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Biodiversity of Rotifera in some tropical floodplain lakes of the Brahmaputra river basin, Assam (N.E. India)

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Abstract

One hundred and sixteen species of Rotifera are recorded from seven floodplain lakes of the Brahmaputra basin (northeastern India), the highest rotifer biodiversity recorded from these biotopes in the Indian subcontinent to date. The Australasian *Brachionus dichotomus reductus* and *Lecane batillifer*; the Oriental *Keratella edmondsoni, Lecane blachei* and *L. acanthinula;* the Palaeotropical *Lecane braumi, L. lateralis, L. unguitata, Trichocerca tropis, Testudinella greeni* and *T. brevicaudata;* the Pantropical *Brachionus donneri* and a rather widely distributed *Horaella brehmi* represent taxa of biogeographical interest. Three species are new additions to the Indian rotifer fauna and eight are new to the N.E. region. Lecanidae > Brachionidae = Colurellidae > Trichocercidae > Testudinellidae comprise the largest fraction (68.0%) of the examined fauna. Comments are made on the general nature and composition of the rotifer taxocoenosis as well as on acidophilic elements, ecology of various taxa and on the species richness of different lakes.

Introduction

Floodplain lakes comprise an important component (Sugunan, 1997) of inland aquatic resources of India (over 0.20 million ha) and its North-Eastern region (0.12 million ha). They cover about 93% of the total lentic fish-prone area of Assam state (Goswami, 1997). Very little is, however, known about their zooplankton diversity in general and that of Rotifera in particular (Sharma, 1996, 1998). Our knowledge of the qualitative richness of rotifers in these biotopes of Assam is to date confined to a number of unpublished works (Lahon, 1983; Goswami, 1985; Yadava, 1987; Goswami, 1997).

The present study deals with the biodiversity of Rotifera in seven floodplain lakes of the Brahmaputra basin, Assam (N.E. India) with special reference to the general nature and composition of the taxocoenosis, biogeography and ecology as well as to their species richness and community similarities between different lakes.

Materials and methods

Seven floodplain lakes (locally called *beels)* of the Brahmaputra basin (Fig. 1A–C) Assam State (N.E. India) were studied. Of these, five, namely Puwa Saikia 1, Puwa Saikia 2, Kunwari, Butikor and Batua (94° 56′ E; 26° 75′ N) are located in the Dhemaji district of Upper Assam, Dhir beel (90° 50′ E; 26° 25′ N) is located in the Dhubri district and Dighali beel (91° 80′ E; 26° 28′ N) is located in the Kamrup district. Water and qualitative plankton samples were collected from the beels during summer (May), monsoon (July), post-monsoon (October) and winter (January) seasons during 1994–1995. Water samples were analyzed for temperature, specific conductivity, pH, dissolved oxygen and total alkalinity. Plankton samples were obtained by towing a nylobolt plankton net (No. 25; 50 μm) and preserved in 5% formalin. These samples were screened, various rotifer taxa isolated, and identified following Kutikova (1970), Koste (1978) and Segers (1995). Percentage similar-

