

The Biodiverse Rotifers (Rotifera: Eurotatoria) of Small Wetlands of the Brahmaputra River Floodplains of Lower and Upper Assam, Northeast India

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ABSTRACT

Rotifera assemblages of small floodplain wetlands (*dobas* or *dubies*) of lower and upper regions of the Brahmaputra river basin of Assam state of northeast India (NEI) reveal 157 species, belonging to 34 genera and 18 families, and highlight notable speciose constellation of up to 50 species/sample. One species, each is new to the Oriental region and Assam, and species of global and regional biogeographic interest form notable fractions. The biodiverse rotifer fauna and various interesting species are hypothesized to habitat diversity of the sampled *dobas* or *dubies*, impact of 'the Assam-gateway'- an important biogeographic corridor of India, and location of the study area in the Indo-Burmese biodiversity hot-spot. Lecanidae and Lepadellidae are species-rich families, both of lower and upper Assam wetlands; upper Assam wetlands, in particular, are characterized by a distinct paucity of the Brachionidae and *Brachionus* spp., the relative paucity of *Trichocerca*, *Keratella* and *Mytilina* species, rare occurrence of *Asplanchna* and *Filinia* species, and lack of species of Conochilidae and Hexarthridae. Our results indicate the littoral-periphytic nature and tropical character of the rotifers. Overall, this study is an important contribution to Rotifera biodiversity of small lentic habitats of India, Asia and that of the tropics and subtropics.

Keywords: Biodiversity, *dobas*, *dubies*, interesting species, 'Rotifera paradox'

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Introduction

Small lentic ecosystems form over 90% of the standing water resources of our biosphere and ~ 30% of the global lentic biotopes by surface area and are thus suggested to be more explicitly considered in analyses of biodiversity, limnology and global processes (Céréghino et al. 2014). They are recognized as hotspots both in terms of species composition and biological traits (EPCN 2008) and are often considered as keystone systems for the conservation of biodiversity (Oertli et al. 2010; Céréghino et al. 2014; Vad et al. 2017; Oertli 2018). The management of these biotopes and that of their metazoan diversity is usually neglected (Céréghino et al. 2008; Oertli 2018) despite more vulnerability to severe threats of extinction and habitat degradation (Moss et al. 2011). The small lentic biotopes have attracted relatively more attention in hydro-biological works from India, but the relevant literature largely depicts paucity of studies on

zooplankton diversity. A critical analysis attributes this lacuna to the limited sampling, ad-hoc reports by amateurs loaded with incomplete species lists, and lack of taxonomic expertise. Nevertheless, our studies from NEI (Sharma and Sharma 2015a; Sharma and Kensibo 2017; Sharma et al. 2017) hypothesized these water bodies to be one of the biodiverse habitats of the Indian sub-region vis-à-vis Rotifera - an important group of freshwater zooplankton, an integral link of aquatic food-webs, and food for larvae and adult fish (Tuna and Ustaoglu 2016; Apaydin Yağcı et al. 2017).

The state of Assam of NEI, a part of the Indo-Burmese biodiversity hotspot, is notably known for the fluvial floodplains of the Brahmaputra river with characteristic small lentic wetlands (commonly known as *dobas* or *dubies*) forming an integral part of the rural landscape of the Brahmaputra valley. Sharma and Sharma (2014) first indicated ecological diversity importance of small wetlands in context of

Rotifera of NEI and suggested their detailed assessment. The present study is thus an endeavor to analyze and compare species composition and richness of the rotifer assemblages of small wetlands of lower and upper reaches of the Brahmaputra river floodplains of Assam state. We provide an inventory of the documented taxa, illustrate interesting species, and comment on nature and composition of the rotifer fauna with reference to species richness, new records, important taxa, extraordinary high species consortium and elements of global and regional distribution interest. This study merits biodiversity and biogeographic interest for Rotifera of the

floodplains of India, Asia as well as that of the rotifer heterogeneity of the small lentic ecosystems of the Indian sub-region.

Material and Methods

The present study is based on analysis of plankton and semi-plankton samples collected, on several occasions during 2005-2015, from small floodplain wetlands (*dobas* or *dubies*) from scattered localities (Figure 1.A-C) of Dhubri, Goalpara, Kokrajhar, Bongaigaon, Barpeta, Kamrup, Nalbari and Dispur districts of lower Assam (24°8'-26°8'N; 89°8'-92°2'E), and from Biswanath, Golaghat, Jorhat, Majuli, Lakhimpur,

