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The millipede family Striariidae Bollman, 1893. II. New records and species of the genus *Amplaria* Chamberlin, 1941 (Diplopoda, Chordeumatida, Striarioidea)

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Abstract

The millipede genus *Amplaria* Chamberlin, 1941 (senior synonym of *Vaferaria* Causey, 1958 and *Speostriaria* Causey, 1960) is endemic to western North America, from Mt. Palomar and San Luis Obispo, California, north to southwestern British Columbia, Canada, and east to northern Idaho. Seven species names are currently assigned to the genus. Below I describe ten additional new species: ***Amplaria crawfordi***, ***Amplaria fontinalis***, ***Amplaria rykkenae***, ***Amplaria arcata***, ***Amplaria baughi***, ***Amplaria staceyi***, ***Amplaria umatilla***, ***Amplaria cervus***, ***Amplaria mendocino*** and ***Amplaria flucticulus***, and provide new records of *Amplaria nazinta* Chamberlin.

Key words: new species, *Striaria,* California, Oregon, Washington, troglobites

Introduction

The millipede family Striariidae Bollman, 1893 is endemic to North America and doubtless one of the most deviating families in the Order Chordeumatida, with heavily sclerotized cuticle covered by a cerotegument, a hood-like collum, three-lobed epiproct and metazonites with prominent longitudinal crests (Figs. 1, 14, 20, 27, 42). Sexual dimorphism is pronounced and affects the head, collum, mandibles and legpairs 1 to 7 of males to a greater or lesser degree. Only the genus *Striaria* Bollman, 1888, occurs in the eastern United States, in the Appalachian Mountains and foothills from southern Ohio and northern Virginia south to Alabama and Georgia, though a few outliers are found in northern Idaho (based on unpublished records of undescribed species). In the western states along the Pacific Coast (California, Oregon and Washington), the family shows more diversity with two subfamilies, Striariinae Bollman 1893 and Trisariinae Shear 2020; two described genera, *Amplaria* and *Trisaria* Shear, 2020 (Shear & Krejca 2007, Shear *et al.* 2017, Shear 2020); and numerous undescribed subfamilial, generic and species taxa that will be the subject of later papers in this series. Indeed, given the probably narrow endemism of species of *Amplaria* and the relatively low level of collection effort, many more of this genus await collection and description.

Amplaria originally included species from both the eastern and western parts of the United States, but Shear and Krejca (2007) showed that the supposed eastern species were actually members of *Striaria.* They also synonymized the genus *Speostriaria* Causey, 1960, with *Amplaria* and described two new species from caves in the Sierra Nevada of California. Shear, Nosler and Marek (2017) resolved the identity of *Amplaria nazinta* (Chamberlin, 1910), and Shear (2020) synonymized the monotypic genus *Vaferaria* Causey, 1960, with *Amplaria.* In addition, Shear (2020) described a new subfamily, genus, and three new species in Striariidae.

The characters of *Amplaria,* as opposed to those of the two other genera now included in the family (*Striaria* Bollman, 1893 and *Trisaria* Shear, 2020), were discussed in some detail by Shear and Krejca (2017) and Shear (2020). Some additional useful characters are added in the discussion of the genus given below.

Methods

Specimens were field-preserved in 70–85% ethanol. Morphological studies were done using an Olympus SZH

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stereomicroscope and an Olympus BX50 compound microscope equipped with Nomarski optics. Gonopods, ninth legs, pregonopodal legs and other body parts were temporarily mounted on microscope slides in glycerine for study up to 400X magnification. Drawings were made from these slides using a drawing tube fitted to the BX50. Measurements were taken using an ocular micrometer on the SZH (lengths of millipedes are highly variable because the body rings can be extended and telescoped to a considerable degree) or transferred from scale lines on scanning electron micrographs. Specimens were mounted and air-dried on 12.7-mm diameter aluminum scanning electron microscopy (SEM) stubs affixed with double-sided carbon conductive tape. These were sputter-coated with a 40 nm thickness layer of platinum and palladium metals using a Leica EM ACE600 high vacuum sputter coater. Scanning electron micrographs were taken with a FEI Quanta 600 FEG environmental SEM. Photographs and drawings were edited and refined using GIMP and plates were composed in InkScape.

All specimens, including types, used in this study will be deposited in the collection of the California Academy of Sciences, San Francisco, California, USA, with the exception of the types of *Amplaria crawfordi,* n. sp., which will be deposited in the Burke Memorial Museum of the University of Washington, Seattle, Washington, USA. Scanning Electron Microscopy stubs with parts of types and other specimens will be deposited later in the same repositories.

Abbreviations used in the Figures

aac: anterior angiocoxite
cf: coxal flask of legpair 3
cx: coxa
cx3: coxa of legpair 3
cx4: coxa of legpair 4
cxp: coxal process
cxt2: coxotrochanter of legpair 2
fc: flagellocoxite
hp: hypoproct
lab: labrum
lcc: lateral lobe of colpocoxite
lh: labral hook
man: mandible
numerals: ring numbers
pa: paraproct
pac: posterior angiocoxite
pcb: postcoxal bar of ring 3
pcc: posterior lobe of colpocoxite
pf2: prefemur of second legpair
pf3: prefemur of third legpair
ptr7: modified pleurotergal rim of ring 7
pyg: pygidium
R2: ring 2
s: sternum
s2: sternum of legpair 2
s9: sternum of legpair 9
t3: telopodite of legpair 3
t9: telopodite of legpair 9
tp2: trochanteral process of legpair 2
tr1: tarsus of legpair 1
vd: openings of vasa deferentia

Taxonomy

Family Striariidae Bollman, 1893

Subfamily Striariinae Bollman, 1893

Genus *Amplaria* Chamberlin, 1941.

Amplaria Chamberlin, 1941, p. 9. *Type species: Amplaria eutypa* Chamberlin, 1941 (by monotypy). Shear & Krejca, 2007, p. 25. Shear, Nosler & Marek, 2017, p. 234. Shear, 2020, p. 282.

Speostriaria Causey, 1960, p. 26. *Type species: Striaria shastae* Causey, 1958 (by original designation). Synonymized by Shear & Krejca (2007).

Vaferaria Causey, 1958, p. 180. *Type species: Striaria imberbis* Loomis, 1936 (by original designation). Synonymized by Shear (2020)

Included species: *Amplaria nazinta* (Chamberlin, 1910), *Amplaria eutypa* Chamberlin, 1941, *Amplaria imberbis* (Loomis, 1936), *Amplaria eldora* (Chamberlin, 1953), *Amplaria shastae* (Causey, 1960), *Amplaria muiri* Shear & Krejca, 2007, and *Amplaria adamsi* Shear & Krejca, 2007, and the ten new species described below.

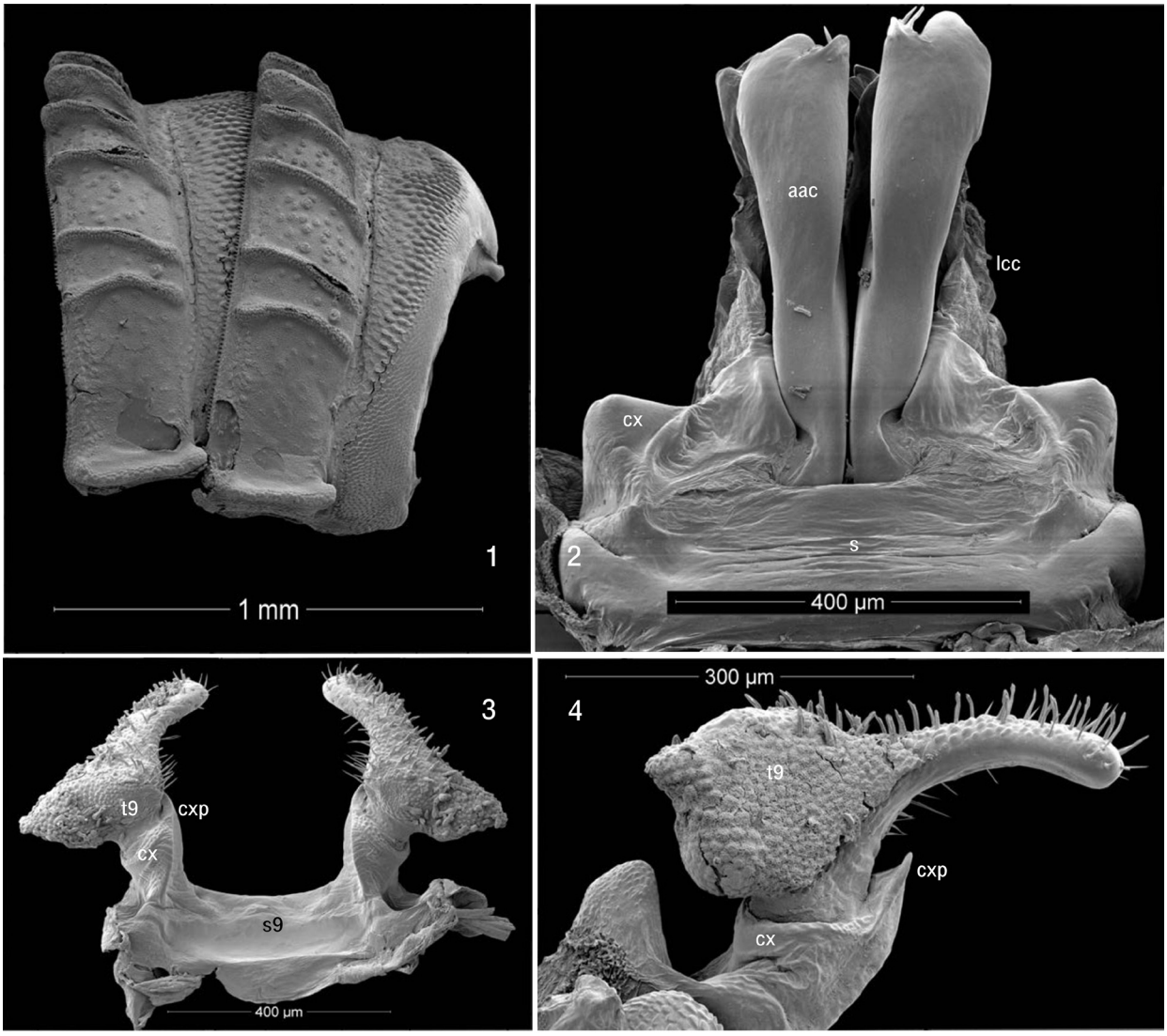
Secondary sexual characters of the males: The characters of *Amplaria* have been discussed in some detail by Shear and Krejca (2007) and Shear (2020). Most of the taxonomically useful characters are to be found, as usual in millipedes, in the secondary sexual modifications of the males, including the gonopods and ninth legs. Such characters are of variable occurrence from species to species and hence useful in diagnosing new taxa. Males of *Amplaria* may or may not have pronounced hooks or sinuate spines at the lateral corners of the labrum (Figs. 8, 15; mistakenly referred to as the mentum in Shear & Krejca [2007]). The mandibular stipes is sometimes angular distally and with a sawtooth posterior edge. The collum in males is both longer and broader than in females. The first legpair may be much larger than the second or about the same size, and some of its podomeres may bear long, needle-like setae, or highly modified twisted, spatulate ones (Figs. 16, 17; sometimes both types are present). The second legpair carries the openings of the vasa deferentia on the coxae as short, extensible, membranous tubes (Fig. 40), and the trochanters have variously developed distal knobs with specialized setae (Fig. 32); the trochanters may be fused to the coxae and the coxae themselves fused bilaterally (Fig. 6). The telopodites of the second legpair may be shorter and more slender than those of the first pair, or subequal to them. The third legpair has much enlarged coxae, extended into flask-like structures (*i.e.*, Fig. 21), the tips of which have specialized curled setae and insert at rest into the openings of the vasa deferentia on the second coxae or are held in front of the male's "face"; the flasks may be large and tightly appressed to one another in the midline (Fig. 6), or small, well separated and divergent; the telopodites are usually reduced and the prefemora may be modified with a distoventral lobe (Fig. 6). Behind the third coxae, prominent bars extend on either side from the third pleurotergite, supporting the third coxae (Fig. 13). The coxae of the fourth and fifth legpairs may have a deep, distal depression and be covered in long, fine setae (Fig. 41). The fourth, fifth and sixth legpairs are enlarged, with flattened podomeres, as are the seventh legs, which in addition have enlarged coxae that cover the bases of the gonopods.

