



Towards a List of Available Names in Zoology, partim Phylum Rotifera

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Abstract

Many, mostly older, names of animal species are nomenclaturally problematic, either because their orthography is unstable, or they cannot be linked reliably to a taxonomic identity, due to the lack of recognisable descriptions and/or types. Yet, they represent available (*sensu* International Code of Zoological Nomenclature) names and must be taken into account in zoological works. This situation, with available senior, yet dubious names confounding nomenclature, is undesirable. It creates uncertainties at a time when molecular approaches are revolutionizing our concepts of species diversity, and fails us when the current extinction crisis calls for efficient, accurate, and constructive approaches to document, monitor, and conserve biodiversity.

The International Code of Zoological Nomenclature (The Code) provides a means to address this issue by restricting availability, application and orthography of names to those included in the *List of Available Names in Zoology* (LAN). The Code (Art. 79) allows an international body of zoologists in consultation with the Commission to propose a candidate part of the LAN for a major taxonomic field. We explore this possibility for 3570 species-group names of Phylum Rotifera (of which 665 are problematic), by presenting such a candidate Rotifera part of the LAN. The web site of the International Commission on Zoological Nomenclature (<http://www.iczn.org>) will hold both the candidate list and a forum to facilitate consultation on the candidate list, while the list itself also can already be freely downloaded from three other Internet sites: <http://fada.biodiversity.be>, <http://rotifer.anasp.org/LAN>, and www.hausdernatur.at/rotifera. We give here an overview of the general approach and procedures applied in preparation of the candidate list, and anticipate that our effort will promote the process as well as result in a standard list of names for use in taxonomy, the Global Names Architecture and other biodiversity information initiatives.

Key words: International Code of Zoological Nomenclature, taxonomy, nomenclature, names standards

Introduction

Since the publication of Linnaeus's *Systema Naturae* over 250 years ago, the practice of referring to organisms using a binominal nomenclature has become a universal tool in scientific communications. The International Commission on Zoological Nomenclature (the Commission) oversees development of the International Code of Zoological Nomenclature (the Code), which promotes much-needed stability in the application and use of scientific names. The Code's principles of typification, priority, synonymy and homonymy have contributed greatly to the success of the system.

Nevertheless, over the past two and a half centuries, problematic, yet available names (in the sense of the Code) have proliferated. These issues may be related to various aspects of nomenclature such as inconsistent

orthography, yet names for which taxonomic identity cannot be determined due to the absence of type specimens or adequate descriptions also offer serious problems. Many problematic names have been temporarily categorised as *species inquirendae* or assigned, without full justification, as junior subjective synonyms of established species. The preferred approach to dealing with problematic names remains the careful revision of name-bearing types and original publications. However, such an approach may not be possible if there is no type material, or if the quality of type material is inadequate, and/or if the original description does not permit identification. Problematic names can, under restricted circumstances, be declared *nomina oblita* if relevant criteria as formulated in the Code are met (see Art. 23.9.1 and 2). Even with this, a large number of cases remain that seem unresolvable. The standard procedure to stabilize these is to (1) obtain specimens that by some measure can be surmised as being conspecific to the original material, from a locality as close, and as similar as possible, to their type localities; (2) designate neotypes and publish descriptions of these specimens; and (3) evaluate the taxonomic identity of neotypes and decide whether they should be treated as subjective synonyms of established species, or whether they represent a separate and valid species. In the event that the taxon in question belongs to a cryptic species group— an all too common phenomenon in rotifers—this could destabilize familiar names. Whatever the outcome, it is clear that completing this procedure for several hundred problematic cases would be impractical because the benefits are unlikely to justify the effort and resources required. This is a problem that is especially critical at a time when taxonomists have difficulty demonstrating the relevance of their science to the world, but when taxonomic efforts are needed to document our disappearing biodiversity.

