

## Loktak Lake, Manipur, revisited: A Ramsar site as the rotifer (Rotifera: Eurotatoria) biodiversity hot-spot of the Indian sub-region

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**Abstract.** The plankton and semi-plankton samples collected at Loktak Lake in Manipur state of northeast India (NEI), between February 2015 and January 2017, revealed 180 rotifer species belonging to 42 genera and 22 families. Our report raises the total richness of the phylum known from this Ramsar site to 189 species and thus assigns this floodplain wetland the status of the most species-rich rotifer hot-spot of the Indian sub-region. Two species are new to the Oriental region and 25 are new records from Manipur. The rotifer fauna is characterized by a number of species of global (~18% of species) and regional biogeographic (~15% of species) interest, high richness and common occurrence of ‘tropic centered’ *Lecane*, relative paucity and scarceness of *Brachionus*, *Filinia*, *Hexarthra* and *Conochilus* species, and littoral-periphytic assemblages with a number of small-sized species. The present study is interesting for the rotifer ecosystem diversity update of this well-sampled floodplain wetland of the Indian sub-region. We estimate 270+ Rotifera species from this lake system pending specific analysis of periphytic, colonial, and benthic taxa as well as of likely cryptic diversity of certain species complexes.

**Key words.** Biogeography, ecosystem diversity, floodplain wetland, heterogeneity.

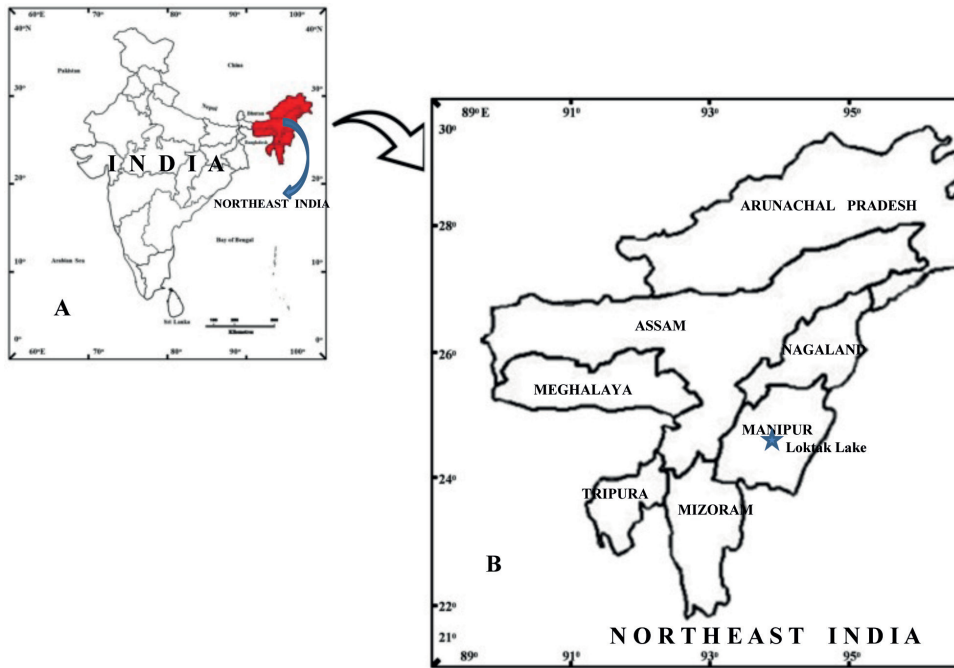
### INTRODUCTION

Rotifera have been documented and described from different parts of India for more than a century but there is still paucity of information on their ecosystem diversity in different aquatic biotopes because of limited studies, inadequate sampling, incomplete inventories and lack of taxonomic expertise (Sharma & Sharma 2017). Nevertheless, our investigations over the last two decades have highlighted the global importance of the floodplain lakes (locally termed ‘beels’ or ‘pats’) of northeast India (NEI) (Sharma & Sharma 2014a, 2014b, 2017) regarding Rotifera biodiversity and biogeography. Deepor beel, a Ramsar site located in this region, has been reported to be one of the most rotifer speciose individual ecosystems of India (Sharma & Sharma 2015). Sharma et al. (2016) extended the investigations to Loktak Lake – another Ramsar site – and provided a notable update on the rotifer fauna reported earlier by Sharma (2009). The present intensive sampling culminated in more biodiverse assemblage characterizing this floodplain wetland of NEI as a rotifer hot-spot of the Indian sub-region. An inventory of the rotifer species recorded till date from Loktak Lake is presented. Remarks are made on salient features of the composition and species richness of Rotifera, and on new records and taxa of biogeographic importance. Various interesting species reported in this study are illustrated.

