



MALENKA DIABLO, A NEW SPECIES OF STONEFLY FROM THE DIABLO RANGE OF CALIFORNIA, U.S.A. (PLECOPTERA: NEMOURIDAE)

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ABSTRACT

Malenka diablo sp. n. (Plecoptera: Nemouridae) is named from the Diablo Range of west-central California. The new species is proposed based on specific details of the male paraprocts and cerci. The adult male, adult female, and larva are described and supported by colorized scanning electron micrographs (SEM) and color images. Additionally, SEM data is presented for the morphologically similar species *M. biloba* (Claassen, 1923).

Keywords: Plecoptera, Nemouridae, *Malenka*, stonefly, new species, California

INTRODUCTION

The western Nearctic Nemouridae genus *Malenka* Ricker, 1952 presently includes 12 species, five of which are known from California (DeWalt et al. 2018). Recent collecting in the Diablo Range, mountains that form the eastern flank of the Pacific Coast Ranges southeast of the San Francisco Bay area (Encyclopedia Britannica 2017) has revealed an additional species that is apparently closely related to *M. biloba* (Claassen, 1923) and *M. murvoshi* Baumann & Kondratieff, 2010. Herein, we provide a description of this new species supported by colorized scanning electron micrographs (SEM) and color images. Additionally, we provide a comparative diagnosis of *M. biloba* and *M. murvoshi* also supported by SEM and color images.

MATERIAL AND METHODS

Adult stoneflies were collected using either a beating sheet or an aerial net. Larvae were collected with an aerial net with the net pulled taut and disturbing the stream substrate allowing contents to flow into the net. Adults and larvae were preserved in 80% ethanol. Coordinate data for new material were recorded directly using Topo Maps version 1.16 for iPhone. Additional material was examined from the C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, Colorado (CSUIC), plotting of coordinate data and map measurements were accomplished using ArcMap, ArcGIS 10.4.1 (ESRI 2016). Level III ecoregion data were obtained from the US Environmental Protection Agency (USEPA 2018). Coordinate data for legacy records were gathered