The characteristic gonopods are described and illustrated in detail in Shear (2020) and in this paper. Fundamentally, each gonopod consists of two prominent angiocoxites (anterior and posterior), a flagellocoxite, and a two-lobed colpocoxite (Figs. 45–57). The ninth sternite is broad and bowl-shaped, accommodating the resting gonopods. The ninth legpair (*i.e.*, Fig. 3), often incorrectly referred to as "posterior gonopods," are strongly reduced and consist only of a coxa, which may have a short apophysis at the mediodistal margin; a small, probably vestigial coxal gland pore; and a flattened single-articled telopodite which loosely articulates with the ventral edge of the seventh pleurotergite (Fig. 36). The telopodite may have a long, finger-like mesal extension (Fig. 3). The tenth legpair resembles subsequent pairs but has large coxal gland pores.

Nonsexual characters: The number of ommatidia varies between species from none to about 15. The ommatidia are of irregular shape and size and usually poorly pigmented. Evidently unique to *Amplaria* is a specially modified type of seta found on the legs (Fig. 23). Progressing distally on any leg, these setae transition gradually to ordinary ones. A character that has previously been overlooked affects the terminal segment, or pygidium. In several species, the pygidium is elongated and flattened (Figs. 19, 20) and the notches between the three characteristic lobes are much deeper than in other species. The degree to which this is the case varies from species to species. The waxy

coating, or cerotegument, is obvious in many of the SEM images presented here, as it cracks and partially flakes off during handling. Specimens of *Amplaria* species may be white to uniformly pale tan, or with four purplish-brown spots evenly spaced across each ring, two near the pleurotergal ventral edge on each side and two dorsally, on either side of the median sulcus. Seen from above, the dorsal spots blend into what appear to be two continual dark stripes on a light background (the "two-striped" pattern). In those species darkly pigmented, the collum and pygidium are sometimes a strongly contrasting white.

Species groups: The distribution of the characters briefly listed above and the unique forms they take in some of the new species, initially suggested to me that perhaps as many as three new genera could be named and described. However, due to the few and scattered records, implying the existence of additional species and the relatively uniform gonopod plan, I decided only to designate three species groups in addition to the "classic" *Amplaria* species obviously close to the type (which I have left ungrouped). When more collecting has been done and we know more about the full range of species now in the genus, and genetic data perhaps becomes available, these species groups may be elevated to separate genera.



FIGS. 1–4. *Amplaria nazinta, A. crawfordi.* Figs. 1–3. *Amplaria nazinta.* Fig. 1. Rings 8 and 9, lateral view. Fig. 2. Gonopods, anterior view. Fig. 3. Legpair 9, anterior view. Fig. 4. *A. crawfordi,* right leg 9, anterior view.

The Nazinta Species Group

This group of three similar species includes *A. nazinta, A. crawfordi,* n. sp., and *A. fontinalis,* n. sp. Members of this group are distinct in the fusion and enlargement of the second coxae and trochanters of the males, as well as

the long, needle-like setae of the male first legs and the large third coxal flasks, tightly appressed in the midline. The anterior angiocoxites of the gonopods have a terminal lateral branch that in turn is divided apically into several short, acute processes.

Amplaria nazinta (Chamberlin), 1910
Figs. 1–3, 45, 46

Striaria nazinta Chamberlin 1910, p. 242; Loomis 1936, p. 408.
Amplaria nazinta, Chamberlin, 1941, p. 9; Causey 1958, p. 180; Shear & Krejca 2007, p. 26; Shear, Nosler & Marek, 2017, p. 234.

Notes: I present here some additional illustrations (Figs. 1–3, 45, 46) of *A. nazinta.* Parts of these specimens are mounted on SEM stub WAS34-6.

New records: OREGON: *Curry Co.*: 13 mi N, 5 mi W of Brookings, T39S/R14W/S5, 200' asl, 12 February 1972, E. M. Benedict, m. *Washington Co.*: 1.7 mi W of Timber, T3N/R5W/S3, 900' asl, 27 November 1971, E. M. Benedict, m.

***Amplaria crawfordi,* new species**
Figs. 4–6, 47, 48

Types: Male holotype and male and female paratypes from west of Thornton Creek, 47.698°, -122.279°, 80' asl, Seattle, King Co., Washington, collected 10–15 April 2002 by Jerry Austin; deposited in Burke Memorial Museum of the University of Washington, Seattle, Washington. Parts of these specimens are mounted on SEM stub WAS34-8.

Diagnosis: Similar to and clearly related to *A. nazinta* and *A. fontinalis,* n. sp. Distinct from the former in the longer, finger-like extension of the ninth leg telopodite (Fig. 4), and from the latter in having a few more ommatidia and in details of the gonopod (compare Figs. 2 and 5).

Etymology: I take pleasure in naming this species for my esteemed colleague, Rod Crawford, curator of terrestrial invertebrates at the Burke Memorial Museum of the University of Washington, Seattle, Washington.

Description: *Male holotype.* Length, about 10 mm, width 0.9–1.0 mm. Four small, poorly formed black ommatidia. Labrum without hooks; mandible not modified. First legpair larger than second and third, femur and postfemur with long, needle-like setae. Second legpair coxae fused in midline and to their respective trochanters, short apophysis with specialized setae on trochanteral part (Fig. 6). Third coxal flasks basally fused, distally tightly appressed in midline, enlarged, sharply angled anteriorly; third telopodites reduced in size, prefemur with strong, distoventral lobe (Fig. 6). Pleurotergal bars of third ring broad, not touching in midline. Coxae of legpairs four and five not modified, telopodites enlarged, with flattened podomeres. Pygidium short. Color medium chestnut brown (after long preservation).

Gonopods (Fig. 5, 47, 48) with anterior angiocoxite apically divided; lateral branch slender, rebranched, deflexed at tip. Posterior angiocoxite expanded, *in situ* sheathing three or four flagellocoxites. Ninth legpair coxae without prominent apophysis, mesal apex acute; telopodite with long, finger-like mesal extension (Fig. 4).

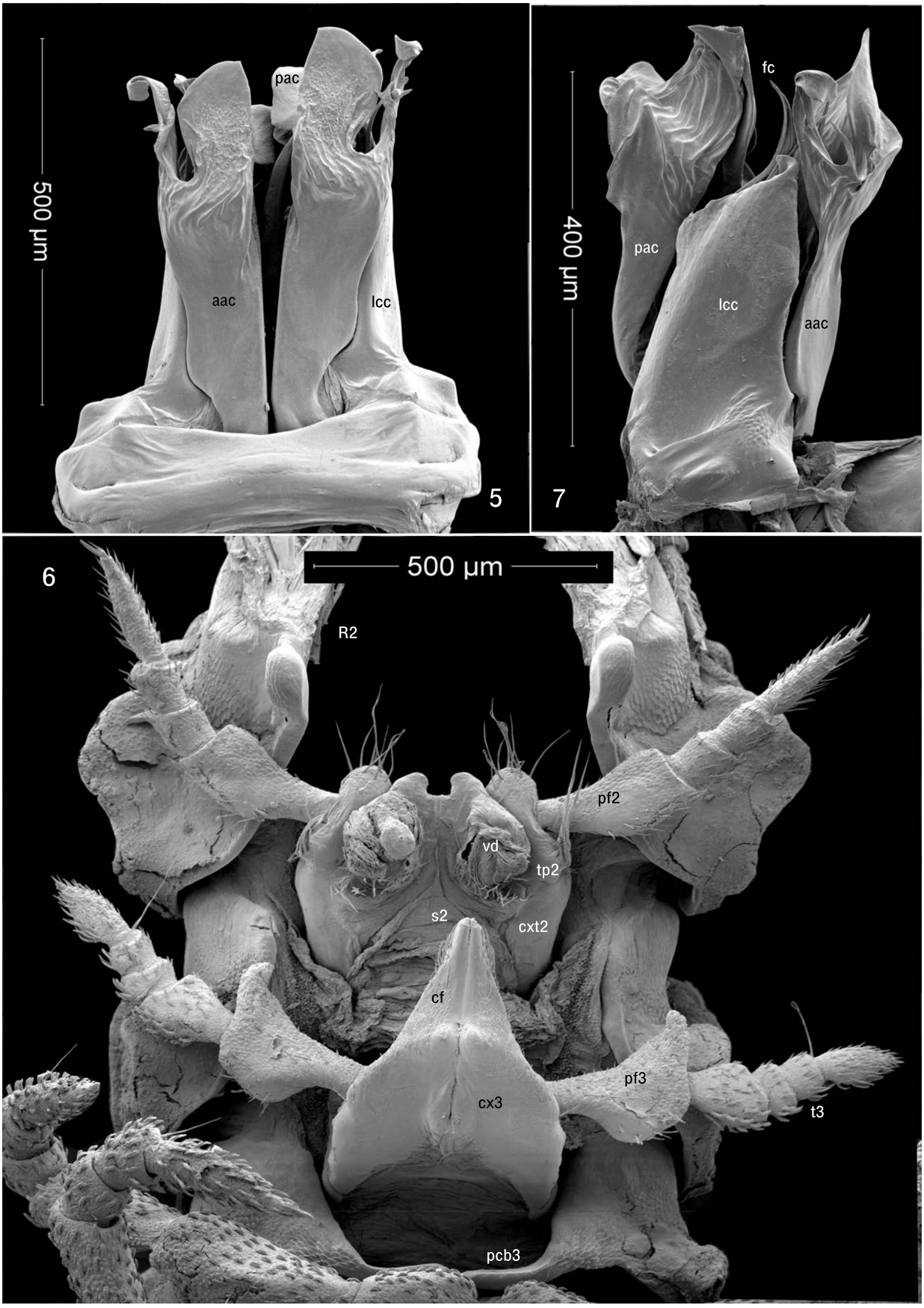
Females similar in non-sexual characters to males.

