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 serratoidea (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 aidequata 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 Neophephera bicolor McDunnough (Neophepherediidae) cannot be placed to any nominal species. Parameletus cresus (McDunnough) (Siphlonuridae), Plauditus rubrolateralis (McDunnough) (Baetidae), and Rhithrogena gaspeensis McDunnough (Heptageniidae) are distinctive species but are known from few records.

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 serratoidea (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 aidequata McDunnough (Heptageniidae) et Siphlonurus autumnalis McDunnough (Siphlonuridae); ces trois dernières espèces sont signalées pour la première fois aux États-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. Tous les larves antérieurement citées sous le nom de Neophephera bicolor McDunnough (Neophepherediidae) n’ont pu être attribuées à aucune espèce nominale. Parameletus cresus (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, Cinygmulida confusa (McDunnough), syn.nov., is treated under Cinygmulida 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 pygmaea (Hagen) (PERC): 16 male adults (one set new records), Steuben Co., Fawn R. at Orland, 22.viii.1979, JF Ciborowski and JM McCafferty (PERC); two larvae, Saskatchewan at Ranger Station, 30.vii.2000, JF Ciborowski (PERC).

Acerpenna sp. A. One larva, 115°00’W, 13.viii.1979, JC Ciborowski and JM McCafferty (PERC); three larvae, Bay Regional Park, 24.vii.1999, JF Ciborowski (PERC).

Diagnosis

Baumgardner et al. (1997) and others might be a dark form of A. pygmaea intermediate adults of A. akataleptos. Acerpenna akataleptos was reported by McDunnough (1926) as lacking a posterior medial projection between postclaws, distinguishing it from A. pygmaea (Fig. 3) but, its claspers are rounded, and the apex of the pro-segment 2 (Fig. 1). We examined slide-mounted genitalia, and thus we do not support mounting or preservation techniques.

Distribution

Acerpenna akataleptos remains restricted to Colorado that might have been collected by a portion (McCafferty et al. 1993; Waltz et al. 1997) to species from Texas and possibly New Mexico. As there are no records of the species in any previous confusion with A. pygmaea, A. akataleptos are based on misidentifications material from Texas was not available.

Remarks

We conclude that A. akataleptos is a species reported since its original description (1926) and length) and perhaps limited range, may include all known adults of this group.

Larvae of A. akataleptos are from Alberta and Saskatchewan, which is consistent to be the larvae of A. akataleptos of Morihara and McCafferty (1979). In A. macdunnoughi and A. pygmaea, the segments 7 are similar to A. pygmaea, but the middle and posterior abdominal coloration. These are not demonstrated by this account.
Acerpena pygmaea (Hagen). One male adult, Quebec, 19.6.1925, FM Ide (PERC); 16 male adults (one set male genitalia on slide), three female adults, Indiana, Steuben Co., Fawn R. at Orland, at light, 29.7.1975, AV Provonsha and M Minno (PERC); two larvae, Saskatchewan, Cypress Hills Provincial Park, W block, Battle Cr. at Ranger Station, 30.7.2000, JM Webb (SASK).

Acerpena sp. A. One larva (slide mounted), Alberta, Pembina R., 53°37'N, 115°00'W, 13.8.1979, JC Ciborowski (PERC); one larva (slide mounted), same data but 24.8.1979 (PERC); three larvae (parts on slide), Saskatchewan, Fir R. at Hudson Bay Regional Park, 24.7.1999, 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. Acerpena akataleptos demonstrates the darker abdominal segments 2–6 reported by McDunnough (1926) and Traver (1935a), and the presence of a ventral postero medial projection between the bases of the male forceps (Fig. 1) clearly distinguishes it from A. pygmaea (Fig. 2). Acerpena macdunnoughi has a similar postero medial 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

Acerpena 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 Acerpena 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 paraprocts 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.
Plauditus rubrolateralis (McDunnough) (Baetidae)

Material examined


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 most congeners. Based on the study of several Acentrella Bengtsson, we found that abdomen and the shape of tubulatures. Therefore, these characters do not occur in certain other Plauditus species, as such a combination with the prominent marking.

