



WHAT IS *CAPNIA UMPQUA* FRISON? (PLECOPTERA: CAPNIIDAE), DISTRIBUTION AND VARIATION OF TERMINALIA

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ABSTRACT

Capnia umpqua Frison is redescribed from specimens from Oregon and California. Images of the male and female terminalia are provided by scanning electron micrographs of specimens from throughout its range. Color photographs taken using a light microscope are also given illustrating the male terminalia. Complete distribution data are listed for material identified in this study. The misidentification of the concept of *C. umpqua* in Nelson and Baumann (1989) is corrected making it possible to correctly identify adults.

Keywords: Stoneflies, Plecoptera, Capniidae, *Capnia umpqua*, taxonomy, distribution, California, Oregon.

INTRODUCTION

The Holarctic stonefly genus *Capnia* contains 56 species in North America (Stark et al. 2009). The species *Capnia umpqua* was described by Frison (1942) from southern Oregon and adequate figures were provided. Jewett (1959, 1960) in his studies of the stoneflies of the Pacific Northwest and California included the species with one of Frison's figures and gave additional records from Trinity County, California. This species was incorrectly figured and keyed in the revision of the then known 52 species of *Capnia* in North America (Nelson and Baumann 1989) and placed in the Californica Group. These authors inadvertently used an undescribed species to illustrate and diagnose the male because it had paired knobs on tergum 9 and the female subgenital plate narrowed apically, which did not conform to Frison's original description of knobs on tergum 8

and a subgenital plate that was broadly rounded to triangular apically. Thus, it was impossible to key out true *C. umpqua* specimens using this publication. However, even though the majority of the specimens listed under *C. umpqua* in Nelson and Baumann (1989) were that species, those used for the illustrations are actually an undescribed species in the Californica Group that will be addressed in a subsequent publication.

The problems noted above were discovered by "the junior author", who along with our colleague Eugene Drake collected a series of specimens from Trabuco Canyon, Orange County, California. Males had paired knobs only on the posterior margin of tergum 8 and the epiproct closely resembled Frison's *C. umpqua*, but they would not key out or fit the illustrations given in Nelson and Baumann (1989). Specimens and sketches were sent to Bill Stark in

2005, who agreed that the male terminalia resembled those of the originally described *C. umpqua* and that the species illustrated under this name in Nelson and Baumann (1989) was not the true *C. umpqua*.

The type specimens of *C. umpqua* were borrowed from the Illinois Natural History Survey, which confirmed the identity of the species and showed that the specimens used in Nelson and Baumann (1989) were indeed different. Specimens from Trabuco Canyon and the types of *C. umpqua* were sent to "the senior author" and C. Riley Nelson at Brigham Young University for examination. Subsequently, scanning electron micrographs were made of several populations from central Oregon to southern California, including paratypes from the original type series. It was noted that the specimens from Trabuco Canyon had an epiproct that was relatively longer and narrower, as compared to populations from northern California, leading us to wonder if the southern populations might represent a different species. However, after examining several populations from Oregon and California, including paratypes from the Umpqua River, it was concluded that *C. umpqua* exhibits both inter- and intra specific geographical variation. Most *Capnia* species show little variation in the shape of the epiproct, but the more elongate form and the longer apical slit of the epiproct in *C. umpqua* apparently allow it to vary from being narrow to almost bulbous at midlength.

Consequently, since the possibility of confusion exists in the identification of *C. umpqua* in Oregon and California, based on the illustrations and keys found in Nelson and Baumann (1989), it was deemed necessary to clarify the taxonomic status of *C. umpqua* in the literature. We have thus redescribed the true *C. umpqua* based on the holotype and paratypes from Oregon. In addition, electron micrographs are provided for specimens from several populations from central Oregon to southern California to indicate the range of morphological variation of the epiproct. Color photographs of the male terminalia are included, which will make it easier to compare specimens with those being studied with a light microscope. A discussion section is provided which separates *C. umpqua* from the closely related species, and corrects the key and figure errors found in Nelson and Baumann (1989). Finally, a complete listing of specimens identified as *C. umpqua* in this study is given.

MATERIAL AND METHODS

Adult specimens were collected using a beating sheet and upon examination of streamside vegetation, leaf debris and large objects. Microscope studies were carried out with a WILD M-5 at the University of North Texas and a WILD M-8 at Brigham Young University. Scanning electron micrographs were taken using a Philips XL2 ESEM FEG at Brigham Young University, Provo, Utah.

