

Phyto-Diversity Study of Understorey Herbaceous Plants within the Sub-Tropical Forest in Pachhunga University College, Aizawl, Mizoram, India

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Abstract

*The geographical distribution and relative abundance of understorey herbaceous plants has been studied since the beginning of the 20th century. In forest stratum although plant species richness is higher in herbaceous layer it experiences higher natural extinction rates than plant species in other strata. Global biodiversity loss is occurring at an ever-increasing rate. Thus, threats to herbaceous layer species are most often a function of threats to forest biodiversity. This work has done much to increase our understanding of functional roles of herbaceous plants in forest ecosystems. The study investigated a total of 47 herbaceous plants of 23 families within 30 quadrats of 1×1 m². The results of the study showed that *Ageratum conyzoides* (Family Asteraceae) ranked the first in IVI (13.44), followed by *Cyrtococcum patens* (Family Poaceae) which ranked second in the IVI (12.87) with the highest number of individuals of 53 species and *Polygonum punctatum* (Family Polygonaceae) in the third ranked in the IVI (11.82). *Lycopodium cernuum* (Family Lycopodiaceae) is the recessive species and consequently ranked the lowest in the IVI. However, more in-depth knowledge of herbaceous diversity can serve as a measure for future monitoring of management facilities. It is, therefore, necessary to conserve the herbaceous vegetation.*

Keywords: Biodiversity, Herbaceous Plants, Disturbances, Conservation, Mizoram.

Introduction

The herbaceous layer is defined as, “the forest stratum composed of all vascular species that are a meter (m) or less in height”. It is the structure and function of forest ecosystems and represents less than 1% of the biomass of the forest, yet can contain 90% or more of the plant species of the forest and contribute up to 20% of the foliar litter to the forest floor that is generally of higher nutrient content than that of trees^{1,2}. Among a large number of plant species, herbaceous plants having medicinal properties are enormously used by the people to treat many diseases all over the world³. India is a home to about 15% medicinal plants and approximately 90% of the plant population is growing in its varied climatic zones⁴. About 95% of the plants are used as raw materials for pharmaceuticals⁵. Despite herbaceous species are found to have higher natural extinction rates than plant species in other strata. According to Levin and Wilson⁶, extinction rates of herbaceous plants are more than three times that of hardwood tree species and approximately five times that of gymnosperms. Therefore, interactions between forest strata and its diversity is an important topic of research at present⁷⁻¹⁰. According to the proposed classification, Mizoram falls under tropical evergreen to semi-evergreen forest in the lower altitude hills and sub-tropical to montane sub-tropical in the high hills¹¹. The total forest covers an area of about 15,825 km² and are exposed to various anthropogenic disturbances, e.g., shifting cultivation, timber logging, extraction of fuel wood by poor/rural tribal, industrialization and infact urbanization. The relationship between the indigenous people of the region and the

vegetation is considered to be both advantageous as well as detrimental to the plant wealth of Mizoram¹². Focuses on plant diversity assessment, use and conservation is a needful aspects towards scientific awareness and for maintaining existence of plants life on the earth. Threats to herbaceous layer species are most often a function of threats to forest biodiversity¹³. Therefore, it is necessary to conserve the herbaceous vegetation. The objective of the study was to assess and analyze the phyto-diversity variation of herbaceous plants in the study area.

Materials and methods

Study area: Pachhunga University College (PUC) is located between 23°72'33" N-latitude and 92°72'72" E- longitude, covers an area of 730 acre and is about 4.9 km away from Aizawl city in College Veng founded in 1958. Because of the successful greening process that has been carried out for nearly four decades, it provides beautiful lush green scenery for the Aizawl city situated at elevation 1080 meters above sea level. Temperature ranges from 20-30°C in summer and 11-21°C in winter. It is also the only institution in Mizoram to be awarded the *Indira Priyadarshini Vriksha Mitra (IPVM)* in 1995, the national award for pioneering and innovative contribution in the field of a forestation/wastel and management, from the Ministry of Environment and Forests.

Vegetation analysis: Field surveys was conducted randomly by laying 30 quadrats of 1×1 m² size at each site to study the community composition and other phyto-sociological

characteristics of the herbaceous vegetation during Spring (March-May), Summer (June-August), Autumn (September-November) and Winter (December-February). Herbaceous plant encountered during the study period was collected and identified.