Distribution


Remarks

Our examination of a long series of specimens from Milk River, Alberta, did not yield evidence that this distinctive species is not rare until more Ephemeroptera material is available. Larvae of P. rubrolateralis are identified as E. fratercula larvae or adults.

Ephemerella fratercula (Lamy, 1820) (Ephemerellidae)

Material examined

Paratype: male adult, Quebec, Wabagab, female adult, Quebec, Covey Hill, 1907; Material: one male adult, Quebec, Covey Hill, 14.vii.1936, JG Traver (CU).

Diagnosis

This is the only known eastern Canadian species in which the male adults have numerous ridges on the abdomen.

Distribution

Most of the Covey Hill material was collected by Traver (1937) from North Carolina. It is known from the list of North Carolina mayflies by Allen and Edmunds (1965) in their catalog of North Carolina mayflies by Pescador et al. (1999). Our examination of additional material from the type locality confirmed its occurrence.

Remarks

The larvae of E. fratercula from eastern North America are difficult to identify, as they are not diagnostic for this species, because larvae are the only known external characters.
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**


**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.

**Ephemera fratercula** McDunnough (Ephemeroellidae)

**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 *Ephemera* 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 1925c). 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 Edmonds (1965) in their revision of the genus *Ephemera*, 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 *Ephemera* 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 Ephemelliniae. Eastern Neartic male adults belonging to the genus *Ephemera* may be identified using the key provided by Allen and Edmunds (1965).

**Serratella molita** (McDunnough) (*Ephemelliniae*)

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

**Material examined**


**Diagnosis**

In the larvae of this species, pronatal tubercles are lacking and the abdominal sternum are each distinctly marked with four black dots. Thus, larvae of this species are easily separated from larvae of other eastern Neartic 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 (1931b) 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. serratoidea* was the presence of banding on the adult caudal filaments of *S. serratoidea* (McDunnough 1931b) 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 exccrescences, but there was no mention of such excrescences in *S. serratoidea* (McDunnough 1931a). The pronotal excrescences of the examined *S. serratoidea* 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. serratoidea* 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. Therefore, we describe *S. molita* and several pronatal excrescences. In light of the above, we accept *S. molita* as a subjective junior synonym of *S. serratoidea*.

**Cinygmulra gartrelli**

**Material examined**

Holotype and allotype: male, Peachland, 23.v.1933, AN Gartrell (PERC); one male adult, British Columbia, 18/21.iv.1934, AN Gartrell (PERC).

Additional material: two female adults, British Columbia, 18/21.iv.1934, AN Gartrell (PERC); two male adults, five female adults, British Columbia, 18/21(iv.1934, AN Gartrell (PERC).

**Distribution**


**Remarks**

Male adults are recognized by a subapical spine on each penes lobe, slightly margined with brown; these spines are set along the costal margin and at the apex.

**Cinygmulra gartrelli** must be considered a junior subjective synonym, but its status remains questionable, however, because of the difficulty in distinguishing it from its recently acquired collection.

**Diagnosis**

Only the adults collected near Peachland were reported previously for *C. gartrelli* in the Pacific Northwest. The only British Columbia records and new records in the US do not strongly support this species significantly and conspecific with *C. gartrelli* (1954) did not report the species from this recently acquired collection.

**Cinygmulra posterella**

[= *C. confusa*]

**Material examined**

belonging to the genus "Serratella" and Edmunds (1965).

Cinygma melaleucae (nov.)

finity Bay, 17.viii.1929, WJ otis Royal, 21.vii.1928, WJ


lacking and the abdominal s, larvae of this species are genets that have abdominal truncate projection between an arrangement of sternal

from the holotype and type from New Brunswick (McDunnough 1930), as i. Serratella melalitia was not la Edmunds by Allen and S. serratoidea was the pres-order (McDunnough 1931b) male adults of S. molita having prominent pronotal excrescences in S. serratoidea examined S. serratoidea type conical than those of the laths of S. serratoidea from en with identifiable males, aried 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. serratoidea, syn.nov., as a subjective junior synonym of S. molita.

