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STUDIES ON PHYTOSOCIOLOGICAL ATTRIBUTES OF UPPER SHIPRA WATERSHED IN MEGHALAYA

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ABSTRACT

Phytosociological analysis of woody as well as ground vegetation in abundant *jhum* (shifting cultivation) fallows of upper Shipra watershed (USW) in Meghalaya revealed the presence of 34 species of woody perennials belonging to 29 families and 35 species of ground vegetaion belonging to 22 families as components of fallow lands. The importance values index (IVI) was recorded for woody species and ground species. The maximum IVI represented by *Pinus kesiya* (81.5) and minimum by *Embelica officinails* (1.02) for woody species. Similarly the IVI values for ground vegetation were maximum for *Lantana camara* (45.7) and minimum for *Inula cappalim* (1.02). Shannon diversity index (SDI), Simpson dominance index (Sdl), Pileou evenness index (PEI), Margalef species richness index (MSRI) for woody species were 2.79, 0.10, 0.79 and 5.37 respectively and for ground vegetation were 3.16, 0.06, 0.88 and 4.56, respecgively.

INTRODUCTION

The North Eastern Region (NER) of India, comprising the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura, is predominantly hilly, inhabited by different tribes. A distinct agroclimatic conditions prevailing in this region is due to high rainfall, acidic soil, predominance of steep terrain and heterogeneity in species composition. These features result into fragility of the ecosystem. This region covers an area of 2, 62, 179 sq. km. The vegetation and their products were used to fulfil the needs like food, fodder, fuel-wood, timber, fruits etc. of 39.41 million populations.

Shifting cultivation and *"Bun'* farming are prevalent in NER causing tremendous soil and water loss through run off. This has resulted in soil and environmental degradation in this region. Due to increase in population and developmental activities, the fallow cycle has reduced to short (3-5 years) causing depletion in plant diversity. Population pressure was not alarming for degradation of land cover when the cycle was 20-30 years (Ramankrishnan and Toky 1978, Thangam 1992).

The long gap phase of *jhum* cycle was allowing enough gaps to develop the

vegetation up to secondary successional stage. In this way species become more prominent and get greater opportunities to establish themselves. However, there are many examples which shows the biological invaders altered the communities as a whole, and shifting cultivationis one of the type of disturbances which itself effects the invasion of secondary successional communities. During the successional period the vegetation get enough time to undergo many changes with perturbations by invasion of many exotic species and thus changing the communities as a whole (Whittaker 1965).

MATERIALS AND METHOD

Study site

The USW is located in the Umsning development block of the Ri-Bhoi district of Meghalaya between 25°40'13"-25°43'17" N latitude and 91°54'12"-91°57'26" E longitude; covering an area of 925.64 ha with altitude range of 920-1350 msl. The general climate of the USW is humid, sub-tropical and the temperature seldom rises above 28°C. The average maximum and minimum temperature was 27.7°C and 7.2° C, respecgively. The average annual rainfall is about 2399 mm, most of which was received during the months of April to October and total rainfall was distributed over 173 days. Mean annual relative humidity ranges between 58 to 92 percent. This watershed drains into Umiam river.

The phyto-sociological analysis of the vegetation was done in the entire watershed by using twenty randomly placed quadrates of 10x10m and 2x2m size for woody species and ground vegetation respectively. All species were collected during the study period and they were identified with the help of different literature (Kanjilal *et al.* 1934-40, Haridasan and Rao 1985) and Botanical Survey of India, Eastern Circle, Shillong. The frequency, density, abdundance and IVI of the species were worked-out following Mishra (1968) and Muller-Dombois and Ellenberg (1974). All plant species having more than 0.5 cm cbh were considered as woody species, while less than 5 cm were grouped under ground vegetation. To measure the distribution pattern, abundance to frequency ratio (A/F) was calculated. Dominance distribution pattern (DDP) and various indices such as diversity index (Shannon and Wiener 1963), dominance index (Simpson 1949), evenness index (Pielou 1975), species richness index (Margalef 1958) were also computed.

RESULTS AND DISCUSSION

The phytosocilogical characteristics of woody vegetation was composed of 34 species belonging to 29 families, which showed that *Schima wallichii* and *Pinus kesiya* had 90% frequency followed by the *Wedlandia* sp., *Litsea citrata* and *Syzygium cumuni,* respectively. The tree density ranging in USW was observed from 0.05 tree/ 100m^2 to 5.7 tree/100m^2 which clearly indicate the over exploitation of the area by shifting cultivation or *bun* cultivation. Total stand density of woody species was 2780 stem/ha with a basal area of 3.88 m^2/ha. *Pinus kesiya* has maximum stand density (114) followed by *Schima wellichii (95); similarly,* maximum basal area was also contributed by *P. kesiya* (0.36) followed by *Schima wallichii* (0.15) and *Grewia*

multiflora (0.03). The abundance of woody species found maximum in *Dendroalamus hamiltonii* (73) followed by *Delbergia stipulata* (9.5) while *E. offcinallis* were found minimum. The IVI of woody species showed that *P. kesiya* had the maximum IVI and most prominent tree species in the USW and followed by the *S. wallichii, Wendlandia* grandiflora and *Dendrocalamus hamiltonii.* the distribution pattern of the woody species showed that there was onlyone species. *(W. grandiflora)* having random distribution while all other species showed contagious distribution pattern (Table 1).

