

# Bdelloid rotifer taxa described since 1965 with the addition of a new species

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## Abstract

We present an annotated list of the more than 40 bdelloid taxa that have been described since the publication of Josef Donner's *Ordnung Bdelloidea* in 1965. Additionally, a *Habrotrocha* specimen that was misidentified in the literature is designated here to be a new species.

## Introduction

Despite being more than 50 years old, Donner's *Ordnung Bdelloidea* [1] is still the most complete identification guide for bdelloid rotifer species. However, any serious student of these animals needs to be aware of the additional taxa that have been described since 1965. A partial list of taxa for the years 1965–1995 was published earlier [2]. Since then several additional species of bdelloids have been described. We present here a list of all bdelloids described since 1965. We are also assigning a previously misidentified *Habrotrocha* specimen to be a new species.

Any attempted taxonomic revision of bdelloids will eventually face the question of what to do with the subspecies that were occasionally described until about 30 years ago. In a sexually reproducing species, a subspecies is taken to be a geographically segregated and morphologically differentiated population that can still interbreed with the other populations of the species [3]. Since bdelloid rotifers reproduce asexually, delineations based on interbreeding are irrelevant. We are not aware of alternative subspecies criteria applicable to asexual organisms, which have been differentiated from each other, until the advent of gene sequencing, primarily using morphological criteria (morphospecies). In fact, the use of the subspecies category in asexual organisms has been recommended against [4].

As is the case with sexually reproducing species, the morphological traits of an asexual morphospecies would also be expected to display some range of variability. However, we

do not know of any published treatments of this subject as it applies to bdelloids. Any clonal population of bdelloids is an evolutionarily independent unit. The difficulty is in determining how much variation is enough to designate such a population to be a separate species while bypassing the subspecies category. A more extensive treatment of this subject is outside the scope of this paper. For the time being, it might be advisable to avoid the erection of new subspecies of bdelloids and raise all previously described and well-marked subspecies to the species level.

## Annotated list of taxa

The bdelloid taxa that have been described since 1965 are as follows in alphabetical order. The general locality of each taxon is given along with additional commentary for some taxa. The number of taxa, excluding the 19 subspecies of *Dissotrocha aculeata*, is 42.

*Abrochtha carnivora* Ricci *et al.* 2001 [5]: Hometown, Barbados. The feeding behavior of this carnivorous species deserves further study, especially to understand how relatively large prey (other rotifers) pass through its trophi seemingly intact as shown in a drawing in the description.

*Abrochtha kingi* Birky *et al.* 2011 [6]: Snowy Range, Wyoming, U.S.A. This and the next two *Abrochtha* species were delimited primarily based on the DNA sequences of the cytochrome c oxidase subunit I genes. Otherwise, the most obvious morphological differences between them were the dimensions of their trophi and the number of major teeth they had.

*Abrochtha meselsoni* Birky *et al.* 2011 [6]: Virginia Dale, Colorado, U.S.A.

*Abrochtha sonneborni* Birky *et al.* 2011 [6]: Tucson, Arizona, U.S.A.

*Adineta acuticornis* Haigh 1967 [7]: Thames, New Zealand.

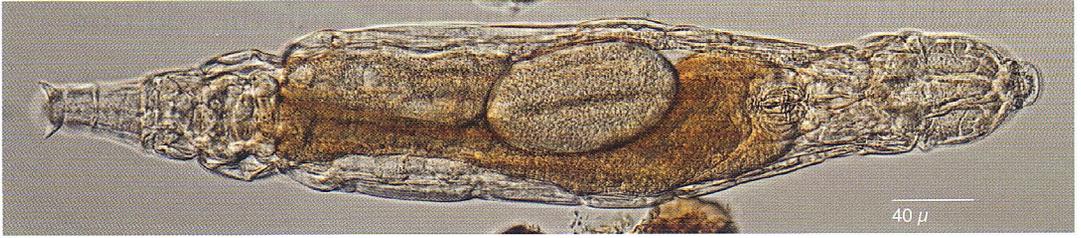


FIG. 1. *Adineta editae* Iakovenko *et al.* 2015 (Antarctica).

*Adineta coatsae* Iakovenko *et al.* 2015 [8]: Victoria Land, Antarctica.

*Adineta editae* Iakovenko *et al.* 2015 [8]: Rocka Islands, Antarctica (Fig. 1).

*Adineta emsliei* Iakovenko *et al.* 2015 [8]: Ross Island, Antarctica.

*Adineta fontanetoi* Iakovenko *et al.* 2015 [8]: Beaufort Island, Antarctica.

*Adineta ricciae* Segers & Shiel 2005 [9]: Bonegilla, Australia.

*Anomopus chasmagnathi* Mañé-Garzón & Montero 1973 [10]: Santa Lucia River, Uruguay.

