

Rich freshwater rotifer fauna of small lentic ecosystems of south Andaman, Andaman Sea, India (Rotifera: Eurotatoria)

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Abstract. Small lentic ecosystems are hypothesized to be interesting habitats for metazoan diversity. This study is undertaken to document Rotifera of small freshwater bodies of south Andaman, India. A total of 112 species (S), belonging to 32 genera and 19 families, recorded in our intensive February 2017 collections, indicate rich and diverse assemblage of the taxon. Total richness comprises ~ 27 % of the rotifer species known from India and thus affirms biodiversity interest and habitat diversity of the sampled habitats. This report adds 42 species, seven genera and three families to the taxa reported till date from freshwaters of the Andaman and Nicobar islands. Rotifera meta-analysis indicates distinct increase in richness of Lecanidae > Brachionidae > Trichocercidae and two-fold increase in *Brachionus* species. The biogeographically interesting elements comprise 8.0 % of S and several species indicate regional distribution importance. The rotifer fauna shows high richness of cosmopolitan species (~68% of S) and a number of tropical and subtropical species (~22 % of S). The present study highlights distinct scope to augment Rotifera diversity of the Andaman and Nicobar islands freshwaters vis-à-vis intensive sampling of varied habitats.

Keywords. Composition, insular freshwaters, new records, species richness.

INTRODUCTION

Rotifera have been reported from inland freshwaters from distant parts of India since the first faunal survey of Anderson (1889) but these metazoans were firstly documented from insular freshwaters off the Indian mainland by Sharma (2017) based on samples from south Andaman collected during January 1990. Realizing the biodiversity importance of more investigations from insular waters, south Andaman freshwaters are revisited after a time period of 27 years to augment diversity of the taxon vis-à-vis our hypothesis on small lentic ecosystems as interesting rotifer habitats. The rich and diverse rotifer assemblages observed in this study merit interest for the diversity and distribution of the Indian Rotifera. An inventory of the examined species is presented, various new records are illustrated and remarks are made on

composition, richness, new reports, interesting taxa. The results provide useful update for faunal analysis of the taxon off insular freshwaters of these islands located in the Andaman Sea.

MATERIALS AND METHODS

This study is based on analysis of samples collected, during February 2017, from about 40 freshwater ecosystems (Table 1) located between 11° 30.619'N latitude and 92° 43.432' E longitude of south Andamans, Andaman Sea, India (Fig. 1). The plankton and semi-planktonic samples were collected from varied small lentic freshwater bodies by towing a nylobolt plankton net (# 50 µm) and were preserved in 5% formalin. All samples were screened, the rotifers were isolated and mounted in Polyvinyl alcohol–lactophenol, and observed with Leica (DM 1000) stereoscopic phase contrast

