

## SYSTEMATICS AND BIOLOGY OF *ACENTRELLA TURBIDA* (McDUNNOUGH) (EPHEMEROPTERA: BAETIDAE)

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**Abstract.**—The larval stage of *Acentrella turbida* (McDunnough) is described for the first time. Populations from British Columbia and Oregon are the basis of the description and also represent new geographic records for the species. *Acentrella carolina* (Banks), the only other described species of *Acentrella* lacking hindwings in North America, is shown to be a junior synonym of *A. turbida*. Keys are provided for distinguishing North American species of *Acentrella* in both the adult and larval stages. The European species *A. sinaica* Bogoescu is closely related to *A. turbida*, the two sharing nearly identical larval and adult morphology but differing mainly in the presence or absence of hindwings, respectively. Abdominal coloration of male adults of *A. turbida* quickly fades in alcohol-preserved specimens. Notes on emergence times and habitat of *A. turbida*, based mainly from studies on the Atnarko River in British Columbia, are provided.

**Key Words.**—Insecta, Ephemeroptera, Baetidae, *Acentrella turbida*, North America, larval description, keys

A major problem in the taxonomy of the Ephemeroptera of North America, and elsewhere, is the lack of descriptive and comparative larval data (McCafferty et al. 1990). This is particularly acute in the complex family Baetidae, where many species remain unknown in the larval stage, and where larval characteristics often are indispensable for both species diagnosis and interpreting phylogenetic relationships (e.g., Waltz & McCafferty 1987a, b, c; McCafferty & Waltz 1990). Within Baetidae, species previously described under the name *Pseudocloeon* Klapálek in North America are especially poorly known as larvae. These species have been variously recombined with other genera (see McCafferty & Waltz 1990) because *Pseudocloeon* proved to be an artificial construct for baetine species possessing paired marginal intercalaries in the forewings and lacking hindwings.

Certain species originally described in *Pseudocloeon* have proven to belong to *Acentrella* Bengtsson. In North America this has included *A. carolina* (Banks) and *A. turbida* (McDunnough) (Waltz & McCafferty 1987a). *Acentrella* has recently been comprised of five nominal species in North America, the other three being *A. ampla* Traver, *A. insignificans* (McDunnough), and *A. lapponica* Bengtsson (McCafferty & Waltz 1990). Of these species, only *A. turbida* has been thought to be unknown as larvae. Upon recently procuring an extensive series of adults and larvae of *A. turbida* from British Columbia, we sought to study this material and provide a first larval description. Our analysis and comparison with other *Acentrella* indicated that *A. turbida* and *A. carolina* are conspecific.

We report *Acentrella turbida* in British Columbia for the first time. The rugged coastal area of British Columbia, from where it was collected, was discussed by Wigle & Thommasen (1990). We also have studied larvae from Oregon that match

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the associated larvae from British Columbia. Previously, *A. turbida* was reported from Alberta (McDunnough 1924), Utah (Edmunds 1954), and Colorado (McCafferty et al. 1993). *Acentrella carolina* s. auctt. has been known from eastern and midwestern North America.

In addition to nomenclatural changes, we herein give: (1) a morphological description of the larvae of *A. turbida*, (2) comments on possible relationships of the species, (3) diagnostic keys to the larvae and male adults of *Acentrella* species in North America, (4) some notes on the adult coloration in the species, and (5) notes on the habitat and biology of the species in British Columbia. The larval description will serve as a first complete description of the species, because larval morphological information previously has been restricted to incomplete data referred to *A. carolina* in keys by McDunnough (1931, 1932).

Materials upon which this study has been based are deposited in the Oregon State University Collection, the Purdue Entomological Research Collection, and in private collections of the authors.