*Bradyscela hoonsoi* Song & Min 2015 [11]: Wanggok-ri, Korea.

*Dissotrocha aculeata* subspecies Bērziņš 1982a [12]: Bērziņš described 19 subspecies of *Dissotrocha aculeata* Ehrenberg that differed from each other in the numbers of the spines or knobs on their trunks. These were given the following names: *D. a. multiplicans*, *D. a. serangodes*, *D. a. inserta*, *D. a. multicollis*, *D. a. simplex*, *D. a. gossei*, *D. a. rachis*, *D. a. ecksteini*, *D. a. decemcuspis*, *D. a. murrayi*, *D. a. repanda*, *D. a. reversa*, *D. a. markmani*, *D. a. milnei*, *D. a. octocollis*, *D. a. hebes*, *D. a. quadrispinosa*, *D. a. quadricarinata* and *D. a. didyma*. One problem with the descriptions of Bērziņš from 1982 (see also his *D. bjoerki* and the two *Mniobia* species) is that they were issued in two typewritten reports that were distributed privately. It is arguable whether they would qualify as “published work” under the ICZN Articles 8 and 9. The biological significance of these subspecies is also unclear as discussed above. It is necessary to relocate and restudy these animals to determine if they could be designated as distinct species or are simply representatives of a variable species.

*Dissotrocha bjoerki* Bērziņš 1982b [13]: Brazil. The original spelling of the species name was *björki*, which has been changed to *bjoerki* under the ICZN Article 27 [14]. Bērziņš did not explain why he thought this variety was a distinct species; it had 10 spines, but so did five of the *D. aculeata* subspecies he described.

*Dissotrocha decembullata* Koste 1996 [15]: Etosha National Park, Namibia.

*Dissotrocha guyanensis* Rougier & Pourriot, 2006 [16]: Kaw River, French Guiana.

*Dissotrocha kostei* Segers 2007 [14]: Etosha National Park, Namibia. This was originally described as *Dissotrocha hertzogi aculeata* by Koste (1996). But because it had distinct morphological traits, Segers designated it a separate species.

*Habrotrocha antarctica* Iakovenko *et al.* 2015 [8]: Ross Island, Antarctica.

*Habrotrocha angusticollis alterversa* Koste 1970 [17]: Osnabrück, Germany. *Habrotrocha angusticollis* Murray 1905 [18] is a case-building species. There are four subspecies, including this one, that are distinguished from each other by the length and the curvature of the necks of their cases. Koste’s (1970) statement that his *H. a. alterversa* was a transitional form between two other subspecies hints at the possibility that there is just one species that builds cases with variable structures.

*Habrotrocha devetteri* Iakovenko *et al.* 2015 [8]: Ross Island, Antarctica.

*Habrotrocha vermadskii* Iakovenko *et al.* 2015 [8]: Galindez Island, Antarctica (Fig. 2).

*Habrotrocha vicina* Donner 1980 [19]: Brazil.

*Macrotrachela donneri* Iakovenko *et al.* 2015 [8]: Victoria Land, Antarctica.



FIG. 2. *Habrotrocha vernadskii* Iakovenko et al. 2015 (Antarctica).

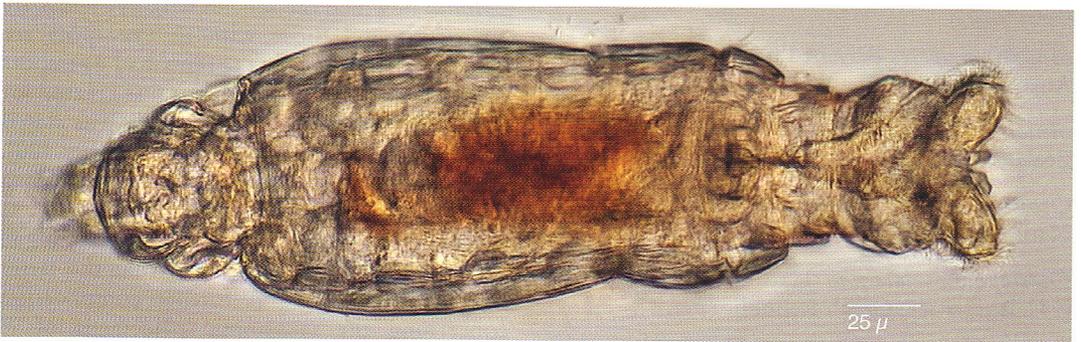


FIG. 3. *Macrotrachela jankoi* Iakovenko et al. 2015 (Antarctica). The Antarctic rotifers were from samples provided by the courtesy of Nataliia Iakovenko and Karel Janko.

*Macrotrachela extensa* Haigh 1965 [7]: Onewhero, New Zealand.