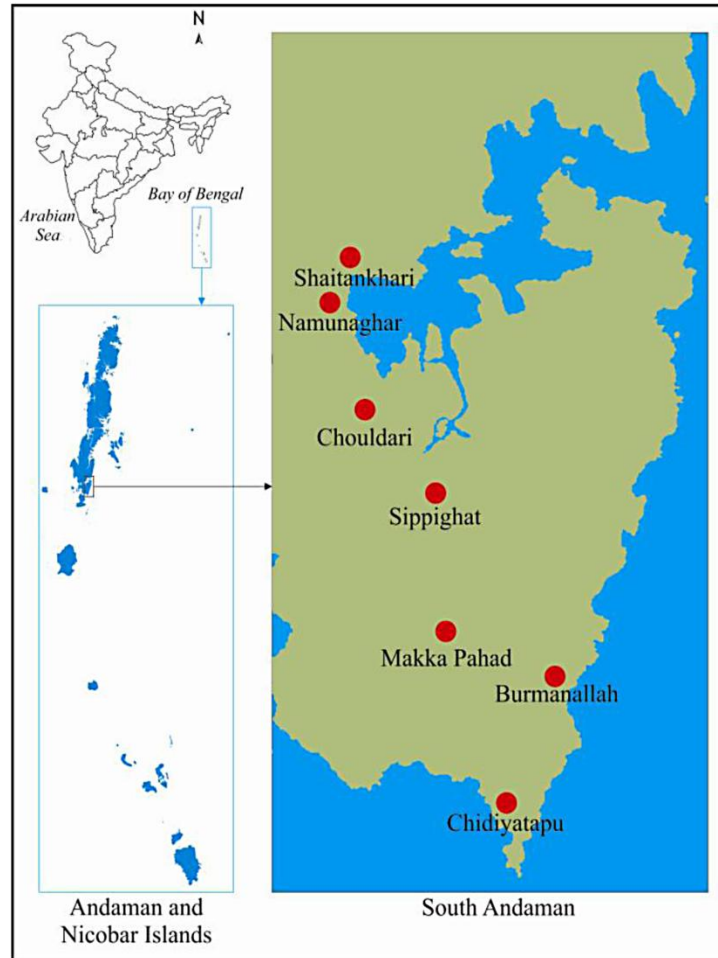


Figure 1. Map of India indicating the Andaman & Nicobar Islands; map of the Andaman & Nicobar Islands indicating south Andaman; map (part) of south Andaman indicating the sampled area (Google map).

microscope fitted with an image analyzer. The works of Koste (1978), Segers (1995), Sharma (1998), Sharma & Sharma (1999, 2000, 2008) were followed for identification of the rotifer taxa. The micro-photographs of some interesting taxa are provided and measurements are indicated in micrometers (μm).

RESULTS

Our collections from freshwaters of south Andaman revealed 112 species of Eurotatoria; a detailed systematic list of the recorded taxa is presented below:

Phylum Rotifera Class Eurotatoria Subclass Monogononta Order Ploima

Family Brachionidae

1. *Anuraeopsis coelata* De Beauchamp, 1932 *
2. *A. fissa* (Gosse, 1851)
3. *Brachionus angularis* Gosse, 1851
4. *B. bidentatus* Anderson, 1889
5. *B. calyciflorus* Pallas, 1766
6. *B. caudatus* Barrois & Daday, 1894 *
7. *B. diversicornis* (Daday, 1883) *
8. *B. donneri* Brehm, 1951 *

9. *B. durgae* Dhanapathi, 1974 *
10. *B. falcatus* Zacharias, 1898
11. *B. forficula* Wierzejski, 1891 *
12. *B. quadridentatus* Hermann, 1783
13. *B. rubens* Ehrenberg, 1838
14. *B. urceolaris* O.F. Muller, 1773 *
15. *Keratella tropica* (Apstein, 1907)
16. *Platyias leloupi* (Gillard, 1967) *
17. *Platyias quadricornis* (Ehrenberg, 1832)
18. *Platonus patulus* (O.F. Müller, 1786)

Family Epiphaniidae

19. *Epiphanes brachionus* (Ehrenberg, 1837)

Family Euchlanidae

20. *Beauchampiella eudactylota* (Gosse, 1886)
21. *Euchlanis dilatata* Ehrenberg, 1832
22. *Dipleuchlanis propatula* (Gosse, 1886)
23. *Tripleuchlanis plicata* (Levander, 1894)

Family Mytilinidae

24. *Lophocharis salpina* (Ehrenberg, 1834) *
25. *Mytilina acanthophora* Hauer, 1938
26. *M. bisulcata* (Lucks, 1912)
27. *M. ventralis* (Ehrenberg, 1830)

Family Trichotriidae

28. *Macrochaetus collinsi* (Gosse, 1867) *
29. *Trichotria tetractis* (Ehrenberg, 1830)
30. *Wolga spinifera* (Western, 1894) *

