



TWO INTERESTING NEW SPECIES OF *ISOPERLA* FROM NORTHERN CALIFORNIA (PLECOPTERA: PERLODIDAE)

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ABSTRACT

Isoperla laucki sp. n. and *I. karuk* sp. n. are described from the Coast Range in northwestern California. *Isoperla laucki* is shown to be a peculiar member of the genus in western North America based on the male aedeagus, female egg and color pattern of the nymph. *Isoperla karuk* is included in the *Isoperla marmorata* complex, where it shares a sclerotized club-shaped process on the male aedeagus. Images of the male and eggs of both species and the female subgenital plate and nymphal mouth parts of *I. laucki* are provided as scanning electron micrographs. A color photograph of the nymphal habitus of *I. laucki* is included. Distribution data are given for the confirmed specimens available of both species.

Keywords: Plecoptera, Perlodidae, *Isoperla*, new species, California

INTRODUCTION

Jewett (1960), in his stoneflies of California, listed 8 species of *Isoperla* from California. The genus *Isoperla* in western North America was subsequently revised nearly twenty years later (Szczytko & Stewart 1979). They recognized 21 species but did not include *I. decolorata* (Walker) from Great Bear Lake, Canada, which they later rectified (Szczytko & Stewart 2002). To this total of 21 species was added *I. baumanni* and *I. roguensis* (Szczytko & Stewart 1984), *I. miwok* (Bottorff et al. 1990), and *I. muir* (Szczytko & Stewart 2004). Currently, a total of 25 species of *Isoperla* are known from western North America.

While studying the stonefly fauna of northwestern California, it became apparent that

additional species of *Isoperla* remained undescribed. After reviewing material over a two year period, and with the encouragement of Stan Szczytko, we decided to describe two distinctive new species from California: *I. laucki* sp. n. from the Klamath River drainage and *I. karuk* sp. n. from the Klamath and Mad River drainages.

MATERIAL AND METHODS

Specimens were studied from the following collections: Brigham Young University Collection (BYUC), Provo, Utah; C.P. Gillette Museum of Arthropod Diversity (CSUC), Fort Collins, Colorado and Jonathan Lee Collection (JJLC), Eureka, California.

Adult genitalia, eggs and nymphal mouthparts were studied using a WILD M8 stereomicroscope and a PHILIPS XL2 ESCM FEG scanning electron microscope at Brigham Young University, Provo, Utah. Adult and nymphal characters were studied using a ZEISS Stemi SV-11 stereomicroscope in Eureka, California. The descriptions of the life stages generally follow Szczytko & Stewart (1979).

Isopterla laucki sp.n.
(Figs. 1-16, 33)

Material examined. Holotype ♂ from California, Humboldt Co., Dragsaw Spring @ Rd 13N01, 23-VIII-07, J.J. Lee. Paratypes (J.J. Lee, Collector): – California, Humboldt Co., Red Mountain Ck. @ Rd 10N12, 4-VIII-05, 1 ♀; 10-VIII-05, 1 ♀; 20-X-05, 1 ♀; 14-XII-05, 9 larvae; 23-VI-06, 3 ♀; 3-VII-06, 2 ♀; 25-VIII-06, 6 ♂, 1 ♀, 4 larvae; 25-VII-07, 1 ♀, 2 larvae, 1 ♂ (reared 9-VIII-07); 8-VIII-07, 1 ♂, 1 larva; 23-VIII-07, 1 ♀, 1 ♂ & 1 ♀ (reared 26-VIII-07), 1 ♂ (reared 27-VIII-07), 1 ♀ (reared 28-VIII-07); 29-VIII-07, 1 larva; 11-VIII-08, 3 larvae, 1 ♀ (reared 29-VIII-08); Dragsaw Spring @ Rd 13N01, 25-VII-07, 1 ♂, 1 ♀; 29-VIII-07, 1 ♀; 11-VIII-08, 1 ♀; 28-VIII-08, 1 ♂; spring east of Boise Ck., Hwy. 299, 21-III-07, 1 larva; spring @ East Fork Willow Creek Campground, 3-VII-07, 1 ♂; 10-VII-07, 1 ♂, 1 ♀; 28-V-08, 1 ♀; 9-VI-08, 2 larvae. Holotype deposited at the California Academy of Sciences.