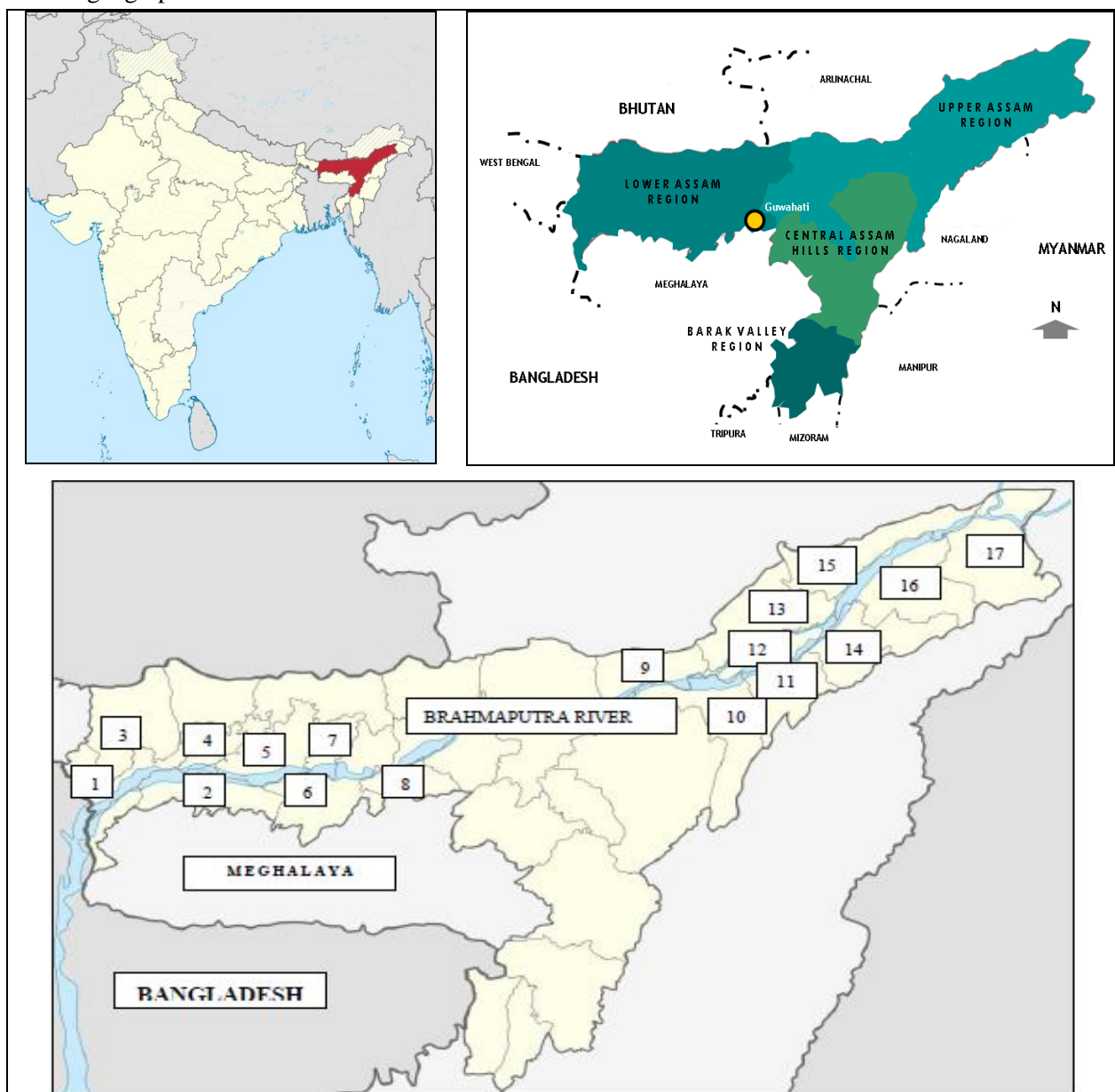


Figure 1. A-C: A, map of India indicating northeast India (NEI) and the state of Assam; B, map of Assam; C, map indicating the sampled districts of Lower Assam and Upper Assam [1-Dhubri; 2-Goalpara; 3-Kokrajhar; 4-Bongaigaon; 5-Barpeta; 6-Kamrup; 7-Nalbari; 8-Dispur; 9-Biswanath; 10-Golaghat; 11-Jorhat; 12-Majuli; 13-Lakhimpur; 14-Sibsagar; 15-Dhemaji; 16-Dibrugarh; 17-Tinsukia]

Sibsagar, Dhemaji, Dibrugarh and Tinsukia districts of upper Assam (26°4'-27°8'N; 93°8'-95°6'E). All the collections were made by towing nylobolt plankton net (# size 50µm) and were preserved in 5% formalin. Individual samples were screened with a Wild stereoscopic binocular microscope; the rotifers were isolated and mounted in polyvinyl alcohol–lactophenol and were observed with Leica DM 1000 stereoscopic phase contrast microscope fitted with an image analyzer. Various rotifer taxa were identified following the works of Koste (1978), Segers (1995), Sharma (1998), Sharma and Sharma (1999, 2000, 2008), and Jersabek and Leitner (2013) except for two indeterminate species warranting more specimens. The biogeographic remarks were made by vide Segers (2007), Sharma and Sharma (2017) and Jersabek and Leitner (2013). The microphotographs were provided for interesting species and measurements were indicated in micrometers (µm). The percentage similarity between the rotifer communities was calculated vide Sørensen's index (Sørensen 1948). The voucher collections are submitted to the holdings of Zoological Survey of India, Kolkata.