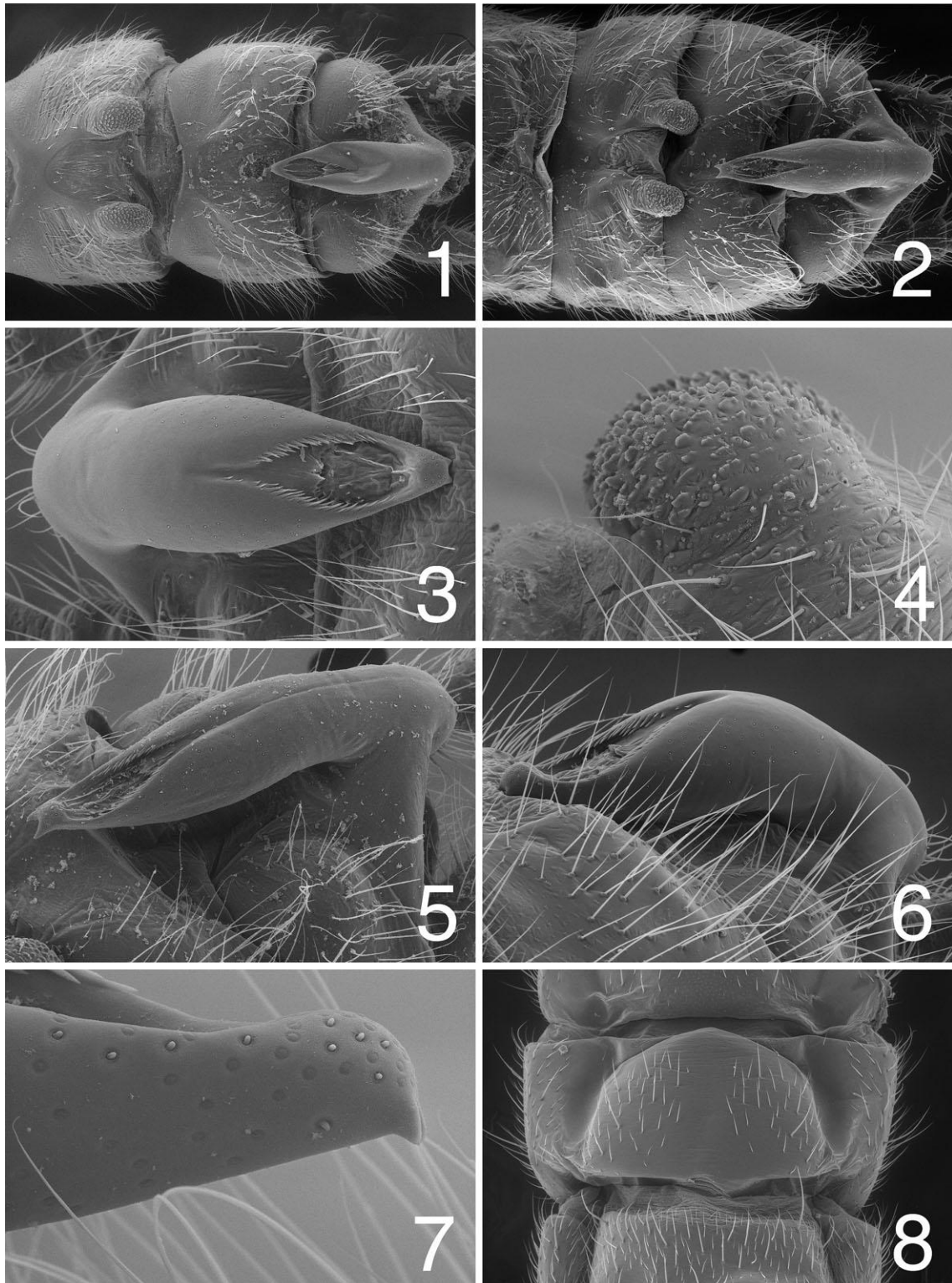
Specimens were studied from the following institutions: Aquatic Bioassessment Laboratory Chico, Chico, California (ABLC); Brigham Young University, Provo, Utah (BYUC); California Academy of Sciences, San Francisco, California (CASC); Illinois Natural History Survey, Champlain, Illinois (INHS); Kenneth W. Stewart Collection, University of North Texas, Denton, Texas (KWSC); University of California, Berkeley, California (UCBC); Wayne C. Fields Collection, Newcastle, California (WCFC).

Capnia umpqua Frison

(Figs. 1-10)

Capnia umpqua Frison 1942:65, Figs. 9a-c. Holotype ♂, Illinois Natural History Survey: Umpqua River, Douglas County, Oregon.

