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THE GENUS *CHERNOKRILUS* RICKER (PLECOPTERA: PERLODIDAE)

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ABSTRACT
The perlodine *Chernokrilus erratus* (Claassen) is considered a junior subjective synonym of *C. misnomus* (Claassen). This rare stonefly is associated with spring-fed runs and small streams in the Coast Range of northern California and Oregon.

Keywords: Plecoptera, Perlodidae, *Chernokrilus*, California, Oregon, USA

INTRODUCTION

In 1952, Ricker established the subgenus *Chernokrilus* within *Isogenus* to include two species with darkly infuscated wings, short submental gills, and the apparent unusual, variable, condition of the arms of mesosternal Y-ridge approaching either the anterior or posterior ends of furcal pits, and the presence of lobes on male sterna seven and eight. He designated *Perla misnoma* Claassen as the type of the subgenus. The two included species were originally described by Needham and Claassen (1925) in their monograph as *P. obscura* and *P. venosa*, but later renamed as *P. misnoma* and *P. errata*, respectively by Claassen (1936) because of homonymy. A complete characterization of both species was hampered by lack of material, only the holotype male of *C. erratus* was known and apparently two specimens of *C. misnomus* were available at the time of Ricker's study. Ricker (1952) cautioned that his illustrations of the male genitalia of *C. erratus* were possibly inaccurate due to the condition of the specimen. In 1959, Jewett noted: "Specimens of this subgenus are rarely collected, only a single male being known for each of the two described species. Additional male specimens and the nymph would prove of great interest." Jewett (1965) added *Isogenus venustus*, no doubt due to its general similar habitus to described *Chernokrilus* species, but Bottorff et al. (1989) placed this species in the new genus *Susulus*. Illies (1966) recognized *Chernokrilus* as a genus, and Stark and Szczyztko (1984) placed the group in the tribe Perlodini.

Larvae of *Chernokrilus* are known to occur in spring-fed runs and small streams of the Coast Range of northern California and Oregon, *C. erratus* recorded from California and *C. misnomus* from Oregon and California (Stark et al. 2007). For several years the authors have examined specimens throughout the geographical range of the genus and concluded that only one form was valid. Interestingly, the close geographical proximity of both type localities also suggested that only one species was present. A study was undertaken to examine available material and provide new illustrations of the diagnostic characters for this genus.

***Chernokrilus misnomus* (Claassen)**
(Figs. 1-14)

Perla obscura Needham and Claassen, 1925:92. Holotype ♀. Type locality: Oregon Caves (Josephine Co.), Oregon (CASC), examined.
Perla misnomus Claassen, 1936:62. Replacement name.
Isogenus (*Chernokrilus*) *misnomus*: Ricker, 1952:95.
Chernokrilus misnomus: Illies, 1966:355.
Perla venosa Needham and Claassen, 1925:93. Holotype ♂ (No. 1152). Type locality: Fieldbrook (Humboldt Co.), California (USNM), examined.
Perla errata Claassen, 1936:62. Replacement name. New Synonymy
Isogenus (*Chernokrilus*) *erratus*: Ricker, 1952:94.
Chernokrilus erratus: Illies, 1966:355.

