

Terrestrial Isopoda (Crustacea, Oniscidea) from the coasts of Costa Rica, with descriptions of three new species

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Abstract: Seven species of terrestrial isopods are recorded from the coasts of the Pacific and Caribbean sides of Costa Rica. Three species (*Buchnerillo neotropicalis*, *Hawaiioscia nicoyaensis* and *Trichorhina biocellata*) are described as new and two species (*Tylos niveus* and *Armadilloniscus* cf. *carabicus*) are newly recorded from the country. The poorly known species *T. niveus* is also illustrated. At present the total number of terrestrial isopod species recorded from Costa Rica is 30. Interestingly four typical littoral halophilic species (*Ligia baudiniana*, *Tylos wegeneri*, *T. niveus* and *A. cf. carabicus*) are present on both the Pacific coast of Costa Rica and on the coasts of the lands encompassed by the Caribbean Sea. With the sole exception of *A. cf. carabicus*, no morphological differences could be detected from the Pacific and Caribbean populations of those species. Rev. Biol. Trop. 66(Suppl. 1): S187-S210. Epub 2018 April 01.

Key words: Crustacea, Isopods, biodiversity, *Buchnerillo*, *Hawaiioscia*, *Trichorhina*, Gulf of Nicoya, Central America.

Up to date, the diversity of Costa Rican terrestrial isopods is poorly known. Only 25 species in 16 genera and 10 families are presently recorded, numbers that are certainly very small for a tropical country like Costa Rica. Many records are very old, mainly dated in the first half of 1900 (Richardson, 1910, 1913; Arcangeli, 1927, 1930, 1957; Van Name, 1936), while only the families Philosciidae and Scleropactidae have been recently revised by Leistikow (1997a, 1997b, 1998, 2000a, b, 2001) and Schmidt (2007). However, all the records come from sporadic collections. Only few records are known for most of the forested

areas and only two species (*Ligia baudiniana* Milne Edwards, 1840 and *Tylos wegeneri* Vandel, 1952) were reported from the coasts of the country.

This paper deals with recent collections of Oniscidea from both the Pacific and Caribbean coastal areas of Costa Rica, and includes the descriptions of three new species and two new records for the country.

MATERIALS AND METHODS

The specimens included in this paper have been collected in November 2015 on both

sandy and rocky coasts of the Pacific side of Costa Rica. Also included are littoral terrestrial isopods deposited in the collection of the Museo de Zoología, Universidad de Costa Rica (MZUCR), San José. Specimens were collected by hand and stored in 75 % ethanol. The geographic co-ordinates of the locations were taken using WGS84 datum. Identifications are based on morphological characters. For each new species the material examined, description, etymology and remarks are given. For each species already recorded from Costa Rica the bibliographic references, material examined, distribution and remarks (when necessary) are included. Some poorly known species have been illustrated to facilitate future recognition. The taxa are illustrated with figures prepared with the aid of a camera lucida mounted on Wild M5 and M20 microscopes and digitally drawn using the method by Montesanto (2015, 2016). For some species pictures were taken with a Scanning Electron Microscope Hitachi S-3700N.

Abbreviations: BM = The Natural History Museum, London, MZUCR = Museo de Zoología, Escuela de Biología, Universidad de Costa Rica, San José, Costa Rica, MZUF = Museo di Storia Naturale dell'Università, Sezione di Zoologia "La Specola", Florence, Italy.

SYSTEMATIC ACCOUNT

Family Ligiidae Leach, 1814

Genus *Ligia* Fabricius, 1798

Ligia baudiniana Milne Edwards, 1840

Ligia (*Hirtiligia*) *baudiniana*,
Schultz, 1974: 167, figs 122-3.

Ligia baudiniana; Leistikow, 1997a: 1417,
figs. 2-7; Leistikow & Wägele, 1999: 2;
Schmalfuss, 2003: 141.

