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Additions to the millipede family Caseyidae Verhoeff, 1909. IV. Two new genera and three new species (Chordeumatida, Striarioidea, Caseyidae)

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Abstract

Paropiona Shear & Marek, **gen. nov.** is described from northwestern and central Washington State, USA. It includes two new species, *Paropiona gardneri* Shear & Marek, **sp. nov.** from Pacific and Cowlitz Counties, and *Paropiona aenigma* Shear & Marek, **sp. nov.** from Clallam, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Thurston and Wahakiakum Counties. *Opionoides* Shear & Marek, **gen. nov.** is monotypic with only *Opionoides cataracta* Shear & Marek, **sp. nov.** from Coos Co. Oregon. The new genera are related to, but distinct from the genus *Opiona* Chamberlin, 1951.

Key words: Pacific Northwest, new taxa, gonopod anatomy, biogeography

Introduction

The millipede family Caseyidae Verhoeff, 1909 is represented in its center of greatest species diversity in the Pacific Coast states of the USA (California, Oregon, Washington) and extends north with reduced diversity through British Columbia, Canada, to southern Alaska. Gardner & Shelley (1989) published the first comprehensive review of the family, and described two new genera, 30 new species, and five new subspecies. They reviewed the history of the study of the family up to 1989, and Shear & Marek (2024) supplemented this review, extending the record to 2021 and proposed a new subfamily Ochrogrammatinae Shear & Marek, 2024, including the genera *Ochrogramma* Gardner & Shelley, 1989, and *Vasingtona* Chamberlin, 1941. Presently the family Caseyidae includes seven genera and 46 species. Males of the new genera and three species described here conform generally to the secondary sexual characters of *Opiona* Chamberlin, 1951, but have quite different gonopods, and in the case of species of *Paropiona*, **gen. nov.**, their ninth legs (sometimes called "posterior gonopods")

Methods

Specimens were field-preserved in various concentrations of alcohol but are now in 70% ethanol. Morphological studies were done using an Olympus SZH stereomicroscope and an Olympus BX50 compound microscope equipped with Nomarski optics. For scanning electron microscopy (SEM), specimens were first cleaned in an ultrasonic cleaner, then mounted on 12.7 mm diameter aluminum stubs using double-sided adhesive carbon discs and allowed to air-dry. These were sputter coated with a 40-nm thick layer of platinum and palladium, using a Leica EM ACE600 high vacuum sputter coater. SEM micrographs were taken with a FEI Quanta 600 FEG environmental scanning electron microscope. Micrographs were edited and refined using GIMP, and plates were composed in InkScape. Geographic coordinates were recorded from label data, and in some cases retrospectively georeferenced in Google Earth and may include several meters of error; all coordinates were rounded off to three decimal places.

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All specimens used in this study are deposited in the Virginia Museum of Natural History, Martinsville, Virginia, USA (VMNH).

List of abbreviations

aac anterior angiocoxite
ac angiocoxite
ap accessory pore of gonapophysis
cc colpocoxite
cg coxal gland
cl coxal lobe of third legpair
cp coxal process
cxs gonopod coxosternum
cx(#) coxa of numbered (#) legpair
f10 femur of legpair 10
ga gonapophysis
lcp lateral coxal process
mcp mesal coxal process
p pore
pac posterior angiocoxite
pf(#) prefemur of numbered (#) legpair
s gonopod sternum
s (#) sternum of numbered (#) legpair
t gonopod telopodite
t(#) telopodite of numbered (#) legpair
vd opening of *vas deferens*

In the distribution sections, m and mm mean single and multiple males, respectively, and f and ff meant single and multiple females respectively.

Taxonomy

Order Chordeumatida Pocock, 1894

Suborder Striariidea Cook, 1896

Superfamily Caseyoidea Verhoeff, 1909

Family Caseyidae Verhoeff, 1909

Caseyidae: Verhoeff 1909: 567; Cook & Collins 1895:68; Chamberlin, 1941a: 22, 1941b: 10, 1947: 9, 1951:8, 1952: 2; Causey, 1952: 113, 1954: 81, 1955: 90, 1963: 193; Loomis, 1966: 225; Shear, 1972: 258, 2011: 51, 2021: 109, Shear & Crawford, 2019: 575; Shear & Leonard, 2007: 24; Gardner & Shelley, 1989: 185; Shelley, 1993: 168; Shelley *et al.*, 2007: 14.

Paropiona Shear & Marek, new genus

Type species ***Paropiona gardneri*** **Shear & Marek, new species**.

Diagnosis. Species of this genus are unique among caseyids in entirely lacking gonopod colpocoxites. Differing from *Vasingtona* Chamberlin, 1941 and *Ochrogramma* Gardner & Shelley, 1989 in lacking the ventral lamina of the mandible in males seen in those genera. From *Caseya* Cook & Collins, 1895, the new genus differs in not having the coxae of the seventh legpair of the male greatly enlarged and with complex processes. In species of *Opiona* Chamberlin, 1951, the gonopods have colpocoxites and flagellocoxites; these are absent in species of *Paropiona* **gen. nov.** In addition, the reduced telopodites of the male ninth legs of *Opiona* species are rounded and button-like, while in species of *Paropiona* they are narrow and sinuously curved. From *Opionoides* **gen. nov.,** *Paropiona* species differ in lacking gonopod flagellocoxites (possibly vestigial in one species); *Opionoides* gonopods have both flagellocoxites and colpocoxites and have a crown of thorny processes on the anterior angiocoxites. The posterior angiocoxites are densely fimbriate on their mesal surfaces in *Opionoides*; these features are not found in *Paropiona* species. The ninth leg telopodites of *Opionoides cataracta,* **sp. nov.**, are like those of *Opiona* species.

Etymology. The name of the new genus is feminine in gender and conveys its relationship to the genus *Opiona.*

Description. Caseyid millipedes with 30 rings, about 8–12 mm long (Figs 30, 31)

Mandibles of males not modified.

Male first legpair (Fig. 1) somewhat reduced, with few elongate, flattened, spiral setae on postfemur and tibia; tarsi with sparse ventral tarsal comb.

Male second legpair (Figs 2, 13) with long coxal gonapophyses slightly curved, subequal in length to reduced telopodites; telopodite femora long, more distal podomeres much shortened. Gonapophyses with opening of *vas deferens* at base, more distal accessory pore present.

Male third legpair (Figs 3, 13) with prominent, flattened, rounded coxal lobes tightly appressed in midline, lacking apical tuft of modified setae. Telopodites attached midway distal on coxae, with four podomeres; prefemora not flattened or enlarged.

Male legpairs four to seven slightly encrassate, otherwise unmodified.

Gonopods (Figs 4–7, 14–16) with coxae and sternum fused without midline suture. Anterior angiocoxites slightly inclined posteriorly, simple, erect or sinuously curved. Posterior angiocoxites present or absent. Flagellocoxite absent or possibly vestigial in *P. gardneri* **sp. nov.** Gonopod telopodites large, robust, erect and divergent or passing anteriorly between angiocoxites. Colpocoxites absent.

Male legpair nine (Figs 8–10, 17–20) with elongate coxae bearing divided coxal process, the mesal branch thin and appressed to telopodite. Coxal pore present at base of coxal process. Telopodite single podomere, narrow, elongate, with apical tuft of stout setae directed mesally.