Phylum Rotifera— here taken to include Bdelloidea, Monogononta and Seisonida, but not Acanthocephala (see Fussmann (2011) for a recent review), contains microscopic organisms that are a taxonomic challenge in several ways. First, as a group they cannot be identified using a unified method. For example, most Dicranophoridae, Notommatidae, and all Bdelloidea and Collothecidae require examination of living specimens and/or destructive methods to study morphology of the jaws (trophi) for routine identification. On the other hand, the Brachionidae, Lecanidae, Lepadellidae, and Trichocercidae can only be adequately identified using preserved, well-contracted specimens. Second, the absence of type material is very common in this group: our own efforts have revealed that no type specimen at all is known to exist for the vast majority of nominal taxa. In addition, many original descriptions lack the necessary detail, or are of insufficient quality, to determine identity of the specimens studied. Finally, recent research has shown several instances of cryptic diversity; in fact, every morphospecies studied by molecular techniques so far has proven to consist of a complex of species (e.g., Fontaneto *et al.* 2011; Gomez *et al.* 2002; Schröder & Walsh 2010; Suatoni *et al.* 2006; Walsh *et al.* 2009).

The fourth edition of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature, 1999) introduced the option for international bodies of zoologists to propose, in consultation with the Commission, candidate parts of the *Lists of Available Names in Zoology* (Art. 79) (LAN). This tool can help stabilize nomenclature by removing available names that cannot be linked to a taxonomic identity simply by not including them in the LAN. This procedure is similar to that applied by bacteriologists when they adopted their 1980 “*Approved Lists of Bacterial Names*” (Skerman *et al.* 1989). As far as zoological nomenclature is concerned, ours is the first independent attempt at a candidate part of the *List of Available Names in Zoology* that has made it to this point. Here, we briefly illustrate the concept of a LAN for zoology, give an outline of the approach and procedure followed in producing the candidate Rotifera part of the List, and propose ways to deal with redundant names. We anticipate that this will contribute to the creation of a much-needed names standard for all zoological taxa that should be instrumental to facilitate retrieval and reference to information on living and fossil organisms, and to illustrate the process by which such lists can be created. As such, this work contributes to several biodiversity information initiatives, such as, the Global Names Architecture (Patterson *et al.* 2010), or Catalogue of Life (Bisby *et al.* 2011).

The List of Available Names in Zoology

The goal of establishing a LAN is described in Article 79.4 of the Code:

“79.4.1. A name occurring in an adopted Part of the List of Available Names in Zoology is deemed to be an available name and to have the spelling, date, and authorship recorded in the List (despite any evidence to the contrary).”

“79.4.2. A nominal taxon denoted by a name occurring in an adopted Part of the List of Available Names in Zoology is deemed to have the name-bearing type recorded therein (despite any evidence to the contrary).”

“79.4.3. No unlisted name within the scope (taxonomic field, ranks, and time period covered) of an adopted Part of the List of Available Names in Zoology has any status in zoological nomenclature despite any previous availability.”

This article has the goal of making an approved LAN the ultimate nomenclatural resource determining availability, orthography, authorship, date, and type of any name. Considering the obvious nomenclatural importance of such a list, any proposed candidate part of the LAN must meet stringent criteria. It must pass an elaborate procedure as outlined in Article 79 of the Code prior to being considered and, eventually, adopted by the Commission. A crucial element in the relevant Code articles is that omission of names is an integral element of the procedure leading towards the LAN; thus, the LAN becomes the instrument by which problematic available names obstructing the stability of nomenclature are removed.

In preparing the candidate Rotifera part of the LAN, we meticulously followed the guidance provided in the relevant articles of the Code (Art. 10.7, 79). Additional information will be included in the notification on the candidate Rotifera part of LAN that will be published by the Commission and its *ad hoc* committee (Art. 79.2.1). The scope of the Rotifera part of the LAN project is species-group names in Phylum Rotifera, made available prior to 1st of January 2000, (Art. 79.1.1). This date was chosen to allow sufficient time so that nomenclatural acts published in less easily obtainable journals prior to that date were not overlooked, in accordance with Art. 79.2.2.4. Additionally, this date is consistent with the one at which the present edition of the Code came into effect.