Distribution: Known only from the type locality.

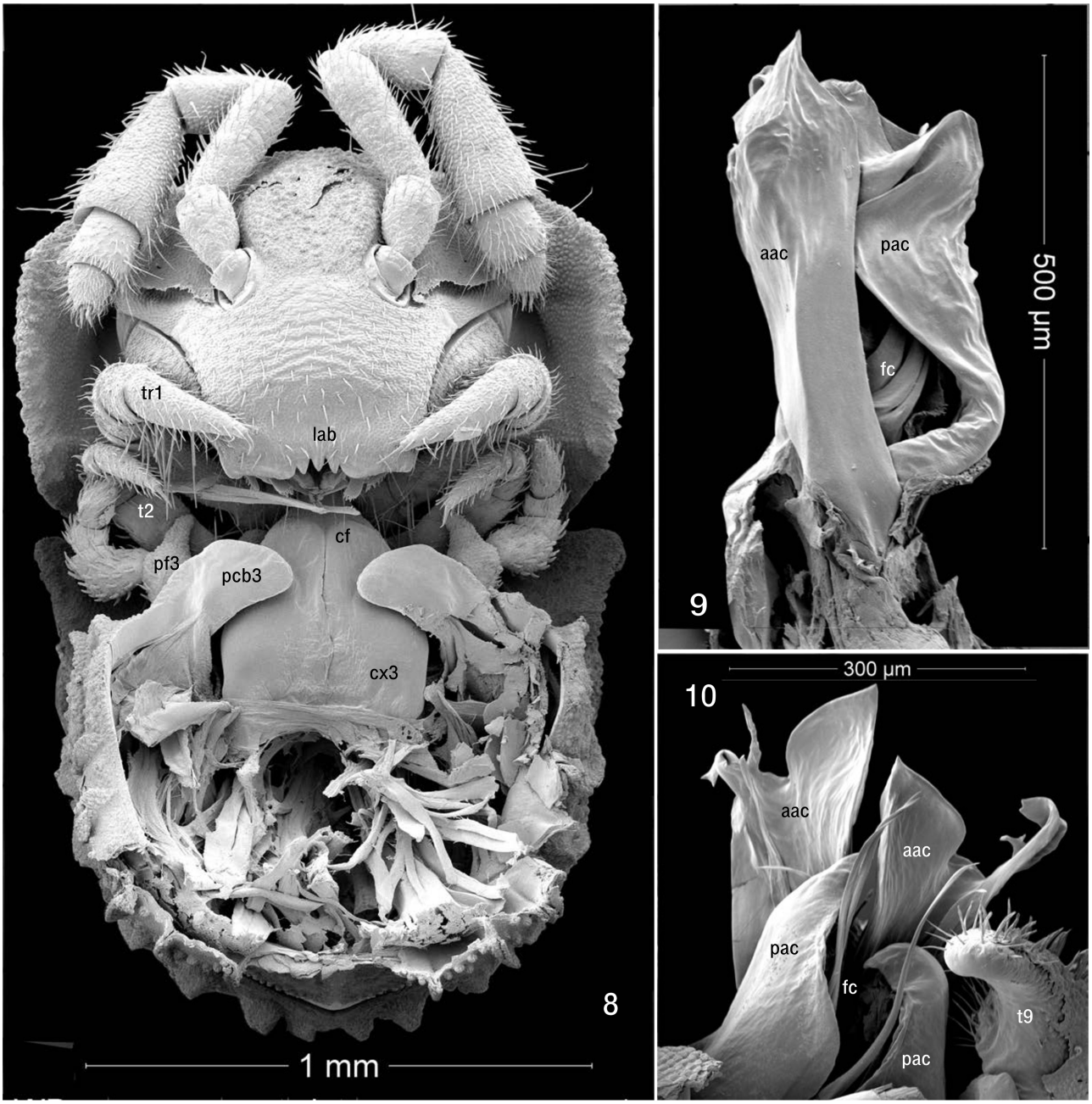
***Amplaria fontinalis,* new species**
Figs. 7–10, 49, 50

Types: Male holotype and 5 male and 3 female paratypes from Spring Creek Hatchery, State Route 14, 45.7280°, -121.5445°, 50' asl, Skamania Co., Washington, collected 30 November 2003 by W. Leonard. Parts of these specimens are mounted on SEM stub WAS34-9.

Diagnosis: Distinct from *A. nazinta* in the longer, finger-like extension of the ninth leg telopodite; and from *A. crawfordi* in the differing shape of the gonopod (compare Figs. 47, 48 with 49, 50), and having more numerous ommatidia.



FIGS. 5–7. *Amplaria crawfordi, A. fontinalis.* Figs. 5, 6. *Amplaria crawfordi.* Fig. 5. Gonopods, anterior view. Fig. 6. Legpairs 2 and 3, ventral view. Fig. 7. *A. fontinalis,* left gonopod, lateral view.



FIGS. 8–10. *Amplaria fontinalis*. Fig.8. Head and first 3 rings of male, ventral view. Fig. 9. Left gonopod, mesal view. Fig. 10. Gonopod tips, posterior view.

Etymology: The species epithet *fontinalis* (Latin: of the spring) is an adjective referring to the type locality, Spring Creek Federal Fish Hatchery.

Description: *Male holotype*. Length, about 10 mm, width 0.9–1.0 mm. Seven to 9 small, round, black ommatidia in triangular patch. Labrum without hooks (Fig. 8); mandible not modified. First legpair larger than second and third, femur and postfemur with long, needle-like setae (Fig. 8). Second legpair coxae fused in midline and to their respective trochanters, short apophysis with specialized setae on trochanteral part. Third coxal flasks basally fused, distally tightly appressed in midline, enlarged, sharply angled anteriorly; third telopodites reduced in size, prefemur with strong, distoventral lobe (Fig. 8). Pleurotergal bars of third ring broad (Fig. 8), not touching in midline. Coxae of legpairs four and five not modified. Pygidium short. Color pale tan (after long preservation).

Gonopods (Figs. 7, 9, 10, 49, 50) with anterior angiocoxite apically divided; lateral branch slender, rebranched but with fewer subdivisions than in *A. crawfordi*, which are stouter, deflexed and notched at tip. Posterior angiocoxite apically expanded, *in situ* sheathing three or four flagellocoxites. Ninth legpair coxae without prominent apophysis, telopodite (Fig. 10) with long, finger-like extension.

Females similar to males in nonsexual characters.

Distribution: Known only from the type locality.

The Rykkenae Species Group

This group of two species (*A. rykkenae,* n. sp., and *A. arcata,* n. sp.) is characterized by the elongate pygidium (Figs. 14, 19) present in both sexes and by several fine, acute, often branched processes posteriodistal on the anterior angiocoxite of the gonopods.

Amplaria rykkenae, new species

Figs. 11–14, 51, 52

Types: Male holotype from 1 mi ENE of Upper Soda, Sweet Home Road, Willamette National Forest, 44.4131°, -122.2619°, 1840' asl, Linn Co. Oregon, collected 1 October 2001 by Jessica Rykken; male paratypes from 4 mi WSW of Upper Soda, 44.4015°, -122.3749°, 1440' asl, collected 27 November 2001, and from 4 mi WNW of Upper Soda, 44.4085°, -122.3844°, 612' asl, collected 15 August 2001, both localities on Sweet Home Road, Willamette National Forest, Linn Co., Oregon, both collected by Jessica Rykken. Parts of these specimens are mounted on SEM stub WAS34-7.

Etymology: I am pleased to name this species for the collector, Jessica Rykken, presently entomologist at Denali National Park, Alaska.

Diagnosis: Distinct from *A. arcata,* the other species in the group, in having the femora of the second legpair in males of normal size, and the more prominent acute process at the tip of the gonopod anterior angiocoxite (Fig. 12).

Description: *Holotype male.* Length, about 11 mm, width about 1.0 mm. Seven or 8 poorly formed, unpigmented ommatidia in triangular patch. Labral hooks long, nearly straight. Mandible not modified. Legpairs 1 and 2 similar in size, first legs without long setae, tarsi ventrally armed with twisted, spatulate setae. Trochanters of second legs without processes, small group of specialized setae present, femora of normal size. Coxal flasks of third legs evenly curved, tapering, pleurotergal bars of third ring narrow, not meeting in midline. Legpairs 4–7 enlarged, with flattened podomeres, coxae unmodified except for lobes on coxae 7. Metazonital crests moderate, segmental setae long, filamentous. Pygidium elongate, deeply divided between lobes (Fig. 14). Color uniform pale tan.

Gonopods (Figs. 11, 12, 51, 52) with numerous spiculate processes posterioapically on anterior angiocoxites, coxites cup-like apically; posterior angiocoxites rather narrow, not greatly expanded distally, sheathing 3 or 4 flagellocoxites. Ninth legpair (Fig. 13) with long lateral coxal apophysis, mesally with poorly sclerotized fungiform area possibly representing vestigial coxal glands.

Females not collected.

Distribution: Known only from the general vicinity of Upper Soda, Oregon.