Cinygma gartrelli McDunnough (Heptageniidae)

Material examined


Diagnosis

Male adults are recognized by the presence of a serrate inner spine and a ventral subapical spine on each penis 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

Cinygma 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 (1935a) provided an identification key for Nearctic male adults belonging to this genus, there are presently no keys that incorporate all described species.

Cinygma par (Eaton) (Heptageniidae)

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

Material examined

Cinygma 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), Additional 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).


**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 Nearthic 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 (1935a) 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 1935a) 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 congeners larvae. Although Traver (1935a) provided an identification key for Nearthic male adults belonging to this genus, there are presently no keys that incorporate all described species.

**Heptagenia adaequata** McDunnough (Heptageniidae)

**Material examined**


**Diagnosis**

Adults of _H. adaequata_ are brown, triangular patches on the abdomen.

**Distribution**

_Heptagenia adaequata_ was found in one Saskatchewan material (McDunnough) mentioned that G Edmunds collected in Idaho, but no other data were available. States by Edmunds et al. (1976). The species of the species in Idaho and reported examined).

**Remarks**

These new records also represent important records. The species name has sometimes been used (e.g., Edmunds et al. 1976). Most western Nearthic records for the species have been examined using the key provided by Traver (1935a).

**Ironodes flavipennis** McDunnough (Heptageniidae)

**Material examined**

_Holotype_: male adult, British Columbia, 1935. _Additional material_: one adult, British Columbia, 1935. _Additional material_: one adult, British Columbia, 1935.

**Diagnosis**

Male adults of _I. flavipennis_ are those found in other congeners near to the species. They are black, with pale brown penes lobes and golden patch slightly (Day 1952) marked in the postocular region. The larvae of _I. flavipennis_ is generally similar to _I. adaequata_ (McDunnough 1924).

**Distribution**

_Ironodes flavipennis_ is widely distributed in North America. The species is generally similar to _I. adaequata_ (McDunnough 1924).

**Remarks**

The 1989 collection of _I. flavipennis_ is one of the reasons this species has difficulties associated with its identification.
ale adults, five female adults, 8.vi.1929, JH Pepper (CNC);
Pepper (CNC); 47 larvae, Al-
1.vi.1929, JH Pepper (CNC).
ale Co., West Lost Trail Cr.,
larvae, Colorado, Routt Co.,
viii.1967, BR Oblad (PERC);
Lumber Mill, nr. Wolf Creek
ark Co., Spencer, 6.vii.1969,
Co., Big Cottonwood Cr. at
tle (PERC); one male adult

spine on each penes lobe that

can geners.

of C. confusa, which was
1924). Coloration differences
male genitalia, namely "the
Dunnough (1924) to separate
tected from the same locales.
confusa were closely related,
with C. par. Edmunds (1962)
tal site led to significant vari-
sidered C. hyalina. The ef-
orphology of both larvae and
(e.g., McCafferty and Huff
of adult specimens consistent
that exhibited a range of
(Dunnough 1924). There-
synonym of C. par
not be distinguished confi-
1935a) provided an identifica-
t, there are presently no keys

(Heptageniidae)

RN Chrystal (CNC). Addi-
4.vii.1930, JH Pepper (CNC); R
at Salmon, 3.vii.1987, GF
Co., "ca. 2 mi. E Elsie;"

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, 1925a), Bedmarik 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 report 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 (1935a).

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

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 (1935a, Fig. 6; 1935b, 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 1935a), whereas the
larvae of other Ironodes species have tarsi that are more darkly (Traver 1935a) 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 1935a,
1935b).

