Rotifer News

A newsletter for rotiferologists throughout the world

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In this issue:

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Editorial: *New developments in Rotifer News (RN) 2022*

Following the release of *Rotifer News* Issue 34, a lot of enthusiasm has been re-initiated among rotiferologists globally. Several suggestions have been received for improvements not only in future issues of RN but also in the RN Website (RNW). These will be implemented in the near future. During the regular Virtual Rotifer Collaboratorium (VCR), Bob Wallace suggested adding a unit on the RN website about the Repository of data. It has been already added to the RNW. It is hoped that rotifer workers in future would add the raw data from their previously published works. Another development in the RNW has been the addition of a unit of updates. This helps users check the updates easily. The unit of Rotifer Images now also includes videos (see *Atrochus tentaculatus*).

As in the RN 34, the current issue also carries some historical photos of participants of the previous International Rotifer Symposia. From the RN issue 36 onwards, some photos of historical importance of prominent rotifer workers who gave talks in different workshops will be included. In the analysis on the Bibliometry of Rotifera, two most cited articles, surprisingly missing from the databases Web of Science and Scopus (with rotifer* as subject or keyword) are included in this issue. A. Herzig, Advisory Board Member (RN), is co-author of one these works.

Availability of rotifer identification keys is essential for the studies on taxonomy and ecology of this group. Specialized guides on different Families of Rotifera, which were initiated by HJ Dumont, still serve for rotifer identification and a few more guides are yet to appear. Other sources such as chapters on rotifers in general zoology reference works such as the Thorp and Covich's Freshwater Invertebrate volumes are also valuable for both ecology and taxonomy of Rotifera. Some regional guides on Rotifer Identifications can be also useful, although the text may be in languages other than English language. The front pages of two such Identification guides are included in this issue. If such guides from other regions are available, the authors are encouraged to submit front pages for inclusion in the future RN issues. Beautiful artwork using rotifers as the subject is on the lighter side of our research in this group.

Since this issue, the Rotifer News has received endorsement from the International Society of Limnology (SIL), and thus the logo of SIL decorates our newsletter. Updated information on the XVI International Rotifer Symposium is now available in the Rotifer News website and in this issue of the newsletter.

The Abstracts from the VRC have been included in this issue. Also, abstracts containing Rotifer* from the SIL 2021 have been added with permission from SIL.

Rotifer News wishes you happy new year 2022

S.S.S. Sarma

XVI Rotifer Symposium: update

Zagreb (Croatia), Sept. 5-9, 2022

Dear colleagues, Rotifer family:

Registration for Rotifera XVI is open!
Registration for the long-awaited IRS ROTIFERA XVI, 5 to 9 September 2022 in Zagreb, Croatia, is open! After two years of living with the COVID virus, and although it is still a threat, we are hopeful that it won't obstruct us in holding the conference. You are all invited to present your research related to Rotifera (Seisnoida, Bdelloidea, Monogononta) and their phylogenetically related groups (e.g., Acanthocephala) and participate in the activities of the conference.

You can submit your participation through the Registration Form.

Opportunity: Donation
For young scientists (≤30 years old) and/or researchers from countries with low GDP, a few anonymous donors have provided funds to cover the cost of the registration fee for Rotifera XVI. Note that these funds will cover only a limited number of participants. Candidates interested in this opportunity are invited to contact us using the conference email address before January 31, 2022. In that email please provide (1) a short narrative that explains your circumstances and (2) your Curriculum vitae (≤ 250 words). We will send you the final decision as soon as possible.
Do not hesitate to send us your CV or other possible questions on email rotiferaXVI@biol.pmf.hr

More info

Best wishes,
Maria Špoljar

On behalf of Rotifera XVI Organizing Committee

Conversations from the Rotifer Family

The first lively conversation from the "Rotifer Family" was initiated by RL Wallace on 17th Feb. 2015 by raising the question of using Trophi vs Trophus. This was followed by a series of interesting opinions. Because the discussion on this topic was hidden within communications among members on the Oldenburg serverlist, this information may not be available for other non-members. Considering the importance of this topic, it has been decided to make it available to the global rotiferologists. The email correspondence follows the date and time based on US central time. The original messages were edited slightly.
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17 February 2015 at 16:16
Rotifer community
Is the word "trophi" plural and "trophus" singular? OR do we use

Is the word "trophi" plural and "trophus" singular? OR do we use "trophi" for both singular and plural, like the biological species (singular) and species (plural). That is, in contrast to international currency: specie (singular) [i.e., dollar, pound, euro] and species (plural) [i.e., dollars, pounds, euros]. I've heard it both ways.
Robert L. Wallace

17/02/2015 01:16 PM
Given that it the term has been swallowed --so to speak-- by English, I think that we could make it into whatever we want to make it. Sort of like the word Television, which I have been informed by our Latinist here is a combination of Latin and Greek.
Robert L. Wallace

17/02/2015 11:05 AM
I thank all of my colleagues for their comments. You have confirmed my understanding of this grammatical issue. Now I am well armed to inform an editor that he or she is wrong!
Robert L. Wallace

Feb 17, 2015 at 11:27 AM
I Googled it. Several sources say the singular is trophus. Now, does that refer to the whole thing, or to one of the two sides, as in upper jaw and lower jaw?
C. William Birky, Jr.,

17/02/2015 16:25 PM
I think that trophi should always be plural. Trophi are a composite element. So, the noun trophi should behave like in scissors or trousers, which are composite elements that do not exist in the singular form. But I have no idea if this rule holds true in English or not ...
Diego Fontaneto

February 17, 2015 8:58 AM
I fully agree with Diego.
Marina Manca

17/02/2015 12:29 PM
Well, just to try to make things more clear, on the basis of a Latin culture root, I wish to make clear the use of some words. The term 'species' is a latin noun, and belongs to fifth declination (singular nominative: species; genitive: speciei, and plural nominative: species, plural genitive: speciorum). As for the term trophi, I agree with Diego.
Cited from Hudson & Gosse 1886 'The Rotifera or Wheel Animalcules' at page 7, under the paragraph 'The Mastax' it is reported ... 'the contained hard parts,or trophi, consists of two hammer-like bodies, the mallei, and of a third anvil-piece, called the incus, etc.'
Thus the term 'trophi' is plural, and refers to a structure made of multiple elements.
Claudia Ricci

17/02/2015 19:46
In my opinion no. Trofè (in ancient greek) means food. And trophic is the adjective referred to food (ex. trophic chain, oligotrophic lake, etc). But the word 'trophi' or 'trophus' does not exist in ancient greek.
Claudia Ricci

17/02/2015 04:19 PM
Claudia is right, the root of the word is Greek: the most proximate word is the adjective "trophis", plural "trophi", which means "well fed". It is the same root of the nouns "trophè" (food) and tropheia (food, but also salary). According to the origin of the word, singular would be, in case, "trophis", not "trophus". However, singular is not adequate for the reason provided by Diego, in my opinion.
Marina Manca

Feb 17, 2015 at 12:11 PM
It seems that trophi originates from Greek…. makes the singular term trophus admissible? From Merriam Webster
“2: the masticating organs of a rotifer including the incus and the two mallei; broadly: mastax.
Origin of TROPHI New Latin, plural of trophus mouth, from Greek trophos feeder, from trophein to nourish. From Dictionary of Invertebrate Zoology: trophi (noun, plural; singular trophus; Greek trophe, food): 1. (Arthropoda) The mouth parts, especially of insects and barnacles, collectively.
2. (Rotifera) The mastacatory apparatus of the mastax”
Christian Jersabek

17-02-2015 17:42
The German word for trousers is „Hose“, and for scissors we have “Schere”. Both are in singular form, as we regard them as single functional units.
I think that if we speak of it as one functional unit, the singular form trophus should be used. If we look at it as a set of trophic elements, trophi may also be legitimate. The latter only sounds weird to me if used for the one unity that I can isolate from a single specimen. Apparently people see it differently depending on what their native tongue is.
A comparable English term perhaps is skeleton (sing.), similarly a set of elements tied together by ligaments and muscles.
Why don’t we vote? – Could be interesting to hear what the family thinks and how the result would relate to languages.
Christian Jersabek

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17 Februar 2015 17:50
"Trophi" is a Latin word, and the word in Latin is "permanently plural", or so my teacher in rotiferology Mrs Margareta De Ridder - who was knowledgeable on these things - repeatedly corrected me (:-)) when I used the singular "trophus". Her explanation was exactly that which Diego gave. So I'd side with Diego on this.
Hendrik Segers

18/02/2015 04:54 AM
Comment of Diego correct
De Smet Willem

18/02/2015 10:00 AM
There is some precedence for using the singular as Trophi. Ruttner-Kolisko's Die Binnengewasser (English translation) uses "trophi" in places where the word should be singular on pages 6-7, e.g., Fig 5 referring to a single image of the mastax+trophi, and the first sentence on page 7 discussing the "trophi of

any rotifer." In this example, she refers to the trophi as encompassing both upper and lower portions (fulcrum, rami, unci, manubria).

Hilary Smith

10/10/2021 11:00 AM (*conclusion*)

We have not picked up this discussion for some time. When I posed it early in 2015 I was engaged in a debate with an editor over use of trophus vs. trophi. That conversation started because I used trophi in a sentence that read something like "The trophi of the genus *Ptygura* is termed malleoramate." The editor wanted me to use trophus, and argued that *Danio rerio* (zebrafish) was a species of fish, but that *Lepomis gibbosus* (pumpkinseed), *Lepomis cyanellus* (green sunfish), and *Lepomis macrochirus* were fishes. I do not remember which opinion won the day for that publication. Now I am of two opinions on the matter. The first is that authors may use whatever term the publisher (editorial staff) permits; if the sentence is well written we will understand what you mean from the context. The second is that if we must settle on one way to identify the rotiferan jaw — either as trophus (singular) and trophi (plural) or trophi (inclusive for both) — I prefer the collective use. Thus I might say that "The malleoramate trophi of *Ptygura beauchampi* are adapted to process small particles, as are the trophi of all *Ptygura* and indeed all species in family Flosculariidae."

Robert L. Wallace

Virtual Rotifer Collaboratorium

During the last few months of 2021, we had three interesting sessions of the Virtual Rotifer Collaboratorium (VRC) (see screen shots). We discussed some details on the upcoming IRS-16 in Croatia with Maria Spoljar; I believe she found some of the comments and ideas proposed by Linda May, Bob Wallace and SSS Sarma useful. This session was followed by a talk on marine and freshwater rotifers in Greece by Evangelia Michaloudi. The talk was very interesting as was the study site; the Aristotle University of Thessaloniki situated right on the Aegean Sea coast. The prospect of walking out of the laboratory, collecting marine samples and returning to study them is just fascinating. Evangelia's talk was followed by a presentation on rotifers associated with macrophytes in Polish water bodies by Natalia K Kippen, in December, 2021. The presentation was very informative and generated a healthy discussion. The talks by Evangelia and Natalia stimulated generated a lot of ideas; hopefully some of the researchers present at these events will take these up for further investigation.