The phyto-sociological characteristics of ground vegetation were represented by 35 species belonging to 22 families. The studies showed that *Lantana camara* had the maximum frequency (75%) followed by *Ageratum conjoides* and*Eupatorium odoratum. Lantana camara* had the maximum density (154 plant/m^2) and *Halmskoldia chinensis, Cassia occidentalis* and *Ainslia spinosa* had minimum density.

The stand density of ground vegetation was 2,69,000 plant/ha with a basal area of 38.75 m^2/ha. *Lantara camera* had maximum stand density (308) followed by *Ainslia spinosa* (189). Similarly, maximum basal area was also contributed by these two species. The basal area of ground vegetation ranged from 21.88 to 2.62, which showed that *Lantana camara* had maximum (21.88) and minimum in *Curcuma angustifolia* (2.62). The abundance of ground vegetation was high for *Ainslia spinosa* (63) followed by *Themeda arguens* (37) instead of *L. camera.* the IVI of ground vegetation showed that *L. camera* had the maximum IVI and minimum was recorded for *Inula cappalim* (Table 2). The distribution pattern of ground vegetation followed similar pattern as woody species.

Population structure of USW area was obtained based on the girth frequency showed that the greater number of trees in lower girth classes. It clearly indicated that this stand harbors a growing population (Fig. 1). The girth class frequency distribution of woody species also revealed that with increase in girth class there was marked decrease in number of individuals. The density-diameter distribution (population structure) of ground vegetation showed reverse trend. The result also exhibited the better regeneration pattern for the ground vegetation. The diameter distribution of trees has been often being used to represent the population structure of forests (Khan *et al.* 1987, Rao *et al.* 1990). Dominance-diversity curves for woody species and ground vegetation showed low equitability and high dominance.

The USW area showed low diversity of plant species. SDI was computed for woody species was low (2.79) and Sdl showed higher value (0.12). Diversity of USW is low and dominance was high compared to other forest types of the Meghalaya as given by Jamir (2000) it ranged from 3.9 to 4.3. MSRI also sowed lower value (5.37), while the PEI was high (0.79) (Table 3). In terms of species rrichness and diversity these areas are very poor compared to other forests of the state.

The SDI for ground vegetation was found higher (3.16) than the woody counterparts and Sdl was low (0.06). Similar species diversity was reported by Kala *et al* 1997). This clearly indicates that disturbances cause reduction in species diversity. Other abiotic factors such as soil, wind velocity and soil erosion seem to influence the structure and composition of these area. MSRI showed lower (4.56) and evenness was higher (0.88) than the woody species of the same area (Table 3).

The comparison of biodiversity status of USW area based on species richness clearly indicated that ground vegetation showed maximum growth (Table 3). Shifting cultivation in the watershed area had contributed major threat to the plant species. It may alter species composition due to elimination of certain species and also by invasion of exotic species such as *Lantana camera* and *Dendrocalamus* sp. etc from surrounding areas. Tripathi *et al* (1996) reported that tree felling and timber cutting for fuel-wood collection during the past few decades had degraded the forests resources of the state. The vegetation from this area was destroyed at a great extent by age-old traditional shifting cultivation and other anthropogenic activities practised extensively in the state. Due to these activities the varieties of successional communities developed on the degraded shifting cultivated area.

Species composition in major forest types and sacred groves in the state were worked out by several workers Tripathi (1996) and Jamir (2000), but there is paucity of data on watershed area in state. Present study showed that conservation of plant diversity in USW area is prerequisite concern. Neeraj *et al.* (2001) reported that the presence of successional tree species like *P. kesiya, D. hamiltonii* and other ground species like *L. camera,* resulted the successional nature of the community. Tilman (1988) also reported that the successional stages were not absent from early successional environment.

The maximum diversity may be attributed due to better regeneration pattern of the species (Singh and Singh 1991). Pandey and Singh (1985) also reported an increase in species diversity in disturbed ecosystems. Essen *et al.* (1992) have reported that change from late to early stage of forest development are more drastic and may account for the largest alteration of biological diversity.

