Analysis of some historically unfamiliar Canadian mayflies (Ephemeroptera)

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Abstract—Twelve historically unfamiliar Ephemeroptera species described from Canada over 65 years ago were studied. Diagnostic characters are given that validate *Acerpenna akataleptos* (McDunnough) (Baetidae), whereas certain larval specimens of the genus *Acerpenna* Waltz and McCafferty cannot yet be associated with any species. *Cinygmula confusa* (McDunnough, 1924), **syn.nov.**, (Heptageniidae) is shown to be a junior synonym of *Cinygmula par* (Eaton, 1885), and *Serratella serratoides* (McDunnough, 1931), **syn.nov.**, (Ephemerellidae) is shown to be a junior synonym of *Serratella molita* (McDunnough, 1930). New distribution records are given for *Ironodes flavipennis* Traver (Heptageniidae), *Cinygmula gartrelli* McDunnough, *Heptagenia adaequata* McDunnough (Heptageniidae), and *Siphlonurus autumnalis* McDunnough (Siphlonuridae), including the first substantiated records for the latter three from the United States. A first larval description of *S. autumnalis* is provided. *Ephemerella fratercula* McDunnough (Ephemerellidae) is apparently rare, but its previously doubtful North Carolina record is confirmed. All larvae previously reported as *Neoephemera bicolor* McDunnough (Neoephemeridae) cannot be placed to any nominal species. *Parameletus croesus* (McDunnough) (Siphlonuridae), *Plauditus rubrolateralis* (McDunnough) (Baetidae), and *Rhithrogena gaspeensis* McDunnough (Heptageniidae) are distinctive species but are known from few records.

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Résumé—Douze espèces rares d'éphéméroptères décrites au Canada il y a plus de 65 ans et jusqu'alors mal identifiées ont été étudiées. Grâce à des caractères diagnostiques le spécimen *Acerpenna akataleptos* (McDunnough) (Baetidae) a été validé, tandis que certains spécimens larvaires du genre *Acerpenna* Waltz et McCafferty ne peuvent encore être associés à aucune espèce. Il est montré : que *Cinygmula confusa* (McDunnough, 1924), **syn.nov.**, (Heptageniidae) est un synonyme plus récent de *Cinygmula par* (Eaton, 1885) et que *Serratella serratoides* (McDunnough, 1931), **syn.nov.**, (Ephemerellidae) est un synonyme plus récent de *Serratella molita* (McDunnough, 1930). De nouvelles localités viennent s'ajouter aux répartitions d'*Ironodes flavipennis* Traver (Heptageniidae), *Cinygmula gartrelli* McDunnough, *Heptagenia adaequata* McDunnough (Heptageniidae) et *Siphlonurus autumnalis* McDunnough (Siphlonuridae); ces trois dernières espèces sont signalées pour la première fois aux Etats-Unis. Une première description larvaire de *S. autumnalis* est donnée. *Ephemerella fratercula* McDunnough (Ephemerellidae) est rare apparemment, mais sa présence douteuse en Caroline du Nord est confirmée. Touts les larves antérieurement citées sous le nom de *Neoephemera bicolor* McDunnough (Neoephemeridae) n'ont pu être attribuées à aucune espèce nominale. *Parameletus croesus* (McDunnough) (Siphlonuridae), *Plauditus rubrolateralis* (McDunnough) (Baetidae) et *Rhithrogena gaspeensis* McDunnough (Heptageniidae) sont des espèces distinctes mais qui demeurent encore peu connues.

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Introduction

The value of accurately documenting biological diversity in insects has received increased recognition in recent years; however, the documenting of smaller, aquatic insect orders has generally lagged behind that of the larger orders (Allan and Flecker 1993). Therefore, it is not surprising that a number of mayfly species (Ephemeroptera) are poorly known. These species need evaluating to ascertain their status and accurately gauge their relative environmental vulnerability. The validity of unfamiliar or poorly studied species should be reviewed, and if they are not valid, the appropriate synonymy should be established. If valid, additional records should be sought and the geographic distribution evaluated to determine whether the species are merely infrequently collected, truly rare, or perhaps extinct.

Ten historically anomalous mayfly species described from the United States were recently evaluated by McCafferty (2001). As a result, these species were variously shown to be valid and with new records, junior synonyms of more familiar species or, in two instances, extinct. As a companion study, we reviewed 12 species described from Canada over 65 years ago that have had either doubtful or no collection data associated with them since their description. Other Canadian species that currently fit these criteria are not treated here because their status will be reviewed in conjunction with ongoing revisionary work on the genera to which they belong. This study will not only improve the environmental risk assessment associated with the species treated, but we trust, will serve to stimulate further recognition and study of pertinent mayfly populations. Following the nomenclature of McCafferty (1996), Lugo-Ortiz and McCafferty (1998), and Wiersema (2000), we treat the 12 species alphabetically by family, under their determined valid name. For example, *Cinygmula confusa* (McDunnough), **syn.nov.**, is treated under *Cinygmula par* (Eaton). Material examined is deposited in the following institutions:

CNC	Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada.
CU	Cornell University Insect Collection, Ithaca, New York, United States.
FAMU	Florida A&M University, Tallahassee, Florida, United States.
INHS	Illinois Natural History Survey, Urbana, Illinois, United States.
PERC	Purdue Entomological Research Collection, West Lafayette, Indiana, United States.
SASK	University of Saskatchewan, Saskatoon, Saskatchewan, Canada.
UMC	Wilbur R Enns Entomology Museum, University of Missouri, Columbia, Missouri, United States.