Material examined. The following abbreviations include: BYUC (Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah); BPSC (B. P. Stark Collection, Clinton, Mississippi; CNIC (Canadian National Collection, Ottawa, Canada); CASC (California Academy of Sciences, San Francisco, California); CSUC (C. P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, Colorado); JJLC (J. J. Lee Collection, Eureka, California); KWSC (K. W. Stewart Collection, Denton, Texas); SWSC (S. W. Szczytko Collection, University of Wisconsin, Stevens Point, Wisconsin); and USNM (United States National Museum, Smithsonian Institution, Washington, D.C.).
CALIFORNIA: Humboldt Co., Fieldbrook, 30 May 1903, H. S. Barber, (Holotype-*erratus*) 1 ♂ (USNM); stream, 0.8 mi. E Berry Summit, Hwy 299, 19 May 1998, B. P. Stark, C. R. Nelson, I. Sivec & S. W. Szczytko, 1 ♀ (BPSC); same data, 1 ♀ (SWSC); stream, 2.5 mi. E Berry Summit. Hwy 299, 19 May 1998, B. P. Stark, C. R. Nelson, I. Sivec & S. W.Szczytko, 1 ♀ (BPSC); 7 June 2005, R. W. Baumann & B. C. Kondratieff, 1 ♀ (BYUC); 19 May 2006, J. J. Lee, 3 ♂, 1 ♀ (BYUC, CSUC); 3 July 2007, J. J. Lee, 1 ♀ (BYUC); Boise Creek, Hwy 299, 24 May 2006, J. J. Lee, 3 ♂, 2 ♀ (BYUC); Janes Creek, Arcata, 26 May 2006, J. J. Lee, 2 ♀ (CSUC); Jolly Giant Creek, Arcata, 21 April 1986, J. M. H., 2 ♂ (BYUC); 14 May 1994, J. J. Lee, 2 ♀ (BYUC); 8 April 2006, J. J. Lee, 3 ♂ (CSUC); 18 April 2006, J. J. Lee, 2 ♂ (CSUC); 21 April 2006, J. J. Lee, 4 ♂, 2 ♀ (BYUC); 20-23 April 2007, J. J. Lee, 2 ♂, 3 ♀ (BYUC); Red Mountain Creek, rd 10N12, 21 June 2005, J. J. Lee, 1 ♀ (BYUC); Willow Creek, Hwy 299, junction East Fork Willow Creek, 22 June 1985, R. W. Baumann, C. R. Nelson & M. F. Whiting, 1 ♀ (BYUC); East Fork Willow Creek, East Fork Campground, 8 May 2007, J. J. Lee, 1 ♂ (CSUC). Marin Co., trickle, Alpine Lake, 1 May 1955, S. W. Hitchcock, 1 ♂ (USNM). Mendocino Co., Angelo Coast Range Preserve, University of California, near Branscomb, 1 June 2000, M. D. Terry & I. S. Winkler, 1 ♂ (BYUC). Siskiyou Co., Big Spring, Mount Shasta City Park, 7 July 1969, B. P. Stark & K. W. Stewart, 1 ♀ (BPSC); 16 May 1982, B. P. Stark & D. D. Zeigler, 1 pharate ♂ (BPSC); 20 May 1998, B. P. Stark, C. R. Nelson, I. Sivec & S. W. Szczytko, 1 ♀ (BPSC); 25 May 2007, R. W. Baumann & B. C. Kondratieff, 1 ♂, 1 ♀ (BYUC, CSUC). Trinity Co., Coffee Creek, 7 June 1934, E. C. Van Dyke, 1 ♀ (CASC); stream, Hwy 36, mile 12.96, 9 May 2007, J. J. Lee, 1 ♂ (CSUC); 11 mi. S Denny, 22 June 1985, C. M. and O. S. Flint, Jr. 3 ♀ (USNM).
OREGON: Benton Co., Mary's Peak, 17 May 1958, H. Hacker, 1 ♂ (BYUC); Parker Creek, Mary's Peak, 7 July 1967, D. M. Lehmkuhl, 1 ♂ (USNM); 7 June 1983, K. W. Stewart & S. W. Szczytko, 2 ♂, 1 ♀-reared (BYUC, KWSC); 23 June 1985, K. W. Stewart & B. C. Poulton, 1 ♂, 1 ♀-reared (KWSC); 26 June 1985, R. W. Baumann, C. R. Nelson & M. F. Whiting, 1 ♂ (BYUC); 1 June 2000, B. P. Stark, I. Sivec & M. C. Zuniga, 1 ♀ (BPSC); upper Oak Creek, 3 miles above McDonald Forest gate, 25 May 1999, K. W. Stewart and N. H. Anderson, 1 ♀-reared (KWSC); Yew Creek, NE Alsea, 1 June 1946, B. R. Smith, "Neallotype", 1 ♂ (CNIC). Clatsop Co., seeps, Nehalem River, 4 mi. SW Spruce Run Campground, 6 June 1991, R. W. Baumann & B. P. Stark, 1 ♀ (BYUC); tributary, Nehalem River, Hwy 26, N Jewell, 4 May 1999, K. W. Stewart, 1 ♂ (KWSC). Curry Co., seep near Bear Creek Road, Elk River Canyon, 2 June 1991, B. P. Stark, R. W. Baumann & C. G. Henderson, 1 ♀-reared (BPSC). Josephine Co., Oregon Caves, 23 July 1922, E. C. Van Dyke, (Holotype-*misnomus*) 1 ♀ (CASC). Lane Co., Prather Creek, Rujada Campground, 25 June 1985, R. W. Baumann, C. R. Nelson & M. L. Whiting, 1 ♀ (BYUC). Tillamook Co., 0.5 mi. SE Hebo, Hwy 22, 17 May 1982, B. P. Stark & D. D. Zeigler, 1 ♂-reared (BPSC); Munson Creek, Munson Falls State Park, 12 June 2005, R. W. Baumann & B. C. Kondratieff, 1 ♂, 1 ♀ (BYUC, CSUC); Nestucca River, 4 mi. E Little Nestucca Park, 13 May 1982, K. W. Stewart & D. D. Zeigler, 1 pharate ♂ (KWSC).

