

Copepod taxonomy: Discovery vs. recognition

David M. Damkaer

21318-195th Ave. SE, Monroe, Washington 98272-9481, U.S.A.

Abstract.—A table of copepod orders, families, and type genera, with authors and dates, revealed a general marked delay between the discovery of a genus and the establishment of higher taxa based on that genus. The average time from genus definition to order definition was 51 yr. For families, this delay was 31 yr, with a range of 0 to 159 yr. Excluding the 54 families defined simultaneously with the discovery of their type genus, the average delay was 42 yr. The future trajectory of accumulating family definitions is discussed. The present dynamics of copepod taxonomy may require additional decades before a falling off of new orders and families can be predicted.

A recently published copepod classification (Bowman & Abele 1982), in contrast to many such summaries, indicated authors and dates for taxa down to family. Since that publication, other authors have made additions or alterations to this classification (Fosshagen & Iliffe 1985, 1989; Ho 1990, 1991; Kim 1991, Grygier 1994). A revised classification of the current 10 copepod orders and 205 families is given in Table 1; changes from the table of Bowman & Abele are indicated. It became of interest to plot the establishment of the listed families by decade (Fig. 1), as a representation of the historical awareness of copepods as a large, distinct group of Crustacea. What is apparent is a steady increase in defined families over 160 yr, with at least four periods of exceptionally rapid progress. These periods can be attributed mostly to James Dwight Dana (1840s and 1850s), to Wilhelm Giesbrecht (1890s), to Georg Ossian Sars (1900s and 1910s), and to several investigators since 1950. Besides an obvious expression of personal energy, the association of those periods with individuals reflects in part an ability to sample in or obtain material from a wide variety of new habitats. There is also a necessary time-lag, since in any era there had to be a reasonable background of described species against which

the higher taxa could be discerned. [Note that an investigator could have defined nearly any and all of these higher taxa from literature, without once looking at a specimen—fortunately, this was not the case.]

A second relationship (Fig. 1) shows the establishment of the highest taxa within Copepoda, namely the eight orders into which the subclass was divided, as given by Bowman & Abele (1982), and two orders added in the subsequent decade (see Ho 1990). Again, this indicated a steady increase over the same long time. But was the establishment of these 10 orders, and their contained families as well, indicative of newly discovered fundamental copepod types, or were these higher taxa based on delayed recognition? Answering this question first for the copepod orders, it was seen that the genera upon which all 10 principal groups are based had been defined between 1776 and 1977, with 8 by 1891 and with 7 by 1865. The range of time between discovery of the genus and the recognition that it represented an entirely new major copepod division was 0 yr, for Siphonostomatoida, to 88 yr, for Mormonilloida. The average time from discovery of the genus to the definition of the order for which that genus is the type was 51 yr. That the earliest order, Cyclopoida, was defined in 1835 does not

Table 1.—Copepod classification to family, including type genera of families (modifications to Bowman & Abele (1982) indicated by *). The original date of a preoccupied and replaced genus name is indicated by PN.

*Subclass Copepoda Milne Edwards, 1830

Order Calanoida Sars, 1903

Acartiidae Sars, 1903
Acartia Dana, 1846

Aetideidae Giesbrecht, 1892
Aetideus Brady, 1883

Arietellidae Sars, 1902
Arietellus Giesbrecht, 1892

Augaptilidae Sars, 1905
Augaptilus Giesbrecht, 1889

Bathypontiidae Brodsky, 1950
Bathypontia Sars, 1905

*Boholiniidae Fosshagen & Iliffe, 1989
Boholina Fosshagen, 1989

Calanidae Dana, 1849
Calanus Leach, 1816

Calocalanidae Bernard, 1958
Calocalanus Giesbrecht, 1888

Candaciidae Giesbrecht, 1892
Candacia Dana, 1846

Centropagidae Giesbrecht, 1892
Centropages Krøyer, 1849

Clausocalanidae Giesbrecht, 1892
Clausocalanus Giesbrecht, 1888

Diaixidae Sars, 1902
Diaixis Sars, 1902

Diaptomidae Baird, 1850
Diaptomus Westwood, 1836

Discoidae Gordejeva, 1975
Disco Grice & Hulsemann, 1965

Epacteriscidae Fosshagen, 1973
Epacteriscus Fosshagen, 1973

Eucalanidae Giesbrecht, 1892
Eucalanus Dana, 1852

Euchaetidae Giesbrecht, 1892
Euchaeta Philippi, 1843

Heterorhabdidae Sars, 1902
Heterorhabdus Giesbrecht, 1898 (PN 1863)