### MATERIAL & METHODS

Loktak Lake (93° 46’ – 93° 55’ E, 24° 25’ – 24° 42’ N; area: 286 km<sup>2</sup>; max. depth: 4.58 m, mean depth: 2.07 m), Bishnupur/Imphal districts of Manipur (NEI), is an interesting floodplain lake system (Figs 1 A–C) characterized by its floating mats of vegetation called “Phumdi” which are inhabited by endangered brow-antlered deer (*Rucervus eldi eldi*). This Ramsar site is reported to have a diverse assemblage (233 species) of aquatic macrophytes (Tunginba Singh, 2013)

The qualitative plankton and semi-plankton samples were collected between February 2015 and January 2017 at three sampling sites: Loktak A (93°45’56.3” E; 24°32’13.5” N; alt. 726 m asl), Loktak B (93°47’58.1” E; 24°30’39.1” N; alt. 714 m asl) and Loktak Barrage (93°45’43.5” E; 24°32’46.9” N; alt. 718 m asl). In addition, others from different parts (pats) of Loktak Lake basin are analyzed. The samples were collected by towing a nylobolt plankton net (#50 µm mesh size) and preserved in 5% formalin. All samples were screened with a Wild stereoscopic binocular microscope; individual rotifers were isolated and mounted in Polyvinyl alcohol-lactophenol, and were observed with a Leica (DM 1000) stereoscopic phase contrast microscope fitted with an image analyzer. The rotifer taxa were identified using Koste (1978), Segers (1995), Sharma (1978a, 1978b, 1983, 1998), Sharma & Sharma (1987, 1997, 1999, 2000, 2008, 2013), and Jersabek and Leitner (2013). The voucher collections are in the holdings of the Department of Zoology, North-Eastern Hill University, Shillong.



**Fig. 1A–C.** A. Map of India showing northeast India; B. Map of northeast India indicating Manipur state and location of Loktak Lake; C. Loktak Lake – a Ramsar site showing typical ‘Phumdi’

**RESULTS**

A total of 180 species representing 42 genera and 22 families were identified in our collections from Loktak Lake. Our study raises the total number of rotifers known from this Ramsar site to 189 species. The following is a detailed systematic list of the recorded taxa.

**Systematic list of Rotifera  
recorded from Loktak Lake, Manipur**

**Phylum:** Rotifera  
**Class:** Eurotatoria  
**Subclass:** Monogononta  
**Order:** Plouma

**Family: Brachionidae**

1. *Anuraeopsis fissa* (Gosse, 1851)
2. *Brachionus angularis* Gosse, 1851
3. *B. bidentatus* Anderson, 1889
4. *B. calyciflorus* Pallas, 1766
5. *B. caudatus* Barrois & Daday, 1894
6. *B. diversicornis* (Daday, 1883)\*\*
7. *B. durgae* Dhanapathi, 1974
8. *B. falcatus* Zacharias, 1898
9. *B. forficula* Wierzejski, 1891\*\*
10. *B. kostei* Shiel, 1983
11. *B. mirabilis* Daday, 1897
12. *B. quadridentatus* (Hermann, 1783) s. lat
13. *Keratella cochlearis* Gosse, 1851
14. *K. edmondsoni* Ahlstrom, 1943\*\*
15. *K. lenzi* Hauer, 1953
16. *K. tecta* (Gosse, 1851)
17. *K. tropica* (Apstein, 1907)
18. *Platyias leloupi* (Gillard, 1967)
19. *P. quadricornis* (Ehrenberg, 1832)
20. *Platyonus patulus* (O.F. Müller, 1786)

**Family: Epiphanidae**

21. *Epiphanes brachionus* (Ehrenberg, 1837)