The following are larval records where no

associated adults are available. The major river drainage is given in parentheses when known. **CALIFORNIA:** Humboldt Co., Bridge Creek (North Fork Elk River), 19 Sept. 2002, (JJLC); Cedar Creek, Hwy 299, above junction Willow Creek (Trinity River), 25 April 1987, R. W. Baumann, B. P. Stark, C. R. Nelson & S. A. Wells (BYUC); Cloquet Creek, Redwood National Park (Redwood Creek), 18 Aug. 2005, H. Ambrose; Freshwater Creek, Freshwater (Humboldt Bay), 29 Sept. 2000, (JJLC); Graham Gulch, near Freshwater (Freshwater Creek), 28 Sept. 1995, (JJLC); Upper Hostler Creek, Hoopa Valley Indian Reservation (Trinity River), 28 Sept. 2005, Hoopa TEPA; Little Lost Man Creek, Redwood National Park (Prairie Creek), 9 June 2005, H. Ambrose; Little South Fork Elk River, Headwaters Forest (Humboldt Bay), 31 Oct. 1996, (JJLC); Salmon Creek, Headwaters Forest (Humboldt Bay), 5 Oct. 1995, (JJLC); Strongs Creek (Eel River), 4 Sept. 2002, (JJLC); Mendocino Co., Dream Stream, Sanctuary Forest, near Whitethorn (Mattole River), 23 Sept. 1992, D. R. Lauck & J. J. Lee (JJLC). Siskiyou Co., Butler Creek, (Salmon River), 18 Oct. 1994, J. J. Lee & S. Terence; South Fork Elk Creek (Klamath River), 29 March 1993; Grant Creek (Salmon River), 30 May 1995, J. J. Lee and S. Terence. Sonoma Co., Salal Creek, near Sea Ranch (Coastal), 27 Sept. 2000, J. J. Lee & N. Craig. Trinity Co., Bidden Creek, Hwy 299 (Trinity River), 26 Nov. 1983, D. R. Lauck & J. J. Lee.