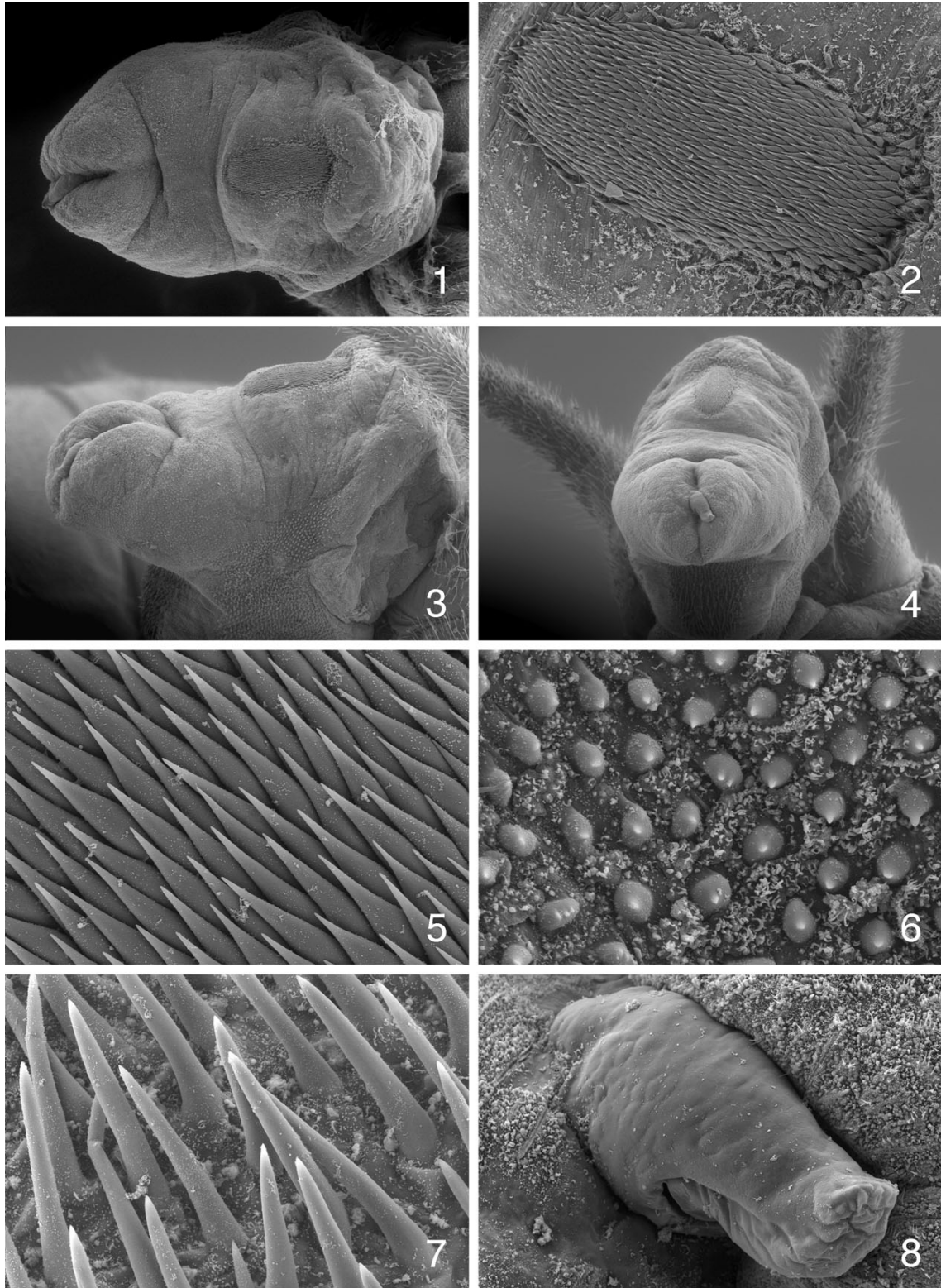
Male. Macropterous. Length of forewings 10.0-11.0 mm; length of body 9.0-10.0 mm. General body color golden yellow. Head yellow, light U-shaped pattern forward of anterior ocellus, orange brown patch inside “U” extends to frontal margin; interocellar area light orange brown; occiput orange brown mesally behind lateral ocelli, occipital suture lines light; posterior corners behind eyes with brown rugose patch and scattered short spinules. Antennae yellow at base, infusate distally. Pronotum widest anteriorly, with narrow band of light brown rugosities lateral to median, yellow stripe. Wings slightly hyaline yellow, veins brown, and fumose yellow in costal space. Legs yellow, covered with short spines, tibiae with incomplete dorsal brown band in proximal one-fourth. Abdomen bright yellow, vesicle on eighth sternum yellow orange, with scattered short setae, longer setae on posterolateral margins, shallowly rounded posteriorly and appearing oval, width approximately