*ACENTRELLA TURBIDA* (McDUNNOUGH), 1924

*Pseudocloeon turbidum* McDunnough, 1924

*Pseudocloeon carolina* Banks, 1924, NEW SYNONYM

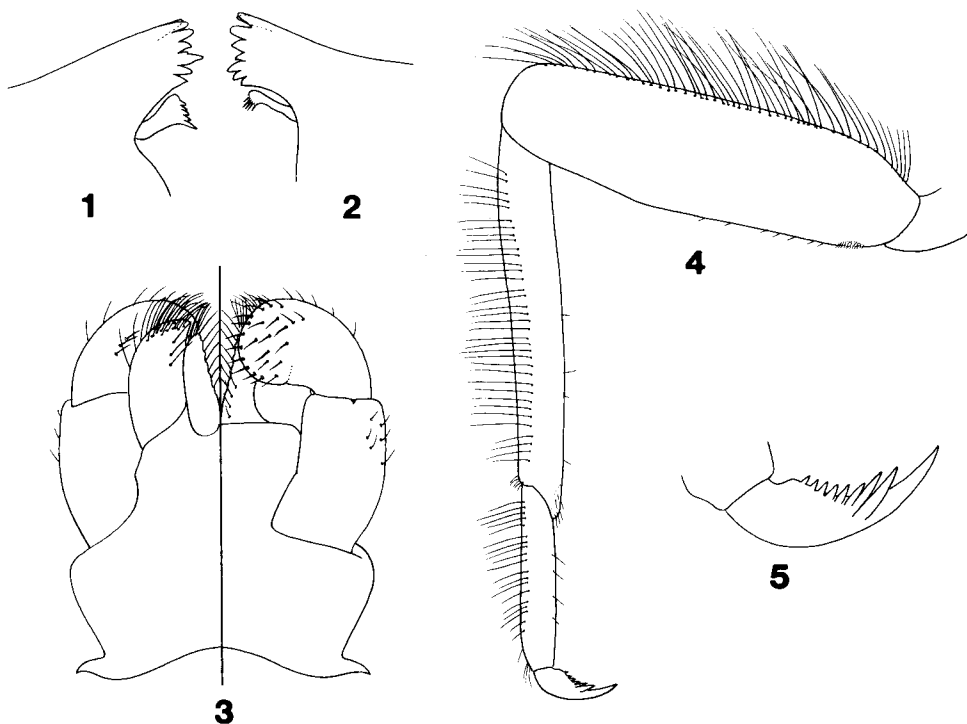
*Acentrella turbida* (McDunnough): Waltz and McCafferty, 1987a

*Acentrella carolina* (Banks): Waltz and McCafferty, 1987a, NEW SYNONYM

*Larval Morphology*.—Length excluding caudal filaments: 4–6 mm. *Head*: head capsule broader than long; frons without medial process. Antennae longer than head capsule, with pedicel subequal to scape in length (each with fine setae). Labrum width approximately  $2.0 \times$  length; submarginal setae 1 + 5–6; other setae present at base. Right and left mandibles with incisors (Figs. 1 and 2) bent backward and inner surface serrate at margin, with 7–9 discernible denticles (outermost dorsally juxtaposed to second denticle); molar process of left mandible prominent (height ca.  $2.0 \times$  basal width). Maxillary palpi short and robust, subequal in length to galealaciniae. Labial palpi (Fig. 3) compact, subequal in length to apices of glossae and paraglossae; segment 2 length subequal to segment 3, with lobe weakly developed, and with 2–3 dorsal setae; innermost setal row of each paraglossa with 5–6 setae; each glossa with 5–6 setae projecting medially. *Thorax*: Hindwingpads absent. Legs (Fig. 4) with well-developed row of long fine setae on femora, tibiae and tarsi; femoral setae approximately  $0.60\text{--}0.75 \times$  width of femora; short, sharp setae on venter of femora and tibiae, and somewhat longer ones on venter of tarsi; claws (Fig. 5) with 8–10 denticles and lacking distal subapical setae. *Abdomen*: Dorsal color pattern as in Figs. 6–8. Tergal surfaces with fine setae, without scales, and with tergal marginal spines poorly developed as short, sharp, single spiculae. Paraproct surface with pores, setae, and small spines; posteromedial margins with sparse spines. Abdominal gills  $1.5\text{--}2.0 \times$  length of respective tergum, slightly asymmetrical, with posterior margins more rounded, and both margins smooth with very sparse fine setae. Caudal filaments not banded; median terminal filament consisting of one segment.

