

An annotated checklist of New Zealand mayflies (Ephemeroptera), 2018

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Abstract

The New Zealand mayfly (Ephemeroptera) fauna currently comprises 55 described species belonging to 20 genera in eight families. All species and genera are endemic to New Zealand, as are three families. The purpose of this paper is to draw together the fragmented information of published literature in the form of a checklist of New Zealand Ephemeroptera. The checklist is annotated with species authority and publication details, type specimen information (sex, life stage, type locality, collector, specimen repository), distribution and conservation status data, and previously recognised names, including synonyms. References to all valid species descriptions and previously recognised names are included in the bibliography.

Keywords: New Zealand, mayflies, Ephemeroptera, type localities, type specimens, species distributions, conservation status

Introduction

The mayflies (Ephemeroptera) are an ancient insect lineage dating back over 300 million years and are believed to be the most primitive group of extant winged insects (Grimaldi & Engel 2005; Bauernfeind & Soldán 2012). They are represented on all continents except Antarctica, but have strong distributional affinities to specific biogeographical regions (Gressitt 1967; Barber-James et al. 2008). Only three families have global distributions, the remaining 39 being fairly evenly distributed between the northern and southern hemispheres.

Globally, about 3,600 mayfly species have been described (Barber-James et al. 2013; M. Sartori and H. Barber-James pers. comm., May 2018; P. Suter pers. comm., May 2018), making the Ephemeroptera one of the smaller orders of insects.

The New Zealand mayfly fauna comprises 55 described species in 20 endemic genera and eight families, three of which are also endemic to New Zealand (Ichthybotidae, Rallidentidae, Siphlaenigmatidae). They have close phylogenetic relationships with the cold-adapted mayflies of southern South America and Australia, land masses which like New Zealand, were parts

of the ancient continent of Gondwana (Edmunds 1975; Tsui & Peters 1975; Gibbs 2016). The first mayflies described from New Zealand were *Coloburiscus humeralis* (Walker, 1853) (as *Palingenia humeralis*) and *Neozephlebia scita* (Walker, 1853) (as *Baetis scita*). In the following 50 years, nine valid species were described by Eaton (1871, 1883–1888, 1899) and McLachlan (1873, 1894). Eaton (1899) also provided the first annotated checklist of New Zealand Ephemeroptera (as Ephemeridae), which included 11 species. Subsequently, Hudson (1904) published a popular account of the biology of New Zealand aquatic insects that also included one new mayfly species, and Tillyard (1923) added two more. Phillips (1930) made a comprehensive revision of the New Zealand mayfly fauna, including descriptions of eight new species, but in the following 50 years only four more species were described (Lestage 1935; Penniket 1962, 1966; Peters 1971).

Checklists of the aquatic and water-associated insects of New Zealand, which included mayflies, were published by Wise (1965, 1973) who also produced a synonymic checklist of the smaller hexapod orders that listed 27 mayfly species (Wise 1977). Included amongst a large series of papers on the New Zealand Leptophlebiidae, Towns and Peters (1979a, b) and Towns (1983b) described eight species in seven genera, and eight further species were included in their subsequent monograph (Towns & Peters 1996), which elevated the total number of New Zealand mayflies to 42. More recently, a revision of the Nesameletidae by Hitchings and Staniczek (2003) added three species of *Nesameletus*. Eight species of *Deleatidium* (Hitchings 2008, 2009, 2010; Hitchings & Hitchings 2016) and a species of *Rallidens* (Staniczek & Hitchings 2014) have also been described by

these authors. A new genus and species of Leptophlebiidae, *Aupouriella pohei*, was also described by Winterbourn (2009). Other valuable New Zealand mayfly contributions include the distribution maps of specimens held in the Canterbury Museum (Hitchings 2001; Hitchings et al. 2015) and a chapter in Volume 2 of ‘*The New Zealand Inventory of Biodiversity*’ (Gordon 2010), which provides an excellent summary of the New Zealand mayfly fauna and includes a list of 48 species.

The purpose of this paper is to draw together fragmented information from the published literature in the form of a checklist of New Zealand Ephemeroptera. The checklist is annotated with species authority and publication details, type specimen information (sex, life stage, type locality, collector, specimen repository), distribution and conservation status data, and previously recognised names, including synonyms. References to all valid species descriptions, and to previously recognised names, are included in the bibliography.

Format of the checklist

The higher classification (suborder and family) of the New Zealand Ephemeroptera used in this paper is based on “McCafferty’s system” presented in Ogden and Whiting (2005, see Figure 2B). However, it is acknowledged that the status of the suborders Pisciforma and Setisura are in question (Ogden et al. 2009) and may be subject to change. The higher classification is presented first, followed by an annotated checklist of genera and species in each family. Binomial names are listed in alphabetical order by family, genus and, when recognised, subgenus. These are annotated with species authority and publication page number, and with type

specimen information if known (sex, life stage, type locality, collector, specimen repository). Specimen data are followed by recognised species distributions and conservation status classifications. Distributions are indicated by the two letter locality codes of Crosby et al. (1998) (Figure 1) and North, South, and Offshore Island localities are separated by two solidus symbols (*//*). Conservation status classifications are sourced directly from the most recent listings for New Zealand freshwater invertebrates (Grainger et al. 2014). Finally, other names by which valid species have been known are given, and it is stated whether these names were by original designation (*orig.*), synonyms (*syn.*) or the result of recombination (*comb.*). Further, notes are also given to indicate that a name was published without a description of the taxon (*undesc.*), was misspelt (*spell.*), or was the result of misidentification (*misid.*). Reference details are provided for each entry.

