



A new species of *Paradella* Harrison & Holdich, 1982 (Crustacea: Isopoda: Sphaeromatidae) from Baja California, Mexico, with a key to East Pacific species

REGINA WETZER¹ & NIEL L. BRUCE²

¹Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, CA 90007; email: rwetzer@nhm.org

²Marine Biodiversity and Biosecurity, National Institute of Water and Atmospheric Research, Private Bag: 14901, Kilbirnie, Wellington, New Zealand; email: n.bruce@niwa.co.nz

Abstract

Paradella garsonorum sp. nov., from the high intertidal of Baja California, Mexico, is described and figured, the fourth species from the East Pacific region, the third species from the Gulf of California. It is distinguished from other species of the genus by both uropodal rami having sinuate lateral and mesial margins that provide a notably attenuated appearance to the male uropodal rami, and the pleon with upturned lateral margins. The generic diagnosis is revised, known species in the genus are listed and a key to the eastern Pacific species provided.

Key words: Crustacea, Sphaeromatidae, Isopoda, *Paradella*, taxonomy, Baja California, Mexico, East Pacific

Introduction

Paradella is a small genus of 14 named species, with a wide distribution in warm–temperate and tropical waters of the tropical Pacific Ocean, Indian Ocean and Caribbean. Recent shallow-water collections in Baja California, Mexico, discovered a new species of *Paradella* (Bruce & Wetzer 2004) and further collections as well as material held over from previous collections revealed the presence of another species of *Paradella* that is here described.

There is a group of clearly related species that occurs in the tropical and temperate East Pacific, these species being *Paradella diana*e (Menzies, 1962), *P. setosa* (Glynn, 1968), *P. tiffany* Bruce & Wetzer, 2004, and *P. garsonorum* sp. nov. These species share a similar ornamentation of pereonite 7, the pleon and pleotelson, and characteristically upturned flanges to the lateral margins of the pleon. One of these species, *Paradella diana*e, has been widely translocated by international shipping to ports around the world, and the original distribution of that species remains uncertain.

Methods

Terminology, measurements and descriptions follow Bruce (e.g. 1997, 2003). The generic description was produced using a DELTA (Dallwitz *et al.* 1997) using the sphaeromatid generic data set that is under development.

Abbreviations: LACM—Natural History Museum of Los Angeles County; CNCR—Colección Nacional de Crustáceos, Instituto de Biología, Universidad Nacional Autónoma de México; PMS—plumose marginal setae; RS—robust seta/e.

Paradella Harrison & Holdich, 1982

Paradella Harrison & Holdich, 1982: 99.—Harrison, 1984: 386.—Harrison & Ellis, 1991: 943.—Kensley & Schotte, 1989: 223.—Storey, 2002: 139.—Bruce & Wetzer, 2004: 2.

Type species: *Paradella octaphymata* Harrison & Holdich, 1982, by original designation.

Diagnosis. Body vaulted, dorsal surfaces smooth or with nodular ornamentation, without setae or with sparse setae; with ability to conglobate; strongly sexually dimorphic. Pleon consisting of 4 visible segments (as determined by lateral sutures); pleonite 1 entire; sutures (except first) running to posterior margin, merging, short; dorsal surface without process, with 2 or more pairs of tubercles; posterior margin even, with 'keys'. Pleotelson anteriorly as wide as pleon, without dorsal process; posterior margin with subapical Y-shaped foramen connected to posterior by narrow slit, with ventral thickened rim; lateral margins forming ridge. Epistome anteriorly narrow, without median constriction. Penial processes basally fused, long (extending to pleopod 1 rami). Pleopod 1 rami not operculate; exopod lamellar. Pleopod 2 endopod about as long as exopod; appendix masculina inserted basally, on short proximal lobe of endopod. Uropod rami broad, lamellar.

Description. *Head* with rostral point present, simple, separating antennular bases; anterior margin simple, without paired incisions in front of eyes, lateral margins not laterally extended to body outline (antennules more or less ventral). *Pereonite 1* lateral margins not anteriorly produced, not laterally enclosing head; pereonites 2–7 or 5–7 with posterior margin raised, forming narrow transverse ridge (usually on pereonites 5–7); anteriorly without keys. Sternite 1 without cuticular mesial extensions. Pereonite 6 simple, dorsally without bosses, processes or marginal extensions. Pereonite 7 as wide as pereonite 6, forming part of body outline, dorsally without bosses, processes or marginal extensions or with bifid posteriorly directed process. *Coxae* distally wide, those of pereonites 2–7 overlapping the one behind, coxae without ventral 'lock and key' processes, without grooved articulation; those of pereonite 6 not large, not overlapping those of pereonite 7. *Pleon* posterior margin even, as wide as pleotelson; pleonal sternite narrow; pleotelson vaulted, weakly biddomed.

Antennule peduncle with basal articles mesially not in contact, peduncle articles 1 and 2 robust, article 3 slender; article 1 not produced; article 2 approximately 0.5 as long as article 1; with articles 2 and 3 colinear, article 3 longer than article 2; flagellum shorter than peduncle, longer than peduncular article 3. *Antenna* peduncle articles all colinear, of similar thickness, less robust than peduncle articles of antennule.

Epistome anteriorly not prominently extended, elongate, posteriorly enclosing labrum.