**Family: Euchlanidae**

22. *Beauchampiella eudactylota* (Gosse, 1886)
23. *Dipleuchlanis propatula* (Gosse, 1886)
24. *Euchlanis dilatata* Ehrenberg, 1832
25. *E. incisa* Carlin, 1939
26. *E. meneta* Myers, 1930
27. *E. semicarinata* Segers, 1993#
28. *E. triquetra* Ehrenberg, 1838
29. *Tripleuchlanis plicata* (Levander, 1894)

**Family: Mytilinidae**

30. *Lophocharis salpina* (Ehrenberg, 1834)
31. *Mytilina acanthophora* Hauer, 1938
32. *M. brevispina* (Ehrenberg, 1830)\*\*

33. *M. bisulcata* (Lucks, 1912)
34. *M. lobata* Pourriot, 1996
35. *M. michelangellii* Reid & Turner, 1988
36. *M. ventralis* (Ehrenberg, 1832)

**Family: Trichotriidae**

37. *Macrochaetus danneelae* Koste & Shiel, 1983
38. *M. longipes* (Myers, 1934)
39. *M. sericus* (Thorpe, 1893)
40. *Trichotria tetractis* (Ehrenberg, 1830)
41. *Wolga spinifera* (Western, 1894)

**Family: Lepadellidae**

42. *Colurella adriatica* (Ehrenberg, 1837)
43. *C. obtusa* (Gosse, 1886)
44. *C. sulcata* (Stenroos, 1898)
45. *C. uncinata* (O.F. Müller, 1773)
46. *Lepadella acuminata* (Ehrenberg, 1834)
47. *L. apsicora* Myers, 1934
48. *L. apsidea* Harring, 1916
49. *L. benjamini* Harring, 1916
50. *L. bicornis* Vasisht & Battish, 1971
51. *L. biloba* Hauer, 1958\*\*
52. *L. cristata* (Rousselet, 1893)\*\*
53. *L. costatoides* Segers, 1992
54. *L. dactyliseta* (Stenroos, 1898)
55. *L. desmeti* Segers & Chittapun, 2001
56. *L. discoidea* Segers, 1993
57. *L. ehrenbergi* (Perty, 1850)
58. *L. eurysterna* Myers, 1942
59. *L. heterostyla* (Murray, 1913)
60. *L. lindau* Koste, 1981
61. *L. neglecta* Segers & Dumont, 1995\*
62. *L. minuta* (Weber & Montet, 1918)
63. *L. ovalis* (O.F. Müller, 1786)
64. *L. patella* (O.F. Müller, 1773) s. lat
65. *L. quadricarinata* (Stenroos, 1898)
66. *L. quinquecostata* (Lucks, 1912)
67. *L. rhomboides* (Gosse, 1886)
68. *L. triba* Myers, 1934
69. *L. triptera* Ehrenberg, 1830
70. *L. vandenbrandei* Gillard, 1952
71. *Squatinella mutica* (Ehrenberg, 1832)

**Family: Lecanidae**

72. *Lecane acanthinula* (Hauer, 1938)#
73. *L. aculeata* (Jakubski, 1912)
74. *L. aeganea* Harring, 1914
75. *L. arcula* Harring, 1914
76. *L. aspasia* Myers, 1917
77. *L. batillifer* (Murray, 1913)\*\*
78. *L. blachei* Berzins, 1973
79. *L. bifastigata* Hauer, 1938\*\*
80. *L. bifurca* (Bryce, 1892)
81. *L. bulla* (Gosse, 1851) s. lat  
*L. bulla diabolica* (Hauer, 1936)