Male. Macropterous. Length of forewings 15-18 mm. Length of body 12-15 mm. General color black to brown with distinct yellow areas on head and pronotum (Fig. 1). Submental gills obscure to scarcely projecting beyond edge of submentum. Wings darkly infuscated. Tenth tergum cleft, hemitergal lobes small, broadly rounded with peg-like setae and long hairs (Figs. 2, 5); basal anchor of epiproct large, darkly sclerotized, 5-pronged (Fig. 2); base between lateral stylets with long hairs (Fig. 6), epiproct completely surrounded by paragenital lobes in repose, tapered distally and proximally, expanded medially, covered with fine hairs ventrally and abundantly near the apex (Figs. 4, 5, 7, 8, 9); distinct darkly sclerotized dorsal band from base of anchor to hook, tip of hook covered with short sclerotized scales (Figs. 4, 7, 9, 10). Lateral stylets short, broadly rounded at tip (Figs. 2, 5, 6).

Female. Macropterous. Length of forewings 16-22 mm; Length of body 18-22 mm. Coloration similar to male. Subgenital plate broadly rounded, extending over ca. 2/3 sternum 9, apex entire or emarginate (Fig. 3).

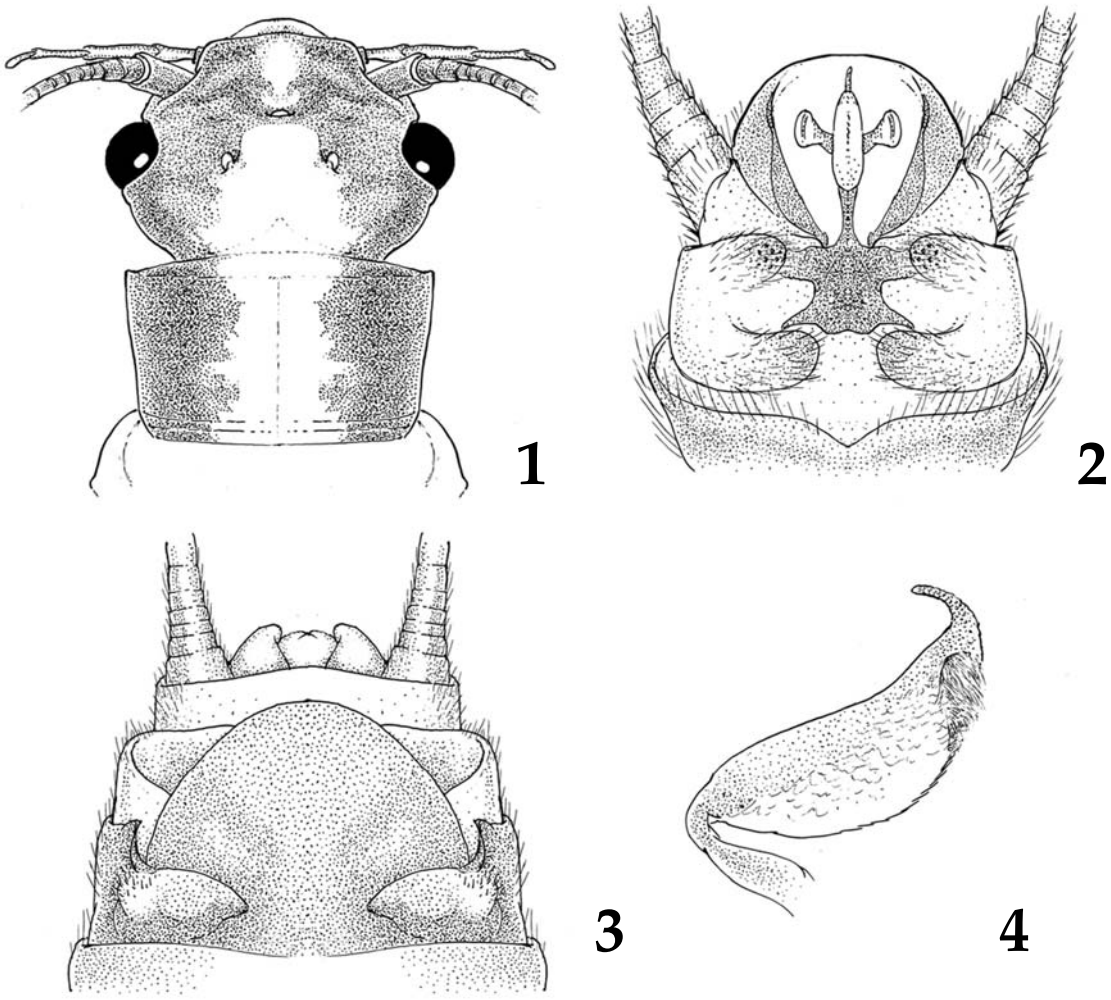
Egg. Oval, triangular in cross section (Figs. 11, 12), collar absent, globular bodies near poles located along the walls of follicle cell impressions (Fig. 11).