Mandible incisor wide, multicuspid; lacinia mobilis present; spine row normal, molar process gnathal surface with transverse ridges, rounded. *Maxillule* lateral lobe with RS, some or all serrate, mesial lobe with 4 major heavily RS. *Maxilla* with nodular setae on middle and lateral lobes nodular. *Maxilliped* palp articles 2–4 mesial margins lobate, article 2 not expanded; endite distal margin truncate, with clubbed RS, anteromesial (upper) marginal ridge without long curved serrate RS.

Pereopod 1 ambulatory; dactylus secondary unguis simple; setae on merus and propodus short. Pereopod 1 (or 1–3), inferior margins of merus, carpus and propodus without conspicuous RS. Pereopod 2 similar in proportion to pereopod 3, dactylus with secondary unguis simple, short and stout. Pereopods 3–7 dactylus with secondary unguis simple. Pereopods with inferior margins of ischium to carpus bearing dense setulose fringe; ischium superior margin with sinuate acute RS, pereopods 1–3 (or 1–4) ischium superior margin without long stiff slender setae.

Penes tapering smoothly from midlength, apex acute.

Pleopod 1 exopod with longitudinal axis weakly oblique, distally subtruncate or truncate; endopod of similar proportions to exopod, mesial margin lamellar, distally angular, endopod proximomesial heel present. *Pleopods 1 and 2* exopod distal margins not deeply serrate. *Appendix masculina* with straight margins, longer than and extending beyond endopod, distally acute. *Pleopod 3* exopod transverse suture present, endopod transverse ridges absent, endopod of similar proportions to exopod. *Pleopod 4* rami without PMS; exopod with thickened transverse ridges present, transverse suture absent, lateral margin not thickened, with short simple marginal setae; endopod with thickened transverse ridges present; mesial margin with deep distal notch, proximomesial lobe present. *Pleopod 5* exopod with thickened transverse ridges present, transverse suture present, incomplete, lateral margin with short simple setae, not thickened, distally usually with 3 discrete scale patches forming protruding lobes; endopod with thickened transverse ridges present, with proximomesial lobe.

Uropod rami not strongly flattened, not forming part of continuous body outline; exopod (of adult male) similar in length to endopod, lamellar, lateral margin simple, finely serrate or smooth, distally broadly rounded or narrowly rounded or distally acute; endopod lamellar, distally broadly rounded.

Female. Mouthparts of female not metamorphosed. Marsupium formed from 4 pairs of oostegites, anterior pocket absent, posterior pocket absent, oostegites not overlapping at mid-line. Ornamentation of pereonites, pleon and pleotelson less developed than in male; uropod rami of similar proportions, lateral margin of exopod not upturned.

Species included: *P. acutitelson* (Menzies & Glynn, 1968), Puerto Rico; *P. bakeri* (Menzies, 1962b), Chile; *P. diana* (Menzies, 1962a), Baja California, Mexico (now widely translocated by international shipping, e.g. Bey *et al.*, 2001,

Hass & Knott, 1998); *P. garsonorum* **sp. nov.**, Baja California, Mexico; *P. harrisoni* Müller, 1995; Kenya; *P. heptaphymata* Shoukr, Mona & Rizk, 1987, Suez Canal, Egypt; *P. octaphymata* Harrison & Holdich, 1982, **type species**, Great Barrier Reef, Queensland and Vietnam, South China Sea (Kussakin & Malyutina, 1993); *P. plicatura* (Glynn, 1970), Venezuela; *P. quadripunctata* (Menzies & Glynn, 1968), Puerto Rico; *P. setosa* (Glynn, 1968), Pacific Panama; *P. tomleklek* Storey, 2002, Phuket, Thailand; *P. tuberculata* Müller, 1991, Society Islands (Tahiti); *P. tumidicauda* (Glynn, 1970), Venezuela; *P. tiffany* Bruce & Wetzer, 2004, Baja California, Mexico.

Known undescribed species: *Paradella* sp. Baja California, Mexico, from mangrove prop-roots.

Remarks. Current generic diagnoses in the Sphaeromatidae are more restrictive than previously. A critical revision of those species placed in *Dynamenella* Hansen, 1905 (see Harrison & Holdich 1982), would likely see transfer of some of those species and some of the numerous *incertae sedis* species into *Paradella*, notably those species with merging Y-shaped pleonal sutures and a long appendix masculina.

Paradella can best be identified by males having a distinct dorsally-directed, Y-shaped and posteriorly closed pleotelson foramen, long, tapering and basally fused penial processes, a long and basally narrow appendix masculina that usually extends beyond the distal margin of the endopod, both sexes with two fused Y-shaped pleonal sutures, entirely lamellar pleopod 1 rami and pereopod dactyli with a simple secondary unguis.

Distribution. Widespread in shallow-water habitats in temperate and tropical regions of the Pacific Ocean, Indian Ocean and tropical western Atlantic; probably world wide, but not recorded from the eastern Atlantic or Mediterranean, nor from temperate northwestern Pacific (Japan, Korea).

***Paradella garsonorum* sp. nov.**

Material examined

All material from Mexico, Gulf of California, Baja California Sur.

