



## NEW MORPHOLOGICAL OBSERVATIONS AND PHYLOGENETIC PLACEMENT OF *CAPNIA SHASTA* (PLECOPTERA: CAPNIIDAE)

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### ABSTRACT

The male epiproct of *Capnia shasta* is redescribed and the presence of a lower lobe is noted. *Capnia shasta* is moved to the *C. ventura* species Subgroup of the *C. californica* Group as defined by Nelson (2004). A redescription of the male epiproct is provided and supported by scanning electron micrographs. We also report this species from the Salmon River drainage, Marble Mountains, northern California.

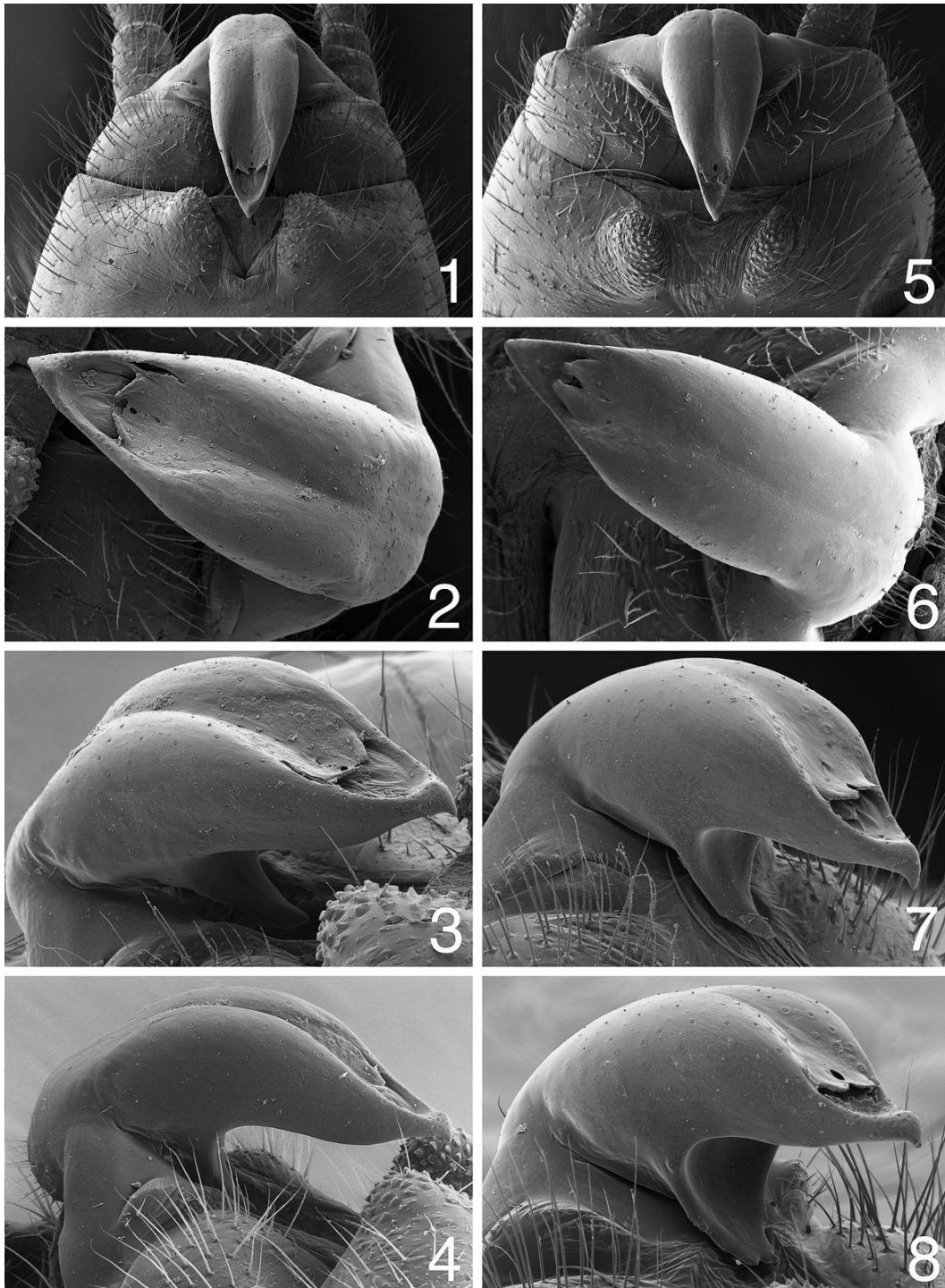
**Keywords:** Plecoptera, stonefly, Capniidae, *Capnia*, California, Coast Range

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### INTRODUCTION

*Capnia shasta* Nelson and Baumann (2009) has had an interesting history, appearing in the stonefly literature tangentially 24 years ago. It first appeared as a group of four illustrations incorrectly labeled as *C. umpqua* in Nelson and Baumann (1989) as was noted in Baumann and Stewart (2009) and noted and corrected in Nelson and Baumann (2009). Nelson and Baumann (2009) attempted to clarify the status of this species illustrated and keyed in Nelson and Baumann (1989) by describing *C. shasta*. Their description stated that the epiproct was composed of only a single well-developed dorsal process. This decision was based on the illustrations in Nelson and Baumann (1989) as well as the specimens and the scanning electron micrographs (SEM) in Nelson and Baumann (2009). Recently, one of the authors (J.J. Lee) collected specimens from near Sulphur Creek,

close to the type locality and additional specimens from a site along Salmon River Road in Siskiyou County, California. Male specimens clearly possessed a lower lobe on the epiproct. It was difficult to directly observe this structure because it was closely appressed to the abdomen beneath the larger upper lobe of the epiproct. Upon reexamining the male holotype of *C. shasta* we concluded that the lower process was missed in the original description, where the epiproct was characterized as “with only a single process well-developed” (Nelson and Baumann 2009). The epiproct of this species does indeed possess a lower process. The process is relatively small, usually closely appressed to, and sometimes appearing to be imbedded in, the softer dorsal surface of tergum 10. We provide the following addendum to the description of the epiproct.