Documentation of species in the above format enables one to search for any published name, including synonyms, and it provides easy access to relevant publication information including page number, type data, known distributions and conservation status. Distribution data provided for each species are based on records in the literature, records from official New Zealand databases (National Rivers Water Quality Network) and collections (New Zealand Arthropod Collection, Museum of New Zealand, Canterbury Museum, Otago Museum), and data from a nation-wide New

Zealand mayfly field survey of adults and nymphs, undertaken by the author during 2013–2016. The combined dataset from all sources currently comprises 73,459 records and forms the basis of an inaugural national mayfly database presently under construction by the author. However, it is by no means exhaustive, as material exists in several national collections that are yet to be assessed, i.e., part of the New Zealand Arthropod Collection, the Auckland Museum Collection and the NIWA Collection.

Status of type material in Canterbury Museum, Museum of New Zealand and New Zealand Arthropod Collection were confirmed by their respective collection curators. However, at the time of publication no response had been received from The Natural History Museum, London, regarding type material held there. In addition, the type repository of *Coloburiscus tonnoiri* Lestage, 1935 is currently unknown but “may be in a museum in Brussels” (Terry Hitchings, Canterbury Museum Research Fellow, pers. comm., 11 April 2018). The following abbreviations are used to indicate repositories of type material listed in the checklist:

BMNH - The Natural History Museum, London, England

CMNZ - Canterbury Museum, Christchurch, New Zealand

NMNZ - Museum of New Zealand/ Te Papa Tongarewa, Wellington, New Zealand

NZAC - New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand

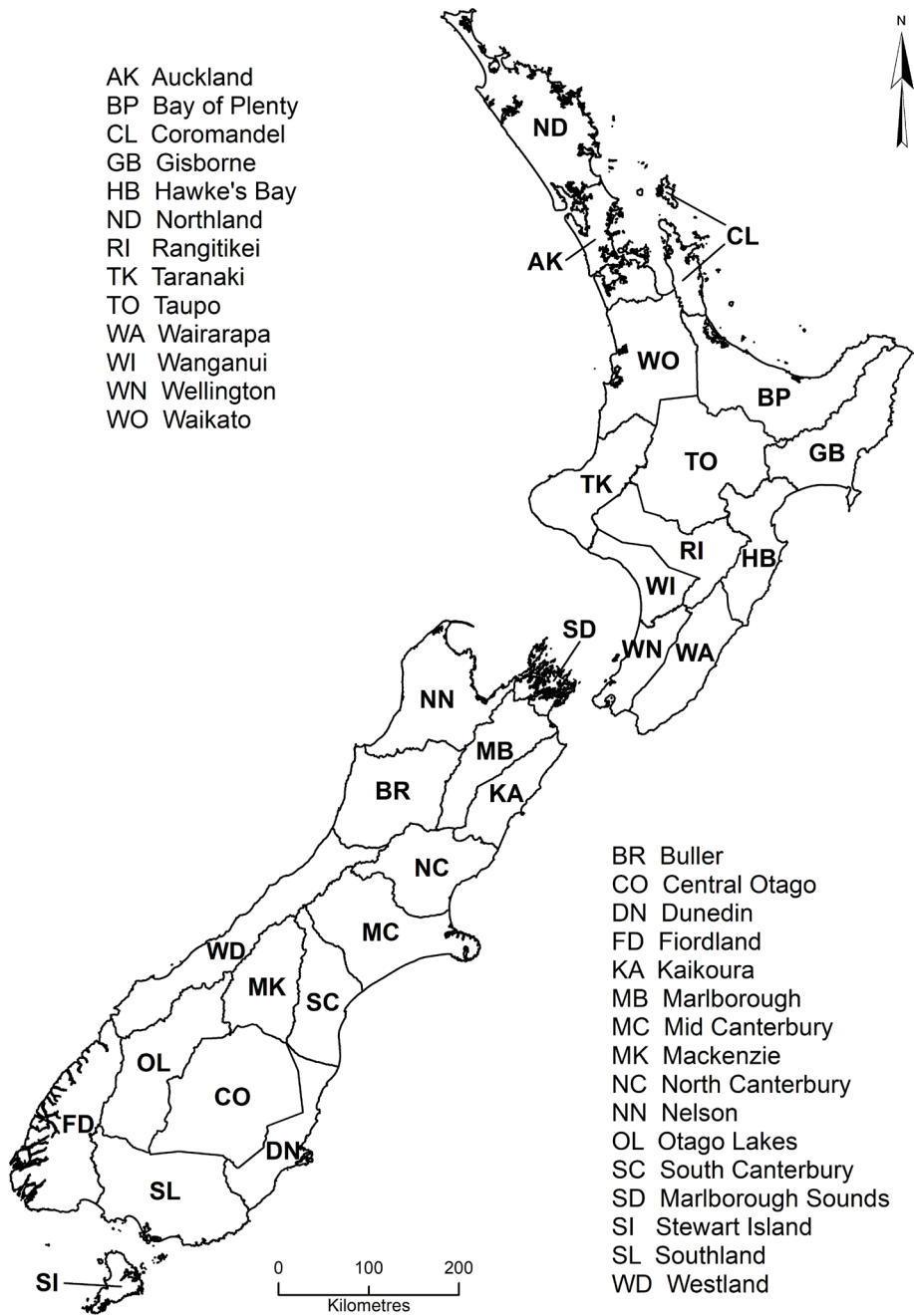


Figure 1. Map of New Zealand with area codes used to describe specimen distribution records. For more details, including offshore island area codes, see Crosby et al. (1998).

Higher classification of New Zealand Ephemeroptera

Class: Insecta

Order: Ephemeroptera Hyatt & Arms, 1890: 69

Suborder: Furcatergalia

Family: Ichthybotidae Demoulin, 1957: 336

Family: Leptophlebiidae Banks, 1900: 246 (as Leptophlebini)

Suborder: Pisciforma

Family: Ameletopsidae Edmunds, 1957: 246 (as Ameletopsinae)

Family: Nesameletidae¹ Kluge et al., 1995: 115

Family: Oniscigastridae Lameere, 1917: 62 (as Oniscigastrina)

Family: Rallidentidae Penniket, 1966: 169 (as Rallidentinae)

Family: Siphlaenigmatidae Penniket, 1962: 394

Suborder: Setisura

Family: Coloburiscidae Edmunds in Edmunds et al., 1963: 11
(as Coloburiscinae)

Species checklist of New Zealand Ephemeroptera

AMELETOPSIDAE

Ameletopsis Phillips, 1930: 324

Ameletopsis perscitus (Eaton, 1899): 291, “♀ imago, No. 26. Wellington (Hudson)”. Holotype: BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, RI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Ephemera*, n.s., near *Coloburus* (undesc.) (Hudson 1892: 105)
- *Ameletus perscitus* (orig.) (Eaton 1899: 291)
- *Ameletopsis perscitus* (spell.) (Mosely 1932: 6)

COLOBURISCIDAE

Coloburiscus Eaton, 1888: 332, 346

Coloburiscus humeralis (Walker, 1853): 552, “♀ imago, New Zealand (Sinclair)”. Holotype: BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, HB, RI, WI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Palingenia humeralis* (orig.) (Walker 1853: 552)
- *Baetis remota* (syn.) (Walker 1853: 564)
- *Coloburus humeralis* (comb.) (Eaton 1868: 89)
- *Coloburus* [= *Coloburiscus*] *humeralis* (comb.) (Eaton 1888: 332)

¹ Also Riek, 1973: 164 (as Nesameletinae)

Coloburiscus tonnoiri Lestage, 1935: 353 (*nomen dubium*), “♂ imago, Nekotupu², New Zealand (Tonnoir)”. Holotype: repository unknown. Distribution: AK // – . Conservation status: Taxonomically Indeterminate & Data Deficient.

ICHTHYBOTIDAE

Ichthybotus Eaton, 1899: 285

Ichthybotus bicolor Tillyard, 1923: 228, “♂ imago, Maitai River, Nelson (Philpott)”. Holotype: Was Cawthron Institute, Nelson, now NZAC. Distribution: – // SD, NN, BR, WD, MB, KA, NC, MC, SC, OL, CO, DN. Conservation status: Not Threatened.

Ichthybotus hudsoni (McLachlan, 1894): 270, “Wellington (Hudson)”. No holotype designated. Lectotype: “♂ imago, Wellington, (Hudson)”, BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, HB, RI, WI, WN, WA // – . Conservation status: Not Threatened.

- *Ephemera hudsoni* (orig.) (McLachlan 1894: 270)

LEPTOPHLEBIIDAE

Acanthophlebia Towns, 1983: 28

Acanthophlebia cruentata (Hudson, 1904): 33, “Wellington”. No holotype designated. Lectotype: “♀ subimago, Campbell’s Stream, Karori, Wellington (Hudson)”, NMNZ. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, HB, RI, WN, WA // – . Conservation status: Not Threatened.

- *Atalophlebia cruentata* (orig.) (Hudson 1904: 33)
- *Zephlebia* (*Zephlebia*) *cruentata* (comb.) (Penniket 1961: 9)

Arachnocolus Towns & Peters, 1979: 444

Arachnocolus phillipsi Towns & Peters, 1979: 446, “♂ imago, Cascade Stream, Auckland (Towns)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TK // – . Conservation status: Not Threatened.