Larva. Larva described by Stewart and Stark (2002).

Remarks. Needham and Claassen (1925) indicated that *P. obscura* could be the female of *P. venosa* but the "relative size of the sexes does not indicate this." Body and wing measurements of the two types fall in the size variation of material examined during this study. Ricker (1952) used the presence or absence of a well-developed hook at the tip of the epiproct to distinguish the males of the two species. However, all specimens examined from Oregon and California possessed a tip with a distinct hook. The "straight" tip of the epiproct in the specimen Ricker (1952) illustrated is apparently an artifact. In his Figure 48, the tip appears curved.

Ricker (1952) placed emphasis on the patterns of the mesosternal Y-ridge for separating subgenera in both the larva and adult in the Perlodidae. However, in *Chernokrilus*, he had a dilemma because specimens available seemed to be variable as to where the arms of the Y-ridge terminated. In the female from Oregon, the arms of the Y-ridge reached the posterior corners of the furcal pits, but also exhibited short median forks directed to the anterior pits (Ricker 1952). In the male from California the arms appear to extend to the anterior corners of the furcal pits (Ricker 1952). Thus, Jewett in his studies of the stoneflies of the Pacific Northwest and California used this Y-ridge character to separate the two named species (Jewett 1959 and 1960). Jewett (1960) followed Ricker (1952) suggesting that *C. erratus* from California has the arms of the Y-ridge extending to the anterior corners of the furcal pits, and that *C. misnomus* from Oregon has the arms reaching the posterior corners. This separation of the *Chernokrilus* species from California and Oregon by mesosternal Y-ridge characters has persisted until the present.

Because the use of a generic character to separate two species in the same genus appeared problematic, many adults and larvae from localities in California and Oregon were examined, and most specimens have the arms of the mesosternal Y-ridge reaching the posterior corners of the furcal pits. However, one larva from each state exhibited, an additional pair of