Material examined: 1 ♂, 2 ♀♀ (MZUF 9684), Playa Pita, S of Tárcoles, Puntarenas, 9°44'32.9" N and 84°37'53.0" W, under logs on a sandy beach, 27.XI.2015, leg. S. Taiti, R. Vargas & J.A. Vargas; 1 ♂ (MZUCR 2580-02), Isla San José, Islas Murciélago,

Guanacaste, 21.IV.2003; 13 ♂♂, 18 ♀♀ (MZUCR 2865-01), Reserva de Cabo Blanco, sector San Miguel, 10.VII.1994, leg. L.A. Mena; 1 ♀ (MZUCR 3154-03), Playa Blanca, Punta Morales, sandy beach, 29.XI. 2011, leg. J.A.Vargas & J. Sibaja, det. R. Vargas; 1 ♂ (MZUCR 1870), Isla Cabuya, Cabo Blanco, 16.XII.1992, leg. L. Mena; 6 ♀♀ (MZUCR 2069-01), Manuel Antonio, Quepos, Aguirre, Puntarenas, 3.IX.1984, leg. B. Morera, det. A. Leistikow; 1 ♂, 1 ♀ (MZUCR 2070-01), same locality, 2.IX.1984, leg. B. Morera, det. A. Leistikow; 3 ♂♂ (MZUCR 2076-01), Sámara, Guanacaste, date?, leg. O. Breedy.

Costa Rican records: Puntarenas (Schultz, 1974). Puntarenas Prov., Corcovado, Punta Salsipuedes; Limón Prov., Punta Cahuita; Isla San Lucas (Leistikow, 1997a).

Distribution: Atlantic and Pacific shores of the Americas from Florida to Brazil and from California to Ecuador, including Galapagos Islands (Schmalfuss, 2003).

Remarks: At present, this is the only species of *Ligia* recorded from both coasts of Costa Rica. The species has been fully redescribed and illustrated by Leistikow (1997a).

Family Tylidae Milne Edwards, 1840

Genus *Tylos* Audouin, 1826

Tylos wegeneri Vandel, 1952

Tylos wegeneri; Schultz, 1983: 682; Leistikow & Wägele, 1999: 4; Schmalfuss & Vergara, 2000: 10; Schmalfuss, 2003: 324.

Costa Rican records: Puntarenas (Schultz, 1983).

Distribution: USA: Florida; Costa Rica: Pacific Coast; Lesser Antilles: Saint Martin; Trinidad; Tobago; Venezuela (Schmalfuss, 2003).

Remarks: *Tylos wegeneri* was recorded from Puntarenas by Schultz (1983). This is the only record of this species for the Pacific coast, while the species seems to be widespread in the Caribbean Sea. However, no records from the Caribbean coast of Costa Rica are known. For a description and figures of this species see Vandel (1952) and Schultz (1970).

Tylos niveus Budde-Lund, 1885
Figs. 1, 2

Material examined: 3 ♂♂ (MZUCR 2867-02), Boca Coronado, manglar Terraba-Sierpe, 3.IX.2008, leg. L. Rolier Lara.

Distribution: Florida; Bahamas; Bermudas; Cuba; Tobago; Bonaire; Dominica; Curazao; Virgin Islands; Puerto Rico; Mexico; Belize; Venezuela; Colombia; Brazil

(Schmalfuss, 2003; Carpio-Díaz, López-Orozco, Herrera-Medina, Navas-S., & Bermúdez, 2016). New record for Costa Rica.

Remarks: The main characters of this species are illustrated in Figs. 1 and 2 to confirm its identification and facilitate future recognition. For a complete list of synonyms of this species see Schmalfuss & Vergara (2000). This is the first record for the Pacific coast.

