Title: **Assessment of bryophyte diversity in selected localities of Assam (NE India): A quantitative approach**

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Importance of work

The present work elucidates quantitative assessment of bryophytes occurring in selected grids of Assam, a significant region of North-east India. It highlights the distribution pattern of these plants across the different habitats and other ecological parameters are also used comprehensively to assess the status of species, not dealt sofar in Indian context in general and for Assam in particular. The study revealed 4 species as new addition to North-East India and 7 species as new to Assam.

RESEARCH ACCOUNT

Assessment of bryophyte diversity in selected localities of Assam (NE India): A quantitative approach

A study on the quantitative estimation of diversity in the selected 32 grids at bryophyte rich localities of Assam lying-in north-East region has been carried out. Assessment has been made in 160 macroplots of 10×10 m, randomly established in the forest and within each macro-plot, multiple microquadrats of 5 (10×10 cm) were placed at different habitats viz. saxicolous, terricolous and epiphytic. A total of 80 taxa belonging to 29 species of liverworts under 18 genera and 10 families and about 51 species of mosses belonging to 27 genera and 13 families were assessed. In the study area, Lejeuneaceae, Fissidentaceae, *Cololejeunea latilobula* (Herzog.) Tixier and *Entodontopsis tavoyensis* (Hook ex Harv.) W. R. Buck & R. R. Ireland were the dominant families and taxa, respectively. Four species are new additions to north-East India and seven taxa are new reports for Assam region. The present study elucidates the species diversity as well as the species richness and evenness of the region which can further define their importance in the community.

Keywords: Diversity assessment, Species richness, Evenness, Assam.

Bryophytes play an important role in maintaining plant community structure and serve as an important part of our ecosystem. With an approach of quantitative assessment of the bryophyte diversity in selected regions of Assam, present study has been done. This state lies in the northeast region of India and has three physiographic divisions, which favours the unique diversity of flora and fauna. The assessment was done by measuring different diversity indices measuring relation of species abundance in communities[1]. These index mainly deals with the species richness (no. of species) and species evenness (how uniformly abundant species are in a community)[2]. It projects the information of the sampling data, species diversity, species

importance in the community. There are numerous diversity indices to evaluate species diversity between different communities. These diversity indices can be translated into information for Bioresources inventory, mapping, livelihood and its economic value. This paper broadens the spectrum of diversity indices through finding Simpson Index, Shannon Weiner Index, Important Value Index, Species Area Curve, Raunkier's Law of Frequency of these cryptogams (Bryophytes) of Assam. In fact, the quantitative study can be further used to access its importance in the community as these cryptogamic plants had helped in maintaining the community structure since the Ordovician period.

Earlier many renowned workers provided their valuable researches upon which the concept is based now. Some significant international contributions provided on quantitative community analysis related to Bryophyte Ecology on Signy Island[3]. Lee & Roi worked on gradient analysis of bryophytes in Jasper National Park, Alberta[4]. Later, Bates deliberated the quantitative approaches in Bryophyte Ecology[5]. Kreb discussed the importance and problems associated with Ecology[6]. Wolf studied diversity patterns and biomass of Epiphytic bryophytes and lichens[7]. Pharo and Beattie described regional species richness and species turnover of bryophytes and lichen of Australia[8]. Later detailed studies on application of diversity indices to appraise plant availability in traditional medicinal markets of south Africa[9]. Newmaster compared plot sampling and floristic habitat sampling for estimation of Bryophyte diversity[10]. Mandl et al. compared alpha and beta diversity patterns of ferns, bryophytes and macrolichens[11]. Mokany made contribution by combining alpha and beta diversity models[12]. Hofmeister et al. provided work on quantitative assessment of old forest related to cryptogam species richness[13].

The studies related to quantitative assessment of non-flowering plants are sporadic in India. Pande studied eco-physiological aspects of Bryophytes in Nainital Hills[14]. Tewari et al. studied the epiphytic succession in three major tree species- *Cedrus deodara*, *Quercus floribunda* and *Q. leucotrichophora* in a wet forest of Kumaun Himalaya and found that total biomass and species number per unit area increases with trunk size[15]. Awasthi et al. studied bryophyte diversity on stem surface of *Erythrina arborescens* and observed that 17 species of moss growing on tree bark while liverworts was not growing on that plant[16]. Bargali et al. studied bryophyte vegetation associated with *Platanus orientalis* L. and compared with other tree species of Nainital and found that 15 species are common on dominant tree of that locality while 12 species are confined to *P. orientalis*[17]. Later, Studies on habitat distribution of several acrocarpous mosses was assessed[18]. Earlier studies from Assam revealed around 143 liverworts and hornworts[19.] Barukial studied ecological assessment of 162 taxa of bryophytes under 90

genera and 30 families with reference to their habitat[20]. He found that frequencies of diverse microhabitats are 52.3% (terricolous), 35.27% (epiphytic) and 8.72% (aquatic) [20].