S. Nandini

Organizer, Virtual Rotifer Collaboratorium

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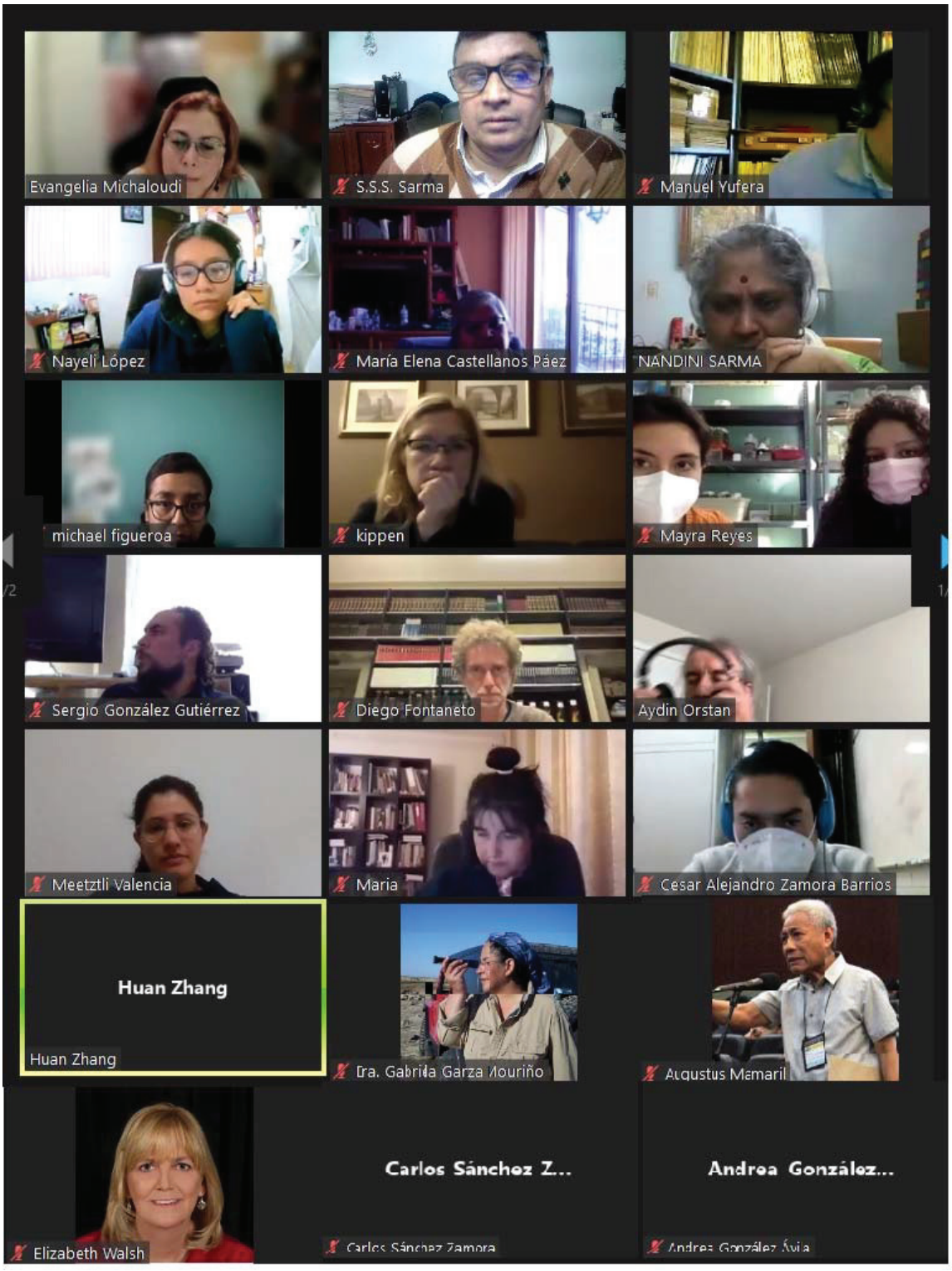
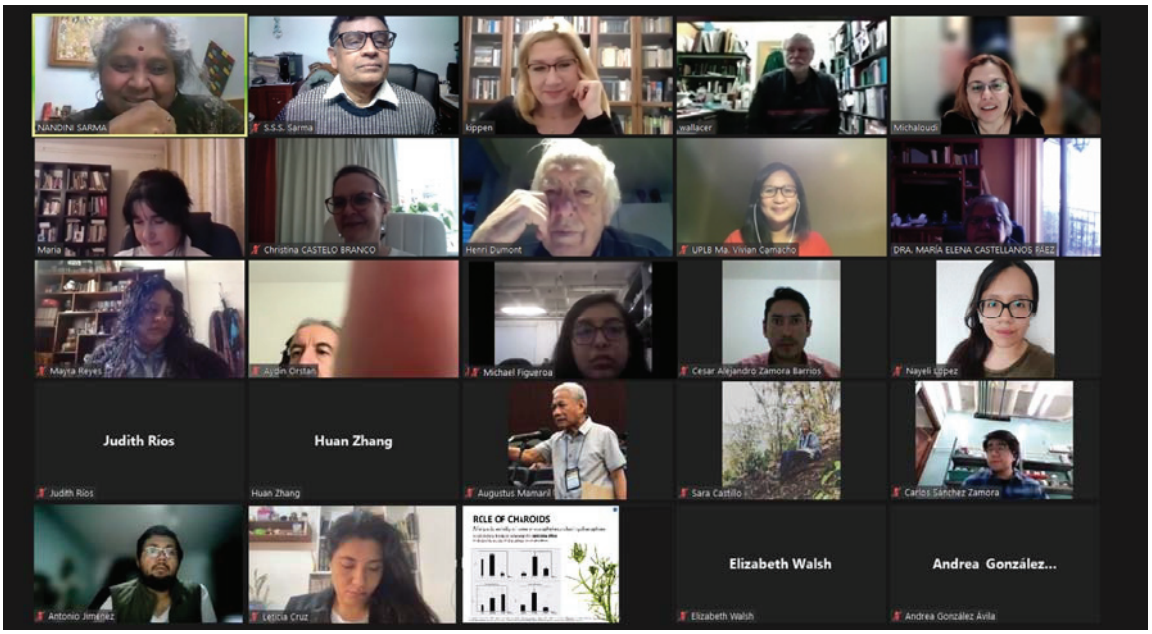


VRC Meeting of November, 2021 in progress



VRC Meeting of December, 2021 in progress

Abstracts from Virtual Rotifer Collaboratorium

Morphology and population dynamics of rotifers in a fluctuating environment

Nischal Devkota, Romana Salis, Lars-Anders Hansson*
Lund University, Sweden

*Author presented on 19th May, 2021

Rotifers are known to respond rapidly to environmental fluctuations and thereby being a group of taxa that show considerable fluctuations in abundance and species dominance. The mechanisms of those sometimes 100-fold variations in abundance are not fully understood, especially not in a climate warming scenario. We have therefore addressed climate, but also predators may affect abundances, as well as morphology of rotifers in replicated, experimental mesocosm systems, where we exposed the organisms to heat waves. Some rotifer species, such as *Filinia* spp., *Pompholyx* spp. and *Polyarthra* spp. showed an inverse response to temperature (heat waves), whereas others, such as *Keratella* spp., responded with higher abundances to heat waves compared to control (ambient) mesocosms. Hence, we should expect some rotifer genera, such as *Keratella*, to flourish, whereas others may expose a less positive development in abundance in a climate warming scenario.

Working with bdelloids: morphological diversity versus taxonomical adversity

Aydin Örstan*
Germantown, Maryland, U.S.A.
Author presented on 17 August 2021

The first half of the presentation was about a research project on the

bdelloid rotifers of the Hawlings River in Maryland, U.S.A. This project was initiated by the chance discovery in the river of an undescribed *Philodinavus* species. However, the subsequent collections resulted in the finding of a different bdelloid with highly unusual morphological characters. The eventual description of this bdelloid as a new species, *Coronistomus impossibilis*, placed in the new family Coronistomidae was summarized. Some of the methods used in the field were also explained. This was followed by a discussion of three problems that stymie taxonomical research in bdelloids. These problems, posed here as questions, are the following.

1. How do we improve the species identifications?
2. Are there subspecies of bdelloids?
3. Do we need to revise the higher level taxa?

A pdf version of the presentation is available at:
https://www.researchgate.net/publication/353980348_working_with_bdelloids_morphological_diversity_versus_taxonomical_adversity

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Marine and Freshwater Rotifera in Greece

Evangelia Michaloudi*

School of Biology, Department of Zoology, Aristotle University of Thessaloniki, Greece

*Author presented on 9 November 2021

Marine zooplankton studies traditionally focus on the mesozooplankton size class (>200 μm), ignoring smaller species and developmental stages (<200 μm). Using both small and big mesh sized nets (50 and 200 μm, respectively) we collected samples at the urban sea front of the city of Thessaloniki [Thessaloniki Bay is a eutrophic coastal basin of Thermaikos Gulf, Northern Aegean (eastern Mediterranean Sea)]. The zooplankton community collected with nets of 200 μm mesh ranged in terms of abundance from 2 to 15 X 10^2 individuals/m^3 while the community collected with 50 μm mesh ranged from 2 to 17 X 10^4 individuals/m^3, highlighting the underestimation of the zooplankton community when studying the mesozooplankton size class. The dominating microzooplankton community i.e. the small size fraction of the mesozooplankton contained a big percentage of Rotifera populations. Five species were identified all belonging to the genus *Synchaeta, namely S. baltica, S. grimpey, S. vorax, S. neapolitana, S. triophthalma*. Their populations peak in numbers in mid-October, while the seasonal variations are under study along with environmental parameters (temperature, pH, salinity, nutrients, phytoplankton) trying to identify the ones affecting the Rotifera fluctuations.

Freshwater zooplankton data from 32 Greek freshwaters (natural lakes, dams and rivers) collected from 1984 to 2021 (published and unpublished data) are available in my Lab. These data that mainly refer to the pelagic zone of the freshwater ecosystems revealed 185 species including species complexes. The family with

most species is Brachionidae followed by Synchaetidae, Lecanidae, Trichocercidae and Lepadelidae. The most frequently (>50%) recorded species were *Keratella cochlearis*, *Keratella tecta*, *Keratella quadrata*, *Filinia longiseta*, *Asplanchna priodonta*, *Trichocerca similis*. The end products we are aiming for from this study is a) an updated Rotifera checklist of Greece, b) a photographic guide providing pictures with recorded morphological variations and c) an electronic user friendly guide for citizen science and educational programs.

Studies on rotifers in a large tropical country (Brazil): much work ahead

Christina Wyss Castelo Branco*

Núcleo de Estudos Limnológicos / Departamento de Zoologia. Instituto de Biociências / Universidade Federal do Estado do Rio de Janeiro, Brazil

*Author presented on 29 June 2021

As the largest tropical country in the world, Brazil presents numerous challenges for the inland water research. Considering the high diversity of aquatic ecosystems, there are still few comprehensive studies on rotifers and the research history on them reflects the work of few Brazilian and foreigner researchers who helped to unveil part of the species richness. Despite several contributions since the beginning of 20th century (e.g., Murray, 1913), the knowledge of the Brazilian rotifer fauna is still incomplete, and species richness underestimated due to limited sampling effort and scarcity of taxonomists.