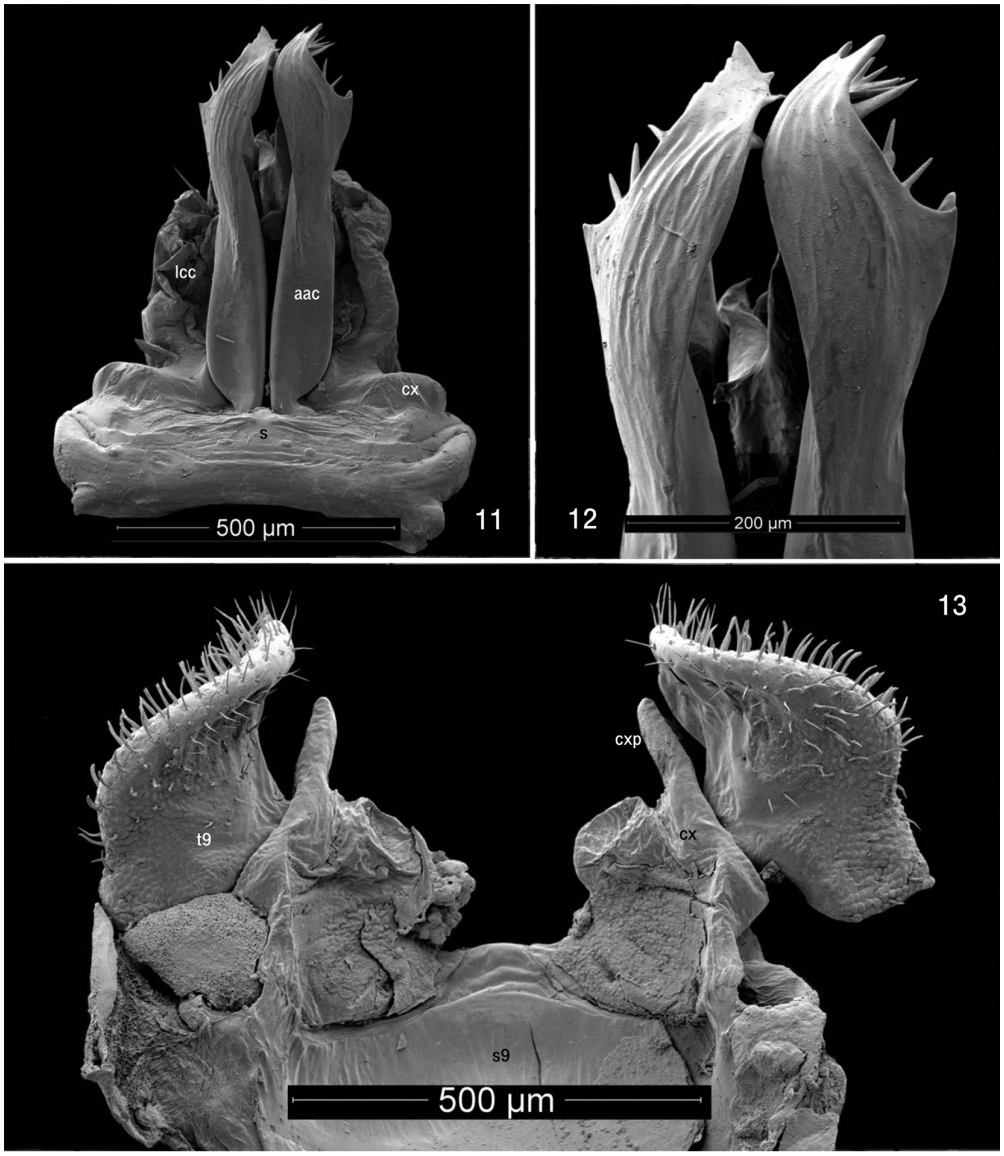
Amplaria arcata, n. sp.

Figs. 15–26

Types: Male holotype and male paratype from Prairie Creek Redwoods State Park, 41.3729833°, 124.0138833°, 252' asl, Humboldt Co., California, collected 21 December 2006 by C. H. Richart, A. Fusek (Richart collection number CHR 1041). Parts of these specimens are mounted on SEM stubs: WAS33-18, WAS34-1, WAS34-2 and WAS34-3.

Diagnosis: Distinct from *A. rykkenae,* the other species in the group, in having the femora of the second pair of legs of the males much enlarged, nearly as wide as long (Fig. 15).

Etymology: The species name is a noun in apposition and refers to the nearby town of Arcata, where the species was also collected



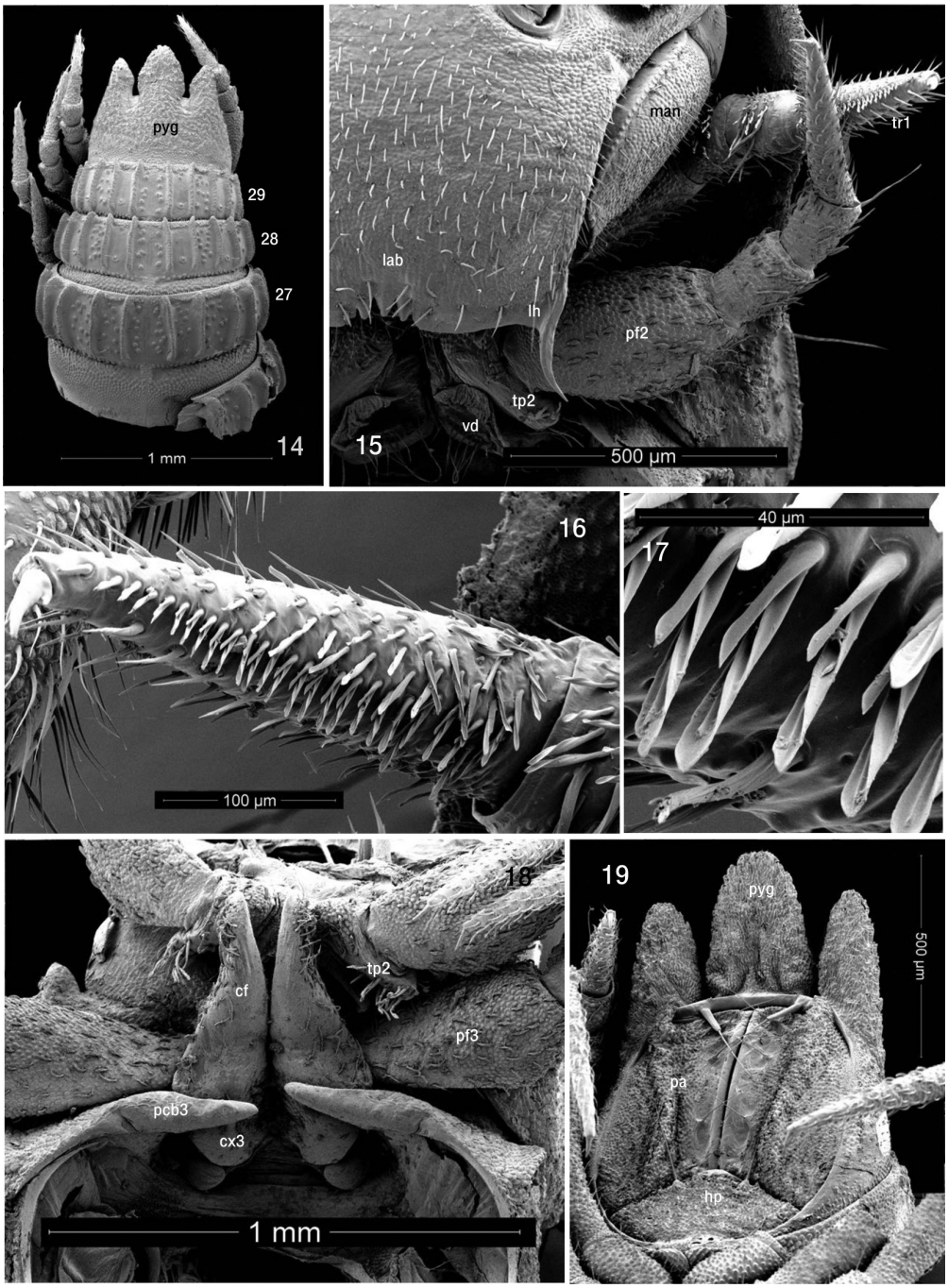
FIGS. 11–13. *Amplaria rykkenae.* Fig. 11. Gonopods, anterior view. Fig. 12. Gonopod tips, anterior view. Fig. 13. Legpair 9, anterior view.

Description: *Male paratype.* Length about 10.5 mm, width about 1.0 mm. Seven or eight black ommatidia in triangular patch. Labrum with long, sinuate hooks; mandible not modified (Fig. 15). Legpairs 1 and 2 subequal, legs 1 without long setae, tarsi ventrally with twisted, spatulate setae (Figs. 15–17). Trochanters of second legs with short ventral process with patch of specialized setae, femora enlarged, oval, inflated. Coxal flasks of third legs (Figs. 18, 21) evenly curved, tapering, pleurotergal bars of third ring narrow, not meeting in midline (Fig. 18). Legpairs 4–7 enlarged, with flattened podomeres, coxae unmodified except for lobes on coxae 7. Metazonital crests prominent, more so posteriorly, posterior part of crests raised on rings 21–27 (Fig. 20). Pygidium elongate (Fig. 19, 20), divisions between lobes deep, narrow. Color medium tan, crests darker, posterior edge of each crest outlined in purplish brown.

Gonopods (Figs. 25, 26) similar to those of *A. rykkeni,* but with fewer spiculate processes on posteriodistal part of anterior angiocoxites, which bear large, blunt lateral lobes. Ninth legs (Fig. 24) also similar to those of *A. rykkeni,* articulating loosely with depressions in pleurotergal margins of ring 7.

Female similar to males in nonsexual characters.