We assembled the candidate Rotifera part of LAN on behalf of the international community of rotiferologists. The initiators of the Rotifera LAN project proposed such a list at the XII International Rotifera Symposium held in Berlin, August 2009. At that time, an open invitation was issued to any interested expert to join the effort, in order to maximize community support and ownership. The rotifer symposium convenes every three years and is open to professional and citizen experts in various disciplines of fundamental and applied science (aquaculture, ecology, evolution, and taxonomy), with rotifers as their common interest. The meeting in Berlin endorsed our endeavor by a near-unanimous vote (no negative votes; one abstention) from over 100 participants.

Format of the candidate Rotifera part of the LAN

Article 79.1 of the Code clearly prescribes the information that must be provided for each name included in the LAN. This information includes the following:

- The bibliographic reference to the work in which the name is established, its authorship, its date of publication and its status (Art. 79.1.2),
- Details of the name-bearing type (Art. 79.1.3): repository and status of name-bearing types, if available, and
- For any name that has been the subject of a Commission ruling, the relevant Opinion and the status of the name as ruled therein (Art. 79.1.4).

Our candidate Rotifera part of LAN further contains the following:

- The correct spelling of the name, with, if relevant, gender agreement as appropriate in its original combination,
- The name of the genus of the name in its original combination,
- The name of the species and genus, in the case of names originally proposed or made available at subspecific rank, of the original combination, and
- Author and publication date of the name.

To facilitate use and utility of the list, we further included, for each name, its present taxonomic status and the present combination if different from the original, and whether the name is declinable: i.e., ends in a Latin or Latinized

adjective or participle in the nominative singular that must agree in gender with the generic name with which it is combined (Art. 31.2). As this information is not required according to the relevant Article of the Code, it does not form part of the LAN proper, which we indicate by placing it between square brackets. Some examples of entries in Jersabek *et al.* (2011), the candidate Rotifera part of the LAN, are noted here.

- *abstrusa*, *Cephalodella*, Myers 1934; American Museum Novitates, 699: p.13, fig.14; syntypes: AMNH 699 [valid as *Cephalodella abstrusa*; name declinable]
- *acrodon*, *Encentrum*, Wulfert 1936; Archiv für Hydrobiologie, 30: p.429, fig.21; no deposited type known [valid as *Encentrum acrodon*; name undeclinable]
- *ahlstromi*, *Brachionus havanaensis*, Lindeman 1939; Transactions of the American Microscopical Society, 58: p.213, fig.9; no deposited type known [valid as *Brachionus ahlstromi*; name undeclinable]
- *amphiceros*, *Brachionus*, Ehrenberg 1838; in Ehrenberg, C G, *Die Infusionsthierchen als vollkommene Organismen. Ein Blick in das tiefere organische Leben der Natur*: p.511, pl.63, fig.2; no deposited type known [junior subjective synonym of *Brachionus calyciflorus* Pallas, 1766; name undeclinable]
- *intermedia*, *Pedalia*, Wiszniewski 1929; Bulletin de l'Académie Polonaise des Sciences et des Lettres: p.137, pl.7, figs.1-5; no deposited type known; placed on the Official List of Specific Names in Zoology, Code Op. 326, available: *intermedia*, *Pedalia*, Wiszniewski, 1929, Bull. Acad. pol. Sci. Lettr. (Cl. Sci. math. nat.), (B) 1929(2): 137 (Rotifera); [valid as *Hexarthra intermedia*; name declinable]
- *ornata*, *Monostyla*, Harring & Myers 1926; Transactions of the Wisconsin Academy of Sciences, 22: p.402, pl.36, figs.1-2; syntypes: ANSP 99, AMNH 373; [preoccupied as *Lecane ornata* (Harring & Myers, 1926) non (Daday, 1897), replaced by *Lecane myersi* Segers, 1993; name declinable]
- *pachypus*, *Encentrum*, Remane 1949; Kieler Meeresforschung, 6: p.61, figs.6,7; no deposited type known; [junior homonym of *Encentrum pachypus* Wulfert, 1936, replaced by *Encentrum remanei* Voigt, 1957; name undeclinable]
- *vitrea*, *Metopidia*, Shephard 1911; Proceedings of the Royal Society of Victoria, 24: p.55; no deposited type known; [*nomen novum* for *Metopidia ovalis* Shephard, 1892, nec non (Müller, 1786); valid as *Lepadella vitrea*; name declinable]