My interest and I believe my love for rotifers started during my Undergraduation days - a path with no return. However, several research opportunities and my curiosity on different topics took me along different paths. The focus on rotifers begun on graduation, when I studied the zooplankton community in Paranoá reservoir (Branco & Senna, 1996), although the presence of cyanobacteria has drawn more interest and consequently publications. Later, already working at Federal University of the State of Rio de Janeiro (UNIRIO) with research and teaching activities, I was finally able to delve deeper into the study of rotifers in shallow lakes and coastal lagoons (Branco et al., 2005). In coastal lakes, some surprises such as a new species (José de Paggi et al., 2000).

UNIRIO is a federal public university, financed by the government of Brazil. Like all public universities in Brazil, students do not pay for tuition or fees. In the supervision of students regarding zooplankton, and coordinating projects that took me to several parts of Brazil, we were able to study rotifers along a river in the Pantanal (Branco et al., 2018) and the influence of the flood pulse on them in an Amazonian blackwater lake (Nova et al., 2014). Everywhere, in that path with no return, always the feeling of much to do ahead. From the twenty-six Brazilian states, we have a survey of rotifers to date only in four, and

even in them, many aquatic ecosystems with no studies. Meanwhile, an invasive rotifer species is quietly expanding in Brazil. *Kellicottia bostoniensis* is the single rotifer within a group of 163 no-native species recorded in Brazilian freshwater ecosystems (Macedo et al., 2020). If *K. bostoniensis* may cause changes in planktonic assemblages, we still do not know. Concluding, many tasks ahead: from the encouragement of new rotiferologists among students, working groups to survey areas not yet studied, training on taxonomy, foster molecular techniques, and to explore the rotifers as indicators in environmental monitoring, as a food source for fish fry and to be used in ecotoxicity tests. Among those, perhaps the biggest challenge is to encourage the formation of new researchers in view of the scarcity of investment on education, research, and the special shortage of scholarships and budgets for biodiversity studies in the current times in the country.

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Branco CWC, Silveira R & Marinho, MM (2018). Flood pulse acting on a zooplankton community in a tropical river (Upper Paraguay River, Northern Pantanal, Brazil). Fundamental and Applied Limnology 192: 23-42.

José de Paggi S, Branco CWC & Kozlowsky-Suzuki (2000). A new species of *Macrochaetus* (Rotifera, Trichotriidae) in a coastal lagoon of Rio de Janeiro State (Brazil). Studies on Neotropical Fauna and Environment 35:157-160.

Macêdo RL, Franco AC, Klippel G, Oliveira E, Silva L, Santos L, Branco CWC (2020). Small in size but rather pervasive: the spread of the North American rotifer *Kellicottia bostoniensis* (Rousselet, 1908) through Neotropical basins. BioInvasions Records 9(2): 287–302.

Murray J (1913). South American Rotifera. Journal of the Royal Microscopical Society (I): 229–245; (II): 341–362; (III): 449–454.

Nova CC, Rocha AM, Branco CWC & Bozelli RL (2021). New insights on the relation between zooplankton and humic substances in tropical freshwater ecosystems. Anais da Academia Brasileira de Ciências 93:1-19.

Ecological value of macrophytes in a rotifer world

Natalia Kuczyńska-Kippen*

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*Author presented on 7 Dec. 2021

Aquatic vegetation occurring in shallow water bodies, including littoral-dominated lakes and ponds, divide the area into diverse microhabitats. The level of heterogeneity of macrophytes has a considerable structuring effect on rotifers, on both the distribution of certain species and on functional groups, such as life-forms (pelagic and littoral) or trophic-associated rotifers (eutrophic vs. mesotrophic community). Rotifer similarity is highest in habitats with a similar architecture, such as habitats of low complexity (e.g. *Typha, Nymphaea*) and habitats of high spatial and morphological complexity (e.g. *Chara, Myriophyllum, Ceratophyllum*). Moreover, the type of habitat (elodeids, helophytes, water) is a highly influential factor for the rotifer community compared to the effect lake specificity, season or even type of catchment area. The presence of aquatic vegetation and particularly of elodeids, apart from increasing the diversity, share of littoral rotifers and the chance for rare species to occur, reduces the occurrence of eutrophic rotifers and increases that of mesotrophic ones. This is why any kind of plant cover, even macrophytes typical for eutrophic waters (e.g., *Ceratophyllum demersum*) will create a valuable habitat for conservation purposes.

However, it is not only the most complex central part of a macrophyte stand that can create advantageous conditions for rotifer community development. Edges between two habitats (open water vs. macrophytes) can also provide additional possibilities for species co-existence, resulting in higher species diversity occurring in ecotones, even though at the edge of macrophytes we can expect to have lower habitat complexity than in the central part of the plant bed.

The degree of human impact in the immediate vicinity of a water body determines the occurrence of specific assemblages of rotifers and despite strong human-related transformations (e.g. urbanisation or farmland), macrophyte-dominated water bodies may be a source of diverse organisms, including many valuable and rare species, provided that the mosaic of habitats is maintained. This confirms the great suitability of rotifers for environmental studies, as they respond to habitat type but can also detect varying levels of human stress in the surroundings of a water body.

Notes and News

NSF grants keep rotifers alive in Ripon College (Ripon, WI)

Robert L. Wallace has received a four-year research grant from NSF (The National Science Foundation, USA) to study different aspects of the ecology and evolution of rotifers. This is collaborative research with rotiferologists from University of Massachusetts Lowell (Rick Hochberg) and the University of Texas El Paso (Elizabeth J. Walsh). Thus, all three institutions have

received research funding to accomplish the objectives. Receiving grants from NSF is both tough and stiff, especially during these times when most resources are diverted to combat covid-19. Members of Rotifer-Family congratulate all the awardees. **Source**: Ripon College postings https://ripon.edu/2021/03/22/robert-l-wallace-receives-four-year-research-grant-from-nsf/

Rare sight of Atrochus tentaculatus Wierzejski, 1893

A couple of photos and a video of *Atrochus tentaculatus* were taken from a single specimen. This specimen was collected during 2013 from a temporary waterbody in the State of Morelos (Mexico) located at an altitude of ca. 1000 meters above sea level during 2013. The species has been reported from the Australian, Oriental and Palearctic regions of the world. Hunt is still on for this species from similar waterbodies in Central Mexico.

Atrochus tentaculatus Wierzejski, 1893
Video: *https://youtu.be/6vulrJXIxrY*

Cristian Alberto Espinosa-Rodríguez
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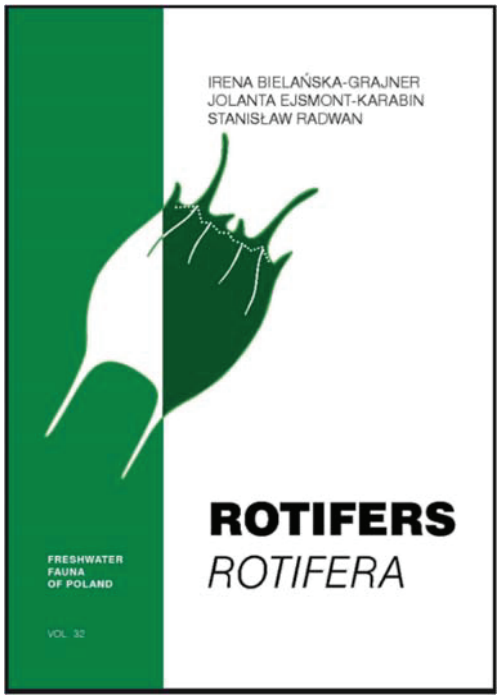
Regional Guides on Rotifer Identification



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The book is also available as an e-book at:
http://virtualo.pl/rotifers_rotifera_monogononta/biologia/naukowe_akademickie/ebook/c578i199106

or

http://ebookpoint.pl/ksiazki/rotifers-rotifera-monogononta-na-bielanska-grajner-jolanta-ejsmont-karabin-sta,e_0fls.htm

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Bielańska-Grajner I., Ejsmont-Karabin J., Iakovenko N. 2013. Wrotki, Rotifera, Bdelloidea. In: Fauna Słodkowodna Polski, zesz. 32C, Polskie Towarzystwo Hydrobiologiczne. Uniwersytet Łódzki. Wydawnictwo Uniwersytetu Łódzkiego, Łódź: 1-154 pp. ISBN 978-83-7969-085-5 (In Polish)

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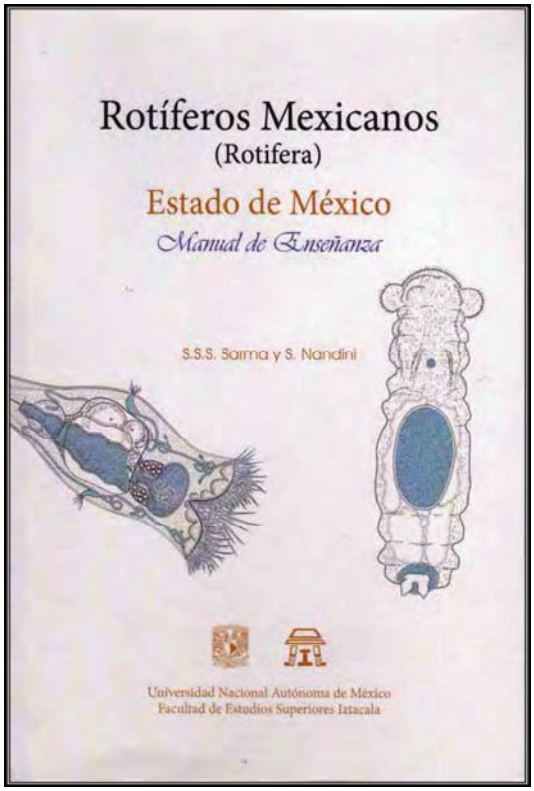

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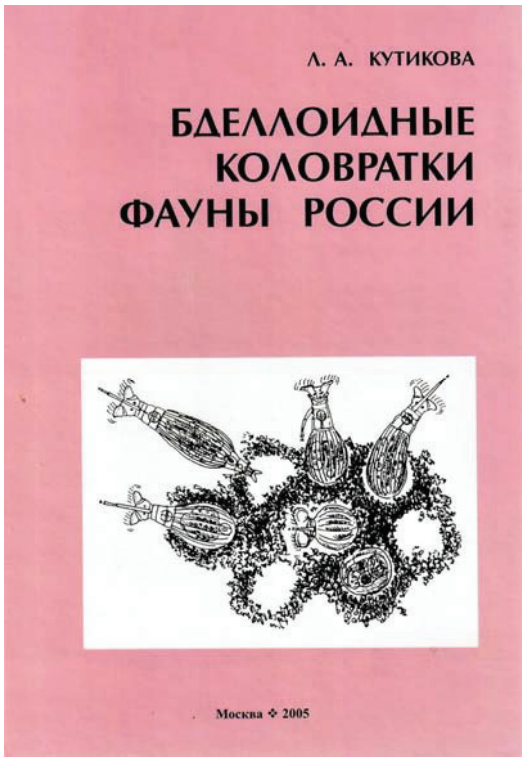

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Scanning and information sent by:
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Rotifera in Bibliometry

Some prominent works that escaped from the net of Web of Science and Scopus with Rotifer as subject word:*

The limitations of indexing by the Web of Science (WoS core collection) and Scopus, especially for older literature become evident when one performs Boolean search from these databases using the key/subject word *Rotifer**. However, such missing works can be very important for understanding the role of rotifers in the zooplankton community structure. Here are a few examples from literature that were not indexed in WoS or Scopus under the key/subject word “Rotifer*”

Sommer, U., Gliwicz, ZM., Lampert, W., Duncan, A. 1986. The PEG-model of seasonal succession of planktonic events in fresh waters. Archiv Hydrobiologie 106: 433-471. (Times cited in WoS: 1430; Scopus: not found).
Article contained information on the maximal rotifer densities, relation between rotifers and other zooplan-kton groups etc.

