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A Higher Level Classification of All Living Organisms

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Abstract

We present a consensus classification of life to embrace the more than 1.6 million species already provided by more than 3,000 taxonomists' expert opinions in a unified and coherent, hierarchically ranked system known as the Catalogue of Life (CoL). The intent of this collaborative effort is to provide a hierarchical classification serving not only the needs of the CoL's database providers but also the diverse public-domain user community, most of whom are familiar with the Linnaean conceptual system of ordering taxon relationships. This classification is neither phylogenetic nor evolutionary but instead represents a consensus view that accommodates taxonomic choices and practical compromises among diverse expert opinions, public usages, and conflicting evidence about the boundaries between taxa and the ranks of major taxa, including kingdoms. Certain key issues, some not fully resolved, are addressed in particular. Beyond its immediate use as a management tool for the CoL and ITIS (Integrated Taxonomic Information System), it is immediately valuable as a reference for taxonomic and biodiversity research, as a tool for societal communication, and as a classificatory "backbone" for biodiversity databases, museum collections, libraries, and textbooks. Such a modern comprehensive hierarchy has not previously existed at this level of specificity.

Introduction

Biological classification (taxonomy) aims to simplify and order the immense diversity of life into coherent units called taxa that have widely accepted names and whose members share important properties. It synthesizes information concerning a great variety of characters (e.g.,

morphological; molecular: genes, metagenome, and metabolome; etho-ecological). There is currently no consensus among the world's taxonomists concerning which classification scheme to use for the overall hierarchy of life, in part because of the confusion resulting from Hennig's [1] redefinition of previous terminology of classification, which has not been universally accepted; the separate goals of cladification and classification [2]; and conflicting or unresolved evidence for phylogenetic relationships. The continuing advances in the use of specialized analytical tools from many different fields and their resulting conclusions and assumptions require regular updates as advances in knowledge are made.

Biological classification can integrate diverse, character-based data in a phylogenetic framework, which allows a broad user community to utilize the disparate knowledge of shared biological properties of taxa. Phylogeny is, therefore, the basis for these biological classifications but there is still strong debate over their accounting for evolutionary divergence or information content other than the branching pattern [3]. Accordingly, classifications have often been labeled either phylogenetic or evolutionary, depending mainly upon whether or not they reject paraphyletic groups [3, 4].

While the type of classification to be used to support further exploration and analysis of any biological scenario may be important, it is not the subject of this paper. The proposed classification does not address detailed phylogenetic questions and, while hierarchical and reflective of phylogeny, is not itself a phylogenetic tree. The aim of this classification is to be a pragmatic means of managing the ever-increasing knowledge of the diversity of life, its relationships, characteristics, and properties. Indeed, the past two decades have witnessed an explosion in biodiversity research and informatics, emphasizing the need for a quality list of accepted scientific names of the more than 1.9 million described living species [5] and for greater consensus on how to classify them at higher taxonomic ranks. Since 2001, Species 2000 and the Integrated Taxonomic Information System (ITIS) have worked with their respective contributors to complete a comprehensive species list, called the Catalogue of Life (CoL). The CoL Annual Checklist (http://www.catalogueoflife.org/annual-checklist/2014/) already contains more than 1.6 million valid or accepted species names provided by more than 140 taxonomic databases involving more than 3,000 taxonomists [6]. More than 82% of the global species databases are provided at the rank of class or below (includes 1.3 million species), and more than 63% are provided at the rank of order or below (includes 1.0 million species). Owing to the heterogeneity in higher level classification among the contributed databases, the CoL managers sought a practical and coherent hierarchical classification that could serve as a framework for data integration. Here we explain the rationale behind the consensus higher level classification that we propose for CoL use.

Our goal, therefore, is to provide a hierarchical classification for the CoL and its contributors that (a) is ranked to encompass ordinal-level taxa to facilitate a seamless import of contributing databases; (b) serves the needs of the diverse public-domain user community, most of whom are familiar with the Linnaean conceptual system of ordering taxon relationships; and (c) is likely to be more or less stable for the next five years. Such a modern comprehensive hierarchy did not previously exist at this level of specificity. In this sense it summarizes overarching aspects of the tree of life, including both paraphyletic and monophyletic groups, both being important in facilitating meaningful communication among scientists and between the scientific community and society.

The most recent higher level classification to this level was published more than 30 years ago, before the advent of modern molecular analysis [7]. Beyond the immediate use for CoL, the hierarchy is valuable as a reference for taxonomic and biodiversity research, as a tool for societal communication, and as a stable classificatory "backbone" for biodiversity databases, museum collections, libraries, and textbooks, to name a few applications.

Approach

When Linnaeus introduced his novel "system of nature" in the mid-18th century, he recognized three kingdoms of nature: *Regnum Vegetabile* (plants), *Regnum Animale* (animals), and *Regnum Lapideum* (minerals) that has long since been abandoned. However, as is evident from the title of his work, he introduced lower level taxonomic categories (named class, order, genus, and species), each successively nested within higher ranked categories. Linnaeus' system has proven to be robust for more than 250 years (see the comprehensive discussion and suggestions for dealing with potential conflicts in Vences *et al.* [8]). In modern-day classifications, the starting point for botanical names is Linnaeus' *Species Plantarum* [9] and for zoological names it is the tenth edition of the *Systema Naturae* [10]. Since Linnaeus, the expansion of knowledge and the increase in the number of described species has required an expansion of the number of hierarchical levels (ranks) within the system. The categories of family and phylum (or division) were introduced in the early 19th century and many intermediate categories have been added since. There is currently little agreement about the general names for categories above that of kingdom; here we use superkingdom rather than empire or domain. In addition, there are three separate codes that govern the assignment and use of scientific names, each with different requirements and terminology and consequences for their classifications. For algae, fungi, and plants (ICN: *International Code of Nomenclature for algae, fungi, and plants*), the principle of priority does not apply above rank of family; for animals (ICZN: *International Code of Zoological Nomenclature*), priority does not apply above the family-group ranks; and for prokaryotes other than Cyanobacteria (ICNB: *International Code of Nomenclature of Bacteria*), only the categories ranked as class and below are covered by the code. A recent paper by the International Committee on Bionomenclature compares terminology among six current nomenclatural codes and makes recommendations for their use in improving communication [11].

In 2005, on behalf of the International Society of Protistologists, Adl et al. [12] presented a nested eukaryote-only cladification that used the names of six supergroups—Amoebozoa, Opisthokonta, Rhizaria, Excavata, Chromalveolata, and Archaeplastida (= Plantae) [13–17]—as the highest ranked eukaryote groups. Their schema was updated in 2012 [18], with Rhizaria and Chromalveolata replaced by SAR plus four small hacrobian groups. Although these taxa are nested, and ranked by a "bulleted" system, Adl et al. avoided the use of Linnaean higher category names (phylum, class, order, family) that would have more usefully denoted rank. Insofar as the nested groups comprise a mix of taxon names based on priority (i.e., according to the year of introduction of the name), many individual genera as well as traditional taxon names (family through class) end up having the same rank in the Adl et al. hierarchy, while at the same time having different suffixes or none at all. The ranks assigned therein often seem to reflect our present partial ignorance of relationships more than careful assessment of relative phenotypic disparity as in Linnaean taxonomy. This is very confusing when these "group names" (genus to kingdom) are used in isolation without regard to phylogenetic relativity. Two of the great benefits of Linnaean-ranked categories and their standardized suffixes are that they instantly relativize taxa that are otherwise unknown to the non-specialist and also indicate the relative degree of phenotypic distinctiveness amongst groups. The overarching higher level classification used by the CoL, therefore, uses the standard formal categories, as it is intended to be simultaneously pragmatic and informative of both evolutionary relatedness and relative phylogenetic subordination. A classification should be biologically well-grounded and widely useful. In its simplicity, it provides less detail about relationships than a complete phylogeny but is still congruent with it [19]. Our classification is not intended to compete with a cladification such as Adl et al.'s—both are valid ways of ordering the living

world—but we would argue that their's is less comprehensible to many in the public-domain user communities.

These actual complexities of phylogenetic history emphasize that classification is a practical human enterprise where compromises must be made [20]. We have therefore named only groups generally considered to have had a monophyletic origin, even though some of them may be paraphyletic (i.e., do not include all descendants of their last common ancestor) and others, e.g., Euglenozoa, Rhizaria, Cercozoa, include subgroups (such as Euglenophyceae, Chlorarachnea, and *Paulinella*) that evolved by the symbiogenetic merger of two fundamentally different lineages [21], while others have had infusions of genes from elsewhere [22] and therefore do not conform to any purely formal definition of monophyly. We have not adopted the view that one should never accept paraphyletic groups in a classification but rather have evaluated each case of paraphyly on its practicability and usage. In some cases (e.g., classical bryophytes) we accepted the splitting of paraphyletic taxa into holophyletic groups (groups with a monophyletic origin that also include all descendants of their last common ancestor, i.e., clades). In others we retained ancestral (paraphyletic) taxa when it seemed beneficial to do so (e.g., Prokaryota, Protozoa, Crustacea, Sarcopterygii, Reptilia). For practical purposes we treat Proteobacteria and Cyanobacteria as holophyletic phyla even though both exclude their mitochondrial and chloroplast descendants, neither of which is now a bacterium but an evolutionarily chimaeric cell organelle. We have conservatively retained several groups where evidence for paraphyly or holophyly is contradictory, such as Archaea (Archaebacteria).

A panel of experts representing the major taxonomic disciplines was convened to review, revise, and update the existing incomplete CoL hierarchy. These authors consulted more than 200 sources (see S1 Appendix), most of which were from recent taxonomic publications and websites. The product is a current and practical classification that meets the panel's established goal. In achieving a consensus, the panel was required to make some compromises that may require future revision as the related issues are resolved. While all of these individuals made contributions to the hierarchy, not all necessarily endorse every aspect of it. The CoL classification will undergo review and revision at five-year intervals to consider changes as necessary.

Results and Discussion

We are proposing a two-superkingdom (Prokaryota and Eukaryota), seven-kingdom classification that is a practical extension of Cavalier-Smith's six-kingdom schema [19]; the latter has been used, for example, in the compendious checklist of marine biota of Chinese seas [23] and in the first comprehensive national inventory of biodiversity for New Zealand [24–26]. For each of these kingdoms we had to exercise our taxonomic judgment and reach a practical compromise among diverse opinions and usages and conflicting evidence about certain phylogenetic questions important for defining the boundaries between and ranks of major taxa, including kingdoms. Our schema includes: the prokaryotic kingdoms Archaea (Archaebacteria) and Bacteria (Eubacteria), and the eukaryotic kingdoms Protozoa, Chromista, Fungi, Plantae, and Animalia. We have retained 14 ranks from superkingdom to order (Table 1). Several key taxonomic issues, some not fully resolved, are discussed below.

Prokaryota

The higher classification of prokaryotes is still somewhat unsettled. Woese and Fox [27] treated Archaebacteria (Archaea) and Eubacteria (Bacteria) as separate kingdoms. Margulis and Schwartz [28] recognized the superkingdom Prokarya, containing one kingdom Bacteria that

Table 1. List of ranks used in the hierarchy with the number of taxa per rank.

Rank	Number of Taxa
Superkingdom	2
Kingdom	**7**
Subkingdom	11
Infrakingdom	8
Superphylum	6
Phylum	**96**
Subphylum	60
Infraphylum	4
Superclass	12
Class	**351**
Subclass	145
Infraclass	23
Superorder	52
Order	**1,467**

Main ranks are in bold type; unnamed taxa are not counted.