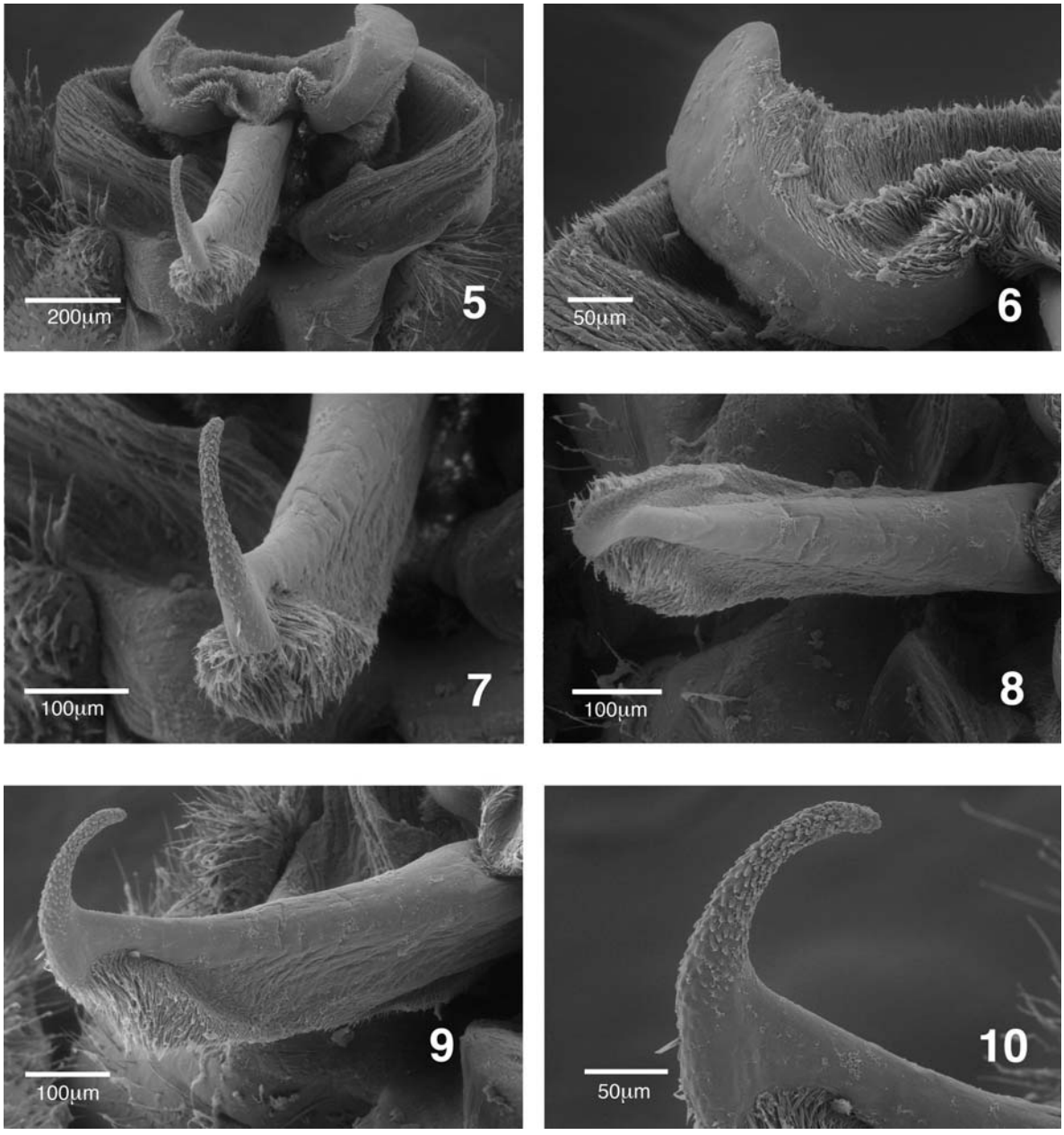


Figs. 1-4. *Chernokrilus misnomus*, (Jolly Giant Creek, California.) 1. Head and pronotum, 2. Male terminalia, dorsal, 3. Female subgenital plate, 4. Male epiproct, lateral.

short medial arms that if extended, reaches the anterior corners of the pits (Fig. 13). Close examination confirmed that these short arms were actually present in most mature larvae, but were not usually well developed. Images made with an electron microscope show that the arms even branch in adult individuals such as the two females photographed (Figs. 13, 14). A total of 17 adult specimens from California and 12 adults from Oregon were examined and most had the mesosternal arms reaching the posterior corners of the furcal pits. The paired medial arms were also present, but were not as easily seen because the area between the pits is darkly pigmented. However, in occasional specimens the inner arms are better developed and almost reach the anterior corners of the furcal pits. It appears as if an inverted triangle has been superimposed on the middle of the mesosternum, giving two sets of Y-ridges, one reaching the posterior corners and the second pair almost extending to the anterior corners (Figs. 13 and 14). Additionally, Ricker (1952) described the submental gills as short, but in all adult specimens examined, the submental gills are obscure, scarcely discernable, not projecting beyond the edge of the submentum.