Study Area

Assam is located in north east Indian region situated south of eastern Himalaya. The climate of Assam lies in Tropical monsoon Rainforest experiencing heavy rainfall with high humidity. The localities as shown in map 1 were Kamar Kuchi, Reng Beng Grant, Lalmathi, Amlighat, Milanpur, Tegheriya, Burapahar, Itabhata, Hathikhuli, Kohora Range, Nambor Habi, Barapathar, Langtibuk, Amlakhi, Diliram Chetri, Diphu, Gautam basti, Deory Tinali, Pudum Pukhuri, Umpoo, Udali, Diphu, Balijana, Dhokapara, Dudhnoi, Dhupdhara, Boko, Khetabara, Puthimari, Harimura, Lokhra and Panikhaiti.

Methodology

The study was carried out in 32 grids of high and moderate priority in Assam during 10th October to 1st November 2018. In each grid, 5 random macroplots of 10×10 m was laid and within macro-plot, 5 quadrats of 10×10 cm were placed at different habitats viz. saxicolous, terricolous and epiphytic. The quantitative data in form of percentage cover was taken. Further, plants were air dried and transferred to brown packets. Plant samples were soaked and washed in tap water for morphological and anatomical study and were mounted in 30% Glycerine to further investigate under the microscope. The specimens were deposited in Bryophyte Herbarium, CSIR- National Botanical Research Institute, Lucknow (LWG). The vegetation data were calculated for density (=Total no. of individuals/No. of quadrats studied), relative density (R.D.=Density of given sp.×100/Sum of Density), abundance (=Total no. of individuals/No. of quadrats in which species occur), relative abundance (R.D.=Abundance of given species×100/Sum of abundance), frequency (=Total no. of quadrats in which species occur/Total no. of quadrats×100), frequency class (According to Raunkier's Law) class A=0-20; class B=21-40; class C=41-60; class D=61-80; class E=81-100, relative frequency (R.F.=No. of Sp. Occurrence ×100/count of all frequency), Importance Value Index/IVI (R.D.+R.F.+R.A.), Simpson index[21] and Shanon-Weiner index[21].

Result & Discussion

Identification of bryophyte specimens in 32 grids revealed occurrence of 80 species (Table 1) in the study area. The study has revealed five new records for north-east India viz. *Fissidens biformis* Mitt., *Fissidens orishae* Gangulee, *Fissidens zollingeri* Mont., and *Entodontopsis tavoyensis* (Hook ex Harv.) W. R. Buck & R. R Ireland and new records for Assam viz.

Hydrogonium consanguineum (Thw. et Mitt.) Hilp., *Lopholejeunea abortiva* (Mitt.) Stephani, *Oxystegus cylindrothecus* (Mitt.) Gangulee, *Philonotis leptocarpa* Mitt., *Riccia sorocarpa* Bisch, *Solmsiella biseriata* (Austin) Steere and *Thuidium venustulum* Besch. The data clearly demonstrates that more representation of mosses than liverworts in the study area. The most dominant family of liverworts in the study area is Lejeuneaceae with 11 taxa, followed by Jungermanniaceae with 6 species and the dominant moss family was Fissidentaceae with 15 taxa, followed by Pottiaceae with 8 taxa and Hypnaceae with 7 species. Within the study area, species with maximum percentage cover were *Fissidens ceylonensis* Dozy & Molk., *Gemmabryum apiculatum* (Schwagr.) J. R. Spence & H. P. Ramsay, *Philonotis mollis* (Dozy & Molk.) Mitt. and *Riccia sorocarpa* Bisch.. In terms of density, species such as *Fissidens ceylonensis* (20), *Gemmabryum apiculatum* (20), *Philonotis mollis* (20), *Ectropothecium cyperoides* (Hook. Ex Harv.) A. Jaeger (19.1) and *Solenostoma hyalinum* (Lyell) Mitt. (19) were densely populated. According to Raunkier's class, frequency of species to class E (most frequent) were *Entodontopsis tavoyensis* and *Erpodium glaziovii* Hampe while *Barbula indica* (Hook) Spreng., *Cololejeunea latilobula, Fissidens virens* Thwait ex Mitt., *Fissidens zollingeri* Mont., *Lopholejeunea* sp1, and *Garckea phascoides* (Hook.) Müll. Hal. belongs to class D. The occurrence of species according to Raunkier's class has been placed in respective classes. The study depicts that maximum number of species are placed in class A (41 taxa), followed by B (19 taxa), then by C class (12 taxa), D class (6 taxa) and E class (2) taxa as given in Fig 1. The most abundant species in the study area were *Fissidens ceylonensis* (100), *Gemmabryum apiculatum* (100), *Philonotis mollis* (100) and *Riccia sorocarpa* (100). The Simpson Index showed a high richness value of 0.98 in terms of species abundance and evenness,while Shanon index represented more richness and evenness with a value of 3.8 forming stable diversity. The study area has rich bryophyte species diversity as the number of species are still increasing (Fig 2). The IVI has been used in ecological indices as it states ecological importance of a species in a given community. It also helps in prioritizing species conservation whereby species with low IVI value needs high conservation priority as compared to the species with high IVI value. The high IVI value exhibited by species like *Barbula indica* (Hook) Spreng., *Claopodium prionophyllum* (Müll. Hal.) Broth., *Ditrichum heteromallum* (Hedw.) Britt., *Ectropothecium cyperoides* (Hook. ex Harv.) A. Jaeger, *Ectropothecium dealbatum* (Reinw. & Hornsch.) A Jaeger, *Ectropothecium zollingeri* (Müll. Hal.) A. Jaeger, *Entodontopsis tavoyensis* (Hook ex Harv.) W.R. Buck & R.R Ireland, *Erpodium glaziovii* Hampe, *Fissidens crispulus* var *robinsonii* (Broth.) Z. Iwats., *Gemmabryum apiculatum* (Schwagr.) J.R. Spence & H.P. Ramsay, *Jackiella javanica* Schiffn. var *cordifolia, Jungermannia gollanii* Stephani, *Jungermannia tetragona*