We refer to the candidate Rotifera part of the LAN proper as our A-list. Although not explicitly requested by the Code, we compiled a list of problematic names that cannot be linked to a taxonomic identity, as the B-list. Such a list of problematic names now is a component of the Commission's directions for the implementation of Art. 79 (D. Fautin, *in litt.*). The B-list contains names now available in the sense of the Code that purportedly or effectively pertain to rotifers but for which there is no type specimen and, as judged unanimously by at least three rotifer taxonomists, possess an unrecognizable description. As required by Article 79.2.2.1 of the Code, the candidate Rotifera part of the LAN is freely available and open for review by the international community of zoologists. The web site of the Commission (<http://www.iczn.org>) holds both the candidate list and a forum to facilitate consultation on the draft. The candidate list is further freely downloadable from the websites of the Freshwater Animal Diversity Assessment project, at <http://fada.biodiversity.be>, of the Academy of Natural Sciences of Philadelphia, at <http://rotifer.ansp.org/LAN>, and of the 'Haus der Natur' in Austria, at www.hausdernatur.at/rotifera. Through the publication of an announcement by the Commission that a candidate part of the LAN is available for review, all zoologists are invited to contribute comments during a period of twelve months (Art. 79.2.2.1). After this time, a revised draft will be issued not less than two years from the date of publication of the notice and, again, will be subject to debate and revision during a second period of twelve months. A final draft will then be presented to the Commission for final adoption (Art. 79.2.2.6).

Preparing the candidate Rotifera part of the List of Available Names in Zoology

The candidate Rotifera part of the LAN is largely based on authoritative checklists by Harring (1913a), Wiszniewski (1954), Segers (2007), and the taxonomic reviews listed in Table 1. We also examined every original publication that establishes new species-group names of rotifers. We established four criteria to differentiate between names that can be linked to a taxonomic identity and names that cannot be linked. These criteria are outlined below. As a matter of course, only names that pertain to rotifers are included in the candidate list. Few names

of species-group taxa that were originally proposed as being rotifers but that do not belong to this group remain after the review by Harring (1913a). Wiszniewski (1954) reported simply that *Pterodina flava* Scheer, 1934 is “pas un Rotifère” (a peritrich ciliate?). Of relatively recent names, there are three cases: *Colurella monodactylos* Althaus, 1957, *C. althausae* De Ridder, 1977 (both ?*Dysteria* sp., ciliates: Turner, 1995), and *Conochilus arboreus* Rajendran, 1971 (see Segers & Wallace 2001; a peritrich ciliate: W. Foissner *in litt.*). We appended to our B-list names that were originally proposed for rotifers, but that do not pertain to organisms in this taxon.

TABLE 1. List of major global treatises on Rotifera used during the compilation of the candidate Rotifera part of the List of Approved Names in Zoology.

- Rotifera: Harring (1913a), Segers (2007), Wiszniewski (1954)
- Bdelloidea: Donner (1965), Kutikova (2005)
- ASPLANCHNIDAE, GASTROPODIDAE, LINDIIDAE, MICROCODIDAE, SYNCHAETIDAE, TROCHOSPHAERIDAE: Nogrady & Segers (2002)
- CONOCHILIDAE: Segers & Wallace (2001)
- DICRANOPHORIDAE, ITURIDAE: De Smet & Pourriot (1997)
- LECANIDAE: Segers (1995)
- NOTOMMATIDAE, SCARIDIIDAE: Nogrady et al. (1995)
- PROALIDAE: De Smet (1996)
- TRICHOCERCIDAE: Segers (2003)

1) Only names that are at present available in the sense of the Code are considered.