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included a subkingdom Archaea; Cavalier-Smith also treated Archaebacteria and Eubacteria as prokaryote subkingdoms [19, 29]. Commonly used sources of prokaryote names, such as the List of Prokaryotic Names with Standing in Nomenclature (LPSN) [30] and the Taxonomic Outline of Bacteria and Archaea (TOBA) [31] treat Bacteria and Archaea as separate domains but are silent about the category of kingdom. While these sources list the names of phyla in common use as a service to the user, they are not validly published under the ICNB. We have not placed phylum names in quotation marks as they have but we have so designated a few prokaryote names at lower ranks that are in common use but not (or not yet) valid. As no prokaryote names above the ranks of class are covered by ICNB rules, there is no official higher classification of prokaryotes [32] and any attempt at such is necessarily difficult. We have chosen to adopt the classification in current use by the Catalogue of Life. It is derived from the TOBA and recognizes Bacteria and Archaea as equivalent in rank to the eukaryote kingdoms. We treat them as *de facto* kingdoms until there is a better resolution of their status. The number of negibacterial "phyla" currently recognized [30] is probably excessive compared with eukaryotes and mainly reflects uncertainty about the true relationships of many small phyla, probably exaggerating the significance of their biological disparity. Greater use of multigene trees rather than over reliance on rRNA gene trees alone may eventually allow further simplification by grouping them into fewer phyla, possibly only about half the present number [28].

Protozoa and Chromista

Unicellular eukaryotes, usually called protists, comprise a polyphyletic group of eukaryotes that do not undergo tissue formation through the process of embryological layering. They include ancestrally unicellular eukaryotes directly descended from bacteria by the origin of the nucleus, endomembrane, cytoskeleton, and mitochondria. Assigning them to separate kingdoms was historically difficult when only light microscopy was available but is now

considerably facilitated because of advances in electron microscopy and gene sequencing. Formerly, the unicellular amoeboid group Myxozoa with multicellular spores was included in Protozoa but these protists are now firmly within the animal kingdom, having been proven to be greatly simplified parasitic animals. Yeasts are unicellular fungi that evolved polyphyletically from multicellular filamentous ancestors and are assigned to one of three higher fungal phyla. Microsporidia are highly reduced intracellular parasites traditionally considered to be Protozoa, but they have been known for two decades to be related to Fungi. At one time it was thought microsporidia had evolved from Fungi and therefore were placed in that kingdom [19, 33]. For several years multigene trees were contradictory about whether microsporidia branched within or diverged from Fungi. The latest evidence is that they are most closely related to rozellids [34], which also have been treated either as Fungi or Protozoa. If this recent phylogeny [34] is correct, both should be in the same kingdom. Here we take the view that the best demarcation between Protozoa and Fungi lies immediately before the origin of the chitinous wall around vegetative fungal cells and associated loss of phagotrophy [33]. We therefore include microsporidia and rozellids in Protozoa (vegetatively wall-less, typically phagotrophs) not Fungi (vegetatively walled osmotrophs).

For decades, taxonomists have debated the boundary between Protozoa and Plantae. We accept the view that it should be placed just prior to the evolutionary origin of chloroplasts and that Plantae should comprise all eukaryotes with plastids directly descending from the initially enslaved cyanobacterium, i.e., Viridiplantae (green plants), Rhodophyta (red algae), and Glaucophyta (glaucophyte algae), but exclude those like chromists that got their chloroplasts from plants secondarily by subsequent eukaryote-to-eukaryote lateral transfers. Therefore, all green algae are included in Viridiplantae and Plantae and are excluded from Protozoa. The only photosynthetic Protozoa are Euglenophyceae, which obtained their chloroplasts subsequently from an enslaved green alga [21].

The boundary between Protozoa and Chromista has been more controversial. Chromista was established to include all chromophyte algae (those with chlorophyll *c*, not *b*) considered to have evolved by symbiogenetic enslavement of another eukaryote (a red alga) as well as all heterotrophic protists descended from them by loss of photosynthesis or entire plastids [35]. With phylogenetic advances it has become clearer that alveolates (once considered Protozoa) are related to chromistan heterokont algae (and related heterotrophic heterokonts) and more distantly to Rhizaria, the three together forming the major group Harosa (equivalent to SAR). Consequently, Chromista has been greatly expanded to include all Harosa as well as other former protozoa that turned out to be related to haptophytes or cryptophytes. Chromista now includes many groups once treated as Protozoa [19], an expansion followed here. In multigene trees, this expansion is the most difficult part of the entire eukaryote tree to resolve. They sometimes show one or both of Plantae and Chromista as a clade but often their major subgroups are intermingled in contradictory ways [36, 37]. This may be a consequence of the eukaryote-eukaryote chimaeric history of chromists that acquired some genes from red algae or of the very rapid basal radiation of the robust corticate clade (i.e. Plantae plus Chromista). Because of this, some question whether Chromista represents a clade, yet trees are still too poorly resolved to eliminate the likelihood from cell evolutionary considerations that Chromista and Plantae are genuinely distinct sister clades. Evidence that Harosa is a clade is very strong. Evidence that Haptista plus Cryptista are a clade Hacrobia is strong on some trees but questioned by others [37].

Protozoa, like Prokaryota, is certainly a paraphyletic taxon [38]; Animalia, Fungi, Plantae, and Chromista all evolved from it. In our hierarchy Protozoa comprises seven phyla, of which

four are probably clades and three paraphyletic. We do not consider it useful in a general classification to subdivide the paraphyletic phyla into numerous smaller ones, often with only a handful of species that most have never heard of, even though a few specialists might favor that despite their constituent subgroups not differing radically in cell structure. For both Protozoa and Chromista we have favored large groups with shared body plans, analogous to extremely diverse animal phyla like Chordata and Arthropoda. The higher proportion of ancestral (paraphyletic) phyla in Protozoa compared with terminal groups like animals and plants is unsurprising because they were the first eukaryotes and they diverged early on but with many fewer associated major changes in body plan than occurred during the much later radiation of bilateral animals. Distinct early diverging protozoan clades can be remarkably similar morphologically and biologically [39].

Fungi

As stated earlier, we take the view that the best demarcation between Protozoa and Fungi lies immediately before the origin of the chitinous wall around vegetative fungal cells and associated loss of phagotrophy. We use an updated version of the higher classification presented in the 10th Edition of the *Dictionary of Fungi* [40]. The evolutionarily convergent Oomycetes such as the serious pest *Phytophthora*, formerly treated as Fungi, belong instead in phylum Pseudofungi of the heterokont Chromista.

Plantae

As with the other kingdoms, Plantae is classified in a variety of ways. Margulis and Schwartz [28] restricted Plantae to land plants (embryophytes or higher plants) and popularized the use of kingdom Protoctista to include lower plants (green, red, and glaucophyte algae) and lower Fungi as well as chromists with classical protozoa. Many now consider such a kingdom too broad and heterogeneous and the associated separation of lower and higher plants in different kingdoms to be undesirable. Now taxonomists almost universally classify lower and higher plants together in the single kingdom Plantae and lower and higher fungi within the single kingdom Fungi. We have adopted this delimitation of Plantae here [19, 35] (for which Archaeplastida [12, 18] is a less familiar recent synonym). The structure of plastid genomes and the derived chloroplast protein-import machinery support a single origin of glaucophytes, red algae, green algae, and embryophytes (land plants). The ancestral embryophyte is thought to have originated from relatives of the Charales (stoneworts) or Coleochaetales (Charophyta). Jeffrey [41] first grouped charophytes and embryophytes as a clade Streptophyta, which was later validated as a superphylum [42] and reduced to phylum by Bremer [43].

Chase and Reveal [44] published a phylogenetic classification of land plants, reasoning that "If the major clades of green algae are recognized as classes, then all land plants, the embryophytes, should be included in a single class, here recognized as Equisetopsida." This argument, however, overemphasizes cladistic level compared with phenotypic disparity, and is contrary to traditional assignment of phylum (or division) status to the main bryophyte, "pteridophyte" and seed-plant subgroups. This latter treatment was exemplified in the 2008 Annual Checklist of the CoL, which listed three bryophyte phyla, four pteridophyte phyla, and five seed-plant phyla, reflecting the arrangement found in many university textbooks of the late 20th century and in Margulis and Schwartz's *Five Kingdoms* [28]. Here we recognize four embryophyte phyla—three of bryophytes (liverworts, hornworts, and mosses) and a single phylum Tracheophyta for vascular plants—with all species characterized by a diploid phase having xylem and phloem. Bryophyte specialists tend to treat each of the three major bryophyte groups as phyla—Marchantiophyta, Anthocerotophyta, Bryophyta [45, 46]. We have chosen a

conservative approach to the higher classification of plants, largely consistent with Mabberley [47] for the embryophyte ranks above class, while using Chase and Reveal [44] and Stevens [48] for the lower ranks.

Animalia (Metazoa)

The numbers of phyla and classes with extant species in kingdom Animalia differ according to molecular and morphological partitioning in phylogenies [49–59] as well as the preferred treatments of specialists of particular traditional phyla and where to "draw the line" between related taxa and how to rank them—the ranking of phylum versus subphylum is sometimes rather subjective. Based on the contributions of taxonomic experts to an outline of higher level classification and survey of taxonomic richness [60, 61], as many as 39 animal phyla might be recognized (more, if Porifera were abandoned as a phylum and constituent major clades given higher rank [62]). Below we discuss some issues encountered in arriving at decisions for our proposed classification, which accepts 34 animal phyla.

(1) Porifera—one phylum or three? Nielsen [62] argued that 'The three apparently monophyletic sponge groups Silicea, Calcarea, and Homoscleromorpha do not constitute a monophyletic group, and the "phylum Porifera" thus has to be abandoned.' More recent studies alternatively support paraphyly [63] or holophyly [58, 64] of sponges. Until the issue is resolved, we will follow the Porifera community [65–67] in retaining one phylum Porifera with four classes.

(2) Status of Myxozoa. Recent work on the vermiform myxozoan *Buddenbrockia* has demonstrated conclusively that myxozoans are extremely simplified Cnidaria, possibly Medusozoa [68, 69]. We classify Myxozoa as a subphylum of Phylum Cnidaria.

(3) Flatworms—monophyletic or not? In 1995, Nielsen [70] wrote "The delimitation of the phylum [Platyhelminthes] is not much in question," but recent molecular analyses, combined with a careful reconsideration of morphology and anatomy, have confused the classification of Platyhelminthes, affecting particularly Acoela, *Xenoturbella*, and Nemertodermatida. Egger *et al.* [71] reviewed the evidence, noting the contrast between morphological and phylogenomic data. Whereas the stem-cell system and the mode of replacing epidermal cells unite both Acoela and Rhabditophora and are not found in any other bilaterian lineage, phylogenomic data support a separation of these two groups, a conclusion reached by Philippe *et al.* [72] based on mitochondrial genes, a phylogenomic data set of 38,330 amino-acid positions, and miRNA complements. We follow Philippe *et al.* [72] and Tyler and Schilling [73] in uniting Acoela, *Xenoturbella*, and Nemertodermatida as the deuterostome phylum Xenacoelomorpha. The remaining internal classification of Platyhelminthes is also somewhat problematic. We propose a classification that is based in part on Riutort *et al.* [74] and Tyler [75].

(4) Phylum Gnathifera or phyla Acanthocephala, Gnathostomulida, Micrognathozoa, and Rotifera? Until recently, all four of these groups were commonly treated as separate phyla [28, 61, 76–80]. However, numerous recent molecular and morphological analyses nest Acanthocephala within Rotifera [81–86]. A syncytial epidermis links rotifers, *Seison* and Acanthocephala; Ahlrichs [87, 88] proposed Syndermata for this clade. As revealed by transmission electron microscopy [89] and scanning electron microscopy [90], the jaw apparatus of gnathostomulids and rotifers is remarkably similar. That of *Seison* is less obviously homologous [91] and the Seisonidea may have diverged from rotifers at an early stage of their evolution. On the other hand, *Seison* has similar sperm to acanthocephalans and the epidermis of both groups contains bundles of filaments. *Limnognathia maerski*, representing a new category of organism (Micrognathozoa) from cold fresh waters in Greenland and the Crozet Islands [92, 93], has a remarkable jaw apparatus (the most complicated known among invertebrates) with

clear homologies, in both the jaw elements and musculature, with the trophi in Rotifera and the jaws in Gnathostomulida. The jaw apparatus and musculature, as well as molecular analyses, unite these taxa as a clade known as Gnathifera (see [86, 92]). In the analysis by Giribet *et al.* [94], the issue remained unresolved, as Micrognathozoa appeared independent of Gnathostomulida and Rotifera, with unclear affiliation. Edgecombe et al. [59] and Nielsen [95] retain phylum status for Gnathostomulida, Micrognathozoa, and Rotifera but not Acanthocephala. We treat each of the major gnathiferan groups as a phylum, including Acanthocephala, following Monks and Richardson [79], though some of us think that the number of gnathiferan phyla ought to be substantially reduced when their phylogeny, including ingroup relationships of Rotifera sensu lato, is more firmly established.