Results

The plankton and semi-plankton collections examined from small wetlands of the Brahmaputra River floodplains of lower and upper Assam reveal 157 species belonging to 34 genera and 18 families. A detailed systematic list of the observed taxa is presented below:

Systematic list of Rotifera recorded from small wetlands of upper and lower Assam

Phylum	: Rotifera
Class	: Eurotatoria
Subclass	: Monogononta
Order	: Ploima
Family	: Brachionidae
1	<i>Anuraeopsis fissa</i> Gosse, 1851
2	<i>Brachionus angularis</i> Gosse, 1851
3	<i>B. bernini</i> Leissling, 1924
4	<i>B. bidentatus</i> Anderson, 1889
5	<i>B. budapestinensis</i> Daday, 1885
6	<i>B. calyciflorus</i> Pallas, 1766
7	<i>B. caudatus</i> Barrois & Daday, 1894
8	<i>B. dichotomus reductus</i> Koste & Shiel, 1980 #@
9	<i>B. diversicornis</i> (Daday, 1883)
10	<i>B. durgae</i> Dhanapathi, 1974
11	<i>B. falcatus</i> Zacharias, 1898
12	<i>B. forficula</i> Wierzejski, 1891
13	<i>B. kostei</i> Shiel, 1983 #@
14	<i>B. mirabilis</i> Daday, 1897
15	<i>B. nilsoni</i> Ahlstrom, 1940@

16	<i>B. quadridentatus</i> Hermann, 1783
17	<i>B. rubens</i> Ehrenberg, 1838
18	<i>Keratella cochlearis</i> (Gosse, 1851)
19	<i>K. edmondsoni</i> Ahlstrom, 1943 #
20	<i>K. javana</i> Hauer, 1937 #@
21	<i>K. lenzi</i> Hauer, 1953
22	<i>K. tecta</i> (Gosse, 1851)
23	<i>K. tropica</i> (Apstein, 1907)
24	<i>Plationus patulus</i> (O.F. Muller, 1786)
25	<i>Platylas leloupi</i> Gillard, 1967
26	<i>P. quadricornis</i> (Ehrenberg, 1832)

Family : Euchlanidae

27	<i>Beauchampiella eudactylota</i> (Gosse, 1886)
28	<i>Dipleuchlanis propatula</i> (Gosse, 1886)
29	<i>Euchlanis dilatata</i> Ehrenberg, 1832
30	<i>E. incisa</i> Carlin, 1939
31	<i>E. triquetra</i> Ehrenberg, 1838
32	<i>Tripleuchlanis plicata</i> (Levander, 1894)

Family : Mytilinidae

33	<i>Lophocharis salpina</i> (Ehrenberg, 1834)
34	<i>Mytilina acanthophora</i> Hauer, 1938
35	<i>M. bisulcata</i> (Lucks, 1912)
36	<i>M. brevispina</i> (Ehrenberg, 1830)
37	<i>M. michelangellii</i> Reid & Turner, 1988
38	<i>M. ventralis</i> (Ehrenberg, 1830)

Family : Trichotriidae

39	<i>Macrochaetus longipes</i> Myers, 1934
40	<i>M. sericus</i> (Thorpe, 1893)
41	<i>Trichotria tetractis</i> (Ehrenberg, 1830)
42	<i>Wolga spinifera</i> (Western, 1894)

Family : Lepadellidae

43	<i>Colurella adriatica</i> Ehrenberg, 1831
44	<i>C. obtusa</i> (Gosse, 1886)
45	<i>C. uncinata</i> (O.F. Müller, 1773)
46	<i>Lepadella acuminata</i> (Ehrenberg 1834)
47	<i>L. apsicora</i> Myers, 1934
48	<i>L. apside</i> Harring, 1916
49	<i>L. benjamini</i> Harring, 1916
50	<i>L. biloba</i> Hauer, 1958
51	<i>L. costatoides</i> Segers, 1992
52	<i>L. dactyliseta</i> (Stenroos, 1898)
53	<i>L. desmeti</i> Segers and Chittapun, 2001 **#@
54	<i>L. discoidea</i> Segers, 1993 #
55	<i>L. ehrenbergi</i> (Perty, 1850)
56	<i>L. heterostyla</i> (Murray, 1913)
57	<i>L. minuta</i> (Weber & Montet, 1918)
58	<i>L. ovalis</i> (O. F. Müller, 1786)
59	<i>L. patella</i> (O.F. Muller, 1773)
60	<i>L. quinquecostata</i> (Lucks, 1912)
61	<i>L. rhomboides</i> (Gosse, 1886)
62	<i>L. triptera</i> Ehrenberg, 1830
63	<i>L. vandenbrandei</i> Gillard, 1952 #@
64	<i>Squatinella lamellaris</i> (O. F. Müller, 1786)

