



New Records of Rotifer Fauna in the Upper Cambodian Mekong River Basin

SEANGHUN MEAS*

Centre for Biodiversity Conservation, Department of Biology, Faculty of Science,
Royal University of Phnom Penh, Phnom Penh, Cambodia
Email: meas_seanghun@yahoo.com

RATHA SOR

Centre for Biodiversity Conservation, Faculty of Science, Royal University of Phnom Penh,
Phnom Penh, Cambodia

Received 18 December 2012 Accepted 30 January 2013 (*Corresponding author)

Abstract Rotifer samples were seasonally collected in 2010 from ponds, lakes, reservoirs and rivers in the upper part of the Cambodian Mekong River in Kratie, Stung Treng and Ratanakiri Provinces. A 30 µm mesh plankton net was used to collect samples. The water quality parameters: temperature, pH, electrical conductivity, turbidity and dissolved oxygen were also collected from each of the sampled sites. A total of 175 species of Monogononta Rotifers were found, 64 of which were new Cambodian species records. This investigation brings the total number of rotifers identified from Cambodia to 260 species. Of the 4 habitat types, ponds had the highest species richness, followed by lakes, reservoirs and rivers.

Keywords rotifers, species richness, Mekong River basin, Cambodia

INTRODUCTION

Rotifers are microscopic zooplanktons that are mostly found in freshwater, although they have also been recorded from saline waters and terrestrial environments, including moist tree bark. Rotifer are very important to aquatic food webs as they provide a food source for other aquatic animals, including larger zooplankton and fish larvae in both natural and human made habitats and improving the water quality by the consumption of algae (Beres et al., 2005; Tasevska et al., 2010).

Several studies of rotifers have been conducted in Cambodia and new species records continue to be found. Bēzins (1973) found several species, *Anchitestudinella mekongensis*, *Brachionus donneri*, *Filinia camasecla*, and *Lecane blachei* in the Mekong River near Phnom Penh City. A biomonitoring program along the Lower Mekong River Basin subsequently recorded at least 65 species in the Cambodian Mekong River basin (Davidson et al., 2006 & Vongsombath et al., 2009). The number of rotifer species was substantially increased by Meas & Sanoamuang (2008) who found 143 species, of which 102 species were new country records. Data have also been collected on seasonal changes of plankton and zoobenthos in Tonle Sap Great Lake but the identity of these species was not presented (Ohtaka et al., 2010). The first description of sessile rotifers was recently conducted and 23 species were found, all of them were new country records to (Segers et al., 2010). Furthermore, at least 79 species of rotifer were found in ponds from the north of Cambodian Mekong River basin, seventeen of them were new records in Cambodia (Min et al., 2011), one of which *Lepadella punctata* is considered to be rare in Thailand (Chittapun et al., 2003). The most recent study found one hundred and seven species in lakes and reservoirs from the northern part of the Cambodian Mekong River basin, twenty-five of them were new country records (Sor et al., 2011).

According to rotifer distribution known to Southeast Asia (Segers, 2001, 2007), most of the species found in Cambodia are considered common or cosmopolitan species, except a few which were endemic to Southeast Asia. These endemic species include *Anchitestudinella mekongensis* Bēzins, 1973, *Brachionus murphyi* Suzuki, 1996, *Cephalodella songkhlaensis* Segers &

Pholpunthin, 1997, *Keratella edmonsoni* Ahlstrom, 1943, *Lecane blachei* Bērziņš, 1973, *L. superaculeata* Sanoamuang & Segers, 1997, and *L. thailandensis* Segers & Sanoamuang, 1994.

OBJECTIVE

This investigation aimed to explore the diversity of rotifers in the Upper of Cambodian Mekong River Basin from 4 different habitats within 2 different seasons in the year 2010.