82. *L. closterocerca* (Schmarda, 1898)  
 83. *L. crepida* Harring, 1914  
 84. *L. curvicornis* (Murray, 1913) s. lat  
 85. *L. decipiens* (Murray, 1913)  
 86. *L. dorysimilis* Trinh Dang, Segers  
 & Sanoamuang, 2015\*\*  
 87. *L. doryssa* Harring, 1914  
 88. *L. elegans* Harring, 1914  
 89. *L. elongata* Harring & Myers, 1926\*\*  
 90. *L. flexilis* (Gosse, 1886)  
 91. *L. furcata* (Murray, 1913)  
 92. *L. hamata* (Stokes, 1896) s. lat  
 93. *L. haliclysta* Harring & Myers, 1926  
 94. *L. hastata* (Murray, 1913)\*\*  
 95. *L. hornemanni* (Ehrenberg, 1834)  
 96. *L. inermis* (Bryce, 1892)  
 97. *L. inopinata* Harring & Myers, 1926  
 98. *L. lateralis* Sharma, 1978  
 99. *L. latissima* Yamamoto, 195\*\*  
 100. *L. leontina* (Turner, 1892)  
 101. *L. ludwigii* (Eckstein, 1883)  
 102. *L. luna* (O.F. Müller, 1776) s. lat  
 103. *L. lunaris* (Ehrenberg, 1832)  
 104. *L. marchantaria* Koste & Robertson, 1983\*  
 105. *L. monostyla* (Daday, 1897)  
 106. *L. nitida* (Murray, 1913)  
 107. *L. niwati* Segers, Kothetip & Sanoamuang, 2004  
 108. *L. obtusa* (Murray, 1913)  
 109. *L. ohioensis* (Herrick, 1885)  
 110. *L. papuana* (Murray, 1913)  
 111. *L. ploenensis* (Voigt, 1902)  
 112. *L. pusilla* Harring, 1914  
 113. *L. pyriformis* (Daday, 1905)\*\*  
 114. *L. quadridentata* (Ehrenberg, 1832)  
 115. *L. rhenana* Hauer, 1929  
 116. *L. rhytida* Harring & Myers, 1926  
 117. *L. ruttneri* Hauer, 1938  
 118. *L. signifera* (Jennings, 1896)  
 119. *L. simonneae* Segers, 1993  
 120. *L. solfatarata* (Hauer, 1938)#  
 121. *L. stenroosi* (Meissner, 1908)  
 122. *L. superaculeata* Sanoamuang & Segers, 1997\*\*  
 123. *L. syngenes* (Hauer, 1938)\*\*  
 124. *L. tenuiseta* Harring, 1914  
 125. *L. thienemanni* (Hauer, 1938)  
 126. *L. undulata* Hauer, 1938  
 127. *L. unguitata* (Fadeev, 1925)  
 128. *L. unguilata* (Gosse, 1887)

**Family: Notommatidae**

129. *Cephalodella forficula* (Ehrenberg, 1832)  
 130. *C. gibba* (Ehrenberg, 1832)  
 131. *C. mucronata* Harring & Myers, 1921  
 132. *C. trigona* (Rousselet, 1895)\*\*  
 133. *Monommata longiseta* (O.F. Müller, 1786)  
 134. *M. maculata* (Harring & Myers, 1924)

135. *Monommata* sp.#136. *Notommata spinata* Koste & Shiel, 1991**Family: Scaridiidae**137. *Scaridium longicaudum* (O.F. Müller, 1786)**Family: Gastropodidae**138. *Ascomorpha ecaudis* Perty, 1850139. *A. ovalis* (Bergendal, 1892)**Family: Trichocercidae**140. *Trichocerca abilioi* Segers & Sarma, 1993#141. *T. bicristata* (Gosse, 1887)142. *T. capucina* (Wierzejski & Zacharias, 1893)\*\*143. *T. cylindrica* (Imhof, 1891)144. *T. edmondsoni* (Myers, 1936)145. *T. elongata* (Gosse, 1886)146. *T. flagellata* Hauer, 1938147. *T. insignis* (Herrick, 1886)148. *T. hollaerti* De Smet, 1990149. *T. longiseta* (Schrank, 1802)150. *T. maior* Hauer, 1936151. *T. pusilla* (Jennings, 1903)\*\*152. *T. rattus* (O.F. Müller, 1786)153. *T. scipio* (Gosse, 1886)154. *T. similis* (Wierzejski, 1893)155. *T. sulcata* (Jennings, 1894)\*\*156. *T. tenuior* (Gosse, 1886)157. *T. weberi* (Jennings, 1903)**Family: Asplanchnidae**158. *Asplanchna priodonta* Gosse, 1850**Family: Synchaetidae**159. *Ploesoma lenticulare* Herrick, 1855160. *Polyarthra vulgaris* Carlin, 1943161. *Synchaeta oblonga* Ehrenberg, 1832\*\*162. *S. pectinata* Ehrenberg, 1832**Family: Dicranophoridae**163. *Dicranophoroides caudatus* (Ehrenberg, 1832)164. *Dicranophorus forcipatus* (O.F. Müller, 1786)**Order: Gnesiotrocha****Family: Flosculariidae**165. *Floscularia ringens* (Linnaeus, 1758)#166. *Sinantherina semibullata* (Thorpe, 1893)167. *S. spinosa* (Thorpe, 1893)168. *S. socialis* (Linnaeus, 1758)**Family: Hexarthridae**169. *Hexarthra mira* (Hudson, 1871)\*\***Family: Conochilidae**170. *Conochilus unicornis* Rousselet, 1892