Acerpenna akataleptos (McDunnough) (Baetidae)

Material examined

***Acerpenna akataleptos*. Holotype:** male adult, Alberta, Medicine Hat, 14.viii.1925, FS Carr (CNC). **Paratype:** same data (genitalia on slide) (CNC). **Additional material:** two male adults, Alberta, Medicine Hat, 25.vii.1930, JH Pepper (CNC); one male adult, three female adults, same locale, 22.vii.1930 (CNC); one male adult, Alberta, Lethbridge, 28.vii.1930, JH Pepper (CNC); one male adult, Alberta, Cypress Hills, 21.vii.1930, JH Pepper (CNC).

***Acerpenna macdunnoughi* (Ide).** One male adult (genitalia on slide), Indiana, Perry Co., Poison Cr., "ca. 5 mi. NW Derby," 14.v.1976, AV Provonsha and M Minno (PERC).

***Acerpenna pygmaea* (Hagen).** One male adult, Quebec, 16.vi.1925, FP Ide (PERC); 16 male adults (one set male genitalia on slide), three female adults, Indiana, Steuben Co., Fawn R. at Orland, at light, 29.v.1975, AV Provonsha and M Minno (PERC); two larvae, Saskatchewan, Cypress Hills Provincial Park, W block, Battle Cr. at Ranger Station, 30.vii.2000, JM Webb (SASK).

***Acerpenna* sp. A.** One larva (slide mounted), Alberta, Pembina R., 53°37′N, 115°00′W, 13.viii.1979, JC Ciborowski (PERC); one larva (slide mounted), same data but 24.viii.1979 (PERC); three larvae (parts on slide), Saskatchewan, Fir R. at Hudson Bay Regional Park, 24.vii.1999, JM Webb (SASK).

Diagnosis

Baumgardner *et al.* (1997) and Waltz *et al.* (1998) suggested that *A. akataleptos* might be a dark form of *A. pygmaea*. However, we found significant differences between adults of *A. akataleptos* and *A. pygmaea* that confirm the validity of *A. akataleptos*. *Acerpenna akataleptos* demonstrates the darker abdominal segments 2–6 reported by McDunnough (1926) and Traver (1935*a*), and the presence of a ventral posteromedial projection between the bases of the male forceps (Fig. 1) clearly distinguishes it from *A. pygmaea* (Fig. 2). *Acerpenna macdunnoughi* has a similar posteromedial projection (Fig. 3) but, in *A. akataleptos*, the projection is more broadly rounded, and the apex of the projection is nearly subequal to the level of the base of forceps segment 2 (Fig. 1). We examined genitalia on pinned specimens in addition to slide-mounted genitalia, and thus we do not believe this character state is an artifact of mounting or preservation techniques.