Male legpair 10 (Figs 11, 12, 21) with enlarged coxae bearing large, frequently everted glands and hooked coxal process; trochanters with small, distal, bifid process; prefemora and femora with a ventral row of acute denticles.

Notes. The modifications of the pregonopodal legs of the males in the two species of *Paropiona* are very similar to those found in species of *Opiona.* However, we noted a feature of the gonapophyses of the second legs that has not been seen before in any caseyids: an accessory pore distal to the opening of the *vas deferens*, which is situated at the base of the gonapophysis. An examination of a few species of *Opiona* confirms that at least in those species, this pore also occurs. This accessory pore is not present in species of the subfamily Ochrogrammatinae (Shear & Marek 2024) nor in species of *Caseya*. The gonopods of the two species of *Paropiona* differ strongly from those of *Opiona* species in lacking colpocoxites, arising from a coxosternum and lacking flagellocoxites (a single vestigial flagellocoxite may be present in *P. gardneri* **sp. nov.**), which are numerous in those species, and often complexly sheathed by the posterior angiocoxites. *Paropiona* gonopods are in fact so different from those of any other caseyids that establishing even tentative homologies among them is difficult. The gonopods proper arise from a coxosternite and consist of two divisions: anterior and posterior. The anterior division is angiocoxal and in *Paropiona gardneri* **sp. nov.**, consist of anterior and posterior angiocoxites, while in *Paropiona aenigma* **sp. nov.**, there is only a single angiocoxite. While functional flagellocoxites appear to be absent in both species of the genus, a small vestigial branch arising from the posterior surface of the anterior angiocoxite in *P. gardneri* gonopods may be flagellocoxal. In *P. aenigma* **sp. nov.**, the posterior angiocoxites and any trace of flagellocoxites are apparently absent. We are referring to the posterior divisions of the gonopods as telopodites because they appear to arise from sockets in the coxosterna. It is possible that these structures could also be heavily sclerotized homologs of what we have called the colpocoxites in other caseyids. However, caseyid colpocoxites are very lightly sclerotized and amorphous in shape. If our interpretation is correct, colpocoxites are absent in species of *Paropiona.* Telopodites are uncommon as a

component of the gonopods of most of the families of Chordeumatida, the functional gonopod divisions developing primarily from the coxae. The ninth legs of the males of *Paropiona* species are reduced to the coxae and single telopodite podomeres, as is typical of caseyids; however, instead of being rounded, globular and button-like, they are elongate and curved, with tufts of stout, ensiform setae in a mesal group at their tips. The coxal processes are bifid, as in many *Opiona* species, but the lateral branch is small, thin, and usually closely appressed to the telopodite so that its presence is sometimes obvious only in SEM images. The mesal branch is much more robust, sinuously curved and as long or slightly longer than the telopodite. At the base of this mesal branch is a small pore; we have also observed such a pore in species of *Ochrogramma* (Shear & Marek 2024) and think this pore is homologous to the much larger pores of the tenth coxae, where spermatophores are formed.

While the majority of collections of both species of *Paropiona* **gen. nov.**, were collected from November to March, as expected for winter-active chordeumatidan millipedes, some were taken as early as September and as late as June, indicating perhaps a longer period of activity than in other chordeumatidans in the region.

Paropiona gardneri Shear & Marek, sp. nov.

Figs 1–12

Types: Male holotype from east of Frontage Road on Rose Valley Road, Cowlitz Co. Washington, 46.1692°N, -122.7080°W, collected 29 April 2007 by W. Leonard and C. Richart (collection number CR1840). Two male and four female paratypes from Ellsworth Creek Preserve, 46.431°N, -123.890°W, collected 23 November 2003 by W. Leonard *et al.* Parts of the paratype males are mounted on SEM stubs WS37-18 and WS38-6.

Etymology. We are pleased to name this unusual species for Michael R. Gardner, coauthor of the first comprehensive review of the family Caseyidae (Gardner & Shelley 1989).

Diagnosis. Distinct from *Paropiona aenigma* **sp. nov.**, the only other known species in the genus, in having both anterior and posterior angiocoxites of the gonopods. Only a single angiocoxite is present in *P. aenigma.*

Description. *Holotype male.* 11.0 mm long, about 1.1 mm in diameter (Fig. 30). Triangular eyepatch of 21 ommatidia. Thoracic rings smooth, cylindrical, pale brownish gray irregularly marked with cream white. Ring macrosetae short, acute, in nearly straight row across posterior margin of metazonite.

First legpair (Fig. 1) short, stout, coxae fused in midline; postfemur, tibia with few elongate, slightly flattened setae.

Second legpair (Fig. 2) with coxae bearing long, curved gonapophyses (**ga**) sparsely setose on anterior surface; *vas deferens* (**vd**) and accessory pore (**ap**) both basal; telopodites (**t2**) reduced, femora long, postfemora and tibiae very short, tarsi button-like, clawless.

Third legpair (Fig. 3) with elongate coxae (**cx3**) extended into broad, flattened, sparsely setose lobes (**cl**); reduced telopodites (**t3**) of four podomeres attached at base of coxal lobes, femora not flattened or enlarged, tarsi with single, long, apical setae.

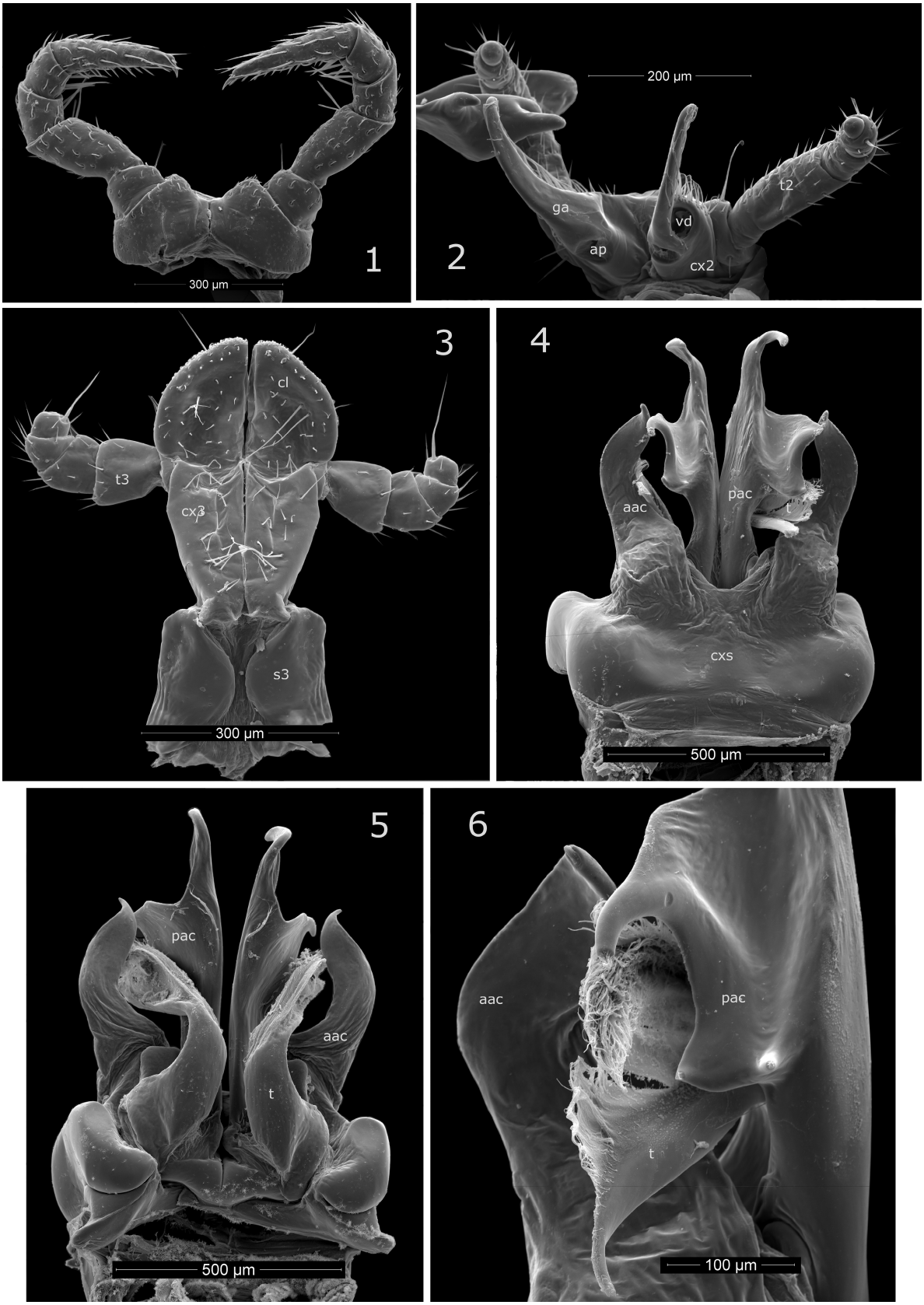
Fourth through seventh legpairs scarcely enlarged.