Holotype: ♂ (4.3 mm) (LACM CR 2003-042.1), Ensenada de los Muertos (also known as Bahía de los Suenos), from beach in front of 'Giggling Marlin Yacht Club', 23.994°N 109.826°W, 6 Oct 2003, from beneath large rocks on/in coarse sand in the mid-intertidal zone, salinity 34 ppt, hand, fixed and preserved in 95% ethanol, UC Mexus station 27, coll. T.A. Haney, RW03.288. *Paratypes:* ♂ (4.0 mm, dissected and figured) (LACM CR 2000-068.1), Bahía de los Muertos, Boca del Alamo, 23.888°N 109.796°W, beneath large rounded stones in high intertidal zone, fixed and preserved in 75% ethanol, 10 Jan 2000, coll. T.A. Haney, RW00.104. 4 ♂ (3.2) (LACM CR 2000-068.2), (4.1, 5.0, 5.1 mm) (LACM CR 2000-068.3), 2 subadults (2.7, 4.1 mm) (CNCR 24688), 1 ♂ (4.3 mm), 1 ♀ (ovig. 3.6 mm) (LACM CR 2000-068.4), 1 ♀ (ovig. 3.7 mm) (CNCR 24669), 3 subadults (2.9, 3.2, 3.6 mm), same data as previous (RW00.104). 1 ♂ (3.6 mm) (CNCR 24670), 8 subadults (2.7, 2.8, 3.0, 3.0, 3.1, 3.1, 3.2, 3.6 mm) (LACM CR 2003-042.2) (RW03.288).

Description of male. Body about 1.8 times as long as greatest width (pereonite 6); dorsal surfaces smooth. *Head* anterior margin with single weak, slightly crenulated transverse ridge, ventral rostral process weakly developed. Head and pereonite 1 subequal in length, pereonite 1 about 1.8 times as long as pereonite 2, unornamented; pereonites 2, 3, and 4 subequal, pereonite 4 <5 <6 >7; pereonites 1 to 7 with increasingly thicker and more crenulate posterior margins; pereonites 5–7 with increasingly more prominent, posteriorly directed paired tubercles. *Coxae* without evident sutures, progressively increasing in size posteriorly, those of pereonite 7 more stout than those of previous pereonites, dorsal margin lightly crenulate with stout blunt dorsally directed tooth. *Pleon* with lateral margin upturned. *Pleotelson* dorsum granular, with 6 nodules set as transverse rows of 4 and 2; ventral pleopodal cavity deep, posterior margin thickened, V-shaped; dorsal pleotelson sinus heart-shaped with cuticular thickening especially around anterior edges, posteriorly completely closed.

Antennule peduncle article 1 1.6 times as long as wide, about 1.5 times as long as article 2; article 2 with 3 palmate setae; article 3 subequal in length to article 2, slender, 3.1 times as long as wide; article 4 very short, nearly entirely fused with article 3; flagellum extending slightly beyond posterior margin pereonite 1, 11-articled with aesthetascs on the 6 distalmost articles. *Antenna* peduncle articles 1–3 short, subequal in length, article 4 4.0 times as long as article 1, article 5 1.4 times as long as article 4; flagellum extending to posterior margin of pereonite 2, with 15 articles, 1.5 times as long as peduncle.

Epistome square, with weak lateral constriction. *Right mandible* incisor with 3 cusps, spine row with 2 serrate spines and 4 blunt spines, several very fine setae below round molar process; palp article 2 0.8 times as long as article 1, distolateral margin with 6 biserrate setae, becoming progressively longer distally; article 3 with 11 serrate setae, terminal seta longest. *Left mandible* incisor with 3 cusps, lacinia mobilis and spine row. *Maxillule* lateral lobe mesial margin with 9 long simple setae, gnathal surface with 10 serrate RS, and 1 simple seta subapical, fine setae on distal margin; mesial lobe with 4 comb and 1 simple seta. *Maxilla* lateral lobe with 3 curved nodular serrate RS; middle lobe with 4 curved nodular serrate RS; mesial lobe with 5 biserrate RS, 2 stout and many slender simple setae. *Maxilliped* endite lateral margin weakly sinuate, distal margin with 4 stout blunt RS, set in amongst 5 plumose RS, mesial margin with 1 coupling

hook; palp articles 2–5 with about 14, 11, 9, and 8 simple setae, respectively.

Pereopod 1 robust, *basis* about 2.1 times as long as greatest width, proximal ventral margin with short fringe setae; *ischium* 1.6 times as long as propodus, 2.3 times as long as wide, inferior margin with 1 seta, superior margin with 1 seta and 6 short simple spines; *merus* 2.7 times as long as *ischium*, inferodistal angle with 3 acute simple setae, inferior margin with dense setulose fringe, superior margin with 1 long simple seta; *carpus* approximately as long as wide, subtriangular, inferior margin with 5 simple setae set amongst dense setulose fringe; *propodus* 2.5 times as long as wide, inferior margin with setulose fringe and single simple setae, superior margin with 3 short simple setae, distally several small comb setae, dorsal surface with 1 seta; *dactylus* about 0.5 times as long as propodus, unguis inferior margin with prominent serrate cuticular scales, secondary unguis simple, straight, with 3 simple setae at base. *Pereopod 2* *basis* 2.6 times as long as greatest width, ventral margin with 4 simple setae; *ischium* 0.8 times as long as *basis*, superior margin with 3 setae, inferior margin with 4 setae; *merus* 0.5 as long as *ischium*, superior margin with 1 seta, inferior margin with 3 setae and setulose fringe; *carpus* subequal to *merus*, superior margin with 3 simple and 1 palmate seta, entire inferior margin with setulose fringe interspersed with slender simple setae and 1 palmate seta; *propodus* 1.3 times as long as *ischium*, superior margin with 6 simple setae, dorsolateral angle with 2 palmate seta (1 long, 1 short), inferior margin with setulose fringe interspersed with 4 simple slender setae; *dactylus* about 0.4 times as long as propodus, unguis inferior margin with 2 rows of stout cuticular scales, secondary unguis simple, straight with 4 simple setae. *Pereopods 3–7* similar and longer than pereopods 1 and 2. *Pereopod 7* *basis* 2.7 times as long as greatest width, ventral margin with 4 setae and many very short setae; *ischium* 1.1 times as long as *basis*, 2.7 times as long as greatest width, superior margin with setulose fringe and 3 simple setae, inferior margin with 7 setae, small clump of setules distalmost; *merus* 0.5 times as long as *ischium*, superior margin with 2 setae (distalmost long seta, moderately stout), inferior margin with setulose fringe and 3 interspersed setae; *carpus* 0.8 times as long as *merus*, distalmost margin with 6 setae, inferior margin with 3 patches of setulose fringe interspersed with setae; *propodus* 0.8 times as long as *ischium*, 4 times as long as wide, superior margin with 3 setae, distalmost angle with 4 setae, inferior margin with 9 setae and distal patch of setulose fringe; *dactyl* 0.3 times as long as propodus.