Family Lepadellidae

31. *Colurella obtusa* (Gosse, 1886)
32. *C. uncinata* (O.F. Müller, 1773)
33. *Lepadella acuminata* (Ehrenberg, 1834)
34. *L. apsida* Haring, 1916
35. *L. biloba* Hauer, 1938
36. *L. costatoides* Segers, 1992
37. *Lepadella dactyliseta* (Stenroos, 1898) *
38. *L. discoidea* Segers, 1993
39. *L. ovalis* (O. F. Müller, 1786)
40. *L. patella* (O.F. Muller, 1773)
41. *L. rhomboides* (Gosse, 1886)
42. *L. triptera* Ehrenberg, 1830
43. *L. (Heterolepadella) apsicora* Myers, 1934
44. *L. (H.) ehrenbergi* (Perty, 1850)
45. *L. (H.) heterostyla* (Murray, 1913)

Family Lecanidae

46. *Lecane aculeata* (Jakubski, 1912)

47. *L. arcula* Haring, 1914
48. *L. batillifer* (Murray, 1913)
49. *L. bifurca* (Bryce, 1892)*
50. *L. bulla bulla* (Gosse, 1851)
L. bulla diabolica (Hauer, 1936)
51. *L. closterocerca* (Schmarda, 1898)
52. *L. curvicornis* (Murray, 1913)
53. *L. decipiens* (Murray, 1913)*
54. *L. doryssa* Haring, 1914*
55. *L. elegans* Haring, 1914*
56. *L. flexilis* (Gosse, 1886)
57. *L. furcata* (Murray, 1913)
58. *L. haliclysta* Haring & Myers, 1926*
59. *L. hamata* (Stokes, 1896)
60. *L. hastata* (Murray, 1913)*
61. *L. hornemanni* (Ehrenberg, 1834)*
62. *L. inermis* (Bryce, 1892)*
63. *L. inopinata* Haring & Myers, 1926
64. *L. lateralis* Sharma, 1978
65. *L. leontina* (Turner, 1892)
66. *L. ludwigii* (Eckstein, 1883)*
67. *L. luna* (O.F. Müller, 1776)
68. *L. lunaris* (Ehrenberg, 1832)*
69. *L. monostyla* (Daday, 1897)
70. *L. nana* (Murray, 1913)*
71. *L. nitida* (Murray, 1913)
72. *L. obtusa* (Murray, 1913)*
73. *L. papuana* (Murray, 1913)
74. *L. pusilla* Haring, 1914*
75. *L. pyriformis* (Daday, 1905)*
76. *L. quadridentata* (Ehrenberg, 1830)
77. *L. signifera* (Jennings, 1896)
78. *L. simonneae* Segers, 1993*
79. *L. stenroosi* (Meissner, 1908)*
80. *L. thienemanni* (Hauer, 1938)
81. *L. undulata* Hauer, 1938*
82. *L. unguitata* (Fadeev, 1925)
83. *L. unguilata* (Gosse, 1887)

Family Notommatidae

84. *Cephalodella gibba* (Ehrenberg, 1830)*
85. *C. mucronata* Myers, 1924*
86. *C. trigona* (Rousselet, 1895)*

Family Scaridiidae

87. *Scaridium longicaudum* (O.F. Müller, 1786)

Family Gastropodidae

88. *Ascomorpha ecaudis* Perty, 1850*

Family Trichocercidae

89. *Trichocerca bicristata* (Gosse, 1887)*
90. *T. bidens* (Lucks, 1912)*

91. *T. cylindrica* (Imhof, 1891)
92. *T. flagellata* Hauer, 1938
93. *T. insignis* (Herrick, 1885)*
94. *T. longiseta* (Schränk, 1802)
95. *T. pusilla* (Jennings, 1903)*
96. *T. rattus* (O.F. Müller, 1786)
97. *T. ruttneri* Donner, 1953*
98. *T. similis* (Wierzejski, 1893)
99. *T. tigris* (O.F. Müller, 1786)*
100. *T. weberi* (Jennings, 1903)