Figs. 1-8. *Capnia shasta* male genitalia. Figs. 1-4. California, Shasta County, creek near Castle Crags State Park. 1. Terminalia, dorsal. 2. Epiproct, dorsal. 3. Epiproct, dorsolateral. 4. Epiproct, lateral. Figs. 5-8. California, Siskiyou County, tributary, Salmon River, Salmon River Road. 5. Terminalia, dorsal. 6. Epiproct, dorsal. 7. Epiproct, dorsolateral. 8. Epiproct, dorsolateral, anterior.

## MATERIALS AND METHODS

We examined specimens with Wild M-8 and Olympus SZX12 stereomicroscopes. Additional SEMs were made at the BYU Electron Optics Laboratory using a Philips XL30, ESEM FEG microscope as in Nelson and Baumann (2009). Figure plates were prepared at the M.L. Bean Museum graphics laboratory. Specimens studied are deposited at the following collections; Brigham Young University Collection, Provo, Utah (BYUC); Jon J. Lee Collection, Eureka, California (JJLC); United States National Collection, Smithsonian Institution, Washington, D.C. (USNM).

## RESULTS AND DISCUSSION

### *Capnia shasta* Nelson and Baumann (Figs. 1-8)

*Capnia umpqua* Nelson and Baumann 1989:306.

*Capnia shasta* Nelson and Baumann 2009:188. Type locality, California: Shasta County, Sulphur Creek, Castle Crags State Park, N 41.15587° W 122.36285°.

**Material examined. California:** Shasta Co., small tributary of Castle Creek flowing from north, above Castle Creek Road, approximately milepost 1.5, N 41.15614° W 122.35319°, 18 February 2010, J.J. Lee, 4♂, 7♀ (BYUC, JJLC); Sulphur Creek, Castle Crags State Park, N 41.15587° W 122.36285°, 16 February 1985, R.W. Baumann & C.R. Nelson, holotype ♂ (USNM) and 3♂, 4♀ paratypes (BYUC). Siskiyou Co., creek, mile 1.9, Salmon River Road, N 41.38061° W 123.46496°, 4 February 2011, J.J. Lee, 3♂, 4♀ (BYUC, JJLC); 9 February 2011, J.J. Lee, 26♂, 12♀ (BYUC, JJLC).

**Male.** Epiproct with inflated dorsal process and shorter ventral process. Other features as in original description by Nelson & Baumann (2009). When fully visible anteriorly, the epiproct has the appearance of a small bird with its gape wide open (Figs. 1-8).

**Discussion.** Nelson (2004) included four species of *Capnia* in the *C. ventura* species Subgroup of the *C. californica* Group: *Capnia kersti* Nelson, *C. regilla* Nelson and Baumann, *C. saratoga* Nelson and Baumann, and *C. ventura* Nelson and Baumann. We are including *C. shasta* in the *C. ventura* Subgroup based on the epiproct structure. *Capnia shasta* can be

distinguished from the other subgroup members by features given in Nelson and Baumann (2009) and by the short lower process of the epiproct described herein.

**Phylogeny.** The cladogram given as Fig. 10 in Nelson and Baumann (2009) showed *C. shasta* as part of a polytomy with members of the *C. californica* Group. This hypothesis needs to be re-evaluated based on the actual state of the epiproct of *C. shasta* presented herein. With the recognition of the lower process of the epiproct, three characters in the matrix of Nelson and Baumann (2009) must be recoded: character 5 changes from 1 to 0 by redefining the appropriate upper process; 17 changes from 0 to 1 indicating an apomorphic deep notch between the two processes of the epiproct; and 18 changes to an apomorphic narrow lower process. In using the branch rearrangement facility in MacClade 4.08a (Maddison and Maddison 2005), two most parsimonious trees result, both of which clearly move *C. shasta* into the *C. ventura* Subgroup and require little change to the Nelson and Baumann (2009) hypothesis of relationships. One places *C. shasta* basal to all members of the subgroup (from *C. regilla* to *C. ventura* in Fig. 10 of Nelson and Baumann (2009)) and the other places this taxon further up the tree between *C. regilla* and *C. saratoga*. Analysis using new information we present here resolved the tree to a more basal polytomy and by consensus created a polytomy further up the tree, within the *C. ventura* Subgroup. Resolution of this polytomy will require using additional morphological or molecular characters.

**Distribution.** The most recent collections of *C. shasta* were made in small creeks that the authors predict have reduced surface flow in the summer. This species is now known from three localities in the Coast Ranges of northern California, two near Castle Crags and one in the Salmon River drainage.

## ACKNOWLEDGMENTS

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