

Diversity and local status of bryophytes in Mai pokhari of Ilam district, east Nepal

Nirmala Pradhan¹✉ and Ragnhild Heimstad²

¹Natural History Museum, Tribhuvan University, Swayambhu, Kathmandu, Nepal

²Multiconsult ASA, Nedre Skoeyenvei 2, 0276 Oslo, Norway

bryonep@yahoo.com

ABSTRACT

Bryophytes in Mai Pokhari area of Ilam District, east Nepal was studied in September 2013 to investigate species diversity and status. A total of 42 bryophytes were compiled occurrence status. *Plagiochila exigua* (Taylor) Taylor, *Dicranella setifera* (Mitt.) A. Jaeger, *Trematodon kurzii* Hampe ex Gangulee and *Pseudobarbella niitakayamensis* Nog. recorded in this study are new additions to Nepal. Wet and damp areas around this lake are suitable habitats for the sporophytic growth of many bryophyte species.

Keywords: sporophyte, new record, habitat, lake, Ilam

INTRODUCTION

Bryophytes, non-flowering plants, are widely distributed at various geographical localities in the tropical to the Himalayan bioclimatic zones of Nepal. The gametophyte stage of this group of plants shows dominance in their life cycle while the sporophyte stage is short lived showing distinct alternation of generations. The unbranched sporophyte produces a single terminal sporangium bearing spores in it. In average, the size of this plant varies from 0.5 mm to 166 cm long (Pradhan, 2015).

The diverse distribution patterns of bryophytes are mainly due to their greater dispersal capacity through the minute spores present in their capsules. The elaters in Hepaticae and peristome teeth in Musci play significant role for the dispersal of spores. The favorable conditions of environment like humidity and precipitation contribute for the luxuriant growth of this group of plants in nature. In Nepal, their distribution pattern and diversity change has remarkably been displayed from the lowest elevation of 62 m to 6,500 m in the Himalayan Zone (Pradhan, 2015). The species richness of this plant is highest in the temperate region which remains a transition zone for the subtropical and subalpine species. Most of the endemic species have been recorded in this region (Grau *et al.*, 2007).

In Nepal, bryophytes have been studied mostly from Central Nepal. Few studies on bryophytes in east Nepal are available. Thirty-three moss species were reported from the entire Ilam district (Higuchi & Takaki, 1990). Ilam district is important as it has Mai Pokhari lake from where *Sphagnum nepalensis* (Sphagnaceae), an endemic peat moss floating on the surface of the lake water was reported. Compared to the reports of 10 chlorophacean algae, 30 pteridophytes, 8 gymnosperms, and 197 angiosperms (monocots, 30 pteridophytes (Rai, 2009; Bhattarai, 2073), only 3 bryophytes (*Marchantia* sp., *Sphagnum nepalense* and *Funaria*

sp.) were reported from Maipokhari Ramsar site by Bhattarai (2073). To enrich knowledge on bryophytes of this important Ramsar site, a study has been carried out to list the species diversity and status.

MATERIALS AND METHODS

Study area

Mai Pokhari, a small temperate lake with an area of 90 hectare is situated at 2,240 m of elevation in Ilam district of east Nepal. Natural springs and rains are the main water sources for this lake system (DPR, 2015). Situated at its geographical stand of 27° 25' N and 87°55' E, this lake was registered as Ramsar Site in October 8, 2008. The main flora around this lake includes *Schima wallichii*, *Castanopsis*, *Pinus*, *Rhododendron* species etc and many epiphytic orchids.