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 difficu-
lties associated with its identification and the misrepresentation of its male genitalia.
in the literature (see Diagnosis above). Thus, the identification keys provided by Traver (1935a) 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. arcticus Traver, have eyes that are contiguous or nearly so, as is the case in Epeorus (Traver 1935a, 1935b). 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**


**Diagnosis**

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

**Neophephera bicolor** McDunnough (Neophephemeridae)

**Material examined**

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


Diagnosis

The adults of N. bicolor are distinguished from those of other congenic 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 1925b; Traver 1935a).

Remarks

Neophephera 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 1925b) or N. youngi (Berner 1956) and, therefore, the paratype label must be in error. In a revision of the Neophepheraeidae, 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 Neophephera 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 Neophephera sp. A, until rearing experiments are conducted. All known adults and larvae belonging to the family Neophepheraeidae 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 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. 3a).

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 (1935a) provided a key for male adults of P. croesus and P. midas.

Siphlonurus autumnalis McDunnough (Siphlonuridae)

Material examined


Diagnosis

The adults of S. autumnalis, genitalia: “the first joint of the forewings projecting inner angle, as is found in P. midas, the inner margin rounded; further back between the forceps bases is a long, angulally excavate” (McDunnough 1938). The male is dark veins and crossveins and, unlike P. midas, has distinct ventral markings on the abdomen.

Description

Mature larva. Body length 25-30 mm. Surface mottled brown on pale-yellow background. Lateral ocellus contiguous with posterior margin of pronotum. Head generally pale; femora with narrow and tarsi with basal and apical band, with brown anteromedial discolored, prodominal tracheae dark and conspicuous anteromedially (Fig. 5); sternum 9 median projection slightly concave. Single segments 3–7; gill trachea broad, submedial crossband and lateral.

Distribution

This species was reported from Washington (1931a). An anecdotal report of sighting was substantiating data by Newell (1970), who reportedly had seen from Washington and actual records, which include data study and authentication by other specimens of S. autumnalis that unequivocally and formally establish its range in

Remarks

The above description refers to the genus Siphlonurus, and presumably to the species S. autumnalis. Larvae in this genus are commonly confused with the larvae of the genus Siphlonurus. Eaton (1958) performed with confidence without knowledge of the larval morphology characteristics of the genus, was unable to identify western Nectaridae adults at the definitive late summer emergence period.

The few records and collected are a part of the habitat of the larva, on the rocky edge waters of large rivers and streams (Edmunds et al. 1976).
l) (Siphlonuridae)

Curran (CNC); one male adult, distinguished in the adult stage from species of Parameletus Bengtsson of the forewings and the structure of P. croesus is tinted wing of P. midas may be tinted of P. croesus has a deep notch during 1923, Fig. 3a).

Itawa, Ontario.

within the last 75 years. We do not know the habits of species in the genus except years, little collecting of formerly, the short vernal life of species (Edmunds 1957; McCafferty ts of this genus swarm in early spring in pools that may contain emer iacae) (Edmunds et al. 1976). The id a key for male adults of

P (Siphlonuridae)


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 1931a). 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 submedial 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 pos tero-median 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 (1931a). 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 (1935a) 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).
Acknowledgements

G Stuart Walley (Nepean, Ontario) discussed these species and provided personal insight. Ian Smith and Raymond Hutchinson provided assistance with material at the Canadian National Collection. The following individuals assisted by loaning or donating material for study: Ed DeWalt and Colin Favret (Illinois Natural History Survey), George Edmunds (Salt Lake City), E. Richard Hoebeke (Cornell University), Dennis Lehmkuhl (University of Saskatchewan), Jan Peters (Florida A&M University), Pam Reece (The University of British Columbia), Robert Sites (University of Missouri at Columbia), Robert Waltz (Indiana Department of Natural Resources), and Jeff Webb (University of Saskatchewan). We thank Catherine Rayon (Purdue University) and Alain Thomas (University of Paul Sabatier) for assistance and discussion. This study was funded in part by Canacoll Foundation grant 178 to LMI, a fellowship from the United States Environmental Protection Agency to LMI, and United States National Science Foundation grant DEB-9901577 to WPM.

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(Rceived: 26 July 2001; accepted: 22 January 2002)