Penial processes 4 times as long as basal width.

Pleopod 1 endopod and exopod with approximately 27 and 20 PMS respectively; endopod subtriangular, 1.1 times as long as exopod, 1.5 times as long as greatest width, proximolateral margin straight; exopod with oblique axis, distal margin subtruncate; peduncle mesial margin with 3 coupling hooks. *Pleopod 2* endopod and exopod subequal with approximately 18 and 27 PMS respectively; endopod subtriangular, 1.1 times as long as wide at base (greatest width), appendix masculina reaching distalmost tip of longest PMS, apex narrowly rounded, peduncle with 3 coupling hooks. *Pleopod 3* endopod and exopod with approximately 20 and 12 PMS respectively; peduncle with 3 small coupling hooks on mesial margin. *Pleopod 4* endopod distomesial margin with prominent excision, exopod lateral margin with approximately 12 fine simple setae, peduncle medial margin with 1 simple seta. *Pleopod 5* exopod with 2 scale patches and proximal suture. *Uropod* rami dorsal surfaces granular; exopod margins serrate, sinuate, apically narrowed, somewhat longer than endopod; endopod margins serrate (only anteriormost mesial margin smooth).

Female. Similar to the male but for: body overall more setose, dorsal ornamentation less prominent, pleotelson weakly ornamented. Posterior margin of pleotelson with medial, vertical, ventrally open, keyhole-shaped slit. Uropods barely reaching posterior margin of pleotelson; exopod outer margin weakly crenulate, distally weakly acute; endopod outer margin not crenulate, distally rounded. Gravid females with approximately 6–8 mancas; without free oostegites.

Size. Males 3.2–5.2 mm, mean ($n = 7$) 4.2 mm; ovigerous female 3.6, 3.7 mm (two only), subadults, including non-ovigerous females 2.7–4.3 mm, mean ($n = 7$) 3.4 mm.

Remarks. *Paradella garsonorum* sp. nov. belongs to a group of East Pacific species characterized by having paired sub-median nodules on the pleon and paired nodules on the dorsal surface of the pleotelson. The other species with pleonal nodules are *P. diana*e (Menzies, 1962) and *P. tiffany* Bruce & Wetzer, 2004. All of these species (adult males) have large or expanded pereonite 7 coxae and the lateral margin of the pleon and uropod peduncle are flattened, dorsally upturned into flange or blade. The character states that allows ready identification of *P. garsonorum* are the sinuate and serrate margins to the uropods, particularly the exopod which appears apically narrow and sub-acute, and extends slightly beyond the endopod apex. In contrast the similar *P. diana*e has ovate uropods, which appear subequal in length, with an evenly convex lateral margin on the uropodal exopod.

Figures 5A and 5B depict adult male variability in which some individuals have more or less dorsal ornamentation. Figure 5 images are of individuals from the same locality and collecting event (RW00.104). A, B, and C are 3 adult males.

Generic diagnoses have over time been clarified (e.g. Harrison & Holdich 1982) and some *Dynamenella* have been reassigned to *Paradella*. There are still some species of *Dynamenella* that may be incorrectly placed as attention to pleonal structures had previously not been considered. Further there are 12 species placed in *Dynamene* (the original combination) or *Dynamenella* that are regarded as *incertae sedis*, six of these are from the United States west coast, namely Oregon and California.

Distribution. Vicinity of type locality only, Baja California Sur, Mexico.