Data analysis: The data recorded was quantitatively analyzed for density, frequency and abundance¹⁴ and their relative values were determined¹⁵. These values were summed up to get importance value index (IVI) of individual species¹⁶. The ratio of abundance to frequency (A/F) for different species was determined by eliciting the distribution pattern¹⁷. Diversity indices was calculated by Shannon's Index¹⁸ and McIntosh Index¹⁹, dominance indices was calculated by Simpson's Index²⁰ and Berger Parker Index²¹, species richness indices was determined by Margalef's Diversity²² and Menhinick's Index²³ while species Evenness Index was determined by using Pielou²⁴.

Results and discussion

A total of 47 herbaceous species of 23 families were reported from the study site (Table-2). Asteraceae (16 species) and Poaceae (5 species) were the most dominant families, Cyperaceae (3 species) and Amaranthaceae, Polypodiaceae and Lygodiaceae (2 species each). The remaining 17 families were represented by one species each (Figure-1). *Cyrtococcum patens*, *Imperata cylindrica*, *Ageratum conyzoides*, *Kylling abbrevifolia* were the most dominant herbaceous species respectively. Among all the species, *C. patens* showed highest values of density (1.77) as well as abundance values (8.83) and *A. conyzoides* showed highest frequency values (40%).

Dominant species based on IVI during all seasons at the site (Figure-2) were *A. Conyzoides* (13.44), *C. Patens* (12.87), *Polygonum punctatum* (11.82), *I. cylindrica* (11.32), *K. brevifolia* (11.05), *Eleusine indica* (10.91), *Eupatorium odoratum* (10.44), *Ichnanthus vicinus* (10.38), *Bidens pilosa* (9.43), *Achyranthes aspera* (8.4). Some of the recessive species that ranked lowest in the IVI were *Lycopodium cernuum* (1.87), *Vernonia cinera* (1.93), *Oxalis corniculata* (2.41) and *Scleria terrestris* (2.78).

Among the recorded plants species, mostly plant leaves are used as a source of herbal medicine and rest of the plant parts are used randomly to treat diseases (Table-2).

Different diversity indices recorded at the study site are presented in Table-1. Shannon diversity, evenness and richness index showed slightly higher trend while dominance index showed an inverse trend to that of Shannon diversity (Figure-3). The results are in consonance to the findings of Kharkwal²⁵, Shameem²⁶ and Yaqoob²⁷.

In accordance to the findings, inverse relationship between diversity and dominance index revealed that dominance of herbaceous layer are shared by many in the forest²⁵. The evenness indices ranged between 0-1 indicate that low dominance result in more or regular distribution of plant species. If the evenness value is higher, the variation in communities between the species would be less.

The distributions of species in certain habitats are influenced by climatic factors²⁸. Certain species usually grow together in a particular environment because they have similar requirements for existence in terms of environmental factors such as light, temperature, water, soil nutrients and drainage. So, high IVI of a species indicate its dominance, regeneration properties and greater ecological amplitude.

During spring and summer seasons, an increasing trend in species diversity was observed which may be due to the availability of moisture in the form of rains that goes on sprouting thereby adding new species that resulted in more diversity²⁶ (Figure-4). During autumn and winter seasons, a declined in species number was observed which may be due to severity in climatic conditions²⁹, lower rate of evolution and diversification of communities.

Abundance and frequency ratio (A/F) revealed that most of the species were contagiously distributed. It may be due to vegetative reproduction and other multitude factor^{30,31}. The same results have also been reported by Ilorkar³², Shadangi²⁹ and Shameem²⁶. According to Odum³³ contagious distribution is mostly performed in natural condition due to small but significant variation in environmental conditions.