**Family: Testudinellidae**171. *Testudinella amphora* Hauer, 1938172. *T. brevicaudata* Yamamoto, 1951173. *T. emarginula* (Stenroos, 1898)174. *T. parva parva* (Ternetz, 1892)*T. parva bidentata* (Ternetz, 1892)\*\*175. *T. patina* (Hermann, 1783)176. *T. tridentata* Smirnov, 1931**Family: Trochosphaeridae**177. *Filinia brachiata* (Rousselet, 1916)#178. *F. camasecla* Myers, 1938179. *F. longiseta* (Ehrenberg, 1834)180. *F. opoliensis* (Zacharias, 1898)181. *F. saltator* (Gosse, 1886)182. *Trochosphaera aequatorialis* Semper, 1872**Family: Collothecidae**183. *Collotheca ornata* (Ehrenberg, 1832)\*\***Subclass: Digononta****Order: Bdelloidea****Family: Habrotrochidae**184. *Habrotrocha angusticollis* (Murray, 1905)#**Family: Philodinidae**185. *Dissotrocha aculeata* (Ehrenberg, 1832)\*\*186. *Rotaria macroceros* (Gosse, 1851)187. *R. neptunia* (Ehrenberg, 1832)188. *R. rotatoria* (Pallas, 1766)\*\*189. *R. tardigrada* (Ehrenberg, 1830)#

\* New records from India; \*\* New records from Manipur; # not observed in this study