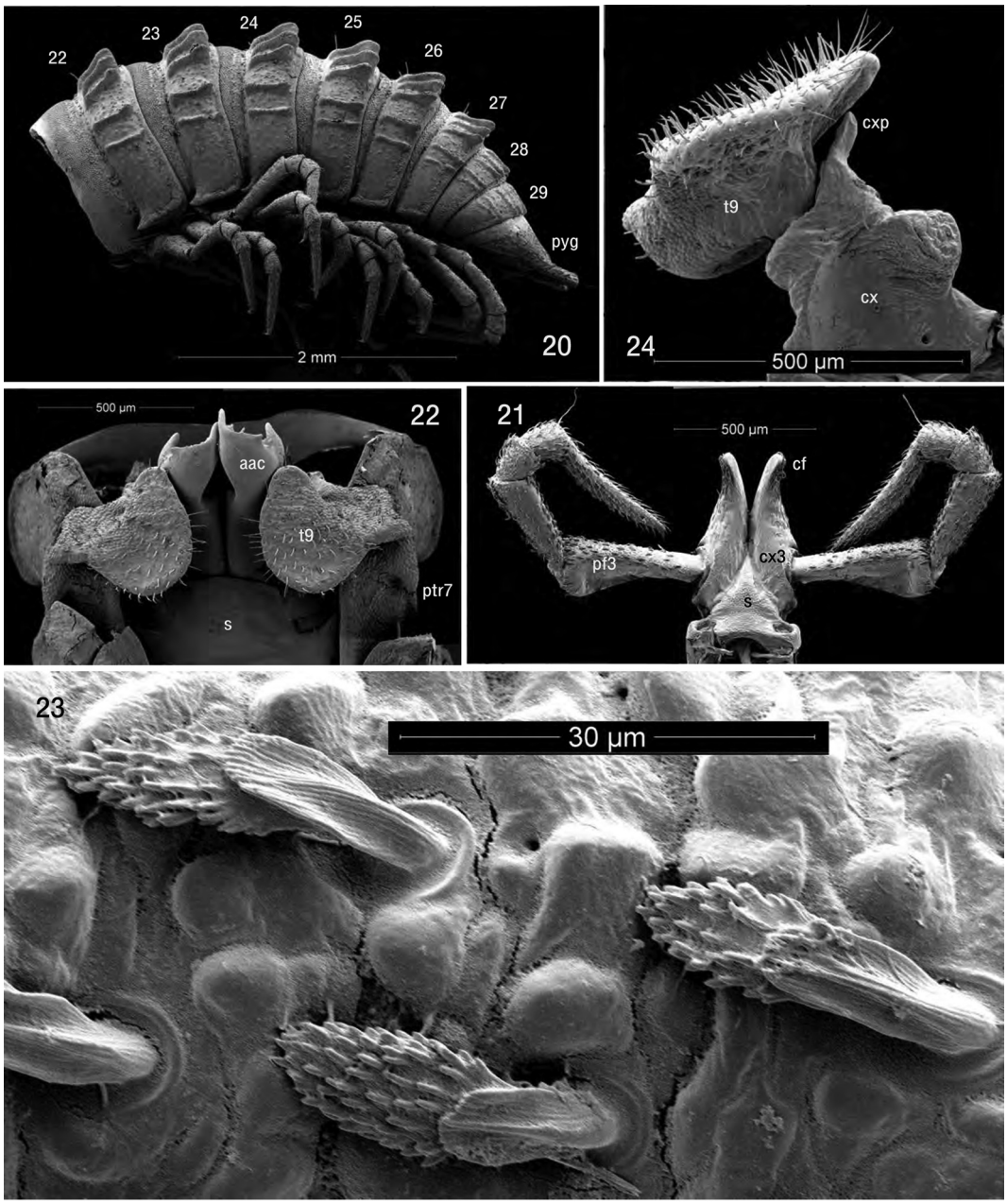
Distribution: In addition to type locality known from CALIFORNIA: *Humboldt Co.:* Arcata, Community Forest east of Humboldt State University, 40.8699°, -124.0725°, collected 31 March 2011 by C. H. Richart *et al.* mmff.



FIGS. 14–19. *Amplaria rykkenae, A. arcata.* Fig. 14. *Amplaria rykkenae,* posterior end of male, dorsal view. Figs. 15–19. *A. arcata.* Fig. 15. Left side of head and first two legpairs of male, anterior view. Fig. 16. Tarsus of legpair 1, lateral view. Fig. 17. Special setae of tarsus 1. Fig. 18. Second and third legpair of male, ventral view. Fig. 19. Pygidium, ventral view.

The Imberbis Species Group

Like the Rykkenae Group, this species group contains two species, *Amplaria imberbis* (Loomis) and the new species *A. staceyi.* The group is presently endemic to coastal southern California, *A. imberbis* from San Luis Obispo Co., and *A. staceyi* from Mt. Palomar, San Diego County—the southernmost known occurrence of a striariid species. The group is characterized by rather simple gonopods, very large trochanteral processes on the male second legpair, and the small coxal flasks of the male third legpair, with the pleurotergal bars of ring 3 practically obsolete. For a description and illustrations of *A. imberbis,* see Shear (2020).



FIGS. 20–24. *Amplaria arcata.* Fig. 20. Posterior end of male, lateral view. Fig. 21. Legpair 3 of male, anterior view. Fig. 22. Gonopod complex, ventral view. Fig. 23. Special setae of legpair 3.

Amplaria staceyi, new species

Figs. 31–34, 58, 59

Types: Male holotype and male and female paratypes from the Weir Trail, Palomar Mountain State Park, 33.3435°, -116.9072°, 1395 m asl, San Diego Co., California, collected March 26, 2017, by C. Richart, BJ Stacy, C. Lee, M. Salkiewicz & C. DeGroof (Richart collection #CHR5309). Additional paratypes from Pauma Valley, Palomar Mountain, 33.3417°, -116.9044°, collected 12 February 2017 by C. Richart, BJ Stacey & J. Keller (Richart collection #CHR5216), and from South Grade Road, Palomar Mountain, 33.3065°, -116.8774°, 13 22 m asl, collected 5 May 2011 by A. Schoenhofer. Parts of these specimens are mounted on SEM stub WAS34-12.

Diagnosis: Very close to *A. imberbis,* but distinct in details of the gonopods (cf. Figs. 33–34, 58, 59 with Figs. 11, 12 in Shear [2020]).

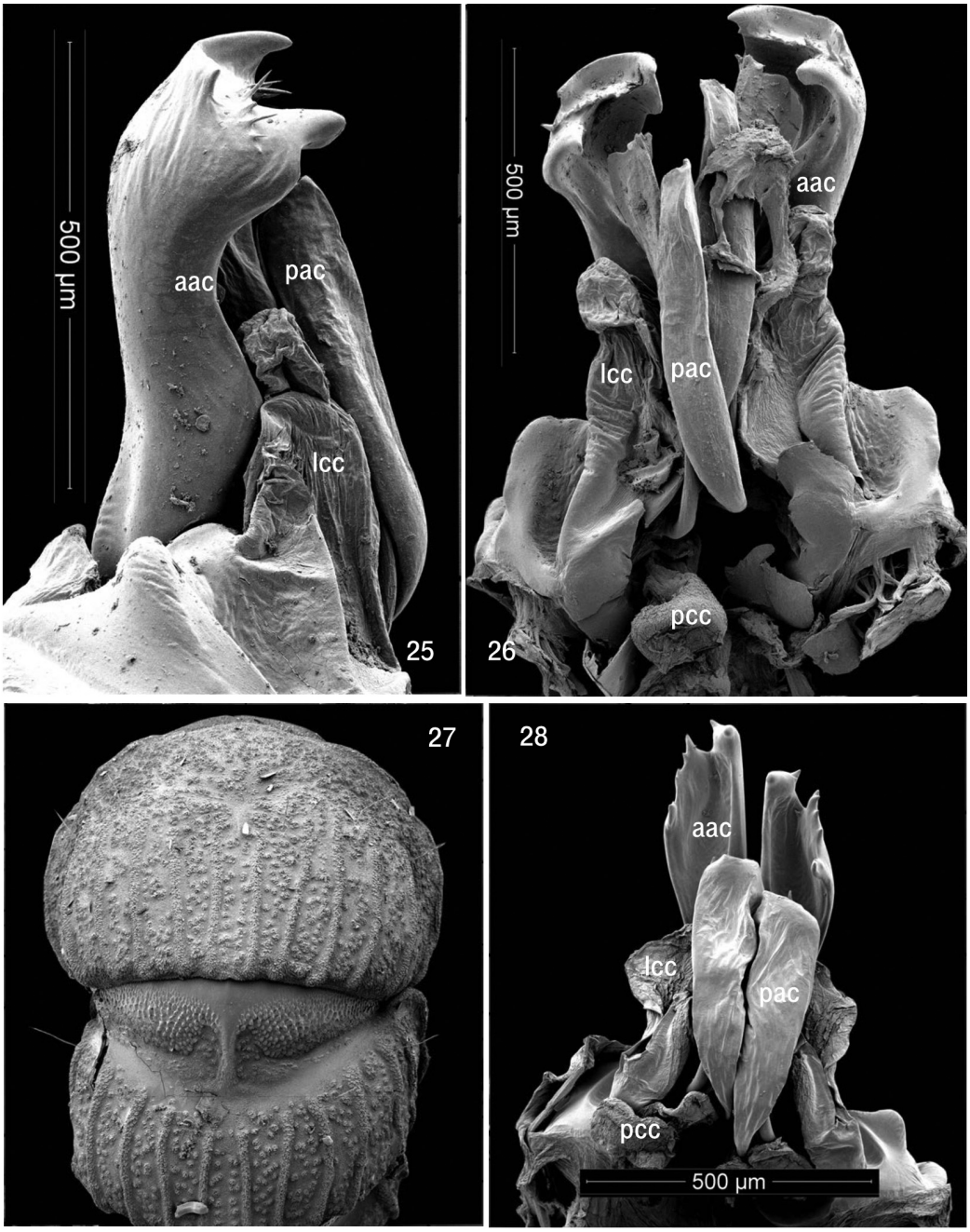
Etymology: As requested by Casey Richart, this species is named for BJ Stacey for his extraordinary contributions to community science and for being among the collectors that discovered this species.

Description: *Male holotype.* Length about 9.0 mm, width 0.85 mm. Five black ommatidia in triangular patch. Labrum without hooks. Mandibular stipes with acute distal corner, otherwise not modified. Legpair 1 larger than legpair 2, without needle-like setae, tarsus with twisted, spatulate setae ventrally. Trochanters of legpair 2 with ventral projection about twice as long as podomere, densely set with specialized setae (Fig. 32). Legpair 3 coxal flasks short, about as long as width of coxae; pleurotergal bars of ring 7 short, scarcely reaching lateral sides of third coxae (Fig. 31). Legpairs 4–7 enlarged, podomeres flattened. Metazonital crests of moderate height. Pygidium short. Color pale tan with "2-stripe" pattern in darker purplish brown, purplish brown pleural spots, pygidium white.