*Diagnosis*.—See key.

*Species Relationships*.—*Acentrella turbida* is most closely related to *A. sinaica* Bogoescu, presently known from Romania, Italy, Poland, Portugal, and Switzer-



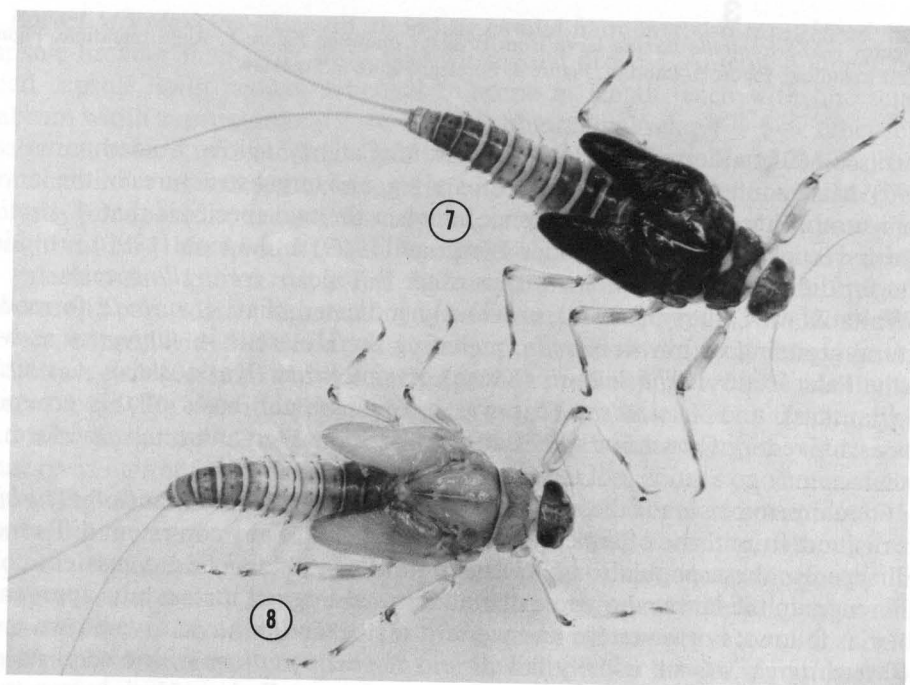
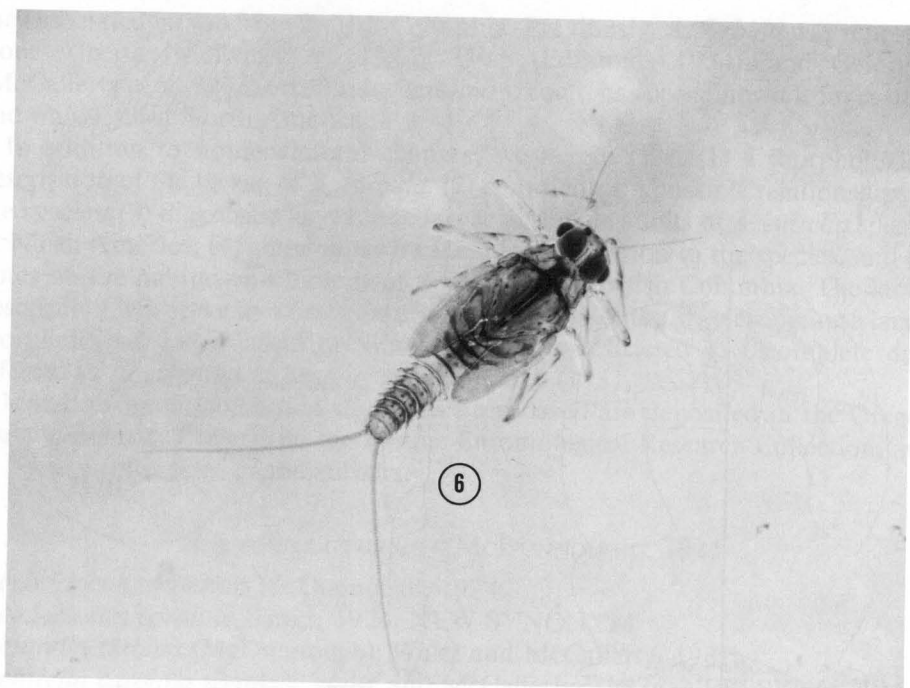
Figures 1–5. *Acentrella turbida* larva from British Columbia. Figure 1. Right mandible. Figure 2. Left mandible. Figure 3. Labium. Figure 4. Foreleg. Figure 5. Foreclaw.