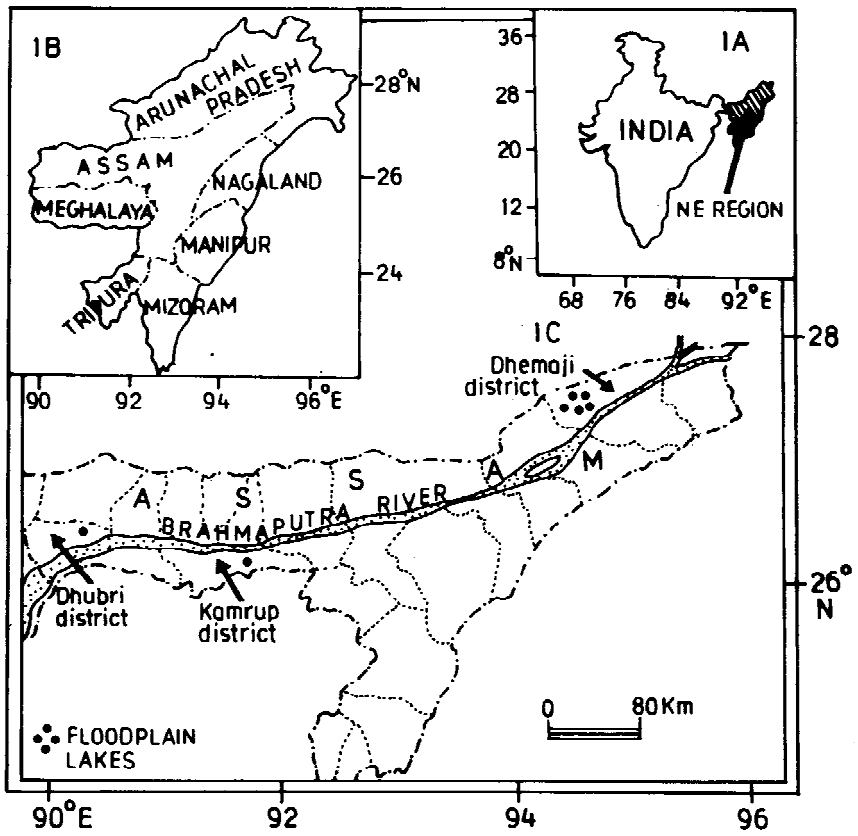

Figure 1. (A) Map of India showing North-Eastern Region. (B) Different states of North-Eastern India. (C) Map of Assam State showing various (seven) floodplain lakes.

ities between the rotifer communities of the different floodplain lakes were calculated *vide* Sorensen's index (Sorensen, 1948).

Results and discussion

The present study reveals distinct variations in abiotic factors (Table 1) in the different beels; all these ecosystems, however, can be assigned to 'Class I' category *vide* Talling & Talling (1965). Puwa Saikia 1 and Puwa Saikia 2 indicate distinctly low ionic concentrations and low total alkalinity and, hence, depict 'very soft-acidic waters'. Dhir and Dighali are grouped by their 'soft-slightly acidic to alkaline waters'. Kunwari beel exhibits 'acidic hard water' character while Butikor and Batua beels show 'slightly acidic to slightly alkaline hard waters'. The specific conductivity and alkalinity values of all the beels are notably lower than those from the Kashmir valley (Khan, 1987), West Bengal (Vass, 1989) and Bihar (Singh & Roy, 1990). Water temperature varies within a range expected for water bodies in tropical regions and dissolved oxygen concentrations correspond with values recorded earlier from upper Assam (Sharma & Hussain, 1999).

Segers et al. (1993) hypothesize that (sub) tropical floodplains are the world's richest habitats for rotifers. The present report (116 species) from seven beels of the Brahmaputra basin (Table 2) supports this generalization as these biotopes contain the richest rotifer fauna ever recorded from the Indian subcontinent. The examined taxocoenosis is rich and diversified; the documented species comprise about 35% of the Indian Rotifera, about 80% of the fauna of North-Eastern India and raise the species record from this region to 145. Species richness is, however, relatively lower than in the floodplains of the river Niger, Nigeria (Segers et al., 1993) but nearly equals to the report of 118 species in the floodplains of the river Nan, northern Thailand (Sanoamuang, 1998). Interestingly, all 34 genera and 19 Eurotatorian families recorded to date from the N.E. region are represented in the present study and the generic and family diversity is,

Table 1. Variations in certain abiotic factors in different floodplain lakes

Abiotic factors	Water temp. (°C)	Specific Conductivity (μS cm^{-1})	pH	Dissolved oxygen (mg l^{-1})	Alkalinity (mg l^{-1})
Floodplain lakes:					
Puwa Saikia 1	17–29	21–32	5.0–6.6	4.0–6.4	16–22
Puwa Saikia 2	18–29	22–33	5.0–6.7	4.0–6.4	14–21
Dhir	18–32	71–131	6.4–7.4	5.2–10.2	17–58
Dighali	18–30	56–94	6.5–7.2	4.3–9.2	28–45
Kunwari	20–33	110–123	5.0–6.8	4.8–9.6	50–76
Butikor	18–32	106–162	5.0–7.2	4.8–6.4	68–108
Batua	21- 32	136–184	6.5–7.5	3.2–10.4	86–110

therefore, rich in comparison with 60 genera and 25 families of Rotifera reported till now from India. In addition, *Lepadella lindaui, L. minoruoides* and *Filinia camasecla* are new records for this country while five other species namely *Keratella edmondsoni, Lecane blachei, Trichocerca tropis, Sinantherina spinosa* and *Filinia saltator* represent new records for the region.