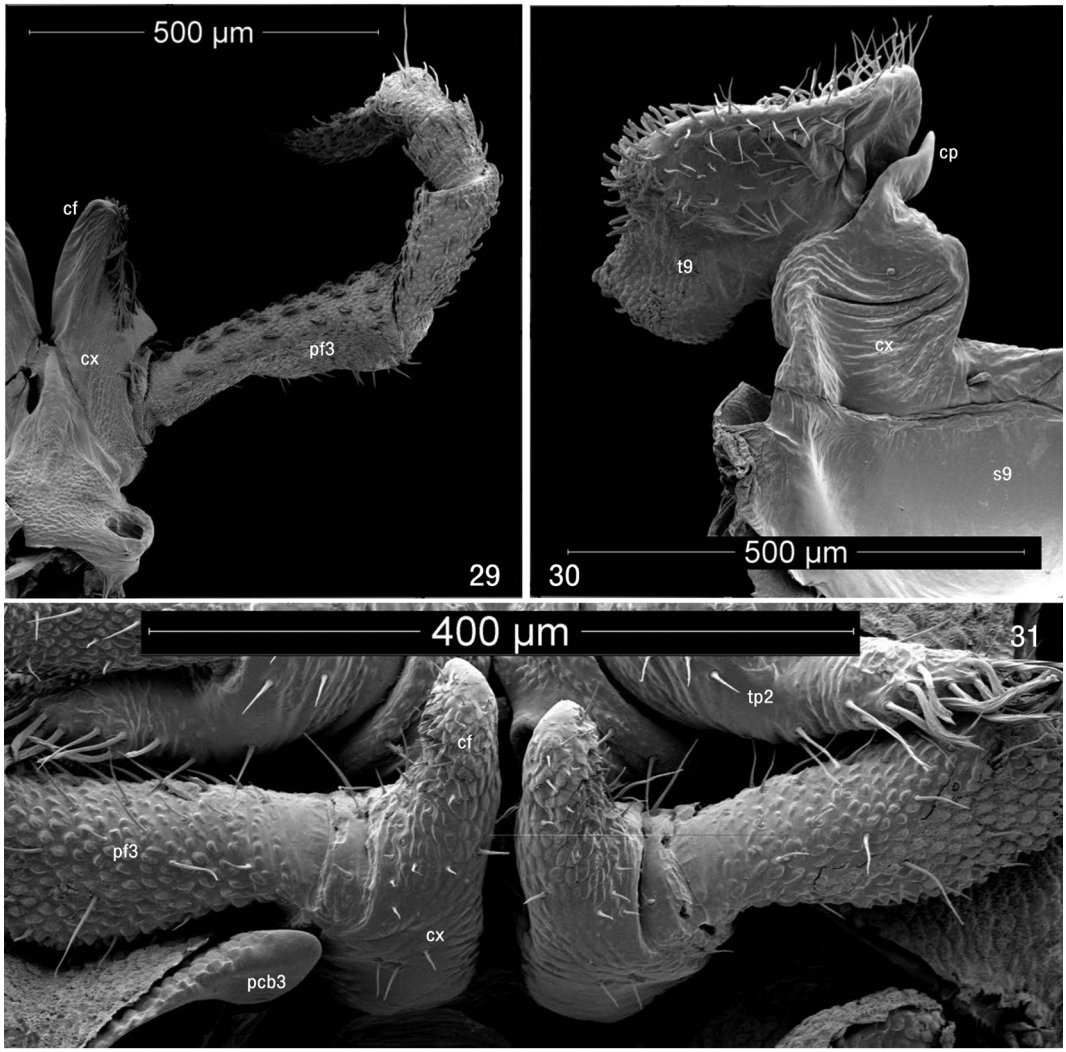
Gonopods (Figs. 33, 34, 58, 59) simple, anterior angiocoxite scoop-like, with small, triangular lateral tooth subapically; posterior angiocoxite basally narrow, sharply curved, apically widened, sheathing four acute flagellocoxites. Ninth legpair without coxal process, telopodite typical.

Females similar to males in nonsexual characters.

Distribution: Known from several collections from Palomar Mountain.



FIGS. 25–28. *Amplaria arcata, A. baughi.* Figs. 25, 26. *Amplaria arcata.* Fig. 25. Right gonopod. posterior view. Fig. 26. Gonopods, posterior view. Figs. 27. 28. *A. baughi.* Fig. 27. Collum and second ring, dorsal view. Fig. 28. Gonopods, posterior view.



FIGS. 29–31. *Amplaria baughi, A. staceyi.* Figs. 29, 30. *Amplaria baughi.* Fig. 29. Left leg 3 of male, anterior view. Fig. 30. Right leg 9 of male, anterior view. Fig. 31. *A. staceyi,* lepair 3 of male, posterioventral view.

Ungrouped Species

Amplaria baughi, new species

Figs. 27–30, 53

Types: Male holotype and female paratype from O'Hara Campground, Selway River Road, 7 mi E of State Road 12, 46.0852°, -115.5174, 600' asl, Nez Perce-Clearwater National Forest, Idaho Co., Idaho, collected 16 April 2004 by W. Leonard; additional male and female paratypes collected at the same place 14 October 2006 by W. Leonard, C. Richart & A. Fusek, and 13 September 2010 by W. Leonard. Parts of these specimens are mounted on SEM stub WAS34-15.

Diagnosis: The only *Amplaria* species known at this time from Idaho. Distinct from other species in the form of the anterior angiocoxites of the gonopods (Fig. 28, 53), the relatively unmodified prefemur of male leg 3 and the long, sinuate process on the coxa of male ninth leg.

Etymology: This species is named for Jim Baugh, of Ellensburg, Washington, at the request of Bill Leonard and in recognition of his work collecting millipedes and other invertebrates in the states of Idaho and Washington.

Description: *Male holotype.* Length, about 10 mm, width about 1.0 mm. Five black ommatidia arranged in two rows. Labrum with sinuate hooks at each angle. Mandibles not modified. Legpairs 1 and 2 of similar size; pair 1 without needle-like setae, tarsus with flattened, twisted setae. Trochanters of legpair 2 nearly unmodified, small

ventral process bears single specialized seta. Coxal flasks (Fig. 29) relatively short, curved anteriorly, telopodites of legpair 3 reduced, prefemora not strongly modified. Pleurotergal bars of ring 3 crossing in midline. Crests low on collum (Fig. 27), higher on anterior rings, then reduced again on posterior segments. Pygidium short. Color medium brown, with "two-striped" pattern in dark purplish brown, lateral spots of metazonites purplish brown.

Gonopods (Figs. 28, 53) with anterior angiocoxites erect, straight, lateral edge with irregular teeth apically; posterior angiocoxites broad, sheathing 3 or 4 rather short flagellocoxites. Ninth legpair coxae with strong, sinuate distal process (Fig. 30); flattened telopodite loosely articulates with depression on pleural margin of metazonite of ring 7.

Females similar to males in nonsexual characters.

Distribution: Known only from the type locality.

Amplaria umatilla, new species

Figs. 35–37, 54, 55

Types: Male holotype and male paratype from Tiger Creek, Umatilla National Forest, 45.9800500, -118.0522833°, 2417' asl, Umatilla Co., Oregon, collected 24 October 2003 by W. Leonard; additional male paratype from same locality, but 45°58.685', -118°03.137'. Parts of these specimens are mounted on SEM stub WAS34-11.

Diagnosis: Distinct in the form of the gonopods (Figs. 37, 54, 55), and in the angular, overlapping median termini of the pleurotergal bars of ring 7 (Fig. 35).

Etymology: The species name, a noun in apposition, is from the Umatilla National Forest and Umatilla County, Oregon.

Description: *Male holotype.* Length, about 11 mm, width 1.0 mm. Five ommatidia in two rows. Labrum with long, slightly sinuous hooks at each angle. Mandibles not modified. Legpairs 1 and 2 similar in size (Fig. 35); legpair 1 without needle-like long setae, tarsi with spatulate, twisted setae ventrally. Second trochanters with moderate posteriorventral processes, bearing groups of specialized setae. Legs 3 with coxal flasks long, asetose, diverging; prefemora distally expanded, telopodites not strikingly reduced (Fig. 35). Pleurotergal bars of ring 3 expanded, angular distally, overlapping in midline. Crests moderate. Pygidium short. Color uniform medium brown.

Gonopod (Figs. 37, 54, 55) anterior angiocoxites with broad, two-toothed lateral process, smaller teeth distally on posterior surface. Posterior angiocoxites narrow at origin, broadening distally, sheathing 3 or possibly 4 long flagellocoxites. Ninth legpair with small distal coxal process, flattened telopodites articulating loosely with depression on pleural margin of ring 7 (Fig. 36).

Females not collected.

Distribution: Known from the two close-by localities listed under *Types.*

Amplaria cervus, new species

Figs. 38–40, 56

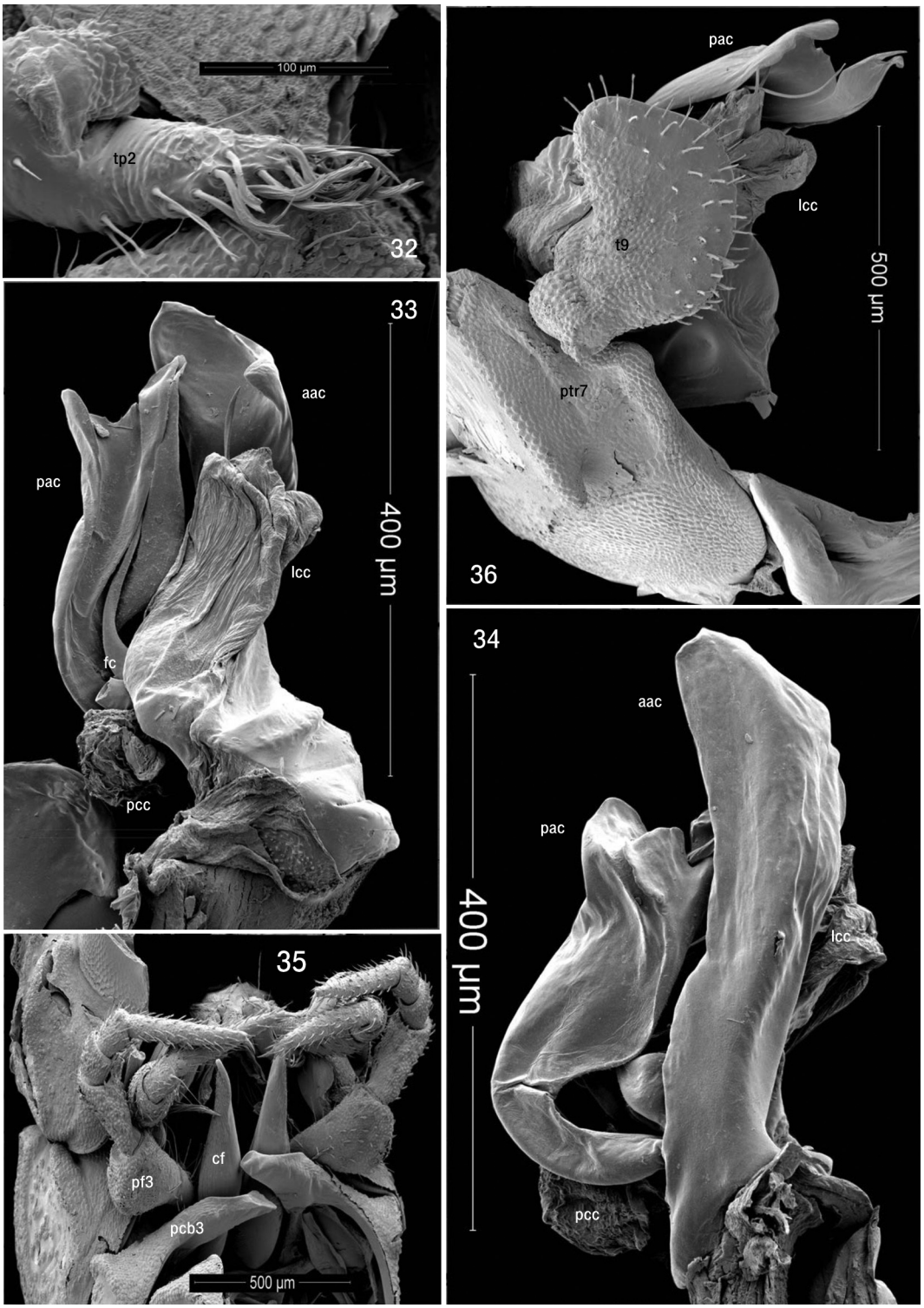
Types: Male holotype from Wrigley Road along the North Fork of the Elk River, 6 mi NE of Loleta, 40.6991°, -124.1168°, 80' asl, Humboldt Co., California, collected 21 December 1977 by A. K. Johnson. Parts of the male holotype are mounted on SEM stub WAS34-14.