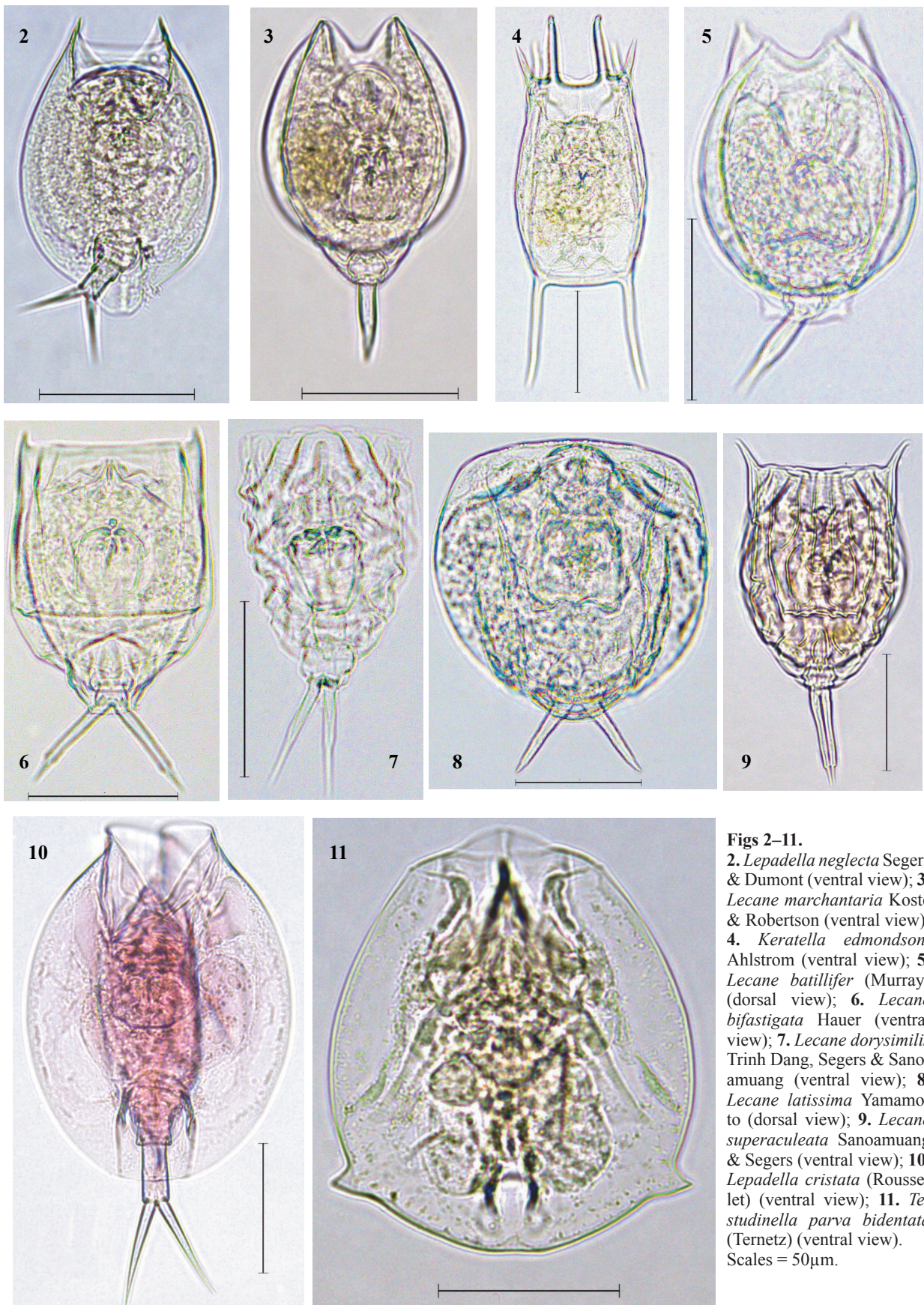
*Lepadella neglecta* (Fig. 2) and *Lecane marchantaria* (Fig. 3) are new records from India. *Brachionus diversicornis*, *B. forficula*, *Cephalodella trigona*, *Collotheca ornata*, *Dissotrocha aculeata*, *Hexarthra mira*, *Keratella edmondsoni* (Fig. 4), *Lecane batillifer* (Fig. 5), *L. bifastigata* (Fig. 6), *L. dorysimilis* (Fig. 7), *L. elongata*, *L. hastata*, *L. latissima* (Fig. 8), *L. pyriformis*, *L. superaculeata* (Fig. 9), *L. syngenes*, *Lepadella biloba*, *L. cristata* (Fig. 10), *Mytilina brevispina*, *R. rotatoria*, *Synchaeta oblonga*, *Trichocerca capucina*, *T. pusilla*, *T. sulcata* and *Testudinella parva bidentata* (Fig. 11) are new records from Manipur state of NEI. Lecanidae (57 species), Lepadellidae (30 species), Brachionidae (20 species), and Trichocercidae (18 species) collectively formed 66.1% (125 species) of the total rotifer species richness now known from Loktak Lake. Euchlanidae and Notommataidae included eight species each, while Testudinellidae and Trochosphaeridae are represented by six species each.

**DISCUSSION**

Our report of 180 species characterizes the biodiverse rotifer assemblages of Loktak Lake, raises the total species richness known from this wetland to 189 species and thus categorizes this Ramsar as the most species rich Rotifera hot-spot of the Indian sub-region and one of the globally most diverse rotifer biotopes. The results affirm the hypothesis of Segers et al. (1993) on (sub) tropical floodplains as the world's richest rotifer habitats and also endorse the speciose nature of the rotifers of the floodplain lakes of NEI (Sharma & Sharma 2014a, 2014b). The total species richness comprises ~42% and ~76% of Rotifera species known till date from India (Sharma & Sharma 2017) and northeast India (BKS, unpublished), respectively. Our inventory exceeds the highest Indian report of 171 rotifer species (Sharma & Sharma 2015) from Deepor beel – a Ramsar site and an important floodplain lake of NEI. This study marks a significant richness update on the taxon from Loktak basin compared to earlier reports of 120 (Sharma 2009) and 152 species (Sharma et al. 2016). The listing of 42 genera and 22 families affirms rich higher level diversity of Eurotatoria as compared with 65 genera and 25 families of the phylum known from India (Sharma & Sharma 2017). The biodiverse Rotifera fauna is hypothesized to result from micro-habitat diversity and environmental heterogeneity of Loktak Lake while high richness in our plankton and semi-plankton collections is hypothesized to result from greater habitat diversification due to the influence of the littoral vegetation (Green 1972; Serafim et al. 2003). We also attribute the reported high richness to the 'rotiferologist effect' (cf. Fontaneto et al. 2012).