Gonopods (Figs 5–7) arising from and fused to coxosternum. Anterior angiocoxites (**aac**) broad, sigmoid, curved first posteriorly, then anteriorly; posterior angiocoxites (**pac**) extending anteriorly between anterior angiocoxites, with broad lateral lamella, curved, acute tip. Telopodites (**t**) large, robust, following curve of posterior angiocoxites, distally divided into many fine microfibers (Fig. 6). Possible vestigial flagellocoxite (**f?**, Fig. 7) attached to posterior surface of anterior angiocoxite.

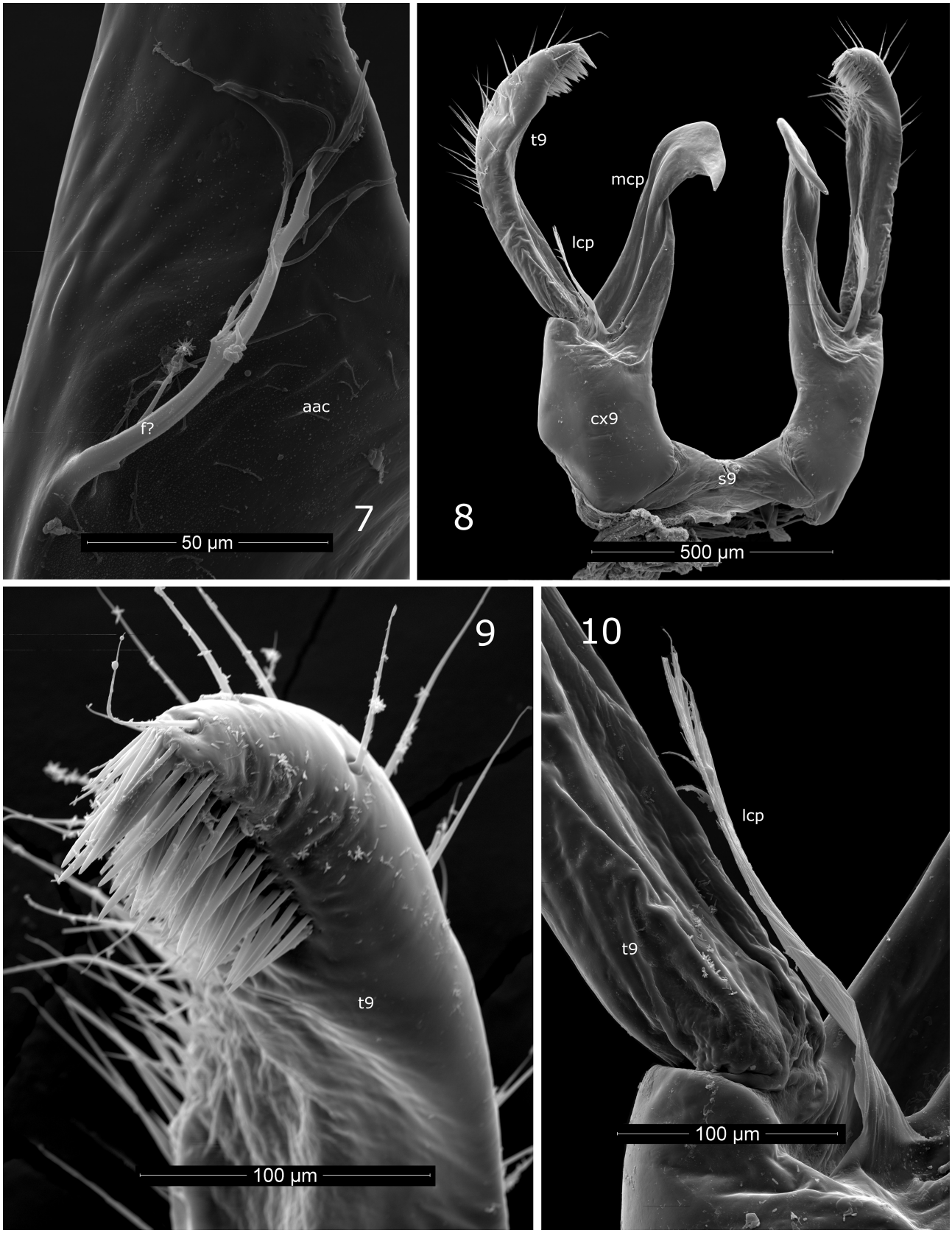
Ninth legpair (Figs 8–10) coxae (**cx9**) elongate, with bifid coxal process; medial branch of process (**mcp**) shorter than telopodite, strongly hooked, with lateral groove or channel running to tip from pore at base of process; lateral branch (**lcp**) thin, flattened, appressed to mesal surface of telopodite, divided at tip into fine fibers. Telopodite (**t9**) narrow, elongate, with apicomedial cluster of many stout setae (Fig. 9).

Tenth legpair (Fig, 11, 12) with much enlarged glandular coxae (**cx10**) carrying long, posterior, curved process. Telopodite smaller than those of adjacent legs, trochanter (**tr10**) with small, bifid process (**trp**), prefemora (**pf10**) and femora (**f10**) with rows of short, acute tubercles.