Bottrell, HH., Duncan, A., Gliwicz, ZM., Grygierek, E., Herzig, A., Hillbricht-Ilkowska, A., Kurasawa, H., Larsson, P., Weglenska, T. 1976. Review of some problems in zooplankton production studies. Norwegian Journal of Zoology 24: 419-456. (Times cited in WoS: 1269; Scopus: not found).
..Many aspects of Rotifera were considered in this review article…

Highly cited works on Rotifers from Web of Science

Web of Science states that highly cited papers rank in the top 1% by citations for given field and publication year. Earlier WoS used other terms like Citation Classics. In all there are 10 articles that received this distinction according to WoS.

Zaki, MA., Ashour, M., Heneash, AMM., Mabrouk, MM., Alprol, AE., Khairy, HM., Nour, AM., Mansour, AT., Hassanien, HA., Gaber, A. & Elshobary, ME 2021. Potential applications of native cyanobacterium isolate (*Arthrospira platensis* NIOF17/003) for biodiesel production and utilization of its byproduct in marine rotifer (*Brachionus plicatilis*) production. Sustainability 13: 1769. DOI 10.3390/su13041769

…..The authors showed that algal-free lipid is useful for producing B. plicatilis…

Piano, E., Souffreau, C., Merckx, T., Baardsen, LF., Backeljau, T., Bonte, D., Brans, KI., Cours, M., Dahirel, M., Debortoli, N., Decaestecker, E.,De Wolf, K., Engelen, JMT., Fontaneto, D., Gianuca, AT., Govaert, L., Hanashiro, FTT., Higuti, J., Lens, L., Martens, K., Matheve, H., Matthysen, E., Pinseel, E., Sablon, R., Schon, I., Stoks, R., Van Doninck, K., Van Dyck, H., Vanormelingen, P., Van Wichelen, J., Vyverman, W., De Meester, L. & Hendrickx, F 2020. Urbanization drives cross-taxon declines in abundance and diversity at multiple spatial scales. Global Change Biology 26: 1196-1211. DOI 10.1111/gcb.14934

…….The authors studied aquatic (cladocerans), limno-terrestrial (bdelloid rotifers) and terrestrial... Their results showed negative impact of urbanization on abundance and species richness...

Marletaz, F., Peijnenburg, KTCA., Goto, T., Satoh, N. & Rokhsar, DS 2019. A new spiralian phylogeny places the enigmatic arrow worms among gnathiferans. Current Biology 29: 312. DOI 10.1016/j.cub.2018.11.042

…The authors found that chaetognaths clustered together with rotifers, gnathostomulids, and micrognathozoans…

Mills, S., Alcantara-Rodriguez, JA., Ciros-Perez, J., Gomez, A.,Hagiwara, A., Galindo, KH., Jersabek, CD., Malekzadeh-Viayeh, R., Leasi, F., Lee, JS., Welch, DBM., Papakostas, S., Riss, S., Segers, H., Serra, M., Shiel, R., Smolak, R., Snell, TW., Stelzer, CP., Tang, CQ., Wallace, RL., Fontaneto, D. & Walsh, EJ. 2017. Fifteen species in one: deciphering the *Brachionus plicatilis* species complex (Rotifera, Monogononta) through DNA taxonomy. Hydrobiologia 796: 39-58. DOI 10.1007/s10750-016-2725-7

…Using sequences of COI and ITS1 of B. plicatilis complex the authors showed the existence of 15 species within the complex….

Jeong, CB., Won, EJ., Kang, HM., Lee, MC., Hwang, DS., Hwang, UK., Zhou, B., Souissi, S., Lee, SJ. & Lee, JS. 2016. Microplastic size-dependent toxicity, oxidative stress induction, and p-JNK and p-p38 activation in the monogonont rotifer (*Brachionus koreanus*). Environmental Science & Technology 50: 8849-8857
DOI 10.1021/acs.est.6b01441

…The authors evaluated accumulation and adverse effects of ingesting microplastics on Brachionus koreanus….

Zhang, C., Cui, F., Zeng, GM., Jiang, M., Yang, ZZ., Yu, ZG., Zhu, MY., Shen, LQ. 2015. Quaternary ammonium compounds (QACs): A review on occurrence, fate and toxicity in the environment. Science of the Total Environment 518: 352-362. DOI 10.1016/j.scitotenv.2015.03.007
……Quaternary ammonium compounds are toxic to fish, daphnids, algae, rotifer and microorganisms.

Setala, O., Fleming-Lehtinen, V. & Lehtiniemi, M. 2014. Ingestion and transfer of microplastics in the planktonic food web. Environmental Pollution 185: 77-83. DOI 10.1016/j.envpol.2013.10.013
…..The authors experimentally showed the ingestion of microspheres by mysid shrimps, copepods, cladocerans, rotifers, polychaete larvae and ciliates…

Hamre, K., Yúfera, M., Ronnestad, I., Boglione, C., Conceicao, LEC. & Izquierdo, M. 2013. Fish larval nutrition and feed formulation: knowledge gaps and bottlenecks for advances in larval rearing. Reviews In Aquaculture 5: S26-S58
…..The authors reviewed literature on the larval nutritional requirements, the nutritional value of live feeds and the development of formulated diets…..

Dahms, HU., Hagiwara, A. & Lee, JS. 2011. Ecotoxicology, ecophysiology, and mechanistic studies with rotifers. Aquatic Toxicology 101: 1-12. DOI 10.1016/j.aquatox.2010.09.006

…..The authors reviewed data on the potential of use of rotifers in ecophysiology, ecotoxicology and environmental genomics….

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Top 20 records containing rotifer*

Comments: S.S.S. Sarma

Articles containing rotifer* as keyword downloaded from Web of Science (WoS, core collection) and Scopus are arranged based on author names. The trends from the Tables 1 and 2 are subject to many limitations:

1. The indexing agencies use different criteria of coverage (journal listing) and indexing terms.

2. The period of information coverage also differs.

3. Variants of author names (e.g., compound names with and without hyphen (A. Hillbricht-Ilkowska and A. HillbrichtIlkowska), maiden names (N. Iyer vs S. Nandini), spellings of names (e.g., T. Nogradi and T. Nogrady) are not considered.

4. Changes in the phylum name (Infusoria, Roratoria, Rotifera etc.) are not applied.

5. Poor coverage of books and book chapters in the databases.

6. The descending order would also change if one takes into account of different databases (Biological Abstracts, Zoological Records, ASFA etc.).

7. This is only a quantitative information and does not indicate the quality of research. In addition, the number of works recorded for each author could be also high as the search term (rotifer*) eliminates works from other fields (e.g., cladocerans).

The name of country presented for each author is based on the last known address. It is important to note that both these databases offer the possibility of corrections with reference to one's contributions covered in the database. These must be done by the individual authors to keep the database relatively free from errors.

Considering these limitations, the tables must be viewed with caution. However, the listings here do not dangerously mislead the users regarding the relative contributions made by the different workers on the area of rotifer research. Data retrieved on 20 Dec 2021.

Table 1. Authors and the corresponding number of articles obtained from Web of Science (core collection) using the key word Rotifer*.

Author's name	Country	Number of works
Sarma SSS	Mexico	198
Nandini S	Mexico	172
Snell TW	USA	145
Hagiwara A	Japan	143
Gilbert JJ	USA	139
Lee JS	South Korea	97
Fontaneto D	Italy	95
Segers H	Belgium	93
Serra M	Spain	90
Ricci C	Italy	77
Xi YL	China	67
Wallace RL	USA	64
Carmona MJ	Spain	54
Walsh EJ	USA	54
Ejsmont-Karabin J	Poland	51
Rico-Martínez R	Mexico	51
Pourriot R	France	50
Sorgeloos P	Belgium	46
Clement P	France	45
Koste W	Germany	42

Table 2. Authors and the corresponding number of articles obtained from Scopus using the key word Rotifer*.

Author's name	Country	Number of works
Sarma SSS	Mexico	184
Nandini S	Mexico	166
Hagiwara A	Japan	152
Snell TW	USA	138
Gilbert JJ	USA	109
Segers H	Belgium	97
Fontaneto D	Italy	95
Serra M	Spain	90
Lee JS	South Korea	88
Ricci C	Italy	78
Xi YL	China	78
Ejsmont-Karabin J	Poland	66
Wallace RL	USA	59
Carmona MJ	Spain	50
Rico-Martínez R	Mexico	48
Shiel RJ	Australia	47
Pourriot R	France	47
Sorgeloos P	Belgium	46
Bonecker CC	Brazil	43
De Smet WH	Belgium	42

Rotifers and Ecotoxicology (Recent works)

Byeon, E., Choi, B.-S., Park, J.C., Kim, M.-S., Kim, D.-H., Lee, J.-S., Lee, Y.H., Jeong, C.-B., Hwang, U.-K., Hagiwara, A., Lee, J.-S. 2021 The genome of the freshwater monogo-nont rotifer *Brachionus angularis*: Identification of phase I, II, and III detoxification genes and their roles in molecular ecotoxicology. Compa-rative Biochemistry and Physiology - Part D: Genomics and Proteomics 38: 100821.

Byeon, E., Yoon, C., Lee, J.-S., Lee, Y.H., Jeong, C.-B., Lee, J.-S., Kang, H.-M. 2020. Interspecific biotrans-formation and detoxification of arsenic compounds in marine rotifer and copepod. Journal of Hazardous Materials. 391: 122196.

Gribble, K.E. 2021. *Brachionus* rotifers as a model for investigating dietary and metabolic regulators of aging. Nutrition and Healthy Aging 6: 1-15.

Hébert, M.-P., Fugère, V., Beisner, B.E., Barbosa da Costa, N., Barrett, R.D.H., Bell, G., Shapiro, B.J., Yargeau, V., Gonzalez, A., Fussmann, G.F. 2021. Widespread agrochemicals differentially affect zooplankton biomass and commu-nity structure. Ecological Applications (In press).

Huang, X., Cui, H., Duan, W. 2020 Ecotoxicity of chlorpyrifos to aquatic organisms: A review. Ecotoxicology and Environmental Safety 200: 110731.

Kang, H.-M., Kim, M.-S., Choi, B.-S., Kim, D.-H., Kim, H.-J., Hwang, U.-K., Hagiwara, A., Lee, J.-S. 2020. The genome of the marine monogononT rotifer *Brachionus rotundiformis* and insight into species-specific detoxification com-ponents in *Brachionus* spp. Comparative Biochemistry and Physiology - Part D: Genomics and Proteomics 36: 100714.

Kim, D.-H., Kim, M.-S., Hagiwara, A., Lee, J.-S. 2021. The genome of the minute marine rotifer *Proales similis*: Genome-wide identification of 401 G protein-coupled receptor (GPCR) genes. Comparative Biochemistry and Physiology - Part D: Genomics and Proteomics 39: 100861.