The qualitative importance of two 'tropic-centred' genera namely *Lecane* and *Brachionus* imparts general tropical character to the rotifer taxocoenosis. In fact, the former genus alone accounts for 25.8% of the overall diversity as well as in individual beels (24.1–29.6%); such a feature compares well with its 26.9% and 28.5% contributions to the floodplain lakes of upper Assam (Sharma, unpublished data) and of the river Niger (Segers et al., 1993), respectively. The lecanid richness, however, corresponds with habitats in the floodplain of the Parana river, Brazil (Bonecker et al., 1994) and that of the river Nan, Thailand (Sanoamuang, 1998) but is in striking contrast to low *Lecane* richness in some beels of lower Assam (Lahon, 1983; Goswami, 1985, 1997). The tropical nature of the studied rotifer fauna is further supported by the low number of species of 'temperate-centred' *Keratella* (4 species) and *Synchaeta* (1 species), qualitative predominance of cosmopolitan species (64.7%) and high diversity of pantropical/cosmotropical elements (22.4%). All the stated aspects corroborate with salient features of many tropical rotifer faunas from different parts of the globe (Green, 1972; Pejler, 1977; Fernando, 1980; Dumont, 1983; Dussart et al., 1984; Sanoamuang et al., 1995; Sharma, 1996, 1998; Segers, 1996).

Biogeographically interesting elements constitute an important fraction (13%) of the rotifer fauna. Two Australasian elements, *Brachionus dichotomus reductus* and *Lecane batillifer* and the Palaeotropical *Testudinella greeni*, deserve special interest and are to date restricted to North-Eastern India. Comments on the distribution of *L. batillifer* were made by Sharma & Sharma (1997), while Sharma (1990) remarked on the occurrence of *T. greeni.* The present report comprises the second record of the last two species from India. In addition, this study includes three Oriental species - *Keratella edmondsoni, Lecane blachei* and *L. acanthinula.* Of these, the distributional ranges of *K. edmondsoni* and *L. blachei* are presently extended to the N.E. region. Furthermore, our material indicates five other Palaeotropical species i.e., *Lecane braumi, L. lateralis, L. unguitata, Trichocerca tropis* and *Testudinella brevicaudata*. Remarks on the distribution of the first three lecanids were made by Sharma & Sharma (1997) while the remaining species were commented on by Segers et al. (1993). The Pantropical *Brachionus donneri,* the Arctic-temperate *Dicranophorus luetkeni* as well as rather widely distributed *Trichocerca cylindrica* and *Horaella brehmi* also are interesting species; *T. cylindrica* occurs in Arctic-temperate, Oriental and Australian regions while *H. brehmi* is recorded from Palaearctic, Oriental, Australian and Neotropic regions.

Lecanidae (30 species) >Brachionidae (16 species) = Colurellidae (16 species) >Trichocercidae (10 species)>Testudinellidae (8 species), in the stated order, comprise the largest component (68.0%) of overall rotifer biodiversity and of the communities in the individual beels (64.8–72.2%). Such a pattern is in general confirmity with the composition of Indian Rotifera and also with the findings of Segers et al. (1993). The present report of 116 species is in distinct contrast to 64 species from five floodplain lakes of upper Assam (Sharma, unpublished data) but depicts about