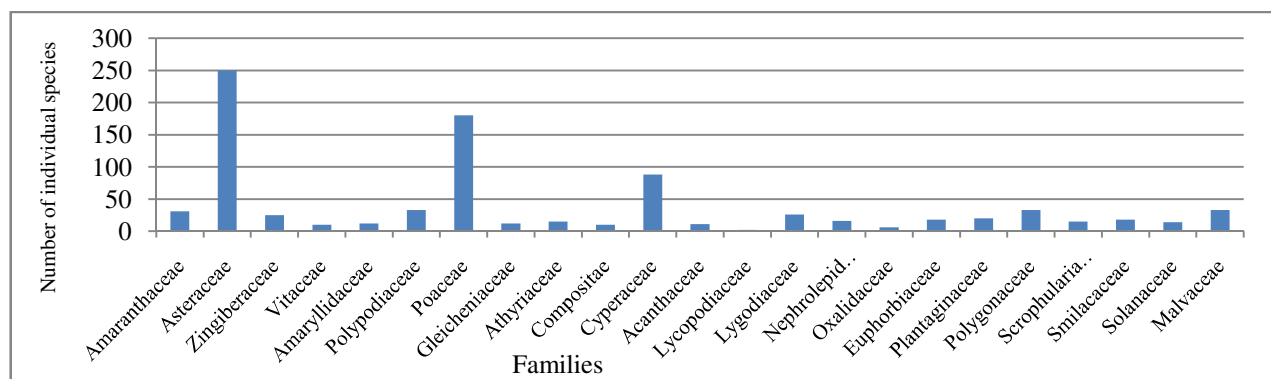


Figure-2: Families of herbaceous species recorded under study.

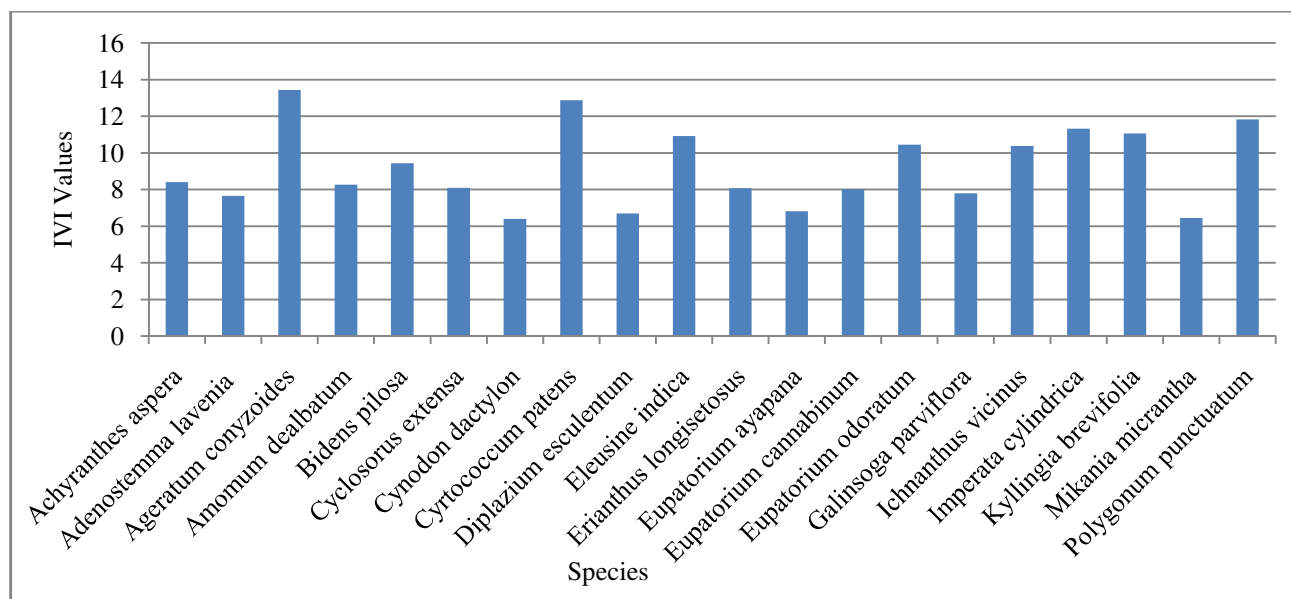


Figure-3: Twenty most dominant herbaceous species recorded based on IVI.

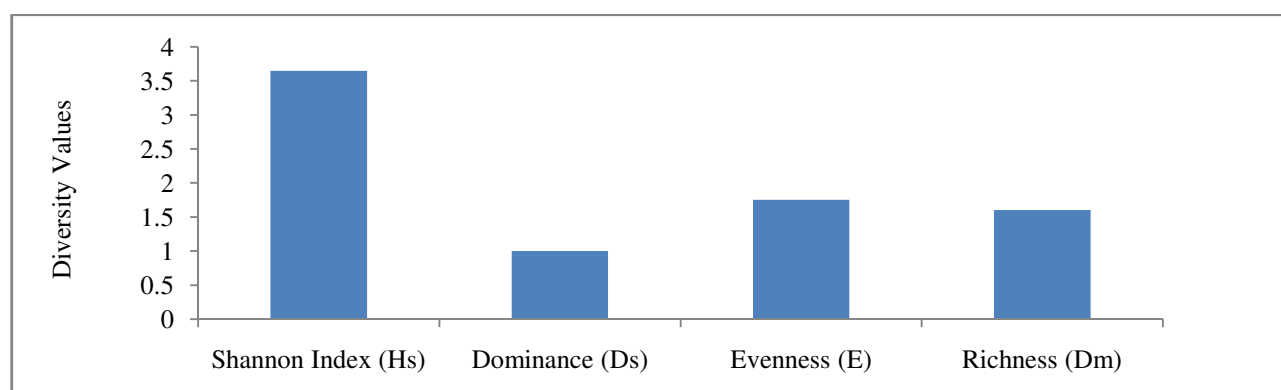


Figure-4: Different diversity estimates of herbaceous species during study period.

