Canarium resiniferum</i>
3.	Shady	650	N 27°8'287", E 93°33'31"	SE	35	2	<i>Spondias pinnata</i> , <i>Castanopsis</i> sps., <i>Elaeocarpus floribundus</i> , <i>Adhatoda zeylanica</i>

Table 2. Community types, their distribution and major tree associates

Code	Community Type	SR	Habitat Type	Altitudinal Range (m)	Major Associate Species
1	<i>Castanopsis</i> sps.- <i>Spondias pinnata</i> - <i>Terminalia chebula</i> - <i>Adhatoda zeylanica</i> mixed	1 (Site 1)	Shady	600	<i>Rhus javanica</i> , <i>Canarium resiniferum</i> , <i>Toona ciliata</i> , <i>Altingia excelsa</i>
2	<i>Altingia excelsa</i> - <i>Elaeocarpus floribundus</i> - <i>Adhatoda zeylanica</i> - <i>Canarium resiniferum</i> mixed	1 (Site 2)	Moist	630	<i>Cinnamomum</i> sps., <i>Toona ciliata</i> , <i>Eurya acuminata</i> , <i>Pandanus furcatus</i>
3	<i>Spondias pinnata</i> - <i>Castanopsis</i> sps.- <i>Elaeocarpus floribundus</i> - <i>Adhatoda zeylanica</i> mixed	1 (Site 3)	Shady	650	<i>Adhatoda zeylanica</i> , <i>Actinodaphne obovata</i> , <i>Rhus javanica</i> , <i>Altingia excelsa</i>

Abbreviations used: SR= Site representation

In general, a total of 14 species (11 families, 13 genera) of trees have been recorded in the communities delineated from the Bath Potu Forest of Itanagar, Arunachal Pradesh (Figure 1). The families are Acanthaceae, Altingiaceae, Anacardiaceae, Burseraceae, Combretaceae, Elaeocarpaceae, Fagaceae, Lauraceae, Meliaceae, Pandanaceae, and Theaceae. Families Anacardiaceae, Elaeocarpaceae and Lauraceae were represented by 2 species each while the rest of families represented by single species.

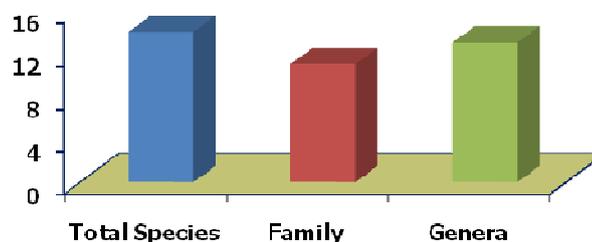


Fig 1. Distribution of species, family and genera

In general, among the forest communities the richness of trees ranged from 7-11. The richness of trees was highest in *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed (11), followed by *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed (08) and *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed (7), communities (Table 3).

General Community Structure

In the forest zone, the total tree density ranged from 840.00-900.00 Ind ha⁻¹. *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed community had maximum tree density (900.00 Ind ha⁻¹), followed by *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed (860.00 Ind ha⁻¹) and *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed (840.00 Ind ha⁻¹), communities (Table 3).

Communities: Composition and Structure

Composition and structure of the communities delineated in the Bath Potu Forest of Itanagar, Arunachal Pradesh is as follows:

1. *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed community

A total of 11 tree species were recorded in this community. The total tree density was 900.00 Ind ha⁻¹. *Castanopsis* sp. (Density 180.00 Ind ha⁻¹, IVI 43.84) was the dominant tree and, *Spondias pinnata* (Density 160.00 Ind ha⁻¹, IVI 39.83), *Terminalia chebula*

(Density 140.00 Ind ha⁻¹, IVI 38.30) and *Adhatoda zeylanica* (Density 140.00 Ind ha⁻¹, IVI 34.74) were the major tree associates (Table 4, 5).

2. *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed community

A total of 08 tree species were recorded in this community. The total tree density was 860.00 Ind ha⁻¹. *Altingia excelsa* (Density 180.00 Ind ha⁻¹, IVI 50.63) was the dominant tree and, *Elaeocarpus floribundus* (Density 200.00 Ind ha⁻¹, IVI 49.23), *Adhatoda zeylanica* (Density 100.00 Ind ha⁻¹, IVI 43.13) and *Canarium resiniferum* (Density 80.00 Ind ha⁻¹, IVI 38.02) were the major tree associates (Table 4, 5).