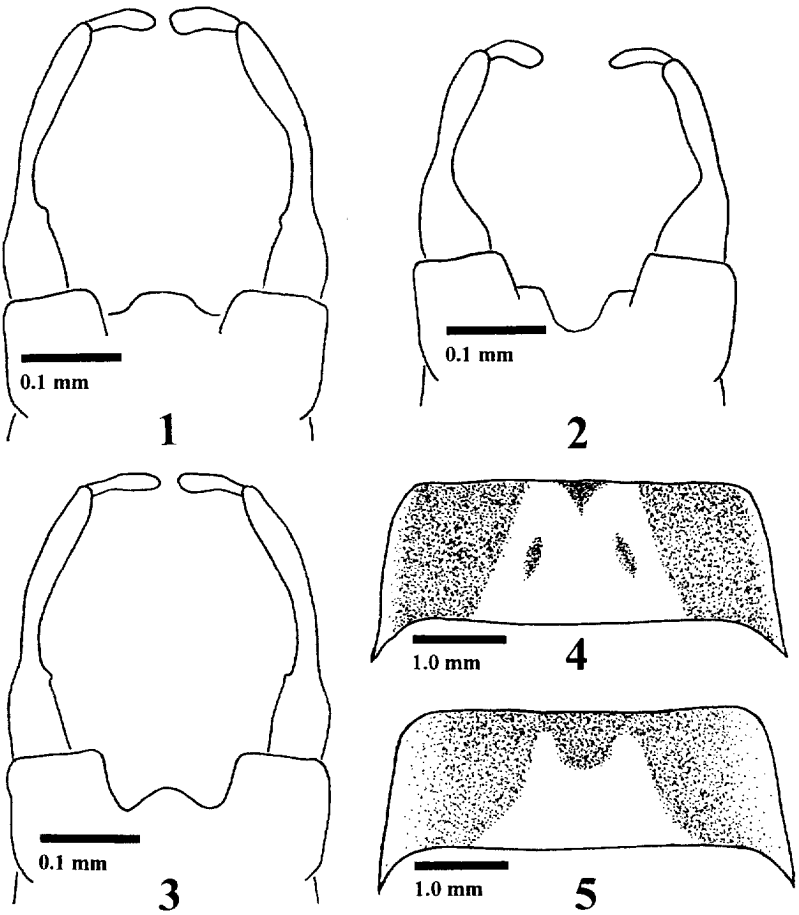
Distribution

Acerpenna akataleptos remains known only from Alberta. Larval variants from Colorado that might have been *A. akataleptos* have proven to be *A. pygmaea* (McCafferty *et al.* 1993; Waltz *et al.* 1998). Baumgardner *et al.* (1997) reported this species from Texas and mentioned populations known from northern California. In fact, there are no records of the species from California, and based on distribution and previous confusion with *A. pygmaea*, we must assume that the Texas records of *A. akataleptos* are based on misidentifications of *A. pygmaea* adults (see above). The material from Texas was not available for examination.

Remarks

We conclude that *A. akataleptos* is a valid species that has not been correctly reported since its original description, possibly owing to its small size (2.5–3.0 mm in length) and perhaps limited range. There are presently no identification keys that include all known adults of this genus.

Larvae of *A. akataleptos* are unknown. We have, however, seen five larvae from Alberta and Saskatchewan, which we call *Acerpenna* sp. A, that may eventually prove to be the larvae of *A. akataleptos*. These larvae will key to *A. pygmaea* in the key of Morihara and McCafferty (1979); however, they are intermediate in form between *A. macdunnoughi* and *A. pygmaea*. The dorsal setation of the tibia and the shape of gills 7 are similar to *A. pygmaea*, but the mouthparts, abdominal coloration, and paraproct are similar to *A. macdunnoughi*. Two larvae from Saskatchewan had a somewhat intermediate abdominal coloration. The need for rearing small baetids in western Canada is demonstrated by this account.



FIGURES 1–5. 1–3, male genitalia (ventral view): 1, *Acerpenna akataleptos*; 2, *A. pygmaea* (after Berner 1940); 3, *A. macdunnoughi* (after McCafferty and Morihara 1979). 4 and 5, *Siphlonurus autumnalis*: 4, fifth abdominal tergum; 5, fifth abdominal sternum.

Plauditus rubrolateralis (McDunnough) (Baetidae)

Material examined

***Acentrella parvula* (McDunnough).** One male adult and associated exuviae, Indiana, Pulaski Co., Tippecanoe R. at Co. Rd., "1.5 mi. S Tipp. R. St. Pk.," 31.v.1978 (emerged in lab 6.vi), M Minno, D Bloodgood (PERC).

***Plauditus rubrolateralis*. Holotype:** male adult, Alberta, Milk River, 13.ix.1929, JH Pepper (CNC).

***Plauditus* sp.** Ten male adults, Oklahoma, Pushmataha Co., Kiamichi R. at unnamed road in Tuskahoma, 6.viii.1993, DE Baumgardner (PERC).

Diagnosis

Our examination of the holotype of *P. rubrolateralis* confirmed that male adults of this species are distinguishable from other male adults of the genus *Plauditus* Lugo-Ortiz and McCafferty by the presence of relatively large, centrally located spots on the

abdominal sterna. The structure of male genitalia in *P. rubrolateralis* is consistent with congeners. Based on the study of some other male adults of the genera *Plauditus* and *Acentrella* Bengtsson, we found that the presence of lateral reddish patches on the abdomen and the shape of turbinate eyes varied within some populations and species. Therefore, these characters do not distinguish *P. rubrolateralis* consistently from certain other *Plauditus* species, as suggested in the past, except when they are taken in combination with the prominent markings on the abdominal sterna.

Distribution

Plauditus rubrolateralis remains known only from Alberta (McDunnough 1931*a*). Long and Kondratieff (1996) listed this species for Tennessee based on a misidentification by Berner (1977) (S Long, Gainesville, Florida, personal communication).

Remarks

Our examination of a long series of unidentified CNC adult baetid specimens from Milk River, Alberta, did not yield additional material of *P. rubrolateralis*. It is possible that this distinctive species is now extinct, but we will continue to regard it as extant until more Ephemeroptera material can be collected and identified from western Canada. Larvae of *P. rubrolateralis* remain unknown. There are presently no reliable identification keys for larvae or adults of this genus.

Ephemerella fratercula McDunnough (Ephemerellidae)

Material examined

Paratype: male adult, Quebec, Covey Hill, 25.vi.1924, GS Walley (PERC); one female adult, Quebec, Covey Hill, 02.vii.1927, GS Walley (PERC). **Additional material:** one male adult, Quebec, Covey Hill, 25.vi.1927, GS Walley (PERC); one male adult (genitalia and wings on slides), North Carolina, Watauga Co., Valle Crucis, 05.vi.1936, JR Traver (CU).