Lindenb., *Notoscyphus paroicus* Schiffner, *Pallavicinia lyelli* (Hook.) Gray, *Philonotis mollis* (Dozy & Molk.) Mitt., *Plagiochila sciophila* Nees ex Lindenb., *Riccia sorocarpa* Bisch., *Solenostoma hyalinum* (Lyell) Mitt., *Stereophyllum ligulatum* A. Jaeger., *Vesicularia levieri* Cardot and *Vesicularia montagnei* (Schimp.) Broth. is likely due to their higher relative frequencies, densities and abundance compared to other species (Table 1). The presence of many species with lower IVI value viz. *Cheilolejeunea imbricata* (Nees) Hatt., *Cololejeunea ceratilobula* (P. C. Chen) R. M. Schust., *Fissidens griffithii* Gangulee, *Fissidens semiperfalcatus* Dixon., *Fissidens flaccidus Mitt.*, *Mitthyridium fasciculatum* subsp *cardotii* (M. Fleisch), *Philonotis leptocarpa*, *Pseudosymblepharis bombayensis* (Müll. Hal.) P. Sollman, *Trocholejeunea sandvicensis* Mizut., *Radula obscura* Mitt., *Schiffneriolejeunea indica* (St.) Udar & Awasthi, *Trocholejeunea sandvicensis* Mizut. and *Solenostoma torticalyx* (Stephani) C. Gao in the area states that the respective species are rare in the study area and need conservation urgencies. Species *Cololejeunea latilobula* conquered in about 71 microquadrats (10×10 cm) followed by *Entodontopsis tavoyensis* which occurred in about 60 microquadrats. The dominated species occurring in several localities were viz., *Cololejeunea latilobula* recorded from 15 sites, followed by *Entodontopsis tavoyensis* reported from 13 sites, followed by *Archilejeunea minutilobula*, *Calymperes tenerum* and *Fissidens zollingeri* encountered from 8 sites and *Erpodium glaziovii*, *Fissidens virens* and *Garckea phascoides* occurred at seven sites. The sites having rich species diversity were Pudum Pukhuri with 15 species belonging to 14 genera and 12 families, subsequent another site, Lokhra Hills with 13 species belonging to 12 genera and 11 families. following another site, Tegharia waterfall with 12 species belonging to 10 genera and 9 families. Other localities like Hathikhuli, Naambor Habi and Balijana exhibited the occurrence of eleven taxa of liverworts and mosses. Whittaker plot or rank abundance curve (Fig. 3) depicts both species richness and evenness. Species are ranked according to their abundance (no. of individuals) i.e. most abundant species is given rank 1, the second most abundant species is given rank 2 and so on. Species richness can be observed as the number of species and species evenness indicating that a steep gradient indicates low evenness among species and a shallow gradient tells that the study site has high evenness as abundance (no. of individuals) of species are closer. Species such as *Fissidens ceylonensis*, *Gemmabryum apiculatum*, *Philonotis mollis* and *Riccia sorocarpa* are placed under rank 1 as they have same abundance values, likewise *Hyophila involuta* (Rank 2), *Ectropothecium cyperoides* (Rank 3), *Solenostoma hyalinum* (Rank4), *Fissidens crispulus* var *robinsonii* (Broth.) Z. Iwats. (Rank 5) and the least abundant species were given latter ranks viz. *Fissidens pulchellus* Mitt., *Fissidens semiperfalcatus* Dixon., *Radula obscura* Mitt., *Schiffneriolejeunea indica*, *Solenostoma*

clavellatum Mitt. ex Steph., *Solmsiella biseriata* (Austin) Steere, *Trocholejeunea sandvicensis*, *Cololejeunea ceratilobula*, *Fissidens flaccidus*, *Mitthyridium fasciculatum* subsp *cardotii* (M. Fleisch) and *Solenostoma torticalyx* respectively.