METHODOLOGY

A total of 64 rotifer samples were seasonally collected from rivers, lakes, reservoirs, streams and ponds (Table 1) in three provinces in northeast Cambodia (Fig. 1), Forty samples were collected in the late dry season from 25th to 30th April 2010 from 4 habitat types, and twenty four samples were collected in the late rainy season from 7th to 12th November 2010 from only 3 habitat types (excluding river samples) using a 30 micrometer mesh plankton net (Table 1). A sample was obtained by dragging the net 15 times through open water in each habitat. All samples were preserved by adding a small volume of 4% formalin. Environmental parameters measured at each sampled locality included water temperature, pH, conductivity (pH/EC/TDS/Temperature, model HI 98129 • HI 98130, HANNA Instruments company), turbidity (ISO Portable Turbidity meter, model HI 98713, HANNA Instruments company), and dissolved oxygen (Dissolved Oxygen Meter, model HI 9146, HANNA Instruments company). The locations of the sampling sites were recorded using a Global Positioning System (GPS). The sampling sites are part of a detailed study to evaluate rotifer distribution and diversity in the upper part of the Cambodian Mekong River basin, which in turn may serve as a baseline study for assessing the change of water quality in this region.

Rotifers were identified of species level under a compound microscope using published keys (Segers, 1995; de Smet & Pourriot, 1997; Nogrady & Segers, 2002). Photographs of rotifers were taken using an Olympus BX51 attached to the microscope. Species nomenclature follows Segers (2007).

Correlation analysis was carried out to determine whether there was any linear relationship between species counts and the various environmental parameters measured.

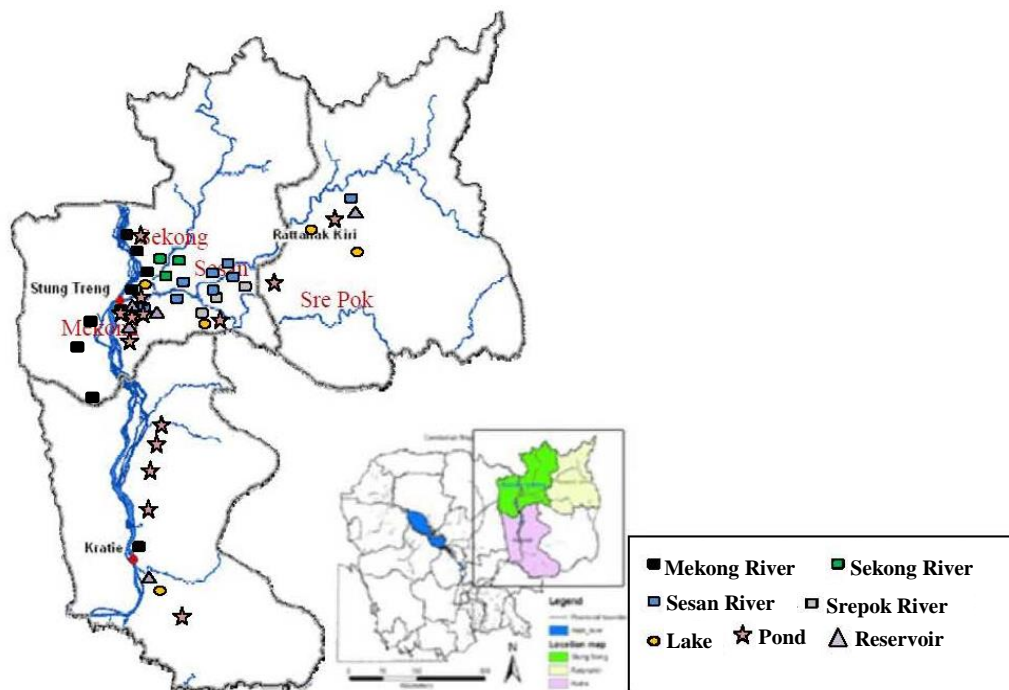


Fig. 1 Study area

Table 1 Number of samples in each habitat types

Habitat types	Number of Samples		Total Number of Samples	Total Number of Sampled Localities
	Late dry season	Late rainy season		
River	20	0	20	20
Pond	10	14	24	14
Reservoir	5	5	10	5
Lake	5	5	10	5
Total	40	24	64	44

RESULTS AND DISCUSSION

One hundred and seventy five species of rotifers were recorded from this study, 64 of which were new Cambodian species records (Table 2). The highest number of species found was in a pond in Stung Treng Province collected in April 2010 with 44 species (44 of 175 species= 25.14%), followed by a reservoir sampled in November 2010 (39/175 species= 22.28%) also in Stung Treng Province. The lowest number of species from a sample was collected from a pond in Ratanakiri Province with only 3 species (3/175 species= 1.71%). However a sample from the Mekong River in Kratie Province contained no rotifers.

Overall the highest number of species were found in ponds (e.g. a pond Stung Treng Province, 44 species), followed by lake and reservoir, with the river tending to support few species (0 species at a Mekong River site in Kratie Province).