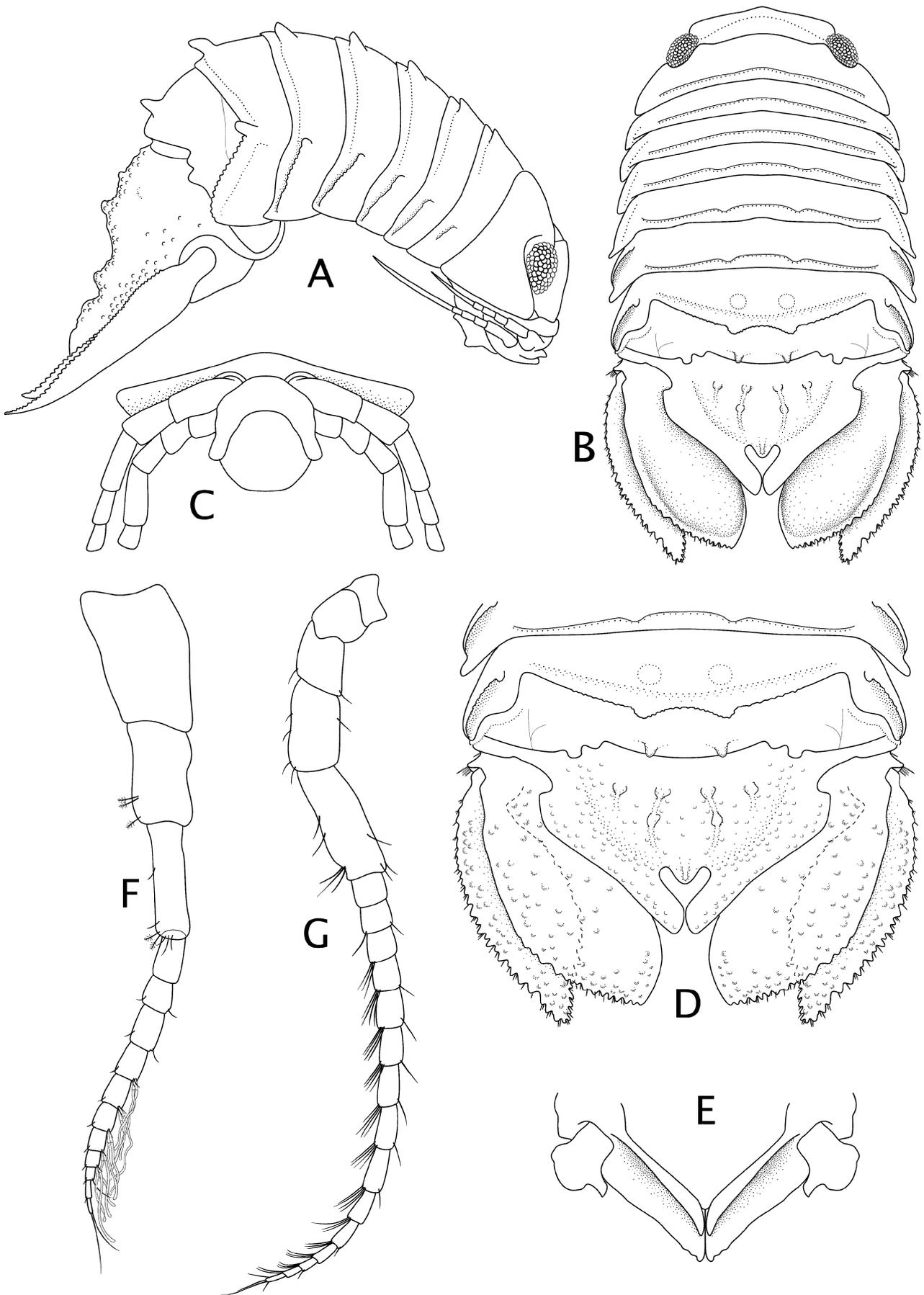


FIGURE 1. *Paradella garsonorum* sp. nov. Male holotype (A–D), male paratype (E–F). A, lateral view; B, dorsal view; C, frons and anterior of head in ventral view; D, pleon; E, pleotelson, F, antennule; G, antenna.