Lucicutiidae Sars, 1902
Lucicutia Giesbrecht, 1898 (PN 1863)

Mecynoceridae Andronov, 1973
Mecynocera I. C. Thompson, 1888

Megacalanidae Sewell, 1947
Megacalanus Wolfenden, 1904

Mesaiokeratidae Matthews, 1961
Mesaiokeras Matthews, 1961

Metridiidae Sars, 1902
Metridia Boeck, 1865

Paracalanidae Giesbrecht, 1892
Paracalanus Boeck, 1865

Parapontellidae Giesbrecht, 1892
Parapontella Brady, 1878

Table 1.—Continued.

*Subclass Copepoda Milne Edwards, 1830

Phaennidae Sars, 1902
Phaenna Claus, 1863

Phyllopodidae Brodsky, 1950
Phyllopus Brady, 1883

Pontellidae Dana, 1853
Pontella Dana, 1846 (PN 1828)

Pseudocyclopidae Giesbrecht, 1893
Pseudocyclops Brady, 1872

Pseudocyclopiidae Sars, 1902
Pseudocyclopia T. Scott, 1892

Pseudodiaptomidae Sars, 1902
Pseudodiaptomus Herrick, 1884

Ridgewayiidae M. S. Wilson, 1958
Ridgewayia I. C. Thompson & A. Scott, 1903

Ryocalanidae Andronov, 1974
Ryocalanus Tanaka, 1956

Scolecithricidae Giesbrecht, 1892
Scolecithrix Brady, 1883

Spinocalanidae Vervoort, 1951
Spinocalanus Giesbrecht, 1888

Stephidae Sars, 1902
Stephos T. Scott, 1892

Sulcanidae Nicholls, 1945
Sulcanus Nicholls, 1945

Temoridae Giesbrecht, 1892
Temora Baird, 1850

Tharybidae Sars, 1902
Tharybis Sars, 1902

Tortanidae Sars, 1902
Tortanus Giesbrecht, 1898 (PN 1883)

Order Harpacticoida Sars, 1903

Adenopleurellidae Huys, 1990
Adenopleurella Huys, 1990

Aegisthidae Giesbrecht, 1892
Aegisthus Giesbrecht, 1891

Ambunguipedidae Huys, 1990
Ambunguipes Huys, 1990

Ameiridae Monard, 1927
Ameira Boeck, 1865

Ancorabolidae Sars, 1909
Ancorabolutus Norman, 1903

Balaenophilidae Sars, 1910
Balaenophilus P. O. Aurivillius, 1879

Cancrincolidae Fiers, 1990
Cancrincola C. B. Wilson, 1913

Canthocamptidae Sars, 1906
Canthocamptus Westwood, 1836

Canuellidae Lang, 1948
Canuella T. & A. Scott, 1893

Cerviniidae Sars, 1903
Cervinia Brady, 1878

Chappuisiidae Chappuis, 1940
Chappuisius Kiefer, 1938

Cletodidae T. Scott, 1904
Cletodes Brady, 1872

Table 1.—Continued.