Conclusion

Our study added some new findings to North East India viz. *Fissidens orishae* which was earlier documented from Eastern Ghats region of Odisha; *Entodontopsis tavoyensis* was earlier known from central India, eastern Ghats, gangetic Plains and western Himalaya; *Fissidens biformis* and *Fissidens zollingeri* was earlier documented from western Ghats. Species like *Hydrogonium consanguineum* which was earlier reported from central India, eastern Ghats, eastern Himalaya, gangetic plains and western Himalayan region, *Lopholejeunea abortiva* recorded earlier from eastern Ghats, western Ghats and Meghalaya of north-East India, *Solmsiella biseriata* which was earlier reported from eastern Ghats and north-Eastern region of Manipur[22], *Riccia sorocarpa* which has been found in gangetic Plains, eastern and western Himalayan region, *Thuidium venustulum* earlier reported from eastern Himalaya, North-East India (Manipur and Nagaland), *Philonotis leptocarpa* earlier known from Eastern and western Himalaya, *Oxystegus cylindrothecus* (Mitt.) Gangulee known from eastern Himalayas, eastern Ghats, western Ghats and gangetic Plains are new records for Assam region. By application of different approaches to assess the bryophyte diversity it has been found that species are dominant in some localities as compared to others. Simpson Index (0.98) provides data in terms of species abundance and evenness and shanon index (3.8) represents more richness and evenness. Species area curve clearly indicates the rich bryophyte diversity in the study area as number of species are still increasing. Furthermore, IVI values predict the important species viz., taxa with low IVI value needs high conservation priority as compared to the species with high IVI values.

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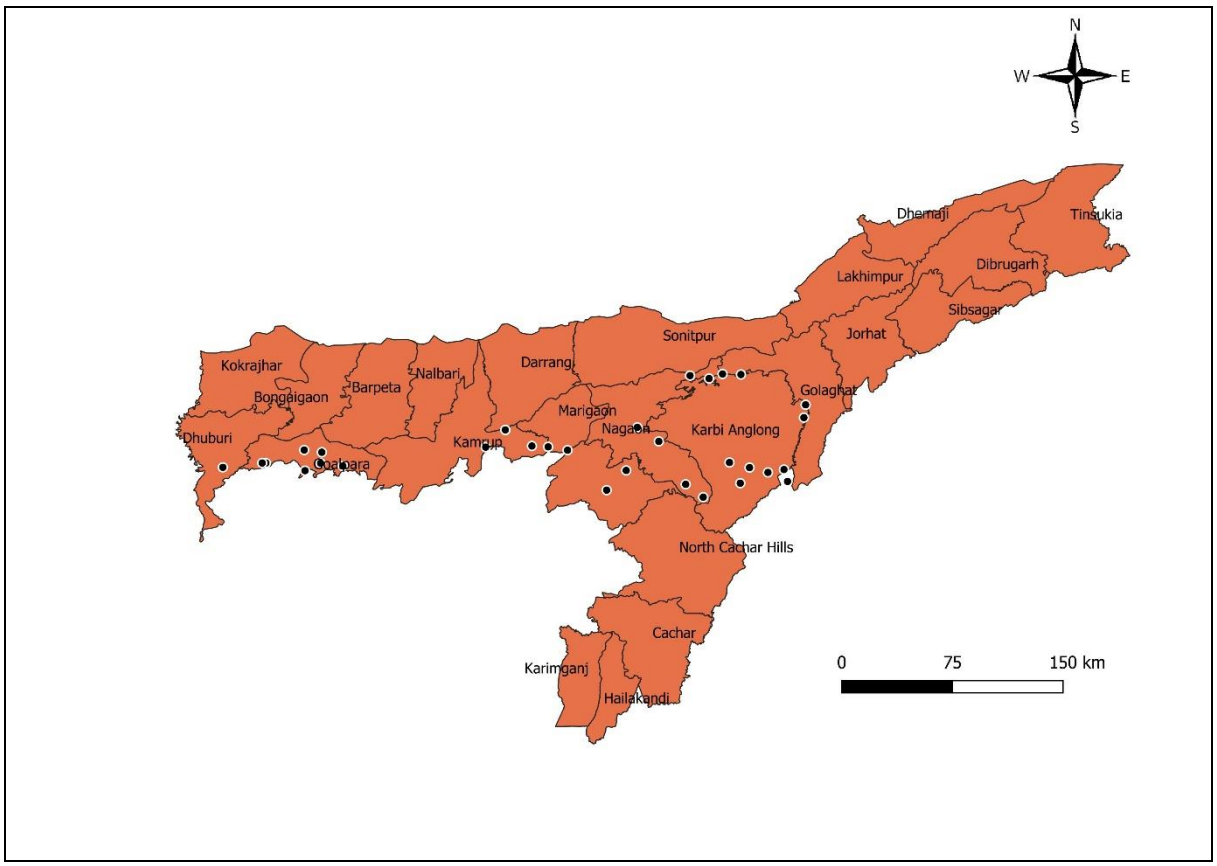