3. *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed mixed community

A total of 07 tree species were recorded in this community. The total tree density was 840.00 Ind ha⁻¹. *Actinodaphne ovata* (Density 40.00 Ind ha⁻¹, IVI 37.42) was the dominant tree and, *Spondias pinnata* (Density 180.00 Ind ha⁻¹, IVI 73.36), *Castanopsis* sp. (Density 180.00 Ind ha⁻¹, IVI 49.54) and *Elaeocarpus floribundus* (Density 140.00 Ind ha⁻¹, IVI 41.37) were the major tree associates (Table 4, 5).

Table 3. Community wise distribution of species richness, density, species diversity and concentration of dominance

Site	Community Type	SR	Species Richness	Density (Ind ha-1)	Species Diversity (H')	Concentration of Dominance (cd)
1	<i>Castanopsis</i> sp.- <i>Spondias pinnata</i> - <i>Terminalia chebula</i> - <i>Adhatoda zeylanica</i> mixed	1 (Site 1)	11	900.00	-2.11	0.14
2	<i>Altingia excelsa</i> - <i>Elaeocarpus floribundus</i> - <i>Adhatoda zeylanica</i> - <i>Canarium resiniferum</i> mixed	1 (Site 2)	8	860.00	-1.96	0.16
3	<i>Spondias pinnata</i> - <i>Castanopsis</i> sps.- <i>Elaeocarpus floribundus</i> - <i>Adhatoda zeylanica</i> mixed	1 (Site 3)	7	840.00	-1.84	0.17

Abbreviations used: SR= Site representation

Species Diversity (H') and Concentration of Dominance (Cd)

The diversity of trees in the Bath Potu Forest of Itanagar, Arunachal Pradesh is presented in Table 3. In general, species diversity (H') for trees ranged from 1.84 to 2.11. The diversity of trees was highest in *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed (2.11), followed by *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed (1.96) and *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed (1.84), communities. Concentration of dominance of trees in the Bath Potu Forest of Itanagar, Arunachal Pradesh is presented in Table 3. In general, concentration of dominance of trees ranged from 0.14 to 0.17. Concentration of dominance of trees was highest in *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed (0.17), followed by *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed (0.16) and *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed (0.14), communities. Community wise distribution of species richness, density, species diversity and concentration of dominance of Pine Groove Forest zone is presented in (Table 3).

Resource utilization pattern

Total 14 species (11 families and 13 genera) of trees have been found in the phytosociological survey of the Bath Potu Forest, Itanagar, Arunachal Pradesh (Table 6). These species have been used as medicine, wild edible/food, fodder, fuel, timber, dye, handicrafts, religious, ornament and various other uses.

Indigenous uses

The inhabitants nearby villages were dependent on plant resources for medicine, wild edible/food, fodder, fuel, timber, dye, handicrafts, religious, ornament and various other uses. Many of these species is being used for curing various diseases/ ailments. For example, a fruit of *Terminalia chebula* is used for cough, stomach disorder, tooth ache and asthma in children's; leaves of *Cinnamomum* sps. is used for colic pain, diarrhoea; fruit of *Rhus javanica* is used for curing dysentery; fruit of *Canarium resiniferum* is used for urinary complaints (Table 6). Among all the species, some species have multipurpose utility (Table 6), for example, *Toona ciliata* for medicine, timber, fodder and ornamental; *Pandanus furcatus* for medicine, handicrafts, flavour etc.; *Eurya acuminata* for dye, timber and fuel; *Castanopsis* sps. for edible, fuel and religious.

Table 4. Community wise density (Ind/ha) of trees

S.N.	Species	Community Types		
		1	2	3
1	<i>Actinodaphne obovata</i>	20.00	0.00	40.00
2	<i>Adhatoda zeylanica</i>	140.00	100.00	140.00
3	<i>Altingia excelsa</i>	60.00	180.00	60.00
4	<i>Canarium resiniferum</i>	20.00	80.00	0.00
5	<i>Castanopsis</i> sps.	180.00	0.00	180.00
6	<i>Cinnamomum</i> sps.	0.00	60.00	0.00
7	<i>Elaeocarpus aristatus</i>	40.00	0.00	0.00
8	<i>Elaeocarpus floribundus</i>	0.00	200.00	140.00
9	<i>Eurya acuminata</i>	20.00	80.00	0.00
10	<i>Pandanus furcatus</i>	0.00	120.00	0.00
11	<i>Rhus javanica</i>	100.00	0.00	100.00
12	<i>Spondias pinnata</i>	160.00	0.00	180.00
13	<i>Terminalia chebula</i>	140.00	0.00	0.00
14	<i>Toona ciliata</i>	20.00	40.00	0.00