Family Asplanchnidae

101. *Asplanchna brightwelli* Gosse, 1850

Family Synchaetidae

102. *Polyarthra vulgaris* Carlin, 1943

Order Flosculariaceae

Family Floscularidae

103. *Floscularia ringens* (Linnaeus, 1758)
104. *Sinantherina socialis* (Linne, 1758)
105. *S. spinosa* (Thorpe, 1893)*

Family Conochilidae

106. *Conochilus unicornis* Rousset, 1892

Family Hexarthridae

107. *Hexarthra mira* (Hudson, 1871)*

Family Testudinellidae

108. *Pompholyx sulcata* Hudson, 1885*
109. *Testudinella patina* (Hermann, 1783)

Family Trochosphaeridae

110. *Filinia longiseta* (Ehrenberg, 1834)
111. *F. opoliensis* (Zacharias, 1898)

Sub-class Digononta

Order Bdelloidea

Family Philodinidae

112. *Rotaria neptunia* (Ehrenberg, 1832)

*New records from Andaman & Nicobar Islands

Forty-two species (marked*) are new records from Andaman and Nicobar islands while seven

genera namely *Ascomorpha*, *Cephalodella*, *Hexarthra*, *Lophocharis*, *Macrochaetus*, *Pompholyx* and *Volga*, and three Eurotatoria families i.e., Gastropodidae, Hexarthridae and Notommatidae are new additions. *Brachionus donneri* (Fig. 2A), *B. durgae* (Fig. 2B), *Lecane batillifer*, *L. lateralis*, *L. simonneae* (Fig. 2C), *L. unguitata* and *Lepadella discoidea* are elements of biogeographic interest. *Ascomorpha ecaudis* (Fig. 2D), *Cephalodella trigona* (Fig. 2E), *Lecane bifurca*, *L. doryssa*, *L. elegans* (Fig. 2F), *L. haliclysta* (Fig. 2G), *L. hastata* (Fig. 2H), *L. hornemanni*, *L. nana*, *L. obtusa*, *L. pusilla* (Fig. 2I), *L. undulata*, *Lepadella dactyliseta*, *Lophocharis salpina*, *Platyias leloupi* (Fig. 2J), *Trichocerca bicristata*, *T. insignis*, *T. ruttneri* (Fig. 2K), *T. tigris* and *Volga spinifera* (Fig. 2L) are examples of regional distribution interest in India. Lecanidae (38 species) is the most diverse monogonont family; Brachionidae, Lepadellidae and Trichocercidae included 18, 15 and 12 species, respectively. Amongst diverse genera, *Lecane* indicated 38 species while *Lepadella*, *Brachionus*, and *Trichocerca* are represented by 13, 12 and 12 species, respectively.

DISCUSSION

One hundred and twelve species (S), belonging to 32 genera and 19 families of Eurotatoria, observed in our relatively intensive February 2017 collections from south Andaman, indicate rich and diverse Rotifera fauna. The richness comprises ~ 27 % of the rotifer species known from India (Sharma & Sharma 2017) and thus deserves biodiversity interest, and affirms species-rich nature and habitat diversity of the sampled small lentic biotopes. Our report of 42 new species records from freshwaters of the Andaman and Nicobar updates significantly the richness reported from these islands while seven genera and three families are added to the earlier list from south Andaman vide Sharma (2017). Though based on our limited collections, this update is attributed to intensive sampling of varied small wetlands.

Eurotatoria of biogeographic interest (8.0 % of S) reported include the Australasian *Lecane batillifer*; the Oriental *Brachionus donneri* and

Lecane bulla diabolica; the cosmo (sub) tropical *Brachionus durgae*; the palaeotropical *Lecane lateralis*, *L. simonneae*, *L. unguitata* and *Lepadella discoidea*; and the palaeartic *Cephalodella trigona*. Of these, *C. trigona* is known from the Indian sub-region from lower Assam (Sharma et al. 2017); the present report of the Andaman freshwaters thus marked considerable extension of its distribution range. *B. donneri* and *L. simonneae* are known from this country from northeast India (NEI), Kerala and Tamil Nadu and *B. durgae* is characterized by its wider and disjunct distribution. In addition, this study re-affirmed the occurrence of *L. batillifer* and *L. bulla diabolica* from insular freshwaters of Andaman vide a report (Sharma 2017) based on the samples collected about 27 years earlier. Nevertheless, all species currently known from the Andaman freshwaters, except *C. trigona*, are reported from Southeast Asia particularly in the extensively studied Thai Rotifera (Sa-Ardrit et al. 2013).