Common species were *Keratella tropica* (found in 42 of 64 samples = 67.18%), followed by *Anuraeopsis fissa* (41/64 samples = 64.06%), *Lecane bulla* (38/64 samples = 59.37%), *A. coelata* (36/64 samples =56.25%), *Brachionus angularis* and *K. cochlearis* (34/64 samples = 53.12%). Fifty species were found in only one sample (1.56%).

Conductivity, turbidity, pH and temperature data obtained from ponds, lakes and reservoirs were seasonally compared to the number of rotifer species collected from each of the habitats. For conductivity, the number of species seems to be positively correlated in lakes and reservoirs while it tends to be negatively correlated in ponds (Fig. 2), that is the lower the conductivity, the lower the number of rotifer species expected. This finding is in agreement with the study of Jersabek (1995) that found the low numbers of rotifer species at sites with low conductivity. This is more likely to be true in this study because ponds have a higher conductivity and support more species than lakes and reservoirs which have a lower conductivity (Fig. 3).

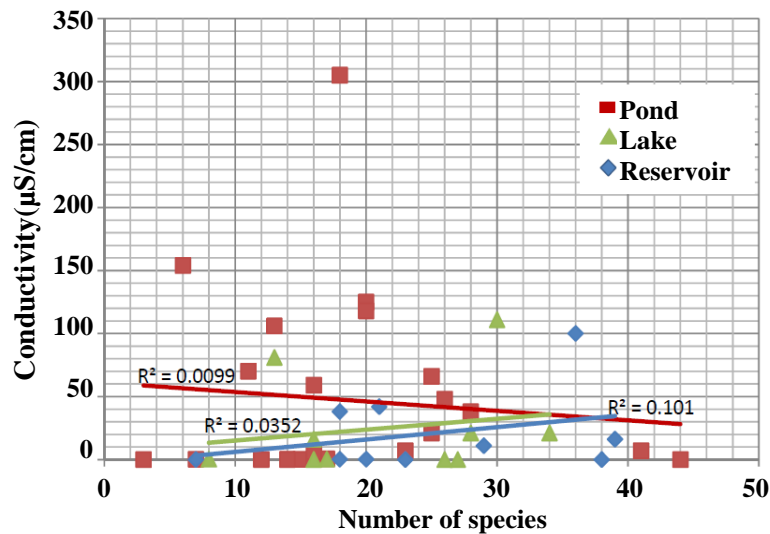


Fig. 2 Correlation between number of species and the level of conductivity in ponds, lakes and reservoirs