land (see Müller-Liebenau 1969, Waltz & McCafferty 1987a, Studemann et al. 1992). Male adult genitalia and mouthpart, leg, and tergal structures of the larvae are symmorphous. The major difference between the two species is that *A. sinaica* retains vestigial hindwings. Müller-Liebenau (1969) and Jacob (1990) provided data for differentiating *A. sinaica* from other European *Acentrella* species.

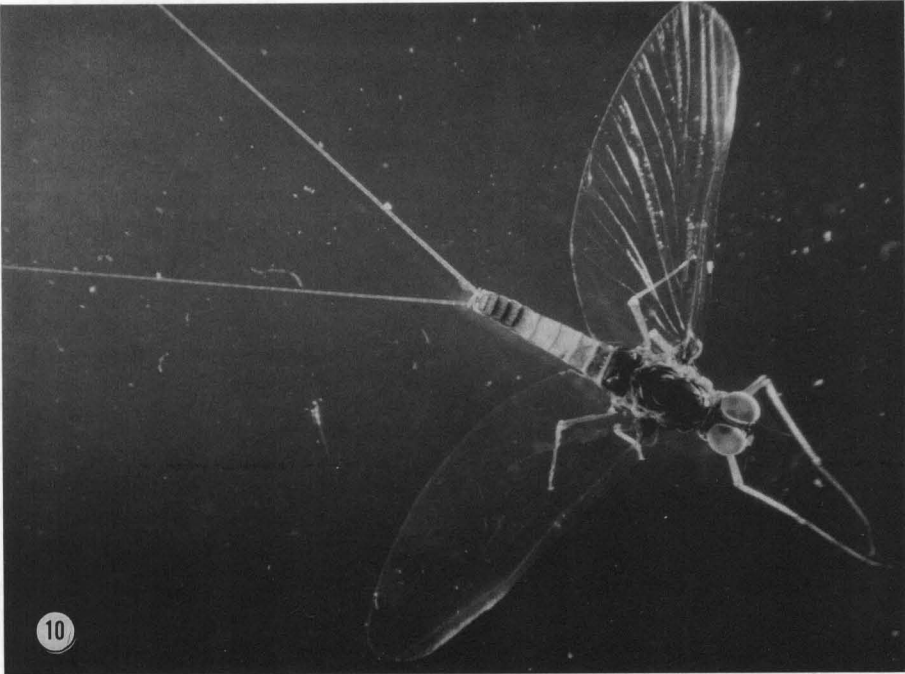
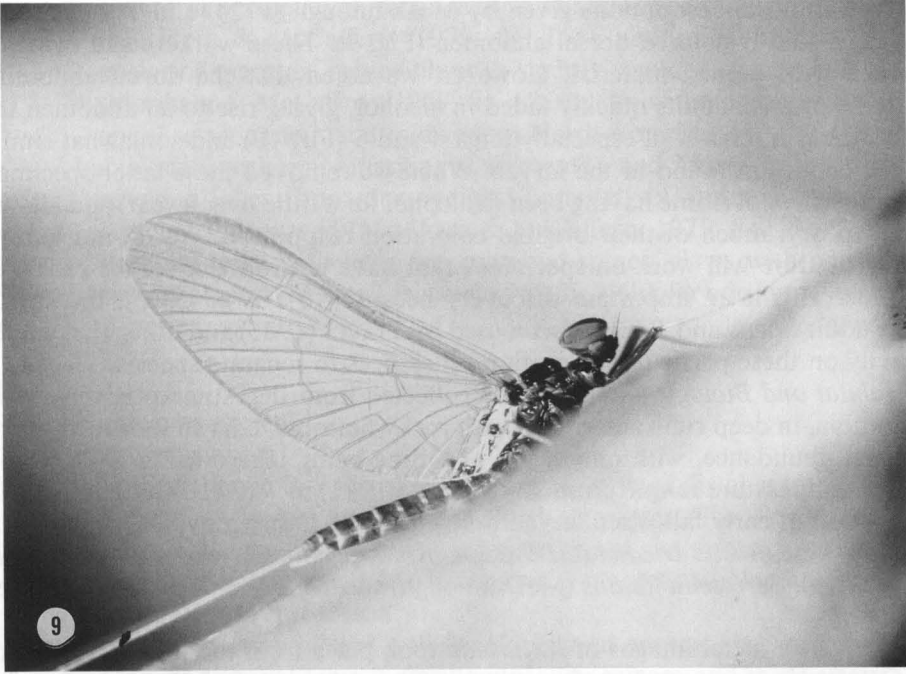
Waltz & McCafferty (1987a) previously indicated that *A. turbida* formed a natural grouping within *Acentrella*, including the Holarctic *A. lapponica* as well as the Palearctic *A. chatauensis* (Kluge), *A. fenestrata* (Kazlauskas), *A. sibirica* (Kazlauskas), and *A. sinaica*. This was inferred on the basis of this grouping possessing reduced posterior spines on the abdominal terga that take the form of spiculae.