*Subclass Copepoda Milne Edwards, 1830
Cristacoxidae Huys, 1990
<i>Cristacoxa</i> Huys, 1990
Cylindropsyllidae Sars, 1909
<i>Cylindropsyllus</i> Brady, 1880
Darcythompsoniidae Lang, 1936
<i>Darcythompsonia</i> T. Scott, 1906
Diosaccidae Sars, 1906
<i>Diosaccus</i> Boeck, 1872
Ectinosomatidae Sars, 1903
<i>Ectinosoma</i> Boeck, 1865
Hamondiidae Huys, 1990
<i>Hamondia</i> Huys, 1990
Harpacticidae Dana, 1846
<i>Harpacticus</i> Milne Edwards, 1840
Laophontidae T. Scott, 1904
<i>Laophonte</i> Philippi, 1840
Latremidae Bozic, 1969
<i>Latremus</i> Bozic, 1969
Longipediidae Sars, 1903
<i>Longipedia</i> Claus, 1863
Louriniidae Monard, 1927
<i>Lourinia</i> C. B. Wilson, 1924 (PN 1866)
Metidae Sars, 1910
<i>Metis</i> Philippi, 1843
Miraciidae Dana, 1846
<i>Miracia</i> Dana, 1846
Neobradyyidae Olofsson, 1917
<i>Neobradya</i> T. Scott, 1892
Paramesochridae Lang, 1948
<i>Paramesochra</i> T. Scott, 1892
Parastenheliidae Lang, 1936
<i>Parastenhelia</i> I. C. Thompson & A. Scott, 1903
Parastenocaridae Chappuis, 1933
<i>Parastenocaris</i> Kessler, 1913
Peltidiidae Sars, 1904
<i>Peltidium</i> Philippi, 1839
Phyllognathopodidae Gurney, 1932
<i>Phyllognathopus</i> Mrazek, 1893
Porcellidiidae Sars, 1904
<i>Porcellidium</i> Claus, 1860 (PN 1840)
Pseudopeltidiidae Poppe, 1891
<i>Clytemnestra</i> Dana, 1848
Tachidiidae Sars, 1909
<i>Tachidius</i> Lilljeborg, 1853
Tegastidae Sars, 1904
<i>Tegastes</i> Norman, 1903
Tetragonicepsidae Lang, 1944
<i>Tetragoniceps</i> Brady, 1880
Thalestridae Sars, 1905
<i>Thalestris</i> Claus, 1863
Tisbidae Stebbing, 1910
<i>Tisbe</i> Lilljeborg, 1853
Order Cyclopoida Burmeister, 1835
Archinotodelphyidae Lang, 1949
<i>Archinotodelphys</i> Lang, 1949

Table 1.—Continued.

*Subclass Copepoda Milne Edwards, 1830
Ascidicolidae Thorell, 1859
<i>Ascidicola</i> Thorell, 1859
Botryllophillidae Sars, 1921
<i>Botryllophilus</i> Hesse, 1864
Buproridae Thorell, 1859
<i>Buprorus</i> Thorell, 1859
Cyclopidae Dana, 1853
<i>Cyclops</i> Muller, 1776
Cyclopinidae Sars, 1913
<i>Cyclopina</i> Claus, 1863
Doropygidae Brady, 1878
<i>Doropygus</i> Thorell, 1859
Enterocolidae Sars, 1921
<i>Enterocola</i> van Beneden, 1860
*Enteropsidae C. W. S. Aurivillius, 1885
<i>Enteropsis</i> C. W. S. Aurivillius, 1885
*Lernaeidae C. B. Wilson, 1917
<i>Lernaea</i> Linnaeus, 1758
*Mantridae Leigh-Sharpe, 1934
<i>Mantra</i> Leigh-Sharpe, 1934
Notodelphyidae Dana, 1853
<i>Notodelphys</i> Allman, 1847
Oithonidae Dana, 1853
<i>Oithona</i> Baird, 1843
Ozmanidae Ho & Thatcher, 1989
<i>Ozmana</i> Ho & Thatcher, 1989
*Phyllodicolidae Delamare-Deboutteville & Laubier, 1960
<i>Phyllodicola</i> Delamare-Deboutteville & Laubier, 1960
*Schizoproctidae C. W. S. Aurivillius, 1885
<i>Schizoproctus</i> C. W. S. Aurivillius, 1885
Speleoithonidae da Rocha & Iliffe, 1991
<i>Speleoithona</i> da Rocha & Iliffe, 1991
Order Poecilostomatoida Thorell, 1859
*Amazonicopeidae Thatcher, 1986
<i>Amazonicopeus</i> Thatcher, 1986
Anchimolgidae Humes & Boxshall, 1996
<i>Anchimoligus</i> Humes & Stock, 1972
Anomoclausidae Gotto, 1964
<i>Anomoclausia</i> Gotto, 1964
Anomopsyllidae Sars, 1921
<i>Anomopsyllus</i> Sars, 1921
*Antheacheridae M. Sars, 1870
<i>Antheacheres</i> M. Sars, 1857
*Anthessiidae Humes, 1986
<i>Anthessius</i> Della Valle, 1880
*Bomolochidae Claus, 1875
<i>Bomolochus</i> von Nordmann, 1832
Catiniidae Bocquet & Stock, 1957
<i>Catinia</i> Bocquet & Stock, 1957
Chondracanthidae Milne Edwards, 1840
<i>Chondracanthus</i> Delaroche, 1811
Clausidiidae Embleton, 1901
<i>Clausidium</i> Kossmann, 1874

Table 1.—Continued.