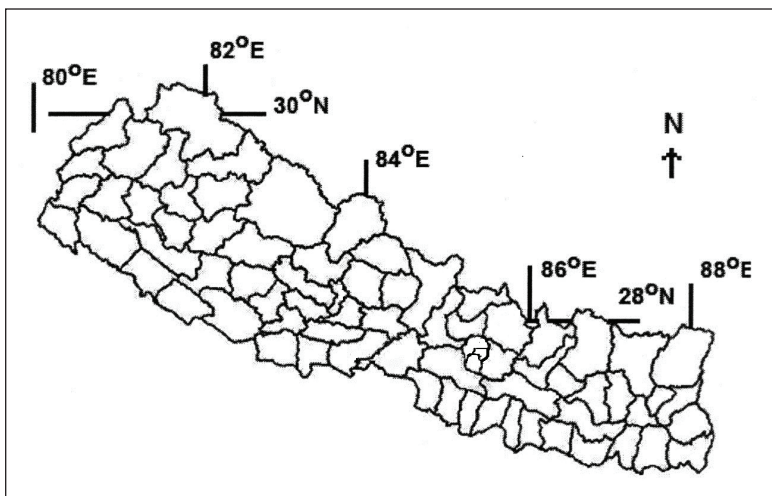


FIG. 1. Circular mark in the Map of Nepal indicates the study area.

Specimens of bryophytes were collected in the month of September of 2013 from different habitats like shaded marshy earth, acidic soil, exposed ground, stone edges, temple wall, tree canopy and tree trunks of Maipokhari, Ilam. A simple pocket knife was used to collect specimens at different habitat types. Hand lens with magnifying power 5-40 x was used for field identification. Local status of each collected specimens were noted as common, fairly common, and rare.

All the collected specimens were identified with the help of relevant literatures (such as Eddy, 1988, 1990 1996; Gangulee, 1969-1980; Chopra, 1975; Pradhan, 2000; So, 1995; Zyu & So, 1996; Smith, 1996; Yang, 2011) at the Natural History Museum using compound microscope of 5-40 magnifying power with eye-piece 15 and ocular micrometer for measuring cell size, spores and other microscopic organs. The magnifying and microscopic photographs were also taken in the laboratory (fig.4, 5).

Brummitt & Powell (1992) and W³TROPICOS were followed for scientific names and author

citations. Identified specimens were preserved in paper packets with well label field data and deposited at the Natural History Museum, Kathmandu with accession numbers of museum for future references.

RESULTS AND DISCUSSION

Species diversity

A total of 42 species of bryophytes belonging to two classes viz. Hepaticae and Musci were recorded from Maipokhari, Ilam, Nepal (appendix I). Of the recorded species, class Hepaticae was represented by 13 species belonging to 10 genera, 10 families and 3 orders. Class Musci showed higher diversity with 29 species under 28 genera, 19 families and 10 orders. Of the recorded Hepaticae, the order Jungermanniales included eight species with six families, Marchantiales represented three species of two families and Metzgeriales with two species in two families. The order Hypnobryales of Musci had high species diversity with the record of nine species under six families but orders like Hookeriales, Orthotrichales, Polytrichales and Sphagnales represented single species of one family only. Other orders like Dicranales represented three species of a single family, Eubryales with four species in two families, Fissidentales with two species in one family, Isobryales with four species in three families and Pottiales with three species in two families only (fig. 2, 3). Of the total genera, only three (*Plagiochila*, *Marchantia* and *Fissidens*) contained two or three species. Out of the total recorded species, *Plagiochila exigua* (Taylot) Taylor of Hepaticae and *Dicranella setifera* (Mitt.) A. Jaeger, *Trematodon kurzii* Hampe ex Gangulee and *Pseudobarbella niitakayamensis* Nog. of Musci were not reported previously from Nepal. *Epiphytic bryophytes like Frullania tamariscii*, *Plagiochila semidecurrrens*, *Bazzania tridens*, *Trachypodopsis serrulata*, *Syrrophodon gardneri*, *Entodon rubicundus*, etc. were also found in this lake area.

Status of bryophytes

Of the total records, nine species were found rare, one endemic, 16 species were fairly common and rest were common species considering their local status. One is typed specimen and four species were recorded new to country’s list. *Dicranella setifera* and *Trematodon kurzii* though common were not recorded before.

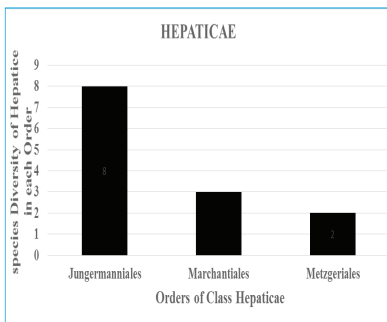


FIG. 2. Species diversity in the orders of Hepaticae class.