Our collections indicated several species of regional distribution interest in the Indian sub-region namely *Ascomorpha ecaudis*, *Lecane bifurca*, *L. doryssa*, *L. elegans*, *L. haliclysta*, *L. hastata*, *L. hornemanni*, *L. nana*, *L. obtusa*, *L. pusilla*, *L. undulata*, *Lepadella dactyliseta*, *Lophocharis salpina*, *Platyias leloupi*, *Trichocerca bicristata*, *T. insignis*, *T. ruttneri*, *T. tigris* and *Wolga spinifera*. Amongst these, *Lecane elegans*, *L. haliclysta* and *Trichocerca insignis* are characterized by their distribution restricted to NEI (Sharma & Sharma 2017) while *Ascomorpha ecaudis*, *Lecane bifurca*, *L. doryssa*, *L. pusilla*, *L. undulata*, *Lepadella dactyliseta*, *Platyias leloupi*, *Trichocerca ruttneri*, *T. tigris* and *Wolga spinifera* exhibit restricted distribution in this country. (Sharma & Sharma loc. cit.). The reports of the stated species from south Andaman freshwaters merit biogeography interest for the Indian as well as south and Southeast Asian Rotifera.

Rotifera of the freshwaters of the Andamans is characterized by notable increase in the richness of Lecanidae > Brachionidae > Trichocercidae in

contrast to 21, 12 and 6 species of three families reported earlier by Sharma (2017), respectively while Lepadellidae recorded only marginal increase. The notable two-fold increase of *Brachionus* species is, however, attributed to intensive sampling of limnetic waters of fish ponds while a majority of the sampled water bodies indicated the littoral-periphytic assemblages concurrent with their wetland character. Our collections indicate richness variations in different habitats and some wetlands record up to 30–40 species individually; the last feature corroborated with the reports from the small wetlands (*dubies* or *dobas*) of the Brahmaputra river basin (Sharma & Sharma 2014). In general, Rotifera assemblages highlight importance of ‘tropic centered’ *Lecane* and *Brachionus*, indicate high number of cosmopolitan species (~68% of S), and tropical and subtropical species together contribute ~22 % of S.

To sum up, this study affirms rich and diverse nature of Rotifera assemblage of our relatively extensive yet limited collections and it reiterates the role of small lentic freshwaters of south Andaman as rich habitats for the taxon. The rotifer fauna records considerable species update with notable increase in richness of Lecanidae > Brachionidae > Trichocercidae and notable two-fold increase in *Brachionus* spp. The study highlights more scope to augment Rotifera richness with extension of investigations to insular freshwaters of other parts of large group of the Andaman and Nicobar islands, with emphasis on intensive sampling of varied habitats in general and small wetlands in particular.

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Table 1: List of the sampled localities of south Andaman