*Subclass Copepoda Milne Edwards, 1830
Clausiidae Giesbrecht, 1895 <i>Clausia</i> Claparede, 1863
Corallovexiidae Stock, 1975 <i>Corallovexia</i> Stock, 1975
Corycaeidae Dana, 1852 <i>Corycaeus</i> Dana, 1845
Cucumariolidae Bouligand & Delamare-Deboutteville, 1959 <i>Cucumariola</i> Peterson, 1958
Echiuophilidae Delamare-Deboutteville & Nunes-Ruivo, 1955 <i>Echiuophilus</i> Delamare-Deboutteville & Nunes-Ruivo, 1955
*Entobiiidae Ho, 1984 <i>Entobius</i> Dogiel, 1908
*Erebonasteridae Humes, 1987 <i>Erebonaster</i> Humes, 1987
*Ergasilidae Burmeister, 1835 <i>Ergasilus</i> von Nordmann, 1832
Eunicicolidae Sars, 1918 <i>Eunicicola</i> Kurz, 1877
Gastrodelphyidae List, 1889 <i>Gastrodelphys</i> Graeffe, 1883
*Herpyllobiidae Hansen, 1892 <i>Herpyllobius</i> Steenstrup & Lutken, 1861
Intramolgidae Marchenkov & Boxshall, 1995 <i>Intramoligus</i> Marchenkov & Boxshall, 1995
Kelleriidae Humes & Boxshall, 1996 <i>Kelleria</i> Gurney, 1927
Lichomolgidae Kossmann, 1877 <i>Lichomoligus</i> Thorell, 1859
Macrochironomidae Humes & Boxshall, 1996 <i>Macrochiron</i> Brady, 1872
*Mesoglicolidae de Zulueta, 1911 <i>Mesoglicola</i> Quidor, 1906
Myicolidae Yamaguti, 1936 <i>Myicola</i> Wright, 1885
Mytilicolidae Bocquet & Stock, 1957 <i>Mytilicola</i> Steuer, 1902
Nereicolidae Claus, 1875 <i>Nereicola</i> Keferstein, 1863
Nucellicolidae Lamb, Boxshall, Mill, & Grahame, 1996 <i>Nucellicola</i> Lamb, Boxshall, Mill, & Grahame, 1996
Octopicolidae Humes & Boxshall, 1996 <i>Octopicola</i> Humes, 1957
Oncaeidae Giesbrecht, 1892 <i>Oncaea</i> Philippi, 1843
*Paralubbockiidae Boxshall & Huys, 1990 <i>Paralubbockia</i> Boxshall, 1977
Pharodidae Illg, 1948 <i>Pharodes</i> C. B. Wilson, 1935
*Philichthyidae Vogt, 1877 <i>Philichthys</i> Steenstrup, 1862

Table 1.—Continued.