The Rotifera species richness of Loktak Lake concurs with the report of "All Taxa Biological Inventories (ATBI)" for the rotifer assemblages of the tropical and subtropical lakes, listing between 123 and 210 species (Dumont & Segers 1996). Total richness is lower than 207, 230 and 252 species reported from the floodplains of Africa (Segers et al. 1993), South America (Serafim Jr. et al. 2003), and Australia (Shiel et al. 1998) while it broadly corresponds with 184 examined species from the Upper Paraná floodplain (Bonecker et al. 1994, 1998, 2005; Lansac-Tôha et al. 1997) of Brazil. On the other hand, Loktak Rotifera is more diverse than the records of 114 species (Jose de Paggi 2001) from the Rio Pilcomayo National Park (a Ramsar site), Argentina, 124 species (Oguta lake) and 136 species (Iyi-Efi lake) from the Niger delta (Segers et al. 1993) of Africa, 130 species from Lake Guarana, Brazil (Bonecker et al. 1994), 106 taxa from Thale-Noi Lake, a Ramsar site in Thailand (Segers & Pholpunthin 1997), 104 species from Laguana Bufeos, Bolivia (Segers et al. 1998), and 151 (Koste 1974) and 148 species from Rio Tapajos and Lago Camaleao (Koste & Robertson 1983) of Brazil, respectively.





**Figs 2–11.**  
**2.** *Lepadella neglecta* Segers & Dumont (ventral view); **3.** *Lecane marchantaria* Koste & Robertson (ventral view); **4.** *Keratella edmondsoni* Ahlstrom (ventral view); **5.** *Lecane batillifer* (Murray) (dorsal view); **6.** *Lecane bifastigata* Hauer (ventral view); **7.** *Lecane dorysimilis* Trinh Dang, Segers & Sanoamuang (ventral view); **8.** *Lecane latissima* Yamamoto (dorsal view); **9.** *Lecane superaculeata* Sanoamuang & Segers (ventral view); **10.** *Lepadella cristata* (Roussel) (ventral view); **11.** *Testudinella parva bidentata* (Ternetz) (ventral view).  
 Scales = 50µm.



The two Neotropical species (Segers 2007) *Lepadella neglecta* and *Lecane marchantaria* are new to the Oriental Rotifera. The former was described (Segers & Dumont 1995) from Lobo (Broa) reservoir, Brazil; it was confused in the past (Segers & Dumont loc cit.) with *L. quinquecostata*. This remark deserved caution as *L. neglecta* is characterized by its pyriform lorica, slightly narrowed aperture, dorsum domed with seven low but conspicuous semi-longitudinal ridges, and posterior margin projecting and with a minute median notch and thus differed distinctly in its morphology from the latter. *Lecane marchantaria* is deemed to be confused (Segers 1995) with the *L. hamata* complex; it is differentiated from the latter by nearly coincident and broadly V-shaped head aperture margins. Our collections from Loktak basin add 25 new records to the rotifer fauna of Manipur. Our collections reveal important fractions of species of global (~18% of species; 34 species) and regional biogeographic interest (~15% of species; 27 species). The Australasian *Lecane batillifer*; the Neotropical *Lepadella neglecta* and *L. marchantaria*, the Oriental *Keratella edmondsoni*, *Lecane latissima* and *L. superaculeata*, the Indo-Chinese *Lepadella dorysimilis*, and *Cephalodella trigona* and *Lecane bifastigata* are new to the list of Rotifera from Loktak. *Brachionus kostei*, *Dissotrocha aculeata*, *Euchlanis semicarinata*, *Filinia camascela*, *Notommata spinata*, *Lecane aeganea*, *L. aspasia*, *L. dorysimilis*, *L. latissima*, *L. rhenana*, *L. rhytida*, *L. niwati*, *L. solfatara*, *L. superaculeata*, *L. undulata*, *Lepadella desmeti*, *L. vandenbrandei*, *Monommata maculata*, *Notommata spinata*, *Testudinella amphora*, *T. brevicaudata*, *T. parva bidentata*, *Trichocerca abilioi*, *T. edmondsoni*, *T. hollaerti*, *T. maior* and *T. sulcata* are examples of species of regional distribution interest in the Indian Rotifera with their distribution limited till date to NEI (Sharma & Sharma 2017).