Diagnosis

This is the only known eastern Nearctic species of the genus *Ephemerella* Walsh in which the male adults have numerous (about 18–20) ventral spines on the penes.

Distribution

Most of the Covey Hill material was collected near Allen's Brook (McDunnough 1925*c*). The species is known from this report and from another variously accepted report by Traver (1937) from North Carolina. This latter record was accepted in an early list of North Carolina mayflies by Brimley (1938); however, it was not accepted by Allen and Edmunds (1965) in their revision of the genus *Ephemerella*, and the species was not noted in subsequent lists of North Carolina mayflies (*e.g.*, Unzicker and Carlson 1982; Pescador *et al.* 1999). Our examination of Traver's North Carolina specimen and additional material from the type locality indicate that the identification is correct.

Remarks

The larvae of *E. fratercula* are unknown. Therefore, rearings of larval *Ephemerella* from eastern North America will undoubtedly aid in resolving the status of this species, because larvae are the more collected and comparatively documented life

stage of Ephemerellinae. Eastern Nearctic male adults belonging to the genus *Ephemerella* may be identified using the key provided by Allen and Edmunds (1965).

Serratella molita (McDunnough) (Ephemerellidae)

[= *S. serratoides* (McDunnough), **syn.nov.**]

Material examined

***Serratella molita*. Holotype:** female adult, Quebec, Trinity Bay, 17.viii.1929, WJ Brown (CNC). **Paratype:** female adult, Nova Scotia, Annapolis Royal, 21.vii.1928, WJ Brown (CNC).

***Serratella serratoides*. Holotype:** male adult, Quebec, Knowlton, 13.viii.1930, LJ Milne (CNC). **Allotype:** female adult, same data, except 28.vii.1930 (CNC). **Paratypes:** 10 adults, Quebec, Knowlton, 13.vii/13.viii (CNC). **Additional material:** seven female adults, Arkansas, Boone Co., Bear Cr. at St. Rd. 14, "3 mi. W junct. hwys. 281 & 14," 28.v.1974, WP McCafferty, AV Provonsha, L Dersch (PERC); five female adults, four male adults, seven female subimagos, Arkansas, Montgomery Co., Little Missouri R. at Albert Pike Rec. Area, 30.v.1974, WP McCafferty, AV Provonsha, L Dersch (PERC); 10 female adults, Arkansas, Montgomery Co., Ouachita R. at Rocky Shoals Boat Camp at US 270, 1.vi.1974, WP McCafferty, AV Provonsha, L Dersch (PERC); three male adults, three female adults, Pennsylvania, Chester Co., East Branch White Clay Cr., main branch, Stroud Estate, Route 926, 23.vi.1966, JW Richardson, Jr (PERC); six male adults, two female adults, South Carolina, Chesterfield/Lancaster Cos., Lynches R. at Route 265, 17.vi.1985, Kondratieff (PERC).

Diagnosis

In the larvae of this species, pronotal tubercles are lacking and the abdominal sterna are each distinctly marked with four black dots. Thus, larvae of this species are easily separated from larvae of other eastern Nearctic congeners that have abdominal tubercles.

The male adults are recognized by the presence of a truncate projection between the genital forceps, and both male and female adults have an arrangement of sternal dots on the abdomen similar to that of the larvae.

Remarks

Serratella molita has been known previously only from the holotype and paratype. McDunnough (1931*b*) mistakenly reported the paratype from New Brunswick in a study subsequent to his original description of the species (McDunnough 1930), as we confirmed by examination of labels on the type material. *Serratella molita* was not included in the identification key for the genus *Serratella* Edmunds by Allen and Edmunds (1963).

The only putative difference between *S. molita* and *S. serratoides* was the presence of banding on the adult caudal filaments of *S. serratoides* (McDunnough 1931*b*) and the lack of such banding on the two original female adults of *S. molita* (McDunnough 1930). The latter species was described as having prominent pronotal excrescences, but there was no mention of such excrescences in *S. serratoides* (McDunnough 1931*a*). The pronotal excrescences of the examined *S. serratoides* type material were present but appeared to be smaller and more conical than those of the *S. molita* type specimens. Nevertheless, certain female adults of *S. serratoides* from Arkansas, Pennsylvania, and South Carolina, reared or taken with identifiable males, lacked visible banding on the caudal filaments and varied with respect to the

development of the pronotal excrescences. Several of these female adults fit the description of *S. molita*, and several male adults and female subimagos showed larger pronotal excrescences. In light of these observations, we place *S. serratoides*, **syn.nov.**, as a subjective junior synonym of *S. molita*.