Table 2. Species composition of Rotifera in different floodplain lakes

Floodplain lakes	1	2	3	4	5	6	7
Family: Brachionidae							
Anuraeopsis fissa (Gosse)	−	−	+	+	+	−	−
A. coelata (De Beauchamp)	−	−	−	−	+	+	−
Brachionus angularis Gosse	−	−	−	−	+	+	−
B. bidentatus Anderson	+	+	−	+	−	−	+
B. dichotomus reductus Koste & Shiel	−	−	+	−	+	−	+
B. diversicornis (Daday)	−	−	+	+	+	−	−
B. donneri Brehm	+	+	−	+	−	−	−
B. falcatus Zacharias	−	+	+	+	+	+	+
B. forficula Wierzejski	−	−	+	−	+	−	+
B. quadridentatus (Hermann)	+	+	+	+	+	+	+
Keratella cochlearis Gosse	+	+	+	+	+	+	+
K. edmondsoni (Ahlstrom)	−	−	+	−	−	+	−
K. tropica (Apstein)	+	+	+	+	−	−	+
K. lenzi Hauer	+	+	−	−	−	+	+
Platyias quadricornis (Ehrenberg)	+	+	+	+	−	+	+
Plationus patulus (Müller)	+	+	+	+	+	+	+
P. patulus macracanthus (Daday)	+	+	−	−	+	−	+
Family: Euchlanidae							
Euchlanis dilatata Ehrenberg	+	+	+	+	+	+	+
E. incisa Carlin	+	−	+	+	−	−	−
E. triquetra Ehrenberg	−	+	−	+	−	−	−
Dipleuchlanis propatula (Gosse)	+	+	−	+	+	+	+
Manfredium eudactylotum Gosse	+	−	+	+	+	−	+
Family: Mytilinidae							
Lophocharis salpina (Ehrb.)	−	−	+	−	−	−	+
Mytilina acanthophora Hauer	−	−	−	+	−	−	−
M. bisulcata (Lucks)	+	+	−	−	−	+	−
M. ventralis (Ehrenberg)	+	+	+	+	+	+	+
Family: Trichotriidae							
Macrochaetus collinsi (Gosse)	+	−	−	+	+	+	−
M. sericus (Thorpe)	+	+	+	−	−	+	+
Trichotria tetractis (Ehrenberg)	+	+	+	+	+	+	+
Family: Colurellidae							
Colurella obtusa (Gosse)	−	−	−	+	+	−	+
C. sulcata (Stenroos)	+	+	+	−	−	−	−
C. uncinata (Müller)	+	+	+	+	−	+	−
Lepadella acuminata (Ehrenberg)	−	+	+	+	−	−	+
L. apsida Harring	+	−	−	−	−	+	−
L. cristata (Rousselet)	+	+	−	+	+	−	−
L. lindaui Koste	−	−	−	−	+	−	−
L. minuta (Montet)	−	−	−	−	−	+	−
L. minoruoides Koste & Robertson	−	−	−	−	−	−	+
L. ovalis (Müller)	+	+	+	+	+	+	+
L. patella (Müller)	+	+	+	+	+	+	+

Continued on p. 309

Table 2. Continued

Floodplain lakes	1	2	3	4	5	6	7
L. rhomboides (Gosse)	+	+	+	+	−	+	−
L. triba Myers	−	−	−	−	+	−	−
L. triptera Ehrenberg	−	−	+	+	−	−	−
L. (Heterolepadella) ehrenbergi (Perty)	+	+	+	+	+	−	+
L. (H.) heterostyla (Murray)	+	+	−	+	+	+	−
Family: Lecanidae							
Lecane aculeata (Jakubski)	−	−	+	+	+	+	−
L. braumi Koste	+	+	−	−	−	−	−
L. curvicornis (Murray)	+	+	+	+	+	+	+
L. doryssa Harring	−	−	−	+	+	−	−
L. flexilis (Gosse)	+	+	+	+	−	−	+
L. hornemanni (Ehrenberg)	−	−	+	+	+	+	+
L. lateralis Sharma	−	−	+	−	−	−	+
L. leontina (Turner)	+	+	+	+	+	+	+
L. ludwigii (Eckstein)	+	+	−	−	+	+	+
L. luna (Müller)	−	+	+	+	+	+	+
L. nana (Murray)	−	−	+	+	−	−	+
L. ohioensis (Herrick)	−	−	+	−	−	+	−
L. papuana (Murray)	−	−	+	+	+	+	+
L. pertica Harring & Myers	−	+	−	−	+	+	−
L. signifera (Jennings)	+	+	−	+	−	−	+
L. ungulata (Gosse)	+	−	+	+	+	+	−
L. (Hemimonostyla) blachei Berzins	−	−	−	−	−	+	−
L. (H.) sympoda Hauer	−	−	+	+	−	−	+
L. (Monostyla) acanthinula (Hauer)	−	+	−	−	−	−	−
L. (M.) batillifer (Murray)	+	−	−	−	−	−	−
L. (M.) bifurca (Bryce)	+	−	−	−	−	+	−
L. (M.) bulla (Gosse)	+	+	+	+	+	+	+
L. (M.) closterocerca (Schmarda)	+	+	+	+	+	+	+
L. (M.) lunaris (Ehrenberg)	+	+	+	+	−	−	+
L. (M.) monostyla (Daday)	−	−	−	−	+	−	−
L. (M.) pyriformis (Daday)	−	−	+	+	−	−	−
L. (M.) quadridentata (Ehrenberg)	+	+	−	−	+	+	+
L. (M.) stenroosi (Meissner)	−	−	+	−	−	−	+
L. (M.) thienemanni (Hauer)	−	−	−	−	+	−	−
L. (M.) unguitata (Fadeev)	−	+	−	+	−	+	−
Family: Notommatidae							
Cephalodella forficula (Ehrenberg)	+	+	−	+	−	−	+
C. gibba (Ehrenberg)	−	−	+	+	−	+	−
C. mucronata Harring & Myers	+	−	+	−	+	−	−
Monommata longiseta (Müller)	−	−	−	−	+	+	−
Scaridium longicaudum (Müller)	−	−	+	+	−	−	+
Family: Gastropodidae							
Ascomorpha saltans Bartsch	−	+	−	−	−	−	+
A. ovalis (Bergendal)	−	−	+	+	−	−	−

