

**CONTRIBUTION TO THE BIOLOGY AND SYSTEMATICS
OF *EPHEMERELLA ALLENI*
(EPHEMEROPTERA: EPHEMERELLIDAE)**

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Abstract.—The adult stages of the western Nearctic species *Ephemerella alleni* Jensen & Edmunds are described for the first time based on reared specimens from Mount Rainier National Park, Washington, USA. Male adults are distinguished by having ganglionic marks on the abdominal sternum, genital forceps segment 2 with a distal expansion, penes with short apical projections, and spinulelike setae medially near the outer margin and along the inner margin of the medioapical cleft. Eggs have a smooth chorion. Larvae are distinguished from congeners by having a smooth frons and abdominal terga with distinctive paired spines. Morphological variability in these and other structures can confound identification of single specimens or short series of specimens. Our collection data represent the first new records of the species since its original description in 1966.

Key Words.—*Ephemerella alleni*, Ephemerellinae, Ephemerellidae, stage descriptions, variability, USA Northwest, new distribution data.

Ephemerella alleni Jensen & Edmunds (Ephemeroptera: Ephemerellidae) was described based on larvae that were collected from three locales in northwestern USA: Opal Creek, Lemhi County, Idaho; a small stream in Glacier National Park, Glacier County, Montana; and Lava Creek, Park County, Wyoming (Jensen & Edmunds 1966). No new records have been reported since the original description, and the alate stages have not been described. Allen (1968) included *E. alleni* larvae in an identification key to western North American *Ephemerella* Walsh species and noted that *E. alleni* probably had an affinity with *E. aurivillii* Bengtsson. The species falls within the restricted concepts of the genus *Ephemerella* (Tshernova 1972, Allen 1980) and the subfamily Ephemerellinae (McCafferty & Wang 2000).

Ephemerella alleni larvae were collected and reared to the adult stage as part of recent aquatic insect surveys in Mount Rainier National Park (MRNP) (e.g., Kondratieff & Lechleitner 2002). Based on this and additional material, we are able to provide new distribution data, biological data, and the first descriptions of the adult and egg stages for this relatively unfamiliar species. Our description of the egg is based on eggs that we dissected from a reared female adult. These eggs were temporarily mounted in alcohol on a well slide and examined with a phase-contrast compound microscope at 500× magnification. We provide diagnostic characteristics for both larvae and male adults, because series of specimens from MRNP and elsewhere exhibit variation in morphology, which can make the species difficult to recognize. The present study is part of ongoing faunistic studies of the western United States Ephemeroptera (e.g., Meyer & McCafferty 2001, Lester et al. 2002, McCafferty et al. 2002) and revisionary and descriptive contributions to the genus *Ephemerella* (e.g., Jacobus & McCafferty 2003, Jacobus et al. 2003).

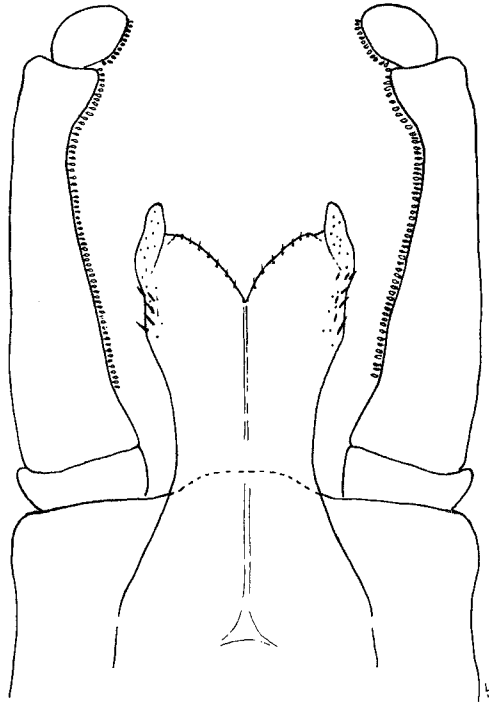


Figure 1. *Ephemera alleni*, male genitalia, dorsal view.

Ephemera alleni Jensen & Edmunds
(Fig. 1)

Types.—Holotype, larva, data: IDAHO. LEMHI Co., Opal Cr at jct Panther Cr, ca. 29 km (18 mi) W of Cobalt, Salmon NF, 12 Jul 1964, Thornton; deposited: Purdue University Entomological Research Collection, West Lafayette, Indiana (PERC). Paratypes: same data and deposition as holotype, 1 larva. WYOMING. PARK Co., Lava Cr, 6.4 km (4 mi) E of Mammoth Hot Springs, Yellowstone NP, 2371 m (7780 ft) elev, 26 Jun 1964, SL Jensen, JW Richardson, 2 larvae; deposited: PERC.

Description.—Egg. Single polar cap, pale; sometimes enlarged, but not nipplelike. Chorion light brown, relatively smooth with few knob-terminated coiled threads distributed relatively evenly over surface.