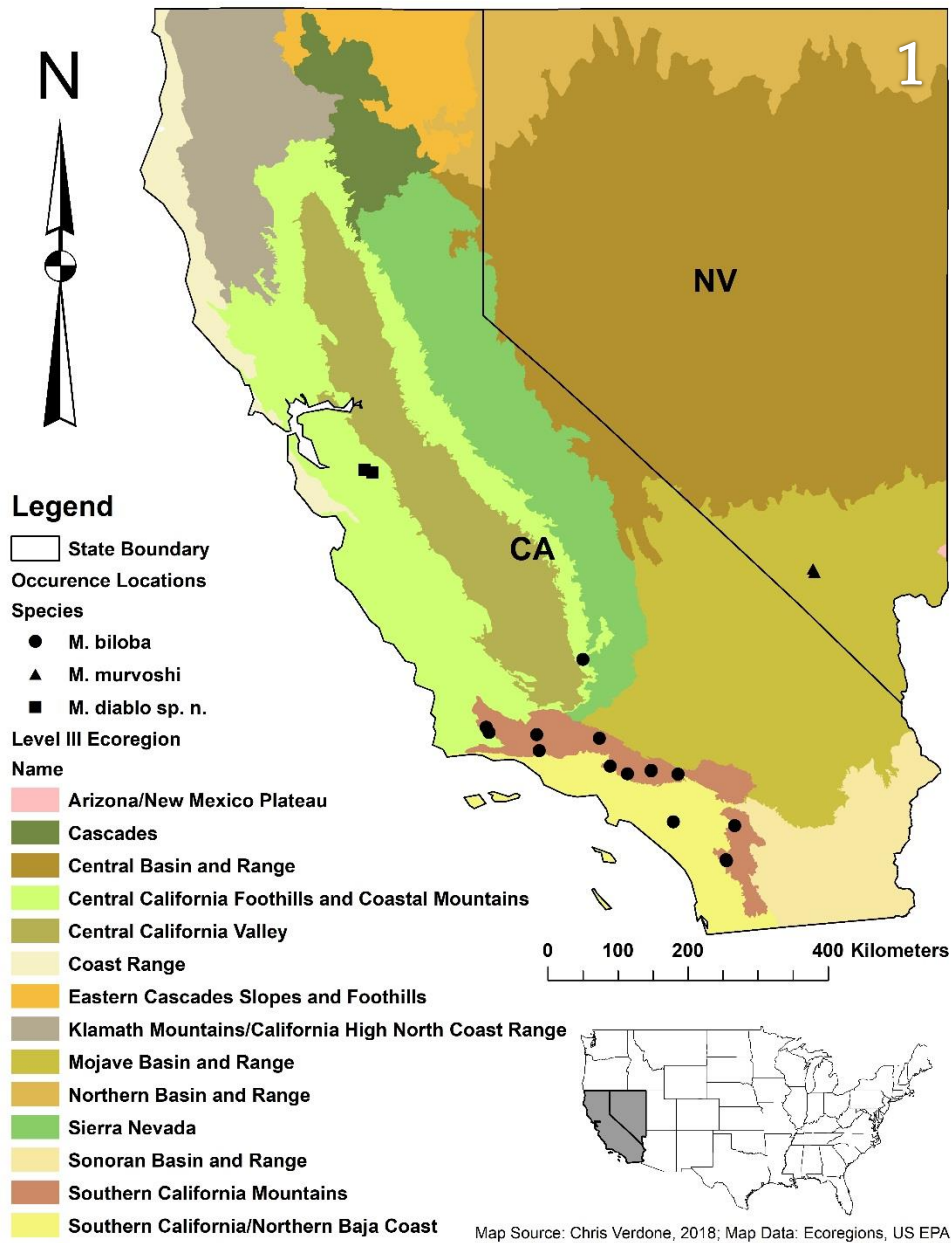


Fig. 1. Distribution of examined material of *Malenka biloba*, *M. diablo* sp. n., and *M. murvoshi*, and level III ecoregions of California and Nevada.

using GEOLocate v. 3.22 (Rios & Bart 2010) and are indicated by “[]”.

Specimens were prepared for SEM following the methods of Verdone and Kondratieff (2018). Scanning electron micrographs were taken using a JEOL JSM-6500F Field Emission Scanning Electron

Microscope at the Central Instrument Facility, Imaging Laboratory, Colorado State University (<http://cif.colostate.edu/imaging-laboratory/>). Scanning electron micrographs were colorized using the quick selection and color balance tools in Adobe Photoshop CS6 Extended. Color images were



Fig. 2. *Malenka diablo* sp. n., male habitus, dorsal, Colorado Creek, Santa Clara County, California.

captured using a Canon EOS 5D digital camera with a Canon MP-E 65 mm 5X macro lens. Images are a compilation of serial photomicrographs taken at progressively deeper focal planes using Stack Shot and controlled by Visionary Digital Passport software (Visionary Digital, Palmyra, Virginia). Composite images were assembled using Zerene Stacker version 1.04 (Zerene Systems LLC, Richland, WA). Measurements and image adjustments including background color correction, color levels and sharpening functions were achieved using Adobe Photoshop CS6 Extended.

The male holotype of the new species is deposited in the National Museum of Natural History, Washington, DC (NMNH). Additional paratypes are deposited in the C.P. Gillette Museum of Arthropod Diversity, Colorado State University,

Fort Collins, Colorado (CSUIC) and the Monte L. Bean Museum, Brigham Young University, Provo, Utah (BYU). Morphological terminology follows that of Baumann (1975).