(5) The scalidophoran phyla Adrianov and Malakhov [96] erected phylum Cephalorhyncha for Kinorhyncha, Loricifera, Priapula, and Nematomorpha. The first three of these phyla have in common an eversible snout (introvert) with scalid spines and inner and outer retractor muscles, a similar excretory filter (protonephridium), and similar sense organs, providing strong justification for uniting them in a single clade, the Scalidophora [97]. There is also molecular support, though not unanimity, for a clade of Kinorhyncha, Loricifera, and Priapula, known as Scalidophora. On the other hand, Kinorhyncha has internal and external body segmentation lacking in the other groups. Neuhaus and Higgins [98] noted that conflicting evidence exists for every one of the possible sister-group relationships among these phyla and prefer to keep them separate in a superphylum Scalidophora (which is preferred over Cephalorhyncha, the latter name originally including the Nematomorpha). We recommend separate scalidophoran phyla, though the number might be greatly reduced when the phylogeny becomes clearer.

(6) The chordate subphyla Cephalochordata and Urochordata Some sequence analyses have questioned the monophyly of Chordata [99, 100]. Nielsen [95] maintains Urochordata (or Tunicata) and Cephalochordata as separate phyla, whereas the group Urochordata is closer to Vertebrata (craniates), in a clade Olfactores, than Cephalochordata. We retain all three groups as traditional chordate subphyla.

Many users of classifications would prefer a stable, unchanging system. Yet classifications are syntheses of biological knowledge, particularly contemporary phylogenetic understanding of taxa, that must be regularly updated in accord with new scientific discoveries. Taxonomy must therefore navigate between the dual perils of ignoring important advances and making premature or unnecessary changes. We seek stability in nomenclature at the species level but at higher levels the concepts and compositions of major taxa, and therefore the scope of well-known names, must inevitably shift as new organisms are discovered and evolutionary affinities are better understood. The fact that we have been able to agree on a practical unified classification shows that taxonomists can broadly agree, despite the diverse experiences, viewpoints, and to some extent, differing philosophies of classification represented on our panel. The present classification (as, indeed, all classifications) should be regarded as interim, and it will inevitably change in certain respects, some hinted at above. However, we suspect that the recent torrent of radical re-evaluations (resulting especially from the application of DNA sequencing and other new techniques) may lessen as time passes. We hope that this unusually comprehensive classification will be widely useful and provide a sound basis for further improvement. A complete proposed classification from superkingdom to order is provided in Table 2 and is available for download at <http://www.catalogueoflife.org/col/>. Below the rank of infrakingdom, we have followed the convention used in the Catalogue of Life and listed taxon names alphabetically. This allows easier searching by those not familiar with the phylogenies of

Table 2. Proposed hierarchical classification from superkingdom to order.

SUPERKINGDOM PROKARYOTA			
KINGDOM ARCHAEA [= ARCHAEBACTERIA]			
	Phylum Crenarchaeota		
		Class “Aigarchaeota”	
			Order N.N. ("*Ca*. *Caldiarchaeum*")
		Class “Korarchaeota”	
			Order N.N. ("*Ca*. *Korarchaeum*")
		Class “Thaumarchaeota”	
			Order Cenarchaeales
		Class Thermoprotei [= Crenarchaeota]	
			Order Acidilobales
			Order Desulfurococcales
			Order Fervidicoccales
			Order Sulfolobales
			Order Thermoproteales
	Phylum Euryarchaeota		
		Class Archaeoglobi	
			Order Archaeoglobales
		Class Halobacteria	
			Order Halobacteriales
		Class Methanobacteria	
			Order Methanobacteriales
		Class Methanococci	
			Order Methanococcales
		Class “Methanomicrobia”	
			Order N.N. (*Methanocalculus*)
			Order Methanocellales
			Order Methanomicrobiales
			Order Methanosarcinales
		Class Methanopyri	
			Order Methanopyrales
		Class “Nanohaloarchaea”	
			Order N.N. (e.g., "*Ca*. *Nanosalinarum*")
		Class Thermococci	
			Order Thermococcales
		Class Thermoplasmata	
			Order Thermoplasmatales
KINGDOM BACTERIA [= EUBACTERIA]			
SUBKINGDOM NEGIBACTERIA			
	Phylum Acidobacteria		
		Class N.N. (*Bryobacter*)	
		Class Acidobacteria	
			Order Acidobacteriales
		Class Holophagae	
			Order Acanthopleuribacterales
			Order Holophagales
	Phylum Aquificae		
		Class Aquificae	
			Order Aquificales
	Phylum Armatimonadetes		

(*Continued*)

Table 2. (*Continued*)

	Class Armatimonadia	
		Order Armatimonadales
	Class Chthonomonadetes	
		Order Chthonomonadales
	Class Fimbriimonadia	
		Order Fimbriimonadales
Phylum Bacteroidetes		
	Class Bacteroidia	
		Order Bacteroidales
	Class Cytophagia	
		Order Cytophagales
	Class Flavobacteria	
		Order Flavobacteriales
	Class Sphingobacteriia	
		Order Sphingobacteriales
Phylum Caldiserica		
	Class Caldisericia	
		Order Caldisericales
Phylum Chlamydiae		
	Class Chlamydiae	
		Order Chlamydiales
Phylum Chlorobi		
	Class Chlorobia	
		Order Chlorobiales
	Class Ignavibacteria	
		Order Ignavibacteriales
Phylum Chrysiogenetes		
	Class Chrysiogenetes	
		Order Chrysiogenales
Phylum Cyanobacteria [= Cyanophyta]		
	Class Cyanophyceae [= Phycobacteria]	
		Order Chroococcales
		Order Nostocales
		Order Oscillatoriales
		Order Pseudoanabaeniales
		Order Synechococcales
	Class Gloeobacteria [= Gloeobacterophyceae]	
		Order Gloeobacterales
Phylum Deferribacteres		
	Class Deferribacteres	
		Order Deferribacterales
Phylum Deinococcus-Thermus [= Hadobacteria]		
	Class Deinococci	
		Order Deinococcales
		Order Thermales
Phylum Dictyoglomi		
	Class Dictyoglomia	
		Order Dictyoglomales
Phylum Elusimicrobia		
	Class Elusimicrobia	

(*Continued*)

Table 2. (*Continued*)

		Order Elusimicrobiales
Phylum Fibrobacteres		
	Class Fibrobacteria	
		Order Fibrobacterales
Phylum Fusobacteria		
	Class Fusobacteriia	
		Order Fusobacteriales
Phylum Gemmatimonadetes		
	Class Gemmatimonadetes	
		Order Gemmatimonadales
Phylum Lentisphaerae		
	Class Lentisphaeria	
		Order Lentisphaerales
		Order Victivallales
	Class Oligosphaeria	
		Order Oligosphaerales
Phylum Nitrospira		
	Class "Nitrospira"	
		Order "Nitrospirales"
Phylum Planctomycetes		
	Class Phycisphaerae	
		Order Phycisphaerales
	Class Planctomycea	
		Order Planctomycetales
Phylum Proteobacteria		
	Class Alphaproteobacteria	
		Order N.N. (e.g., *Breoghania*)
		Order Caulobacterales
		Order Kiloniellales
		Order Kordiimonadales
		Order Magnetococcales
		Order “Parvularculales”
		Order Rhizobiales
		Order Rhodobacterales
		Order Rhodospirillales
		Order Rickettsiales
		Order Sneathiellales
		Order Sphingomonadales
	Class Betaproteobacteria	
		Order N.N. (*Chitinivorax*)
		Order Burkholderiales
		Order Hydrogenophilales
		Order Methylophilales
		Order Neisseriales
		Order Nitrosomonadales
		Order "Procabacteriales"
		Order Rhodocyclales
	Class Deltaproteobacteria	
		Order N.N. (e.g., *Deferrisoma*)
		Order Bdellovibrionales

(*Continued*)

Table 2. (*Continued*)

			Order Desulfarculales
			Order Desulfobacterales
			Order Desulfovibrionales
			Order Desulfurellales
			Order Desulfuromonadales
			Order Myxococcales
			Order Syntrophobacterales
		Class Epsilonproteobacteria	
			Order Campylobacterales
			Order Nautiliales
		Class Gammaproteobacteria	
			Order N.N. (e.g., *Alkalimonas*)
			Order Acidithiobacillales
			Order Aeromonadales
			Order Alteromonadales
			Order Cardiobacteriales
			Order Chromatiales
			Order “Enterobacteriales”
			Order Legionellales
			Order Methylococcales
			Order Oceanospirillales
			Order Orbales
			Order Pasteurellales
			Order Pseudomonadales
			Order “Salinisphaerales”
			Order Thiotrichales
			Order “Vibrionales”
			Order Xanthomonadales
		Class Zetaproteobacteria	
			Order Mariprofundales
	Phylum Spirochaetae		
		Class "Spirochaetes"	
			Order Spirochaetales
	Phylum Synergistetes		
		Class Synergistia	
			Order Synergistales
	Phylum Thermodesulfobacteria		
		Class Thermodesulfobacteria	
			Order Thermodesulfobacteriales
	Phylum Thermotogae		
		Class Thermotogae	
			Order Thermotogales
	Phylum Verrucomicrobia		
		Class Opitutae	
			Order Opitutales
			Order Puniceicoccales
		Class Verrucomicrobiae	
			Order Verrucomicrobiales
SUBKINGDOM POSIBACTERIA			

(*Continued*)

Table 2. (*Continued*)

Phylum Actinobacteria		
	Class Actinobacteria	
		Order Acidimicrobiales
		Order Actinomycetales
		Order Bifidobacteriales
		Order Coriobacteriales
		Order Euzebyales
		Order Gaiellales
		Order Nitriliruptorales
		Order Rubrobacterales
		Order Solirubrobacterales
		Order Thermoleophilales
Phylum Chloroflexi [= Chlorobacteria]		
	Class Anaerolineae	
		Order Anaerolineales
	Class Caldilineae	
		Order Caldilineales
	Class Chloroflexia	
		Order Chloroflexales
		Order Herpetosiphonales
	Class Dehalococcoidia	
		Order Dehalococcoidales
	Class Ktedonobacteria	
		Order Ktedonobacterales
		Order Thermogemmatisporales
	Class Thermomicrobia	
		Order Sphaerobacterales
		Order Thermomicrobiales
Phylum Firmicutes		
	Class Bacilli	
		Order Bacillales
		Order Lactobacillales
	Class Clostridia	
		Order Clostridiales
		Order Halanaerobiales
		Order Natranaerobiales
		Order Thermoanaerobacterales
	Class Erysipelotrichia	
		Order Erysipelotrichales
	Class Negativicutes	
		Order Selenomonadales
	Class Thermolithobacteria	
		Order Thermolithobacterales
Phylum Tenericutes		
	Class Mollicutes	
		Order Acholeplasmatales
		Order Anaeroplasmatales
		Order Entomoplasmatales
		Order Haloplasmatales
		Order Mycoplasmatales

(*Continued*)

Table 2. (*Continued*)

SUPERKINGDOM EUKARYOTA		
KINGDOM PROTOZOA		
SUBKINGDOM EOZOA		
INFRAKINGDOM EUGLENOZOA		
Phylum Euglenozoa		
Subphylum N.N.		
	Class Diplonemea	
		Order Diplonemida
	Class Kinetoplastea	
		Order Bodonida
		Order Prokinetoplastida
		Order Trypanosomatida
Subphylum Euglenoida		
	Class N.N.	
		Order Petalomonadida
		Order Ploeotiida
	Class Euglenophyceae	
		Order Euglenida
		Order Eutreptiida
	Class Peranemea	
		Order Heteronemida
		Order Peranemida
		Order Rhabdomonadida
Subphylum Symbiontida		
	Class Postgaardea	
		Order Postgaardida
INFRAKINGDOM EXCAVATA		
Phylum Loukozoa		
Subphylum Eolouka		
	Class Jakobea	
		Order Jakobida
	Class Tsukubea	
		Order Tsukubamonadida
Subphylum Neolouka		
	Class Malawimonadea	
		Order Malawimonadida
Phylum Metamonada		
	Class Anaeromonadea	
		Order Oxymonadida
		Order Trimastigida
	Class Carpomonadea	
		Order Carpediemonadida
		Order Chilomastigida
		Order Dysnectida
	Class Eopharyngea	
		Order Diplomonadida
		Order Retortamonadida
	Class Trichomonadea	
		Order Cristamonadida
		Order Spirotrichonymphida