The goal of a LAN is not to create new available names. Therefore, names that are at present unavailable, such as *nomina nuda*, incorrect subsequent spellings not in prevailing usage (Art. 33.3), and names proposed for taxa of infrasubspecific rank, established after 1960 (Art. 15.2), are not included in the entire Candidate part of the LAN.

Many species of Rotifera are notorious for their morphological variability. Phenotypic plasticity, both through cyclomorphosis or development of predator-induced defensive structures, is common. This has led to the establishment of numerous infrasubspecific taxa. A majority of these were originally proposed to denote taxa at species-group rank and were later recognized as infrasubspecific variants of established species or, if proposed at infrasubspecific rank, were at one time or another before 1985 treated as denoting a taxon at species-group rank (e.g., by Bartoš 1959; Kutikova 1970: see Art. 45.6.4.1) and are therefore available. Cyclomorphosis, the seasonal succession of morphologically distinct variants of the same species, was recognized as a source of environmentally induced morphological variation as early as 1900 (Krätschmar 1908; Lauterborn 1900; 1904). Indeed, Harring (1913a: p. 19) stated that “*Brachionus capsuliflorus* Pallas is so variable, in fact, it is difficult to find two specimens alike, that to introduce names for each form would practically amount to giving individual names...”. Thus, we interpreted names proposed in combination with the term “var.” or “f.” (or equivalent) before 1960, in the context of studies reporting on morphological variation, as being unambiguously proposed for an infrasubspecific entity, and therefore unavailable (Art. 45.6.4), in addition to those names proposed in quadrimina (Art. 45.5). On the other hand, we interpret names derived from geographical names as indicating subspecificity, in the absence of an explicit indication by their original authors.

A more easily resolved issue concerns a multitude of names established by J.-B. Bory de St. Vincent in numerous publications during the early 19th century. This author merely renamed previously established species, and “As far as can be judged from his writings, he never saw a rotifer” (*dixit* Harring 1913a, p. 41). Consequently his names are objective synonyms of those they were supposed to replace, and do not as such pose a taxonomic or nomenclatural problem.

2) Any name for which there is a name-bearing type, regardless of the quality of its accompanying description, is retained as available.

Because of the principle of typification, the existence of any type specimen, even specimens in poor condition, automatically results in the retention of the corresponding name. In Rotifera, there are relatively few species-group names for which any type material exists. This is because the identification of many species requires study of living specimens and/or application of destructive techniques to examine trophi morphology. Adequate methods for preserving rotifers only became available in the late 19th century (Rousselet 1893). The practice of designating type material slowly gained ground in rotiferology since H. K. Haring (1913b) began the practice. Nonetheless, before release of the fourth edition of the Code (effective 1 January 2000), when fixation of (a) type specimen(s) in the original publication became mandatory, fewer than one in four rotifer taxonomists were designating type material while proposing new species-group names. Unfortunately, an important collection of types by H.K. Haring and F.J. Myers, reported as having been deposited in the American Museum of Natural History (New York), has been unaccounted for since the 1960s (Jersabek 2005). We found that a few additional name-bearing types are lost, either because of deficient preservation conditions or because they appear never to have arrived at the repository indicated in the description.

We compared rotifer collections in European and North American institutions with the corresponding original designations, and were able to verify or emend the status for over one-third of all previously published type fixations. If slide preparations of a designated 'type' or 'holotype' turned out to contain several specimens, these are regarded syntypes; specimens designated or labelled 'paratype(s)' or 'co-type(s)' without formal, published fixation of a holotype are considered name-bearing types.

There are only 372 published type designations for a total of 3570 species- group named rotifers (up through 31 December, 1999). Adding name-bearing types found while examining natural history collections or collection catalogues that had not been referred to as such in the corresponding original publications raises the number to 633, which is still less than 18% of the total. To comply with Article 72.4.7 of the Code, we diligently checked through examination of additional evidence (e.g., correspondence between published information and information on dates and localities on labels) whether the specimens concerned are indeed name-bearing types.