Cinygmula gartrelli McDunnough (Heptageniidae)

Material examined

Holotype and allotype: male adult and female adult, British Columbia, Deep Cr., Peachland, 23.v.1933, AN Gartrell (CNC). **Paratype:** one male adult, same data (PERC); one male adult, British Columbia, Adams R., 20.v.1937, JK Jacob (PERC). **Additional material:** two female adults, British Columbia, Chase, 18.v.1937, JK Jacob (PERC); two male adults, five female adults, British Columbia, Powers Cr., Westbank, 18/21.iv.1934, AN Gartrell (CNC); one female adult, British Columbia, Shingle Cr., Penticton, 18.iv.1934, AN Gartrell (PERC); one female adult, British Columbia, Shingle Creek Rd., Keremeos, 21.iv.1934, AN Gartrell (PERC); four male adults, Utah, Cache Co., Logan Canyon, "4800 ft." elev., 30.vi.1942, CP Alexander (PERC).

Diagnosis

Male adults are recognized by the presence of a serrate inner spine and a ventral subapical spine on each penes lobe. The crossveins of the costal half of the forewing are slightly margined with brown; the forewings and hind wings are tinged with amber along the costal margin and at the base.

Distribution

Only the adults collected near Peachland, British Columbia, in May 1934 were reported previously for *C. gartrelli* (McDunnough 1934). Above, we provide additional British Columbia records and new records from Utah that extend the known range of this species significantly and constitute first records from the United States. Edmunds (1954) did not report the species from Utah, even though the material we examined was from his recently acquired collection.

Remarks

Cinygmula gartrelli must be considered a valid species. Its current environmental status remains questionable, however, because the most recent date of collection is 1942 (see Material examined above). Larval identifications in this genus cannot be made with confidence without reared male adults. Although Traver (1935*a*) provided an identification key for Nearctic male adults belonging to this genus, there are presently no keys that incorporate all described species.

Cinygmula par (Eaton) (Heptageniidae)

[= *C. confusa* (McDunnough), **syn.nov.**]

Material examined

***Cinygmula confusa*. Holotype:** male adult, Alberta, Moraine Lake, 1.viii.1923, J McDunnough (CNC). **Paratypes:** seven male adults, Alberta, Moraine Lake, 1.viii.1923, J McDunnough (CNC). **Addtional material:** 13 male adults, two female adults, Alberta, Waterton Lakes, 6/7.vii.1923, J McDunnough (CNC); one male adult,

one female adult, same data but 30.vi.1923 (CNC); six male adults, five female adults, Alberta, Mt. Crandell Cr./Pass Cr., Waterton Lakes, 27/28.vi.1929, JH Pepper (CNC); one male adult, Alberta, Waterton Lakes, 3.vii.1930, JH Pepper (CNC); 47 larvae, Alberta, Waterton Lakes, small creek south of golf links, 27.vi.1929, JH Pepper (CNC).

Cinygmula par. Two male adults, Colorado, Hinsdale Co., West Lost Trail Cr., "11500 ft." elev., 18.viii.1997, S Simonson (PERC); eight larvae, Colorado, Routt Co., Walton Cr., Highway 40, "6 mi. W Rabbit Ear Pass," 23.viii.1967, BR Oblad (PERC); seven male adults, two female adults, Colorado, Johnson Lumber Mill, nr. Wolf Creek Pass, 15.vii.1945, GFE (PERC); six male adults, Idaho, Clark Co., Spencer, 6.vii.1969, GF Edmunds (PERC); one male adult, Utah, Salt Lake Co., Big Cottonwood Cr. at Stairs Power Plant, "5475 ft." elev., 19.vii.1967, DW Argyle (PERC); one male adult and associated exuviae, same data but 12.vii.1967 (PERC).

Diagnosis

Male adults of *C. par* have a prominent outer lateral spine on each penes lobe that readily differentiates them from male adults of other Nearctic congeners.

Remarks

This analysis was undertaken to address the validity of *C. confusa*, which was known only from the Alberta type material (McDunnough 1924). Coloration differences and "slight but seemingly constant" differences in the male genitalia, namely "the length of the basal spine of the penis," were used by McDunnough (1924) to separate *C. confusa* and *C. hyalina* (McDunnough) that were collected from the same locales. Traver (1935*a*) suggested that *C. par*, *C. hyalina*, and *C. confusa* were closely related, and Edmunds and Allen (1957) synonymized *C. hyalina* with *C. par*. Edmunds (1962) suggested that water temperature at the larval developmental site led to significant variation in populations of *C. par*, including what had been considered *C. hyalina*. The effects of various thermal regimes on the coloration and morphology of both larvae and adults of other heptageniids have been well documented (*e.g.*, McCafferty and Huff 1978; McCafferty and Pereira 1984). We examined series of adult specimens consistent with descriptions of *C. par* (*e.g.*, Eaton 1885; Traver 1935*a*) that exhibited a range of variability that included the characterization of *C. confusa* (McDunnough 1924). Therefore, we place *C. confusa*, **syn.nov.**, as a subjective junior synonym of *C. par*.

Without adult associations, larvae of this species cannot be distinguished confidently from other congeneric larvae. Although Traver (1935*a*) provided an identification key for Nearctic male adults belonging to this genus, there are presently no keys that incorporate all described species.