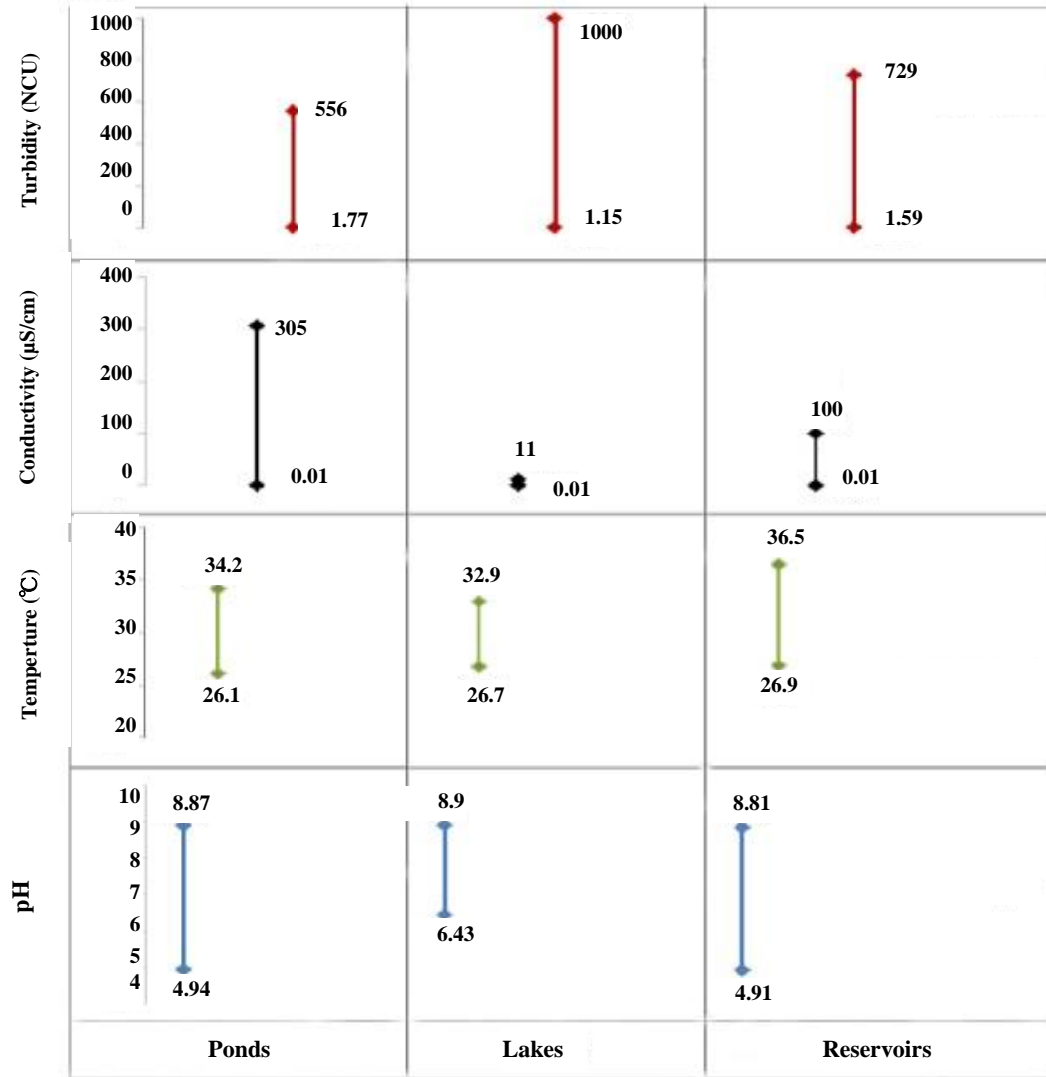


Fig. 3 Range of each water quality parameter in each habitat type

Water temperature is also considered to be one of the most important factors influencing the rotifer community. In this study, the numbers of rotifer species were not significantly correlated with water temperature. This could result from the life history and adaptation of each species to a particular temperature range; for example, *Synchaeta* sp. *Nothola squamula*, *Polyarthra dolichoptera*, *Brachionus angularis*, *Keratella quadrata* and *K. hiemalis* were found out to be negatively correlated with the water temperature (Devetter, 1998).

The other parameters were not found to be significantly different among the three habitat types. The range value of each parameter in each habitat type from site to site. Among the three habitat types, lakes showed a smallest (conductivity) and widest (turbidity) range values (Fig. 3).

Cosmopolitan: Found in at least five of the eight biogeographic regions of the world (Afrotropical, AFR; Antarctic, ANT; Australian, AUS; Nearctic, NEA; Neotropical, NEO; Oriental, ORI; Pacific, PAC; Palearctic, PAL) according to Segers (2007).

CONCLUSION

This study increased the number of new rotifer species records from Cambodia by 64. Ponds, lakes and reservoirs were found to contain a greater number of rotifer species than the river sites which tended to be low. This difference is most likely a result of the high flow in the river providing unsuitable habitat for these tiny organisms which may reduce both the number of species that can

survive in this habitat and their density. In addition to flow the conductivity of the water body appeared likely to be important in determining the number of rotifer species found in particular habitats.

Table 2 New records for Cambodia, their incidence in the present study and occurrence elsewhere