Lecomte, T., Mamindy-Pajany, Y., Lors, C., Lemay, M., Abriak, N.-E., Bazin, C., Vernus, E. 2020. A methodological approach for ecotoxicological characterization of non-hazardous sediments for their beneficial reuse. Journal of Soils and Sediments. 20: 2608-2618.

Lee, Y.H., Kim, M.-S., Jeong, H., Hagiwara, A., Lee, J.-S. 2020. Genome-wide identification and transcriptional modulation of histone variants and modification related genes in the low pH-exposed marine rotifer *Brachionus koreanus*. Comparative Biochemistry and Physiology - Part D: Genomics and Proteomics 36: 100748.

Li, X.-D., Wang, X.-Y., Xu, M.-E., Jiang, Y., Yan, T., Wang, X.-C. 2020 Progress on the usage of the rotifer *Brachionus plicatilis* in marine ecotoxicology: A review. Aquatic Toxicology 229: 105678.

Nandini, S., Zamora-Barrios, C.A., Sarma, S.S.S. 2020. A long-term study on the effect of cyanobacterial crude extracts from

Lake Chapultepec (Mexico City) on selected zooplankton species. Environmental Toxicology and Chemistry. 39(12): 2409-2419.

Osier, M.N., Cohen, R.A. 2020. Mixtures of tetrakis hydroxymethyl phosphonium chloride and ammonium influence plankton community structure in blackwater pond mesocosms. Emerging Contaminants. 6: 62-71.

Park, J.C., Choi, B.-S., Kim, M.-S., Shi, H., Zhou, B., Park, H.G., Lee, J.-S. 2020. The genome of the marine rotifer *Brachionus koreanus* sheds light on the antioxidative defense system in response to 2-ethyl-phenanthrene and piperonyl butoxide. Aquatic Toxicology 221: 105443.

Park, J.C., Hagiwara, A., Park, H.G., Lee, J.-S. 2020. The glutathione S-transferase genes in marine rotifers and copepods: Identification of GSTs and applications for ecotoxicological studies. Marine Pollution Bulletin 156:111080.

Park, J.C., Kim, D.-H., Kim, M.-S., Hagiwara, A., Lee, J.-S. 2021 The genome of the euryhaline rotifer *Brachionus paranguensis*: Potential use in molecular ecotoxicology. Comparative Biochemistry and Physiology - Part D: Genomics and Proteomics 39: 100836.

Park, J.C., Kim, D.-H., Lee, Y., Lee, M.-C., Kim, T.K., Yim, J.H., Lee, J.-S. 2020. Genome-wide identification and structural analysis of heat shock protein gene families in the marine rotifer *Brachionus* spp.: potential application in molecular ecotoxicology. Comparative Biochemistry and Physiology - Part D: Genomics and Proteomics 36: 100749.

Park, J.C., Lee, J.-S. 2021 Genome-wide identification of heat shock proteins in harpacticoid, cyclopoid, and calanoid copepods: Potential application in marine ecotoxicology. Marine Pollution Bulletin 169: 112545.

Portinho, J.L., Oliveira, H.N., Branco, C.C.Z. 2021. Resting egg banks can facilitate recovery of zooplankton communities after short exposure to glyphosate. Ecotoxicology 30: 492-501.

Radlińska, K., Wróbel, M., Stojanowska, A., Rybak, J. 2020. Assessment of the 'oława' smelter (Oława, Southwest Poland) on the environment with ecotoxicological tests. Journal of Ecological Engineering. 21:186-191.

Wang, C., Wang, S., Jiao, X., Yang, B., Liang, S., Luo, Z., Mao, L. 2020. Periodic density as an endpoint of customized plankton community responses to petroleum hydro-carbons: A level of toxic effect should be matched with a suitable time scale. Ecotoxicology and Environmental Safety 201:110723

Špoljar, Maria; Sertić Perić, Mirela; Wang, Haobai; Zhang, Chen; Kuczyńska-Kippen, Natalia; Fressl, Jelena; Ercegovac, Zvonimir: Does the size structure of the littoral community reflect water level fluctuations in shallow waterbodies? // Ecological indicators, 132 (2021), 108330, 15 doi:10.1016/j.ecolind.2021.108330

Zhang, Chen; Zhu, Zixuan; Špoljar, Maria; Kuczyńska-Kippen, Natalia; Dražina, Tvrtko; Cvetnić,Matija; Mleczek, Mirosław: Ecosystem

models indicate zooplankton biomass response to nutrient input and climate warming is related to lake size //Ecological Modelling 464 (2022), 109837

Špoljar M., S. Shumka, O. Tasevska, T. Tomljanović, A. Ostojić, A. Galir Balkić, J. Lajtner, B. Pepa, T. Dražina, I. Ternjej. 2022. Small Standing-Water Ecosystems in the Transitional Temperate Climate of the Western Balkans https://www.springerprofessional.de/en/small-standing-water-ecosystems-in-the-transitional-temperate-cl/19881200

Dražina T., M. Špoljar, M. Miliša 2022. Temporary ponds in Mediterranean islands: oases of biodiversity https://www.springerprofessional.de/temporary-ponds-in-mediterranean-islands-oases-of-biodiversity/19881204

Rotifers and SIL 2021

Rotifers in the SIL 2021 were under-represented

The International Society of Limnology (SIL), founded in 1922, is the oldest global society devoted to inland waters. The Society's periodical meetings (every 2 or 3 years) are the source of active research for rotiferologists. This is because the society has always viewed rotifers as integral members of the aquatic ecosystems of inland waters. The 35th Congress of SIL held in Gwangju, South Korea is certainly a disappointment for rotiferologists as less than 4% of the presented works considered them. This is particularly disheartening considering that Rotifera is one of the few phyla that is often a dominant component in freshwaters. The Abstracts of the SIL 2021 containing Rotifer* are reproduced here with permission from SIL. It is hoped that the visibility of rotifer research in the centennial SIL Congress (Berlin, 7-10 Aug. 2022, *https://www.sil2022.org/*) would be higher as in the same year the 16th International Rotifer Symposium is scheduled (Zagreb, Croatia from Sept. 5–9, 2022, *https://www.rotiferaxvi.biol.pmf.hr/*). Further, both these international meetings will be held within 4 weeks of each other and in cities are not that far apart: ~1000 KM.

Abstracts containing Rotifer from the SIL 2021 Congress are reproduced here verbatim. The original abstract numbering has been retained for easy reference. ©SIL*

R4-O Implications of flow regulation for habitat conditions and phytoplankton populations of the Nakdong River (South Korea)

Hyo Gyeom Kim [1], Friedrich Recknagel [2], hyun-Woo Kim [3], gea-Jae joo [4]

[1] Fisheries Science Institute, Chonnam National University, Korea (Republic of)

[2] Department of Ecological and Evolutionary Biology, University of Adelaide, Australia

[3] department of biological education, sunchon national university, Korea (Republic of)

[4] Department of biological science, Pusan National university, Korea (Republic of)

Anthropogenic regulation of hydrographs is a widespread approach of river management but impacts of river regulation on habitat conditions and aquatic communities have rarely been studied. This study analysed physical, chemical and biological data collected from the lower Nakdong River of South Korea from 2005 till 2009 before weirs were constructed and from 2012 till 2016 after weir construction.
The annually averaged trajectories of limnological variables displayed most significant shifts in seasonality and magnitudes of phytoplankton, zooplankton and nutrient concentrations between the two periods. A partial least square path modelling (PLS-PM) was applied to delineate relationships of diatoms and cyanobacteria with physical-chemical parameters (P), nutrients (N), zooplankton grazing (G) and hydrological parameters (H). Inferential modeling by means of the hybrid evolutionary algorithm (HEA) allowed to identify differences in the importance and threshold conditions of drivers for population dynamics of diatoms and cyanobacteria before and after flow regulation. Results of PLS-PM indicated that diatoms and cyanobacteria were less directly affected by hydrological parameters during post-regulation but by nutrients and zooplankton grazing instead. Inferential models suggested that diatoms dynamics were essentially shaped by thresholds conditions of water temperature (WT) and pH before regulation, and of SiO2 and rotifers after regulation. In contrast, inferential models identified for cyanobacteria dynamics threshold conditions of WT as critical before regulation, and of PO4-concentrations and WT after regulation.
Overall results suggested that flow regulation alters gradually habitat conditions typical for rivers to those of stagnant waters. These findings have to be taken into account for sustainable management strategies of regulated rivers.

R4-O Impact of land use and lake depth on the zooplankton assemblages

Łukasz Sługocki [1], Robert Czerniawski [2]

[1] Department of Hydrobiology, University of Szczecin, Poland

[2] Department of Hydrobiology, University of Szczecin, Poland

Widespread and unreasonable exploitation of the river and lake catchment areas has a negative impact on the preservation and maintenance of proper ecological balance in the aquatic environment. The characteristics of the catchment (land use) and the morphological characteristics of lakes, as fairly stable factors, do not undergo drastic changes as the physicochemical parameters and hence can improve our understanding of the functioning of aquatic ecosystems. The main aim of this work was to evaluate the effect of catchment land use and the

morphological conditions of lakes on the zooplankton communities.
The zooplankton communities in the present study were characterized based on the abundance and body size of zooplankton (Rotifera, Cladocera, and Copepoda) in the selected lakes of Central Europe (NW Poland). The obtained results indicate that both the catchment area and morphological characteristics of lakes show a considerable effect on the zooplankton communities. Anthropogenic and agricultural use of catchment areas leads to an increase in the abundance and a decrease in the body size of zooplankton, which can be attributed to the increased biological productivity of water bodies due to the accumulation of nutrients under the influence of human-induced or natural factors. It was also observed that shallow water bodies have a higher abundance of zooplankton than deeper lakes. We observed that deep lakes with cooler and oxygen-rich water provide more favorable conditions for the development of large- body zooplankton than those provided by shallow lakes. In addition, it is suggested that lakes with populations of particularly rare species should be identified and their catchment areas should be subjected to protective regimes in order to reduce the excessive supply of nutrients and hence eutrophication.

R4-O First record and dispersal of the Neotropic rotifer Brachionus zahniseri Ahlstrom, 1934 in the Palearctic (Lake Ewiges Meer, Germany)

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Brachionus zahniseri Ahlstrom, 1934, a rotifer species endemic to America with probably Neotropical origin (Segers, 2008) has been found since 2010 by the authors in the peat bog Lake Ewiges Meer (Lower Saxony, Germany). Recent findings were reported from Lake Wangermeer in 2018 (Schröder, unpubl.) and Lake Constance 2019 (Überlinger See, Schmidt-Halewicz, pers. com.). The native habitats (small, very shallow black water lakes in South America connected to streams) provide quite harsh environments to thrive with seasonally fluctuating water levels, acidic pH, low conductivity, high temperatures, low oxygen and overall oligotrophic conditions. However, B. zahniseri may become a dominant part of the metazooplankton (Nova et al., 2014) and also endure pH above 8 as well as high conductivity in polytrophic fresh waters. Thus, B. zahniseri seems to be well fitted to colonize similar habitats elsewhere. And indeed, in Lake Ewiges Meer, a fishless, very shallow, dystrophic, yet highly productive peat bog lake with a pH of 4 B. zahniseri became the dominant zooplankter with a maximum abundance of 10800 Ind/L in September 2016, accounting for over 90% of total metazooplankton biomass. Monopolisation by

autochthonous species in this overall species poor habitat obviously was no barrier for B. zahniseri. Although exact time and pathway of introduction to Lake Ewiges Meer is unknown the further dispersal of B. zahniseri is certain considering its adaptation to high temperatures and the predicted impact of global warming in the Palearctic. Furthermore, monitoring in the future will be crucial to show how zooplankton will be adapting to a warmer world.