Heptagenia adaequata McDunnough (Heptageniidae)

Material examined

Holotype: male adult, Alberta, Cowley, 25.vi.1918, RN Chrystal (CNC). **Additional material:** one male adult, Alberta, Medicine Hat, 24.vii.1930, JH Pepper (CNC); one females, two male adults, Idaho, Lemhi Co., Salmon R. at Salmon, 3.viii.1987, GF Edmunds, Jr (PERC); one male adult, Oregon, Clatsop Co., "ca. 2 mi. E Elsie," 15.vi.1963, SG Jewett, Jr (PERC).

Diagnosis

Adults of *H. adaequata* are most easily distinguished from adults of other western Nearctic species of the genus *Heptagenia* Walsh by the presence of prominent, dark brown, triangular patches on the abdomen.

Distribution

Heptagenia adaequata were recorded only from the original Alberta and Saskatchewan material (McDunnough 1924, 1925*a*). Bednarik and Edmunds (1980) mentioned that G Edmunds collected this species from the Salmon River in Salmon, Idaho, but no other data were available and *H. adaequata* was not listed for the United States by Edmunds *et al.* (1976). We are now able, however, to corroborate the presence of the species in Idaho and report another population from Oregon (see Material examined).

Remarks

These new records also represent the first reports of this species within the last 75 years. The species name has sometimes been misspelled as *H. adequata* (*e.g.*, Edmunds *et al.* 1976). Most western Nearctic adults of this genus may be tentatively identified using the key provided by Traver (1935*a*).

Ironodes flavipennis Traver (Heptageniidae)

Material examined

Holotype: male adult, British Columbia, Summerland, 5.v.1933, AN Gartrell (CNC). **Additional material:** one male adult, British Columbia, Mayfly Cr., UBC Research Forest, N of Haney, Maple Ridge, 5.vii.1989, John Richardson (PERC).

Diagnosis

Male adults of *I. flavipennis* have penes lobes that are more strongly curved than those found in other congeneric male adults. Male genitalia of *I. flavipennis* illustrated by Traver (1935*a*, Fig. 6; 1935*b*, Fig. 109) are distorted and, although the shape of the penes lobes is correct, their actual orientation is more similar to that illustrated for other species of the genus *Ironodes* Traver.

The larvae of *I. flavipennis* have "concolorous" tarsi (Traver 1935*a*), whereas the larvae of other *Ironodes* species have tarsi that are more darkly (Traver 1935*a*) or more lightly (Day 1952) marked in the apical third. In addition, the dorsal coloration of the larvae of *I. flavipennis* is generally darker than in other congeneric larvae.

Distribution

Ironodes flavipennis remains known only from British Columbia (Traver 1935*a*, 1935*b*).

Remarks

The 1989 collection of *I. flavipennis* establishes its continued existence. Perhaps one of the reasons this species has not been more generally reported is because of difficulties associated with its identification and the misrepresentation of its male genitalia

in the literature (see Diagnosis above). Thus, the identification keys provided by Traver (1935*a*) should be used with caution.

Our study of *I. flavipennis*, other species of *Ironodes*, and closely related genera, has led to an important observation related to the generic diagnosis of heptageniid mayflies. A much used key to the genera of North American Ephemeroptera by Edmunds and Waltz (1996), which was adapted from that by Edmunds *et al.* (1976), distinguished male adults of *Ironodes* from those of *Epeorus* Eaton on the basis of relative development of basal crossveins of the wings and compound eye separation. The basal crossveins are strongly developed in species of *Ironodes* and not strongly developed in species of *Epeorus*; however, contiguity of compound eyes will not differentiate all male adults of these groups. Certain species of *Ironodes*, including *I. flavipennis* and *I. arctus* Traver, have eyes that are contiguous or nearly so, as is the case in *Epeorus* (Traver 1935*a*, 1935*b*). Therefore, the eye characters in couplet 48 of Edmunds and Waltz (1996: 154) and couplet 45 in Edmunds *et al.* (1976: 102) are not diagnostic, and only the relative development of the basal crossveins can be used consistently to differentiate male adults of the genus *Ironodes* from those of the genus *Epeorus*.

Rhithrogena gaspeensis McDunnough (Heptageniidae)

Material examined

Holotype: male adult, Quebec, Mt. Lyall, "1500 ft." elev., 9.viii.1933, WJ Brown (CNC).

Diagnosis

Male adults of *R. gaspeensis* are clearly differentiated from those of other Nearctic species of *Rhithrogena* Eaton by simple, enlongate penes, similar to those of *R. jejuna* Eaton, but which possess a lateral spine on each lobe (Traver 1935*a*, compare Figs. 100–102).

Distribution

Rhithrogena gaspeensis is known only from Quebec (McDunnough 1933).

Remarks

We strongly suspect that *R. gaspeensis* has not been reported since McDunnough's (1933) original description because its larvae remain undescribed. If the larvae have been collected, they have not been recognizable. Furthermore, there are no identification keys to adults and larvae of all know Nearctic *Rhithrogena* species. In recent years, the larval stage of mayflies has been the stage primarily collected and studied in Canada and elsewhere. A concerted effort is needed both to collect adult mayflies and to rear larvae. Larvae of most *Rhithrogena* species are associated with moderate to swift current in streams.