Diagnosis: Very similar to the following species, *A. mendocino* n. sp., but distinct in some details of the gonopods and in the coxae of the fourth and fifth legpair of males not having a ventral depression and lacking dense, fine setae. The first legs have long, needle-like setae, which are absent in *A. mendocino.*

Etymology: The species name is a noun in apposition, the Latin name of the genus to which the American elk (*Cervus americanus*) belongs, recognizing the type locality along the North Fork of the Elk River.

Description: *Male holotype.* Length, about 11 mm, width 1.0 mm. Fourteen ommatidia in triangular patch. Labrum with long, slightly sinuous hooks at each angle. Mandibles not modified. Legpair 1 larger than legpair 2, with long needle-like setae. Legpairs 2–7 with telopodites of similar size, with flattened podomeres. Second trochanters with moderate posteriorventral processes, bearing specialized setae (Fig. 40). Legs 3 with coxal flasks of moder-

ate length, divergent, with dense setae anterioapically, telopodites not reduced. Pleurotergal bars of ring 3 narrow, just touching in midline. Coxae of legpairs 4, 5, not distally depressed, without fine, dense setae. Crests moderate. Pygidium short. Color uniform pale tan.



FIGS. 32–36. *Amplaria staceyi, A. umatilla.* Figs. 32–34. *Amplaria staceyi.* Fig. 32. Apophysis of left leg 2 of male, ventral view. Fig. 33. Left gonopod of male, lateral view. Fig. 34. Right gonopod of male, mesal view. Figs. 35, 36. *A. umatilla.* Fig. 35. Second and third legpair of male, ventral view. Fig. 36. Gonopod complex, lateral view.

Gonopods (Figs. 38, 56) anterior angiocoxites large, slightly curved, distally sharply bent posteriorly from acute anterior edge, with subapical lateral process. Posterior angiocoxites also large, sharply curved anteriorly from narrow base, widening abruptly, with two distal processes curved, convergent, sheathing 2–4 long flagellocoxites.

Posterior lobes of colpocoxites prominent, poorly sclerotized, with many small cuticular scales. Ninth legpair (Fig. 39) with flattened coxae, very small, acute mesal coxal process.

Females not collected.

Distribution: Known only from the type locality.

FIGS. 37–40. *Amplaria umatilla, A. cervus.* Figs. 37. *Amplaria umatilla,* right gonopod, mesal view. Figs. 38–40. *A. cervus.* Fig. 38. Right gonopod, mesal view. Fig. 39. Legpair 9 of male, anterior view. Fig. 40. Right second coxa and trochanter, posterior view.

Amplaria mendocino, new species

Figs. 41, 57

Types: Male holotype and male paratype from Usal Road, 1 mi N of US 1, 39.7910°, -123.8290°, 700' asl, Mendocino Co., California, collected 20 September 1990 by D. Ubick. Parts of the holotype and paratype are mounted on SEM stub WAS34-16.

Diagnosis: Very similar in gonopod anatomy to the foregoing species, *A. cervus*. Distinct in the ventral depressions on male coxae 4 and 5, which also bear fine, dense setae (Fig. 41). Legpair 1 is not enlarged and lacks needle-like setae.

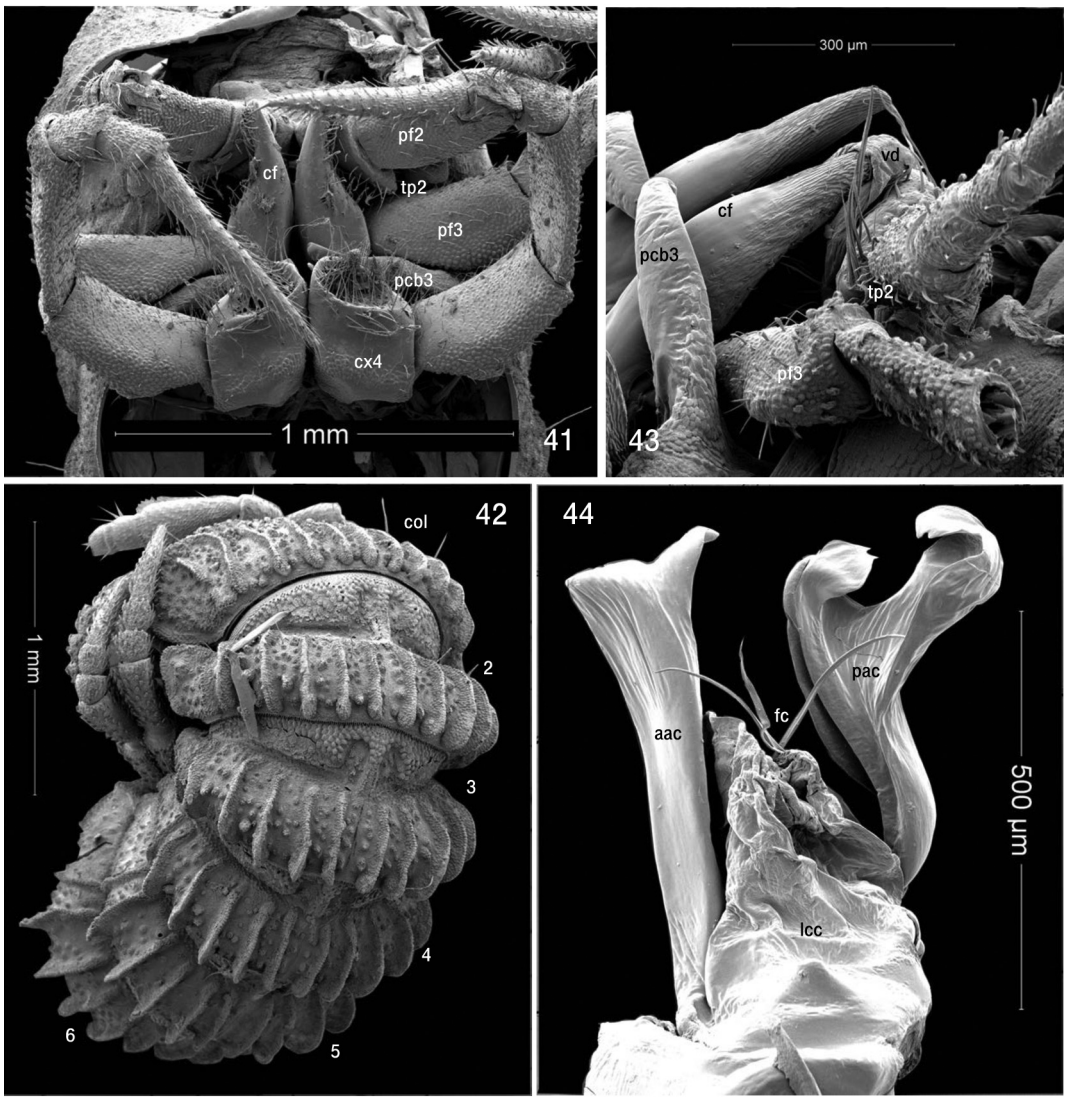
Etymology*:* The species name, a noun in apposition, recognizes the type locality in Mendocino Co., California.

Description: *Male holotype.* Length, about 11 mm, width 1.0 mm. Fourteen ommatidia in triangular patch. Labrum with long, slightly sinuous hooks at each angle. Mandibles not modified. Legpairs 1 and 2 similar in size; legpair 1 lacks long needle-like setae. Legpairs 2–7 telopodites of similar size, with flattened podomeres. Second trochanters with relatively small posteriorventral processes, bearing specialized setae. Legs 3 with coxal flasks of moderate length, divergent, with dense setae anterioapically, telopodites not reduced (Fig. 41). Pleurotergal bars of ring 3 narrow, just touching in midline. Coxae of legpairs 4, 5, distally depressed, with fine, dense setae (Fig. 41). Crests moderate. Pygidium short. Color pale tan, each metazonite with dark purplish dots on posterior ends of crests 3 and 4, metazonites shaded darker laterally.