RESULTS

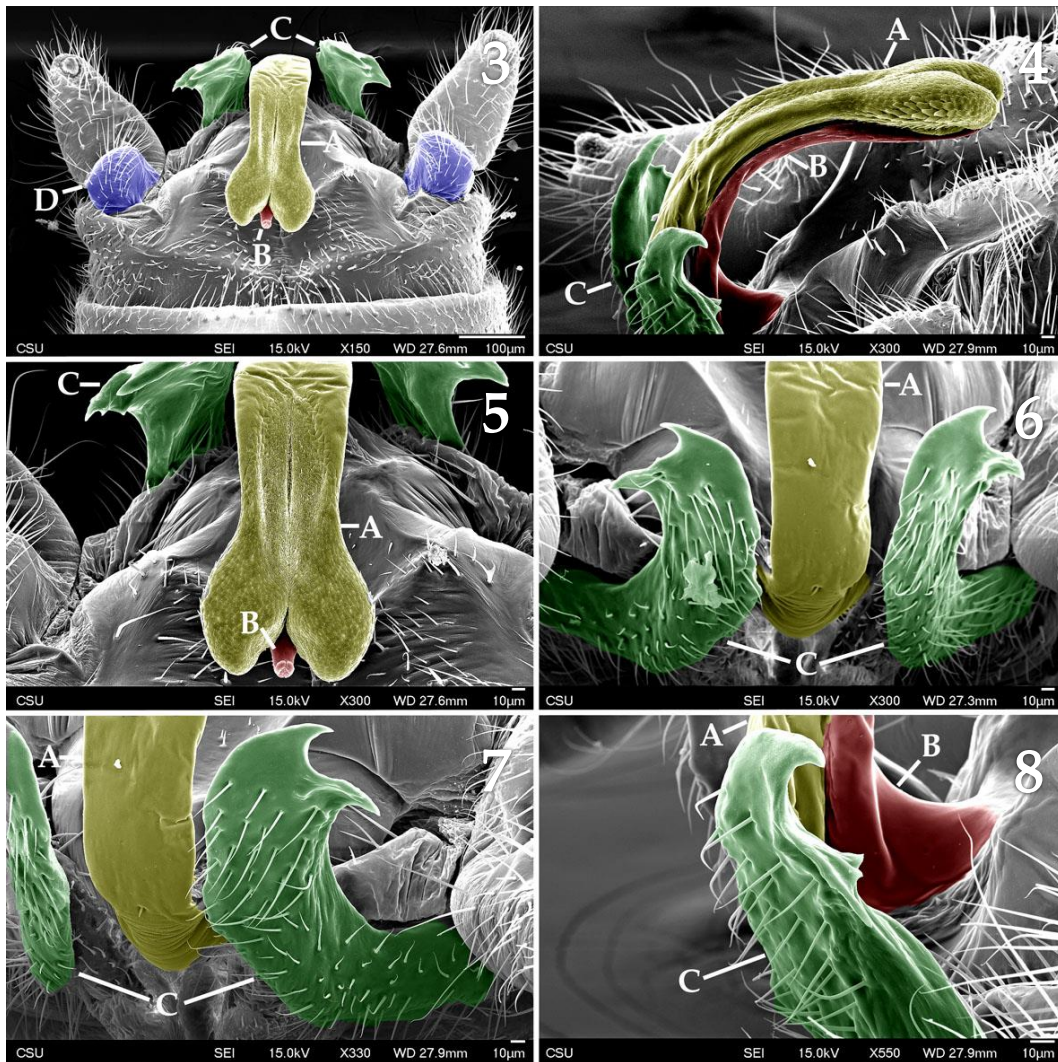
Malenka diablo Verdone & Kondratieff, 2018

(Figs. 2-13)

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:503118>

Material examined. *Holotype* ♂ U.S.A. – **California: Santa Clara Co.**, Colorado Creek, Mines Rd., N 37.43389, W 121.51095, 27 February 2018, B.C. Kondratieff, C.J. Verdone, J.B. Sandberg (NMNH). *Paratypes*: same data as holotype, 19♂ 8♀, 8L (CSUIC); same data as holotype, 3♂, 3♀, 3L (BYU). **Stanislaus Co.**, Del Puerto Creek, Del Puerto Canyon Rd., N 37.40886, W 121.41609, 27 February 2018, B.C. Kondratieff, C.J. Verdone, J.B. Sandberg, 3♂, 1♀ (CSUIC).