Turner *et al.* (1993) has resulted that the viabilityof species increased when the ratio of the disturbance interval to the recovery interval decrased. It is evident from the present study that there is complete absence of woody species in higher girth classes (>20 cm cbh) and relatively low recruitment of seedlings in USW. *P. kesiya, D. hamiltonii* and *L. camera* are growing due to their behaviour, as they are the successional species and they can grow in degraded lands. The survival and growth of plant species depend highly on light availability and soil conditions. Polunin and Stainton (1984) concluded that the diversity of plant species was suppressed by over-exploitation. Nevertheless, growth of *P. kesiya, D. hamiltonii* and *L. camera* showed tendency to grow under such conditions. Therefore, it is urgent to manage such areas intensively by protection and they should be maintained on a long-term basis.

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Table 1. Phytosociological status of woody species (above 5 cm circumference) in USW

Name of the species	Family	Density	Basal area	IVI	Abund.	A/F ratio
Macaranga denticulata	Euphorbiaceae	8	0.005	4.467	2.667	0.178
Pinus Kesiya	Pinaceae	114	0.363	81.535	6.333	0.070
Schima Wallichii	Theaceae	95	0.148	50.393	5.278	0.059
Michelia oblonga	Magnoliaceae	11	0.007	6.044	2.750	0.138
Wendlandia sp	Rubiaceae	32	0.016	16.521	2.909	0.053
Litsea citrata	Lauraceae	23	0.015	10.776	3.833	0.128
Syzygium cumimii	Myrtacear	29	0.023	12.920	4.833	0.161
Alnus nepalensis	Betulaceae	8	0.009	5.772	2.000	0.161
Erythrina indica	Papilionaceae	7	0.009	4.837	2.333	0.156
Olax acuminata	Olacaeceae	9	0.007	5.693	2.050	0.113
Bombax ceiba	Bombacaceae	6	0.008	4.483	2.000	0.113
Saurauria napaulensis	Saurauiaceae	5	0.014	5.116	1.667	0.111
Phoebe lenualata	Lauraceae	2	0.001	2.035	1.000	0.100
Murraya sp	Rutaceae	3	0.003	2.487	1.500	0.150
Quercus glauca	Fagaceae	7	0.003	3.186	3.5000	0.350
Ilex latifoia	Aquifoliaceae	7	0.009	4.049	3.500	0.350
Melia azadirachta	Meliaceae	3	0.003	2.487	1.500	0.150
Gmelina arborea	Verbenaceae	3	0.003	2.487	1.500	0.150
Prunus cerasoides	Rosaceae	14	0.006	3.227	1.500	0.150
Albizia lebbeck	Mimosaccac	3	0.006	2.904	1.500	0.150
Callicarpa arborea	Verbenaceae	3	0.009	3.227	1.500	0.150
Cedrela toona	Meliaceae	4	0.003	3.493	1.333	0.089
Cassia radicata	Cacsalpinaccac	3	0.009	3.227	1.500	0.150
Diospyros sp	Ebenaceae	3	0.008	3.113	1.500	0.150
Heptapleurum wallichii	Araliaceae	3	0.004	2.635	1.500	0.150
Phoenix sp	Arecaceae	4	0.004	2.792	2.000	0.200
Plectranthus wallichii	Lamiaceae	26	0.013	9.536	6.500	0.325
Lyonia ovalifolia	Ericaceae	14	0.005	4.798	7.000	0.700
Dalbergia stipulata	Papilionaceae	19	0.012	6.574	9.500	0.950
Maesa indica	Myrsinaceae	4	0.003	1.918	4.000	0.800
Mahonia pycnophylla	Berberidaceae	5	0.004	2.988	2.500	0.250
Dendrocalamus hamiltonii	Poaceae	5	0.006	3.214	2.500	0.250
Grewia multiflora	Tiliaceae	73	0.028	17.593	73.000	14.600
Embelica officinalis	Euphorbiaceae	1	0.000	1.018	1.000	0.200
		556	0.7747	4529	9.9929	

Talbe 2. Phytosocioligocal attributes of ground vegetition (below 5cm circumferance) in USW