No	Species	Records elsewhere
1	<i>Anuraeopsis navicula</i>	AUS, NEA, NEO, ORI, PAL
2	<i>Asplanchna tropica</i>	AFR, ORI.
3	<i>Brachionus amazonicus</i>	NEO
4	<i>B. sessilis</i>	Cosmopolitan.
5	<i>Cephalodella forficula</i>	AUS, NEA, NEO, ORI, PAC, PAL
6	<i>C. hollowdayi</i>	NEO.
7	<i>C. intuta</i>	Cosmopolitan.
8	<i>C. mucronata</i>	AFR, AUS, NEA, NEO, ORI, PAL
9	<i>C. songkhlaensis</i>	ORI, Thailand.
10	<i>C. tenuior</i>	ANT, AUS, NEA, ORI, PAL
11	<i>C. ventripes</i>	Cosmopolitan; Thailand
12	<i>C. xenica</i>	NEA, PAL
13	<i>Colurella colurus</i>	-
14	<i>C. hindenburgi</i>	Cosmopolitan
15	<i>C. obtusa</i>	Cosmopolitan; Thailand
16	<i>C. sulcata</i>	Cosmopolitan, Thailand, Lao PDR.
17	<i>Conochilus coenobasis</i>	Cosmopolitan, Thailand, Lao PDR.
18	<i>Dicranophorus corystis</i>	NEA, PAL
19	<i>Encentrum felis</i>	AUS, NEA, NEO, PAL; Laos
20	<i>Gastropus hyptopus</i>	Cosmopolitan, Thailand.
21	<i>Itura aurita</i>	Cosmopolitan; Thailand
22	<i>Lepadella monodactyla</i>	-
23	<i>Lecane arcuata</i>	Cosmopolitan; Thailand
24	<i>L. aspasia</i>	NEA, NEO, ORI, PAL; Thailand
25	<i>L. batillifer</i>	AUS, ORI; Thailand
26	<i>L. braumi</i>	AFR, AUS, ORI, Thailand.
27	<i>L. calcaria</i>	NEA, ORI
28	<i>L. fl exilis</i>	Cosmopolitan; Thailand
29	<i>L. inermis</i>	Cosmopolitan, Thailand, Lao PDR.
30	<i>L. inopinata</i>	Cosmopolitan; Thailand
31	<i>L. nelson</i>	AFR, NEO, ORI, Thailand.
32	<i>L. nitida</i>	AFR, AUS, NEO, ORI, Thailand, Lao PDR.
33	<i>L. pumila</i>	AFR, AUS, ORI, PAL
34	<i>L. pyriformis</i>	Cosmopolitan, Thailand.
35	<i>L. schraederi</i>	ORI
36	<i>L. simonneae</i>	AFR, ORI
37	<i>L. tenuiseta</i>	Cosmopolitan; Thailand
38	<i>Lepadella ehrenbergi</i>	Cosmopolitan, Thailand.
39	<i>L. punctata</i>	ORI, PAL; Thailand
40	<i>L. triptera</i>	Cosmopolitan, Thailand.
41	<i>Macrochaetus longipes</i>	Cosmopolitan; Thailand
42	<i>Microcodon clavus</i>	AFR, ANT, AUS, NEA, NEO, ORI, PAL
43	<i>Monommata actices</i>	Cosmopolitan, Thailand.
44	<i>M. caudata</i>	NEA, PAL
45	<i>M. longiseta</i>	Cosmopolitan*, Thailand, Lao PDR.
46	<i>Notommata collaris</i>	Cosmopolitan*.

*Although considered cosmopolitan, this species was not listed in ORI by Segers (2007).

Table 3 New records for Cambodia, their incidence in the present study and occurrence elsewhere (Cont.)

No	Species	Records elsewhere
47	<i>N. endoxa</i>	NEA
48	<i>N. tripus</i>	Cosmopolitan.
49	<i>Polyarthra dolichoptera</i>	AFR, AUS, NEA, ORI, PAC, PAL
50	<i>Resticula melandocus</i>	AFR, AUS, NEA, NEO, ORI, PAL
51	<i>Scaridium bostjani</i>	Cosmopolitan, Thailand, Lao PDR.
52	<i>Squatinella lamellaris</i>	Cosmopolitan, Thailand, Lao PDR.
53	<i>S. leydigi</i>	AUS, NEA, NEO, PAL.
54	<i>Synchaeta oblonga</i>	Cosmopolitan
55	<i>Taphrocampa selenura</i>	AFR, AUS, NEA, NEO, ORI, PAL
56	<i>Testudinella truncata</i>	AFR, NEA, PAL
57	<i>Trichocerca bidens</i>	Cosmopolitan, Thailand, Lao PDR.
58	<i>T. collaris</i>	AFR, AUS, NEA, NEO, ORI, PAL
59	<i>T. heterodactyly</i>	species inquirenda
60	<i>T. iernis</i>	Cosmopolitan; Laos
61	<i>T. macera</i>	AFR, AUS, NEA, PAL
62	<i>T. scipio</i>	Cosmopolitan; Laos
63	<i>T. tenuior</i>	Cosmopolitan, Thailand, Lao PDR.
64	<i>Trocospaera aequatorialis</i>	AUS, NEA, NEO, ORI, PAL.