*Macrotrachela herzigana* Koste 1996 [20]: Madagascar. The overall morphology of this species appears identical with that of *Habrotrocha nodosa* Murray 1911, which was also recorded in Madagascar [20]. The primary differences between them are the trophi structure and the number of major teeth, shown as 2/2 in Koste (1996) and stated to be “many” by Murray [21].

*Macrotrachela ioannae* Iakovenko et al. 2015 [8]: Rocka Islands, Antarctica.

*Macrotrachela jankoi* Iakovenko et al. 2015 [8]: Squa Island, Antarctica (Fig. 3).

*Macrotrachela ligulata* Haigh 1965 [7]: Waipoua Forest, New Zealand.

*Macrotrachela obtusa* Haigh 1966 [22]: Karekare, New Zealand.

*Macrotrachela sonorensis* Örstan 1995 [23]: The type locality of this species was a desert area in Sonora, Mexico. It was recently found in Korea [11]. There is also an unpublished record from Arizona, U.S.A. (William Birky, e-mail to AÖ, 21 December 2016).

*Mniobia conarus* Bērziņš 1982a [12]: Melbourne, Australia. This and the following species were described poorly and it would be difficult to recognize them again. As discussed above under *Dissotrocha aculeata* subspecies, it is also unclear

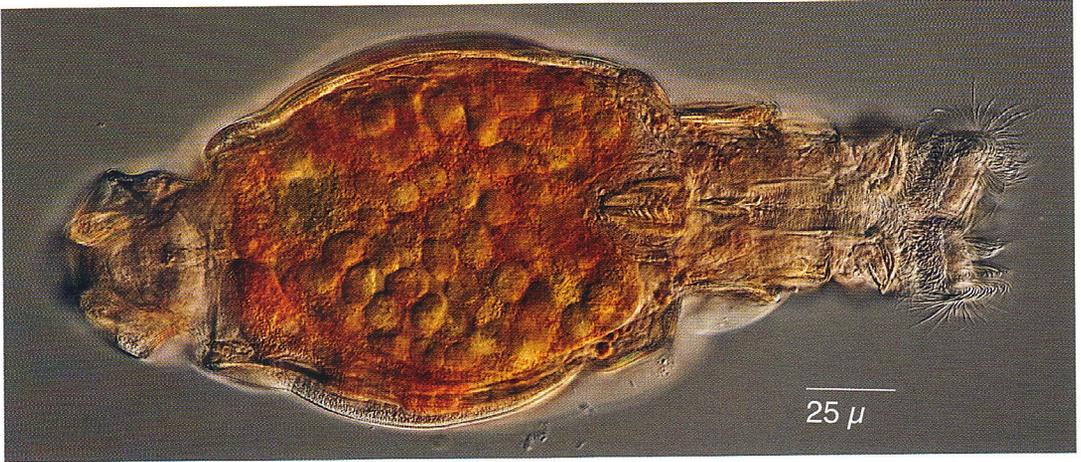


FIG. 4. *Otostephanos jolantae* Iakovenko *et al.* 2013 (type locality, Czech Republic; this specimen, Cologne, Germany).

if the report they were described in could be considered a proper publication under the ICZN.

*Mniobia ocyptetes* Bērziņš 1982 [12]: Melbourne, Australia.

*Mniobia lobata* Haigh 1967 [7]: Thames, New Zealand.

*Otostephanos jersabeki* Koste 1996 [20]: Etosha National Park, Namibia.

*Otostephanos jolantae* Iakovenko *et al.* 2013 [24]: Borkovice, Czech Republic (Fig. 4).

*Otostephanos kostei* Donner 1972 [25]: Danube River, Austria.

*Otostephanos ukrainicus* Iakovenko *et al.* 2013 [24]: Kiev, Ukraine.

*Philodina calceata* Donner 1970 [26]: Salzach River, Austria.

*Philodina dartnallis* Iakovenko *et al.* 2015 [8]: Ross Island, Antarctica.

*Philodina foissneri* Koste 1996 [20]: Etosha National Park, Namibia.

*Philodina shackletoni* Iakovenko *et al.* 2015 [8]: Ross Island, Antarctica.

*Philodinavus aussiensis* Ricci *et al.* 2003 [27]: Mount Beauty, Australia.

*Pseudoembata acutipoda* Wycliffe & Michael 1968 [28]: The taxonomic placement of this species is not clear. It was found in India on a *Caridina* sp., a southeastern Asian genus of

freshwater shrimps. Most bdelloids that are epizoic on aquatic arthropods are in the genus *Embata* in which the species with eye spots are viviparous and those without eye spots are oviparous. Because this species had eye spots but was oviparous, a new genus was created for it. During swimming, *P. acutipoda* was stated to keep its spurs parallel to each other [28]. This trait makes it look almost identical to *Embata laticornis* [18], which also had eye spots. What prevents us from synonymizing *P. acutipoda* with *E. laticornis* is that the latter was viviparous [18]. A further complication concerning the taxonomic placement of *P. acutipoda* is that Vasisht & Chaudhery [29] claimed that its stomach did not have a lumen, thus removing it from the family Philodinidae to the Habrotrochidae. A bdelloid identified as *E. laticeps* [18] has been recorded from *Caridina ensifera* [30]. The quality of the drawings and photographs of the rotifer in the latter paper do not allow us to confirm its identification.