R4-O Use of zooplankton metrics to determine the trophic status and ecological potential of reservoirs, an approach in a large Mediterranean river watershed.

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[2] Institut Cavanilles de Biodiversitat i Biologia Evolutiva ICBIBE), Universidad de Valencia, Spain

[3] Institut Cavanilles de Biodiversitat i Biologia Evolutiva ICBIBE), Universidad de Valencia, Spain

One of the main goals in water management inside European policies is achieve a “good status” in their waterbodies, and for this reason was created the European Water Framework Directive (WFD). Inside their protocols for water monitoring, various Biological Quality Elements (BQE) were proposed, however, despite its important place inside aquatic trophic web, zooplankton was not yet included. Here, we use several zooplankton metrics based on their abundances and biomasses to test if they are suitable to detect differences among trophic status and levels of ecological potential. A large dataset collected at more than 60 reservoirs of Ebro watershed, along ten years and more than 300 sampling occasions was used for this purpose. Our results indicate that most of zooplankton metrics are related with the environmental variables that determine reservoirs trophic state, especially with chlorophyll a and total phosphorus. The metrics with better sensitivity to differentiate trophic status and levels of ecological potential were total zooplankton (ZOO), large zooplankton (LZOO), cladocerans (CLAD) and the zooplankton:chlorophyll a ratio (ZOO:CHLA). Microcrustacean metrics such as Daphnia (DAPHN), copepods (COP), cyclopoids (CYCLO) and calanoids (CALA) were good indicators to separate between high and low water quality in relation to trophic status (oligotrophic vs eutrophic) and ecological potential (good or superior vs moderate). Contrary, zooplankton: phytoplankton biomass ratio (ZOO:PHYTO) together with rotifers (ROT) had the lesser sensitivity to discriminate among trophic state and ecological potential. Zooplankton metrics used at present research can be a valuable tool to determine reservoirs water quality, therefore, we consider that zooplankton should be included as one more BQE within WFD monitoring programs for inland waters.

R4-O River-reservoir hybrid system effects on variations of zooplankton community as size class

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[1] Integrated Biological Science, Pusan National University, Korea (Republic of)

[2] Biological Science, Pusan National University, Korea (Republic of)

[3] Environmental Education, Sunchon National University, Korea (Republic of)

The river is a representative lotic ecosystem, but it is changing into a lentic ecosystem for the use of water resources. The Nakdong River, where rainfall is concentrated due to the summer monsoon climate, was constructed with high density weirs to secure efficient water resources. We confirmed the change in the composition of zooplankton communities between the upper and lower points of the weir. Each four years before (2005-2008) and after (2012-2015) the weirs construction was compared at six sites. Total number of zooplankton species and population density showed seasonal fluctuations. In the rivers where rotifers predominated, the relative abundance of cladocerans and copepods increased after the change. Especially, rotifers and small cladocerans competed each other in relative abundances regardless of the river state. Similarity of species trends appeared between upstream and downstream in the connected river but did not appear after the change. Population density showed unique characteristics for each point. Connected river affected to the species but population density was an intrinsic characteristic of sites. Zooplankton differs in the relative proportion of groups by size depending on the flow type of the water body.

R4-O The role of local abiotic factors on zooplankton community structure in small vs large lakes in Indonesia

Reliana Lumban Toruan [1], Fachmijany Sulawesty [2], Aiman Ibrahim [3], Imroatushshoolikhah Imroatushshoolikhah [4]

[1] Research Centre for Limnology, Indonesian Institute of Sciences, Indonesia

[2] Research Center for Limnology, Indonesian Institute of Science, Indonesia

[3] Research Center for Limnology, Indonesian Institute of Science, Indonesia

[4] Research Center for Limnology, Indonesian Institute of Science, Indonesia

Zooplankton are key players in aquatic food webs facilitating the energy transfer from the primary producer to a higher trophic level. They are also very sensitive to environmental heterogeneity and are used widely as indicators to environmental changes. The zooplankton community structure in several lakes across Indonesia was studied during 2005 to 2015. We investigated the important role of local abiotic factors on zooplankton

community structure in nine shallow lakes varying in size, depth and environmental drivers including macrophyte coverage and food availability (phytoplankton as total Chl-a). Our study revealed a varied number of zooplankton taxa identified from the studied lakes of which rotifers and copepods were the major contributing taxa to biodiversity. Our result also revealed that small lakes have
lower species richness as compared to larger lakes, with small lakes harbour between seven to 26 species while large lakes harbour between 50 to 100 species number. Variation in zooplankton community composition was related to local factors including lake total area, macrophyte coverage and chlorophyll-a concentration. Higher density of rotifers group was found in lakes with dense macrophyte coverage, followed by copepods and cladocerans groups. Despite the lower species number occurring in small lakes, this study revealed that small lakes can represent important habitat for biodiversity. Considering the extent number of small lakes globally, our result indicates the importance role of small water bodies to support landscape biodiversity.

R4-P Differences in relative abundance of zooplankton between surface water and vertical integrated water in the Nakdong River

Min-seok Kim [1], Hae-Kyung Park [2]

[1] Nakdong River Environment Research Center, National Institute of Environmental Research, Korea (Republic of)

[2] Nakdong River Environment Research Center, National Institute of Environmental Research, Korea (Republic of)

Zooplankton are an intermediate stage in the food web connecting primary producers and predators such as small fish, and plays an important role in energy transfer in aquatic ecosystems. Therefore, it is important to understand the zooplankton community structure in order to understand material cycle and energy flow in aquatic ecosystems. Current method of collecting zooplankton in large rivers is surface water filtration. In this study, we collected zooplankton samples by surface water filtration and vertical haul with 64μ m mesh plankton net at three stations (Haepyung, Gangjeong-Goryeong, Chilseo) in the Nakdong River, fortnightly from April 2019 to October 2019, and analyzed the relative abundances of rotifers, cladocera, and copepod of each sample. The results were expressed as the difference between the relative abundances of zooplankton groups in surface water minus those in vertical integrated water. At the shallowest station among three stations, the relative abundance of cladocera showed -7% to 16% differences and that of copepod showed -13% to 13% differences. At the deepest station, the relative abundance of cladocera showed -9% to 32% differences and that of copepod showed -14% to 33% differences. All three stations showed differences in relative abundance between the surface water and vertical integrated water, and the largest difference was shown at the

deepest station. This results indicate surface water is not enough to represent the composition and biomass of the zooplankton of the river water compared to the vertical integrated water in the large rivers.

R4-P Freshwater rotifers in Korean peninsula

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Rotifer diversity of Korea has faunistic complexity about coexistence between northern and southern species. We present an annotated checklist and characteristics of biogeography of the taxa based on the current valid literature records. Korean freshwater rotifer contains 321 valid species grouped into 7 Orders, 25 Families and 61 Genera. The majority of Korean Rotifera (over
10 species) belong to Philodinidae (28.0%), Brchionidae (14.0%), Habrtrochidae (12.8%), Lecanidae (6.9%), Synchaetidae (5.3%), Trichocercidae (4.7%), Lepadellidae (3.7%), Notommatidae (3.4%). The most divers Genus (over 5%) is Habrotrocha followed by Macrotrachela, Philodina, Brachionus. Our study provides new knowledge about rotifer biodiversity concatenated with Korean peninsula and East-Asia.

R6-O Effects of increased mean temperature and extreme heatwaves on plankton communities

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Freshwater ecosystems are presently seriously threatened by global warming, including an increase in annual mean temperatures and increased temperature variability, including extreme heatwaves. While both can drive shifts in abundance, diversity, and richness of planktonic communities, comparative studies are largely lacking. Therefore, in a mesocosm experiment, we tested the effects of constantly increased (by 3℃) temperatures and recurring heatwaves (+6℃) in a setup where both treatments received an identical energy input. This lasted for four weeks (including 2 one-week heatwaves), followed by another four weeks where no warming treatments were applied to study ecosystem resilience. As a model community, we used the natural plankton of the large shallow Lake Balaton. The first heatwave was followed by an immediate increase in phytoplankton biomass. The effects of constant warming were less visible in the short term, but phytoplankton biomass increased significantly towards the end. Within the zooplankton communities, the first negative effects of heatwaves became visible after 1.5 weeks (decreased abundance of the dominant rotifer species, Polyarthra remata), while constant warming led to differences after 2-3 weeks (resulting in elevated densities of copepods and overall significant differences among the treatments based on community composition). Our findings show that heatwaves can have more immediate effects on biodiversity and trophic interactions, while the effects of constantly increased temperatures become only visible in a longer term, in line with the concept of press and pulse disturbances.

R10-O Distribution of zooplankton in soda lakes: a global view

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Soda lakes are found in all continents and from sea level to altitudes more than 2000 m.a.s.l. Most soda lakes are in Asia and Africa. We conducted a literature search over the past 100 years on data published on soda lakes worldwide. We found that many studies focused on the physical and chemical limnology of these lakes, but there were fewer studies on the plankton, especially zooplankton. Among phytoplankton, Arthrospira (Spirulina) was reported from many lakes. Among zooplankton, rotifers were most abundant, often reaching densities of several thousand individuals per liter. The common genera were Brachionus, Hexarthra, Filinia, and Asplanchna. The frequently found cladoceran genera include Moina, Daphnia, Alona and

Macrothrix while copepods are represented by several species of cyclopoids and calanoids. In most soda lakes, the species richness is low. However, the soda pans in the Carpathian basin have more than 150 species of rotifers, cladocerans and copepods. We also analyze the predators found in these systems and their role in structuring these unique communities. The importance of studying the presence of cryptic species in these lakes has also been discussed.

R11-O Effect of malachite green on the survival and reproduction of the rotifer Brachionus havanaensis (Rotifera: Brachionidae)

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The aquaculture industry employs several veterinary medicines to control pests and parasites. Malachite green is a water-soluble dye. It is highly effective in controlling infections in fish caused by fungi, protozoans and helminths. However, uncontrolled use and discharge of malachite green from aquaculture operations is an environmental risk especially to the zooplankton, which are the main component of aquatic ecosystems. Among the different groups of freshwater zooplankton, rotifers are more abundant than others such as crustaceans. In addition, rotifers being sensitive to changes in water quality, are widely used as both indicator species and bioassay organisms. In this work, we quantified the effect of different concentrations (0, 7.5, 15, 30 and 60 mg/L) of malachite green on the life history variables of a common brachionid rotifer, Brachionus havanaensis. The results showed that compared to controls, average lifespan, gross and net reproductive rates, generation time and the rate of population increase of B. havanaensis were all significantly lower in treatments containing malachite green. Both, survivorship and reproduction-related variables, decreased with increase in the concentration of malachite green. These results suggest the need for a governmental regulation to discharge wastewaters containing malachite green from aquaculture ponds into natural waterbodies to protect zooplankton.