Sl. No.	Date of collection	Locality	Latitude	Longitude
1.	07.02.2017	Sippighat	11 ⁰ 34.463' N	92 ⁰ 40.437' E
2.		Sippighat	11 ⁰ 34.469' N	92 ⁰ 40.430' E
3.		Sippighat	11 ⁰ 34.576' N	92 ⁰ 40.406' E
4.		Sippighat	11 ⁰ 35.519' N	92 ⁰ 40.401' E
5.		Sippighat	11 ⁰ 35.515' N	92 ⁰ 40.427' E
6.		Sippighat	11 ⁰ 35.640' N	92 ⁰ 40.601' E
7.		Sippighat	11 ⁰ 36.187' N	92 ⁰ 41.303' E
8.		Sippighat	11 ⁰ 36.266' N	92 ⁰ 41.660' E
9.	08.02.2017	Chouldari	11 ⁰ 36.906' N	92 ⁰ 40.055' E
10.		Chouldari	11 ⁰ 36.719' N	92 ⁰ 40.132' E
11.		Chouldari	11 ⁰ 36.809' N	92 ⁰ 40.415' E
12.		Chouldari	11 ⁰ 36.819' N	92 ⁰ 40.330' E
13.		Chouldari	11 ⁰ 37.019' N	92 ⁰ 40.132' E
14.		Chouldari	11 ⁰ 37.005' N	92 ⁰ 40.078' E
15.		Chouldari	11 ⁰ 37.119' N	92 ⁰ 40.118 E
16.		Chouldari	11 ⁰ 37.108' N	92 ⁰ 40.204' E
17.		Chouldari	11 ⁰ 37.919' N	92 ⁰ 40.324' E
18.		Chouldari	11 ⁰ 38.808' N	92 ⁰ 40.002' E
19.		Chouldari	11 ⁰ 38.005' N	92 ⁰ 39.889' E
20.		Chouldari	11 ⁰ 38.119' N	92 ⁰ 39.902' E
21.		Chouldari	11 ⁰ 38.310' N	92 ⁰ 39.926' E
22.		Chouldari	11 ⁰ 37.876' N	92 ⁰ 39.941' E
23.		Chouldari	11 ⁰ 37.652' N	92 ⁰ 39.832' E
24.		Chouldari	11 ⁰ 37.919' N	92 ⁰ 39.711' E
25.		Chouldari	11 ⁰ 37.964' N	92 ⁰ 39.889' E
26.	09.02.2017	Namunaghar	11 ⁰ 40.280' N	92 ⁰ 40.654' E
27.		Namunaghar	11 ⁰ 41.873' N	92 ⁰ 40.773 E
28.		Shaitankhari	11 ⁰ 41.658' N	92 ⁰ 40.721' E
29.		Shaitankhari	11 ⁰ 41.534' N	92 ⁰ 40.732' E
30.		Shaitankhari	11 ⁰ 42.703' N	92 ⁰ 40.303' E
31.		Shaitankhari	11 ⁰ 42.849' N	92 ⁰ 40.441' E
32.		Shaitankhari	11 ⁰ 43.049' N	92 ⁰ 39.951' E
33.	Shaitankhari	11 ⁰ 43.164' N	92 ⁰ 39.972' E	
34.	10.02.2017	Chidiyatapu	11 ⁰ 30.619' N	92 ⁰ 42.411' E
35.		Chidiyatapu	11 ⁰ 30.631' N	92 ⁰ 42.332' E
36.		Chidiyatapu	11 ⁰ 30.629' N	92 ⁰ 41.499' E
37.	10.02.2017	Chidiyatapu	11 ⁰ 30.688' N	92 ⁰ 41.651' E
38.		Burmahnallah	11 ⁰ 33.652' N	92 ⁰ 43.432' E
39.		Burmahnallah	11 ⁰ 33.617' N	92 ⁰ 43.417' E
40.		Makka Pahad	11 ⁰ 34.418' N	92 ⁰ 43.157' E