Family :	Lecanidae	Family :	Scaridiidae
65	<i>Lecane aculeata</i> (Jakubski, 1912)	117	<i>Scaridium longicaudum</i> (O.F. Müller, 1786)
66	<i>L. aeganea</i> Harring, 1914	Family :	Trichocercidae
67	<i>L. arcula</i> Harring, 1914	118	<i>Trichocerca bicristata</i> (Gosse, 1887)
68	<i>L. bifurca</i> (Bryce, 1892)	119	<i>T. bidens</i> (Lucks, 1912) @
69	<i>L. blachei</i> Berzins, 1973 #	120	<i>T. capucina</i> (Wierzejski & Zacharias, 1893)
70	<i>L. bulla</i> (Gosse, 1851)	121	<i>T. cylindrica</i> (Imhof, 1891)
71	<i>L. calcaria</i> Harring & Myers, 1926 #@	122	<i>T. elongata</i> (Gosse, 1886)
72	<i>L. clara</i> (Bryce, 1892) *#	123	<i>T. flagellata</i> Hauer, 1938
73	<i>L. closterocerca</i> (Schmarda, 1898)	124	<i>T. hollaerti</i> De Smet, 1990#@
74	<i>L. crepida</i> Harring, 1914	125	<i>T. insignis</i> (Herrick, 1886) @
75	<i>L. curvicornis</i> (Murray, 1913)	126	<i>T. longiseta</i> (Schrank, 1802)
76	<i>L. decipiens</i> (Murray, 1913)	127	<i>T. maior</i> (Hauer, 1935) #
77	<i>L. dorysimilis</i> Trinh Dang, Segers & Sanoamuang, 2015 #@	128	<i>T. pusilla</i> (Jennings, 1903)
78	<i>L. doryssa</i> Harring, 1914	129	<i>T. rattus</i> (O.F. Müller, 1776)
79	<i>L. elegans</i> Harring, 1914	130	<i>T. scipio</i> (Gosse, 1886) @
80	<i>L. flexilis</i> (Gosse, 1886)	131	<i>T. similis</i> (Wierzejski, 1893)
81	<i>L. furcata</i> (Murray, 1913)	132	<i>T. tenuior</i> (Gosse, 1886)
82	<i>L. haliclysta</i> Harring & Myers, 1926	133	<i>T. tigris</i> (O.F. Müller, 1786)
83	<i>L. hastata</i> (Murray, 1913)	134	<i>T. weberi</i> (Jennings, 1903)
84	<i>L. hamata</i> (Stokes, 1896)	Family :	Asplanchnidae
85	<i>L. hornemanni</i> (Ehrenberg, 1834)	135	<i>Asplanchna brightwelli</i> Gosse, 1850
86	<i>L. inermis</i> (Bryce, 1892)	136	<i>A. priodonta</i> Gosse, 1850
87	<i>L. inopinata</i> Harring & Myers, 1926	Family :	Synchaetidae
88	<i>L. lateralis</i> Sharma, 1978 #	137	<i>Polyarthra vulgaris</i> Carlin, 1943
89	<i>L. leontina</i> (Turner, 1892)	Family :	Dicranophoridae
90	<i>L. ludwigii</i> (Eckstein, 1883)	138	<i>Dicranophorus forcipatus</i> (O.F. Müller, 1786)
91	<i>L. luna</i> (O. F. Müller, 1776)	Order :	Flosculariaceae
92	<i>L. lunaris</i> (Ehrenberg, 1832)	Family :	Floscularidae
93	<i>L. monostyla</i> (Daday, 1897)	139	<i>Ptygura</i> sp.
94	<i>L. nitida</i> (Murray, 1913)	140	<i>Sinantharina socialis</i> (Linne, 1758)
95	<i>L. niwati</i> Segers, Kotethip & Sanoamuang, 2004 #@	141	<i>S. spinosa</i> (Thorpe, 1893)
96	<i>L. obtusa</i> (Murray, 1913)	Family :	Conochilidae
97	<i>L. papuana</i> (Murray, 1913)	142	<i>Conochilus unicornis</i> Rousselet, 1892
98	<i>L. ploenensis</i> (Voigt, 1902)	Family :	Hexarthridae
99	<i>L. pusilla</i> Harring, 1914	143	<i>Hexarthra mira</i> (Hudson, 1871)
100	<i>L. pyriformis</i> (Daday, 1905)	Family :	Testudinellidae
101	<i>L. quadridentata</i> (Ehrenberg, 1830)	144	<i>Pompholyx sulcata</i> Hudson, 1885
102	<i>L. rhenana</i> Hauer, 1929@	145	<i>Testudinella amphora</i> Hauer, 1938 #@
103	<i>L. rhytida</i> Harring & Myers, 1926@	146	<i>T. brevicaudata</i> Yamamoto, 1951#@
104	<i>L. signifera</i> (Jennings, 1896)	147	<i>T. dendradena</i> de Beauchamp, 1955 #@
105	<i>L. stenroosi</i> (Meissner, 1908)	148	<i>T. emarginula</i> (Stenroos, 1898)
106	<i>L. stichoclysta</i> Segers, 1993 # @	149	<i>T. parva</i> (Ternetz, 1892)
107	<i>L. thienemanni</i> (Hauer, 1938)	150	<i>T. patina</i> (Hermann, 1783)
108	<i>L. undulata</i> Hauer, 1938	151	<i>T. tridentata</i> Smirnov, 1931@
109	<i>L. unguitata</i> (Fadeev, 1925) #	152	<i>Testudinella</i> sp. @
110	<i>L. unguata</i> (Gosse, 1887)	Family :	Trochosphaeridae
Family :	Notommatidae	153	<i>Filinia camasecla</i> Myers, 1938
111	<i>Cephalodella forficula</i> Ehrenberg, 1830	154	<i>Filinia longiseta</i> (Ehrenberg, 1834)
112	<i>C. gibba</i> (Ehrenberg, 1830)	155	<i>F. opoliensis</i> (Zacharias, 1898)
113	<i>C. trigona</i> (Rousselet, 1895) # @	Subclass :	Bdelloidea
114	<i>Monommata grandis</i> Tessin, 1890@	Order :	Philodinida
115	<i>M. longiseta</i> (O.F. Müller, 1786)	Family :	Philodinidae
116	<i>Notommata pachyura</i> (Gosse, 1886)	156	<i>Dissotrocha aculeata</i> (Ehrenberg, 1832)
		157	<i>Rotaria neptunia</i> (Ehrenberg, 1830)

* New record from the Oriental region; ** new record from Assam; # species of global biogeographic interest; @ species restricted to Northeast India.