R11-O Demographic responses of the predator rotifer Asplanchna sieboldii fed Plationus patulus (Rotifera) exposed to cadmium and microplastics.

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Globally microplastics have become common pollutants affecting aquatic ecosystems including zooplankton, an important component of aquatic food webs. Microplastics < 5 mm in size, being within the range of cell diameter of the edible fraction of phytoplankton, are ingested by species of zooplankton such as rotifers and this affects their demography, especially on chronic exposure. In addition, microplastics can adsorb other toxic substances such as heavy metals including cadmium from the medium. However, few studies have considered the effect of cadmium adsorbed to microplastics on the predatory-prey interactions within the zooplankton. Here we studied this aspect using two rotifer species, Asplanchna sieboldii (predator) and Plationus patulus (prey). The prey in three densities (1, 2 and 4 ind./ml), previously exposed to cadmium (at 0.009 and 0.018 mg/l) and microplastics (5 mg/l) were used to grow the predator. Our results showed decreased reproductive rates of A. sieboldii and higher proportion of cruciform morphotype when fed P. patulus, previously exposed to different combinations of cadmium and microplastics. Mechanical damage and physiological changes in the predators due to ingesting contaminated prey, are the main causes of decreased reproduction output and morphotype-related changes.

R11-O Influence of sulfamethoxazoleon the life table paramenters of Brachionus rofundiformis under different Chlorella sp. densities

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Sulfamethoxazole (SMX) is a kind of sulfonamides that is widely used, and it is discharged from various sources and finally aggravated in the rivers and lakes, posing a great threat to human health and the stability of the aquatic ecological environment. There are a lot of studies about the toxicity of antibiotics on alage and daphnia. However, the effect of SMX on rotifers has not been reported. Here, we chose B. rotundiformis as the test organism to assess the effects of SMX on the life table parameters of rotifers. Rotifers were cultured under three different Chlorella sp. densities (1.0×106,

2.0×106, 4.0×106 cells/mL) and five different SMX concentrations (0, 2, 4, 10, 25 mg/L). Results showed that when the food density was 1.0×106 or 2.0×106 cells/mL, the effect of SMX on the peak value of specific age reproduction rate (mx) of B. rotundiformis presented the characteristics of " promotion under low concentration and inhibition under high concentration", this change characteristics didn't show under 4.0×106 cells/mL food density. Consequences of the two-way Anova analysis showed that the interaction between the density of Algal and the concentration of SMX affected the parameters of rotifer life table significantly ($P<0.05$). From the perspective of dose-effect relationship, life expectancy, average life span, net reproductive rate, intrinsic growth rate and proportion of sexual offspring were the appropriate indexes to evaluate the chronic toxicity of SMX to B. rotundiformis. We suggest adding an appropriate amount of antibiotics to the culture medium to achieve antibacterial and growth, so as to deal with the massive death of rotifers due to bacterial infection in the process of culture.

R11-P Effect of cyanotoxins and microplastics on the feeding and filtration rates of Brachionus calyciflorus (Rotifera)

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Increasing eutrophication often leads to proliferation of cyanobacteria. The production of toxic secondary metabolites (cyanotoxins) has adverse effects on zooplankton. Along with the input of nutrients, other anthropogenic pollutants, particularly plastics that enter these ecosystems. Macro (> 5 mm) and micro (< 5 mm) plastics cause mechanical interference or have a synergistic toxic effect with other contaminants. We evaluated the effect of different concentrations of cyanobacterial crude extract and microplastics on the feeding and filtration rates of Brachionus calyciflorus. We filtered 100 l of lake water and estimated the cyanobacteria density and diversity. After five cycles of freezing, thawing and sonication at 14 MHz, the crude extracts were filtered and the microcystin concentration quantified based on ELISA. Spherical polystyrene microplastics (30 µ m, SIGMA) were used. We used the extracted microcystins, microplastics, and a combination of both to test the acute toxicity and feeding behavior. Feeding experiments were set up by exposing the rotifers to sub-lethal concentrations of crude extract, microplastics or both, with Chlorella vulgaris as food. The LC50 for the cyanobacterial crude extract was 2.56 µ g/l; the cyanobacterial

community at the time of collection was dominated by Woronichinia naegeliana. The LC50 for the microplastics was 21.91 mg/L. The mix of microplastics and cyanobacterial crude extract was result in a more lethal effect of microplastics with a LC50 of 16.64 mg/L Our findings highlight the negative effects of microplastics and cyanotoxins on rotifers.

S5-O The characteristic of rotifer community in the river network on a large estuarine island and its relationship with environmental factors

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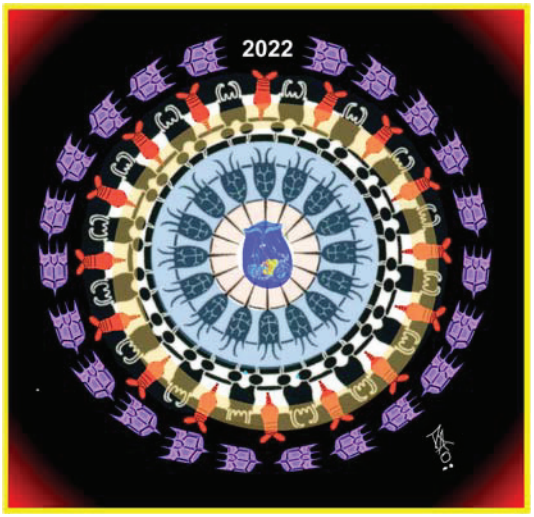
Rotifer is one of the most common animals in aquatic ecosystem and the important primary consumer in cycling of nutrients and energy flow. It is also a kind of sensitive environmental indicators. Their abundance and species composition reflect the water quality. However, there are little studies about rotifer in island. Here, we reported the rotifers communities in the river network on an esturine islands at the mouth of the Yangtze River, China. Bothe auantitative samples of rotifers from 22 sampling sites in the island were collected using 20 μ m and 50 μ m plankton net in January 2021. We also collected eDNA samples. Dissolved oxygen (DO), total nitrogen (TN), total phosphorus (TP), Chlorophyll-a (Chl) and other related twenty physio- chemical parameters were also measured. A total of 25 genera and 55 species of rotifers were recorded, most belonged to the order Monogonota suborder ploima. Among them, genera Brachionus and Filinia have the most species, and both of which have six species. There are six dominant species(D>0.01), and two absolute dominant species (D>0.1), i.e., Brachionus angularis and Polyarthra vulgaris. Environmental DNA analysis only yielded three OTUs of rotifers.

Cluster analysis based on biomass and density are not consistent. According to the biomass cluster analysis, the rotifer communities were divided into three types: dominant by Keratella ticinensis: dominant by Brachionus urceusand Brachionus calyciflorus, and dominant by Brachionus calyciflorus,Syncheate and Brachionus angularis. According to the cluster analysis of rotifer density, the rotifer community is divided into three types. The first is mainly Keratella ticinensis and Polyarthra vulgaris, and the second is mainly Brachionus angularis. The three are mainly Syncheate, Polyarthra vulgaris and Brachionus angularis. Redundant analysis (RDA) showed that the abundance of rotifers in alluvial islands at the mouth of the Yangtze Riverin was positively correlated with environmental factors such as Chl, PH, SD, TP, and negatively correlated with DO.

Rotifera in Digital Art
Rotifer Rangolis*



*Rangoli is a traditional art made on the floor at the entrance to their houses by Indian women on festival occasions. Coloured flours are used artistically to depict a variety of motifs including geometric shapes, flowers, animals and even abstract themes.

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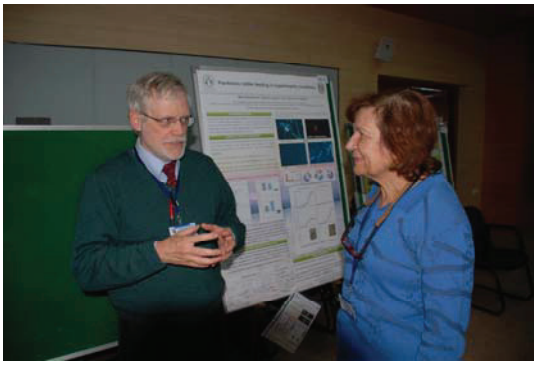
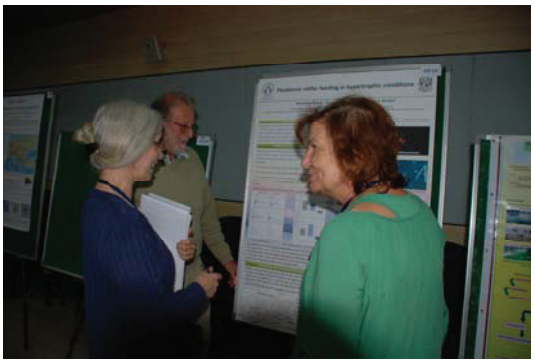
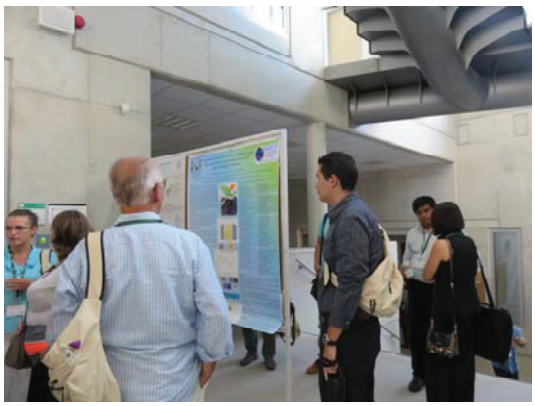
Some historical photos from IRS





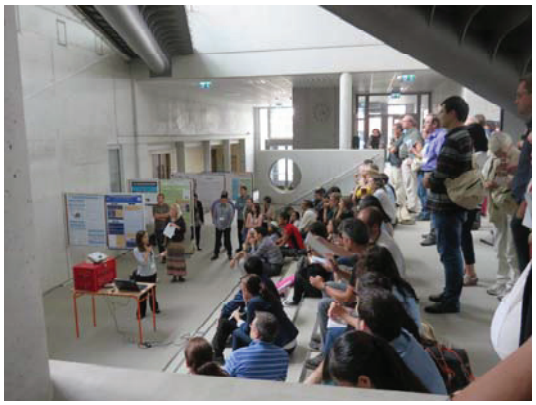




Introduction
Clonal variations for different traits in Brachionus species are known
Lorica morphology: Kutikova & Fernando (1995)
Resting egg morphology: Pourriot et al. (1995)
Swimming behaviour: Gharbi (1995)
Competition and clonal replacement: Snell (1979)
Cyst hatching patterns: Pourriot et al. (1975)
Starvation resistance: Gilbert (2004)
Sensory intensity: Miracle & Serra (1989)
XIV International Rotifer Symposium
XIV ROTIFERA










For high density photos, please contact the Editor, Rotifer News

Historical Photos

Walter Koste with Paul Turner, Juan C. Paggi and Susana José de Paggi in 1988 (Location: Cuiabá, Mato Grosso, Brazil).