- Gen. nov. sp. A (undesc.) (Towns 1976: 46, Table 17; —1978a: 367, 369; —1978b: 411)

*Atalophlebioides*³ Phillips, 1930: 336

Atalophlebioides cromwelli (Phillips, 1930): 385, “Streams round Wellington”. No holotype designated. Lectotype: “♀ imago, Hutt River, Wellington (inferred as Phillips)”, NMNZ. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, HB, RI, WN // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD. Conservation status: Not Threatened.

- *Deleatidium* (*Atalophlebioides*) *cromwelli* (orig.) (Phillips 1930: 385)

² Likely Nihotupu in the Waitakere Ranges, Auckland (see Craig et al. 2012, page 104).

³ A revision of *Atalophlebioides* was also published by Towns and Peters (1978).

***Aupouriella* Winterbourn, 2009: 424**

Aupouriella pobei Winterbourn, 2009: 428, “♂ imago, Whiriwhiri Stream, North Cape (Pohe)”. Holotype: CMNZ. Distribution: ND // – . Conservation status: Nationally Critical.

***Austroclima* Towns & Peters, 1979: 213**

Austroclima jollyae Towns & Peters, 1979: 220, “♂ imago, Cascade Stream, Auckland (Towns)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO, WN // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Atalophlebioides* sp. B (undesc.) (Towns 1978b: 411; —1979: 257)

Austroclima sepia (Phillips, 1930): 383, “Streams round Wellington”. No holotype designated. Neotype: “♂ imago, Cascade Stream, Auckland (Towns)”, NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, HB, RI, WI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Deleatidium (Atalophlebioides) sepia* (orig.) (Phillips 1930: 383)
- *Atalophlebioides sepia* (comb.) (Peters & Edmunds 1964: 238)

***Austronella* Towns & Peters, 1996: 23**

Austronella planulata (Towns, 1983): 17, “♂ imago, Glow-worm Grotto, Waitomo Caves, Waikato (Pugsley)”. Holotype: NZAC. Distribution: ND, AK, WO, BP, TK, TO, GB, HB, RI, WN, WA // – . Conservation status: Declining.

- *Zephlebia (Zephlebia) planulata* (orig.) (Towns 1983b: 17)

***Cryophlebia* Towns & Peters, 1979: 230**

Cryophlebia aucklandensis (Peters, 1971): 47, “♂ imago, rocky stream, Bivouac Hill, Mt Eden, Auckland Islands (Gressitt)”. Holotype: NZAC. Distribution: AI. Conservation status: Naturally Uncommon.

- *Atalophlebioides aucklandensis* (orig.) (Peters 1971: 47)

***Deleatidium* Eaton, 1899: 288**

Deleatidium (Deleatidium) acerbum Hitchings & Hitchings, 2016: 55, “♂ imago, Camp Creek, Westland (Hitchings & Hitchings)”. Holotype: CMNZ. Distribution: – // NN, BR, WD. Conservation status: Not yet assessed.

Deleatidium (Deleatidium) angustum Towns & Peters, 1996: 33, “♂ imago, Cascade Stream, Auckland (Towns)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, HB, RI, WN, WA. Also unverified reports from SD, NN, WD, KA, MC, SC, CO, SL. Conservation status: Not Threatened.

- *Deleatidium myzobranchia* (misid.) (Towns 1979: 255–256)
- *Deleatidium nr myzobranchia* (undesc.) (Towns 1981: 193–194, 197)
- *Deleatidium* sp. A (undesc.) (Towns 1983b: 41–47; —1985: 233; —1987: 353–356)

Deleatidium (Deleatidium) atricolor Hitchings, 2009: 40, “♂ imago, Edwards River, St James Range (Hitchings)”. Holotype: CMNZ. Distribution: – // BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, SL, FD. Conservation status: Not Threatened.

Deleatidium (Deleatidium) autumnale Phillips, 1930: 371, “R. Waikanae and R. Hutt, Wellington district”. No holotype designated. Lectotype: “♂ imago, Hutt River, Wellington (Phillips)”, CMNZ. Distribution: ND, WO, BP, TK, TO, GB, HB, RI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD. Conservation status: Not Threatened.

- *Deleatidium autumnale* (orig.) (Phillips 1930: 371)

Deleatidium (Deleatidium) branchiola Hitchings, 2009: 45, “♂ imago, Mataura River tributary, Hector Mts (Hitchings)”. Holotype: CMNZ. Distribution: – // OL, CO. Conservation status: Naturally Uncommon.

Deleatidium (Deleatidium) cerinum Phillips, 1930: 382, “R. Hutt, Wellington district”. No holotype designated. Lectotype: “♂ imago, Hutt River, Wellington (Phillips)”, CMNZ. Distribution: ND, AK, WO, BP, TK, TO, GB, RI, WN, WA // SD, NN, BR, WD, MB, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Deleatidium cerinum* (orig.) (Phillips 1930: 382)

Deleatidium (Deleatidium) fumosum Phillips, 1930: 372, “Streams round Wellington”. No holotype designated. Neotype: “♂ imago, Hutt River at Kaitoke, Wellington (Towns)”, NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, RI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Deleatidium fumosum* (orig.) (Phillips 1930: 372)
- *Deleatidium* sp. C (undesc.) (Towns 1979: 257; —1981: 194; —1983a: 40–47; —1985: 233; —1987: 353)

Deleatidium (Deleatidium) kawatiri Hitchings & Hitchings, 2016: 61, “♂ imago, Little Ten Mile Creek, Buller (Hitchings)”. Holotype: CMNZ. Distribution: – // NN, BR. Conservation status: Not yet assessed.