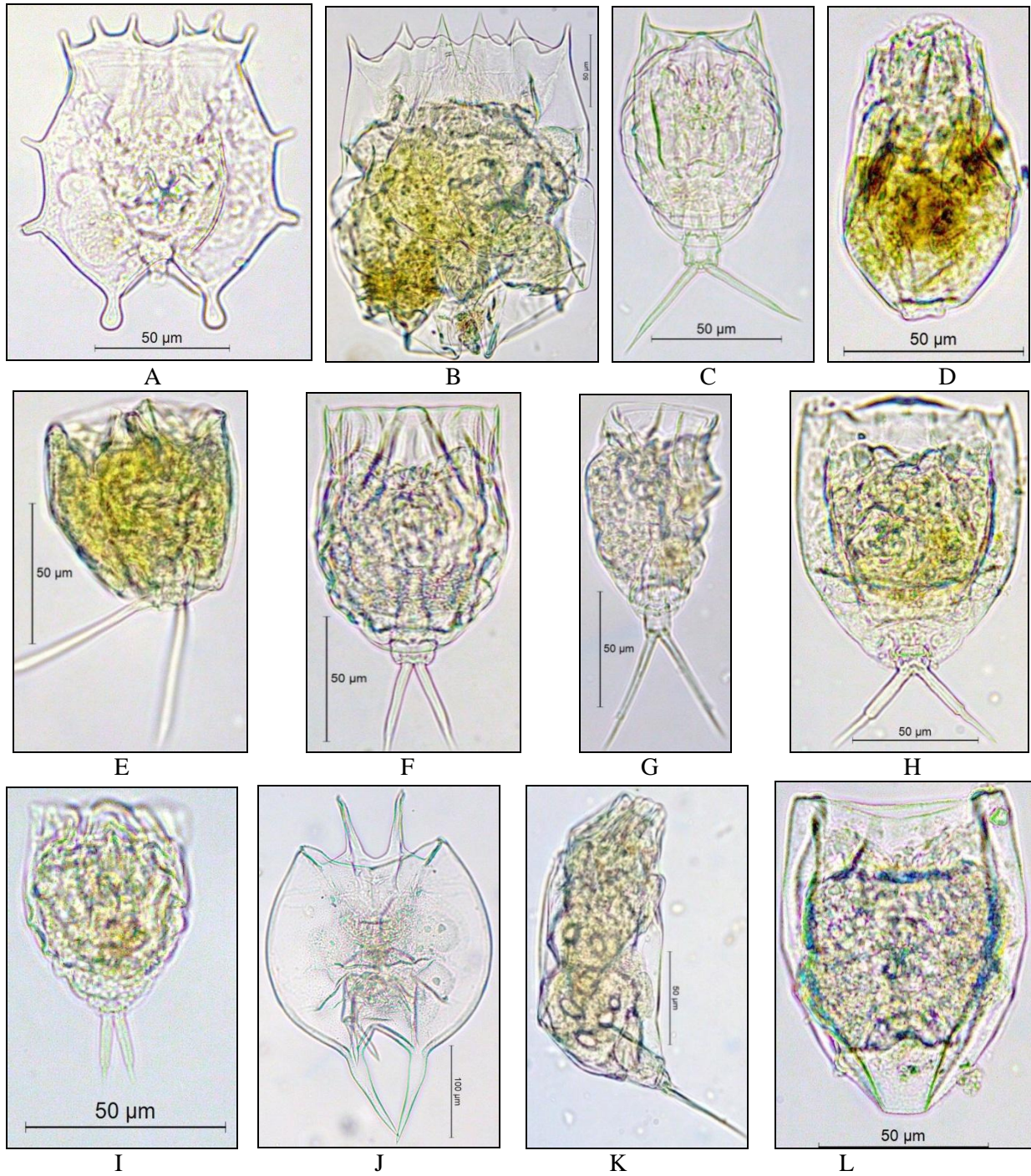


Figure 2. Interesting rotifer species: A = *Brachionus donneri* Brehm, dorsal view; B = *B. durgae* Dhanapathi, dorsal view; C = *Lecane simonneae* Segers, dorsal view; D = *Ascomorpha ecaudis* Perty, dorsal view; E = *Cephalodella trigona* (Rousselet), lateral view; F = *Lecane haliclysta* Harring & Myers, ventral view; G = *L. elegans* Harring, dorsal view; H = *L. hastata* (Murray), ventral view; J = *L. pusilla* Harring, dorsal view; I = *Platyias leloupi* (Gillard), ventral view; K = *Trichocerca ruttneri* Donner, lateral view; L = *Wolga spinifera* (Western), ventral view.

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