Abbreviations used: 1= *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed; 2= *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed; *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed

Table 5. Community wise IVI of trees

S.N.	Species	Community Types		
		1	2	3
1	<i>Actinodaphne obovata</i>	18.97	0.00	37.42
2	<i>Adhatoda zeylanica</i>	34.74	43.13	40.22
3	<i>Altingia excelsa</i>	19.27	50.63	21.07
4	<i>Canarium resiniferum</i>	23.22	38.02	0.00
5	<i>Castanopsis</i> sps.	43.84	0.00	49.54
6	<i>Cinnamomum</i> sps.	0.00	34.15	0.00
7	<i>Elaeocarpus aristatus</i>	18.16	0.00	0.00
8	<i>Elaeocarpus floribundus</i>	0.00	49.23	41.37
9	<i>Eurya acuminata</i>	10.85	27.87	0.00
10	<i>Pandanus furcatus</i>	0.00	25.53	0.00
11	<i>Rhus javanica</i>	30.21	0.00	37.02
12	<i>Spondias pinnata</i>	39.83	0.00	73.36
13	<i>Terminalia chebula</i>	38.30	0.00	0.00
14	<i>Toona ciliata</i>	22.61	31.45	0.00

Abbreviations used: 1= *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed; 2= *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed; *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed

Table 6. Diversity and utilization pattern of tree species

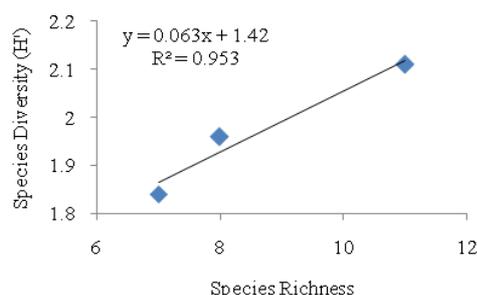
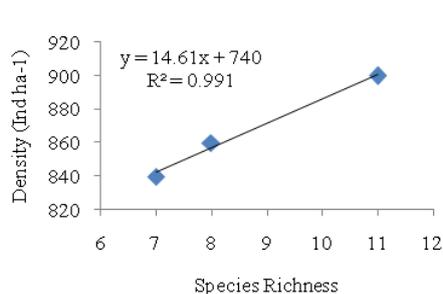
S.N.	Species	Family	Parts Used	Indigenous Uses
1	<i>Actinodaphne obovata</i> Blume	Lauraceae	Lf	Medicinal (Irregular menstruation)
2	<i>Adhatoda zeylanica</i> Medic.	Acanthaceae	Lf, Rt	Medicinal (cough, cold bronchial, troubles); Weeding Pole
3	<i>Altingia excelsa</i> Noronha	Altingiaceae	St, Br, WP	Medicinal (skin disorders); Timber
4	<i>Canarium resiniferum</i> Bruce ex King	Burseraceae	Fr	Medicinal (urinary complaints); Resin
5	<i>Castanopsis</i> sps.	Fagaceae	Lf, Fr, WP	Edible; Religious; Fuelwood
6	<i>Cinnamomum</i> sps.	Lauraceae	Lf	Medicinal (carminative, colic pain, diarrhoea, carminative, anti-flatulent, diuretic, cardiac diseases); Edible
7	<i>Elaeocarpus angustifolius</i> Blume	Elaeocarpaceae	Fr, Sd	Religious
8	<i>Elaeocarpus aristatus</i> Roxb.	Elaeocarpaceae	Fr, Sd	Religious