Neoephemera bicolor McDunnough (Neoephemeridae)

Material examined

***Neoephemera bicolor*. Holotype:** male adult, Quebec, Laprairie, 9.vii.1924, GS Walley (CNC).

***Neoephemera youngi* Berner.** One male adult, Georgia, Houston Co., Echeconnee Cr., "11 mi. S Macon," 5.v.1939, PW Fattig (INHS); one larva, Florida, Liberty Co., Sweetwater Cr., 4.xi.1939, L. Berner (INHS).

***Neoephemera* sp. A.** Two larvae, Michigan, Arenac Co., Riffle R. at Omer, 31.v.1936, Frison & Ross (FAMU); one larva, Missouri, Franklin Co., Meramec R., 41N 1E 20SE, "511 ft." elev., 16.iv.1963, D Kuester (UMC); one larva, Missouri, Maries Co., Gasconade R., 40N 9W 22SE, "599 ft." elev., 16.i.1989, R Duchrow (UMC); three larvae, Missouri, Maries Co., Gasconade R. at Paydown Access, 27.iii.1990, BC Poulton (UMC); one larva, Missouri, Phelps Co., Gasconade R., 37N 10W 13NW, "660 ft." elev., 16.i.1989, R Duchrow (UMC); one larva, same data but 4.vi.1974, F Ryck, Jr (UMC); three larvae, same data but 20.x.1975 (UMC).

Diagnosis

The adults of *N. bicolor* are distinguished from those of other congeneric adults that also have a long terminal filament by their intermediate size, non-annulated tarsi, and non-annulated caudal filaments (Bae and McCafferty 1998).

Distribution

The only valid reports of this species are of male adults collected from Laprairie, Quebec (McDunnough 1925*b*; Traver 1935*a*).

Remarks

Neoephemera bicolor is a valid and distinctive species, but is generally not represented in collections. Its environmental status thus remains questionable.

Several errors regarding this species are worth noting. Burks (1953) reported the species from Georgia; however, our examination of this specimen revealed it to be *N. youngi* Berner. That single male collected from Echeconnee Creek, Georgia, had indeed been discussed by Berner (1956) as *N. youngi*, and Demoulin (1961) did not include Georgia in his distributional data for *N. bicolor*. The specimen is preserved in alcohol, with several associated labels, one of which is a paratype label. The location on the collection-data label does not coincide with paratype locations for either *N. bicolor* (McDunnough 1925*b*) or *N. youngi* (Berner 1956) and, therefore, the paratype label must be in error. In a revision of the Neoephemeridae, Bae and McCafferty (1998) mentioned that *N. bicolor* occurred in Indiana but provided no substantiating records. There is no substantiating data for the species in Indiana or surrounding states. McCafferty and Randolph (1998) mistakenly indicated that Walley (1927) had reported the species for Ontario; this record, however, is attributable to Quebec, not to Ontario (Walley 1927).

Berner (1956) illustrated, keyed, and reported diagnostic characters for some larvae of *Neoephemera* McDunnough from Michigan that he assigned to *N. bicolor*. The determination of these larvae was not based on reared material or on any association with adults. Our examination of the Michigan specimens confirmed that they were distinct from other known larvae and, although they possibly represent *N. bicolor*, it is equally possible that they represent a new species. Additional larval specimens reported as *N. bicolor* from Missouri (Sarver and Kondratieff 1997) appear to be conspecific with the larvae reported from Michigan. We consider the larva of *N. bicolor* to be unknown and, therefore, we regard larvae reported as *N. bicolor* as *Neoephemera* sp. A, until rearing experiments are conducted. All known adults and larvae belonging to the family Neoephemeridae may be identified using the key provided by Bae and McCafferty (1998).

Parameletus croesus (McDunnough) (Siphlonuridae)

Material examined

One male adult, Ontario, Ottawa, 3.vi.1923, CH Curran (CNC); one male adult, Ontario, Ottawa, 3.vi.1925, FP Ide (CNC).

Diagnosis

Parameletus croesus is a distinctive species distinguished in the adult stage from *Parameletus midas* (McDunnough), the only other species of *Parameletus* Bengtsson currently known from eastern Canada, by the coloration of the forewings and the structure of the male genitalia. The inner two-thirds of the forewing of *P. croesus* is tinted with brown, whereas only the costal margin of the forewing of *P. midas* may be tinted brown. Unlike *P. midas* (McDunnough 1938, Fig. 3), *P. croesus* has a deep notch between the bases of the male genital forceps (McDunnough 1923, Fig. 3*a*).

Distribution

Parameletus croesus remains known only from Ottawa, Ontario.