Deleatidium (Deleatidium) kiwa Hitchings, 2010: 33, “♂ imago, Borland Burn, South Branch tributary, Fiordland (Ward & Ward)”. Holotype: CMNZ. Distribution: – // SL, FD. Also unverified report from SI. Conservation status: Naturally Uncommon.

Deleatidium (Deleatidium) lillii Eaton, 1899: 289, “Dunedin (Lillie) and Wellington (Hudson, No. 46)”. Holotype missing. Lectotype: “♂ imago, No. 46. Wellington (Hudson)”, BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, RI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Atalophrisia scita* (misid. & incorrectly attributed to Walker) (Lillie 1898: 167)
- *Deleatidium lillii* (orig.) (Eaton 1899: 289)
- *Deleatidium (D.) lillii* (incorrectly attributed to Walker) (Phillips 1930: 336, 368)
- *Deleatidium lilli* (spell. & incorrectly attributed to Walker) (Mosely 1932: 10)
- *Deleatidium lillii* (comb.) (Ulmer 1938: 105)

Deleatidium (Deleatidium) magnum Towns & Peters, 1996: 40, “♂ imago, Whakapapa Stream, Mt Ruapehu (Crawford)”. Holotype: NZAC. Distribution: TK, TO. Also unverified reports from NN, NC, MC, SC, MK, CO. Conservation status: Naturally Uncommon.

Deleatidium (Deleatidium) myzobranchia Phillips, 1930: 373, “Hawkes Bay, Wellington, Nelson and Canterbury provincial districts”. No holotype designated. Lectotype: “♂ imago, Ngaio, Wellington (Phillips)”, CMNZ. Distribution: ND, AK, CL, WO, BP, TK, TO, RI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Deleatidium myzobranchia* (orig.) (Phillips 1930: 373)
- *Deleatidium* sp. E (undesc.) (Towns 1979: 257)

Deleatidium (Deleatidium) townsi Hitchings, 2009: 36, “♂ imago, Glentui River, Mt Thomas Forest (Ward & Ward)”. Holotype: CMNZ. Distribution: – // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK. Conservation status: Not Threatened.

Deleatidium (Deleatidium) vernale Phillips, 1930: 360, “Tributary of the Kaiwarra⁴ Stream at Ngaio and Khandallah near Wellington”. No holotype designated. Lectotype: “♂ imago, Ngaio, Wellington (Phillips)”, CMNZ. Distribution: ND, CL, TO, GB, RI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD. Conservation status: Not Threatened.

- *Deleatidium vernale* (orig.) (Phillips 1930: 360)

Deleatidium (Deleatidium) wardorum Hitchings, 2010: 28, “♂ imago, Waterfall Creek, Ashley (Hitchings)”. Holotype: CMNZ. Distribution: – // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO. Conservation status: Not Threatened.

Deleatidium (Penniketellum⁵) cornutum Towns & Peters, 1996: 47, “♂ imago, stream at base of Tasman Glacier (Towns & Towns)”. Holotype: NZAC. Distribution: – // BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, FD. Conservation status: Not Threatened.

Deleatidium (Penniketellum⁵) insolitum (Towns & Peters, 1979): 451, “♂ imago, Edwards Valley, nr Arthur’s Pass, North Canterbury (Jackson)”. Holotype: NZAC. Distribution: – // NC, MK. Conservation status: Nationally Endangered.

- *Penniketellus insolitus* (orig.) (Towns & Peters 1979a: 451)

Deleatidium (Penniketellum⁵) patricki Hitchings, 2008: 37, “♂ imago, Flush Stream, Mt St. Bathans, Central Otago (Patrick & Edwards)”. Holotype: CMNZ. Distribution: – // NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, FD. Conservation status: Not Threatened.

⁴ Kaiwharawhara Stream, Wellington.

⁵ I here follow the nomenclature of Towns and Peters (1996) but acknowledge the spelling surrounding the gender may be incorrect. The original designation “Penniketellus” of Towns and Peters (1979a) may be the valid designation.

***Isotbraulus* Towns & Peters, 1979: 439**

Isotbraulus abditus Towns & Peters, 1979: 442, “♂ imago, Small tributary of Waitakere R. nr Anderson’s Track, Auckland (Black)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO, RI // –. Conservation status: Declining.

- *Zephlebia* sp. A (undesc.) (Towns 1978b): 410

***Mauiulus* Towns & Peters, 1979: 224**

Mauiulus aquilus Towns & Peters, 1996: 51, “♂ imago, Rangitukia Stream, Waikato (Summerhays)”. Holotype: NZAC. Distribution: ND, CL, WO, TO, WA // –. Conservation status: Naturally Uncommon.