Male adult. Length: body 9.5–10.2 mm, forewings 10.8 mm, caudal filaments 12.7 mm. Head dark brown. Antennae with scape and pedicel dark brown; basal flagellar segments dark brown, distal segments pale. Ocelli white; base brown with proximal black ring. Compound eyes contiguous; upper portion orange-red; lower portion black. Thorax dark brown with variable pale and black markings; prothorax with median ridge. Wings hyaline with milky tinge; stigmatic area lightly clouded with white; costa and subcosta light brown; some longitudinal veins light brown distally, otherwise pale; intercalaries and crossveins hyaline. Forelegs brown to pale brown, each tarsal segment with pale distal ring; length (mm) of segments: trochanter = 0.4, femur = 2.0, tibia = 2.9, tarsus I = 0.1, tarsus II = 1.0, tarsus III = 1.1, tarsus IV = 1.0, tarsus V = 0.3. Mid- and hindlegs pale with brown distal tarsal segments and claws. Abdomen dark purple-brown anteriorly, red-brown posteriorly. Abdominal terga with pale anterior margin with paired, brown, submedian, saggital streaks, and with pair of pale sublateral spots ringed with brown. Abdominal pleura pale. Abdominal sterna pale, with brown triangles in anterolateral corners and paired submedial maculae; segments 1, 2, and 4–7 with ganglionic marks; sternum 9 brown laterally. Genitalia (fig. 1) brown with forceps pale medially. Penes with medioapical cleft and dorsal mediolongitudinal groove. Penes lobes with stout, spinulelike setae medially near outer margin, and with small, spinulelike setae along inner

margin of cleft; with setal pits near outer margin in distal half, and with slightly developed apical projections. Forceps segment 2 slightly expanded distally; forceps segment 3 ovoid, with length nearly 1.5 × width. Median caudal filament and cerci subequal in length, purple-brown proximally, pale distally, with dark annulations at distal margin of each segment, and covered with hairlike setae.

Female adult. Length: body 10.2–10.7 mm, forewings 11.2–12.5 mm, caudal filaments 12.1 mm. Head pink with dark brown triangle on occiput. Thorax with pink maculation; longitudinal wing veins brown. Abdominal segments 1–8 translucent; segments 1, 8–10 with extensive pink maculation; segments 6 and 7 with few pink maculations; terga 1–10 with posterior margins brown. Otherwise similar to male.

Diagnosis.—Eggs have a single polar cap and smooth chorion, and they are indistinguishable from those of many other western Nearctic *Ephemerella* (Bengtsson 1913, Koss 1968, Studeman et al. 1995, Studemann & Landolt 1997). The egg of *E. mucronata* Bengtsson, in contrast, has the chorionic surface covered with scalelike hexagonal reticulations (Studemann et al. 1995: figs. 16–18, Studemann & Landolt 1997: fig. 12).

Larvae are most easily differentiated from other western Nearctic *Ephemerella* by characters associated with the abdominal terga and head. *Ephemerella alleni* and *E. verruca* have similar small, very sharp spines (“tubercles”) on the posterior margins of at least one of the abdominal terga 4–9 (Allen & Edmunds 1965: fig. 30, Jensen & Edmunds 1966: figs. 4, 5, Allen 1968: figs. 18, 23). The spines of *E. alleni* and *E. verruca* are sharper and closer together than those of congeners. *Ephemerella alleni* larvae (Jensen & Edmunds 1966: fig. 1), however, do not have the blunt suboccipital and ocellar spines (“tubercles”) associated with *E. verruca* (Allen & Edmunds 1965: fig. 71, Jensen & Edmunds 1966, Allen 1968: fig. 16). *Ephemerella alleni* variants that have only slightly developed tergal spines can be difficult to distinguish from certain variants of *E. excrucians* Walsh and *E. dorothea infrequens* McDunnough (see Jacobus & McCafferty 2003), except that *E. alleni* larvae have very few setae, or spicules, on the abdominal terga, and these usually are present only on the anterior half of terga. In addition, whereas the cuticle of most other *Ephemerella* species usually has some white spots or longitudinal stripes, the cuticle of *E. alleni* is usually solid brown.

Male adults of *E. alleni* are distinguished from other western Nearctic *Ephemerella* species by their genitalia (fig. 1). In particular, genital forceps segment 2 is expanded distally, and each penes lobe has stout and spinulelike setae medially near the outer margin, small and spinulelike setae on the distomedial margin, and a slightly developed apical projection. The genitalia of *E. alleni* are most similar to those of *E. aurivillii* (see e.g., Traver 1935: fig. 155, Burks 1953: fig. 130, Allen & Edmunds 1965: fig. 18, Allen 1968: fig. 8), *E. maculata* Traver (Traver 1934: figs. 1, 13, Traver 1935: fig. 155, Day 1956: figs. 3.23a,b, Allen & Edmunds 1965: fig. 16, Allen 1968: figs. 3, 10), and *E. verruca* (Harper & Hawkins 1984: fig. 1). *Ephemerella maculata* and *E. verruca*, however, lack stout, spinulelike setae on the penes, and *E. aurivillii* has a more developed distal expansion of forceps segment 2, penes lobes with much larger apical projections, and larger setae at the margin of the cleft. *Ephemerella alleni* has ganglionic marks on some abdominal sterna.