Material examined. USA: (County listings begin in the North and end in the South) OREGON: Marion Co. mouth, Santiam River, 4 March 1950, S.G. Jewett, Jr., 2 ♂ (CASC). Douglas, Co. Umpqua River, 21 February 1939, S.G. Jewett, Jr., holotype ♂, allotype, ♀, 6 ♂, 6 ♀ paratypes (INHS); South Umpqua River, 1 mile SSE Winston, 25 February 1985, M.J. Stansbury, 9 ♂, 6 ♀ (BYUC). CALIFORNIA: Del Norte Co. Smith River, Jedediah State Park, 12 March 1994, G.R. Fiala, 8 ♂, 10 ♀ (BYUC). Trinity Co. Indian Creek, Hwy 299, junction Trinity River, 16 February 1985, R.W. Baumann & C.R. Nelson, 1 ♂, 1 ♀ (BYUC); Weaver Creek, junction Bowns Creek, 25 January 1985, D.R. Lauck, 1 ♂ (BYUC). Humboldt Co. Bull Creek, Humboldt Redwoods State Park, 17 February 1985, R.W. Baumann & C.R. Nelson, 7 ♂, 5 ♀, 4 larvae (BYUC); Klamath River, Aikens Creek, 25 February 2006, J.J. Lee, 2 ♂, 1 ♀ (BYUC); Klamath River, State Creek, 25 February 2006, J.J. Lee, 1 ♂ (BYUC); Mad River, Mad River Road, first bend, 12 February 2006, J.J. Lee, 52 ♂, 33 ♀ (BYUC); 21 March 2006, J.J. Lee, 17 ♂, 16 ♀ (BYUC); 16 January 2007, J.J. Lee, 21 ♂, 14 ♀ (BYUC);



Figs. 1-8. *Capnia umpqua*, adult terminalia, scanning electron micrographs. 1. male terminalia, dorsal, Umpqua River, Oregon; 2. male terminalia, dorsal, Trabuco Creek, California; 3. male, epiproct, dorsal, anterior, Mad River, California; 4. male, lobe, tergum 8, Umpqua River, Oregon; 5. male, epiproct, lateral, Trabuco Creek, California; 6. male, epiproct, lateral, Mad River, California; 7. male, epiproct, hooked-forked tip, lateral, Umpqua River, Oregon; 8. female, subgenital plate, Mad River, California.

Mad River, Mad River Hatchery, 29 January 2006, J.J. Lee, 7 ♂, 3 ♀ (BYUC); 11 February 2006, J.J. Lee, 1 ♂ (BYUC); 7 March 2006, J.J. Lee, 2 ♂, 1 ♀ (BYUC); 20 March 2006, J.J. Lee, 12 ♂, 9 ♀ (BYUC); 2 January 2007, J.J. Lee, 1 ♂ (BYUC); Redwood Creek, near Orick, 29 January 2006, J.J. Lee, 69 ♂ 39 ♀ (BYUC). Lake Co. Big Canyon Creek, Big Canyon Creek bridge, 15 February 2006, J.J. Lee, 2 ♂, 4 ♀ (BYUC). Mendocino Co. South Fork Eel River, junction Sugar Creek, Coast Range Preserve, 17 February 1985, L.L. Serpa, 10 ♂, 5 ♀ (BYUC); South Fork Eel River, Coast Range Preserve, 18 February 1985, R.W. Baumann & C.R. Nelson, 12 ♂, 12 ♀ (BYUC); Indian Creek, Hwy 128, Indian Creek State Reservation, 18 February 1985, R.W. Baumann & C.R. Nelson, 21 ♂, 20 ♀ (BYUC); Mill Creek, below reservoir east of Talmage, 16 February 2006, J.J. Lee, 1 ♂ (BYUC); Navarro River, Hendy Woods State Park, 18 February 1985, R.W. Baumann & C.R. Nelson, 8 ♂, 12 ♀ (BYUC); Pieta Creek, Hwy 101, junction Russian River, 18 February 1985, R.W. Baumann & C.R. Nelson, 5 ♂, 5 ♀ (BYUC); Russian River, Hwy 101, junction Pieta Creek, 18 February 1985, R.W. Baumann & C.R. Nelson, 1 ♀ (BYUC). Colusa Co. South Fork Stony Creek, Red Bridge, junction Stony Creek, 1

February 2009, J.B. Sandberg & A.B. Richards, 1 ♂ (ABLC). Sonoma Co. Big Austin Creek, Cazadero, 18 February 1985, R.W. Baumann & C.R. Nelson, 13 ♂, 28 ♀, 3 larvae (BYUC). Monterey Co. Carmel River, Boronda Road, 10 March 1982, W.C. Fields, 4 ♂, 3 ♀ and 3 larvae (WCFC). Alameda Co. Arroyo Mocho, 2 miles S Livermore, 2 March 1958, D.D. Lisdale, 1 ♂ (UCBC); Arroyo Mocho Creek, 19 miles SE Livermore, Arroyo Mocho Mines Road, 20 February 1985, R.W. Baumann & C.R. Nelson, 2 ♂, 3 ♀, 4 larvae (BYUC); Arroyo Mocho Creek, 20 miles S Livermore, San Antonio Valley Road, 19 March 1985, R.W. Baumann & C.R. Nelson, 3 ♂, 5 ♀ (BYUC); Arroyo Mocho Mines Road, near county line, 20 February 1985, R.W. Baumann & C.R. Nelson, 13 ♂, 10 ♀ (BYUC). Stanislaus Co. Del Puerto Creek, Frank Raines Park, 20 March 1985, R.W. Baumann & C.R. Nelson, 3 ♂, 5 ♀ (BYUC). Orange Co. Trabuco Canyon, Santa Ana Mountains, 11 January 1988, R.W. Baumann, B.A. Sargent, B.C. Kondratieff & C.R. Nelson, 3 ♂ (BYUC); Trabuco Creek, Trabuco Canyon, 1st concrete low water crossing, 5 April 2005, K.W. Stewart & E.F. Drake, 33° 40' N 117° 32' W, 8 ♂, 58 ♀, (KWSC & BYUC); 25 April 2005, E.F. Drake, 6 ♀ (KWSC).