Map 1: showing study localities of Assam

Table1: showing different parameters of Bryophytes of Assam

Name	Total no. of individuals. (%)	Density	R.D.	Frequency	R.F.	Frequency class	Abundance	R.A.	IVI

1.	***Barbula indica* (Hook) Spreng.**	56.7	11.3	1.40	80	2.66	D	14.17	0.50	4.56
2.	***Brachymenium acuminatum* Harv.**	50	10	1.23	20	0.66	A	50	1.78	3.67
3.	***Calymperes tenerum* Müll. Hal.**	39.5	7.9	0.97	60	2	C	13.16	0.47	3.44
4.	***Cheilolejeunea imbricata* (Nees) Hatt.**	24	4.8	0.59	20	0.66	A	24	0.85	2.1
5.	***Claopodium prionophyllum* (Müll. Hal.) Broth.**	66.6	13.3	1.64	20	0.66	A	66.6	2.37	4.67
6.	***Cololejeunea ceratilobula* (P. C. Chen) R. M. Schust.**	10	2	0.24	20	0.66	A	10	0.35	1.25
7.	***Cololejeunea furcilobulata* (Berne & Jones) Schust.**	37	7.4	0.91	60	2	C	12.3	0.43	3.34
8.	***Cololejeunea latilobula* (Herzog) Tixier.**	35.4	7.08	0.87	80	2.66	D	8.85	0.31	3.84
9.	***Dicranella macrospora* Gangulee**	46.2	9.24	1.14	60	2	C	15.4	0.55	3.69
10.	***Ditrichum heteromallum* (Hedw.) Britt.**	80	16	1.97	20	0.66	A	80	2.85	5.48
11.	***Ectropothecium cyperoides* (Hook. ex Harv.) A. Jaeger**	95.5	19.1	2.36	40	1.33	B	47.75	1.70	5.39
12.	***Ectropothecium dealbatum* (Reinw. & Hornsch.) A Jaeger**	80	16	1.97	20	0.66	A	80	2.85	5.48
13.	***Ectropothecium zollingeri* (Müll. Hal.) A. Jaeger**	80	16	1.97	20	0.66	A	80	2.85	5.48
14.	***Ectropothecium* sp1**	80	16	1.97	20	0.66	A	80	0.66	5.48
15.	***Entodontopsis anceps* (Bosch. & Sande Lac.)**	29.2	5.8	0.71	40	1.33	B	14.6	0.52	2.56
16.	***Entodontopsis tavoyensis* (Hook ex Harv.) W.R. Buck & R.R Ireland**	47	9.4	1.16	100	3.33	E	9.4	0.33	4.82
17.	***Erpodium glaziovii* Hampe**	51.1	10.2	1.26	100	3.33	E	10.22	0.36	4.95
18.	***Fissidens biformis* Mitt.**	57.5	11.5	1.42	40	1.33	B	28.75	1.02	3.77
19.	***Fissidens ceylonensis* Dozy. & Molk.**	100	20	2.47	20	0.66	A	100	3.57	6.7
20.	***Fissidens crispulus* var *robinsonii* (Broth.) Z. Iwats.**	90	18	2.22	20	0.66	A	90	3.21	6.09
21.	***Fissidens griffithii* Gangulee**	20	4	0.49	20	0.66	A	20	0.71	1.86
22.	***Fissidens laxitextus* Broth. ex Gangulee.**	46.6	9.32	1.15	20	0.66	A	46.6	1.66	3.47
23.	***Fissidens mittenii* Par.**	41.2	8.24	1.01	40	1.33	B	20.6	0.73	3.07
24.	***Fissidens orishae* Gangulee**	50.6	10.12	1.25	60	2	C	16.86	0.60	3.85
25.	***Fissidens polysetulus* Mull Hal. ex Nork & Gangulee**	60	12	1.48	60	2	C	20	0.71	4.19
26.	***Fissidens pulchellus* Mitt.**	15.5	3.1	0.38	40	1.33	B	7.75	0.27	1.98
27.	***Fissidens semiperfalcatus* Dixon.**	15	3	0.37	20	0.66	A	15	0.53	1.56
28.	***Fissidens flaccidus* Mitt.**	10	2	0.24	20	0.66	A	10	0.35	1.25
29.	***Fissidens virens* Thwait ex Mitt.**	36.5	7.3	0.90	80	2.66	D	9.12	0.32	3.88
30.	***Fissidens xiphioides* M. Fleisch.**	29	5.8	0.71	20	0.66	A	29	1.03	2.4