Lecane clara (Bryce) is a new record (Figure 2.A) from the Oriental region (marked as *) and

Lepadella desmeti Segers and Chittapun (Figure 2.B) is a new record from Assam state (marked as**). *Brachionus dichotomus reductus* (Figure 2.C), *B. kostei* (Figure 2.D), *Cephalodella trigona*, *Filinia camasecla* (Figure 2.E), *Keratella edmondsoni*, *K. javana*, *Lecane blachei* (Figure 2.F), *L. calcaria* (Figure 3.A), *L. niwati* (Figure 3.B), *L. dorysimilis* (Figure 3.C), *L. lateralis*, *L. stichoclysta*, *L. unguitata*, *Lepadella desmeti*, *L. discoidea*, *L. vandenbrandei*, *Testudinella amphora*, *T. brevicaudata* (Figure 3.D), *T. dendradena*, *Trichocerca hollaerti* (Figure 3.E) and *T. maior* are species of global biogeographic interest (marked as #). *Testudinella* (Figure 3.F) sp. is yet an un-determined species awaiting description

pending examination of more specimens. Our collections indicate 23 species (marked as @) with their distribution in India known to be restricted to NEI.

We report 152 and 125 rotifer species from lower and upper Assam collections, respectively (Table 1) with consistent importance of Lecanidae (45 and 42 species), Lepadellidae (21 species each) and Trichocercidae (16 and 13 species). The comparison of Rotifera species composition of the two study areas records lower richness of the Brachionidae (14 species), *Brachionus* (6 species) and paucity of species of *Keratella* and *Mytilina* especially in our collections from upper Assam wetlands (Table 1).