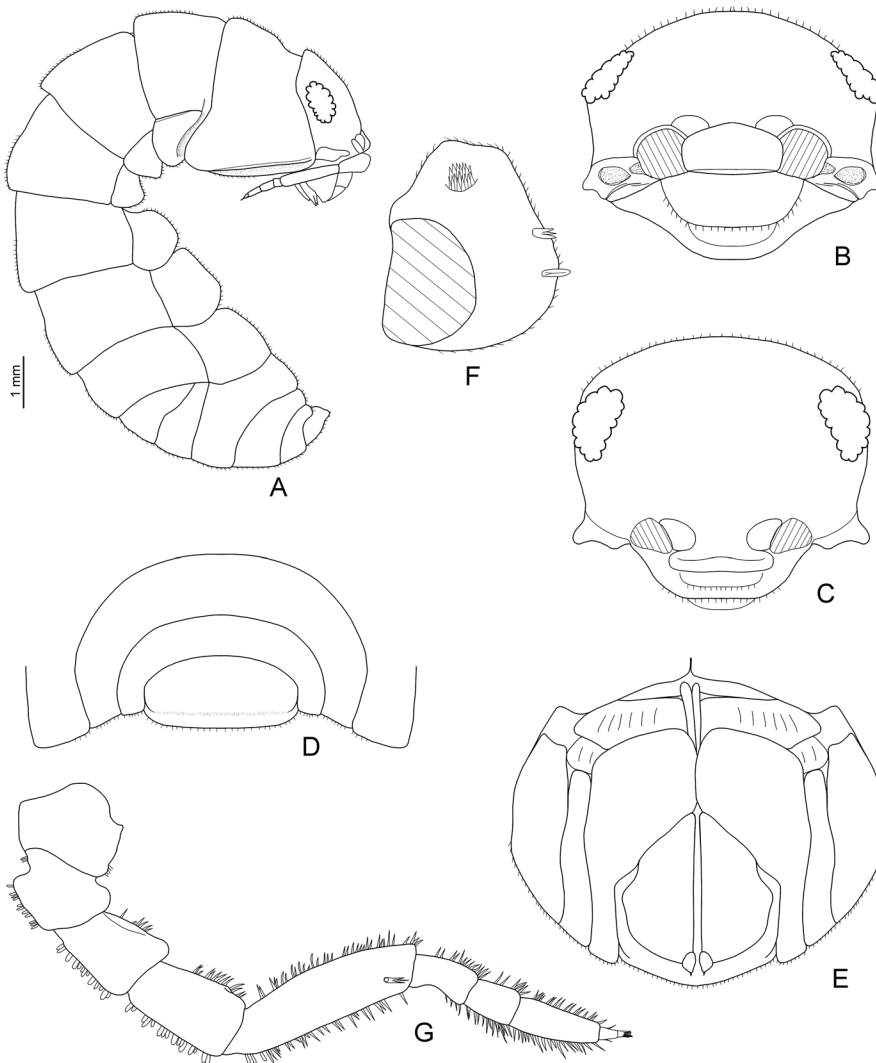


Fig. 1. *Tylos niveus* Budde-Lund, 1885, ♂ from Boca Coronado. **A.** Adult specimen in lateral view; **B.** Cephalon, frontal; **C.** Cephalon, dorsal; **D.** Pleonites 4, 5 and telson, dorsal; **E.** Pleon and uropods, ventral; **F.** Antennula; **G.** Antenna.