Remarks

There are no records of *P. croesus* being collected within the last 75 years. We do not yet consider the species extinct, because much of the habitat of species in the genus *Parameletus* remains unexplored in Canada, and in recent years, little collecting of mayflies has been conducted in the Ottawa area. Additionally, the short vernal life of the larval and alate forms of the genus *Parameletus* (see Edmunds 1957; McCafferty and Edmunds 1997) precludes its easy collection. Adults of this genus swarm in early to late evening, and larvae develop in swamps and forest pools that may contain emergent vegetation of the genus *Carex* Linnaeus (Cyperaceae) (Edmunds *et al.* 1976). The larva of this species is unknown. Traver (1935*a*) provided a key for male adults of *P. croesus* and *P. midas*.

Siphlonurus autumnalis McDunnough (Siphlonuridae)

Material examined

Holotype: male adult, Alberta, Blairmore, 28.viii.1930, JH Pepper (CNC). **Additional material:** three sets larval exuviae, one larva, Washington, Clallam Co., Elwha R. near Elwha, 4.ix.1958, GF Edmunds, Jr, and RK Allen (PERC); three sets larval exuviae, Washington, Grays Harbor Co., East Fork Humptulips R. near Twin Peak, 2.ix.1958, GF Edmunds, Jr, and RK Allen (PERC); two female adults, one set larval exuviae, Washington, Grays Harbor Co., East Fork Humptulips River "6 mi. E Humptulips," 2.ix.1958, GF Edmunds, Jr, and RK Allen (PERC); one male adult, one female adult, five larvae, Washington, Jefferson Co., Quinalt R. near Eena Cr., Olympic Nat'l. Pk., 3.ix.1958, GF Edmunds, Jr, and RK Allen (PERC); one adult, Washington, Jefferson Co., Quinalt R. at jct. North Fork Quinalt R., Olympic Nat'l. Pk., 3.ix.1958, GF Edmunds, Jr, and RK Allen (PERC); two sets larval exuviae, Washington, Lewis Co., Skate Cr. at jct. Cowlitz R. nr. Packwood, 1.ix.1958, GF Edmunds, Jr, and RK Allen (PERC); one larva, two sets larval exuviae, Washington, Pierce Co., Greenwater R. at Greenwater, 5.ix.1958, GF Edmunds, Jr, and RK Allen (PERC).

Diagnosis

The adults of *S. autumnalis* are distinctive based upon the structure of the male genitalia: "the first joint of the forceps not squarely truncate apically (leaving a sharp projecting inner angle, as is found in *occidentalis* [Eaton] and other species), but with the inner margin rounded; furthermore the posterior margin of the subgenital plate between the forceps bases is on a level with the apex of this first joint and is weakly and angularly excavate" (McDunnough 1931*a*). The wings of *S. autumnalis* are clear, with dark veins and crossveins and, unlike many species in this genus, *S. autumnalis* lacks distinct ventral markings on the abdomen of the adult.

Description

Mature larva. Body length 16–20 mm, caudal filaments 4–6 mm. Body generally mottled brown on pale-yellow basal color. **Head:** clypeus and labrum dark brown, tan medially. Lateral ocellus contiguous with median margin of compound eye. **Thorax:** posterior margin of pronotum concave; posterior margin of mesonotum subacute; legs generally pale; femora with narrow basal brown band and broad submedial band; tibiae and tarsi with basal and apical brown bands. **Abdomen:** terga brown laterally, pale medially, with brown anteromedial spot and pair of brown submedian dashes (Fig. 4); abdominal tracheae dark and conspicuous. Sterna mostly pale, dark brown laterally and anteromedially (Fig. 5); sternum 9 brown posteriorly; female with sides of posteromedian projection slightly concave. Gills double on abdominal segments 1 and 2; gills single on segments 3–7; gill tracheation apparent. Each caudal filament with dark, broad, submedial crossband and less conspicuous apical crossband.

Distribution

This species was reported from Alberta and British Columbia by McDunnough (1931*a*). An anecdotal report of the species from Montana was given without any substantiating data by Newell (1970). Jensen (1966) keyed the species based on material he reportedly had seen from Washington but which was not substantiated with data. As elaborated by McCafferty (2000), we are distinguishing such unsupported reports from actual records, which include detailed data and archived material that allow subsequent study and authentication by others. We are able here, however, to provide new records of *S. autumnalis* that unequivocally demonstrate its existence within the past 50 years and formally establish its range in the United States.

Remarks

The above description represents the first formal description of the larval stage of *S. autumnalis*, and presumably it will be of value in the future when species of the genus *Siphlonurus* Eaton are compared more comprehensively. Proper identification of larvae in this genus remains difficult, and based on available descriptions, cannot be performed with confidence without the comparison of reared adults. There are no reliable keys to larvae of this genus, but the key provided by Traver (1935*a*) may be used to identify western Nearctic adults. Additionally, the adults of *S. autumnalis* have a distinctive late summer emergence period.

The few records and collecting locales known for *S. autumnalis* may be due, in part, to the habitat of the larvae, in which collections are seldom made, as it includes rocky edge waters of large rivers where it can be difficult to collect with standard kick screens (Edmunds *et al.* 1976).

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