31.	***Fissidens zollingeri* Mont.**	39.8	7.96	0.98	80	2.66	D	9.95	0.35	3.99
32.	***Fissidens* sp1**	14	2.8	0.34	40	1.33	B	7	0.25	1.92
33.	***Frullania ericoides* (Nees) Mont.**	37.8	7.56	0.93	40	1.33	B	18.9	0.67	2.93
34.	***Garckea phascoides* (Hook.) C. Müll. Hal.**	49.5	9.9	1.22	80	2.66	D	12.3	0.43	4.31
35.	***Gemmabryum apiculatum* (Schwagr.) J.R. Spence & H.P. Ramsay**	100	20	2.47	20	0.66	A	100	3.57	6.7
36.	***Gemmabryum klinggraeffii* (Schimp.) J.R. Spence & H.P. Ramsay**	57	11.4	1.40	20	0.66	A	57	2.03	4.09
37.	***Heteroscyphus argutus* (Nees) Schiffner.**	60.8	12.16	1.50	60	2	C	20.26	0.72	4.22
38.	***Hydrogonium consanguineum* (Thwaites & Mitt.) Hilp.**	50.9	10.18	1.25	40	1.33	B	25.45	0.90	3.48
39.	***Hydrogonium javanicum* (Dozy. & Molk.) Hilp.**	36	7.2	0.89	20	0.66	A	36	1.28	2.83
40.	***Hyophila involuta* (Hook.) A. Jaeger**	96.5	19.3	2.38	40	1.33	B	48.25	1.72	5.43
41.	***Hyophila nymaniana* (M. Fleisch.) M. Menzel.**	59.7	11.94	1.47	40	1.33	B	29.85	1.06	3.86
42.	***Jackiella javanica* Schiffn. var *cordifolia***	89	17.8	2.20	20	0.66	A	89	3.17	6.03
43.	***Jungermannia gollanii* Stephani**	77.5	15.5	1.91	20	0.66	A	77.5	2.76	5.33
44.	***Jungermannia tetragona* Lindenb.**	78.8	15.76	1.94	60	2	C	26.26	0.93	4.87
45.	***Lejeunea anisophylla* Mont.**	20	4	0.49	40	1.33	B	10	0.35	2.17
46.	***Lejeunea* sp 1**	25.7	5.14	0.63	40	1.33	B	12.85	0.45	2.41
47.	***Lopholejeunea abortiva* (Mitt.) Stephani**	41.2	8.24	1.01	60	1.33	C	13.73	0.49	2.83
48.	***Lopholejeunea* sp1**	43.6	8.72	1.07	80	2.66	D	10.9	0.38	4.11
49.	***Marchantia emarginata* Reinw., Blume et Nees subsp. *emarginata***	56.8	11.36	1.40	40	1.33	B	28.4	1.01	3.74
50.	***Marchantia papillata* subsp. *grossibarba* (Stephani) Bischl.**	70.5	14.1	1.74	60	2	C	23.5	0.83	4.57
51.	***Mastigolejeunea humilis* (Gottsche) Schiffner**	42.6	8.52	1.05	60	2	C	14.2	0.50	3.55
52.	***Mastigolejeunea repleta* (Taylor) A. Evans.**	71.2	14.24	1.76	20	0.66	A	71.2	2.54	4.96
53.	***Microdus assamicus* Dixon**	26	5.2	0.64	40	1.33	B	13	0.46	2.43
54.	***Mitthyridium fasciculatum* subsp *cardotii* (M. Fleisch)**	10	2	0.24	20	0.66	A	10	0.35	1.25
55.	***Notoscyphus paroicus* Schiffner**	85.5	17.1	2.11	60	2	C	28.5	1.01	5.12
56.	***Octoblepharum albidum* Hedw.**	49	9.8	1.17	40	1.33	B	24.5	0.87	3.37
57.	***Oxystegus cylindrothecus* (Mitt.) Gangulee**	36.8	7.36	0.90	20	0.66	A	36.8	1.31	2.87
58.	***Pallavicinia lyelli* (Hook.) Gray.**	86.5	17.3	2.17	60	2	C	28.8	1.02	5.19
59.	***Philonotis leptocarpa* Mitt.**	18	3.6	0.44	20	0.66	A	18	0.64	1.74