(*Continued*)

Table 2. (*Continued*)

			Order Trichomonadida
			Order Tritrichomonadida
		Class Trichonymphea	
			Order Lophomonadida
			Order Trichonymphida
	Phylum Percolozoa		
	Subphylum Pharyngomonada		
		Class Pharyngomonadea	
			Order Pharyngomonadida
	Subphylum Tetramitia		
		Class Heterolobosea	
			Order Acrasida
			Order Schizopyrenida
		Class Lyromonadea	
			Order Lyromonadida
		Class Percolatea	
			Order Percolomonadida
			Order Pseudociliatida
SUBKINGDOM SARCOMASTIGOTA			
	Phylum Amoebozoa		
	Subphylum Conosa		
		Class Archamoebea	
			Order Mastigamoebida
			Order Pelobiontida
			Order Rhizomastigida
		Class Dictyostelea	
			Order Dictyostelida
		Class Myxogastrea [= Myxomycetes]	
		Subclass Exosporeae	
			Order Ceratiomyxida
		Subclass Myxogastria	
			Superorder Columelida
			Order Echinosteliida
			Order Fuscisporida
			Superorder Lucisporida
			Order Liceida
			Order Trichiida
		Class Protostelea	
			Order Protostelida
		Class Variosea	
			Order Artodiscida
			Order Holomastigida
			Order Phalansteriida
			Order Varipodida
	Subphylum Lobosa		
		Class Discosea	
		Subclass Flabellinia	
			Order Dactylopodida
			Order Himatismenida
			Order Pellitida

(*Continued*)

Table 2. (*Continued*)

		Order Stygamoebida
		Order Trichosida
		Order Vanellida
	Subclass Longamoebia	
		Order Dermamoebida
		Order Centramoebida
		Order Thecamoebida
	Class Tubulinea [= Lobosea]	
		Order Arcellinida
		Order Echinamoebida
		Order Euamoebida
		Order Leptomyxida
		Order Nolandida
Phylum Choanozoa [with Microsporidia, Animalia, and Fungi constitutes "Supergroup Opisthokonta"]		
Subphylum Choanofila		
	Class Choanoflagellatea	
		Order Acanthoecida
		Order Craspedida
	Class Corallochytrea	
		Order Corallochytrida
	Class Filasterea	
		Order Ministeriida
	Class Ichthyosporea	
		Order Dermocystida
		Order Eccrinida
Subphylum Paramycia		
	Class Aphelidea	
		Order Aphelidida
	Class Cristidiscoidea	
		Order Fonticulida
		Order Nucleariida
	Class Rozellidea	
		Order Rozellida
Phylum Microsporidia [with Choanozoa, Animalia, and Fungi constitutes "Supergroup Opisthokonta"]		
	Class Disporea	
		Order N.N. (e.g., *Nosema*)
	Class Metchnikovellea	
		Order Metchnikovellida
	Class Minisporea [= Microsporea]	
		Order Minisporida [= Minisporea]
	Class Pleistophorea	
		Order Pleistophorida
Phylum Sulcozoa		
Subphylum Apusozoa		
	Class Breviatea	
		Order Breviatida
	Class Thecomonadea	
		Order Apusomonadida
Subphylum Varisulca		
	Class Diphyllatea	

(*Continued*)

Table 2. (*Continued*)

			Order Diphylleida
		Class Glissodiscea	
			Order Mantamonadida
			Order Planomonadida
		Class Hilomonadea	
			Order Rigifilida
KINGDOM CHROMISTA			
SUBKINGDOM HACROBIA			
	Phylum N.N.		
		Class Endohelea	
			Order Heliomonadida
			Order Microhelida
		Class Picomonadea	
			Order Picomonadida
		Class Telonemea	
			Order Telonemida
	Phylum Cryptista		
	Subphylum Palpitia		
		Class Palpitea	
	Subphylum Rollomonadia		
		Class Cryptophyceae	
			Order Cryptomonadales
			Order Pyrenomonadales
			Order Tetragonidiales
		Class Goniomonadea	
			Order Goniomonadida
		Class Leucocryptea	
			Order Katablepharida
			Order Palpitida
	Phylum Haptophyta		
		Class Coccolithophyceae [= Prymnesiophyceae]	
			Order Coccolithales
			Order Coccosphaerales
			Order Isochrysidales
			Order Phaeocystales
			Order Prymnesiales
			Order Syracosphaerales
			Order Zygodiscales
		Class Pavlovophyceae	
			Order Pavlovales
	Phylum Heliozoa		
		Class Centrohelea	
			Order Acanthocystida
			Order Pterocystida
SUBKINGDOM HAROSA [= "Supergroup SAR"]			
INFRAKINGDOM HALVARIA			
Superphylum Alveolata			
	Phylum Ciliophora		
	Subphylum Intramacronucleata		
		Class Armophorea	

(*Continued*)

Table 2. (*Continued*)

		Order Armophorida
		Order Clevelandellida
	Class Colpodea	
		Order Bryometopida
		Order Bryophryida
		Order Bursariomorphida
		Order Colpodida
		Order Cyrtolophosidida
		Order Sorogenida
	Class Litostomatea	
	Subclass Haptoria	
		Order Cyclotrichiida
		Order Haptorida
		Order Pleurostomatida
	Subclass Trichostomatia	
		Order Entodiniomorphida
		Order Macropodiniida
		Order Vestibuliferida
	Class Spirotrichea	
	Subclass Choreotrichia	
		Order Tintinnida
	Subclass Hypotrichia	
		Order Euplotida
		Order Kiitrichida
	Subclass Licnophoria	
		Order Licnophorida
	Subclass Oligotrichia	
		Order Strombidiida
	Subclass Protocruziidia	
		Order Phacodiniida
		Order Protocruziida
	Subclass Stichotrichia	
		Order Sporadotrichida
		Order Stichotrichida
		Order Urostylida
	Class Nassophorea	
		Order Colpodidiida
		Order Microthoracida
		Order Nassulida
		Order Synhymeniida
	Class Oligohymenophorea	
	Subclass Apostomatia	
		Order Apostomatida
		Order Astomatophorida
		Order Pilisuctorida
	Subclass Astomatia	
		Order Astomatida
	Subclass Hymenostomatia	
		Order Ophyroglenida
		Order Tetrahymenida

(*Continued*)

Table 2. (*Continued*)

	Subclass Peniculia	
		Order Peniculida
		Order Urocentrida
	Subclass Peritrichia	
		Order Mobilida
		Order Sessilida
	Subclass Scuticociliatia	
		Order Philasterida
		Order Pleuronematida
		Order Thigmotrichida
	Class Phyllopharyngea	
	Subclass Chonotrichia	
		Order Cryptogemmida
		Order Exogemmiida
	Subclass Cyrtophoria	
		Order Chlamydodontida
		Order Dysteriida
	Subclass Rhynchodia	
		Order Hypocomatida
		Order Rhynchodida
	Subclass Suctoria	
		Order Endogenida
		Order Evaginogenida
		Order Exogenida
	Class Plagiopylea	
		Order Odontostomatida
		Order Plagiopylida
	Class Prostomatea	
		Order Prorodontida
		Order Prostomatida
Subphylum Postciliodesmatophora		
	Class Heterotrichea	
		Order Heterotrichida
	Class Karyorelictea	
		Order Loxodida
		Order Protoheterotrichida
		Order Protostomatida
Phylum Miozoa		
Subphylum Myzozoa		
Infraphylum Apicomplexa		
Superclass Apicomonada		
	Class Apicomonadea	
		Order Chromerida
		Order Colpodellida
		Order Voromonadida
Superclass Sporozoa		
	Class N.N.	
		Order Blastogregarinida
	Class Coccidiomorphea	
	Subclass Coccidea	

(*Continued*)

Table 2. (*Continued*)

		Order Agamococcidida
		Order Eimerida
		Order Ixorheida
	Subclass Coleotrophia	
		Order Coleotrophiida [= Protococciida]
	Subclass Hematozoa	
	Superorder Aconoidia	
		Order Nephromycida
		Order Piroplasmida
	Superorder Haemosporidia	
		Order Hemosporida
Class Gregarinomorphea		
	Subclass Cryptogragaria	
		Order Cryptogregarida (*Cryptosporidium*)
	Subclass Histogregaria	
		Order Histogregarida
	Subclass Orthogregarinia	
		Order Arthrogarida
		Order Vermigregarida
Class Paragregarea		
		Order Archigregarinida
		Order Stenophorida
		Order Velocida
Infraphylum Dinozoa		
Superclass Dinoflagellata		
Class Dinophyceae		
	Subclass N.N.	
		Order Actiniscales
		Order Blastodinales
		Order Coccidinales
		Order Dinamoebales
		Order Lophodinales
		Order Pyrocystales
		Order Thoracosphaerales
	Subclass Dinophysoidia	
		Order Dinophysidales
		Order Nannoceratopsales
	Subclass Gonyaulacoidia	
		Order Gonyaulacales
		Order Gymnodiniales
	Subclass Peridinoidia	
		Order Peridiniales
		Order Prorocentrales
	Subclass Suessioidia	
		Order Suessiales
Class Ellobiopsea		
		Order Ellobiopsida
Class Noctilucea		
		Order Noctilucida
Class Oxyrrhea		

(*Continued*)

Table 2. (*Continued*)

		Order Acrocoelida
		Order Oxyrrhida
	Class Syndinea	
		Order Rastrimonadida
		Order Syndinida
	Superclass Perkinsozoa	
	Class Myzomonadea	
		Order Algovorida
	Class Perkinsea	
		Order Perkinsida
		Order Phagodinida
	Subphylum Protalveolata	
	Class Colponemea	
		Order Colponemida
Superphylum Heterokonta [= "Supergroup Stramenopiles"]		
Phylum Bigyra		
	Class Bikosea	
		Order Anoecida
		Order Bicoecida
		Order Borokida
		Order Pseudodendromonadida
		Order Rictida
	Class Blastocystea	
		Order Blastocystida
	Class Nanomonadea	
		Order Uniciliatida
	Class Opalinea	
		Order Opalinida
		Order Proteromonadida
	Class Labyrinthulea	
		Order Labyrinthulida
		Order Thraustochytriida
	Class Placididea [= Placidiophyceae]	
		Order Placidiida
Phylum Ochrophyta [= Heterokontophyta p.p.]		
	Class Bacillariophyceae [= Diatomeae]	
	Subclass Bacillariophycidae	
		Order Achnanthales
		Order Bacillariales
		Order Cymbellales
		Order Dictyoneidales
		Order Eunotiales
		Order Eupodiscales
		Order Lyrellales
		Order Mastogloiales
		Order Naviculales
		Order Rhopalodiales
		Order Surirellales
		Order Thalassiophysales
	Subclass Coscinodiscophycidae	

(*Continued*)

Table 2. (*Continued*)

		Order Anaulales
		Order Arachnoidiscales
		Order Asterolamprales
		Order Aulacoseirales
		Order Biddulphiales
		Order Chaetocerotales
		Order Chrysanthemodiscales
		Order Corethrales
		Order Coscinodiscales
		Order Cymatosirales
		Order Ethmodiscales
		Order Hemiaulales
		Order Lithodesmiales
		Order Melosirales
		Order Orthoseirales
		Order Paraliales
		Order Rhizosoleniales
		Order Stictocyclales
		Order Stictodiscales
		Order Thalassiosirales
		Order Triceratiales
	Subclass Fragilariophycidae	
		Order Ardissoneales
		Order Climacospheniales
		Order Cyclophorales
		Order Fragilariales
		Order Licmophorales
		Order Protoraphidales
		Order Rhabdonematales
		Order Rhaphoneidales
		Order Striatellales
		Order Tabellariales
		Order Thalassionematales
		Order Toxariales
	Class Bolidophyceae	
		Order Parmales [= Bolidomonadales]
	Class Chrysomerophyceae	
		Order Chrysomeridales
	Class Chrysophyceae	
		Order Chloramoebales
		Order Chromulinales
		Order Chrysosphaerales
		Order Heterogloeales
		Order Hibberdiales
		Order Hydrurales
		Order Ochromonadales
		Order Paraphysomonadida
		Order Synurales
		Order Thallochrysidales
	Class Eustigmatophyceae	