Photo credit:
Susana José de Paggi

Email: *sjdepaggi@gmail.com*

Honouring the Legendary WT Edmondson

"I looked at some water from my backyard aquarium and saw a rotifer. I didn't know anything about them. It just swam through the field of the microscope. Some things are engraved on your mind forever." [1]

— *W.T. Edmondson, as reported by John T. Lehman* (Lehman 2000a)

Background

As part of the celebration of his retirement in June 1986 colleagues in the Department of Zoology of the University of Washington gave Dr. Walles Thomas "Tommy" Edmondson [2] a statue of a sessile rotifer (Fig. 1). [Tommy's life was noteworthy; for detailed reviews of the life of this remarkable scientist consult the eulogies that have been published by Hairston (2000); Lehman (2000a); Lehman (2000b); Lehman and Lehman (2009); Wallace et al. (2001).] After Tommy's death his wife, Yvette Edmondson [3] (nee Hardman), saved the statue and upon her death Dr. Robert T. Paine (Department of Zoology, University of Washington) gave it to Dr. John J. Gilbert, (Department of Biological Sciences, Dartmouth College). Gilbert displayed the statue for several years, and after downsizing his office he sent it to me (RLW). At that point we decided that Tommy's statue should not be passed from one rotiferologist to the next as an award of some sort. We felt that such a decision could not be done in a fair manner, and to ship it about the world with proper care would be costly. Thus, we decided that it should be kept on display at the institution of a researcher who studies rotifers in a way that is directly related to Tommy's interests. This way it would be a reminder of Tommy's career, which began with rotifers (Edmondson 1934). For now it is on display in Farr Hall of Science (Department of Biology, Ripon College, Ripon, WI).

A little biology

This artistic work is a realistic rendering of the sessile rotifer, *Floscularia conifera* (Hudson, 1886) a species that formed a significant part of Tommy's Ph.D. dissertation (Edmondson 1944; Edmondson 1945). Note that sessile species differ from other rotifers in that their offspring swim for a short period of time before attaching to a substratum and undergoing metamorphosis

[1] — Curiously, I (RLW) also remember the first rotifer ever I saw. One summer's day I was using the microscope that my older bother had given me as a gift. A friend, who also had a microscope, and I had been scanning bits of material from an algal mat. At one point I was startled when a bdelloid swam through the field of view. Although I was only about 10 years old, the image became embedded in my memory. We wonder how many readers of *Rotifer News* have been lucky enough to have a similar experience when they were children.

[2] — 24 April 1916 – 10 January 2000. Yale University (1938); PhD, Yale University (1942); National Academy of Sciences (1973). Edmondson was known as Tommy to all those with whom he became acquainted.

[3] — 20 September 1915 – 9 May 2006. Bennington College (1936); PhD, University of Wisconsin (1942); Editor of Limnology and Oceanography (1968–1986).

(Wallace 1980). All species in the genus *Floscularia* are microphagous; that is, they use their ciliated anterior end to collect and consume tiny particles in the water. These cilia are seen extending from the four, circular lobes (the corona), which is located at the top of the statue (Fig. 1, upper right). However, some of the larger particles collected by *F. conifera* are not eaten, and from those the animal builds a tube by adding secretions and making bullet-shaped pellets. [In the congener, *Floscularia ringens* (Linnaeus, 1758), the pellets are spherical.] Pellets are made by the modulus, a cup-shaped organ located between the two prominent dorsal antennae. This model shows one being formed (Fig. 1, upper left & lower). As noted by Wright (1950), the animal arranges the pellets in a fashion that resembles the work of a bricklayer building a circular tower (turret). Thus, as the animal grows the height of the pellet tube increases incrementally.

Tommy was familiar with the fact that the pellets in regions in the tube were of a different color the day after a rainstorm. This is illustrated in Plate V of the classical work by Hudson and Gosse (1886) and is depicted in the statue by lighter colored pellets located about 1/3rd of the way below the corona. Exploiting this knowledge, Tommy developed a practical, but particularly clever, technique to investigate the population growth of *F. conifera*. In a small pond on the campus of Yale University he added colored particles to the water so that the pellets that were made by animals attached to the plant [4] were color-coded. First, he used a mixture of pond water and carmine and then 24 hours later pond water and charcoal. Then after an additional 24 hours, Tommy collected the plant and fixed the material in formalin. This process allowed him to estimate several important parameters about the population of *F. conifera*. That is, over the two-day period he could examine a number of important population dynamics including the following: (1) colonization rates of animals on different regions of the plant; (2) growth rates of animals (by tube elongation between the layers of red and charcoal pellets); (3) death rates (e.g., animals with red but no charcoal layers of pellets); (4) egg to female ratio (embryos remain in the tube of the female); (5) life table statistics: l_x and m_x, and from those R_o and r. Years later he expanded on this concept in publications on the egg ratio technique (Edmondson 1960; Edmondson 1965; Edmondson 1968; Hairston Jr. 2015).

Curiously, at low population levels most of the individuals of *F. conifera* are solitary, but as the population increases, more and more larvae attached, not to plant surfaces, but to the tubes of previously settled adults forming

[4] — In this experiment *F. conifera* were colonizing the carnivorous, aquatic plant *Utricularia* (*vulgaris* var. *americana*) *macrorhiza* Le Conte, 1824. *Utricularia* are commonly known as bladderworts and are a particularly good habitat for sessile rotifers.

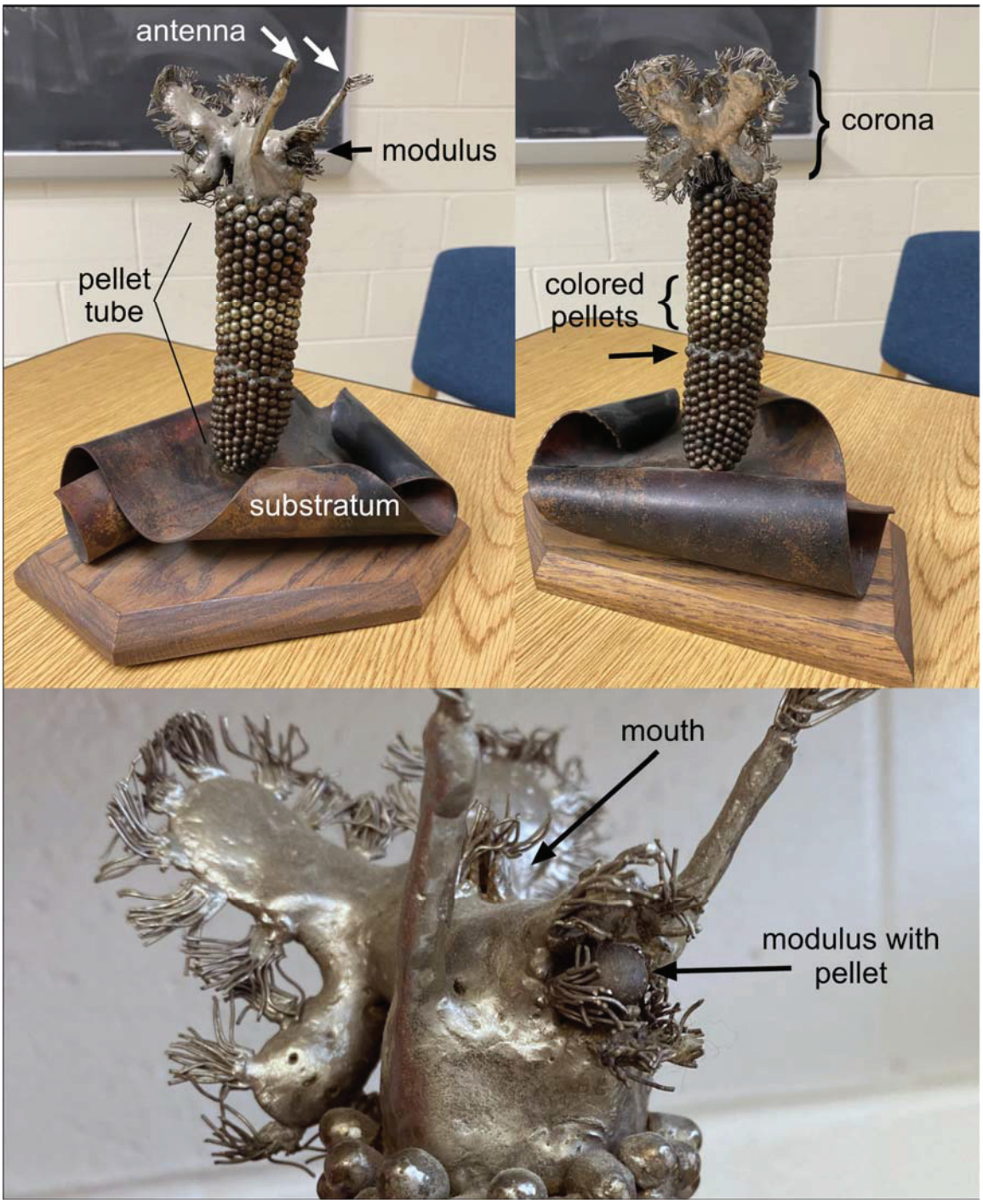


Fig. 1. The Edmondson Statue. Mounted on polished wood, the solitary animal depicted in this work is attached to a bit of plant material (curled metal base plate). Upper left: 3/4th ventral view; upper right: dorsal view of open corona; lower: close up indicating the position of the moth and of the modulus with a pellet being formed. The animal is ~20 cm tall.

colonies. Three types of colony formation are known (Wallace 1987; Wallace et al. 2015). Colony formation in *F. conifera* starts when one larva attaches to an older, previously settled adult. Colonies forming this way can become quite large: sometimes >100 individuals [5]. The phenomenon of colony formation also allowed Tommy to compare social interactions, such as growth and egg deposition rates of solitary individuals versus those living in a colony.

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John J. Gilbert, PhD; Dartmouth College
*Email: wallacer@ripon.edu

December 14, 2021

[5] — RLW personal observation.

Feedback from users

Since the release of Rotifer News number 34, several comments have been received. Some of these observations have been included in this issue.

Everything looks good to me……. **RL Wallace**

You deserve much praise for resurrecting this old tradition in rotifer research…….**TW Snell**

This is the first time in two decades or more that I received a newsletter! …... **T Ramakrishna Rao**

Congratulations… **Ignacio Peñalosa Castro**

Congratulations for the Rotifer News no. 34…. **A. Raymundo Montoya**

This is very interesting…. **Giovanna Flaim**

My sincere congratulations…….. **Jola Ejsmont-Karabin**

Great…… **Télesphore Sime-Ngando**

Nice to see the Rotifer News and send it to the students… **Christina W. Castelo Branco**

Congratulations…… **TJ Pandian**

It is nice to see it going again…… **Ian Duggan**

It came out very nice! …… **HJ Dumont**

The new RN looks great!! ..... **Christian Jersabek**

Congratulations……. **Patricia Dávila Aranda**

It is and will be very useful for those interested in rotifers… **Susana José de Paggi**

About Virtual Rotifer Collaboratorium

Rotiferologists during Q&A listen to Bob Wallace (WI) beef up Natalia Kippen's (Poland) lecture on rotifer-macrophyte association. Never to miss event…… **Andrea Mamaril**

Authors are encouraged to submit contributions to *Rotifer News*.
Contact email account: xirotifera@iztacala.unam.mx

For details, please visit the website:
https://sitios.iztacala.unam.mx/rotifernews/