In addition, Donner [19] introduced the name *Mniobia ostensa* for a variety of *Mniobia animosa* Milne 1916 that Burger [31] had described without naming. However, the same variety had already been named *Mniobia burgeri* by Bartoš [32]. Therefore, *M. ostensa* Donner is a junior synonym of *M. burgeri* Bartoš [2].

### A new bdelloid species

During the preparation of this manuscript, we noticed that the morphology of a bdelloid

specimen Haigh [33] identified as *Habrotrocha gibbosa* de Koning 1947 [34] does not entirely match the original description of that species or the description of any other currently known species. We take this opportunity to describe this bdelloid as a new species.

*Habrotrocha haighi* sp. nov. Örstan & Plewka

Syn: *Habrotrocha gibbosa* Haigh (1965); non *Habrotrocha gibbosa* de Koning 1947.

We have not seen this species, but are relying on its description given by Haigh [33]. The salient morphological features of Haigh's specimen were a flatly arched upper lip with a ligule in the middle; a lateral hump on each side of the antenna; the cuticle of trunk with globular protuberances; the anal pseudo-joint with three low humps and four short spines (two dorsal and two lateral) and an egg covered with protuberances. Additionally, Haigh gave the dental formula as 2/2 and the creeping length of his specimen as 187  $\mu\text{m}$ . He also noted that the stomach of the animal had large food pellets that, along with the morphology of its corona,

justified its placement in the genus *Habrotrocha* (Habrotrochidae).

*Habrotrocha gibbosa* de Koning 1947 lacked humps and spines on its rump (Fig. 5A); the presence or the absence of such structures in bdelloids have traditionally been considered to be significant enough for the delineation of species [1]. Therefore, we believe that the bdelloid Haigh described was not *H. gibbosa* de Koning 1947. We are designating it a new species and naming it after S.B. Haigh in recognition of his studies of the bdelloid rotifers of New Zealand. In accordance with the ICZN Articles 72.5.6 and 73.1.4, we are assigning the specimen that Haigh [33] illustrated in his Figure 1E (reproduced here in Fig. 5B) to be the type (now lost). The type locality (the locality of Haigh's humus sample) was Onewhero, New Zealand.

Haigh's failure to recognize his specimen as a new species appears to have been due to his lack of access to de Koning's (1947) paper. He instead relied on Voigt's brief description of *H. gibbosa* [35] and did in fact note that his specimen differed from Voigt's description.

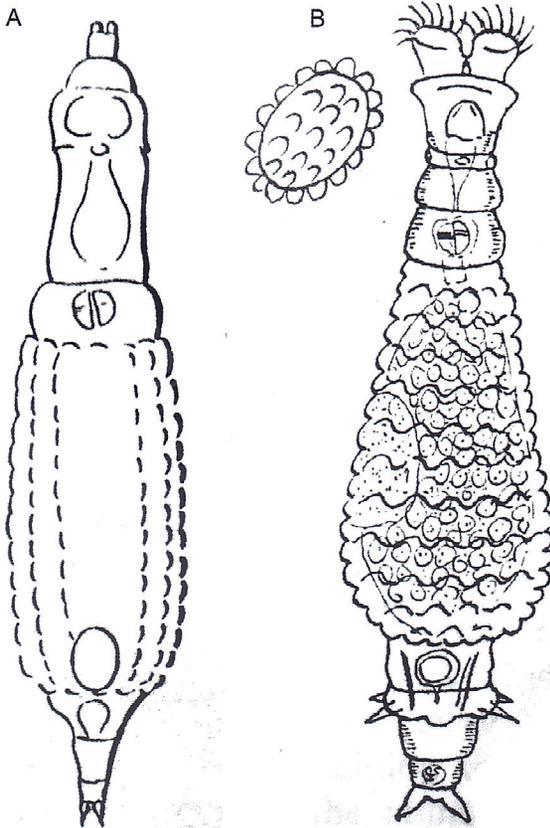


FIG. 5. A: Drawing of creeping *Habrotrocha gibbosa* reproduced from de Koning (1947) showing the rump. B: Drawing of the type of *Habrotrocha haighi* sp. nov. and its egg reproduced from Haigh (1965). The rump has three humps and two dorsal and two lateral spines.

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