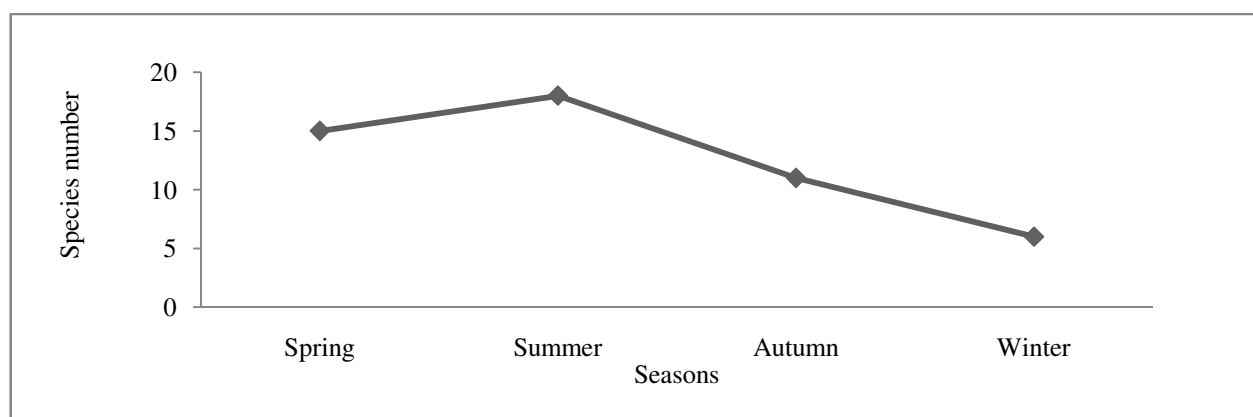


Figure-5: Species recorded during different seasons.

Table-1: Spatial variation in diversity, dominance, richness and evenness of herbaceous species at the study site.

Shannon's Index (H_s)	McIntosh Index (U)	Simpson's Index (D_s)	Berger Parker Index (D_{BP})	Margalef's Diversity (DM_g)	Menhinick's Index (DM_n)	Evenness Index (E)
3.65	149.62	1.00	0.06	6.81	1.60	1.75

Table 2: Total herbaceous species recorded during the study.