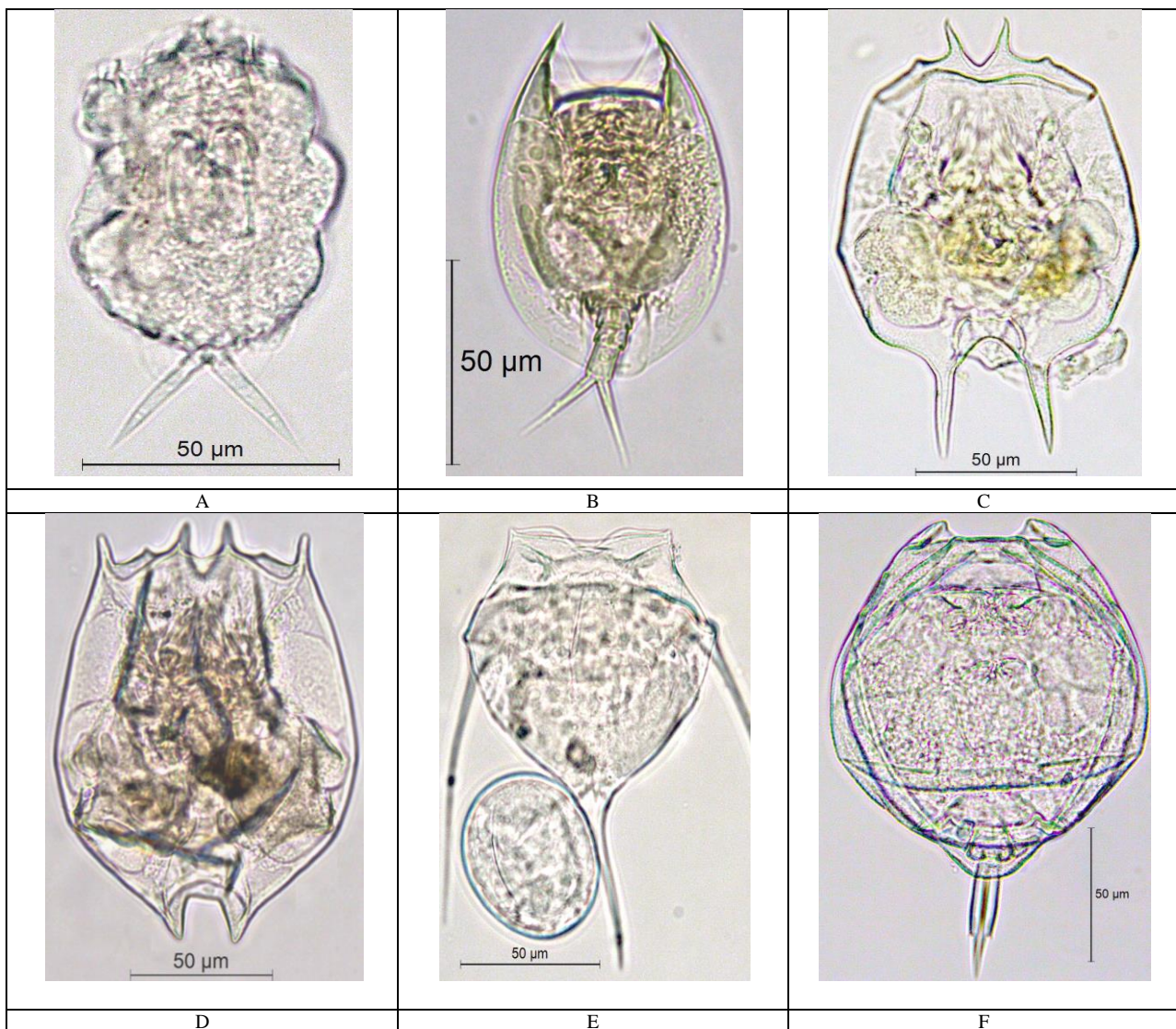


Figure 2. A-F: Rotifers of biogeographic interest (A, *Lecane clara* (Bryce) (dorsal view); B, *Lepadella desmeti* Segers and Chittapun (ventral view); C, *Brachionus dichotomus reductus* Koste & Shiel (ventral view); D, *Brachionus kostei* Shiel (ventral view); E, *Filinia camasecla* Myers with parthenogenetic egg (dorsal view); F, *Lecane blachei* Berzins (dorsal view).

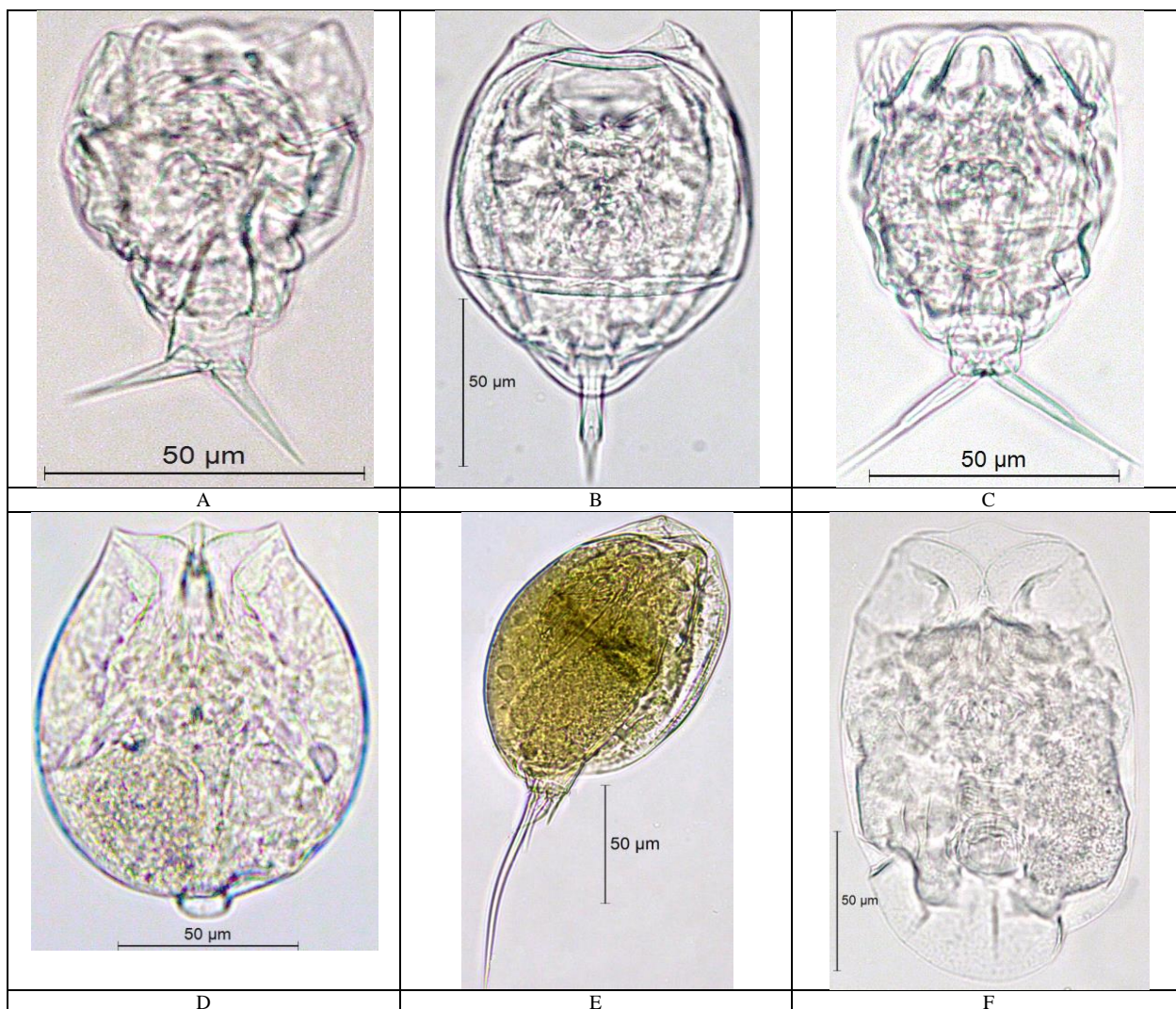


Figure 3. A-F: Rotifers of biogeographic interest (A, *Lecane calcaria* Harring & Myers (ventral view); B, *Lecane niwati* Segers, Kotethip & Sanoamuang (ventral view); C, *Lecane dorysimilis* Trinh Dang, Segers & Sanoamuang (ventral view); D, *Testudinella brevicaudata* Yamamoto (ventral view); E, *Trichocerca hollaerti* De Smet (lateral view); F, *Testudinella* sp. (ventral view)