Mauiulus luma Towns & Peters, 1979: 226, “♂ imago, Cascade Stream, Auckland (Towns)”. Holotype: NZAC. Distribution: ND, AK, WO, BP, TK, TO, GB, RI, WN // NN, BR, WD, MB. Conservation status: Not Threatened.

- *Atalophlebiodes* sp. A (undesc.) (Towns 1978a: 367, 369; —1978b: 411; —1979: 256)

***Neozephlebia* Penniket, 1961: 9**

Neozephlebia scita (Walker, 1853): 570, “New Zealand”. No holotype designated. Lectotype: one of the original two specimens, “♂ imago lacking head, New Zealand (Sinclair)”, BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, RI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Baetis scita* (orig.) (Walker 1853: 570)
- *Leptophlebia nodularis* (syn.) (Eaton 1871: 81)
- *Leptophlebia scita* (comb.) (Eaton 1871: 81)
- *Atalophlebia nodularis* (syn.) (Eaton 1884: 89; —1899: 288; Lillie 1898: 168; Hutton 1898: 216; Hudson 1904: 34; Phillips 1930: 352; Mosely 1932: 8; Kimmins 1960: 295; McLean 1967: 99–104)
- *Atalophlebia scita* (comb.) (Eaton 1884: 90; —1899: 288; Hutton 1898: 216; Hudson 1904: 34; Kimmins 1960: 295)
- *Zephlebia* (*Neozephlebia*) *nodularis* (syn.) (Penniket 1961: 9; Winterbourn & Towns 1981: 18)
- *Zephlebia* (*Neozephlebia*) *scita* (comb.) (Penniket 1961: 9; Winterbourn & Towns 1981: 18)
- *Zephlebia scita* (comb.) (Cadwallader 1975a: 12, 16, 22; —1975b: 16, 20–21; —1975c: 304–308; Michaelis 1977: 366)
- *Zephlebia scital/nodularis* (syn.) (Towns 1978a: 367)
- *Zephlebia nodularis* (syn.) (Towns 1978b: 410; —1979: 255)

***Tepakia* Towns & Peters, 1996: 54**

Tepakia caligata Towns & Peters, 1996: 55, “♂ imago, Waikoha Stream, Waikato (Summerhays)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, WN, WA // –. Conservation status: Not Threatened.

- “a second species of *Isotbraulus*” (undesc.) (Towns & Peters 1979a: 444)

***Zephlebia* Penniket, 1961: 8**

Zephlebia borealis (Phillips, 1930): 356, “Tanekaha, west of Hikurangi, North Auckland”. No holotype designated. Lectotype: “slides of nymphal legs and gills, designated from paratype with no locality data (Phillips)”, BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, RI, WN // –. Conservation status: Not Threatened.

- *Atalophlebia*? n. sp. [also provisionally as *A. borealis*] (orig.) (Phillips 1930: 356)
- *Zephlebia* (*Zephlebia*) *borealis* (comb.) (Penniket 1961: 9)
- *Zephlebia* (*Zephlebia*) sp. (cf. *borealis*) (comb.) (Landa et al. 1980: 171)
- *Zephlebia* (*Terama*) *borealis* (comb.) (Towns 1983b: 19)

Zephlebia dentata (Eaton, 1871): 80, “New Zealand”. No holotype designated. Lectotype: “♂ imago, designated by Kimmins (1960) with locality as New Zealand (collector unknown)”, BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, RI, WI, WN, WA. Also recorded from the upper South Island but may be ‘in error’. Conservation status: Not Threatened.

- *Leptophlebia dentata* (orig.) (Eaton 1871: 80)
- *Atalophlebia dentata* (comb.) (Eaton 1884: 88; —1899: 287; Hutton 1898: 215; Hudson 1904: 31; Phillips 1930: 344; Mosely 1932: 7; Kimmins 1960: 295)
- *Zephlebia* (*Zephlebia*) *dentata* (comb.) (Penniket 1961: 9)

Zephlebia inconspicua Towns, 1983: 12, “♂ imago, Cascade Stream, Auckland (Towns)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TO // –. Conservation status: Not Threatened.

- *Zephlebia* n.sp. B (undesc.) (Towns 1978a: 367)
- *Zephlebia* sp. B (undesc.) (Towns 1976: 44; —Towns 1978a: 369; —1978b: 410)
- *Zephlebia* (*Zephlebia*) *inconspicua* (orig.) (Towns 1983b: 12)

Zephlebia nebulosa Towns & Peters, 1996: 63, “♂ imago, Rangitukia Stream, Waikato (Summerhays)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO // –. Also unverified reports from BR and SD. Conservation status: Naturally Uncommon.

- *Zephlebia* sp. A (undesc.) (Towns 1987: 352–353)

Zephlebia pirongia Towns & Peters, 1996: 65, “♂ imago, Rangitukia Stream, Waikato (Summerhays)”. Holotype: NZAC. Distribution: WO // –. Conservation status: Not Threatened.