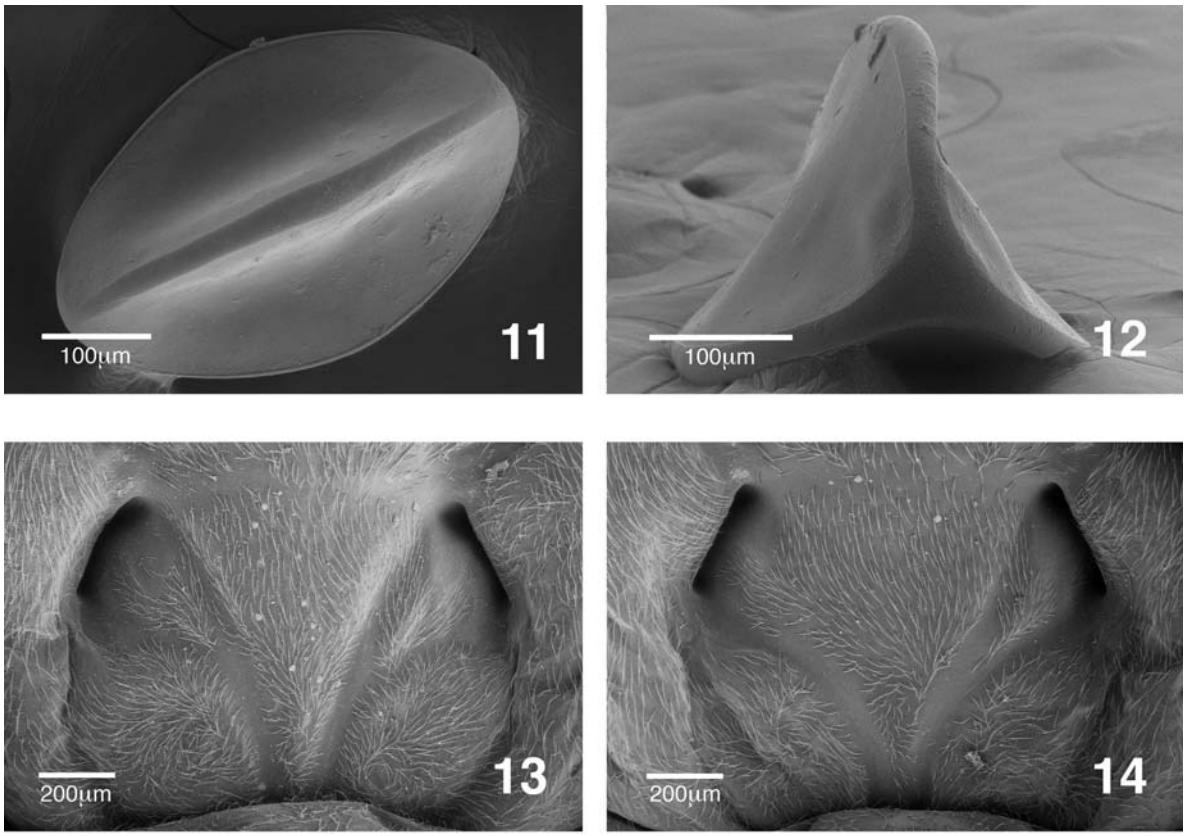
The holotype female of *P. obscura* is in poor shape with the terminalia completely fragmented. The wings are mounted on a slide. The subgenital plate and eggs are typical of the species we recognize as *C. misnomus*. The arms of the mesosternal Y-ridge clearly approach the posterior end of the furcal pits in this specimen. The "Neallotype ♂" listed by Ricker (1952) from Yew Creek (Benton Co., Oregon) was examined and is a typical male of *C. misnomus*.

The holotype male of *P. venosa* was obtained from Cornell University and is also in poor condition, with head, thorax and terminalia in alcohol and the wings mounted on a slide. The arms of the mesosternal Y-ridge clearly approach the posterior ends of the furcal pits in this specimen. The terminalia were extensively cleared previously, and are now



Figs. 5-10. *Chernokrilus misnomus*, Parker Creek, Mary's Peak, Oregon. Male genitalia. 5. Genitalia extruded, dorsal, 6. Lateral stylet, right. 7-10. Epiproct. 7. Apex, dorsolateral, 8. Apex, dorsal, 9. Apex, lateral, 10. Tip, lateral.

fragmented. The epiproct is damaged, but appears to be typical of *C. misnomus*. The concept of this species is aided by Ricker's (1952) illustrations of the specimen. This specimen will be deposited at the Smithsonian Institution as listed in Needham and Claassen (1925).