(*Continued*)

Table 2. (*Continued*)

		Order Eustigmatales
	Class Dictyochophyceae [= Hypogyristea]	
		Order Dictyochales
		Order Olisthodiscales
		Order Pedinellales
		Order Pelagomonadales
		Order Sarcinochrysidales
	Class Phaeophyceae	
	Subclass Dictypophycidae	
		Order Dictyotales
		Order Onslowiales
		Order Sphacelariales
		Order Syringodermatales
	Subclass Discosporangiophycidae	
		Order Discosporangiales
	Subclass Fucophycidae	
		Order Ascoseirales
		Order Asterocladales
		Order Desmarestiales
		Order Ectocarpales
		Order Fucales
		Order Laminariales
		Order Nemodermatales
		Order Phaeosiphoniellales
		Order Ralfsiales
		Order Scytothamnales
		Order Sporochnales
		Order Tilopteridales [= Cutleriales]
	Subclass Ishigeophycidae	
		Order Ishigeales
	Class Phaeothamniophyceae [= Aurophyceae]	
		Order Aurearenales
		Order Phaeothamniales
	Class Picophagophyceae [= Picophagea]	
		Order Picophagales
		Order Synchromales
	Class Pinguiophyceae	
		Order Pinguiochrysidales
	Class Raphidophyceae	
		Order Actinophryida
		Order Commatiida
		Order Raphidomonadales
	Class Schizocladiophyceae	
		Order Schizocladiales
	Class Xanthophyceae	
		Order Mischococcales
		Order Pleurochloridellales
		Order Tribonematales
		Order Vaucheriales
Phylum Pseudofungi [= Oomycota]		

(*Continued*)

Table 2. (*Continued*)

	Class Bigyromonadea	
		Order Developayellida
	Class Hyphochytrea	
		Order Hyphochytriida
		Order Pirsoniida
	Class Oomycetes	
	Subclass Eogamia	
		Order Anisolpidiales
		Order Haptoglossales
		Order Lagenismatales
		Order Olpidiopsidales
		Order Rozellopsidales
	Subclass Peronosporidae	
		Order Peronosporales
		Order Pythiales
		Order Rhipidiales
	Subclass Saprolegniidae	
		Order Albuginales
		Order Leptomitales
		Order Salilagenidiales
		Order Saprolegniales
INFRAKINGDOM RHIZARIA		
Phylum Cercozoa		
Subphylum Endomyxa		
	Class Ascetosporea	
		Order Claustrosporida
		Order Haplosporida
		Order Paradinida
		Order Paramyxida
	Class Gromiidea	
		Order Gromiida
		Order Reticulosida
	Class Phytomyxea	
		Order Phagomyxida
		Order Plasmodiophorida
	Class Vampyrellidea	
		Order Vampyrellida
Subphylum Monadofilosa		
	Class Imbricatea	
	Subclass Placonuda	
		Order Discocelida
		Order Discomonadida
		Order Euglyphida
		Order Marimonadida
		Order Variglissida
	Subclass Placoperla	
		Order Perlofilida
		Order Rotosphaerida
		Order Spongomonadida
		Order Thaumatomonadida

(*Continued*)

Table 2. (*Continued*)

		Order Zoelucasida
	Class Metromonadea	
		Order Metopiida
		Order Metromonadida
	Class Sarcomonadea	
		Order Cercomonadida
		Order Glissomonadida
		Order Pansomonadida
		Order Pseudosporida
		Order Sainouroida
	Class Thecofilosea	
	Subclass Eothecia	
		Order Cryomonadida
		Order Ebriida
		Order Matazida
		Order Ventricleftida
	Subclass Phaeodaria	
		Order Eodarida
		Order Opaloconchida
	Subclass Tectosia	
		Order Tectofilosida
Subphylum Reticulofilosa		
	Class Chlorarachnea	
		Order Chlorarachnida
	Class Granofilosea	
		Order Cryptofilida
		Order Desmothoracida
		Order Leucodictyida
		Order Limnofilida
	Class Skiomonadea	
		Order Tremulida
Phylum Retaria		
Subphylum Foraminifera		
	Class Monothalamea	
		Order Allogromiida
		Order Astrorhizida
		Order Psamminida
		Order Stannomida
	Class Globothalamea	
		Order Carterinida
		Order Globeriginida
		Order Lagenida
		Order Lituolida
		Order Lofusiida
		Order Robertinida
		Order Rotaliida
		Order Testulariida
		Order Trochamminida
	Class Tubothalamea	
		Order Miliolida

(*Continued*)

Table 2. (*Continued*)

			Order Spirillinida
		Subphylum Radiozoa	
			Superclass Polycystinia
			Class Polycystinea
			Order Collodarida
			Order Nassellaria
			Order Spumellaria
			Superclass Spasmaria
			Class Acantharea
			Order Arthracanthida
			Order Chaunacanthida
			Order Holacanthida
			Order Symphyacanthida
			Class Sticholonchea
			Order Taxopodida
KINGDOM FUNGI			
	SUBKINGDOM DIKARYA [= NEOMYCOTA]		
		Phylum Ascomycota	
		Subphylum Pezizomycotina	
			Class Archaeorhizomycetes
			Order Archaeorhizomycetales
			Order Lahmiales
			Order Triblidiales
			Class Arthoniomycetes
			Order Arthoniales
			Class Dothideomycetes
			Subclass N.N.
			Order Acrospermales
			Order Botryosphaeriales
			Order Hysteriales
			Order Jahnulales
			Order Koralionastetales
			Order Patellariales
			Order Trypetheliales
			Subclass Dothideomycetidae
			Order Capnodiales
			Order Dothideales
			Order Microthyriales
			Order Myriangiales
			Subclass Meliolomycetidae
			Order Meliolales
			Subclass Pleosporomycetidae
			Order Mytilinidales
			Order Pleosporales
			Class Eurotiomycetes
			Subclass Chaetothyriomycetidae
			Order Chaetothyriales
			Order Pyrenulales
			Order Verrucariales
			Subclass Eurotiomycetidae

(*Continued*)

Table 2. (*Continued*)

		Order Arachnomycetales
		Order Ascosphaerales
		Order Coryneliales
		Order Eurotiales
		Order Onygenales
	Subclass Mycocaliciomycetidae	
		Order Mycocaliciales
Class Laboulbeniomycetes		
		Order Laboulbeniales
		Order Pyxidiophorales
Class Lecanoromycetes		
	Subclass N.N.	
		Order Candelariales
		Order Umbilicariales
	Subclass Acarosporomycetidae	
		Order Acarosporales
	Subclass Lecanoromycetidae	
		Order Lecanorales
		Order Lecideales
		Order Peltigerales
		Order Rhizocarpales
		Order Teloschistales
	Subclass Ostropomycetidae	
		Order Agyriales
		Order Baeomycetales
		Order Ostropales
		Order Pertusariales
Class Leotiomycetes		
		Order Cyttariales
		Order Erysiphales
		Order Geoglossales
		Order Helotiales
		Order Leotiales
		Order Mediolariales
		Order Rhytismatales
		Order Thelebolales
Class Lichinomycetes		
		Order Eremithallales
		Order Lichinales
Class Orbiliomycetes		
		Order Orbiliales
Class Pezizomycetes		
		Order Pezizales
Class Sordariomycetes		
	Subclass N.N.	
		Order Phyllachorales
		Order Trichosphaeriales
	Subclass Hypocreomycetidae	
		Order Coronophorales
		Order Hypocreales

(*Continued*)

Table 2. (*Continued*)

		Order Melanosporales
		Order Microascales
	Subclass Sordariomycetidae	
		Order Boliniales
		Order Calosphaeriales
		Order Chaetosphaeriales
		Order Coniochaetales
		Order Diaporthales
		Order Ophiostomatales
		Order Sordariales
	Subclass Spathulosporomycetidae	
		Order Lulworthiales
	Subclass Xylariomycetidae	
		Order Xylariales
Subphylum Saccharomycotina		
	Class Saccharomycetes	
		Order Saccharomycetales
Subphylum Taphrinomycotina		
	Class Neolectomycetes	
		Order Neolectales
	Class Pneumocystidomycetes	
		Order Pneumocystidales
	Class Schizosaccharomycetes	
		Order Schizosaccharomycetales
	Class Taphrinomycetes	
		Order Taphrinales
Phylum Basidiomycota		
	Class Entorrhizomycetes	
		Order Entorrhizales
		Order Wallemiales
Subphylum Agaricomycotina		
	Class Agaricomycetes	
	Subclass N.N.	
		Order Auriculariales
		Order Cantharellales
		Order Corticiales
		Order Gloeophyllales
		Order Hymenochaetales
		Order Polyporales
		Order Russulales
		Order Sebacinales
		Order Thelephorales
		Order Trechisporales
	Subclass Agaricomycetidae	
		Order Agaricales
		Order Atheliales
		Order Boletales
	Subclass Phallomycetidae	
		Order Geastrales
		Order Gomphales

(*Continued*)

Table 2. (*Continued*)

		Order Hysterangiales
		Order Phallales
	Class Dacrymycetes	
		Order Dacrymycetales
	Class Tremellomycetes	
		Order Cystofilobasidiales
		Order Filobasidiales
		Order Tremellales
	Subphylum Pucciniomycotina	
	Class Agaricostilbomycetes	
		Order Agaricostilbales
		Order Spiculogloeales
	Class Atractiellomycetes	
		Order Atractiellales
	Class Classiculomycetes	
		Order Classiculales
	Class Cryptomycocolacomycetes	
		Order Cryptomycocolacales
	Class Cystobasidiomycetes	
		Order Cystobasidiales
		Order Erythrobasidiales
		Order Naohideales
	Class Microbotryomycetes	
		Order Hetrogastridiales
		Order Leucosporidiales
		Order Microbotryales
		Order Sporidiobolales
	Class Mixiomycetes	
		Order Mixiales
	Class Pucciniomycetes	
		Order Helicobasidiales
		Order Pachnocybales
		Order Platygloeales
		Order Pucciniales
		Order Septobasidiales
	Subphylum Ustilaginomycotina	
	Class N.N.	
		Order Malasseziales
	Class Exobasidiomycetes	
		Order Ceraceosorales
		Order Doassansiales
		Order Entylomatales
		Order Exobasidiales
		Order Georgefischeriales
		Order Microstromatales
		Order Tilletiales
	Class Ustilaginomycetes	
		Order Urocystidales
		Order Ustilaginales
SUBKINGDOM EOMYCOTA		

(*Continued*)

Table 2. (*Continued*)

	Phylum Chytridiomycota		
		Class Blastocladiomycetes [= Allomycetes]	
			Order Blastocladiales
		Class Chytridiomycetes	
			Order Chytridiales
			Order Lobulomycetales
			Order Neocallimastigales
			Order Olpidiales
			Order Rhizophlyctidales
			Order Rhizophydiales
			Order Spizellomycetales
		Class Monoblepharidomycetes	
			Order Monoblepharidales
	Phylum Glomeromycota		
		Class Glomeromycetes [= Glomomycetes]	
			Order Archaeosporales
			Order Diversisporales
			Order Glomerales
			Order Paraglomerales
	Phylum Zygomycota		
	Subphylum N.N.		
		Class N.N.	
			Order Basidiobolales
	Subphylum Entomophthoromycotina		
		Class N.N.	
			Order Entomophthorales
	Subphylum Kickxellomycotina		
		Class N.N.	
			Order Asellariales
			Order Dimargaritales
			Order Harpellales
			Order Kickxellales
	Subphylum Mortierellomycotina		
		Class N.N.	
			Order Mortierellales
	Subphylum Mucoromycotina		
		Class N.N.	
			Order Endogonales
			Order Mucorales
	Subphylum Zoopagomycotina		
		Class N.N.	
			Order Zoopagales
KINGDOM PLANTAE			
SUBKINGDOM BILIPHYTA			
	Phylum Glaucophyta		
		Class Glaucophyceae	
			Order Glaucocystales
	Phylum Rhodophyta		
	Subphylum Cyanidiophytina		
		Class Cyanidiophyceae	