1.5 to 2 times length. Tenth tergum with posteromedian depression and anteromedian unsclerotized area. Cerci golden brown with scattered short setae, one or two ventral setae approaching 1/2 segment length distally on each segment. Paraprocts bluntly pointed, curving slightly over tergum 10 (Fig. 9). Aedeagus (Figs. 1, 3-4) with an elliptical-shaped patch of stout, brown spinules, located dorsally, patch ranging from 2 to 3 times as long as wide (Figs. 2 & 5); posterobasal patch of short stout, orange brown spinules, forming sinuate rows (Fig. 6); a stronger patch of posteromedial orange brown spinules (Fig. 7) becoming smaller and scattered laterally; aedeagus narrowing apically, cleft at apex, with a short, digitate, lightly sclerotized process arising from cleft (Figs. 4 & 8).

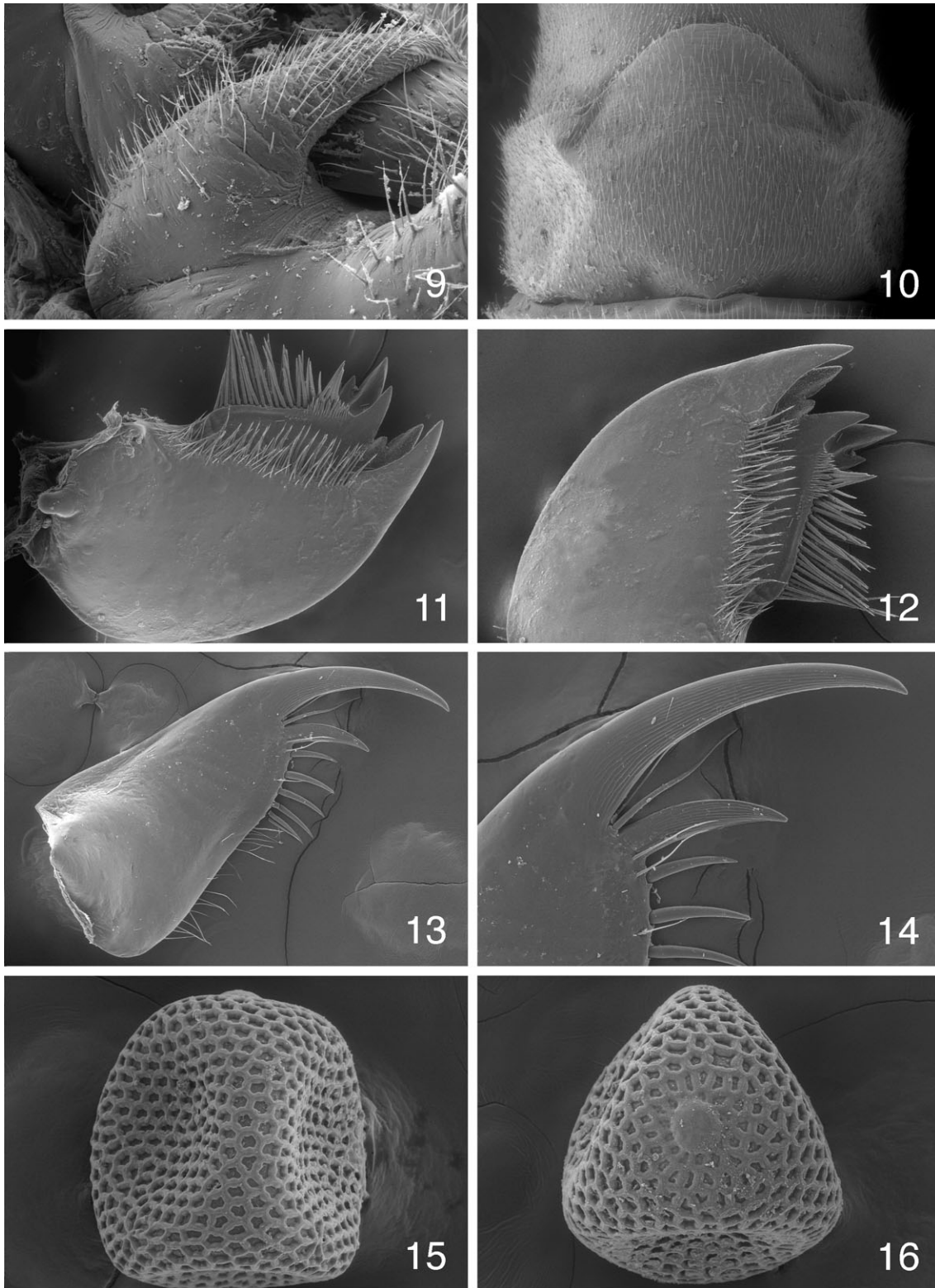
Female. Macropterous. Length of forewings 11.5-12.5 mm; length of body 10.0-11.0 mm. General body color, head and pronotal pigmentation patterns similar to male. Subgenital plate broadly triangular but rounded apically, extending at least over one-half length of ninth sternum (Fig. 10).