*Subclass Copepoda Milne Edwards, 1830
Philoblennidae Izawa, 1976 <i>Philoblenna</i> Izawa, 1976
Pseudanthessiidae Humes & Stock, 1972 <i>Pseudanthessius</i> Claus, 1889
*Rhynchomolgidae Humes & Stock, 1972 <i>Rhynchomoligus</i> Humes & Ho, 1967
Sabelliphiidae Gurney, 1927 <i>Sabelliphius</i> M. Sars, 1862
Sapphirinidae Thorell, 1859 <i>Sapphirina</i> J. V. Thompson, 1829
Serpulidicolidae Stock, 1979 <i>Serpulidicola</i> Southward, 1964
Shiinoidae Cressey, 1975 <i>Shiinoa</i> Kabata, 1968
*Spiophanicolidae Ho, 1984 <i>Spiophanicola</i> Ho, 1984
Splanchnotrophidae Norman & T. Scott, 1906 <i>Splanchnotrophus</i> Hancock & Norman, 1863
Synapticolidae Humes & Boxshall, 1996 <i>Synapticola</i> Voigt, 1892
Synaptiphiidae Bocquet & Stock, 1957 <i>Synaptiphius</i> Canu & Cuenot, 1892
Taeniacanthidae C. B. Wilson, 1911 <i>Taeniacanthus</i> Sumpf, 1871
*Tegobomolochidae Avdeev, 1978 <i>Tegobomolochus</i> Izawa, 1976
Telsidae Ho, 1967 <i>Telson</i> Pearse, 1952
Thamnomolgidae Humes & Boxshall, 1996 <i>Thamnomoligus</i> Humes, 1969
Tuccidae Vervoort, 1962 <i>Tucca</i> Krøyer, 1837
Urocopiidae Humes & Stock, 1972 <i>Urocopia</i> Sars, 1917
Vahiniidae Humes, 1967 <i>Vahinius</i> Humes, 1967
*Vaigamidae Thatcher & Robertson, 1984 <i>Vaigamus</i> Thatcher & Robertson, 1984
Xarifidae Humes, 1960 <i>Xarifia</i> Humes, 1960
Order Siphonostomatoida Thorell, 1859
Artotrogidae Brady, 1880 <i>Artotrogus</i> Boeck, 1859
Ascomyzontidae Thorell, 1859 <i>Ascomyzon</i> Thorell, 1859
Asterocheridae Giesbrecht, 1899 <i>Asterocheres</i> Boeck, 1859
Brychiopontiidae Humes, 1974 <i>Brychiopontius</i> Humes, 1974
Caligidae Burmeister, 1835 <i>Caligus</i> Muller, 1785
*Calverocheidae Stock, 1968 <i>Calverocheus</i> C. B. Wilson, 1932 (PN 1902)
Cancerillidae Giesbrecht, 1897 <i>Cancerilla</i> Dalyell, 1851

Table 1.—Continued.

*Subclass Copepoda Milne Edwards, 1830
Catlaphilidae Tripathi, 1960
<i>Catlaphila</i> Tripathi, 1960
Cecropidae Dana, 1852
<i>Cecrops</i> Leach, 1816
Choniostomatidae Hansen, 1887
<i>Choniostoma</i> Hansen, 1887
Chordeumiidae Boxshall, 1988
<i>Chordeumium</i> Stephensen, 1918
Coralliomyzontidae Humes & Stock, 1991
<i>Coralliomyzon</i> Humes & Stock, 1991
*Dichelesthidae Milne Edwards, 1840
<i>Dichelesthium</i> Hermann, 1804
Dinopontiidae Murnane, 1967
<i>Dinopontius</i> Stock, 1960
Dirivultidae Humes & Dojiri, 1980
<i>Dirivultus</i> Humes & Dojiri, 1980
Dissonidae Yamaguti, 1963
<i>Dissonus</i> C. B. Wilson, 1906
Dyspontiidae Giesbrecht, 1895
<i>Dyspontius</i> Thorell, 1859
Ecbathyriontidae Humes, 1987
<i>Ecbathyrion</i> Humes, 1987
Entomolepidae Brady, 1899
<i>Entomolepis</i> Brady, 1899
*Eudactylinidae C. B. Wilson, 1932
<i>Eudactylina</i> van Beneden, 1853
Euryphoridae C. B. Wilson, 1905
<i>Euryphorus</i> Milne Edwards, 1840
Hatschekiidae Kabata, 1979
<i>Hatschekia</i> Poche, 1902
Hyponeoidae Heegaard, 1962
<i>Hyponeo</i> Heegaard, 1962
Kroyeriidae Kabata, 1979
<i>Kroyeria</i> van Beneden, 1853
*Lamippidae Joliet, 1882
<i>Lamippe</i> Bruzelius, 1858
Lernaeoceridae Gurney, 1933
<i>Lernaeocera</i> de Blainville, 1822
*Lernaeopodidae Milne Edwards, 1840
<i>Lernaeopoda</i> de Blainville, 1822
Lernanthropidae Kabata, 1979
<i>Lernanthropus</i> de Blainville, 1822
Megapontiidae Heptner, 1968
<i>Megapontius</i> Hulsemann, 1965
Micropontiidae Gooding, 1957
<i>Micropontius</i> Gooding, 1957
Myzopontiidae Sars, 1915
<i>Myzopontius</i> Giesbrecht, 1895
Nanaspidae Humes & Cressey, 1959
<i>Nanaspis</i> Humes & Cressey, 1959
Naobranchiidae Yamaguti, 1939
<i>Naobranchia</i> Hesse, 1863
Nicothoidae Dana, 1852
<i>Nicothoe</i> Audouin & Milne Edwards, 1826

Table 1.—Continued.