(*Continued*)

Table 2. (*Continued*)

		Order Cyanidiales
	Subphylum Eurhodophytina	
	Class Bangiophyceae	
		Order Bangiales
		Order Goniotrichales
	Class Florideophyceae	
	Subclass N.N.	
		Order Rhodachlyales
	Subclass Ahnfeltiophycidae	
		Order Ahnfeltiales
		Order Pihiellales
	Subclass Corallinophycidae	
		Order Corallinales
		Order Rhodogorgonales
		Order Sporolithales
	Subclass Hildenbrandiophyceae	
		Order Hildenbrandiales
	Subclass Nemaliophycidae	
		Order Acrochaetiales
		Order Balbianiales
		Order Balliales
		Order Batrachospermales
		Order Colaconematales
		Order Entwisleiales
		Order Nemaliales
		Order Palmariales
		Order Thoreales
	Subclass Rhodymeniophycidae	
		Order Acrosymphytales
		Order Bonnemaisoniales
		Order Ceramiales
		Order Gelidiales
		Order Gigartinales
		Order Gracilariales
		Order Halymeniales
		Order Nemastomatales
		Order Peyssonneliales
		Order Plocamiales
		Order Rhodymeniales
		Order Sebdeniales
	Subphylum Metarhodophytina	
	Class Compsopogonophyceae	
		Order Compsopogonales
		Order Erythropeltidales
		Order Rhodochaetales
	Subphylum Rhodellophytina	
	Class Porphyridiophyceae	
		Order Porphyridiales
	Class Rhodellophyceae	
		Order Dixoniellales

(*Continued*)

Table 2. (*Continued*)

		Order Glaucosphaerales
		Order Rhodellales
	Class Stylonematophyceae	
		Order Rufusiales
		Order Stylonematales
SUBKINGDOM VIRIDIPLANTAE		
INFRAKINGDOM CHLOROPHYTA		
Phylum Chlorophyta		
Subphylum Chlorophytina		
	Class Chlorodendrophyceae	
		Order Chlorodendrales
	Class Chlorophyceae	
		Order N.N. (e.g., Chlorangiopsidaceae)
		Order Chaetopeltidales
		Order Chaetophorales
		Order Chlamydomonadales [= Volvocales]
		Order Oedogoniales
		Order Sphaeropleales
	Class Pedinophyceae	
		Order Marsupiomonadales
		Order Pedinomonadales
		Order Scourfieldiales
	Class Trebouxiophyceae	
		Order Chlorellales
		Order Microthamniales
		Order Phyllsiphonales
		Order Prasiolales
		Order Trebouxiales
	Class Ulvophyceae	
		Order Bryopsidales
		Order Cladophorales
		Order Dasycladales
		Order Oltmansiellopsidales
		Order Scotinosphaerales
		Order Trentepohliales
		Order Ulotrichales
		Order Ulvales
Subphylum Prasinophytina		
	Class Mamiellophyceae	
		Order Dolichomastigales
		Order Mamiellales
		Order Monomastigales
	Class Nephrophyceae [= Nephroselmidophyceae]	
		Order Nephroselmidales
	Class Pyramimonadophyceae	
		Order Palmophyllales
		Order Prasinococcales
		Order Pseudoscourfieldiales
		Order Pyramimonadales
INFRAKINGDOM STREPTOPHYTA		

(*Continued*)

Table 2. (*Continued*)

Superphylum Charophyta			
	Phylum Charophyta		
		Class Charophyceae	
			Order Charales
		Class Chlorokybophyceae	
			Order Chlorokybales
		Class Coleochaetophyceae	
			Order Chaetosphaeridiales
			Order Coleochaetales
		Class Conjugatophyceae [= Zygnematophyceae]	
			Order Desmidiales
			Order Zygnematales
		Class Klebsormidiophyceae	
			Order Klebsormidiales
		Class Mesostigmatophyceae	
			Order Mesostigmatales
Superphylum Embryophyta			
	Phylum Anthocerotophyta		
		Class Anthocerotopsida	
		Subclass Anthocerotidae	
			Order Anthocerotales
		Subclass Dendrocerotidae	
			Order Dendrocerotales
			Order Phymatocerales
		Subclass Notothylatidae	
			Order Notothyladales
		Class Leiosporocerotopsida	
			Order Leiosporocerotales
	Phylum Bryophyta		
		Class Andreaeobryopsida	
			Order Andreaeobryales
		Class Andreaeopsida	
			Order Andreaeales
		Class Bryopsida	
		Subclass Bryidae	
			Order Bartramiales
			Order Bryales
			Order Hedwigiales
			Order Hookeriales
			Order Hypnales
			Order Hypnodendrales
			Order Orthotrichales
			Order Ptychomniales
			Order Rhizogoniales
			Order Splachnales
		Subclass Buxbaumiidae	
			Order Buxbaumiales
		Subclass Dicranidae	
			Order Archidiales
			Order Bryoxiphiales

(*Continued*)

Table 2. (*Continued*)

		Order Dicranales
		Order Grimmiales
		Order Pottiales
		Order Scouleriales
	Subclass Diphysciidae	
		Order Diphysciales
	Subclass Funariidae	
		Order Encalyptales
		Order Funariales
		Order Gigaspermales
	Subclass Timmidae	
		Order Timmiales
	Class Oedipodiopsida	
		Order Oedipodiales
	Class Polytrichopsida	
		Order Polytrichales
	Class Sphagnopsida	
		Order Ambuchananiales
		Order Sphagnales
	Class Takakiopsida	
		Order Takakiales
	Class Tetraphidopsida	
		Order Tetraphidales
Phylum Marchantiophyta		
	Class Haplomitriopsida	
		Order Calobryales
		Order Treubiales
	Class Jungermanniopsida	
	Subclass Jungermanniidae	
		Order Jungermanniales
		Order Porellales
		Order Ptilidiales
	Subclass Metzgeriidae	
		Order Metzgeriales
		Order Pleuroziales
	Subclass Pelliidae	
		Order Fossombroniales
		Order Pallaviciniales
		Order Pelliales
	Class Marchantiopsida	
		Order Blasiales
		Order Lunulariales
		Order Marchantiales
		Order Neohodgsoniales
		Order Sphaerocarpales
Phylum Tracheophyta		
Subphylum Lycopodiophytina		
	Class Lycopodiopsida	
		Order Isoetales
		Order Lycopodiales

(*Continued*)

Table 2. (*Continued*)

		Order Selaginellales
	Subphylum Polypodiophytina	
	Class Polypodiopsida	
	Subclass Equisetidae	
		Order Equisetales
	Subclass Marattiidae	
		Order Marattiales
	Subclass Ophioglossidae [= Psilotidae]	
		Order Ophioglossales
		Order Psilotales
	Subclass Polypodiidae	
		Order Cyatheales
		Order Gleicheniales
		Order Hymenophyllales
		Order Osmundales
		Order Polypodiales
		Order Salviniales
		Order Schizaeales
	Subphylum Spermatophytina	
	Superclass "Angiospermae"	
	Class Magnoliopsida	
		Superorder N.N.
		Order N.N. (e.g., Icacinaceae)
		Superorder Amborellanae
		Order Amborellales
		Superorder Asteranae
		Order Apiales
		Order Aquifoliales
		Order Asterales
		Order Boraginales
		Order Bruniales
		Order Cornales
		Order Dipsacales
		Order Ericales
		Order Escalloniales
		Order Garryales
		Order Gentianales
		Order Lamiales
		Order Paracryphiales
		Order Solanales
		Superorder Austrobaileyanae
		Order Austrobaileyales
		Superorder Berberidopsidanae
		Order Berberidopsidales
		Superorder Buxanae
		Order Buxales
		Superorder Caryophyllanae
		Order Caryophyllales
		Superorder Ceratophyllanae
		Order Ceratophyllales

(*Continued*)

Table 2. (*Continued*)

Superorder Dillenianae
Order Dilleniales
Superorder Lilianae [= Monocotyledones]
Order Acorales
Order Alismatales
Order Arecales
Order Asparagales
Order Commelinales
Order Dasypogonales
Order Dioscoreales
Order Liliales
Order Pandanales
Order Petrosaviales
Order Poales
Order Zingiberales
Superorder Magnolianae
Order Canellales
Order Chloranthales
Order Laurales
Order Magnoliales
Order Piperales
Superorder Myrothamnanae
Order Gunnerales
Superorder Nymphaeanae
Order Nymphaeales
Superorder Proteanae
Order Proteales
Superorder Ranunculanae
Order Ranunculales
Superorder Rosanae
Order Brassicales
Order Celastrales
Order Crossosomatales
Order Cucurbitales
Order Fabales
Order Fagales
Order Geraniales
Order Huerteales
Order Malpighiales
Order Malvales
Order Myrtales
Order Oxalidales
Order Picramniales
Order Rosales
Order Sapindales
Order Vitales
Order Zygophyllales
Superorder Santalanae
Order Santalales
Superorder Saxifraganae

(*Continued*)

Table 2. (*Continued*)

			Order Saxifragales
		Superorder Trochodendranae	
			Order Trochodendrales
	Superclass "Gymnospermae"		
	Class Cycadopsida		
		Subclass Cycadidae	
			Order Cycadales
	Class Ginkgoopsida		
		Subclass Ginkgooidae	
			Order Ginkgoales
	Class Gnetopsida		
		Subclass Gnetidae	
			Order Gnetales
	Class Pinopsida		
		Subclass Pinidae	
			Order Pinales
KINGDOM ANIMALIA			
SUBKINGDOM N.N.			
Phylum Cnidaria			
Subphylum Anthozoa			
	Class Anthozoa		
		Subclass Hexacorallia	
			Order Actiniaria
			Order Antipatharia
			Order Ceriantharia
			Order Corallimorpharia
			Order Scleractinia
			Order Zoantharia [= Zoanthidea]
		Subclass Octocorallia	
			Order Alcyonacea
			Order Helioporacea
			Order Pennatulacea
Subphylum Medusozoa			
	Class Cubozoa		
			Order Carybdeida
			Order Chirodropida
	Class Hydrozoa		
		Subclass Hydroidolina	
			Order Anthoathecata
			Order Gonoproxima
			Order Leptothecata
			Order Siphonophorae
		Subclass Trachylina	
			Order Actinulida
			Order Limnomedusae
			Order Narcomedusae
			Order Trachymedusae
	Class Polypodiozoa		
			Order Polypodiidea
	Class Scyphozoa		

(*Continued*)

Table 2. (*Continued*)

		Order Coronatae
		Order Rhizostomeae
		Order Semaeostomeae
	Class Staurozoa	
		Order Stauromedusae
Subphylum Myxozoa		
	Class Malacosporea	
		Order Malacovalvulida
	Class Myxosporea	
		Order Bivalvulida
		Order Multivalvulida
Phylum Ctenophora		
	Class Nuda	
		Order Beroida
	Class Tentaculata	
		Order Cambojiida
		Order Cestida
		Order Cryptolobiferida
		Order Cydippida
		Order Ganeshida
		Order Lobata
		Order Platyctenida
		Order Thalassocalycida
Phylum Placozoa		
	Class Placozoa *(Trichoplax)*	
Phylum Porifera		
	Class Calcarea	
		Order Baerida
		Order Clathrinida
		Order Leucosolenida
		Order Lithonida
		Order Murrayonida
	Class Demospongiae	
		Order Agelasida
		Order Astrophorida
		Order Chondrosida
		Order Dendroceratida
		Order Dictyoceratida
		Order Hadromerida
		Order Halichondrida
		Order Haplosclerida
		Order Lithistida
		Order Poecilosclerida
		Order Spirophorida
		Order Verongida
	Class Hexactinellida	
		Order Amphidiscosida
		Order Aulocalycoida
		Order Fieldingida
		Order Hexactinosida