Name of the species	Family	Density	Basal area	IVI	Abund	A/ratio
Lantana camara	Verbanaceae	308	0.061	45.681	20.533	0.274
Pteris japonica	Pteridaceae	63	0.013	9.293	21.000	1.400
Saccharum wallichiana	Poaceae	73	0.009	10.199	14.600	0.584
Glychenia wallichiana	Glycheniaceae	105	0.013	13.022	21.000	0.840
Eupatorium odaratum	Asteraceae	116	0.015	17.000	12.889	0.286
Osbekia crintia	melastomataceae	67	0.009	9.670	13.400	0.536
Smilax roxburghii	Smialacaceae	8	0.001	2.961	2.667	0.178
Adiantum sp	Adiantaceae	10	0.001	1.634	10.000	2.000
Echinochloa colona	Poaceae	20	0.003	3.268	10.000	1.000
Rubus moluccanus	Rosaceae	15	0.003	3.179	7.500	0.750
Cassia occidentalis	Caesalpiniaceae	3	0.001	1.087	3.000	0.600
Dysophylla ocimoides	Lamiaceae	16	0.003	4.043	5.333	0.356
Bidents pilosa	Asteraceae	97	0.012	14.572	12.125	0.303
Inula cappalim	Asteraceae	3	0.000	1.017	3.000	0.600
Hedyotes scandents	Rubiaceae	7	0.001	1.534	7.000	1.400
Holmskioldia sanguinea	Verbenaceae	3	0.000	1.017	3.000	0.600
Stachystarpeta jamaicensis	Verbenaceae	60	0.008	7.549	20.000	1.333
Cymbopogon jwarancusa	Poaceae	7	0.001	3.038	2.333	0.156
Themeda arguens	Poaceae	111	0.008	10.020	37.000	2.467
Urena lobata	Malvaceae	50	0.006	6.666	16.667	1.111
Setaria glauca	Poaceae	7	0.001	1.534	7.000	1.400
Milania micrantha	Asteraceae	133	0.017	14.740	33.250	1.663
Thysanolaena maxima	Poaceae	54	0.004	6.033	18.000	1.200
Ainslia spinosa	Asteraceae	189	0.038	23.367	63.000	4.200
Glochidion assamica	Euphorbiaceae	3	0.001	1.087	3.000	0.600
Drymaria cordata	Caryophyllaceae	9	0.001	2.298	4.500	0.450
Ocimum basilicum	Lamiaceae	71	0.009	9.271	17.750	0.888
Galinsoga parviflora	Asteraceae	89	0.011	12.362	14.833	0.494
Solanum indicum	Solanaceae	38	0.005	6.360	9.5000	0.475
Gynura crepizoides	Asteraceae	68	0.009	7.502	34.000	3.400
Mimosa pudica	Mimosaceae	23	0.003	4.285	7.667	0.511
Commelina nudiflora	Commelinaceae	22	0.003	3.445	11.000	1.100
Ageratum conyjoides	Asteraceae	107	0.014	15.454	13.375	0.334
Curcuma angustifoiia	Zingiberaceae	15	0.019	20.928	15.200	0.304
Desmodium sp.	Papilionaceae	45	0.001	4.816	15.000	1.000
				2152	**0.3.51**	**300**

Table .3. Plant diversity status in USW area of meghalaya.

Diversity parameters	woody species cm circumferenece	(>5 cm Ground vegetation (<5 circumference)
Number of species	34	35
Number of familis	29	22
Stand density (stem ha^{-1}	2780	2,69,000
Basal area (m^2ha^{-1}	3.88	38.75
Shannon diversity index	2.79	3.16
Margalef richness index	5.37	4.56
Pieiou evenness index	0.79	0.88
Simpson domonance	0.1	0.06

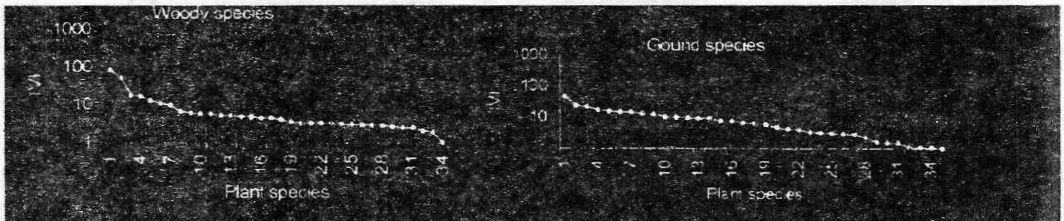

Fig-1. Dominance diversity curve of woody species (>5 cm circumference) and ground species (<5 cm circumference) of Upper Shipra Watershed

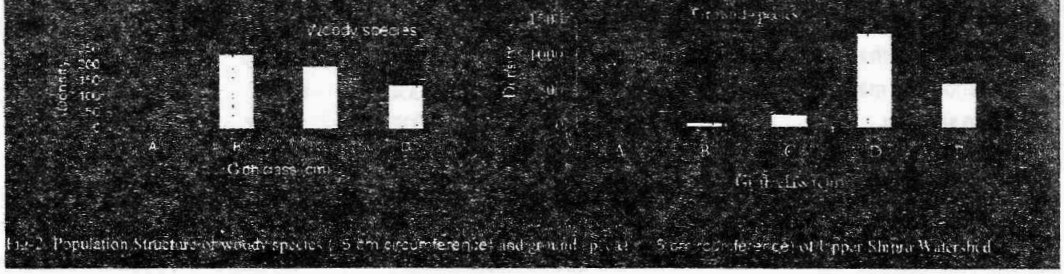

Fig-2. Population Structure of woody species (>5 cm circumference) and ground species (<5 cm circumference) of Upper Shipra Watershed