Egg. Shape nearly triangular in cross section, short and angular, with five nearly equal sides (Figs. 15-16). Collar poorly developed and appearing as a flattened cap. Chorion with thick ridges interspersed with deep angular depressions that cover the remainder of the outer surface. Micropyles set on ridges near bottom third of egg. Mature eggs light brown and almost translucent, appearing like small jewels in preserved specimens.

Larva. Body length of mature nymph 9.0-10.0 mm. General body color brown, with dark clothing hairs. Dorsum of head brown, light M-shaped pattern forward of median ocellus, frontal margin pale, small oval, light patch between frontal pale band and peaks of “M” pattern, similar light patch between median ocellus and compound eyes; interocellar area brown, occiput with light, oval patch adjacent to eyes; light patch posteriorly on occiput broken by dark reticulate lines; sinuate band of occipital spinules separating the two light patches; posterior corners behind compound eyes brown with scattered spinules (Fig. 33). Antennae light brown with apical circlets of short setae; dark clothing hairs on basal segments. Lacinia triangular, bidentate; subapical tooth ca. 1/2 length of apical tooth; 1 or 2 axillary setae, 6-8 stout marginal setae below subapical tooth, setae 7 and/or 8 small; 2 fine submarginal setae



Figs. 1-8. *Isoperla laucki*: 1. Aedeagus, dorsal, 2. Dorsal spinule patch, aedeagus, close up, 3. Aedeagus, lateral, 4. Aedeagus, anterior, 5. Aedeagus, spinule patch, close up, 6. Stout spinules, aedeagus, posterior at base, 7. Large aedeagus spinules, posterior laterally, at base, 8. Digitate process on aedeagus, located in apical cleft.



Figs. 9-16. *Isoperla laucki*: 9. Male paraproct, right, 10. Subgenital plate, female, 11. Nymphal right mandible, ventral, flipped, 12. Nymphal right mandible, ventral, close up, 13. Nymphal right lacinia, ventral, 14. Nymphal right lacinia, ventral, close up, 15. Egg, lateral, 16. Egg, end view.

below subapical tooth; sparse, irregularly spaced fine marginal and submarginal setae below stout marginal setae (Figs. 13-14). Mandibles with 6 cusps in 2 groups of 3; at least middle cusp in each group serrate; median row of long medium stout setae below outer apical cusp to near mandibular base; inner marginal fringe of 40+ long stout setae; right mandible with row of short stout setae below inner 3rd apical cusp (Fig. 11), setae longer and row more extensive on left mandible. Pronotum oval, width slightly narrower than head, brown with reticulate light markings and dark brown border, slightly lighter brown laterally; margin fringed with small stout setae, occasionally longer setae at upper and lower angles and lateral margin. Meso and metanota brown with reticulate markings. Legs light brown with scattered variable sized stout setae, with sparse dorsal fringe of silky setae (Fig. 33). Thoracic sterna with distinct mesal sclera with dark clothing hairs; mesosternal Y-ridge arms extend to posterior corners of furcal pits; with band of erect bristles scattered across anterior surface of mesosternum. Abdominal segments dark brown; terga with paired mesal and lateral light spots; sometimes a third light spot evident forming a mesal triangle with anteromedial pair; lateral light spots often obscured posterior to first few tergites. Cerci with ca. 28 segments; each with posterior circlet of setae, lacking setal fringe.