Table 1. Comparison of Rotifera composition of small wetlands of lower and upper Assam

Taxa	This study	Lower Assam	Upper Assam
Species	157	152	125
Genera	34	34	30
Families	18	18	16
Important families: species (%)			
Lecanidae	46 (29.3%)	45 (29.6%)	42 (33.6%)
Brachionidae	26 (16.6%)	26 (17.1%)	14 (11.2%)
Lepadellidae	22 (14.0%)	21 (13.8%)	21 (16.8%)
Trichocercidae	17 (10.9%)	16 (10.5%)	13 (10.4%)
	111 (70.8%)	108 (71.0%)	90 (72.0%)
Other notable families: species (%)			
Testudinellidae	8	8	7
Euchlanidae	6	6	6
Notommatidae	6	5	5
Mytilinidae	6	6	3
	26 (16.6%)	25 (16.4%)	21 (16.8%)
Important genera: species (%)			
<i>Lecane</i>	46 (29.3%)	45 (29.6%)	42 (33.6%)
<i>Lepadella</i>	18 (11.4%)	16 (10.5%)	17 (13.6%)
<i>Trichocerca</i>	17 (10.9%)	16 (10.5%)	13 (10.4%)
<i>Brachionus</i>	16 (10.2%)	16 (10.5%)	06 (4.8%)
	97 (61.8%)	93 (61.2%)	78 (62.4%)
Other notable genera: species (%)			
<i>Testudinella</i>	7	7	6
<i>Keratella</i>	6	6	4
<i>Mytilina</i>	5	5	3
	18 (11.4%)	18 (11.8%)	13 (10.4%)

Discussion

Our collections from *dobas* or *dubies* of the Brahmaputra river basin reveal 157 species, belonging to 34 genera and 18 families; the richness comprises ~65%, ~52% and ~27% of species of Rotifera known from Assam state, NEI and India (Sharma and Sharma 2017), respectively and thus affirms biodiverse nature of the rotifer assemblage. Besides, 152 and 125 species observed from lower and upper Assam, respectively depict species-rich rotifers of the two study areas individually, while higher community similarity (85.2% vide Sørensen's index) depicts overall homogeneity in species composition but with certain differences.

Lecane clara, a new record from the Oriental region, is diagnosed by its soft lorica and characteristic elongate toes. This lecanid is yet known (Segers 2007) from the African, Neotropical, Nearctic, Pacific, and Palaearctic regions, while our report extends its distribution to the Oriental region. *Lepadella desmeti*, described from Thailand (Segers and Chittapun 2001), is known elsewhere from Neotropical and Pacific regions (Segers 2007). The only earlier record of this species from the Indian sub-region (Sharma and Sharma 2015b) relates to Loktak Lake (a Ramsar site), Manipur state; the present study further extends its distribution within NEI to Assam state. In addition, *Lecane calcaria* and *L. stichoclysta* deserve mention in view of the restricted reports from south Assam (Sharma and Sharma 2019a) and the eastern Himalayas (Sharma and Sharma 2019b).

Interestingly, Rotifera of *dobas* or *dubies* invariably record species consortia of maximum 30-35 species/sample while a few small wetlands from the Majuli River Island and the Dibru-Saikhowa Biosphere reserve of upper Assam indicate speciose constellations of up to 50 species/sample. We categorize these reports as 'Rotifera paradox' following analogy to the classical 'the paradox of the plankton' highlighted by Hutchinson (1961); the former, in turn, is hypothesized to the intriguing possibility of the co-existence of a number of species in 'a relatively isotropic or unstructured environment of small wetlands'.

This study records biodiverse rotifers than the reports from *dobas* or *dubies* of the Majuli River Island (Sharma 2014), small lentic biotopes of Mizoram (Sharma and Sharma 2015a) and Nagaland (Sharma and Kensibo 2017, Sharma et al. 2017), and the Kashmir Himalayan floodplains (Sharma and Sharma 2018). The richness is marginally lower than the reports from small lentic biotopes of the eastern Himalayas (Sharma and Sharma 2019a) and the floodplains of Barak valley of south Assam

(Sharma and Sharma 2019b). The comparisons highlight *dobas* or *dubies* of the Brahmaputra floodplains to be one of the biodiverse rotifer environs of India; this generalization is hypothesized to the function of habitat diversity of the sampled wetlands and sampling intensity vide Fontaneto et al. (2012). Interestingly, this study registers higher rotifer richness than certain global floodplain reports i.e., the Rio Pilcomayo National Park, Argentina (Jose de Paggi 2001); Oguta and Iyi-Efi lakes of the Niger delta (Segers et al. 1993) of Africa; Lake Guarana (Bonecker et al. 1994), and Lago Camaleao (Koste and Robertson 1983) of Brazil; Thale-Noi Lake, Thailand (Segers and Pholpunthin 1997); and it compares well with 151 species known from Rio Tapajos (Koste 1974) of Brazil.