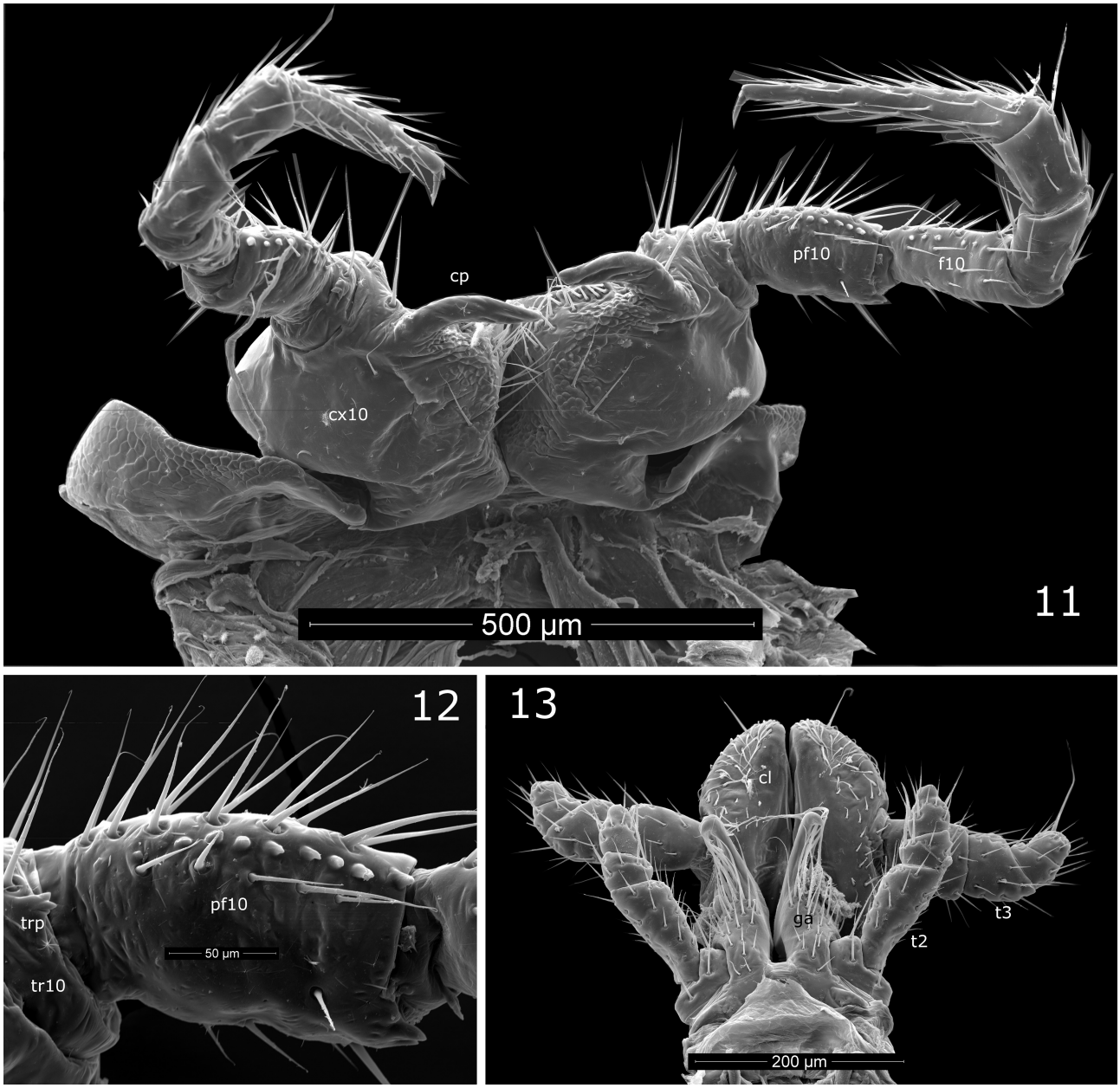
Paratype female. 11 mm long, 1.2 mm in diameter. Nonsexual characters as in male. Vulvae not modified, sparsely setose.



FIGURES 1–6. Paratype male *Paropiona gardneri* Shear & Marek, **sp. nov. 1**. First legpair, posterior view. **2**. Second legpair, anterior view. **3**. Third legpair, posterior view. **4**. Gonopods, anterior view. **5**. Gonopods, posterior view. **6**. Part of gonopod telopodite, posterior view. **Abbreviations**: **aac**, anterior angiocoxite; **ap**, accessory pore; **cl**, coxal lobe; **cxs**, gonopod coxosternite; **cx2**, coxa of leg 2; **cx3**, coxa of leg 3; **ga**, gonapophysis; **pac**, posterior angiocoxite; **s3**, sternum of legpair 3; **t**, gonopod telopodite; **t2**, second leg telopodite; **t3**, third leg telopodite; **vd**, opening of *vas deferens*.



FIGURES 7–10. Paratype male *Paropiona gardneri* Shear & Marek, **sp. nov. 7**. Vestigial (?) posterior angiocoxite, posterior view. **8**. Ninth legpair, posterior view. **9**. Distal part of ninth leg telopodite, posterior view. **10**. Base of ninth leg telopodite and lateral coxal process, posterior view. **Abbreviations**: **aac**, anterior angiocoxite; **cx9**, ninth leg coxa; **lcp**, lateral coxal process; **mcp**, mesal coxal process; **pac**, posterior angiocoxite; **s9**, sternum of ninth legpair; **t9**, ninth leg telopodite.



FIGURES 11–13. **11, 12**. Paratype male *Paropiona gardneri* Shear & Marek, **sp. nov. 11.** Tenth legpair, posterior view. **12.** Prefemur of tenth leg, posterior view. **13**. Male *Paropiona aenigma* Shear & Marek, **sp. nov.**, Second and third legpairs, anterior view. **Abbreviations**: **cl**, coxal lobe; **cp**, coxal process; cx10, coxa of leg 10; **f10**, femur of tenth leg; **pf10**, prefemur of tenth leg; **trp**, trochanter process; **tr10**, trochanter of tenth leg; **t2**, telopodite of second leg; **t3**, telopodite of third leg.

Records. In addition to the holotype and paratype localities: WASHINGTON: *Pacific Co.*: Ellsworth Creek Preserve, 14 March 2003, W. Leonard, m, f; Same, 1 mile north on Parapala Road, 46.415°N, -123.892°W, 20 June 2003, W. Leonard, m; North Nemah River, 46.492° N, -123.824° W, 20 September 2008, C. Richart (collection number CHR3192), mm; 5.9 mi south of Rt. 6 on Trap Creek, 46.541°N, -123.660°W, 334’ asl, 19 November 2005, W. Leonard, C. Richart, m.

Paropiona aenigma Shear & Marek, sp. nov.

Figs 13–21, 31

Types. Male holotype, two male and two female paratypes from Tolmie State Park, 61st Avenue NE, Olympia,

Thurston Co., Washington, 47.120°N, -122.776°W, 20’ asl, collected 4 February 2003 by W. Leonard. Parts of paratype males are mounted on SEM stub WS38-7.

Etymology. The species name, a Latin noun in apposition, refers to our original indecision concerning the placement of this species in *Opiona* or a new genus.

Diagnosis. Distinct from *P. gardneri* **sp. nov.** in the undivided angiocoxite of the gonopods (divided in *gardneri*), relatively shorter telopodites of legpair 2 and in having the coxal processes of legpair 9 spirally curved rather than hooked.