Etymology. We are proud to name this species in honor of our friend, teacher, and colleague David R. Lauck, who taught for many years at Humboldt State University in Arcata, California. He instilled in us the excitement and desire to study the stonefly fauna of the Willow Creek area and the greater Trinity-Klamath River drainage. Humboldt Stripetail is suggested as the common name.

Diagnosis. This species is unique among described western *Isoperla*. Adults in the field can be recognized by the golden yellow color, superficially resembling robust *Sweltsa*. Males can be distinguished by the oval patch of strong spinules dorsally on the aedeagus and the unique lightly sclerotized digitate apical process (Figs. 1-4). Nymphs can be distinguished from other western *Isoperla* species by the presence of an M-shaped pattern on the head, the lack of abdominal striping (Fig. 33), and the erect bristles anteriorly on the mesosternum. Erect bristles are evident in early instars but may be worn off in mature later instars. Nymphs superficially resemble

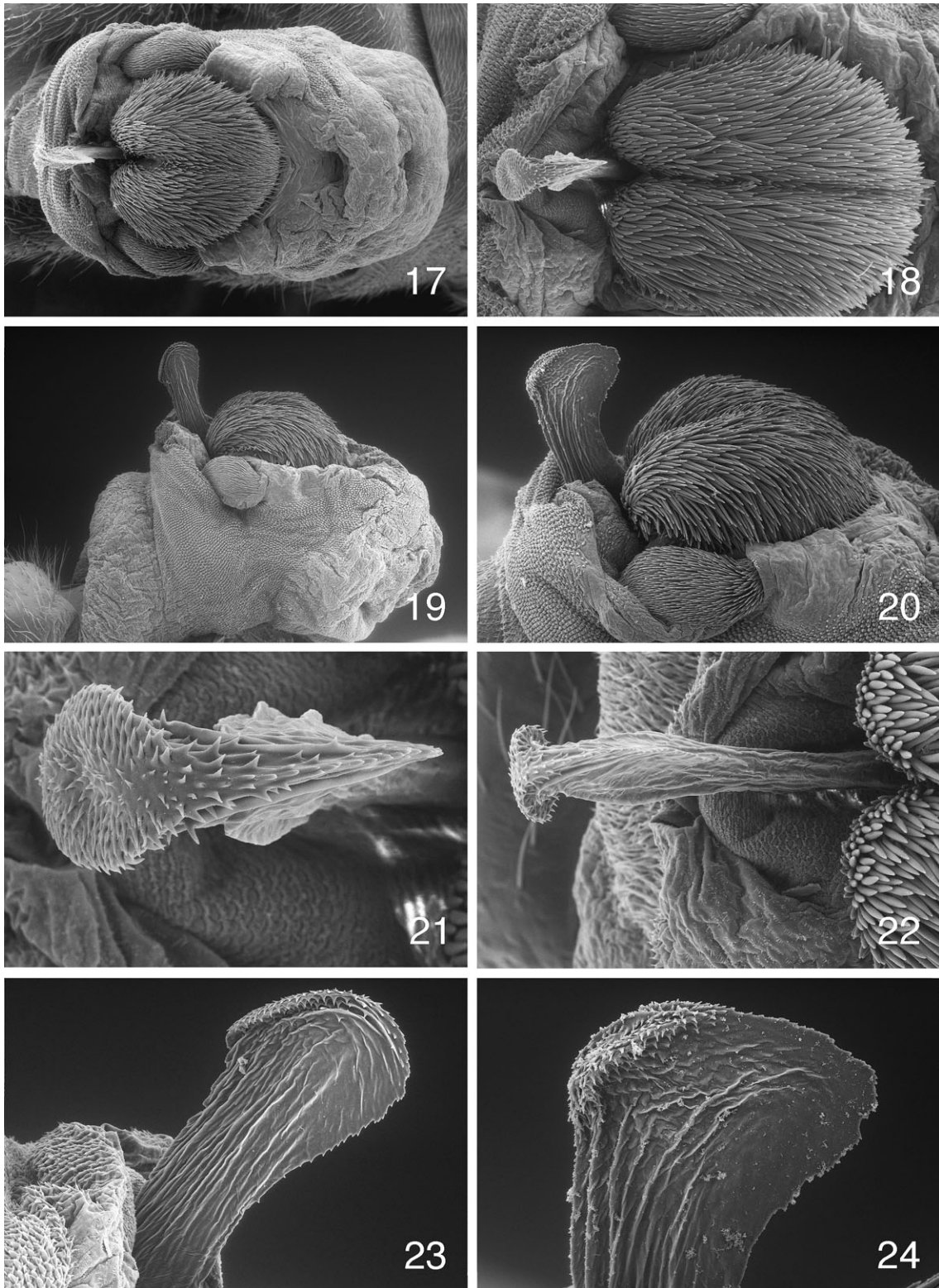
small *Chernokrilus misnomus* (Claassen) and *Calliperla luctuosa* (Banks), however, the small size of late instars, combination of lack of abdominal striping and mesosternal “Y”-arms meeting the posterior corners of the furcal pits, and erect mesosternal bristles distinguishes them. Females have a rounded subgenital plate that extends over half of sternum nine (Fig. 10). The eggs have a distinctive angular shape, with five nearly equal sides (Figs. 15-16).