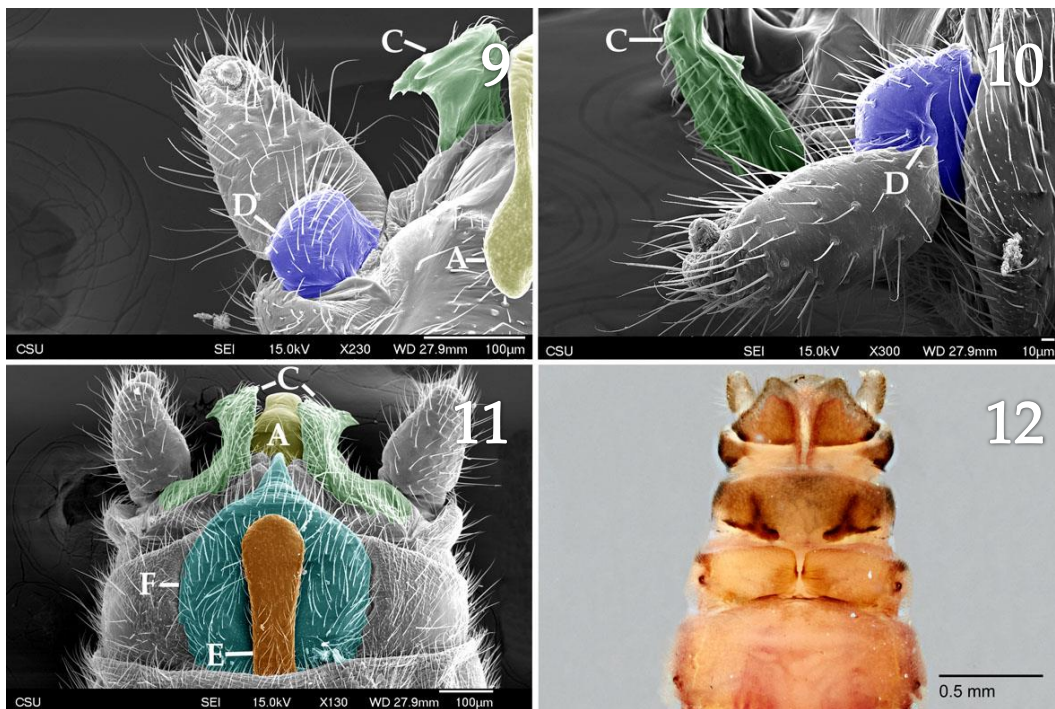
Additional material examined. *Malenka biloba*: **California: Kern Co.**, Dougherty Creek, SR 178, N 35.47293, W 118.71338, 17 April 2018, W.K. Reeves, 2♂, 5♀ (CSUIC). **Los Angeles Co.**, Arroyo Seco Creek, Switzer Campground, [N 34.26380, W 118.14400], 12 January 2012, B.C. Kondratieff, D. Murányi, J.B. Sandberg, C.R. Nelson, 9♂, 8♀ (CSUIC); Coldbrook Creek, Coldbrook Campground, Hwy 39, N 34.29390, W 117.83950, 13 January 2012, B.C. Kondratieff, D. Murányi, J.B. Sandberg, C.R. Nelson, 2♂, 4♀ (CSUIC); Elizabeth Lake Canyon, Cottonwood Campground, [N 34.640264, W 118.504806], 18 January 1992, B.C. Kondratieff, 5♂, 2♀ 2L (CSUIC); Pacoima Canyon Creek, San Gabriel Mountains, N 34.345958, W 118.36593, 19 January 1992, B.C. Kondratieff 2♂ (CSUIC); Soldier Creek, Falling Springs, 2.3 mi. N Coldbrook Campground, N 34.30100, W 117.83800, 13 January 2012, B.C. Kondratieff, D. Murányi, J.B. Sandberg, C.R. Nelson, 3♂, 1♀ (CSUIC). **Orange Co.**, Silverado Canyon, end of Silverado Canyon Rd., [N 33.75194, W 117.55495], 21 November 2005, L. Myers, 1♂, 2♀ (CSUIC). **Riverside Co.**, Strawberry Creek, Hwy 74, 3 mi. W Mountain Center, N 33.71085, W 116.76941, 10 January 2012,



Figs. 3–8. *Malenka diablo* sp. n., male, Colorado Creek, Santa Clara County, California. Epiproct, dorsal sclerite (A: yellow), ventral sclerite (B: red); paraproct, median lobe (C: green); Cercus, mesobasal lobe (D: purple). 3. Terminalia (epiproct, paraprocts, and cerci), dorsal. 4. Epiproct, lateral. 5. Epiproct, dorsal. 6. Paraprocts, median lobes, posterior. 7. Right paraproct, median lobe, posterior. 8. Right paraproct, median lobe, lateral.