Our collections reveal notable examples of global and regional biogeographic interest. The former include 21 species (13.4%) namely (i) the Australasian *Brachionus dichotomus reductus* and *B. kostei*; (ii) the Oriental endemics *Filinia camasecla*, *Keratella edmondsoni*, *L. blachei* and *L. niwati*; (iii) the paleotropical *K. javana*, *Lecane lateralis*, *L. stichoclysta*, *L. unguitata*, *Lepadella discoidea*, *L. vandenbrandei*, *Testudinella brevicaudata* and *Trichocerca hollaerti*; (iv) the Indo-Chinese *Lecane dorysimilis*; (v) the Holarctic *Trichocerca maior*; and (vi) five other species namely *Cephalodella trigona*, *Lecane calcaria*, *Lepadella desmeti*, *Testudinella amphora* and *T. dendradena*. The Australian elements affirm affinity of the rotifer assemblage with Southeast Asian and Australian faunas, while other categories impart affinities with Southeast Asian Rotifera (Sharma and Sharma 2014, 2017). In addition, 23 species (~15%) are known for their Indian distribution till date restricted to NEI, while ~12% species namely *Brachionus durgae*, *Colurella adriatica*, *Lecane aeganea*, *L. doryssa*, *L. elegans*, *L. haliclysta*, *L. hastata*, *L. pusilla*, *L. thienemanni*, *Lepadella benjamini*, *L. dactyliseta*, *L. discoidea*, *L. quinquecostata*, *Macrochaetus longipes*, *Mytilina michelangellii*, *Platyias leloupi*, *Testudinella parva*, *Trichocerca flagellata* and *Volga spinifera* depict regional distribution interest vis-à-vis the Indian Rotifera (Sharma and Sharma 2017). We hypothesize overall biodiverse rotifer assemblage of *dobas* or *dubies* of the Brahmaputra river floodplains and occurrence of sizable fractions of specie of biogeographic interest to impact of 'the Assam-gateway'- a vital biogeographic corridor of India that facilitated extensive interchanges between the Indian and Asian biota (Mani 1974), thus changing the modern biotic composition of the

epigeal ecosystems of India into one of 'predominantly Oriental' nature (Ranga Reddy 2013).

Lecanidae > Brachionidae > Lepadellidae > Trichocercidae, collectively form large fraction (~71%) of the rotifer species known vide this study as well as from lower Assam wetlands. On the other hand, upper Assam wetlands indicate corresponding cumulative importance of these Eurotatoria families (72%) but are characterized by a notable paucity of Brachionidae (14 species). Testudinellidae, Euchlanidae, Notommatidae, and Mytilinidae also deserve attention for collective contributions of 16.4% and 16.8% from lower and upper Assam wetlands, respectively. The 'tropic centered' *Lecane* is most speciose genus both of lower (45 species) and upper Assam (42 species) rotifers. *Lepadella* = *Trichocerca* = *Brachionus* are notable in lower Assam wetlands (31.5%), while *Lepadella* > *Trichocerca* > *Brachionus* (29.8%) deserve attention in upper Assam wetlands but with a distinct paucity of *Brachionus* spp. (6 species; 4.8%). In general, the paucity of the brachionid Rotifera of upper Assam wetlands, concurs with the reports from the floodplains of the Majuli River Island (Sharma 2014) and our results from the states of Meghalaya (Sharma and Sharma 1999), Mizoram (Sharma and Sharma 2015a), Nagaland (Sharma et al. 2017), and Arunachal Pradesh (Sharma and Sharma 2019a) of NEI. Further, the collections from upper Assam are notable for relative paucity of *Trichocerca*, *Keratella* and *Mytilina* species; rare occurrence of *Asplanchna* and *Filinia* species and lack of species of Conochilidae and Hexarthridae. The richness of important Eurotatoria families and genera assigns the littoral-periphytonic nature to Rotifera of *dobas* or *dubies* of the Brahmaputra floodplains, in conformity with the reports from the floodplains of Africa (Segers et al. 1993; Green 2003), Brazil (Koste 1974; Koste and Robertson 1983), Thailand (Segers and Pholpunthin 1997), Argentina (Jose De Paggi 2001) and NEI (Sharma and Sharma 2008, 2014). The high richness of 'tropic centered' *Lecane* and that of *Brachionus* in lower Assam wetlands, large fraction of cosmopolitan species (~67%) and occurrence of several (~20%) pantropical and cosmopolitan species imparts 'tropical character' to the rotifer assemblages of *dobas* or *dubies* following the reports on the tropical rotifer faunas (Fernando 1980; Segers 2008; Sharma and Sharma 2008, 2014, 2017, 2019a).

To sum up, this study is an important contribution to Rotifera biodiversity of small lentic habitats of India, Asia, and tropics and subtropics. The biodiverse rotifers affirm habitat and

environmental heterogeneity of *dobas* or *dubies* of the Brahmaputra floodplains. 'Rotifera paradox' hypothesizes niche diversification enabling co-existence of several species within an unstructured environment of small wetlands. The diverse species composition is attributed to the location the sampled study areas within the key biodiversity area of the Indo-Burma Hotspot as well as the historical influence of 'the Assam-gateway' facilitating incursion of species from Asian and the Oriental faunas. Such studies need to be extended to other small lentic wetlands of NEI and elsewhere in India to explore ecosystem diversity value of small water bodies vs. biodiversity of Indian Rotifera.

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