Description. *Holotype male.* 8.0 mm long, 0.75 mm wide (Fig. 31). Other nonsexual characters as described for *P. gardneri.*

First legpair short, stout, arising from fused coxosternum, lacking specialized setae, tarsal comb obscure.

Second legpair (Fig. 13) with gonapophyses (**ga**) short, diverging, bearing long setae on anterior surface; *vas deferens* and accessory pore not observed; telopodite (**t2**) with five podomeres, terminal podomere button-like, clawless.

Third legpair (Fig. 13) with short, convergent coxal lobes (**cl**) sparsely setose, single long terminal seta; telopodites (**t3**) with four podomeres, terminal podomere with long, single seta.

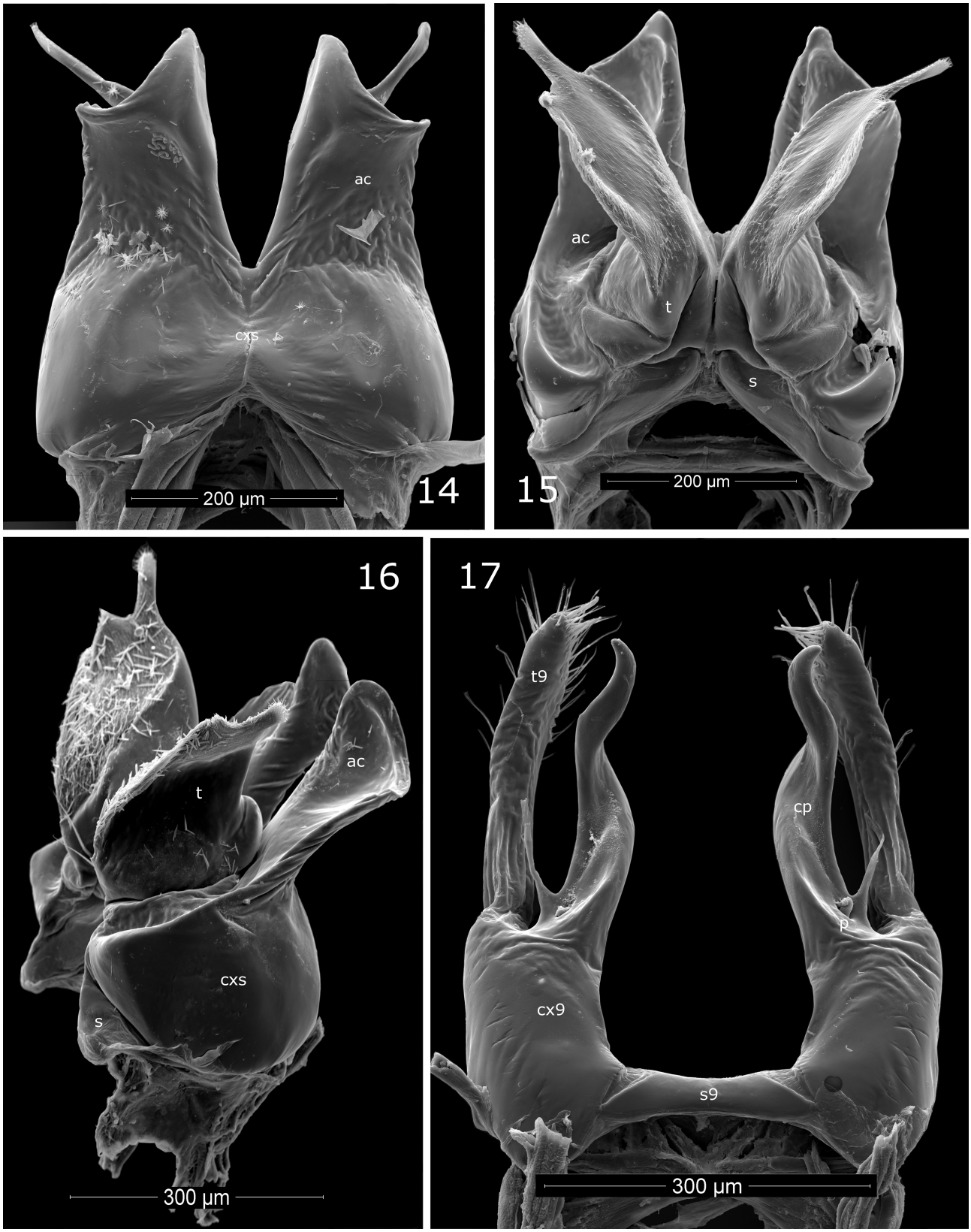
Gonopods in anterior view (Fig. 14) bilaterally fused as coxosternum (**cxs**, Fig. 16), undivided angiocoxites (**ac**) simple, semiquadrate. In posterior view (Fig. 15) angiocoxites (**ac**) slightly spatulate. Telopodites (**t**) as large as angiocoxites, emerging from distinct sockets in coxae, laterally flattened, diverging, with long terminal process tipped with minute spicules. In oblique lateral view (Fig. 16), angiocoxites (**ac**) cupped inward, telopodites (**t**) basally broad.

Ninth legpair (Figs 17–20) sternum (**s9**) narrow, elongated coxae (**cx9**) widely separated; coxal processes (**cp**) with mesal branch thin, short, acute, lateral branch robust, spirally curved, with pore (**p**) at base; telopodites (**t**) slightly longer than coxal processes, narrow, with small tuft of stout setae at tip (Fig. 20).