B.C. Kondratieff, D. Murányi, J.B. Sandberg, C.R. Nelson, 1♀ (CSUIC). **San Bernardino Co.**, Lytle Creek, Applewhite Picnic Area, [N 34.26000, W 117.49600], 9 January 1988, R.W. Baumann, B.J. Sargent, B.C. Kondratieff, C.R. Nelson, 4♂, 2♀ (CSUIC); same location, 8 January 2012, B.C. Kondratieff, D. Murányi, J.B. Sandberg, C.R. Nelson, 33♂, 35♀ (CSUIC). **San Diego Co.**, Fry Creek, Fry Creek Campground, Rd. S-6, N 33.34400,

W 116.88000, 11 January 2012, B.C. Kondratieff, D. Murányi, J.B. Sandberg, C.R. Nelson, 17♂, 5♀ (CSUIC); Iron Spring Creek, Rd. S-6, N 33.33277, W 116.87142, 11 January 2012, B.C. Kondratieff, D. Murányi, J.B. Sandberg, C.R. Nelson, 1♂, 1♀ (CSUIC). **Santa Barbara Co.**, Cachuma Creek, Sunset Valley Rd., [N 34.70248, W 119.91699], 21 January 1992, B.C. Kondratieff, 1♂ (CSUIC). **Ventura Co.**, North Fork Matalija Creek, Wheeler



Figs. 9–12. *Malenka diablo* sp. n., Colorado Creek, Santa Clara County, California. Epiproct dorsal sclerite (A: yellow); paraproct, median lobe (C: green); mesobasal lobe of cercus (D: purple); vesicle (E: orange); hypoproct (F: turquoise). 9. Right cercus and mesobasal lobe, dorsal. 10. Right cercus and mesobasal lobe, lateral. 11. Terminalia (vesicle and hypoproct), ventral. 12. Female sterna 7–10, ventral.

Gorge Campground, Los Padres NF, [N 34.51076, W 119.27498], 20 January 1992, B.C. Kondratieff, 1♂, 1♀, 1L (CSUIC); Reyes Creek, Reyes Creek Rd., [N 34.67949, W 119.30816], 21 January 1992, B.C. Kondratieff, 4♂, 2♀, 2L (CSUIC).

Malenka murvooshi: Nevada: Clark Co., Willow Creek, Willow Creek Campground, [N 36.41774, W 115.76391], 3 April 1981, R.W. Baumann, S.M. Clark, 10♂, 2♀ (CSUIC: Paratypes).

Distribution. U.S.A. – CA (Fig. 1).

Etymology. The new species is named after the region where it was collected, the Diablo Range, mountains that form the eastern flank of the Pacific Coast Ranges southeast of the San Francisco Bay area (Encyclopedia Britannica 2017). The proposed common name is the “Diablo Forestfly”.

Male. Macropterous. Length of forewings 7.0–7.7 mm (n = 10). Length of body 5.0–5.7 mm (n = 10). General body color brown (Fig. 2). Head mostly brown; area between lateral ocelli and eyes yellow-

gold. Antennae uniformly brown (Fig. 2). Occiput with rugose spots. Pronotum with scattered dark rugosities. Legs light brown (Fig. 2). Wings fumose (Fig. 2). Epiproct recurved over abdomen (Figs. 3–4). Apical half of dorsal sclerite divided longitudinally (Figs. 3–5). Dorsal sclerite tightly appressed along division, except at the apex which opens into a deep V-shaped incision (Figs. 3, 5). Apex of dorsal sclerite expanded into lobes bearing large scales laterally (Fig. 4). Ventral sclerite tightly appressed to the dorsal sclerite (Fig. 4). Apex of ventral sclerite bifurcate, directed dorsally and situated within the apical incision of the dorsal sclerite (Figs. 3, 5). Paraprocts composed of three lobes; outer lobe short, blunt, darkly sclerotized, extending to the mesobasal sclerite encircling the cerci. Inner lobe triangular, apex bifurcate, forming a deep U-shaped notch. Median lobe large, bifurcate, curved distally and upward, flanking the epiproct base (Figs. 6–8). Median lobe of subequal