Zephlebia spectabilis Towns, 1983: 14, “♂ imago, Waitakere River, Auckland (Black)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, RI, WN, WA // SD, NN, BR, WD, MB, KA, MC, SC, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

- *Zephlebia* (*Zephlebia*) sp. (undesc.) (Towns 1979: 256; —1981: 194)
- *Zephlebia* (*Zephlebia*) *spectabilis* (orig.) (Towns 1983b: 14)

Zephlebia tuberculata Towns & Peters, 1996: 68, “♂ imago, Rangitukia Stream, Waikato (Summerhays)”. Holotype: NZAC. Distribution: ND, AK, CL, WO, BP, TK, GB, RI // –. Conservation status: Data Deficient.

Zephlebia versicolor (Eaton, 1899): 286, “Wellington (Hudson)”. No holotype designated. Lectotype: “♂ imago, Wellington (Hudson)”, BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, RI, WN, WA // SD, NN, BR, MB. Conservation status: Not Threatened.

- *Atalophlebia versicolor* (orig.) (Eaton 1899: 286; Hudson 1904: 30; Phillips 1930: 339; Mosely 1932: 7; Kimmins 1960: 296; Stout 1969: 491; —1973: 244; —1975: 442)
- *Zephlebia* (*Zephlebia*) *versicolor* (comb.) (Penniket 1961: 8)

NESAMELETIDAE

Nesameletus Tillyard, 1933: 11

Nesameletus austrinus Hitchings & Staniczek, 2003: 24, “♂ imago, Camp Stream, Craigieburn Range (Hitchings)”. Holotype: CMNZ (unavailable for confirmation at time of publication). Distribution: – // NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, SL, FD. Conservation status: Not Threatened.

- *Nesameletus* sp. A (undesc.) (Winterbourn 2003: 41–50)

Nesameletus flavitinctus (Tillyard, 1923): 226, “♀ imago, Waihi Stream, near Tokaanu (Tillyard)”. Holotype: Was Cawthron Institute, Nelson, now NZAC. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, HB, RI, WN // SD, NN, BR, WD, MB, KA, NC, MC, SC, OL, CO, DN. Conservation status: Not Threatened.

- *Ameletus flavitinctus* (orig.) (Tillyard 1923: 226)

Nesameletus murihiku Hitchings & Staniczek, 2003: 22, “♂ imago, Mill Creek, Stewart Island (Hitchings)”. Holotype: CMNZ. Distribution: – // OL, CO, SL, FD // SI. Conservation status: Naturally Uncommon.

Nesameletus ornatus (Eaton, 1883): plate XIX, “Christchurch (Wakefield)”. Holotype missing. Neotype: “♀ imago, Wellington (Hudson, No. 42)”, BMNH. Distribution: ND, AK, CL, WO, BP, TK, TO, GB, HB, RI, WN, WA // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD. Conservation status: Not Threatened.

- *Chirotonetes* (?) *ornatus* (orig.) (Eaton 1883: plate XIX; —1885: 208; —1888: 321)
- *Ameletus ornatus* (comb.) (Eaton 1899: 291, plate X)

Nesameletus vulcanus Hitchings & Staniczek, 2003: 26, “♂ imago, Narbey Stream, Banks Peninsula (Hitchings)”. Holotype: CMNZ. Distribution: – // MC. Conservation status: Nationally Vulnerable.

ONISCIGASTRIDAE

Oniscigaster McLachlan, 1873: 109

Oniscigaster distans Eaton, 1899: 293, “Wainui-o-mata River, Wellington (Hudson, No. 34 and 34b)”. No holotype designated. Lectotype: “♀ imago, Wainuiomata R., N.Z. (Hudson, No. 34)”, BMNH. Distribution: TK, TO, GB, RI, WN // SD, NN, BR, WD, MB, KA, NC, MC, SC, MK, OL, CO, DN, SL, FD // SI. Conservation status: Not Threatened.

Oniscigaster intermedius Eaton, 1899: 292 (*nomen dubium*), “♀ imago, M³Arthur⁶, Nelson, 3600 feet (Hudson, No. 34a)”. Holotype: BMNH. Distribution: – // NN. Conservation status: Data Deficient.

Oniscigaster wakefieldi McLachlan, 1873: 110, “Christchurch, N.Z.”. No holotype designated. Lectotype: “♀ imago, No. 20. Christchurch, N.Z. (Wakefield)”, BMNH. Distribution: ND, WO, TK, TO, GB, WN, WA // SD, NN, BR, WD, MB, KA, NC, OL, CO, DN, SL. Conservation status: Declining.

RALLIDENTIDAE

Rallidens Penniket, 1966: 164

Rallidens mcfarlanei Penniket, 1966: 164, “♂ imago, Waipoua, North Auckland (Penniket)”. Holotype: CMNZ. Distribution: ND, AK, CL, WO, BP, TK, TO, RI, WA // –. Also unverified reports from BR. Conservation status: Not Threatened.

Rallidens platydonis Staniczek & Hitchings, 2014: 2, “♂ imago, Otaio River trib., The Hunters Hills (Morris)”. Holotype: CMNZ. Distribution: – // NN, MB, NC, SC, OL, DN, SL. Conservation status: Declining.