3) Any name that is in common use to denote a valid species-group taxon or any available name that is in common use to denote a taxon currently considered as of infrasubspecific rank, is retained as available.

As nomenclatural stability is our main concern, we retained names in use for well-established valid taxa even when their original description does not permit identification. To determine whether a name is in common use, we checked authoritative checklists and monographs available for many higher-level taxa (see Table 1). Only taxa listed as *species inquirenda(e)* in these works were not automatically included in the candidate Rotifera part of the LAN. This approach was followed for both species-group names as well as for available names currently treated as representing recognisable infrasubspecific variants, as the latter, from a nomenclatorial point of view, are junior subjective synonyms of the nominal taxon, and should remain available.

A consequence of this conservative approach is that many names of species in genera of which trophi morphology is currently considered crucial to their identification but for which such an account is missing (e.g., many of the *Cephalodella* species described by F.J. Myers in the 1920s and 1930s) are retained as potentially valid.

4) Any name that is accompanied with a recognisable description, and that concerns a rotifer, is retained as available.

The remaining names, for which there are no type specimens, are not treated in the global treatises listed in Table 1, or that were treated as *species inquirendae* in any of these, were individually reviewed by at least three of us independently, by checking the original description. Only if there was consensus that the original description is insufficient to enable recognition of the taxon, did we include the name in our list of problematic names. The majority of these are names that have been considered dubious since Haring's (1913a) synopsis, but some are more recent. In most cases these are based on non-contracted specimens of species that can only be studied adequately in the contracted state, or on contracted specimens of species that require the study of living specimens for identification.

To establish the correct orthography of names, we duly followed the relevant articles of the Code and re-examined their original spelling. In the very few cases in which a discrepancy exists between the original and commonly used spelling of a name, and for which the Code does not provide strict guidance, we selected the spelling as used in recent monographs and reviews (Table 1). This situation applied to a few names of bdelloids, and in these cases we adhered to the spelling in Kutikova (2005).

The efforts described herein result in the evaluation of 3570 species-group names in Rotifera, of which 665, or about 18%, are considered dubious following our conservative assessment.

How to deal with the problematic names?

Following the appropriate rules set out in the Code, names on our B-list will eventually be excluded from the Rotifera part of the LAN if and when adopted. This will render them unavailable and thus remove them from zoological nomenclature. This concurs with our goal to facilitate future taxonomic work, but may have undesirable consequences. In particular, while these names would become officially (in the sense of the Code) or secondarily unavailable, they would persist in the scientific literature and would continue to appear, especially in electronic media. Apart of the confusion that could follow, this would challenge the fundamental principle of universality of the Code in zoological nomenclature. In bacteriology, the problem of continued use of names that are not included in the list of approved names exists, although most bacteriologists view this problem as of marginal relevance. However, considering the number of names in zoological nomenclature (two orders of magnitude higher than in bacteriology), the standard practice in zoology of reviewing old literature, and the fact that presenting a single, overarching LAN as a standardized and fixed reference for all names in zoology contrarily to bacteriology is utopian, this may be differently in zoological nomenclature.

In addition, there is no rule that prevents that secondarily unavailable names be re-used for newly described taxa. Such homonymy, while unofficial, could nevertheless cause confusion, so we call upon colleagues to refrain from re-using these names for new taxa in inappropriate combinations.

To enable retrieval of secondarily unavailable names, the Commissions' standing committee on the *List of Approved Names* and *ad hoc* committee on the candidate Rotifera part of LAN, require that names rendered unavailable by being excluded from an approved part of LAN, will be listed, appropriately labeled, in ZooBank (see <http://zoobank.org>, Pyle & Michel 2008, 2009). This will enable easy retrieval of such names and their status, and answers the concern raised above and complies with the governing principles of zoological nomenclature.

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