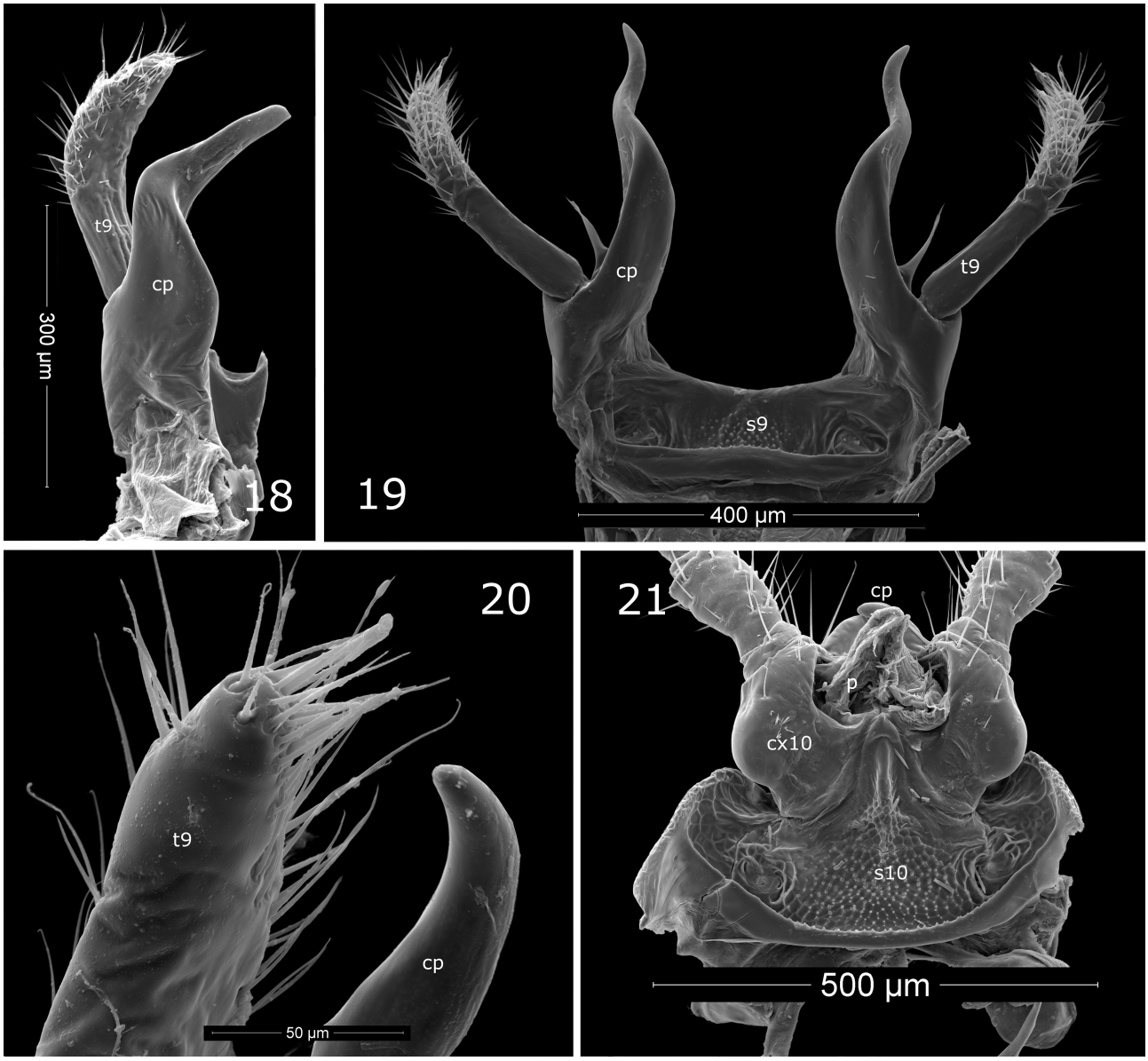
Tenth legpair (Fig. 21) sternum (**s10**) broad, coxae (**cx10**) globular, enlarged, with large pores (**p**), short, curved, blunt coxal processes (**cp**); prefemora and femora with rows of acute tubercles.

Paratype female. 8.0 mm long, 0.8 mm in diameter. Nonsexual characters as in male. Vulvae not modified, sparsely setose.

Records. In addition to the holotype and paratype locality: WASHINGTON: *Clallam Co.*: Deer Park Road, 6.1 mi north of US101, 1123’asl, 14 June 2003, W. Leonard, m. *Grays Harbor Co.*: Canyon River, 47.304°N, -123.509°W, 514’ asl, 3 October 2003, W. Leonard, m, ff; Canyon River, 6 mi west, 1.5 mi north of Matlock, 47.436°N, -123.874°W, 26 May 2003, W. Leonard, mm; 47.314°N, -123.540°W, 13 October 2003, W. Leonard, m, f.; Canyon River, 47.303°N, -123.509°W, 22 June 2002, W. Leonard, m, f. *Jefferson Co.*: Queets River Road, 0.8 mi from US101, Olympic National Park, 3 June 2003, W. Leonard, mf; same, but 4.8 mi from US101, mm; Nolan Crook at US101, 47.701°N, -124.320°W, 3 March 2002, W. Leonard, m, ff; Willoughby Creek at Hoh River, 3.5 mi east of US101, 28 March 2003, W. Leonard, mm; Satsop River, Grady Road, 2 mi north of US101, 22 June 2001, W. Leonard, m, f. *Lewis Co.:* seep beside road along Cowlitz River, east of Riffle Lake, 46.462°N, -122.163°W, 650’ asl, 9 April 2004, C. Richart, W. Leonard, m; Road #4000, southwest of Pe El MacDonald Road, 46.524°N, -123.194°W, 650’ asl, 3 January 2005, W. Leonard, mm, ff. *Mason Co.*: Potlatch State Park, Shelton, 47.361°N, -123.157°W, 20’ asl, 17 February 2002, W. Leonard, m; Skokomish Valley Road at US 101, Purdy Canyon near George Adams Salmon Hatchery, 47.301°N, 123.182°W, 15 February 2003, W. Leonard, m; Kennedy Creek, 0.6 mi upstream from US 101, 47.090°N, -123.095°W, 8 February 2003, W. Leonard, m, f; same, but 47.087°N, -123.091°W, 30 March 2003, mm; same but 47.090°N, -123.095°W, 8 December 2004, m. *Pacific Co.*: Trap Creek, 1.1 mi north of State Route 12, 3 May 2003, W. Leonard, mm; Middle Nemah River drainage, WDFW Type N study basin, 3576 A3300Road, 46.468°N, -123.809°W, 1900’ asl, 7 June 2006, C. Richart, m. *Thurston Co.*: Priest Point (Squaxin) Park, East Bay Drive Northeast, Olympia, 47.070°N, -122.894°W, 100’ asl, 16 February 2003, W. Leonard, m; Wetland bedside Kennedydell Park, 46.987°N, -122.970°W, 50, asl, 4 April 2004, W. Leonard, mm; Capitol State Forest, tributary to Kennedy Creek, 47.023°N, 123°013’, 948’asl, 13 September 2003, W. Leonard, mm; Capitol State Forest, unnamed tributary to Perry Creek, 47.062°N, -123.069°W, 950’ asl, 17 October 2003, W. Leonard, m; Woodard Bay Natural Resource Conservation Area, 2 March 2001, W. Leonard, mm; McAllister Springs, 47.049°N, -122.795°W, 23 February 2004, W. Leonard, mm, ff; McAllister Creek, 5 m south of Steelacom Road, 47.057°N, -122.713°W, 100’ adl, 11 December 2004, W. Leonard, mm; Beach Trail, Evergreen State College campus, Olympia, 47.079°N, -122.978°W, 100’ asl, 22 December 2003, m. *Wahakiakum Co.*: State Route 4 at milepost 23.7, 19 September 2003, W. Leonard, m; Allison Springs, Olympia, 47.048°N, -122.983°W, 29 September 2003, W. Leonard, m; Rock Creek at



FIGURES 14–17. Paratype male *Paropiona aenigma* Shear & Marek, **sp. nov. 14**. Gonopods, anterior view. **15**. Gonopods, posterior view. **16**. Gonopods, oblique lateral view. **17**. Ninth legpair, posterior view. **Abbreviations**: **ac**, angiocoxite; **cp**, coxal process; **cxs**, coxosternum of gonopods; **cx9**, Ninth leg coxa; **s**, sternum of gonopods; **s9**, sternum of ninth legpair; **t**, gonopod telopodite; **t9**, telopodite of ninth leg.



FIGURES 18–21. Paratype male *Paropiona aenigma* Shear & Marek, **sp. nov. 18**. Right ninth leg, mesal view. **19**. Ninth legpair, anterior view. **20**. Distal parts of left ninth leg, posterior view. **21**. Tenth legpair, anterior view. **Abbreviations**: **cp**, coxal process; **cx10**, coxa of tenth leg; **p**, coxal pore of tenth leg; **s9**, sternum of ninth legpair; **s10**, sternum of tenth legpair; **t9**, ninth leg telopodite.