Species Name	Family	Local Name	Medicinal Uses
<i>Achyranthes aspera</i> Linn.	Amaranthaceae	Ui-hlo (M)	Infusion of the plant taken for dysentery and colic. Juice of crushed leaves applied on boils, piles, rheumatism, scorpion sting, sores and wound of the dog. The flowering spikes rubbed with sugar are given orally to the people bitten by mad dog.
<i>Adenostemma lavenia</i> (Linn.) Kuntz.	Asteraceae	Vailen-hlo-suak (M)	Juice of the leaves is applied on wounds.
<i>Ageratum conyzoides</i> Linn.	Asteraceae	Vailen-hlo (M)	Juices of the roots and leaves are useful in skin diseases, caterpillar- sting, ophthalmia, fresh cuts and sores.
<i>Amaranthus spinosus</i> Linn.	Amaranthaceae	Lenhling (M)	Juice of crushed plant is used as antidote in snake bite and nose bleeding.
<i>Amomum Dealbatum</i> Roxb.	Zingiberaceae	Aidu (M)	The plant is used for a cure of enlargement of liver and the stem for tying purposes. The young shoots and buds are eaten.
<i>Bidens pilosa</i> Linn.	Asteraceae	Vawkpui-thal (M)	Infusion of leaves for eye, ear and skin affections.
<i>Blumeopsis falcata</i> (D. Don) Merr.	Asteraceae	Khawnvar-tui-rim-nam (M)	Fresh leaves are used to reduce high temperature, cough and asthma.
<i>Cissus repens</i> Lam.	Vitaceae	Hruipawl (M)	Fresh leaves are eaten as vegetables. Paste of the roots is used for inflamed kidneys and as a poultice for tumours.
<i>Conyza Bonariensis</i> (Linn.) Cronq.	Asteraceae	Buarzen (M)	Fresh leaves are eaten as vegetables and useful in rheumatism.
<i>Conyza lanceolaria</i> (Roxb.) Druce.	Asteraceae	Buarze (M)	Fresh juice of leaves applied on wound, chronic ulcer, dysentery, bronchitis, asthma, cancer and liver ailment.
<i>Curculigo Capitulata</i> (Lour.) Kuntz.	Amaryllidaceae	Phaiphek (M)	Root juice taken orally for stomach disorder and headache. Paste of tender shoots applied on cuts and wound as haemostatic, antiseptic and anesthetic.
<i>Cyclosorus extensa</i> (Bl.) Ching.	Polypodiaceae	Limbirsi (D)	Leaves are used to treat back pain, herpes and skin infection.
<i>Cynodon dactylon</i> (Linn.) Pers.	Poaceae	Phaitual-hlo (M)	Leaves are used as fodder. The plant is useful in fresh cuts and wounds, haemorrhoids, menstrual bleedings, vomiting, fever, burning sensation, strangury, diarrhoea, dysentery, skin diseases.
<i>Cyrtococcum patens</i> (Linn.) A. Camus.	Poaceae	(U)	Leaves are used as fodder.
<i>Dichrocephala integrifolia</i> (Linn.) Kuntz.	Asteraceae	Vawk-ek-a-tum-tual (M)	The tender shoots are used as poultice for insect-bites and stings.
<i>Dicranopteris linearis</i> (Burn.) Underw.	Gleicheniaceae	Ar-thla-dawn (M)	The plant is used to expel intestinal worms, treat boils, ulcers and wound.
<i>Diplazium esculentum</i> (Retz.) Sw.	Athyriaceae	Chakawk (M)	The young fronds are taken as vegetables.
<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	(U)	Decoction of the plant is given for convulsions. Roots are considered sudorific and used in liver complaints.
<i>Erianthus longisetosus</i> Anders. ex. Benth.	Poaceae	Luang (M)	Unknown
<i>Eupatorium ayapana</i> Vahl.	Asteraceae	Paihu (B)	Fresh leaves is used for cut, haemorrhage, ulcers and stomachache. Ethanolic extract of the aerial parts of the plant possess anti-bacterial and anti-fungal properties.
<i>Eupatorium cannabinum</i> Linn.	Asteraceae	Tongol loti (A)	Juice are used for stomachache, urinary trouble. The herb is used in influenza, fever, cathartic, diaphoretic