It remains to be seen if the western and northwestern populations of *A. turbida* are disjunct from those of the east and southeast, and if any consistent differences will separate these populations. We have not been able to find consistent color differences in the larvae; however, the abdominal terga of male adults apparently differ as follows: northwestern and western males tend to have olive brown terga (although terga 3–6 are usually faded) and segment joinings of the cerci do not appear darkened; southeastern and eastern males usually have dark brown terga (also often faded in terga 3–6), and segment joinings of the cerci tend to be darkened. If, in the future, these minor differences prove to be consistent, recognition of two geographic subspecies may be warranted.

*Adult Coloration.*—Freshly collected male adults of *A. turbida* were found to



Figures 6–8. *Acentrella turbida* larvae from British Columbia. Figure 6. Variation 1 (male). Figure 7. Variation 2 (female). Figure 8. Variation 3 (female).



Figures 9–10. *Acentrella turbida* male adults from British Columbia. Figure 9. Color pattern in life. Figure 10. Color pattern after being alcohol-preserved.

be typical of the descriptions given by McDunnough (1924) and Traver (1935), having a solidly colored dorsal abdomen (Fig. 9). These workers had evidently worked with pinned material. However, we noted that the dorsal abdominal patterns of male adults quickly faded in alcohol, giving rise to an abdomen that was lighter in terga 3–6, especially terga 4 and 5 (Fig. 10) and somewhat similar to the condition found in the larvae. When we removed these latter specimens from the alcohol (some having been in alcohol for a little over a year) and allowed them to dry, much of their original coloration reappeared. We do not know if this procedure will work on specimens that have been in alcohol for prolonged periods. This is an important discovery because, to a large extent, the keys to male adult *Baetis* and *Pseudocloeon* used by Traver (1935) and others have relied heavily on these particular coloration differences to separate species.