Continued on p. 310

Table 2. Continued

Floodplain lakes	1	2	3	4	5	6	7
Family: Trichocercidae							
Trichocerca bicristata (Gosse)	+	−	−	+	−	−	−
T. braziliensis Murray	−	−	+	−	−	+	−
T. capucina (Wierzejski & Zacharias)	−	+	−	+	−	−	+
T. cylindrica (Imhof)	+	+	+	−	+	+	−
T. jenningsi Voigt	−	−	+	+	−	−	+
T. longiseta (Schrank)	+	+	−	+	−	−	−
T. rattus (Müller)	−	−	+	−	−	−	+
T. similis (Wierzejski)	+	+	−	−	+	+	−
T. tropis (Hauer)	−	−	−	−	−	+	−
T. weberi (Jennings)	−	−	−	−	+	−	+
Family: Asplanchnidae							
Asplanchna brightwelli Gosse	+	−	+	+	−	+	−
A. priodonta Gosse	−	−	+	−	+	−	+
Family: Synchaetidae							
Synchaeta oblonga Ehrenberg	−	−	−	−	−	+	−
Pleosoma lenticulare Herrick	−	+	−	−	−	−	−
Polyarthra vulgaris Carlin	+	+	+	+	+	+	+
Family: Dicranophoridae							
Dicranophorus forcipatus (Müller)	+	+	−	−	+	−	−
D. luetkeni (Bergendal)	−	−	−	−	−	+	−
Family: Floscularidae							
Sinantherina spinosa (Thorpe)	+	+	−	−	−	−	−
Family: Conochilidae							
Conochilus unicornis Rousselet	−	−	+	+	+	−	+
Family: Hexarthridae							
Hexarthra mira (Hudson)	−	−	+	+	+	+	−
Family: Filiniidae							
Filinia camasecla Myers	+	+	−	−	−	−	+
F. longiseta (Ehrenberg)	−	+	+	+	+	+	−
F. opoliensis (Zacharias)	−	−	+	+	−	−	−
F. saltator (Gosse)	−	−	−	−	+	+	−
Family: Testudinellidae							
Testudinella brevicaudata Yamammoto	−	−	−	−	−	−	+
T. emarginula (Stenroos)	+	+	+	+	−	+	−
T. greeni Koste	−	−	−	−	+	−	−
T. parva parva (Ternetz)	+	+	−	+	−	+	−
T. parva bidentata (Ternetz)	+	+	−	+	−	−	−
T. patina (Hermann)	+	+	+	+	+	+	+
T. tridentata Smirnov	−	−	+	−	+	−	−
Pompholyx sulcata Hudson	−	−	+	+	−	−	+

Continued on p. 311

Table 2. Continued

Floodplain lakes	1	2	3	4	5	6	7
Family: Trichosphaeridae							
Horaella brehmi Donner	–	+	–	–	–	–	–
Family: Philodinidae							
Philodina citrina (Ehrenberg)	–	+	+	–	–	–	+
Rotaria neptunia (Ehrenberg)	–	–	+	+	–	+	–
R. rotatoria (Pallas)	+	–	–	+	+	–	–
Total No. of Species	54	56	64	65	55	56	54

Abbreviations: 1 – Puwa Saikia 1; 2 – Puwa Saikia 2; 3 – Dhir; 4 – Dighali; 5 – Kunwari; 6 – Butikor; 7 – Batua; – = absent; + = present.