(*Continued*)

Table 2. (*Continued*)

		Order Lychniscosida
		Order Lyssacinosida
	Class Homoscleromorpha	
		Order Homosclerophorida
SUBKINGDOM BILATERIA		
INFRAKINGDOM PROTOSTOMIA		
Superphylum N.N.		
Phylum Chaetognatha		
	Class Sagittoidea	
		Order Aphragmophora
		Order Phragmophora
Phylum Orthonectida		
		Order Plasmodigenea
Phylum Rhombozoa		
		Order Dicyemida
		Order Heterocyemida
Superphylum Ecdysozoa		
Phylum Arthropoda		
Subphylum Chelicerata		
	Class Arachnida	
	Superorder N.N.	
		Order Amblypygi
		Order Araneae
		Order Opiliones
		Order Palpigradi
		Order Pseudoscorpiones
		Order Ricinulei
		Order Schizomida
		Order Scorpiones
		Order Solifugae
		Order Uropygi
	Superorder Acariformes	
		Order Sarcoptiformes
		Order Trombidiformes
	Superorder Parasitiformes	
		Order Holothyrida
		Order Ixodida
		Order Mesostigmata
		Order Opilioacarida
	Class Merostomata	
		Order Xiphosura
	Class Pycnogonida	
		Order Pantopoda
Subphylum Crustacea		
	Class Branchiopoda	
		Order Anostraca
		Order Diplostraca
		Order Laevicaudata
		Order Notostraca
	Class Cephalocarida	

(*Continued*)

Table 2. (*Continued*)

Order Brachypoda
Class Malacostraca
Subclass Eumalacostraca
Superorder Eucarida
Order Amphionidacea
Order Decapoda
Order Euphausiacea
Superorder Peracarida
Order Amphipoda
Order Bochusacea
Order Cumacea
Order Isopoda
Order Lophogastrida
Order Mictacea
Order Mysida
Order Spelaeogriphacea
Order Tanaidacea
Order Thermosbaenacea
Superorder Syncarida
Order Anaspidacea
Order Bathynellacea
Subclass Hoplocarida
Order Stomatopoda
Subclass Phyllocarida
Order Leptostraca
Class Maxillopoda
Subclass Branchiura
Order Arguloida
Subclass Copepoda
Infraclass Neocopepoda
Superorder Gymnoplea
Order Calanoida
Superorder Podoplea
Order Cyclopoida
Order Gelyelloida
Order Harpacticoida
Order Misophrioida
Order Monstrilloida
Order Mormonilloida
Order Siphonostomatoida
Infraclass Progymnoplea
Order Platycopioida
Subclass Mystacocarida
Order Mystacocaridida
Subclass Pentastomida
Order Cephalobaenida
Order Porocephalida
Subclass Tantulocarida (e.g., Basipodellidae)
Subclass Thecostraca
Infraclass Ascothoracida

(*Continued*)

Table 2. (*Continued*)

					Order Dendrogastrida
					Order Laurida
			Infraclass Cirripedia		
				Superorder Acrothoracica	
					Order Cryptophialida
					Order Lithoglyptida
				Superorder Rhizocephala	
					Order Akentrogonida
					Order Kentrogonida
				Superorder Thoracica	
					Order Ibliformes
					Order Lepadiformes
					Order Scalpelliformes
					Order Sessilia
			Infraclass Facetotecta (*Hansenocaris*)		
	Class Ostracoda				
					Order Halocyprida
					Order Myodocopida
					Order Paleocopida
					Order Platycopida
					Order Podocopida
	Class Remipedia				
					Order Nectiopoda
Subphylum Hexapoda					
	Class Collembola				
					Order Entomobryomorpha
					Order Neelipleona
					Order Poduromorpha
					Order Symphypleona
	Class Diplura				
					Order N.N. (e.g., *Japygidae*)
	Class Insecta				
		Subclass Archaeognatha			
					Order Archaeognatha
		Subclass Dicondylia			
					Order Zygentoma
		Subclass Pterygota			
			Infraclass Neoptera		
				Superorder Holometabola	
					Order Coleoptera
					Order Diptera
					Order Hymenoptera
					Order Lepidoptera
					Order Mecoptera
					Order Siphonaptera
					Order Strepsiptera
					Order Trichoptera
				Superorder Neuropterida	
					Order Megaloptera
					Order Neuroptera

(*Continued*)

Table 2. (*Continued*)

					Order Raphidioptera
				Superorder Paraneoptera	
					Order Hemiptera
					Order Psocodea
					Order Thysanoptera
				Superorder Polyneoptera	
					Order Blattodea
					Order Dermaptera
					Order Embioptera
					Order Grylloblattodea
					Order Mantodea
					Order Mantophasmatodea
					Order Orthoptera
					Order Phasmida
					Order Plecoptera
					Order Zoraptera
			Infraclass Palaeoptera		
					Order Ephemeroptera
					Order Odonata
	Class Protura				
					Order Acerentomata
					Order Eosentomata
					Order Sinentomata
Subphylum Myriapoda					
	Class Chilopoda				
					Order Craterostigmomorpha
					Order Geophilomorpha
					Order Lithobiomorpha
					Order Scolopendromorpha
					Order Scutigeromorpha
	Class Diplopoda				
		Subclass Chilognatha			
			Infraclass Helminthomorpha		
				Superorder N.N.	
					Order Platydesmida
					Order Polyzoniida
					Order Siphonocryptida
					Order Siphonophorida
				Superorder Juliformia	
					Order Julida
					Order Spirobolida
					Order Spirostreptida
				Superorder Nematophora	
					Order Callipodida
					Order Chordeumatida
					Order Stemmiulida
					Order Siphoniulida
				Superorder Merochaeta	
					Order Polydesmida
			Infraclass Pentazonia		

(*Continued*)

Table 2. (*Continued*)

				Order Glomerida
				Order Glomeridesmida
				Order Sphaerotheriida
			Subclass Penicillata	
				Order Polyxenida
		Class Pauropoda		
				Order Hexamerocerata
				Order Tetramerocerata
		Class Symphyla (e.g., Scolopendrellidae)		
	Phylum Kinorhyncha			
				Order Cyclorhagida
				Order Homalorhagida
	Phylum Loricifera			
				Order Nanaloricida
	Phylum Nematoda			
		Class Chromadorea		
			Subclass Chromadoria	
				Order Chromadorida
				Order Desmodorida
				Order Desmoscolecida
				Order Selachinematida
			Subclass Plectia	
				Superorder Monhysterica
				Order Monhysterida
				Superorder Plectica
				Order Benthimermithida
				Order Leptolaimida
				Order Plectida
				Superorder Rhabditica
				Order Diplogasterida
				Order Drilonematida
				Order Panagrolaimida
				Order Rhabditida
				Order Spirurida
				Superorder Teratocephalica
				Order Teratocephalida
		Class Dorylaimea		
			Subclass Bathyodontia	
				Order Bathyodontida
				Order Mermithida
				Order Mononchida
			Subclass Dorylaimia	
				Order Dorylaimida
			Subclass Trichocephalia	
				Order Dioctophymatida
				Order Marimermithida
				Order Muspiceida
				Order Trichocephalida
		Class Enoplea		
			Subclass Enoplia	

(*Continued*)

Table 2. (*Continued*)

			Order Alaimida
			Order Enoplida
			Order Ironida
			Order Rhaptothyreida
			Order Trifusiida
			Order Tripyloidida
		Subclass Oncholaimia	
			Order Oncholaimida
		Subclass Triplonchia	
			Order Triplonchida
			Order Tripylida
	Phylum Nematomorpha		
			Order Gordioidea
			Order Nectonematoidea
	Phylum Onychophora		
		Class Udeonycophora	
			Order Euonycophora
	Phylum Priapula [= Priapulida]		
		Class N.N. (e.g., Priapulidae)	
	Phylum Tardigrada		
		Class Eutardigrada	
			Order Apochela
			Order Parachela
		Class Heterotardigrada	
			Order Arthrotardigrada
			Order Echiniscoidea
Superphylum Spiralia [= Lophotrochozoa]			
	Phylum Acanthocephala		
		Class Archiacanthocephala	
			Order Apororhynchida
			Order Gigantorhynchida
			Order Moniliformida
			Order Oligacanthorhynchida
		Class Eoacanthocephala	
			Order Gyracanthocephala
			Order Neoechinorhynchida
		Class Palaeacanthocephala	
			Order Echinorhynchida
			Order Heteramorphida
			Order Polymorphida
		Class Polyacanthocephala	
			Order Polyacanthorhynchida
	Phylum Annelida		
		Class N.N.	
			Order Myzostomida
		Class Clitellata	
		Subclass N.N.	
			Order Apodadrilida
		Subclass Hirudinea	
			Order Acanthobdellida

(*Continued*)

Table 2. (*Continued*)

			Order Arhynchobdellida
			Order Rhynchobdellida
		Subclass Oligochaeta	
			Superorder N.N.
			Order N.N. (*Jennaria*)
			Order Branchiobdellida
			Order Capilloventrida
			Order Crassiclitellata
			Order Enchytraeida
			Order Haplotaxida
			Order Lumbriculida
			Order Tubificida
			Superorder Metagynaphora
			Order Moniligastrida
			Order Opistophophora
		Class Polychaeta	
		Subclass N.N.	
			Order N.N. (e.g., Nerillidae)
		Subclass Echiura	
			Order Echiuroinea
			Order Heteromyota
			Order Xenopneusta
		Subclass Errantia	
			Order Amphinomida
			Order Eunicida
			Order Phyllodocida
		Subclass Sedentaria	
			Infraclass Canalipalpata
			Order Sabellida
			Order Spionida
			Order Terebellida
			Infraclass Scolecida (e.g., Arenicolidae)
	Phylum Brachiopoda		
		Class Craniata	
			Order Craniida
		Class Lingulata	
			Order Lingulida
		Class Rhynchonellata	
			Order Rhynchonellida
			Order Terebratulida
			Order Thecideida
	Phylum Bryozoa		
		Class Gymnolaemata	
			Order Cheilostomata
			Order Ctenostomata
		Class Phylactolaemata	
			Order Plumatellida
		Class Stenolaemata	
			Order Cyclostomata
	Phylum Cycliophora		

(*Continued*)

Table 2. (*Continued*)

	Class Eucycliophora	
		Order Symbiida
Phylum Entoprocta		
		Order Coloniales
		Order Solitaria
Phylum Gastrotricha		
		Order Chaetonotida
		Order Macrodasyida
Phylum Gnathostomulida		
		Order Bursovaginoidea
		Order Filospermoidea
Phylum Micrognathozoa		
	Class Micrognathozoa	
		Order Limnognathida
Phylum Mollusca		
	Class Bivalvia	
	Subclass Autobranchia	
		Superorder Heteroconchia
		Order Carditida
		Order Lucinida
		Order Myida
		Order Pholadomyida
		Order Trigoniida
		Order Unionida
		Order Veneroida
		Superorder Pteriomorphia
		Order Arcida
		Order Limida
		Order Mytilida
		Order Ostreida
		Order Pectinida
		Order Pteriida
	Subclass Protobranchia	
		Order Nuculanida
		Order Nuculida
		Order Solemyoida
	Class Caudofoveata	
		Order Chaetodermatida
	Class Cephalopoda	
	Subclass Coleoidea	
		Superorder Decabrachia
		Order Sepiida
		Order Sepiolida
		Order Spirulida
		Order Teuthida
		Superorder Octobrachia
		Order Octopoda
		Order Vampyromorphida
	Subclass Nautiloidea	
		Order Nautilida

(*Continued*)

Table 2. (*Continued*)