Adult variability.—The forelegs of males vary in color from brown to very light brown, almost pale. The distal expansion of genital forceps segment 2 varies slightly in its relative development, but none of the specimens we examined have the expansion as well developed as that of *E. aurivillii*. The number of spinulelike setae on the penes is variable, and sometimes these setae are difficult to observe.

Larval variability.—Some larvae have very slight bumps on the ocellar region of the head, but these bumps are not as well developed as the blunt ocellar spines of *E. verruca*.

The abdominal tergal spines of some larvae are inconspicuous. The caudal filaments of some individuals do not have long setae present laterally. Thus, these individuals will be misidentified as *Serratella* Edmunds when keys or diagnostic characters given by Day (1956), Edmunds (1959), Allen & Edmunds (1963, 1965), and Edmunds & Waltz (1996) are used.

Biology.—Alate stages of *E. alleni* emerge in early summer, and larvae have been collected from cobble and gravel in headwater streams (Jensen & Edmunds 1966), many of which are spring fed. At MRNP, *E. alleni* larvae occur only in larger seeps, and *Drunella doddsii* (Needham), *D. spinifera* (Needham), *Caudatella hystrix* (Traver) (Ephemereillidae), *Ironodes* sp. (Heptageniidae), and *Baetis bicaudatus* Dodds (Baetidae) have been collected together with *E. alleni*. *Caudatella hystrix* has been found with *E. alleni* at several of the Oregon locations cited below. Jacobus & McCafferty (2003) discussed a variant of *C. hystrix* that is found with *E. alleni* in headwater streams.

Distribution.—Our new records of *E. alleni* represent the first new reports of the species in nearly 40 years (Jensen & Edmunds 1966) and indicate a range of geographic distribution that includes mountainous Idaho, Montana, Oregon, Washington, and Wyoming, USA.

Material examined.—USA. IDAHO. CUSTER Co.: trib Jordan Cr, Yankee Fork Salmon R, May 1996, 1 larva [PERC]; same locale, but 4 Sep 1997, 3 larvae [PERC]. MONTANA. SWEET GRASS Co.: Big Timber Cr at Half Moon Campground, Gallatin NF, Crazy Mountains, 46°02'27" N, 110°14'34" W, 10 Jun 2000, WP McCafferty et al., 8 larvae [PERC]. OREGON. DOUGLAS Co.: Bulldog Cr, Umpqua NF, 19 Jun 1998, larvae [PERC]; JACKSON/JOSEPHINE Cos.: McDonald Cr, Rogue River NF, 7 Oct 2000, 12 larvae [PERC]; KLAMATH Co.: Sun Cr and Lost Cr, Sep 1994, 3 larvae [PERC]; same locale, but 18 Aug 1998, 7 larvae [PERC]; same locale, but 9 Sep 1998, 1 larva [PERC]; LANE Co.: Beaver Cr, Willamette NF, Rigdon Ranger District, 15 Aug 1995, 10 larvae [PERC]; Shadow Spring, Willamette NF, Rigdon Ranger District, Sep 1997, 1 larva [PERC]; MARION Co.: trib French Cr at FS Rd 2225-450, ca. 610 m (2000 ft) elev, Willamette NF, Detroit Ranger District, 19 Mar 1998, RW Wisseman, 6 larvae [PERC]; MULTNOMAH Co.: Wahkeena Cr, spring head, Colorado River Gorge, 45°34' N, 122°8' W, 183 m (600 ft) elev, 21 Jun 1989, 1 larva [PERC]. WASHINGTON. PIERCE Co.: stream 3.1 km (1.9 mi) N of Hwy706 on Westside Rd, MRNP, 22 May 2003, Kondratieff, Evans, Schmidt, 8 larvae [Colorado State University Insect Collection, Ft. Collins, Colorado (CSUC)]; unnamed large seep to Tahoma Cr, 3.1 km (1.9 mi) N on Westside Rd off Hwy706, MRNP, 21 Jun 2003, Kondratieff, Zuellig, Schmidt, 1 male adult [CSUC]; seep into Fryingpan Cr at Sunrise Rd, MRNP, 12 Jul 2003, Kondratieff and Schmidt, 1 male adult (reared) [CSUC]; seep at Westside Rd, 0.8 km (0.5 mi) N jct Hwy706, MRNP, 22 May 2003, Kondratieff, Evans, Schmidt, two larvae [CSUC]; hillside stream 2.4 km (1.5 mi) from Hwy706 on Westside Rd, MRNP, 46°45'28" N, 121°52'47" W, 766 m (2513 ft) elev, 21 Jun 2003, BC Kondratieff, RE Zuellig, JP Schmidt, 2 male adults (genitalia dissected—one set on slide, one set in microvial), 3 female adults, 1 female subimago, 8 sets larval exuviae, 13 larvae [CSUC].

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