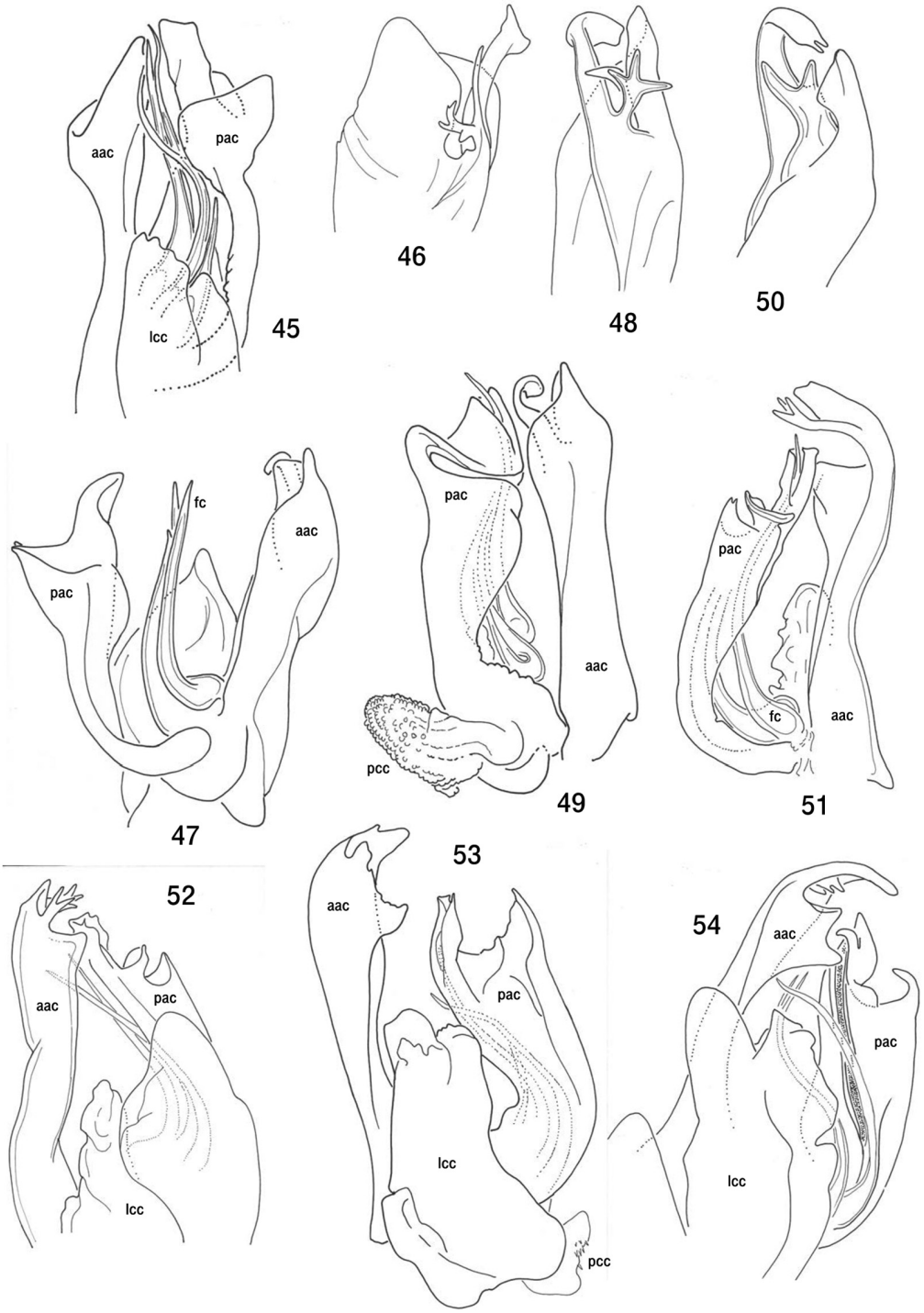
Gonopods (Fig. 57) almost identical to those of *A. cervus,* but anterior angiocoxites differing slightly in shape of distal end (compare Fig. 56 and Fig. 57). Ninth legpair with flattened coxae, very small, acute mesal coxal process.

Females not collected.

Distribution: Known only from the type locality.



FIGS. 41–44. *Amplaria menocino, A. flucticulus.* Fig. 41. *Amplaria mendocino,* legpairs 2–4 of male, ventral view. **FIGS. 42–44.** *A. flucticulus.* Fig. 42. Head, collum and rings 2–6, dorsolateral view. Fig. 43. Legpairs 2 and 3 of male, lateral view. Fig. 44. Right gonopod, lateral view.



FIGS. 45–54. Drawings of gonopods of *Amplaria* species. Fig. 45. Left gonopod of *A. nazinta,* lateral view. Fig. 46. Tip of anterior angiocoxite of *A. nazinta* gonopod, lateral view. Fig. 47. Right gonopod of *A. crawfordi,* mesal view. Fig. 48. Tip of anterior angiocoxite of *A. crawfordi,* lateral view. Fig. 49. Right gonopod of *A. fontinalis,* mesal view. FIG. 50. Tip of anterior angiocoxite of *A. fontalis,* posteriolateral view. Fig. 51. Right gonopod of *A. rykkenae,* mesal view. Fig. 52. Right gonopod of *A. rykkenae,* lateral view. Fig. 53. Right gonopod of *A. baughi,* lateral view. Fig. 54. Right gonopod of *A. umatilla,* lateral view.

Amplaria flucticulus, new species

Figs. 42–44

Types: Male holotype and male paratype from Rippled Cave, 38.4386°, -120.7255°, Amador Co., California, col-

lected 27 June 2009 by G. Graening and M. L. Gates. Parts of these specimens are mounted on SEM stub WAS 34–10.

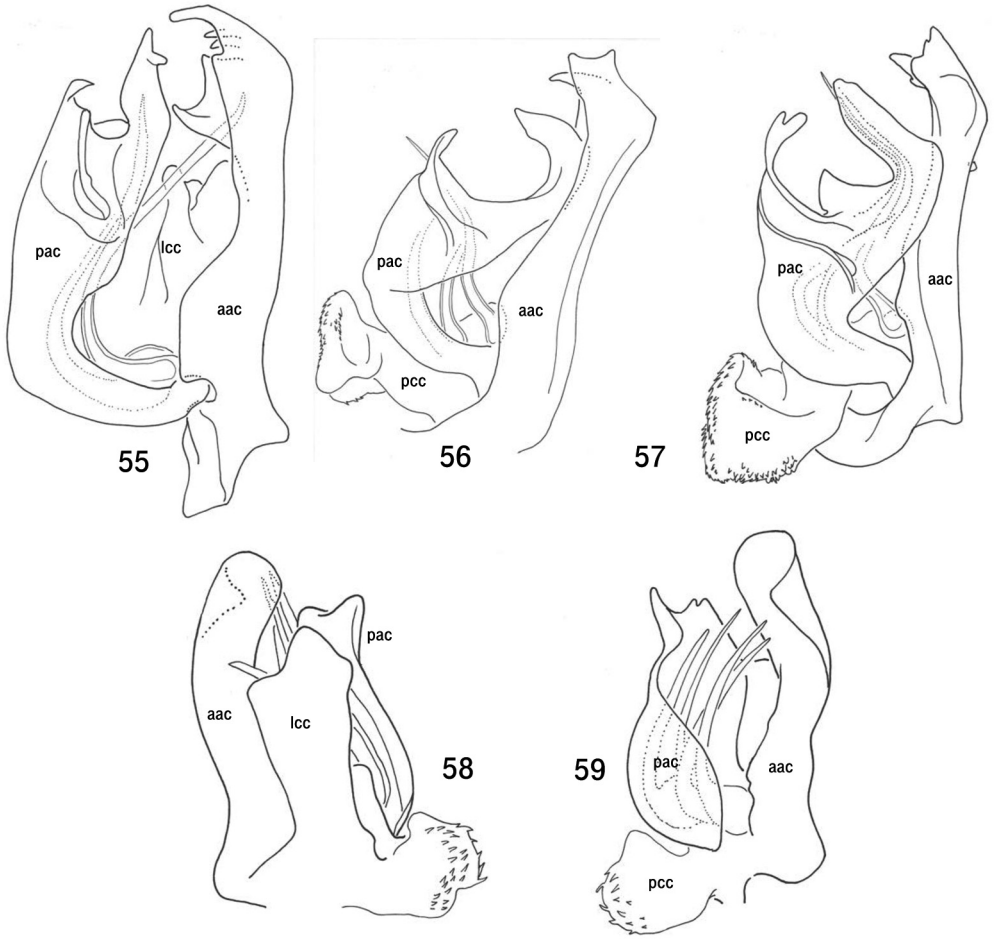
Diagnosis: An eyeless, presumably troglobitic species distinct from *Amplaria shastae,* also an eyeless troglobite and previously the only known one, in being approximately half the size of that species.

Etymology: The species name, a noun in apposition, is a Latin word meaning "ripple" and refers to the name of the type locality.

Description: Length about 12 mm, width 1.1 mm. Ommatidia absent. Mentum lacking hooks. Mandibles not modified. Legpairs 1 and 2 subequal in size; legpair 1 without needle-like setae on prefemora, femora and tibiae, tarsus with spatulate, twisted setae ventrally. Second trochanters with ventrolateral process bearing specialized setae (Fig. 43). Coxal flasks of legpair 3 nearly asetose, long, slightly divergent, prefemora of telopodite with distinct dorsal swelling (Fig. 43), telopodites not reduced in size. Postcoxal bars of ring 3 narrow, overlapping in midline (Fig. 43). Coxae 4–7 not modified, telopodites 4–7 enlarged, podomeres flattened. Crests strongly developed (Fig. 42); segmental setae inconspicuous. Pygidium short. Completely depigmented.

Gonopods (Fig. 44) rather simple, anterior angiocoxites straight, narrow at base, expanded distally, with lateral terminal apophysis. poserior angiocoxites strongly curved, grapple-like, posterior branch much the largest, anterior branch sheathing 3–4 flagellocoxites. Ninth legs typical, with prominent curved coxal process.

Females not collected.



FIGS. 55–59. Drawings of gonopods of *Amplaria* species. Fig. 55. Right gonopod of *A. umatilla,* mesal view. Fig. 56. Right gonopod of *A. cervus,* mesal view. Fig. 57. Right gonopod of *A. mendocino,* mesal view. Fig. 58. Right gonopod of *A. flucticulus,* lateral view. Fig. 59. Right gonopod of *A. flucticulus,* mesal view.

Distribution: Known only from the type locality.

Notes: Rippled Cave is owned by the Western Cave Conservancy and is part of the Weller Natural Preserve. The cave is well-known, frequently visited and is excavated in marble. Access is controlled by the Western Cave Conservancy. The fauna of the cave had been extensively investigated in 1952 and 2002, but *Amplaria flucticulus*

was not collected until 2009. Other potential arthropod troglophiles and troglobites are present and include spiders and springtails, but have not been identified in detail or remain undescribed (unpublished report from The Subterranean Institute, pers. comm. Graening 2020).

I presume that *A. flucticulus* is a troglobite based on eyelessness and complete depigmentation, but the antennae and legs do not appear significantly longer than in surface-dwelling species of the genus, nor is there any indication of "cave gigantism," as seen in *A. shastae*. *Amplaria flucticulus* occurs in the central part of the Sierra Nevada, while two additional *Amplaria* species, *A. adamsi* Shear & Krejca, 2007 and *A. muiri* Shear & Krejca, 2007 are found in caves well to the south, in Kings Canyon and Sequoia National Parks. These latter species have pigmented ommatidia and presumably are troglophilic. *Amplaria shastae* from two caves in Shasta Co. (Elliott et al 2017) is an undoubted troglobite.

Acknowledgements

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