Table 3. Percentage similarities (*vide* Sorensen's index) between rotifer communities in different floodplain lakes

Floodplain lakes	Puwa Saikia 1	Puwa Saikia 2	Dhir	Dighali	Kunwari	Butikor	Batua
Puwa Saikia 1	–	80.4	48.7	58.3	49.6	59.5	54.1
Puwa Saikia 2		–	49.6	60.7	48.7	56.6	63.7
Dhir			–	71.3	52.5	53.3	61.7
Dighali				–	55.3	57.8	59.5
Kunwari					–	59.7	52.6
Butikor						–	42.9
Batua							–

71% community similarity with the same. Total qualitative richness is, however, significantly higher than the reports of 37 species (Goswami, 1985) and 29 species (Goswami, 1997) from some beels of lower Assam and showed 30.0% and 27.6% community similarities with the mentioned works, respectively. Comparison with other Indian works is not feasible because of incomplete species inventories. Further, the qualitative diversity in individual lakes (54–65 species) is highest ever recorded in Indian floodplains but is yet significantly lower than reports of 136 species in Lake Iyi-Efi and 124 species in Lake Oguta in the Niger delta (Segers et al., 1993), 130 species in Lake Guarana, Brazil (Bonecker et al., 1994) and 104 species in Laguana Bufeos, Bolivia (Segers et al., 1998). The 'soft, slightly acidic to slightly alkaline waters of Dhir and Dighali beels indicate higher species richness (64–65 species),with maximum diversity in summer and post-monsoon seasons. Percentage similarity between the rotifer communities in the sampled beels (42.9–80.4%) is relatively higher (Table 3) than report (37.3–68.8%) by Sharma (unpublished data). Maximum percentage similarity is noticed between Puwa Saikia 1 and Puwa Saikia 2 which are identical in their abiotic factors. This is followed by 71.3% similarity between Dhir and Dighali beels which again are grouped together based on their abiotic parameters while similarity ranges between 42.9% and 63.9% in comparison between the rest of the beels.

The acidic to slightly alkaline waters (pH: 5.0–7.4) of the sampled beels are characterized by the presence of various acidophilic rotifers such as *Plationus patulus macracanthus, Dipleuchlanis propatula, Euchlanis triquetra, Mytilina bisulcata, Colurella sulcata, Lepadella cristata, Lecane pertica, Monommata longiseta, Testudinella parva* and *T. tridentata*. This is in conformity with remarks by Sharma (1991, 1996). The distribution of *Lepadella acuminata, Ascomorpha saltans, Trichocerca weberi* and *Testudinella emarginula* in the beels also reveals their acidic nature. Among about 22 species of the genus *Brachionus* known from the Indian waters (Sharma, 1996), only

8 species are included in this account. The relative paucity of brachionid species is attributed to the acidic nature of these biotopes and thus re-affirms the findings of Fernando & Zankai (1981) and Sharma (1996). *Anuraeopsis fissa, Brachionus bidentatus, B. forficula, Dipleuchlanis propatula, Manfredium eudactylotum, Macrochaetus collinsi, M. sericus, Colurella sulcata, Lepadella cristata, Lecane ludwigii* and *L. stenroosi* are observed primarily during warmer months and are, therefore, designated as warm-stenothermal species (*vide* Koste, 1978) in the present observations.

The rotifer fauna is characterized by a predominance of periphytic or littoral elements (86 species; 74.1%) and fewer planktonic rotifers (30 species; 25.9%). This important feature can be assigned to the lack of definite pelagic habitats (De Manuel, 1994) in the beels, their shallow nature and growth of aquatic macrophytes. Only 15 species i.e. *Lepadella lindaui, L. minoruoides, L. triba*, *Lecane acanthinula, L. batillifer, L. blachei, L. monostyla, L. thienemanni, Trichocerca tropis, Synchaeta oblonga, Pleosoma lenticulare, Dicranophorus luetkeni, Testudinella brevicaudata, T. greeni* and *Horaella brehmi* are noticed in only one of the beels. On the other hand, 12 species are observed in all these biotopes while 16 species occurred in at least two beels.

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