Remarks. This species was found in small, perennial spring creeks between 400 and 900 meters elevation. Summer water temperatures ranged from 8°C to 12°C, summer air temperature regularly exceeded 27°C. Females with mature eggs were found from June to October indicating an extended emergence. Early instar nymphs were collected in December; mid to late instar nymphs in March through August, suggesting a univoltine life cycle. Other Perlodidae found with *I. laucki* include: *C. luctuosa*, *C. misnomus*, and *Salmoperla sylvanica* Baumann & Lauck.

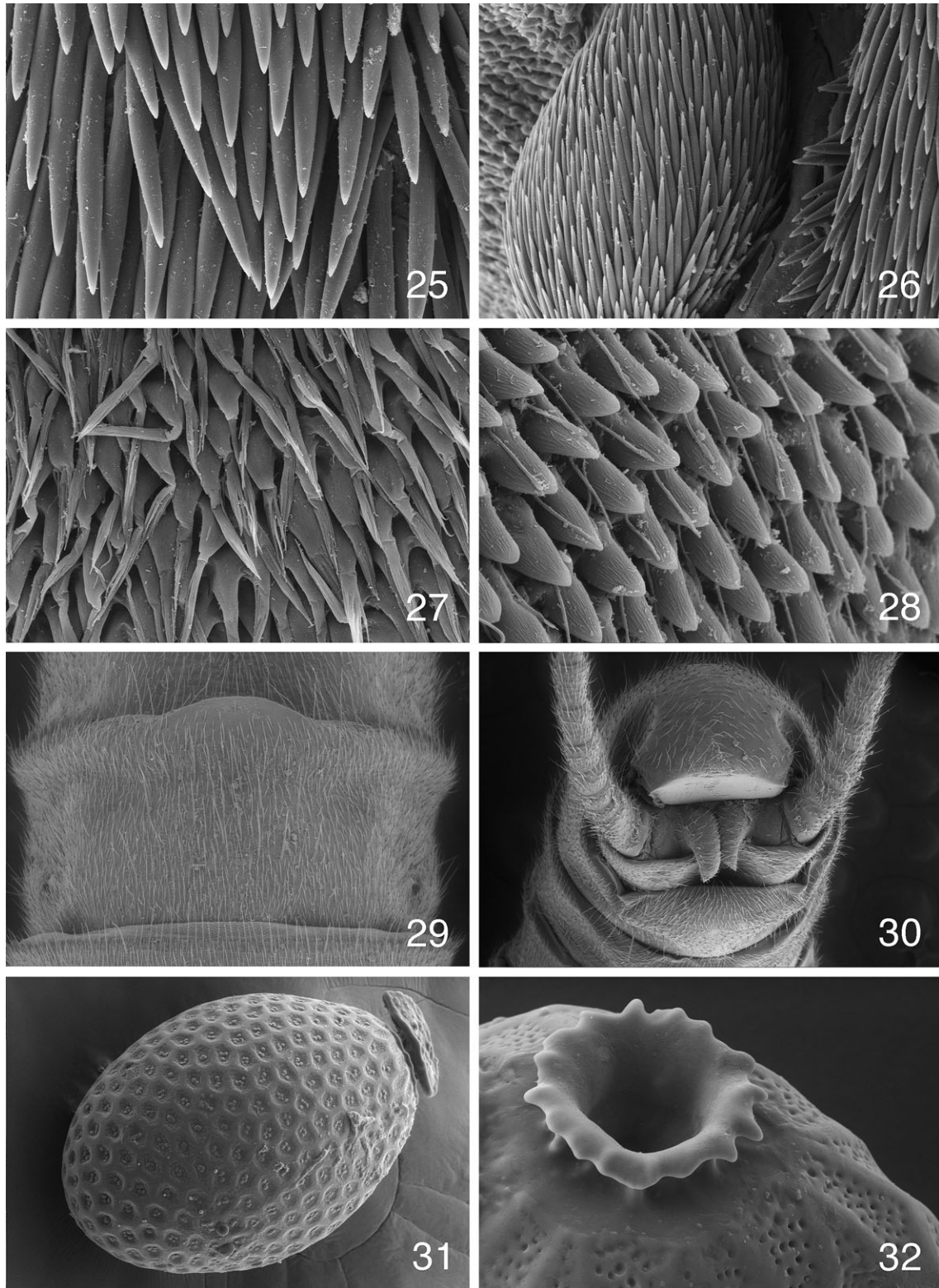
“Drumming” behavior was observed in one male specimen. A laboratory reared female was placed in a container with a field caught male. After approximately 25 hours the female came out of hiding and mating occurred within 15 minutes. The male was observed to touch his vesicle to the substrate 3 to 5 times then raise his abdomen above horizontal and vibrate it before rapidly bringing it back down. This apparent “tremulation” has not been previously reported for *Isoperla* (Stewart 2001) and further investigation is warranted.