Fig. 13. *Malenka diablo* sp. n., male larva, dorsal and cervical gills, ventral (inset), Colorado Creek, Santa Clara County, California.

width throughout its length (Figs. 6–7). Proximal margin with a distally directed, sharply pointed apex (Figs. 6–7). Distal margin with a broadly triangular, distally directed, subapical tooth (Figs. 6–8). Cercus very lightly sclerotized, one segmented with a sclerotized nipple-like process on apex and a mesobasal lobe (Figs. 3, 9–10). Mesobasal lobe simple, lightly sclerotized and reduced to a low knob (Figs. 3, 9–10). Vesicle narrow and elongate, widest towards apex, tapering evenly to the base (Fig. 11). Vesicle surface covered with rounded pit-like indentations, basal and lateral margins with trichoid sensilla (Fig. 11). Hypoproct well developed, base covering medial $\frac{1}{3}$ of sternum nine, apical portion sharply tapered to a narrow, triangular apex and nested between the inner

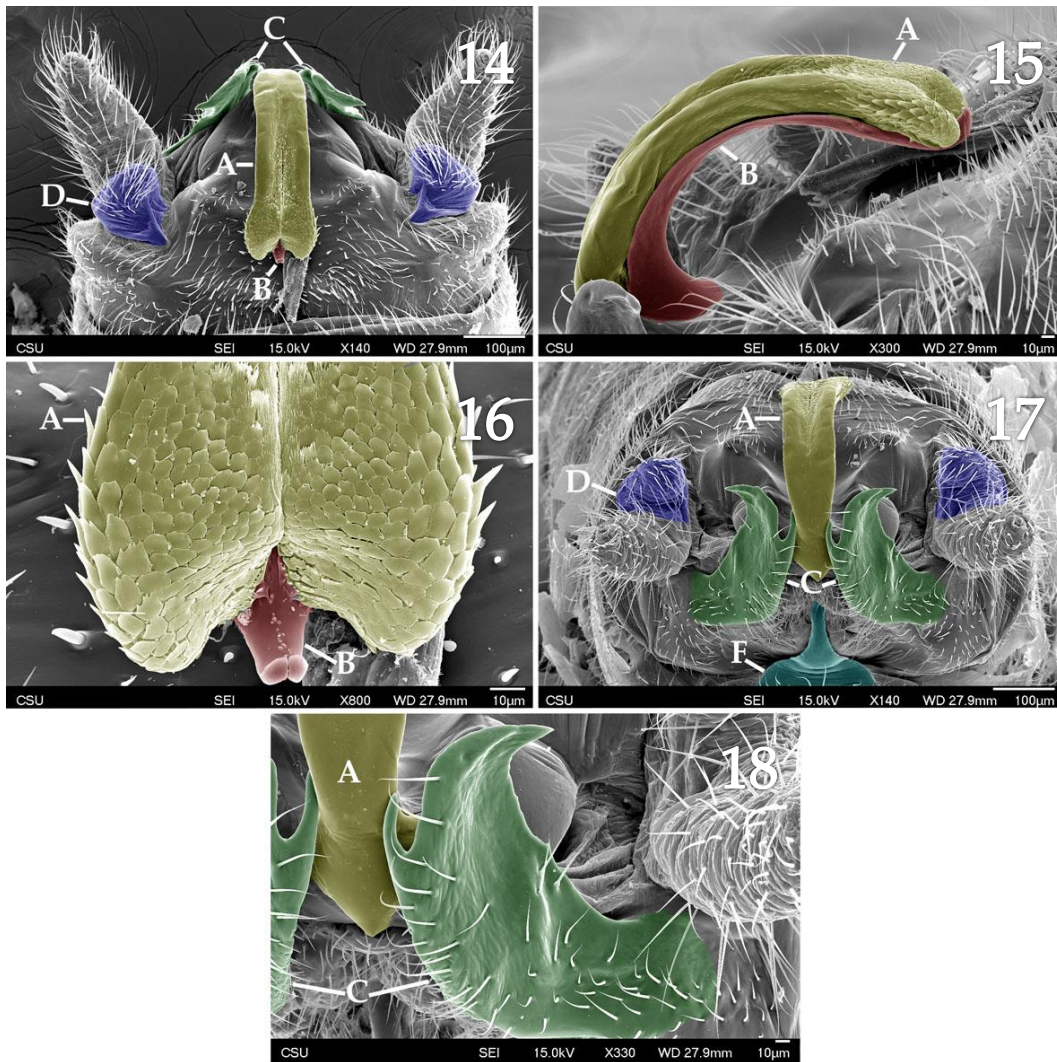
paraproct lobes (Fig. 11).