Elochoman River, 46.276°N, -123.280°W, 317’ asl, 10 January 2004, W. Leonard, C. Richart, mm, ff; Rock Candy Mountain Road, 1 mi south of US101, Capitol State Forest, 28 June 2003, W. Leonard, mm, ff.

Opionoides Shear & Marek, new genus

Type species: ***Opionoides cataracta* Shear & Marek, new species.** Monotypic.

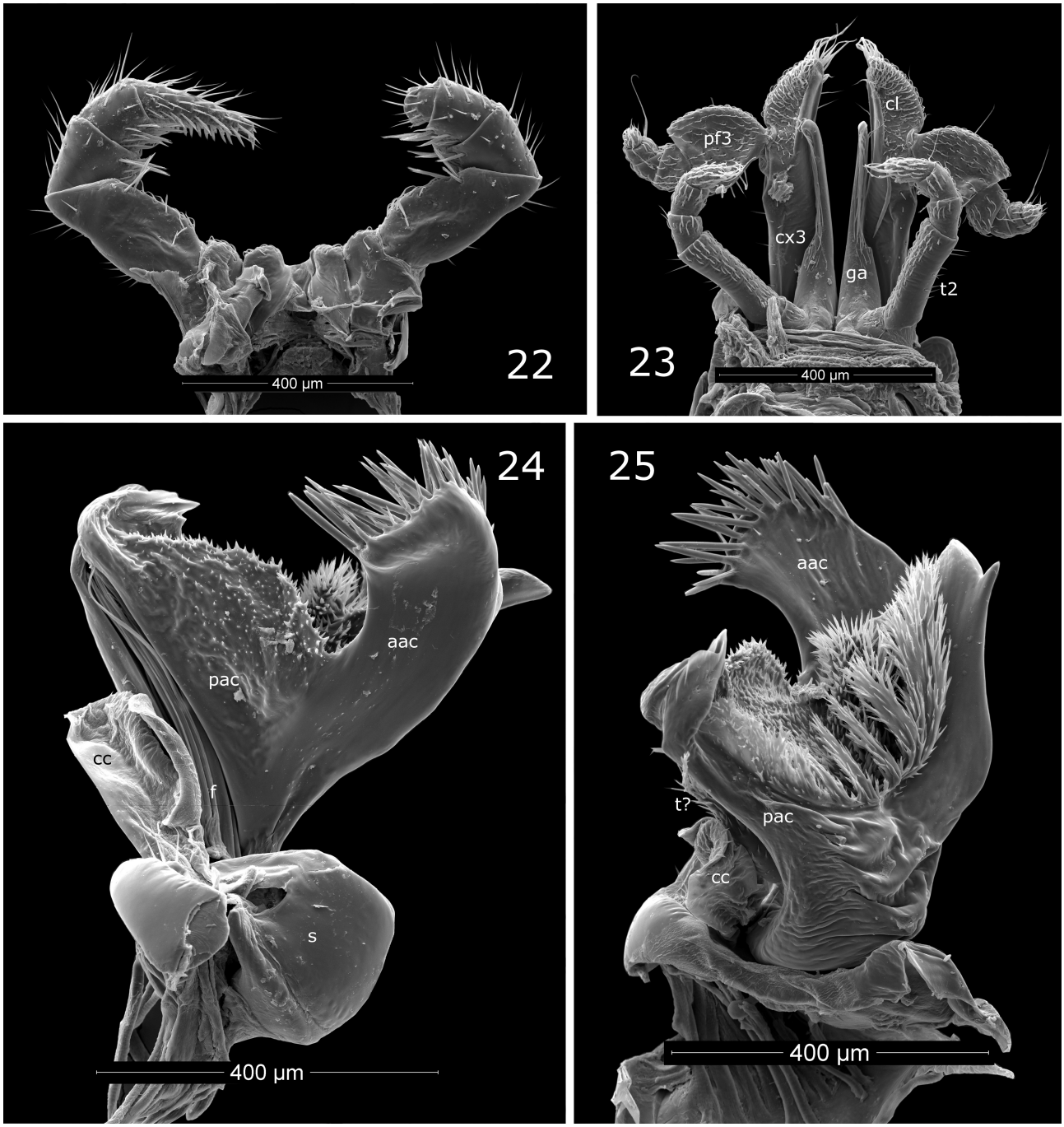
Diagnosis: Distinct in the form of the gonopods (Figs 24–27) from all other caseyid genera. The anterior angiocoxite is distally crowned with an array of stout cuticular spines (not setae) and the large posterior angiocoxites, which project anteriorly between the anterior angiocoxites bear a complex array of feathery, fimbriate processes. Large, poorly sclerotized colpocoxites are present, and a small, fimbriate branch may represent a vestigial telopodite.

Etymology. The genus name is a Greek neologism, “like *Opiona*” and should be considered feminine in gender.

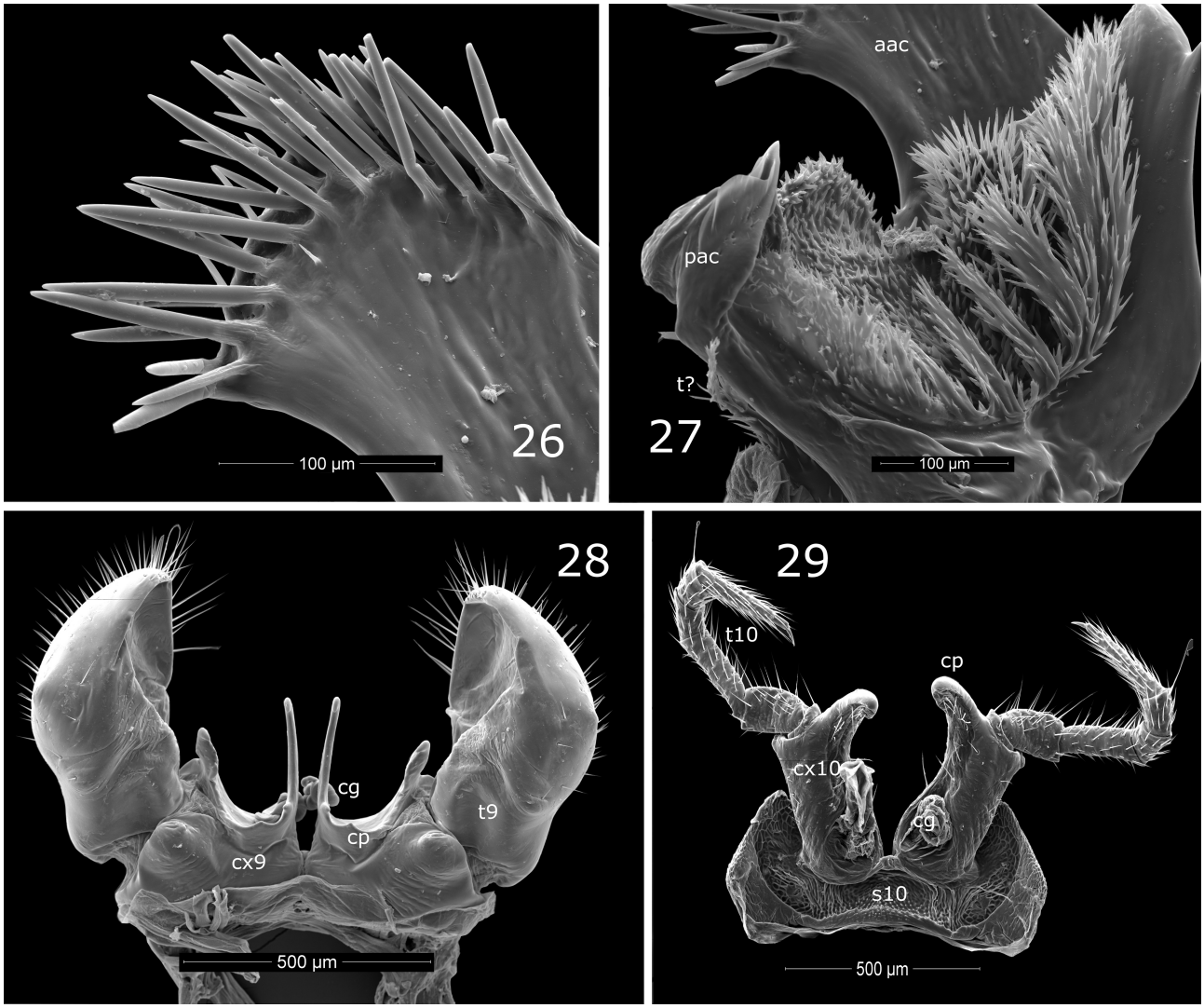
Description. As for the single known species, described below.