60.	***Philonotis mollis* (Dozy & Molk.) Mitt.**	100	20	2.47	20	0.66	A	100	3.57	6.7
61.	***Philonotis turneriana* (Schwaegr.) Mitt.**	31.5	6.3	0.77	40	1.33	B	15.75	0.56	2.66
62.	***Plagiochila sciophila* Nees ex Lindenb.**	79	15.8	1.95	40	1.33	B	39.5	1.41	4.69
63.	***Pseudosymblepharis bombayensis* (Müll. Hal.) P. Sollman**	18.75	3.75	0.46	20	0.66	A	18.75	0.66	1.78
64.	***Radula obscura* Mitt.**	12.5	2.5	0.30	20	0.66	A	12.5	0.44	1.4
65.	***Riccia crispatula* Mitt.**	40	8	0.98	20	0.66	A	40	1.42	3.06
66.	***Riccia plana* Taylor.**	22.5	4.5	0.55	20	0.66	A	22.5	0.80	2.01
67.	***Riccia sorocarpa* Bisch.**	100	20	2.47	20	0.66	A	100	3.57	6.7
68.	***Schiffneriolejeunea indica* (St.) Udar & Awasthi.**	12.5	2.5	0.30	20	0.66	A	12.5	0.44	1.4
69.	***Solenostoma clavellatum* Mitt. ex Stephani**	15	3	0.37	20	0.66	A	15	0.53	1.56
70.	***Solenostoma hyalinum* (Lyell) Mitt.**	95	19	2.34	20	0.66	A	95	3.39	6.39
71.	***Solenostoma torticalyx* (Stephani) C. Gao**	10	2	0.24	20	0.66	A	10	0.35	1.25
72.	***Solmsiella biseriata* (Austin) Steere**	14	3	0.37	20	0.66	A	14	0.50	1.53
73.	***Stereophyllum ligulatum* A. Jaeger.**	88	17.6	2.17	40	1.33	B	44	1.57	5.07
74.	***Taxiphyllum taxirameum* (Mitt.) M. Fleisch.**	60	12	1.48	20	0.66	A	60	2.14	4.28
75.	***Thuidium venustulum* Besch.**	30	6	0.74	40	1.33	B	15	0.53	2.6
76.	***Trichosteleum boschii* (Dozy. & Molk.) A. Jaeger**	42	8.4	1.03	20	0.66	A	42	1.50	3.19
77.	***Trocholejeunea sandvicensis* Mizut.**	15	3	0.37	20	0.66	A	15	0.53	1.56
78.	***Vesicularia levieri* Cardot**	80	16	1.97	20	0.66	A	80	2.85	5.48
79.	***Vesicularia montagnei* (Schimp.) Broth.**	80	16	1.97	20	0.66	A	80	2.85	5.48
80.	***Weissia controversa* Hedw.**	36	7.2	0.89	20	0.66	A	36	1.28	2.83
			808.85	**98.34**	**3000**	**100.27**		**2799.7**	**99.57**	**298.18**

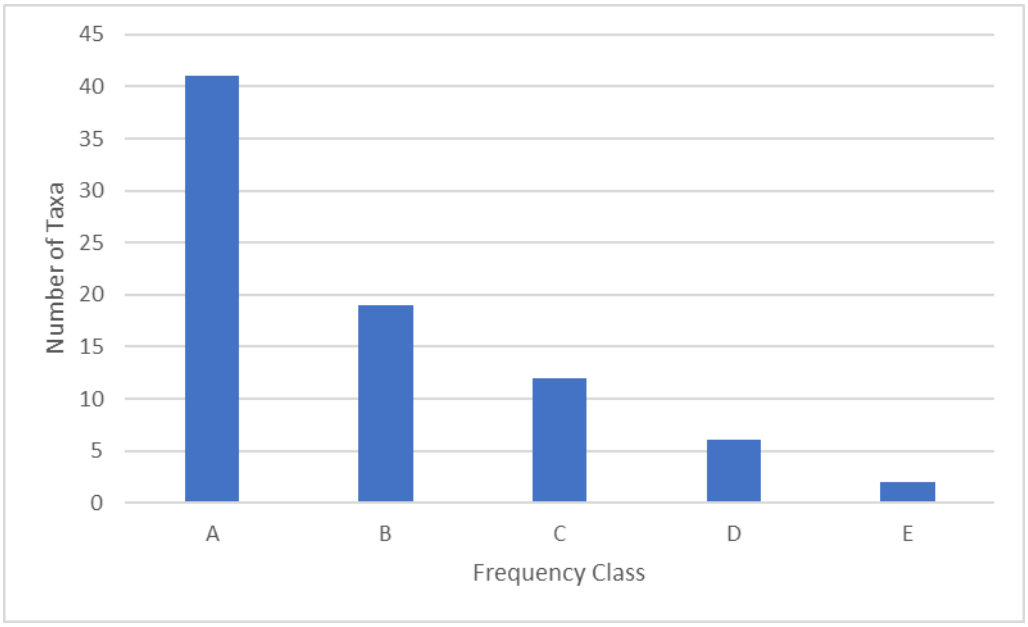

Fig 1: showing distribution of species in respective classes.