Species Name	Family	Local Name	Medicinal Uses
			and emetic.
<i>Eupotarium odoratum</i> Linn.	Asteraceae	Tlangsam (M)	Fish poison. Juices of leaves are applied on fresh wound and nose bleeding.
<i>Galinsoga parviflora</i> Cav.	Asteraceae	Sazu (pui) chaw (M)	The leaves, stem and flowering shoots are eaten. Juice of the plant is applied on cuts.
<i>Galinsoga quadriradiata</i> Ruiz & Pavon	Asteraceae	(U)	An antidote to snake bite. Leaf juice cease bleeding. The herb is rubbed on the skin against nettle stings.
<i>Gnaphalium luteoalbum</i> Linn.	Asteraceae	(U)	Leaves are astringent and vulnerary. Paste of the plant is used in cut and injuries.
<i>Gynuraconyza</i> sp.	Compositae	Buarzo (M)	Decoction of leaves in tuberculosis, cancer, dysentery, stomach ulcer, wounds, skin diseases and as shampoo for treatment of dandruff.
<i>Ichnanthus vicinus</i> (Bail.) Merr.	Cyperaceae	(U)	Leaves used as fodder.
<i>Imperata cylindrica</i> (Linn.) Raeusch.	Poaceae	Di (M)	Pounded roots taken internally against intestinal worms. Commonly used for thatching.
<i>Kyllingia brevifolia</i> Rottb.	Cyperaceae	Pisum- bur (M)	Rhizome is used for poulticing sore leg, fever, diarrhoea and bronchitis.
<i>Lepidagathis hyaline</i> Nees.	Acanthaceae	Vangvat-hlo (M)	Juice of the leaves is applied leech-bite.
<i>Lycopodium cernuum</i> Linn.	Lycopodiaceae	Kangrem (M)	Decoction of the plant for cough and skin lotion in beri-beri.
<i>Lygodium flexuosum</i> (Linn.) Swartz	Lygodiaceae	Dawnzem-pui (M)	The boiled fresh root is used for curing rheumatism, sprains, scabies, ulcers, eczema and cut wounds. Tender leaves are eaten as vegetable.
<i>Lygodium scandens</i> (Linn.) Swartz	Lygodiaceae	Dawnzem (M)	The entire plant is used for improving kidney, urinary tract infections, colds, fever, enteritis- dysentery. Tender leaves are eaten as vegetable.
<i>Mikania Micrantha</i> Kunth.	Asteraceae	Japan-hlo (M)	Infusion of leaves is used in fever, stomach-ache, diarrhea, dysentery, insect bites, scorpion sting and also applied to fresh cuts.
<i>Nephrolepis cordifolia</i> (Linn.) Presl.	Nephrolepidaceae	(U)	Decoction of the leaves is applied in, cuts and injuries, fever, chest congestion.
<i>Oxalis corniculata</i> Linn.	Oxalidaceae	Siak-thur/ Thurte-an (M)	The fresh leaves made into curry are said to improve the appetite and digestion, fevers, diarrhea, dysentery and eye diseases.
<i>Phyllanthus fraternus</i> Web.	Euphorbiaceae	Mithi-sunhlu (M)	Infusion of plant is used for jaundice, dysentery, skin diseases, urino-genital disorders and promote appetite.
<i>Plantago major</i> Linn.	Plantaginaceae	Kelba-an (M)	Decoction of whole plant is used in malarial fevers, diabetes and tuberculosis. Juice of the leaves is used externally for wounds, boils, chronic, ulcers, cuts, otitis, sprain, mouth-sore and tooth-ache.
<i>Polygonum punctatum</i> Ham. syn	Polygonaceae	U	Leaves are employed as a local application for swellings.
<i>Pteridium aquilinum</i> (Linn.) Kuhn.	Polypodiaceae	Katchat (M)	Decoction of rhizomes and fruits are used in treatment of chronic visceral and spleen troubles.
<i>Scleria terrestris</i> Linn.	Cyperaceae	Thip-nem (M)	Unknown
<i>Scopariadulcis</i> Linn.	Scrophulariaceae	Perh-pawng chaw (M)	Juice of crushed aerial parts are used in diabetes, stomach troubles, nausea, diarrhoea, toothache and also for removal of stone in kidney.

Species Name	Family	Local Name	Medicinal Uses
<i>Smilax perfoliata</i> Lour.	Smilacaceae	Kai-ha (M)	Fresh root juice taken for cure of rheumatism.
<i>Solanum khasinum</i> Clark.	Solanaceae	At- hlo (M)	Smoke of dried leaves used for removing toothworm from the mouth.
<i>Spilanthes oleracea</i> Clark.	Asteraceae	Ankasa-te (M)	Crushed flowers used for toothache as a stimulant. Leaves are taken as vegetables.
<i>Urena lobata</i> Linn.	Malvaceae	Sehnap (M)	Infusion of roots are used as an external remedy for rheumatism. Infusion of the tender leaves is used for diarrhoea and dysentery.
<i>Vernonia Cinera</i> Less.	Asteraceae	Kuksim (B), Lohpohi (A)	Decoction of plant is used in diarrhea, dropsy, cough, stomachache, piles, boils, malaria, intestinal colic, dysuria and incontinence of urine in the children.

Where A= Assamese, B= Bengali, C= Chakma, D= Dimasa, M= Mizo, U= Unknown.

Conclusion

The herbaceous layer harbors the great majority of plant diversity in the forests floor. It served as the site of initial competitive interactions for the regeneration phases of dominant canopy species and has the ability to form linkages with the overstorey. Thus, it influenced the ecosystem functions such as energy flow and nutrient cycling, retaining erosion of soil and its fertility. Above all environmental conditions it also supports the diversity of different plant species. Many of the recorded herbaceous plants are of medicinal values used by the local people as a source of their primary health care. Increasing biotic interference and human activities such as non-technical collection of fuel, fodder, medicinal herbs, developmental activities, over-exploitation, burning of ground vegetation, ploughing as a part of agricultural practices are continuously changing the composition of herbaceous plants in space and time. Hence, the plant species diversity, richness and evenness are reducing significantly with increased disturbances in the forest vegetation. Therefore, assessment of herbaceous vegetation is necessary to conserve the needful bio-species and safeguard ecological security.

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