Female. Macropterous. Length of forewings 8.6–10.0 mm ($n = 10$). Length of body 7.0–8.4 mm ($n = 10$). General body coloration similar to male. Seventh sternum produced at the posteromedial margin, lightly sclerotized, bearing a nipple-like projection (Fig. 12). Eighth sternum with a narrow, medial V-shaped notch that extends to the base of segment (Fig. 12). Margins of notch lightly sclerotized (Fig. 12).

Larva. General morphology as for genus (Fig. 13). Length of body 6.0–7.3 mm ($n = 10$). Anterior cervical gill composed of 5–6 branches, posterior gill composed of 7–8 branches (Fig. 13 inset).

Diagnosis. *Malenka diablo* is most similar to *M. biloba* and *M. murvoshi*. Males of these species share the following characters: (1) dorsal sclerite divided longitudinally, apex with a deep V-shaped excavation forming apical lobes bearing large scales (Figs. 3, 5, 14, 16; figs. 1–3, 6, 8–10 in Baumann & Kondratieff 2010); (2) apex of ventral sclerite bifurcate, directed dorsally and situated within the apical excavation of the dorsal sclerite (Figs. 5, 16; figs. 3, 9 in Baumann & Kondratieff 2010); (3) mesobasal lobes of cerci simple (Figs. 9–10, 19–20; figs. 1, 6 in Baumann & Kondratieff 2010); and (4) vesicle surface covered with rounded pit-like indentations, basal and lateral margins with trichoid sensilla (Figs. 11, 21; fig. 12 in Baumann & Kondratieff 2010).

The new species is distinguished from *M. biloba* and *M. murvoshi* by details of the median paraproct lobes and cerci. In the new species, the median lobe of the paraproct is bifurcate apically, bearing well developed points on the proximal and distal margins, with the proximal prong positioned apically and the distal prong subapically (Figs. 6–8). In *M. biloba*, the median paraproct lobe is also bifurcate, but the proximal prong is finger-like, positioned medially and the distal prong is situated apically (Fig. 17–18). In *M. murvoshi*, the paraproct has a single point apically and a small spine on the basal proximal margin (figs. 1, 4, 7, 11 in Baumann & Kondratieff 2010). The new species is further differentiated by the shape of the mesobasal lobes on the cerci. In *M. diablo*, the mesobasal lobe is reduced to a low knob (Fig. 9–10).