9	<i>Eurya acuminata</i> DC.	Theaceae	Lf	Dye; Timber; Fuelwood
10	<i>Pandanus furcatus</i> Roxb.	Pandanaceae	Lf, St, Rt	Medicinal (aphrodisiac, dysentery, snake bite); Miscellaneous (handicrafts, flavours etc.)
11	<i>Rhus javanica</i> Linn.	Anacardiaceae	Fr	Medicinal (Dysentery)
12	<i>Spondias pinnata</i> (L.f.) Kurz.	Anacardiaceae	Lf, Br, Fr	Medicinal (gastric, jaundice, dysentery, diarrhoea, vomiting, rheumatism, aphrodisiac, burns, astringent, refrigerant)
13	<i>Terminalia chebula</i> Retz.	Combretaceae	Fr	Medicinal (cough, stomachic, Purgative, skin ulcer, cardio tonic, tooth ache, asthma in children's); Timber
14	<i>Toona ciliata</i> M. Roem.	Meliaceae	Lf, St, Br, Fl, WP	Medicinal (astringent, dysentery, heal wounds); Timber; Fodder; Ornamental

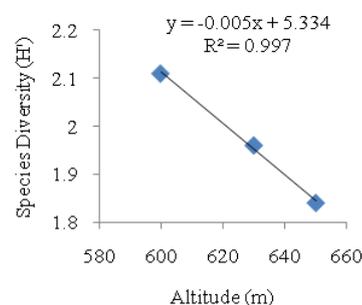
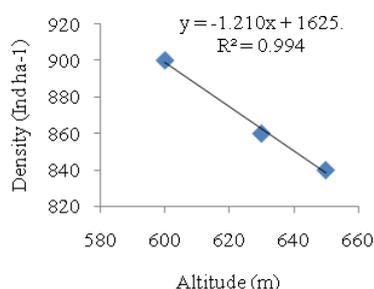
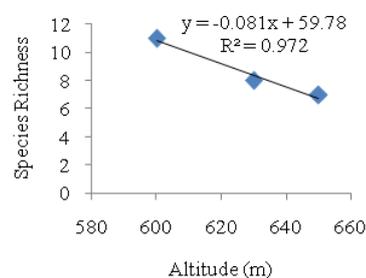
Abbreviations used: Br= Bark; Fl= Flower; Fr= Fruit; Lf= Leaf; Rt= Root; Sd= Seed; St= Stem; WP= Whole plant

Discussion

In the present study 14 species (11 families, 13 genera) of trees have been recorded. Total 3 communities i.e. *Castanopsis* sps.-*Spondias pinnata*-*Terminalia chebula*-*Adhatoda zeylanica* mixed; *Altingia excelsa*-*Elaeocarpus floribundus*-*Adhatoda zeylanica*-*Canarium resiniferum* mixed and *Spondias pinnata*-*Castanopsis* sps.-*Elaeocarpus floribundus*-*Adhatoda zeylanica* mixed have been identified from the selected sites. Resource use pattern of 14 identified species have also been documented. The total density range (840-900 Ind ha-1) showing the more or less similar values within the communities. There is not much difference have seen in species diversity range (1.84-2.11) among the communities also. The values of density (Ind ha-1) and species diversity (H') among the communities are increasing with the increasing values of species richness. A significant positive correlation has been found between species richness and density (Ind ha-1) and species richness and species diversity (H'). It is indicating that area with more species richness has more density and diversity.



Species richness, density (Ind ha-1) and species diversity (H') is decreasing with increasing altitude in the study area. Significant negative correlations have been found between altitude and species richness, density (Ind ha-1) and species diversity (H'). It is indicating that with the increasing altitude the species richness, density (Ind ha-1) and species diversity decreases (H'). The inhabitants of nearby villages are dependent on plant resources for various purposes includes medicine, wild edible/food, fodder, fuel, timber, dye, handicrafts, religious, ornament etc. Among all the species, some species have multipurpose utility. *Toona ciliata*, *Castanopsis* sps., and *Eurya acuminata* are more significant in terms of multipurpose utility.



Conclusion

The present study provides comprehensive information on sites and habitat characteristics, community diversity (composition and structure), distribution patterns, species diversity, concentration of dominance, soil composition of each identified community. The present study conducted in the Bath Putu Forest, Itanagar, Arunachal Pradesh provides data base on compositional and structural diversity, Distribution pattern of species, communities, within different communities, resources use pattern of useful

species and their indigenous uses. In view of the importance of biodiversity of Bath Putu Forest, Itanagar, Arunachal Pradesh protection/conservation of habitats/communities/ecosystems supporting rich diversity and useful species needs to be promoted. Monitoring of the species and communities needs to be promoted. Awareness about the biodiversity value of forests needs to be created among inhabitants. Participation of inhabitants in conservation and management of biological resources needs to be encouraged.

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