***Opionoides cataracta* Shear & Marek, new species.**
Figs 22–29, 32

Types. Male holotype, three male and two female paratypes from Golden and Silver Falls State Natural Area, 43.483°N, -123.933°W, 96 m asl, Coos Co., Oregon, collected 27 May 2007 by C. Richard & A. Fusek. Parts of paratype males are mounted on SEM stub WS 38-5.



FIGURES 22–25. Paratype male *Opionoides cataracta* Shear & Marek, **sp. nov. 22**. First legpair, posterior view. **23**. Second and third legpairs, anterior view. **24**. Left gonopod, lateral view. **25**. Right gonopod, mesal view. **Abbreviations**: **aac**, anterior angiocoxite; **cc**, colpocoxite; **cl**, coxal lobe of third leg; **cx3**, third leg coxa; **f**, flagellocoxites; **ga**, gonapophysis; **pac**, posterior angiocoxite; **pf3**, third leg prefemur; **s**, gonopod sternum; **t2**, second leg telopodite; **t3**, third leg telopodite; **t?**, possible vestigial telopodite of gonopod.



FIGURES 26–29. Paratype male *Opionoides cataracta* Shear & Marek, **sp. nov. 26**. Distal part of anterior angiocoxite, mesal view. **27**. Posterior angiocoxite, mesal view. **28**. Ninth legpair, anterior view. **29**. Tenth legpair, anterior view. **Abbreviations**: **aac**, anterior angiocoxite; **cg**, coxal gland; **cp**, coxal process; **cx9**, Coxa of ninth legpair; **cx10**, coxa of tenth legpair; **t9**, telopodite of ninth leg; **t10**, telopodite of tenth leg.

Etymology. The species epithet, a Latin noun in apposition, "waterfall," refers to the type locality.

Diagnosis. As for the genus.

Description. *Male paratype.* Length about 10 mm, width 1.0 mm. 30 rings (Fig. 32). Twenty-four ommatidia in triangular eyepatch.

Color pale tan, heavily marked anteriorly and dorsally with purplish brown, pale tan areas around segmental setae.

Segmental setae in straight row across posterior margin of metazonites.

First legpair (Fig. 22) short, stout, with few flattened, spiral setae distal on femur, postfemur and tibia; tarsus with setal comb.

Second legpair (Fig. 23) with gonapophyses (**g**) distally attenuate, curved, with long setae anteriorly, *vas deferens* and accessory pore not observed; telopodites (**t2**) with five podomeres, as long as or slightly longer than gonapophyses, femora elongate.

Third legpair (Fig. 23) coxae (**cx3**) with narrow lobes slightly curved inward, setose, prominent tuft of apical setae. Third legpair telopodites with five podomeres, prefemur (**pf3**) strongly expanded, flattened, tarsus minute.

Lepairs four to seven not enlarged.

FIGURES 30–32. 30. Holotype male of *Paropiona gardneri* Shear & Marek, **sp. nov.** Length about 11 mm. **31.** Holotype male of *Paropiona aenigma* Shear & Marek, **sp. nov.** Length about 8 mm. **32.** Paratype male of *Opionoides cataracta* Shear & Marek, **sp. nov.** Length about 10 mm.

Gonopods in lateral view (Fig. 24) with anterior angiocoxite (**aac**) broad, curved, bearing distal crown of many acute spines, not setae (Fig. 26); posterior angiocoxite (**pac**) large, spiculate, sheathing at least four flagellocoxites (**f**); colpocoxite (**cc**) saclike, weakly sclerotized. In mesal view, posterior angiocoxite (**pac**) projecting anteriorly between anterior angiocoxites, bearing many feathery branches and spicules; small fimbriate branch may represent vestigial telopodite (**t**).

Ninth legpair (Fig. 28) with coxae (**cx3**) having posterior humps and coxal processes with widely separated branches (**cp**); lateral branch short, stout, flattened, mesal branch longer, narrow, curved anteriorly. Ninth leg telopodites of single article but with deep sulcus that appears to divide them, deeply excavate mesally.

Tenth legpair (Fig. 29) with broad sternum (**s10**), coxae (**cx10**) elongate, with stout distal, curved processes (**cp**), large coxal glands (**cg**); telopodites (**t10**) reduced.

Paratype female. Length about 11.0 mm, width 1.0 mm. Nonsexual characters as in male. Vulvae not modified.

Records. Known only from the type locality.

Notes. The pregonopodal leg modifications of this species are similar to those of *Opiona* species and related caseyid genera. However, the gonopods are unusual and unique, due to the spines crowning the distal crest of the anterior angiocoxite and the feathery branches of the posterior angiocoxite. While these branches may recall similar structures on the gonopods of ochrogrammatines, in detail they are very different and probably represent a parallel or convergent development. Unlike the foregoing genus, colpocoxites are present, as well as a small branch which may represent a vestigial telopodite. In addition, there are at least four and perhaps more flagellocoxites, which are a feature of *Opiona* gonopods, but not those of *Paropiona.* These are sheathed in the posterior angiocoxite as is the case in *Opiona.* The ninth legpair is also closer to the *Opiona* pattern, rather than *Paropiona,* with rather button-like telopodites. As noted by Gardner and Shelley (1989), some species of *Opiona* have a prominent sulcus in the single telopodite podomere of the ninth legpair which can give the impression that two podomeres are present instead of just one, and this is the case for *Opionoides cataracta,* **sp. nov.** The elongate coxae of the tenth legpair are not found in any *Opiona* species we have examined, but we have not seen them all.

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