Lecanidae > Lepadellidae > Brachionidae > Trichocercidae collectively form a large fraction (~66% of species) of the rotifer fauna of Loktak. The higher lecanid richness compares with the reports from the floodplains of Africa (Segers et al. 1993, 1998; Green 2003), Argentina (Jose de Paggi 2001), Brazil (Koste 1974; Koste & Robertson 1983; Bozelli 1992; Bonecker et al. 1998; Martinez et al. 2000; Serafim Jr. et al. 2003; Bonecker et al. 2005, 2009), Venezuela (Vásquez & Rey 1989), Thailand (Sanoamuang 1998), and India (Sharma & Sharma 2014a, 2014b; Sharma et al. 2017). Nevertheless, the relative paucity of the Brachionidae (20 species) in Loktak basin is in contrast to the above listed studies and the report from the Brahmaputra floodplains of NEI (Sharma & Sharma 2014b).

Our results ascertain the collective importance (~52% of species) of the littoral-periphytonic *Lecane* (57 species) > *Lepadella* (25 species) > *Trichocerca* (18 species). The consistency of the importance of these genera

in the Loktak basin highlights the possibility of rules for the periphytic rotifer assemblages as hypothesized by Green (2003). The relative significance of these taxa concurs with the reports from the floodplains of Argentina (Jose De Paggi 2001), Africa (Segers et al. 1993; Green loc cit.), Brazil (Koste 1974; Koste & Robertson 1983; Bonecker et al. 1998), Thailand (Segers & Pholpunthin 1997; Sanoamuang 1998), and Bolivia (Segers et al. 1998) as well as of Assam state of NEI (Sharma 2014; Sharma & Sharma 2008, 2014a, 2017). High richness of 'tropic centered' *Lecane* also concurred with several reports on the tropical rotifer faunas, i.e., Koste & Shiel (1983), Dussart et al. (1984), Bozelli (1992), Bonecker et al. (1994), Segers (1995), and Sharma & Sharma (2008, 2014a, 2017).

Loktak Rotifera indicates a number of small-sized littoral-periphytonic species of *Colurella*, *Lecane*, *Lepadella* and *Trichocerca*; this feature is hypothesized to result from predation influence of juvenile fish and invertebrates (Baumgartner et al. 1997) though specific studies are needed to confirm this hypotheses. Our collections exhibit the paucity of planktonic rotifers and that of *Brachionus* (10 spp.), *Filinia*, *Hexarthra* and *Conochilus* species in particular. The occurrence of fewer *Brachionus* species corresponds with our reports from the floodplains of the Majuli River Island (Sharma 2014) and the Dibru-Saikhowa Biosphere reserve (Sharma et al. 2017) of upper Assam, NEI. Sharma et al. (2017) proposed the L/B quotient based on *Lecane/Brachionus* species ratios to characterize habitat variations of wetlands of lower Assam, NEI. Based on overall richness of the two genera, the L/B quotient for Loktak Lake indicates a value of 5.7 thus ascertaining 'wetland character' of this Ramsar site; this is affirmed by the littoral-periphytic nature of the lake system with a lack of permanent open-water limnetic conditions.

The morphological variability observed in certain species from Loktak Lake, namely *Lepadella ovalis*, *L. patella*, *Lecane bulla*, *L. curvicornis*, *L. hamata*, *L. leontina*, *L. luna*, *L. lunaris*, *L. quadridentata*, *L. unguata*, *Testudinella emarginula*, *T. patina*, *T. tridentata* and *Platyonus patulus* needs attention for cryptic diversity analysis in light of some interesting studies on such species complexes (Suatoni et al. 2006; Schröder & Walsh 2010; Montero-Pau et al. 2011; Mills et al. 2017).

To sum up, the designation of Loktak Lake as a Rotifera hot-spot of the Indian sub-region, new records, and species of global and regional biogeographic interest highlight the biodiversity and ecosystem diversity importance of this Ramsar site. Our intensive sampling and the results justify this revisit of Loktak Lake with regards its importance to biodiversity and biogeography of the Indian Rotifera. We, however, estimate an occurrence of 270+ species of the phylum from this floodplain lake system pending specific analysis of periphytic, colonial and

benthic taxa, the rotifer-macrophytic associations relating to the characteristic ‘phumdi’, and analysis of cryptic diversity of certain species complexes.

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