Isoperla karuk sp.n.
(Figs. 17-32)

Material examined. Holotype ♂ from California, Humboldt County, Klamath River @ junction of Aikens Creek, 29-III-06, J.J. Lee. Paratypes (J. J. Lee, collector): - California, Humboldt Co., same data as holotype, 29-III-06, 2 ♂; 27-II-08, 1 ♂; 6-III-08, 1 ♀; Mad River @ Mad River Fish Hatchery, 19-IV-06, 2 ♂, 3 ♀; 7-IV-07 2 ♂; 18-IV-07, 1 ♂, 1 ♀; 19-IV-07, 6 ♂; 5-V-07, 1 ♂; 8-IV-08, 1 ♀; 12-V-08, 1 ♀; Mad River @ 1st curve Mad River Rd., 20-III-06, 1 ♂; 29,30-III-07, 12 ♂, 10 ♀; 1-IV-07, 2 ♂, 1 ♀; 3-IV-07, 3 ♂, 1 ♀; 4-IV-07, 1 ♀ (reared); 7-IV-07, 4 ♂; 28-IV-07, 1 ♂; 17-III-08, 1 ♂. Holotype deposited at the California Academy of Sciences.



Figs. 17-24. *Isoperla karuk*: 17. Aedeagus, dorsal, 18. Aedeagus, dorsal, close up, 19. Aedeagus, lateral, 20. Aedeagus, lateral, close up, 21. Aedeagus process, dorsal, close up, 22. Aedeagus process, ventral, 23. Aedeagus process, lateral, 24. Aedeagus process, lateral, close up.



Figs. 25-32. *Isoperla karuk*: 25. Aedeagus, spinules, dorsal patch, 26. Dorsal and lateral aedeagus spinule patches, 27. Spinules, at base of aedeagus, 28. Spinules with hair-like addition, encircling aedeagus, 29. Vesicle, male. 30. Male terminalia, dorsal, showing paraprocts, 31. Egg, lateral, 32. Egg collar, close up.