			Class Gastropoda			
				Subclass Caenogastropoda		
						Order Littorinimorpha
						Order Neogastropoda
				Subclass Cocculiniformia (e.g., Cocculinidae)		
				Subclass Heterobranchia		
						Order Acochlidioidea
						Order Anaspidea
						Order Cephalaspidea
						Order Gymnosomata
						Order Hygrophila
						Order Nudibranchia
						Order Pleurobranchomorpha
						Order Runcinacea
						Order Sacoglossa
						Order Stylommatophora
						Order Systellommatophora
						Order Thecosomata
						Order Umbraculida
				Subclass Neomphalina		
						Order N.N. (e.g., Neomphalidae)
				Subclass Neritimorpha		
						Order Cycloneritimorpha
				Subclass Patellogastropoda		
						Order N.N. (e.g., Patellidae)
				Subclass Vetigastropoda		
						Order N.N. (e.g., Ataphridae)
			Class Monoplacophora			
						Order Tryblidiida
			Class Polyplacophora			
						Order Chitonida
						Order Lepidopleurida
			Class Scaphopoda			
						Order Dentaliida
						Order Gadilida
			Class Solenogastres			
					Superorder Aplotegmentaria	
						Order Cavibelonia
						Order Sterrofustia
					Superorder Pachytegmentaria	
						Order Neomeniamorpha
						Order Pholidoskepia
	Phylum Nemertea					
			Class Anopla			
						Order N.N. (e.g., Gorgonorhynchidae)
			Class Enopla			
						Order Monostilifera
						Order Polystilifera
			Class Paleonemertea (e.g., Carinomidae)			
	Phylum Phoronida					

(*Continued*)

Table 2. (*Continued*)

	Class N.N. (e.g., *Phoronis*)	
Phylum Platyhelminthes		
Subphylum Catenulidea		
		Order Catenulida
Subphylum Rhabditophora		
	Class Macrostomorpha	
		Order Haplopharyngida
		Order Macrostomida
	Class Neoophora	
	Subclass Eulecithophora	
	Infraclass Adiaphanida	
		Order Fecampiida
		Order Prolecithophora
		Order Tricladida
	Infraclass Rhabdocoela	
		Order Dalytyphloplanida
		Order Endoaxonemata
		Order Kalyptorhynchia
	Subclass Neodermata	
	Infraclass Cestoda	
		Order Amphilinidea
		Order Bothriocephalidea
		Order Caryophyllidea
		Order Cyclophyllidea
		Order Diphyllidea
		Order Diphyllobothriidea
		Order Gyrocotylidea
		Order Lecanicephalidea
		Order Litobothridea
		Order Proteocephalidea
		Order Pseudophyllidea
		Order Rhinebothriidea
		Order Spathebothriidea
		Order Tetrabothriidea
		Order Tetraphyllidea
		Order Trypanorhyncha
	Infraclass Monogenea	
		Order Capsalidea
		Order Chimaericolidea
		Order Dactylogyridea
		Order Diclybothriidea
		Order Gyrodactylidea
		Order Mazocraeidea
		Order Monocotylidea
		Order Montchadskyellidea
		Order Polystomatidea
	Infraclass Trematoda	
		Order Aspidogastrida
		Order Diplostomida
		Order Plagiorchiida

(*Continued*)

Table 2. (*Continued*)

			Order Stichocotylida
		Class Polycladidea	
			Order Lecithoepitheliata
			Order Polycladida
		Subclass Proseriatia	
			Order Proseriata
	Phylum Rotifera		
		Class Eurotatoria	
		Subclass Bdelloidea (e.g., Adinetidae)	
		Subclass Monogonta	
			Order Collothecaceae
			Order Flosculariaceae
			Order Ploima
		Class Pararotatoria	
			Order Seisonacea
	Phylum Sipuncula		
		Class Phascolosomatidea	
			Order Aspidosiphoniformes
			Order Phascolosomatiformes
		Class Sipunculidea	
			Order Golfingiiformes
			Order Sipunculiformes
INFRAKINGDOM DEUTEROSTOMIA			
	Phylum Chordata		
	Subphylum Cephalochordata		
			Order Amphioxiformes
	Subphylum Urochordata		
		Class Appendicularia	
			Order Copelata
		Class Ascidiacea	
			Order Enterogona
			Order Pleurogona
		Class Thaliacea	
			Order Doliolida
			Order Pyrosomida
			Order Salpida
	Subphylum Vertebrata [= Craniata]		
	Infraphylum Agnatha		
		Class Cephalaspidomorphi	
			Order Petromyzontiformes
		Class Myxini	
			Order Myxiniformes
	Infraphylum Gnathostomata		
	Superclass Actinopterygii		
		Class Chondrostei	
			Order Acipenseriformes
		Class Cladistei	
			Order Polypteriformes
		Class Holostei	
			Order Amiiformes

(*Continued*)

Table 2. (*Continued*)

	Order Lepisosteiformes
Class Teleostei	
	Order Acanthuriformes
	Order Albuliformes
	Order Alepocephaliformes
	Order Anabantiformes
	Order Anguilliformes
	Order Argentiniformes
	Order Ateleopodiformes
	Order Atheriniformes
	Order Aulopiformes
	Order Batrachoidiformes
	Order Beloniformes
	Order Beryciformes
	Order Blenniiformes
	Order Carangiformes
	Order Centrarchiformes
	Order Characiformes
	Order Cichliformes
	Order Cirrhitiformes
	Order Clupeiformes
	Order Cypriniformes
	Order Cyprinodontiformes
	Order Elopiformes
	Order Ephippiformes
	Order Esociformes
	Order Gadiformes
	Order Galaxiiformes
	Order Gobiiformes
	Order Gonorynchiformes
	Order Gymnotiformes
	Order Hidontiformes
	Order Holocentriformes
	Order Istiophoriformes
	Order Kurtiformes
	Order Labriformes
	Order Lampridiformes
	Order Lepidogalaxiiformes
	Order Lobotiformes
	Order Lophiiformes
	Order Mugiliformes
	Order Myctophiformes
	Order Notacanthiformes
	Order Ophidiiformes
	Order Osmeriformes
	Order Osteoglossiformes
	Order Pempheriformes
	Order Perciformes
	Order Percopsiformes
	Order Pholidichthyiformes

(*Continued*)

Table 2. (*Continued*)

		Order Pleuronectiformes
		Order Polymixiiformes
		Order Salmoniformes
		Order Scombriformes
		Order Siluriformes
		Order Spariformes
		Order Stomiatiformes
		Order Stylephoriformes
		Order Synbranchiformes
		Order Syngnathiformes
		Order Terapontiformes
		Order Tetraodontiformes
		Order Uranoscopiformes
		Order Zeiformes
	Superclass Chondrichthyes	
	Class Elasmobranchii	
		Order Carcharhiniformes
		Order Heterodontiformes
		Order Hexanchiformes
		Order Lamniformes
		Order Myliobatiformes
		Order Orectolobiformes
		Order Pristiformes
		Order Pristiophoriformes
		Order Rajiformes
		Order Squaliformes
		Order Squatiniformes
		Order Torpediniformes
	Class Holocephali	
		Order Chimaeriformes
	Superclass Sarcopterygii	
	Class Coelacanthi	
		Order Coelacanthiformes
	Class Dipnoi	
		Order Ceratodontiformes
		Order Lepidosirenoformes
	Superclass Tetrapoda	
	Class Amphibia	
		Order Anura
		Order Caudata
		Order Gymnophiona
	Class Mammalia	
	Subclass Prototheria	
		Order Monotremata
	Subclass Theria	
	Infraclass Eutheria [= Placentalia]	
		Order Afrosoricida
		Order Artiodactyla
		Order Carnivora
		Order Cetacea

(*Continued*)

Table 2. (*Continued*)

		Order Chiroptera
		Order Cingulata
		Order Dermoptera
		Order Erinaceomorpha
		Order Hyracoidea
		Order Lagomorpha
		Order Macroscelidea
		Order Perissodactyla
		Order Pholidota
		Order Pilosa
		Order Primates
		Order Proboscidea
		Order Rodentia
		Order Scandentia
		Order Sirenia
		Order Soricomorpha
		Order Tubulidentata
	Infraclass Metatheria [= Marsupialia]	
		Order Dasyuromorphia
		Order Didelphimorphia
		Order Diprotodontia
		Order Microbiotheria
		Order Notoryctemorphia
		Order Paucituberculata
		Order Peramelemorphia
Class Reptilia		
	Subclass Aves	
	Infraclass Neognathae	
		Superorder Galloanseri
		Order Anseriformes
		Order Galliformes
		Superorder Neoaves
		Order Accipitriformes
		Order Apodiformes
		Order Bucerotiformes
		Order Caprimulgiformes
		Order Cariamiformes
		Order Charadriiformes
		Order Ciconiiformes
		Order Coliiformes
		Order Columbiformes
		Order Coraciiformes
		Order Cuculiformes
		Order Eurypygiformes
		Order Falconiformes
		Order Gaviiformes
		Order Gruiformes
		Order Leptosomiformes
		Order Mesitornithiformes
		Order Musophagiformes

(*Continued*)

Table 2. (*Continued*)

			Order Opisthocomiformes
			Order Otidiformes
			Order Passeriformes
			Order Pelecaniformes
			Order Phaethontiformes
			Order Phoenicopteriformes
			Order Piciformes
			Order Podicipediformes
			Order Procellariiformes
			Order Psittaciformes
			Order Pteroclidiformes
			Order Sphenisciformes
			Order Strigiformes
			Order Suliformes
			Order Trogoniformes
		Infraclass Paleognathae	
			Order Apterygiformes
			Order Casuariiformes
			Order Rheiformes
			Order Struthioniformes
			Order Tinamiformes
		Subclass Crocodylomorpha	
			Order Crocodylia
		Subclass Rhynchocephalia	
			Order Sphenodontida
		Subclass Squamata	
			Order Anguimorpha
			Order Gekkota
			Order Inguania
			Order Lacertoidea
			Order Scincoidea
			Order Serpentes
		Subclass Testudinata	
			Order Testudines
	Phylum Echinodermata		
	Subphylum Asterozoa		
		Class Asteroidea	
			Order Brisingida
			Order Forcipulatida
			Order Notomyotida
			Order Paxillosida
			Order Peripoda
			Order Spinulosida
			Order Valvatida
			Order Velatida
		Class Ophiuroidea	
			Order Euryalida
			Order Ophiurida
	Subphylum Crinozoa		
		Class Crinoidea	

(*Continued*)

Table 2. (*Continued*)

				Order Comatulida
				Order Cyrtocrinida
				Order Hyocrinida
				Order Isocrinida
		Subphylum Echinozoa		
			Class Echinoidea	
				Subclass Cidaroidea
				Order Cidaroida
				Subclass Euechinoidea
				Infraclass N.N.
				Order Echinothurioida
				Infraclass Acroechinoidea
				Order Aspidodiadematoida
				Order Diadematoida
				Order Micropygoida
				Order Pedinoida
				Infraclass Carinacea
				Order Arbacioida
				Order Camarodonta
				Order Salenioida
				Order Stomopneustoida
				Infraclass Irregularia
				Order Cassiduloida
				Order Clypeasteroida
				Order Echinolampadoida
				Order Holasteroida
				Order Spatangoida
			Class Holothuroidea	
				Order N.N. (*Thyone*)
				Order Apodida
				Order Aspidochirotida
				Order Dendrochirotida
				Order Elasipodida
				Order Molpadida
		Phylum Hemichordata		
			Class Enteropneusta (e.g., Harrimaniidae)	
			Class Pterobranchia	
				Subclass Cephalodiscida (*Cephalodiscus*)
				Subclass Graptolithina
				Order Rhabdopleurida
		Phylum Xenacoelomorpha		
		Subphylum Acoelomorpha		
			Class Acoela (e.g., Diopisthoporidae)	
			Class Nemertodermatida (e.g., Nemertodermatidae)	
		Subphylum Xenoturbellida		
			Class N.N. (Xenoturbellidae)	

Names below rank of infrakingdom are arranged alphabetically within each parent rank, except for taxa that are not named (N.N.). Brackets indicate synonyms. Quoted names are not validly published but in common use.

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the many taxa therein and provides for easier import and manipulation of data by information systems.

Supporting Information

S1 Appendix. List of sources consulted for proposed higher level classification of all living organisms.
(PDF)

S1 Table. Proposed hierarchical classification from superkingdom to order.
(XLSX)

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Author Contributions

Conceived and designed the experiments: MR DG NB TB RB TC-S MG PK TO. Analyzed the data: MR DG NB TB RB TC-S MG PK TO. Wrote the paper: MR DG NB TB RB TC-S MG PK TO.

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