*Habitat and Biology.*—Larvae were collected from the Atnarko River, British Columbia, in deep riffle and rapids with rocky bottoms. Larvae were never taken in great abundance, with only a few at a time being taken with a D-frame net. Water temperature ranged from 14° C (8 Sep 1991) to 7° C (16 Oct 1990) during the period of early fall when larvae were collected. Other mayflies taken with *A. turbida* were *Baetis tricaudatus* Dodds, *Rhithrogena* sp., and *Drunella doddsi* (Needham). *Serratella tibialis* (McDunnough) was common until about mid September.

Emergence of subimagos of *A. turbida* took place from the first to the middle of October in large numbers from deep riffles and runs of moderate to fast flow areas of the river. The daily emergence period began at about 13:00 h and abruptly ceased at about 16:30 h. Emergence occurred during a wide variety of weather conditions, including overcast, rainy, clear, and sunny weather when wind was calm or slight.

Reports of habitat and emergence of *A. turbida* in the east have basically been limited to Traver's (1935) comment that larvae of *A. carolina* were taken abundantly in mountains of North Carolina. In addition, a table by Unzicker and Carlson (1982) indicated that *A. carolina* occurred in the mountains and Piedmont of North and South Carolina and that emergence took place from April to August.

*Material Examined.*—OREGON. COOS Co.: S Frk Coquilla Riv, 12 Jun 1982, C. W. Courtney, several male and female larvae. DOUGLAS Co.: S Umpqua Riv, 19 Jul 1980, C. W. Courtney, several male and female larvae. CANADA. BRITISH COLUMBIA: Bella Coola Watershed, Atnarko R. near Flat Rock, 1–16 Oct 1990, 8–19 Oct 1991, M. J. Wigle, several male and female larvae and adults.

#### KEYS TO THE NORTH AMERICAN SPECIES OF *ACENTRELLA*

##### Mature Larvae

- 1a. Hindwingpads present ..... 2
- 1b. Hindwingpads absent ..... *A. turbida*
- 2a (1b). Dorsum of femora, tibiae, and tarsi with dense row of long, fine setae (Moriyama & McCafferty 1979: fig. 14d); western and far northern North America ..... *A. insignificans*
- 2b. Dorsum of tibiae and tarsi nearly bare (Moriyama & McCafferty 1979: fig. 15b) or with shorter, more robust setae only (Moriyama & McCafferty 1979: fig. 13c) ..... 3
- 3a (2b). Labial palpi with segments 1 and 2 nearly parallel sided (from dor-

- soventral perspective), inner margin of segment 2 almost straight (Mori-hara & McCafferty 1979: fig. 15a); abdominal terga with posterior marginal spines blunt to slightly rounded, not spiculate (Mori-hara & McCafferty 1979: fig. 15e); claws without pair of sub-apical setae; eastern and midwestern North America . . . . . *A. ampla*
- 3b. Labial palpi with inner margins of segments 1 and 2 forming broadly rounded lobes (from dorsoventral perspective), inner margin of segment 2 decurved (Mori-hara & McCafferty 1979: fig. 13b); abdominal terga with very fine marginal spines; claws with paired subapical setae (Müller-Liebenau 1969: fig. 46h); far northern North America . . . . . *A. lapponica*

Male Adults

- 1a. Hindwings present . . . . . 2
- 1b. Hindwings absent . . . . . *A. turbida*
- 2a (1a). Abdominal terga 2–7 translucent brown; length of distal segment of forceps 4 × width; far northern North America . . . . . *A. lapponica*
- 2b. Abdominal terga 2–6 yellow-brown or tinged with smoky brown; length of distal segment of forceps ca. 3 × width; all North American regions represented . . . . . 3
- 3a (2b). Turbinate portion of eyes well developed and orange; body 6–7 mm long; abdominal terga 2–6 yellow-brown; eastern and midwestern North America . . . . . *A. ampla*
- 3b. Turbinate portion of eyes relatively small and bright red; body 4–5 mm long; abdominal terga 2–6 tinged with smoky brown; western and far northern North America . . . . . *A. insignificans*

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