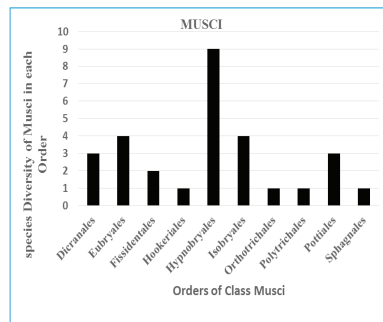


FIG. 3. Species diversity in the orders of Musci class.

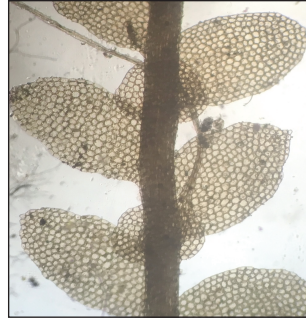
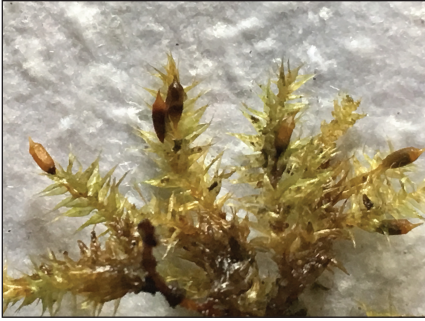


FIG. 4. *Pseudobarbella niitakayamensis* Nog. **FIG. 5.** *Metacalypogeia alternifolia* (Nees) Grolle.

The spread of invasive species, unmanaged constructions and human settlements are imposing direct impact on the habitat of many bryofloral species in this part. This has been observed that the *Sphagnum nepalensis* is losing its status as compared to previous study made in this lake (Pradhan, 2009).

Very little information is available on other aspects of this lake. Rai (2011) in his study revealed the lentic environment of Mai Pokhari lake where macro invertebrates were sampled periodically in two different years. This revealed the occurrence of good natural condition of this lake as indicated by the presence of higher bottom fauna. Department of Plant Resources (DPR, 2015) with an objective to promote tourism in this part has established an educational and plant research center which includes the entire Mai Pokhari forest garden.

Previous record of *Plagiochila exigua* was made by Long and Grolle (1990) in Bhutan. Higuchi and Takaki (1990) provided a list of 36 moss species of the entire Ilam district which covered the elevations of 1030-2000 m.

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REFERENCES

BHATTARAI, K R (2073) *Maipokhari kshetraka banaspatiharu* (English translation *Plants of Maipokhari areas*). Kathmandu: Department of Plant Resources.

BRUMMITT, R K; POWELL, C B (1992) *Authors of plant names*. Royal Botanic Garden, Kew, UK.

CHOPRA, R (1975) *Taxonomy of Indian mosses*. Bot. Monograph 10, Pubs. & Inf. Directorate; New Delhi, India.

DEGUCHI, H; HIGUCHI, M (1992) Mosses from Nepal collected by Botanical expeditions of National Science Museum, Tokyo. 2. *Grimmiaceae Mem Fac Sci Kochi Univ ser D (Biol)* 13: 5–8.

DPR (2016). http://dpr.gov.np/gardens/maipokhari_botanical_garden,_ilam.

DPR (2015) *Mai Pokhari botanical garden*. Department of Plant Resources, Ministry of Forest Resources

and Soil Conservation. Retrieved 10 November 2015.

EDDY, A (1988) *A handbook of Malaysian mosses I*. London: British Museum (Natural History).

EDDY, A (1990) *A handbook of Malaysian mosses II*. London: British Museum (Natural History).

EDDY, A (1996) *A handbook of Malaysian mosses III*. London: British Museum (Natural History).

GANGULEE, H C (1969-1980) *Mosses of eastern India and adjacent regions*. Fasc. 1–8. Published by the Author; Calcutta, India; pp 1–2145.

GRAU, O; J A; GRYTNES; BIRKS, H J B (2007) A comparison of altitudinal species richness patterns of bryophytes with other plant groups in Nepal, Central Himalaya. *Journal of Biogeography* 34: 1907–1915.