*Subclass Copepoda Milne Edwards, 1830
Pandaridae Milne Edwards, 1840
<i>Pandarus</i> Leach, 1816
Pennellidae Burmeister, 1835
<i>Pennella</i> Oken, 1816
Pontoeciellidae Giesbrecht, 1895
<i>Pontoeciella</i> Giesbrecht, 1895
Pseudocycnidae C. B. Wilson, 1922
<i>Pseudocycnus</i> Heller, 1865
Rataniidae Giesbrecht, 1897
<i>Ratania</i> Giesbrecht, 1892
Saccopsidae Lutzen, 1964
<i>Saccopsis</i> Levinsen, 1878
*Sphyrriidae C. B. Wilson, 1919
<i>Sphyrion</i> Cuvier, 1830
Spongiocnizontidae Stock & Kleeton, 1964
<i>Spongiocnizon</i> Stock & Kleeton, 1964
Stellicomitidae Humes & Cressey, 1958
<i>Stellicomes</i> Humes & Cressey, 1958
Tanylepidae Kabata, 1969
<i>Tanylepurus</i> Steenstrup & Lutken, 1861
*Trebiidae C. B. Wilson, 1905
<i>Trebius</i> Krøyer, 1838
Ventriculinidae Leigh-Sharpe, 1934
<i>Ventriculina</i> Bassett-Smith, 1903
Xenocoelomatidae Bresciani & Lutzen, 1966
<i>Xenocoeloma</i> Caullery & Mesnil, 1915
Order Monstrilloida Sars, 1903
*Monstrillidae Dana, 1849
<i>Monstrilla</i> Dana, 1849
*Order Misophrioida Gurney, 1927
Misophriidae Brady, 1878
<i>Misophria</i> Boeck, 1865
Order Mormonilloida Boxshall, 1979
Mormonillidae Giesbrecht, 1892
<i>Mormonilla</i> Giesbrecht, 1891
*Order Platycopioidea Fosshagen, 1985
Platycopiidae Sars, 1911
<i>Platycopia</i> Sars, 1911
*Order Gelyelloida Huys, 1988
Gelyellidae Rouch & Lescher-Moutoue, 1977
<i>Gelyella</i> Rouch & Lescher-Moutoue, 1977
Order uncertain
Chitonophilidae Avdeev & Sirenko, 1991
<i>Chitonophilus</i> Avdeev & Sirenko, 1991
Sponginticolidae Topsent, 1928
<i>Sponginticola</i> Topsent, 1928
Staurosomatidae de Zulueta, 1911
<i>Staurosoma</i> Will, 1844