Figs. 9-10. *Capnia umpqua*, adult male, color photographs, South Fork Stony Creek, California. 9. male terminalia, dorsal; 10. male terminalia, lateral.

Male. Macropterous. Length of forewings 5-7 mm. Length of body 4-6 mm. General color dark brown, with lighter areas around terminalia. Anterior segments of abdomen unmodified. Tergum 8 with large, light triangular area medially, originating as

narrow point near anterior margin and ending in broad wide opening posteriorly (Fig. 9). Lateral margins of light area surrounded by darkly sclerotized border that terminates in a large lateral lobe at the posterior margins of the segment (Figs. 9-10). Paired

lobes on posterior margin of tergum 8 large, heavily sclerotized and rounded terminally, bearing coarse scales over entire surface (Fig. 4). Tergum 9 with large light area below tip of epiproct, with narrow sclerotized band anteriorly (Fig. 9). Epiproct with single lobe or arm, base broad, dorsally with slightly expanded middle section (Figs. 1-3, 9) with a pointed tip, bearing downward, hooked, bilobed process at apex (Figs. 5-7). Lateral profile showing large base, middle section rounded dorsally and narrowing to apex (Figs. 5, 6). Anterior third possessing a dorsal slit or opening that is elongated according to long axis, membranous and is fringed with long spines or stout hairs (Fig. 3).

Female. Macropterous. Length of forewings 6-8 mm. Length of body 5-8 mm. General color similar to male except for the presence of a broad light colored band on dorsal surface of abdominal terga 2-8. Subgenital plate broad and darkly sclerotized, extending over entire width of tergum 8 (Fig. 8). Posterior margin broadly rounded and sometimes more triangular, as shown in figure 9c in Frison (1942).

Discussion. The description of *C. umpqua* in Frison 1942 is brief but adequate. He described the distinctive lobes that occur on the posterior margin of tergum 8 and provided figures. However, Jewett (1958 and 1960) included only Frison's figure of the lateral view of the male terminalia. This makes it easy to see that there is at least one lobe on the posterior margin of tergum 8, but does not show the dorsal view of the terminalia that is so distinctive, and that there are in reality two lobes situated side by side. Additionally, the stonefly chapter (Jewett 1963) in Usinger's book on the aquatic insects of California does not include *C. umpqua*. Jewett's manuscript was probably submitted earlier than the Jewett (1960) booklet that was done for the California Insect Survey. Nelson and Baumann (1989) clearly did not illustrate the true *C. umpqua* and what they included in their key is not that species. Their figures 177 and 178 illustrate the male terminalia of a species that has lateral lobes on tergum 9 instead of tergum 8. The key given for the Californica Group does not work at couplet 1 for *C. umpqua*, since it has paired lobes only on segment 8. The true *C. umpqua* described in this paper is a member of the *C. californica* Group as defined in Nelson and Baumann (1989) and Nelson (2004). The species illustrated in

Nelson and Baumann as *C. umpqua* is presently undescribed, but will be included in a paper now in preparation.

One of the characters used to define the Californica Group in Nelson and Baumann (1989) is that the male epiproct has an anteapical dorsal membranous area. The character is well illustrated for *C. umpqua* in this paper (Fig. 3). Sometimes the area is quite broad and the epiproct immediately below is rounded or swollen (Figs. 3, 6), while at other times the area is narrow and the epiproct below is much thinner (Figs. 1, 2, 5). Generally there is little variation exhibited in the epiproct of members of the genus *Capnia*, but some variability exists in the species *C. umpqua*. This variation occurs over a large geographic range and in members of the same population. Some specimens from Oregon (Fig. 1) at the northern edge of the range are quite thin as are those from the southern end of the range in Orange County, California (Fig. 2, 5). However, several populations in the middle of the range such as those from Humboldt County, California (Fig. 3, 6) exhibit a wider opening and a broader epiproct. It will be interesting to see if this character varies in other members of the Californica Group.

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