Male. Macropterous. Length of forewings 8.5-10.5 mm; length of body 8.0-9.0 mm. General body color medium brown. Head with ocelli and base of antennae connected by dark brown M-shaped pigment band; yellow patch forward of anterior ocellus and between lateral ocelli and compound eye; interocellar space ranging from mostly yellow to an oval, central yellow spot; occiput light brown, with lateral light oval patch broken by brown reticulations, light patch broadly to barely connected to yellow patch adjacent to eyes; antennae brown. Pronotum with wide, median light stripe; disks light brown to lateral margins, rugosities darker brown; anterior and posterior margins cream to light brown. Meso and metanota dark brown, large yellow patch anteriorly between mesonotal wing bases. Wings hyaline, veins brown, fumose in coastal space. Legs light brown, femur with proximal dorsal brown mark and longitudinal dorsal brown stripe, tibia with incomplete narrow brown band in proximal one-fourth. Abdominal terga medium brown dorsally, pale laterally, a pair of median light marks on first few terga, broken brown stripes appearing weakly laterally; abdominal sterna cream colored with brown marks at pleural folds, medial and mediolateral pair of brown spots evident to varying degrees. Vesicle short, broadly rounded (Fig. 29). Cerci brown, segments with one long posteroventral seta. Paraprocts short and stout, apically pointed, barely curving over tenth tergum (Fig. 30). Aedeagus (Figs. 17 & 19) with a large posteromedial bi-hemispherical lobe bearing long, rust colored anteriorly directed spinules (Figs. 18 & 25); a thin, sclerotized, clavate process (lateral view), projecting from midventral margin of bi-hemispherical lobe, keeled dorsally and ventrally, flattening apically, heavily sculptured and spinulate (Figs. 21-24); a pair of lobes positioned laterally on either side of bi-hemispherical lobe, bearing rust colored spinules directed posteriorly (Figs. 17, 20 & 26); a patch of thin light colored spinules located below clavate process, narrowed and fringed apically (Figs. 22 & 27). A band of small, light brown spinules encircling base, with areas projecting forward laterally, spinules short and rounded at apex, each with a lateral hair-like process (Figs. 19 & 28); anterior surface of aedeagus void of spinules (Figs. 17 & 19).

Female. Macropterous. Length of forewings 10.0-10.5 mm; length of body 9.0-10.0 mm. General body color

and head and pronotal pigmentation patterns similar to male. Subgenital plate brown, darker than rest of segment, triangular, terminating in broad triangular point, produced $\frac{1}{4}$ to $\frac{1}{2}$ over length of sternum 9.

Egg. Shape oval, round in cross section, narrower toward poles (Fig. 31). Collar well developed, higher and with broader flanges (Fig. 32) than shown for *I. fulva* and *I. marmorata* in Szczytko & Stewart (1979). Chorion with thickened ridges, forming pentagon shaped depressions, proteinaceous bodies sometimes present. Micropyles appearing on the bottom half of the egg. Color dark brown and opaque.

Larva. Unknown.

Etymology. The species name is a noun in apposition and honors the Karuk people of the Klamath River in northern California. The common name Klamath Stripetail is suggested.

Diagnosis. *Isoperla karuk* is placed in the *Isoperla marmorata* complex which includes *I. marmorata* (Needham and Claassen) and *I. fulva* Claassen. It shares the following characteristics (Szczytko & Stewart 1979): 1. male aedeagus bearing a spinose, club-shaped, sclerotized process; 2. broadly rounded, shallow male vesicle; 3. angulate female subgenital plate (shared with *I. fulva*). The male is easily distinguished from other members of the complex by the unique aedeagus with a bi-hemispherical lobe bearing reddish brown spinulae directed anteriorly and two smaller lobes bearing reddish brown spinulae directed posteriorly. The *I. karuk* female cannot presently be distinguished from the female of *I. fulva* by the shape of the subgenital plate but the egg has a higher and more broadened collar. Nymphs that we believe are *I. karuk* fit the description for *I. marmorata* (Szczytko & Stewart 1979).

Remarks. This species was collected from medium sized rivers close to sea level. Adults were found from February into May. The peak *I. karuk* emergence period, on the Mad River, followed the peak emergence of *I. pinta* Frison and preceded the peak *I. mormona* Banks emergence period. The riverine habitat made benthic collection of nymphs problematic. Several nymphs were collected, however, and three reared nymphs turned out to be three separate *Isoperla* species (*I. karuk*, *I. mormona* and *I. marmorata*?). Field caught females and males were maintained together in order to obtain mature ova. Females were alive after 43 days and appeared



Figure. 33. *Isoperla laucki*. Mature nymph, dorsal, habitus.

to feed on, or at least consume the juice of apple slices.

Since this species is difficult to separate from *I. fulva* in both the male and female adult stages without extruding the aedeagus or studying the eggs, the identity of specimens previously listed as *I. fulva* from California is questionable. Jewett (1960) in his study of the California stonefly fauna listed two records for *I. fulva*: one in El Dorado County and one in Modoc County. Later, Szczytko & Stewart (1979) listed two additional records: Plumas County and Modoc County (Oregon).

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