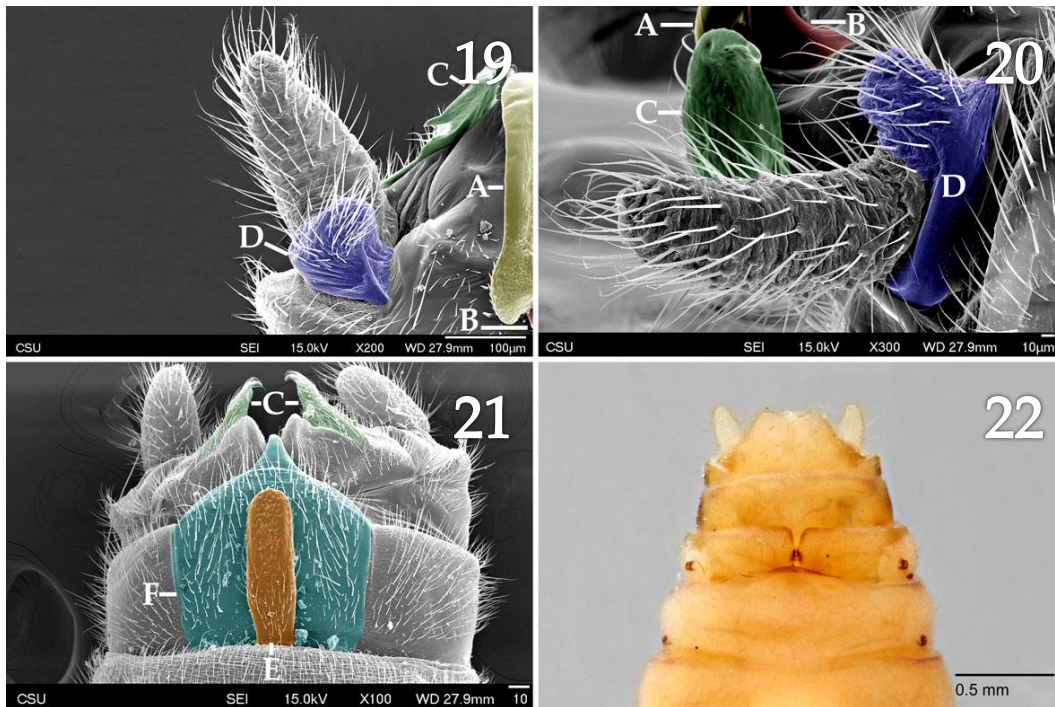
Figs. 14–18. *Malenka biloba*, male, Lytle Creek, San Bernardino County, California. Epiproct, dorsal sclerite (A: yellow), ventral sclerite (B: red); paraproct, median lobe (C: green); cercus, mesobasal lobe (D: purple); hypoproct (F: turquoise). 14. Terminalia (epiproct, paraprocts, and cerci), dorsal. 15. Epiproct, lateral. 16. Epiproct apex, dorsal. 17. Paraprocts, median lobes, posterior and hypoproct apex. 18. Right paraproct, median lobe, posterior.

In contrast, both *M. biloba* and *M. murvoshi* possess mesobasal lobes on the cerci that form swollen, nipple-like lobes (Figs. 19–20; figs. 1, 6 in Baumann & Kondratieff 2010).

Females of *M. diablo* (Fig. 12) cannot be separated from *M. biloba* (Fig. 22) and *M. murvoshi* (fig. 5, 13 in Baumann & Kondratieff 2010) without associated adult males. Larvae cannot be separated from the other similar species by the number of cervical gills

as hypothesized by Baumann and Kondratieff (2010). However, at present, these species appear to be geographically separated.

Biological Notes. There is no information about the biology or life cycle of *M. diablo*. Based on the above records, the emergence period appears to be in late February and early March. The type locality (Fig. 23) and paratype locality (Fig. 24) are 2nd and 3rd order, seasonally intermittent streams in the



Figs. 19–22. *Malenka biloba*, male, Lytle Creek, San Bernardino County, California. Epiproct dorsal sclerite (A: yellow), ventral sclerite (B: red); paraproct, median lobe (C: green); cercus, mesobasal lobe (D: purple); vesicle (E: orange); hypoproct (F: turquoise). 19. Right cercus and mesobasal lobe, dorsal. 20. Right cercus and mesobasal lobe, lateral. 21. Terminalia (vesicle and hypoproct), ventral. 22. Female sterna 7–10, ventral.

Coastal Mountains level III ecoregion (USEPA 2018), at elevations of 806 m and 450 m, respectively. Other adult stoneflies collected with the type specimens were *Taenionema californicum* (Needham & Claassen, 1925) and *Capnia saratoga* Nelson & Baumann, 1987.

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Figs. 23–24. Type localities. 23. Holotype locality, Colorado Creek, Santa Clara County, California, N 37.43389, W 121.51095, 27 February 2018. 24. Paratype locality, Del Puerto Creek, Stanislaus County, California, N 37.40886, W 121.41609, 27 February 2018.

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