HIGUCHI, M; TAKAKI, N (1990) Mosses from Nepal collected by botanical expedition of National Science Museum, Tokyo. In WATANABE, M; MALLA, S B (eds) *Cryptogams of the Himalayas, central and eastern Nepal 2*: 121–161.

https://en.wikipedia.org/wiki/List_of_club-mosses_and_mosses_of_Montana

LONG, D G; GROLLE, R (1990) Hepaticae of Bhutan II. *Journ Hattori Bot Lab* 68: 381–440.

PRADHAN, N (2009) Important of Sphagnum moss in environment, society and industry *Hamro Sampada*, 9(1): 72–73 (B.S. 2066) (in Nepali).

PRADHAN, N (2000) *Materials for a checklist of bryophytes of Nepal*. The Natural History Museum (BM), London, UK.

PRADHAN, N (2015) Bryophytes of Nepal. In JHA, P K; RAJBHANDARY, S (eds) *Frontier's of botany*. Central Department of Botany, Tribhuvan University, Nepal; pp 100–123.

PRADHAN, N (2014) Three new records of *Jungermannia* species (Hepaticae, Jungermanniales) from Nepal. *International Journal of Environment* 3(1): 85–92.

RAI, K R (2011) Comparative studies on lentic environment of Mai Pokhari, Ilam and Kechana jheel wetland ecosystems, Jhapa, Nepal (with reference to bottom dwelling fauna). *Nepalese Journal of Biosciences* 1: 32–36.

RAI, S K (2009) Some chlorophycean algae from Maipokhari lake, Ilam, east Nepal. *Journal of Natural History Museum* 24: 1–8.

SMITH, A J E (1996) *Liverworts of Britain and Ireland*. Cambridge University Press, Cambridge, UK.

SO, M L (1995) *Mosses and liverworts of Hong Kong I*. Heavenly People Depot, Hong Kong.

W³TROPICOS www.tropicos.org.

YANG, J D (2011) *Liverworts and hornworts of Taiwan II*. National Science Council, Taiwan.

ZYU, R L; SO, M L (1996) *Mosses and liverworts of Hong Kong II*. Heavenly People Depot, Hong Kong.

APPENDIX I

Bryophytes collected from Maipokhari, Ilam, East Nepal in September 2013 (Abbreviations: C= Common; E= Endemic; FC: Fairly Common; R= Rare; N= New)

S.N.	Scientific name	Family	Order	Local status	Accession no.
Hepaticae (A)					
1.	<i>Aneura indica</i> Steph.	Aneuraceae	Metzgeriales	R	NHMA556b
2.	<i>Bazzania tridens</i> (Reinw., Blume & Nees) Trevis.	Lophoziaceae	Jungermanniales	FC	NHMA561
3.	<i>Cephalozia bicuspidata</i> L. Dumort.	Cephaloziaceae	Jungermanniales	R	NHMA571
4.	<i>Dumortiera hirsuta</i> (Sw.) Nees	Wiesnerellaceae	Marchantiales	C	NHMA554
5.	<i>Frullania tamarisci</i> (L.) Dumort.	Frullaniaceae	Jungermanniales	C	NHMA553, NHMA562
6.	<i>Lejeunea flava</i> (Sw.) Nees	Lejeuneaceae	Jungermanniales	FC	NHMA564
7.	<i>Marchantia emarginata</i> Reinw., Blume & Nees	Marchantiaceae	Marchantiales	C	NHMA558
8.	<i>Marchantia paleacea</i> Bertol.	Marchantiaceae	Marchantiales	C	NHMA570
9.	<i>Matacalypogeia alternifolia</i> (Nees) Grolle	Calypogeaceae	Jungermanniales	R	NHMA552
10.	<i>Pellia epiphylla</i> (L.) Corda	Pelliaceae	Metzgeriales	R	NHMA563
11.	<i>Plagiochila exigua</i> (Taylor) Taylor	Plagiochilaceae	Jungermanniales	FC/N	NHMA560
12.	<i>Plagiochila killarniansis</i> Pears.	Plagiochilaceae	Jungermanniales	FC	NHMA556a
13.	<i>Plagiochila semidecurrans</i> (Lehm. & Lindenbg.) Lindenbg.	Plagiochilaceae	Jungermanniales	Type Nepal	NHMA555, NHMA559