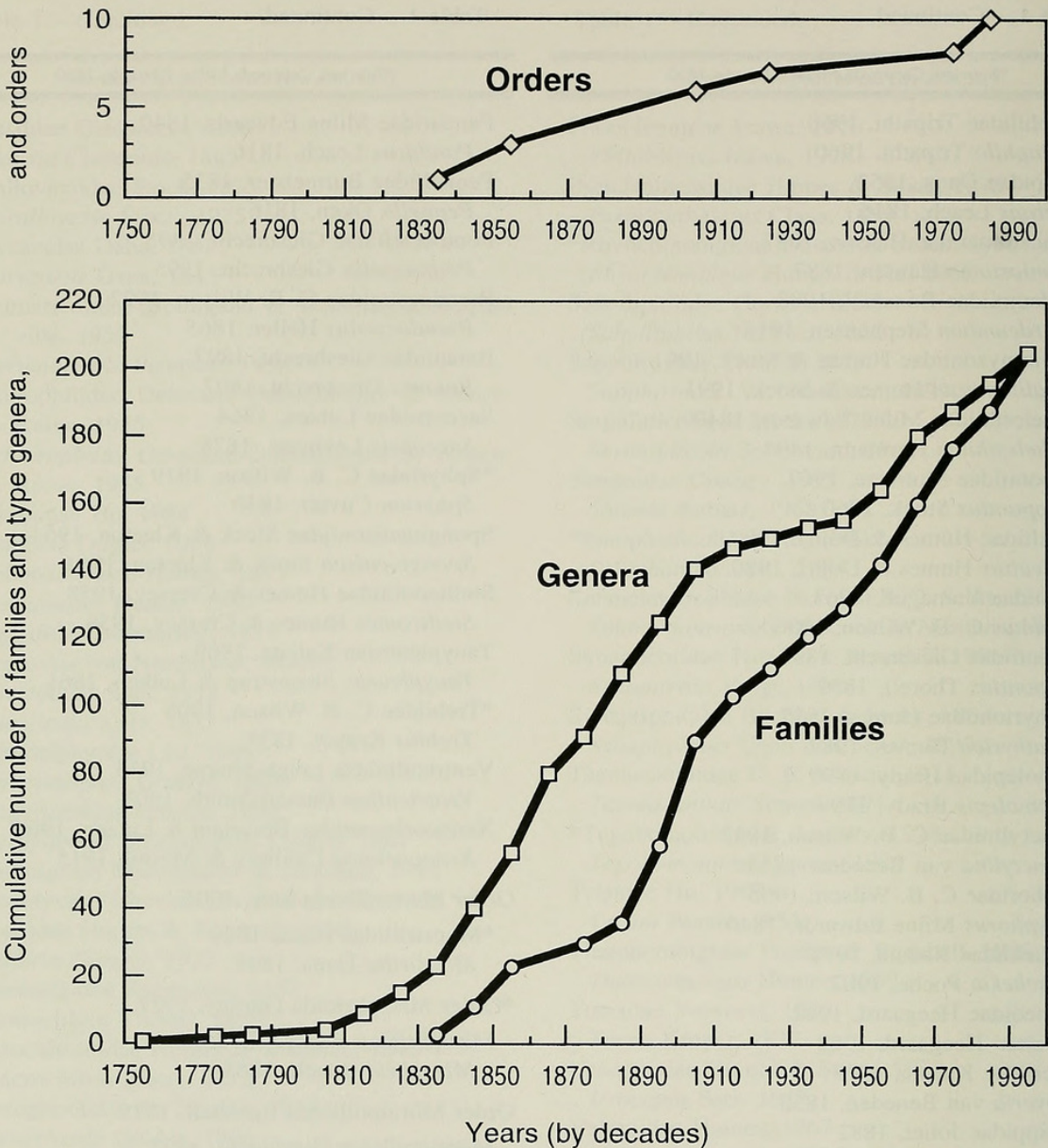


Fig. 1. Cumulative number of defined families, type genera, and orders of copepods, by decade, from 1750 to 1996.

mean that there were no other order-level taxa at that time, but that the other analogous groups have fallen out of favor in the meantime.

This prompted a similar approach toward the families: were they indicative of newly discovered family-level Copepoda, or were they mostly the result of deliberative comparison of accumulating genus descriptions? This was not so easily answered; a foray into the literature spread across the whole of Copepoda to determine the type-genus (and date) for each family was not trivial. This is

also a dynamic process, and undoubtedly alterations and additions are now occurring. In fact, seven families were described in 1996 after the first draft was completed. As with Bowman & Abele, I do not provide references for the indicated authors; this would be beyond the intention of the survey. Some type genera are dated from the time a new name was proposed to replace a preoccupied name; in these cases I have used the older date for the calculations, since the discovery was based on the earlier date; these extended dates are indicated in Table 1.

A third relationship (Fig. 1) shows the time-dependency of the descriptions of what became type-genera for families. The indication, when comparing the family and type-genus curves, is that copepodologists are in general a conservative company. Over the preceding 160 yr, 54 families (26%) were proposed at the time that the type genus was described. (These "instant" families arose between 1846 and 1996, with the median year of 1963; that is, the phenomenon is skewed to recent years, as one might expect given the accumulated background of defined families.) Another way to look at this is that most of the fundamental (family) copepod types were discovered long before they were recognized as such. Overall, the average delay time was 31 yr, with a range of 0 to 159 yr. Excluding the families that were defined at the time the type genus was described, the average delay time for family definition was 42 yr. If the type species, rather than the type genus, is considered, the dates would be set back even farther in some cases, although probably not significantly so.