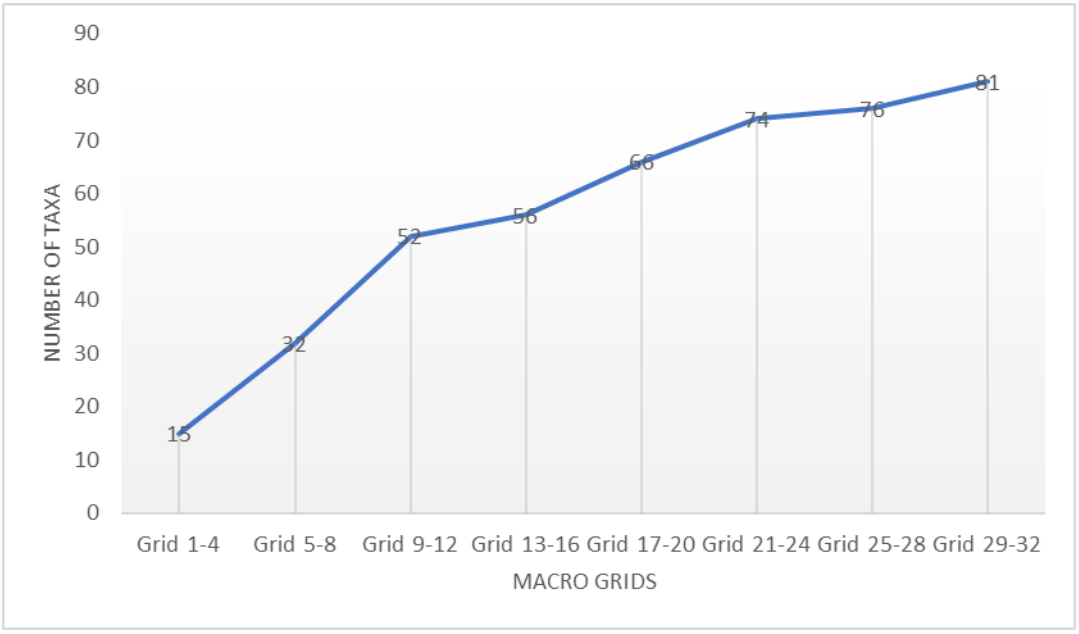

Fig 2: showing species area curve.

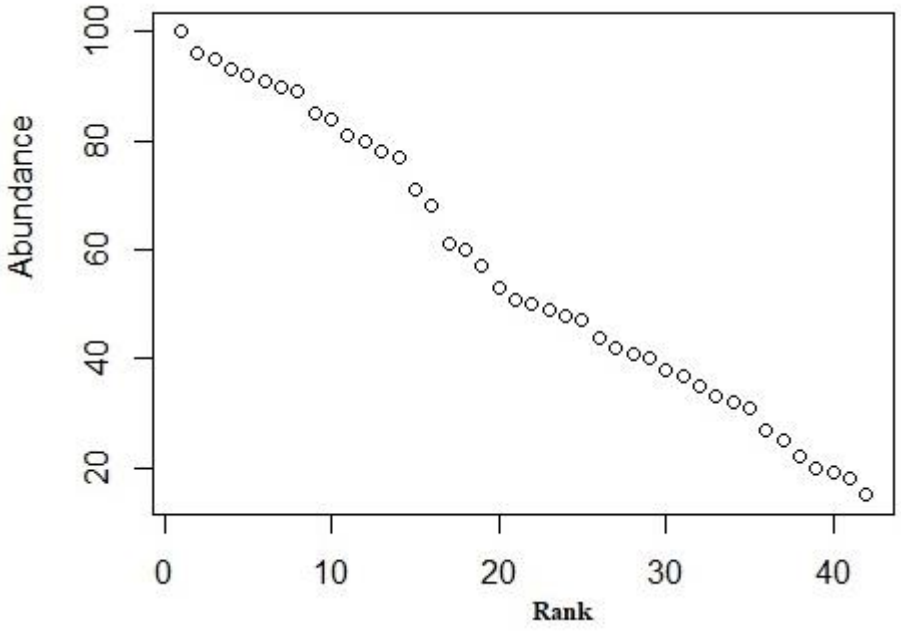

Fig 3: showing Whittaker plot or rank abundance curve.