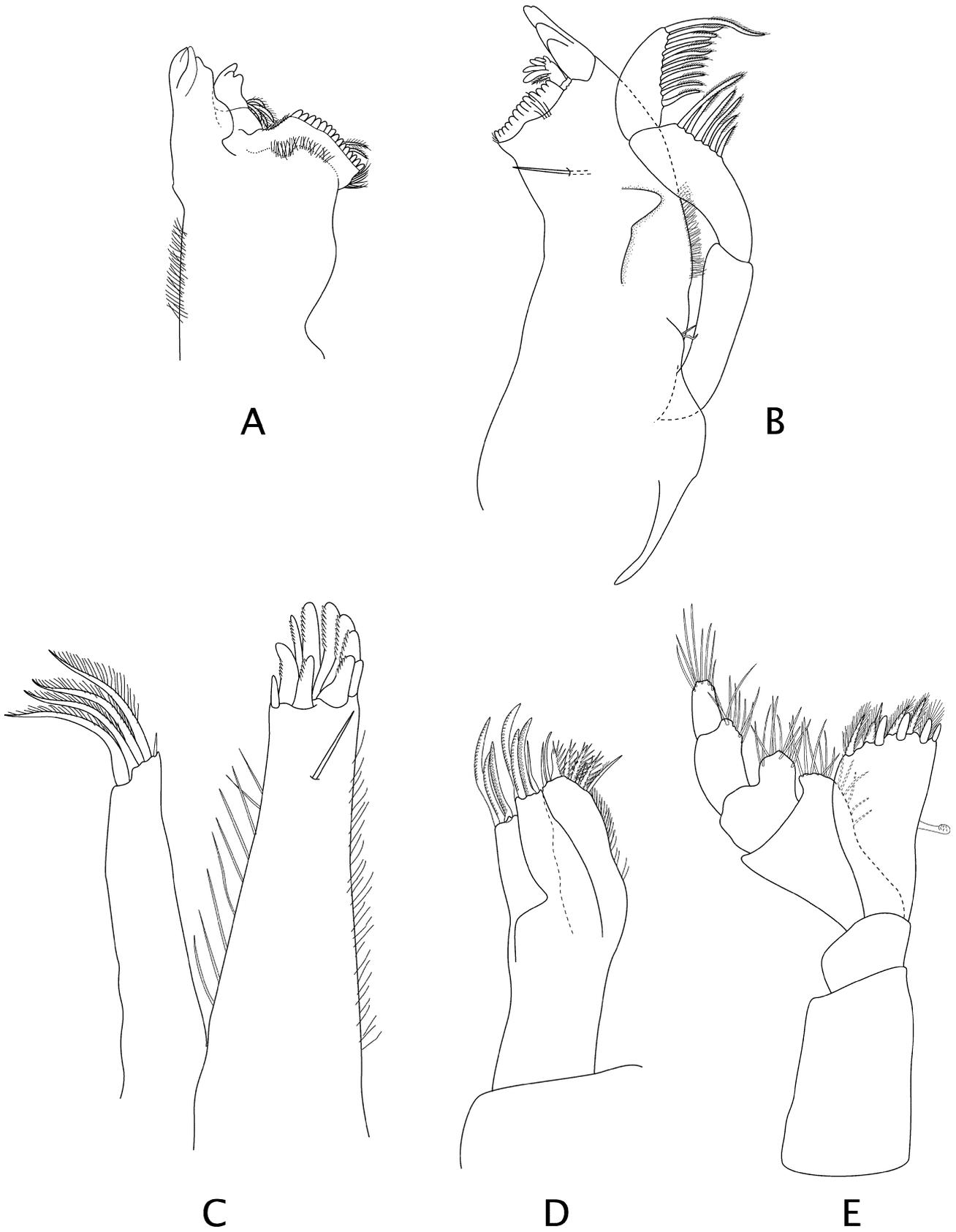


FIGURE 2. *Paradella garsonorum* sp. nov. Paratype (male). A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped.

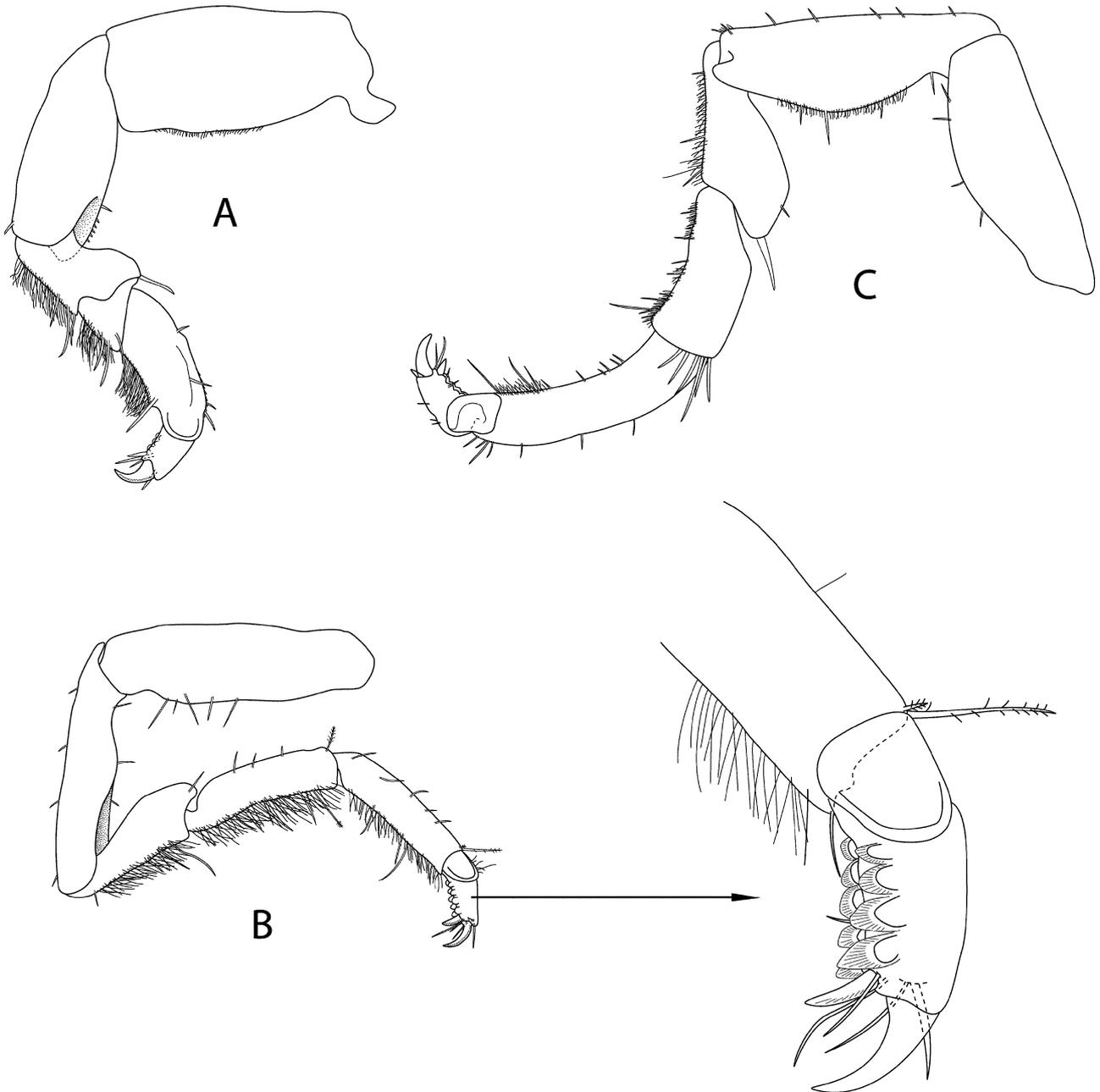


FIGURE 3. *Paradella garsonorum* sp. nov. Paratype (male). A, pereopod 1; B, pereopod 2; C, pereopod 7.