Note that 10 genera would define the present 10 orders, just as the 205 type genera basically define the 205 families. All the many other genera are superfluous, except, of course, that they define the *limits* of higher taxa already defined in their essentials.

Can we use the curves to make predictions? The type-genus curve cannot be predictive, mainly because it does not exist until families are defined; a predictive genus curve would have to include the many more genera besides type genera. The genus curve should not be compared within decades to the family curve; the only comparison should be horizontal, reflecting the time lags. Since families must await the discovery of their type genera, there will always, in general, be a lag time. Recently discovered genera that become type genera force the two curves to converge, since there is obviously not much time available for a newly discovered genus to have be-

come the type of a new family. Future association of the two curves depends on whether families are made from recently described genera (the curves will remain together) or from older genera (the curves will again separate). The availability of large numbers of well-defined families potentially makes it easier to discern new families with the discovery of new genera or with reconsideration of older genera. Clearly, a trend to be avoided would be the creation of a new family from each genus, thereby defeating the notion of a classification hierarchy.

There is no trend suggesting that families might not be defined at the previous rate, or that we are running out of new families. Of course, as new habitats are explored, such as caves and deep-ocean thermal vents, new genera representing new families would be expected. Given the present dynamics of copepod taxonomy, predictions may require a few more decades of observation.

Even without the discovery of absolutely new types, taxa above genera will be added as more details, especially of developmental biology, are added to the framework in place and more comparisons are made. Copepod taxonomy has long been vexed by many imperfectly described species, and a re-working of these will add some surprises. Also, there are some copepod families that cannot now be placed into the defined orders; there are also many genera that are not yet assigned to families. These may be raw material for additional higher taxa, or the discovery of intermediate species may link them to established groups. There is a wealth of material to contemplate, with future intensive rearranging. However, eventually there will be no more orders and no more families to discover.

For those who are depressed by this prospect, and fear coming idleness, there is an infinitude of related research to be done. I offer the insight of Herman Melville (1851): "Dissect him how I may, then, I but

go skin deep; I know him not, and never will."—Moby Dick, Chapter 86.

Literature Cited

- Bowman, T. E., & L. G. Abele. 1982. Classification of the recent Crustacea. Pp. 1–27 in D. E. Bliss, ed., *The biology of Crustacea*. Academic Press, New York 1:1–319.
- Fosshagen, A., & T. M. Iliffe. 1985. Two new genera of Calanoida and a new order of Copepoda, Platycopeioida, from marine caves on Bermuda.—*Sarsia* 70:345–358.
- , & ———. 1989. *Boholina*, a new genus (Copepoda: Calanoida) with two new species from an anchialine cave in the Philippines.—*Sarsia* 74:201–208.
- Grygier, M. J. 1994. Identity of *Thaumatoessa* (= *Thaumaleus*) *typicus* Krøyer, the first described monstrilloid copepod.—*Sarsia* 78:235–242.
- Ho, J.-S. 1990. Phylogenetic analysis of copepod orders.—*Journal of Crustacean Biology* 10(3): 528–536.
- . 1991. Phylogeny of Poecilostomatoida: a major order of symbiotic copepods. In *Proceedings of the Fourth International Conference on Copepoda*.—*Bulletin of the Plankton Society of Japan*, Special Volume:25–48.
- Huys, R. 1988. Gelyelloida, a new order of stygobiont copepods from European karstic systems.—*Hydrobiologia* 167/168:485–495.
- Kim, I.-H. 1991. A new species of *Namakosiramia* Ho & Perkins parasitic on holothurians from Korea (Copepoda: Harpacticoida). In *Proceedings of the Fourth International Conference on Copepoda*.—*Bulletin of the Plankton Society of Japan*, Special Volume:429–435.



Damkaer, David M. 1996. "Copepod taxonomy: Discovery vs recognition." *Proceedings of the Biological Society of Washington* 109, 687–694.

View This Item Online: <https://www.biodiversitylibrary.org/item/107744>

Permalink: <https://www.biodiversitylibrary.org/partpdf/46311>

Holding Institution

Smithsonian Libraries and Archives

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder.

Rights Holder: Biological Society of Washington

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.