Figs. 11-12. *Chernokrilus misnomus*, Red Mountain Creek, California. Eggs. 11. Egg, dorsal, 12. Egg, end view. Figs. 13-14. *Chernokrilus misnomus*, Jolly Giant Creek, California. Female mesosterna. 13. Y-ridge divided and reaching both anterior and posterior corners of furcal pits on both sides, 14. Y-ridge not divided on left side and reaching posterior corner of furcal pit.

Biological Notes. Late instar larvae and adult *Chernokrilus misnomus* have been collected from first and second order headwater streams from sea level to approximately 1,000 m elevation in northern California. These streams are perennial and summer cool. Adults appear in early to mid-April at lower elevations and mid- to late May at higher elevations. At lower elevations the forest is dominated by coast redwood (*Sequoia sempervirens* (D. Don) Endl.), including old growth groves, and at higher elevations by Douglas fir (*Pseudotsuga menziesii* (Mirbel) Franco). Adults of *Chernokrilus* are often found resting on streamside common lady fern (*Athyrium filix-femina* (L.) Roth), about 1 m in height and still unfurling. Field caught females, maintained with males, extruded egg masses within 12 to 15 days. Early instar larvae have been collected in March, prior to adult emergence, often from small seepage tributaries that lose surface flow in the summer. This may suggest delayed egg hatching and early recruitment from these seepage areas. *Chernokrilus misnomus* is associated with *Calliperla luctuosa* (Banks), and they are often the two primary perlodids in these small, perennial creeks. Other Perlodidae collected with *C. misnomus* include the rare *Salmoperla sylvanica* Baumann and Lauck and an

undescribed species of *Isoperla*. In larger streams, *C. misnomus* occurs with the perlid *Doroneuria baumanni* Stark and Gaufin. Other regional stonefly taxa of special interest that are associated with *C. misnomus* include *Pomoleuctra andersoni* (Harper and Wildman) and *Sasquaperla hoopa* Stark and Baumann. Streams that have populations of *Chernokrilus* appear to be primarily fishless. However, Coastal Cutthroat Trout (*Oncorhynchus clarki clarki* (Richardson)) occur in some of the lower elevation creeks. Immature Coastal Giant Salamanders (*Dicamptodon tenebrosus* (Baird and Girard)) were observed at most of the sites where *C. misnomus* was collected and may be the top predator at these sites. Stark et al. (1998) provide a beautiful photograph of a live *C. misnomus,* depicting the strikingly infuscated wings and bright yellow head and pronotal pattern. Regionally, only the adults of *S. venustus* have a similar habitatus, but the long, slender submental gills, and in the male the lack of a distinct lobe on sternum 7 (Bottorff et al. 1989) will distinguish *S. venustus* from *C. misnomus.*

The distribution of this rare genus is limited mostly to small spring-fed runs and small streams in the Coast Range of northern California and Oregon. However, it was also found at a single locality in both states that is on the fringe of the Cascade Mountains. In California, it occurred in Big Spring, Mount Shasta City Park, which is said to be the headwaters of the Sacramento River, and in Oregon it was found in Prather Creek, in the Row River drainage, a tributary of the Willamette River. In these streams, *Chernokrilus* occurs in the same habitats as the Peltoperlidae genera *Soliperla* and *Sierraperla*. Interestingly, *Soliperla* also occurs north into Washington, Montana, and Idaho (Stark and Gustafson 2004). However, *Chernokrilus* and *Sierraperla* have never been reported from north of the Columbia River.

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