Etymology. We take pleasure in naming this species for Richard and Eileen Garson, in recognition of their long standing support of the Natural History Museum of Los Angeles County and especially its research and collections.

Key to the East Pacific *Paradella* (adult males)

1. Posterior margin of pereonite 7 with prominent posteriorly-directed bifid process, completely overlapping and obscuring pleon in dorsal aspect *P. tiffany*
- Posterior margin of pereonite 7 thickened, turned upward as a flange, but without posteriorly directed bifid process.....2
2. Body moderately hirsute.....*P. setosa*
- Body setation sparse, not hirsute.....3
3. Pereonite 7 coxae dorsal margin lightly crenulate. Uropodal exopod longer than endopod, subacute, lat-

eral margin sinuate.....*P. garsonorum* sp. nov.
 — Pereonite 7 coxae dorsal margin not crenulate. Uropodal rami rounded, exopod subequal to endopod
*P. diana*e

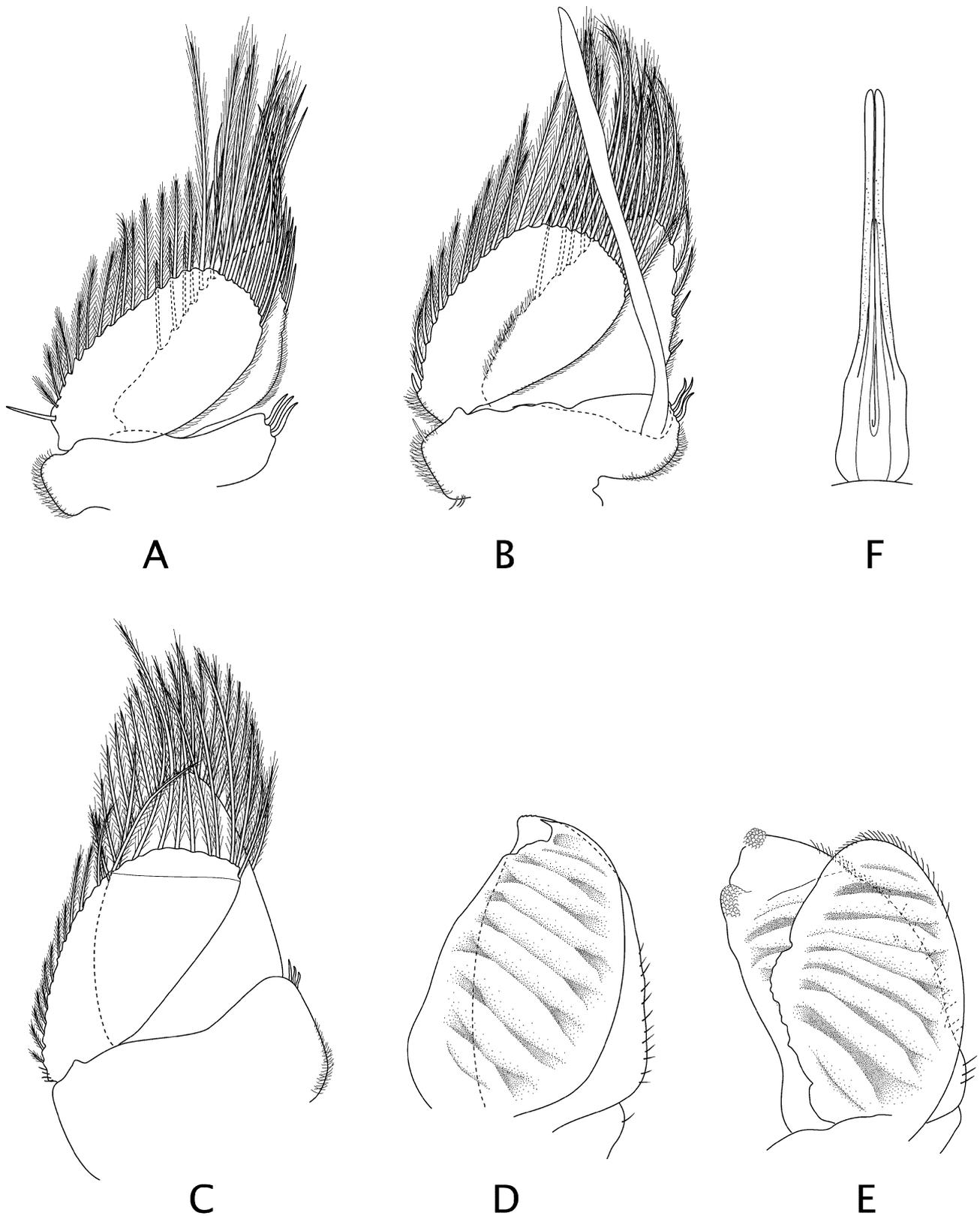


FIGURE 4. *Paradella garsonorum* sp. nov. Paratype (male). A, pleopod 1; B, pleopod 2; C, pleopod 3; D, pleopod 4; E, pleopod 5; F, penes.