ACKNOWLEDGEMENTS

This work was supported by the Centre for Biodiversity Conservation (CBC), Faculty of Science, Royal University of Phnom Penh and Fauna & Flora International, Cambodia.

REFERENCES

- Baribwegure, D. and Segers, H. 2001. Rotifera from Burundi: the lepadellidae (Rotifera: Monogononta). *Hydrobiologia*, 446/447, 247-254.
- Beres, K.A., Wallace, R.L. and Segers, H. 2005. Rotifers and hubbell's unified neutral theory of biodiversity and biogeography. *Natural Resources Modeling*, 18(3), 363-376.
- Berzins, B. 1973. Some rotifers from Cambodia. *Hydrobiologia*, 41(4), 453-459.
- Chittapun, S., Pholpunthin, P. and Segers, H. 2003. Contribution to the knowledge of Thai microfauna diversity: notes on rare peat swamp Rotifera, with the Description to a new Lecane Nitzsch, 1872. *Hydrobiologia*, 501, 7-12.
- Davidson, S.P., Kunpradid, T., Peerapornisal, Y., Nguyen T.M.L., Pathoumthong, B., Vongsambath, C. and Pham, A.D. 2006. Biomonitoring of the lower Mekong River and Selected Tributaries. MRC Technical Paper No. 13, Mekong River commission, Vientiane, Lao PDR.
- Devetter, M. 1998. Influence of environmental factors on the Rotifer assemblage in an artificial lake. *Hydrobiologia*, 387/388, 171-178.
- Jersabek, C.D. 1995. Distribution and ecology of rotifer communities in high-altitude alpine sites-a multivariate approach. *Hydrobiologia*, 313/314, 75-89.
- Meas, S. and Sanoamuang, L. 2008. Rotifer communities in the Cambodian Mekong River basins. *KKU Res. J (GS)*, 8(2), 18-30.
- Min, M., Wong, K.K.W. and Meas, S. 2011. Rotifer fauna in pond samples from the upper Cambodian Mekong river basin, *Cambodian Journal of National History*, 2011(1), 14-22.
- Ohtaka, A., Watanabe, R., Im, S., Chhay, R. and Tsukawaki, S. 2010. Spatial and seasonal changes of net plankton and zoobenthos in lake Tonle Sap, Cambodia. *Limnology*, 11(1), 85-94.
- Segers, H. 2001. Zoogeography of the southeast Asian Rotifera. *Hydrobiologia*, 446/447, 233-246.
- Segers, H. 2003. A biogeographical analysis of rotifers of the genus *Trichocerca* Lamarck, 1801 (*Trichocercidae*, *Monogononta*, *Rotifera*), with notes on taxonomy. *Hydrobiologia*, 500, 103-114.
- Segers, H. and Chittapun, S. 2001. The interstitial Rotifera of a tropical freshwater peat swamp on Phuket island, Thailand. *Belg. J. Zoo*, 131, 65-71.
- Segers, H. and De Smet, W. H. 2008. Diversity and endemism in Rotifera: A review, and *Keratella* Bory de St Vincent. *Biodiversity and Conservation*, 17, 303-316.

- Segers, H. 2007. Annotated checklist of the rotifers (Phylum Rotifera), with notes on nomenclature, taxonomy and distribution. *Zootaxa*, 1564, 1-104.
- Segers, H., Meksuwan, P. and Sanoamuang, L. 2010. New records of sessile Rotifers (Phylum Rotifera: Flosculariacea, Collotheceae) from southeast Asia. *Belg. J. Zool.*, 140(2), 235-240.
- Sor, R., Meas, S. and Segers, H. 2011. Comparison of the rotifer fauna between lakes and reservoirs in the upper part of the Cambodian Mekong River Basin. Royal University of Phnom Penh.
- Tasevska, O., Kostoski, G. and Guseska, D. 2010. Rotifers based assessment of the lake dojran water quality. Ohrid, Republic of Macedonia, 25, 1-8.
- Wallace, R.L., Snell, T.W., Ricci, C. and Nogrady, T. 2006. *Rotifera: Biology, ecology and systematics*. Second edition. Kenobi productions, Ghent, Belgium, and Backhuys Publishers, Leiden, Netherlands.