SIPHLAENIGMATIDAE

Siphlaenigma Penniket, 1962: 389

Siphlaenigma janae Penniket, 1962: 390, “♂ imago, Baxter’s Creek, Stillwater, Westland (Penniket)”. Holotype: CMNZ. Distribution: ND, AK, CL, BP, TK, TO, GB, RI // BR. Conservation status: Nationally Vulnerable.

- *Siphlaenigma edmundsi* (syn.) (Lugo-Ortiz & McCafferty 1998: 210)

⁶ Mount Arthur, Nelson.

Concluding remarks

Fifty-five New Zealand mayflies have been described, two of which are presently best considered *nomina dubia* (*Coloburiscus tonnoiri* Lestage, 1935 and *Oniscigaster intermedius* Eaton, 1899). The fauna comprises eight families, including three endemic to New Zealand (Ichthyobotidae, Rallidentidae, Siphlaenigmatidae), and four shared with Southern Hemisphere continents of Gondwanan origin. The New Zealand species have been described over a 165 year period and can be categorised into five distinct eras based on the time of their description: pre 1905 (12 species), 1920s & 1930s (11 species), 1960s & 1970s (8 species), 1980s and 1990s (11 species) and post 2000 (13 species). Each era is characterised by the activity of a small number of passionate taxonomists who collectively described 0.2–0.7 species per year (Figure 2). In the most recent period (the last 18 years) Mr Terry Hitchings, an honorary research

fellow at Canterbury Museum and his co-authors, have described 13 new species and been almost solely responsible for advancing mayfly taxonomy in New Zealand.

The sporadic nature and low rate of New Zealand mayfly descriptions is not a reflection of the actual biodiversity present, but is more likely attributable to the lack of value (and financial support) placed on taxonomic work by New Zealand policy makers and biodiversity managers. A lack of support for taxonomic work is not limited to the Ephemeroptera by any means and has been expressed more broadly by New Zealand entomologists (Lester et al. 2014) and aquatic scientists (Collier et al. 2016), as well as by taxonomists in other parts of the world (see Winterbourn 2014). A general absence of specialist aquatic insect taxonomists in New Zealand, and particularly at New Zealand universities, has meant that graduates with taxonomic skills are not being produced, which does not

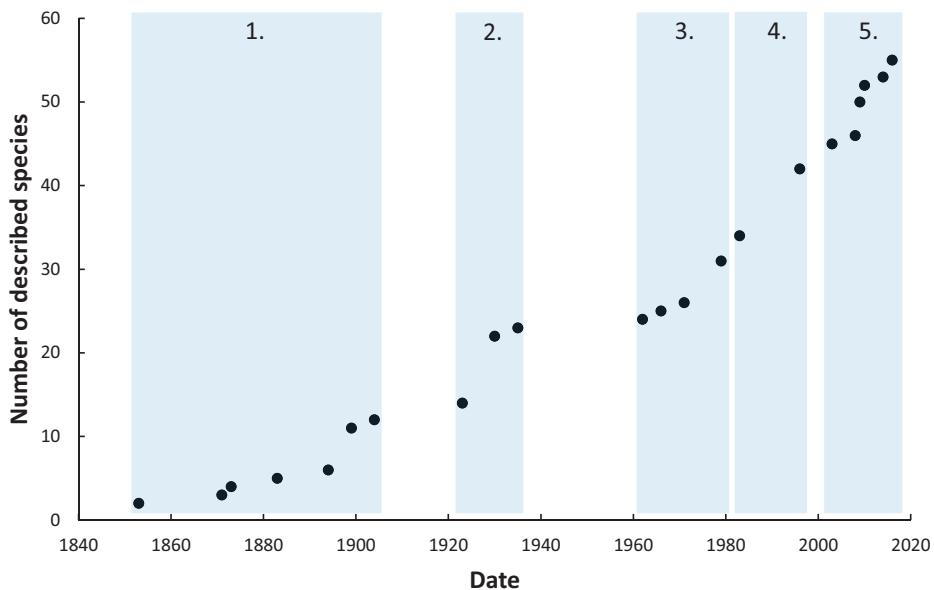


Figure 2. Cumulative frequency of New Zealand mayfly species described over time. Pale blue bars indicate the five eras whose primary contributors are: 1. F. Walker, A. Eaton, R. McLachlan & G. Hudson; 2. R. Tillyard & J. Phillips; 3. J. Penniket & W. Peters; 4. W. Peters & D. Towns; 5. T. Hitchings.

bode well for the future of fundamental taxonomic studies of insects, including aquatic taxa, in this country.

That such studies are needed is well illustrated by the mayflies, as a number of undescribed species, mainly in the genera *Deleatidium*, *Nesameletus* and *Zephlebia* are known to be present in both the North and South islands, and preliminary molecular analyses of some described New Zealand species indicate the possible presence of cryptic species in these and other genera (author's unpublished data). Taxonomic studies combining morphological and molecular data are therefore needed to better understand the diversity of the New Zealand mayfly fauna.

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