Musci (B)						
14.	<i>Aerobryidium filamentosum</i> (Hook.) M. Fleisch.	Meteoriaceae	Isobryales	FC	NHMB703	
15.	<i>Anomobryum filiforme</i> var. <i>concinatum</i> (Spruce) Loeske	Bryaceae	Eubryales	C	NHMB707	
16.	<i>Brachymnium longicollis</i> Ther.	Bryaceae	Eubryales	C	NHMB708	
17.	<i>Brachythecium rutabulum</i> (Hedw.) B.S.G.	Brachytheciaceae	Hypnobryales	C	NHMB725	
18.	<i>Campylopus subgracillis</i> Ren. & Cardot	Dicranaceae	Dicranales	R	NHMB735	
19.	<i>Daltonia marginata</i> Griff.	Hookeriaceae	Hookeriales	R	NHMB704	
20.	<i>Dicranella setifera</i> (Mitt.) A. Jaeger	Dicranaceae	Dicranales	FC/N	NHMB727	
21.	<i>Entodon rubicundus</i> (Mitt.) A. Jaeger	Entodontaceae	Hypnobryales	FC	NHMB721	
22.	<i>Fissidens arolatus</i> Griff.	Fissidentaceae	Fissidentales	FC	NHMB713	
23.	<i>Fissidens zippilianus</i> Dozy & Molk.	Fissidentaceae	Fissidentales	C	NHMB706	
24.	<i>Hydrogonium arcuatum</i> (Griff.) Wijk. & Margad.	Pottiaceae	Pottiales	C	NHMB740	
25.	<i>Hyophila involuta</i> (Hedw.) A. Jaeger	Pottiaceae	Pottiales	FC	NHMB710	
26.	<i>Hypnum cupressiforme</i> Hedw.	Hypnaceae	Hypnobryales	C	NHMB726	
27.	<i>Isopterygium eligans</i> (Hook.) Lindb.	Hypnaceae	Hypnobryales	FC	NHMB719	
28.	<i>Macromitrium moorcroftii</i> (Hook. & Grev.) Schwaegr.	Orthotrichaceae	Orthotrichaeles	FC	NHMB711, NHMB722	
29.	<i>Mnium succulentum</i> Mitt.	Mniaceae	Eubryales	FC	NHMB709, NHMB730	
30.	<i>Plagiothecium neckroideum</i> B.S.G.	Plagiotheciaceae	Hypnobryales	C	NHMB714	
31.	<i>Pogonatum macrophyllum</i> Dozy & Molk.	Polytrichaceae	Polytrichales	FC	NHMB717	
32.	<i>Pseudobarbella nitakayamensis</i> Nog.	Meteoriaceae	Isobryales	R/N	NHMB705	
33.	<i>Ptychomitrium tortula</i> (Harv.) A. Jaeger	Ptychomitriaceae	Isobryales	FC	NHMB728	

34.	<i>Rhodobryum giganteum</i> Hedw.	Bryaceae	Eubryales	C	NHMB718
35.	<i>Sematophyllum subhumile</i> (C. Muell.) A. Jaeger	Sematophyllaceae	Hypnobryales	FC	NHMB731
36.	<i>Sphagnum nepalensis</i> H. Suzuki	Sphagnaceae	Sphagnales	E	NHMB702
37.	<i>Syrrophodon gardneri</i> (Hook.) Schwaegr.	Calympereaceae	Pottiales	C	NHMB720, NHMB723
38.	<i>Taxiphyllum taxirameum</i> (Mitt.) M. Fleisch.	Hypnaceae	Hypnobryales	C	NHMB715
39.	<i>Taxithelium nepalensis</i> (Schwaegr.) Broth.	Sematophyllaceae	Hypnobryales	FC	NHMB739
40.	<i>Thuidium sparsifolium</i> (Mitt.) A. Jaeger	Thuidaceae	Hypnobryales	R	NHMB734
41.	<i>Trachypodopsis serrulata</i> (P. Beauv.) M. Fleisch.	Trachypodaceae	Isobryales	C	NHMB712, NHMB716, NHMB729
42.	<i>Trematodon kurzii</i> Hampe ex Gangulee	Dicranaceae	Dicranales	FC/N	NHMB733