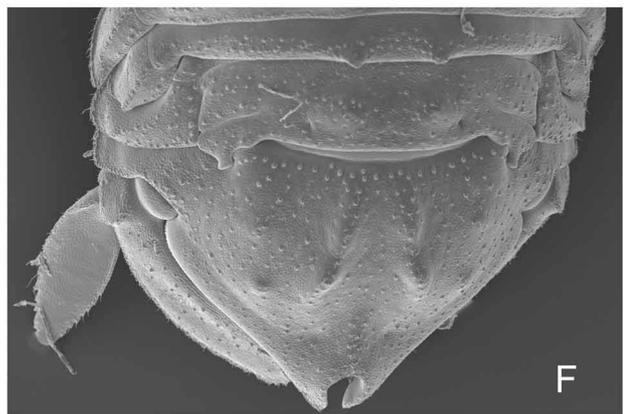
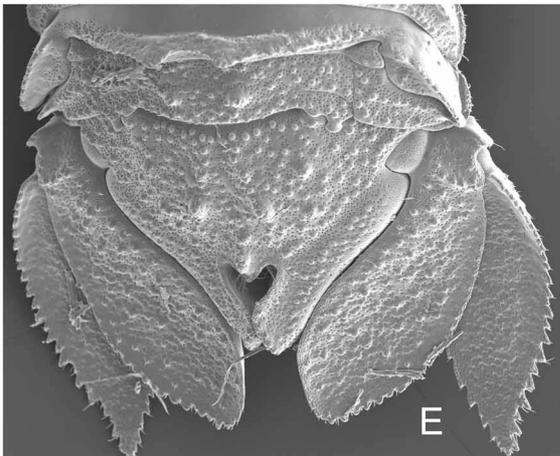
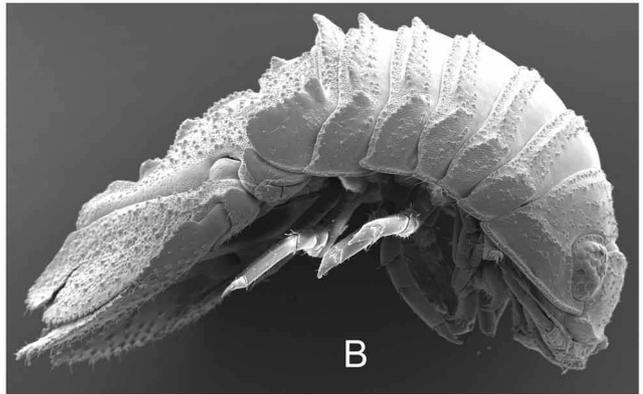
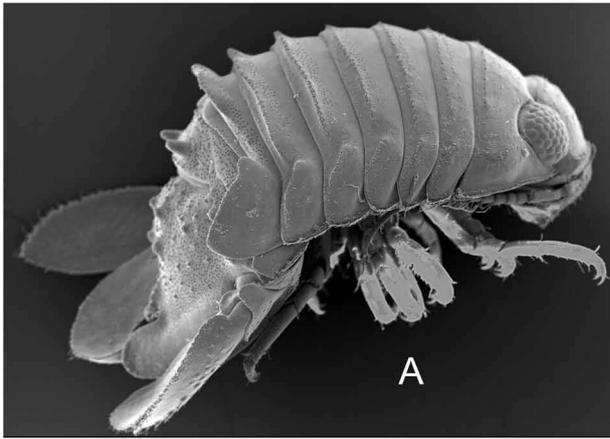


FIGURE 5. *Paradella garsonorum* sp. nov. SEM. A, lateral male; B, lateral male; C, dorsal male; D, dorsal female; E, pleotelson male; F, pleotelson female.

Additional distributional notes

Since the description of *P. tiffany* in 2004, a single subadult specimen is reported from Mexico: Gulf of California, Baja California Norte, San Felipe, ~31.05°N ~114.8°W, intertidal rocks, Rotenone, dipnets, 20 Jan 1968, SIO C 3731 BI 68-2, coll. D. Hoese (RW03.278).

Note that *P. tiffany* and *P. garsonorum* sp. nov. co-occur at Mexico, Gulf of California, Baja California Sur; both species were abundant and represented by all age classes: Bahia de los Muertos, Boca del Alamo, 23.888°N 109.796°W, beneath large rounded stones in high intertidal zone, fixed and preserved in 75% ethanol, 10 Jan 2000, coll. T. A. Haney (RW00.104).

Three *Paradella* species are known from the Gulf of California (*P. dianae*, *P. tiffany*, and *P. garsonorum* sp. nov.). An additional small-sized and yet undescribed species is known from Mexico, Baja California Sur; Bahia de Concepcion, western side of bay at the tombolo, ~26.656°N ~111.747°W, from red mangrove prop roots south of the sand spit, 18 Aug 1981, EWI-10, coll. E. W. Iverson (RW02.095). This is a mixed lot containing *P. dianae* and the undescribed *Paradella*.

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