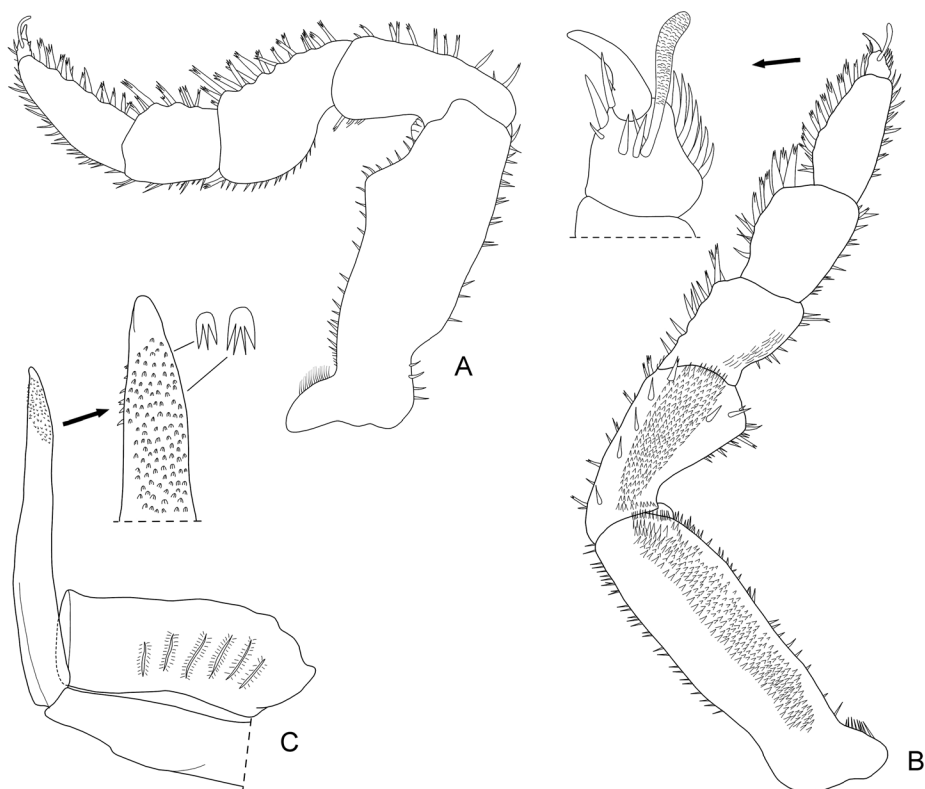


Fig. 2. *Tylos niveus* Budde-Lund, 1885, ♂ from Boca Coronado. A. Pereopod 1; B. Pereopod 7; C. Pleopod 2.

Incertae sedis

Genus *Buchnerillo* Verhoeff, 1942

Buchnerillo neotropicalis n. sp.

Figs. 3-6

Holotype: ♂ (MZUF 9685), Playa Pita, S of Tárcoles, Puntarenas, 9°44'32.9" N and 84°37'53.0" W, sandy beach, under logs, 27.XI.2015, leg. S. Taiti, J.A.Vargas & R. Vargas.

Paratypes: 6 ♀♀ (MZUF 9685), 4 ♀♀ (MZUCR-3529-04), same data as holotype.

Additional material: 2 ♀♀ used for scanning microscope analysis, same data as holotype.

Description: Maximum size: ♂ 1.5 x 0.8 mm; ♀ 1.9 x 1 mm. Colour pale. Animals able to roll up into a perfect ball (Fig. 3A, B). Dorsal body surface covered with tubercles

disposed as follows: five rows on cephalon; three rows on pereonite 1; two rows on pereonites 2 - 7; two rows on pleonites 3 and 4; one row on pleonite 5; four tubercles on telson; each dorsal tubercle apically with one scale-seta (Fig. 3C, D). Cephalon (Fig. 4A, B) with frontal shield grooved, upper margin regularly convex, lower margin sinuous on both sides; eye consisting of 4 ommatidia. Pereonite 1 (Fig. 4B) with semicircular hollow on anterior margin in which ocular lobe fits; postero-lateral corner with schisma, inner lobe rounded and distinctly protruding backwards; posterior margin straight. Pereonites 2 - 4 with triangular epimera. Pereonites 5 - 7 with quadrangular epimera. Pleonites 1 and 2 not visible in dorsal view, pleonite 3 with no visible epimera, pleonite 4 twice as long as pleonite 5 (Fig. 4C). Telson (Fig. 4D) semicircular. Antennula (Fig.

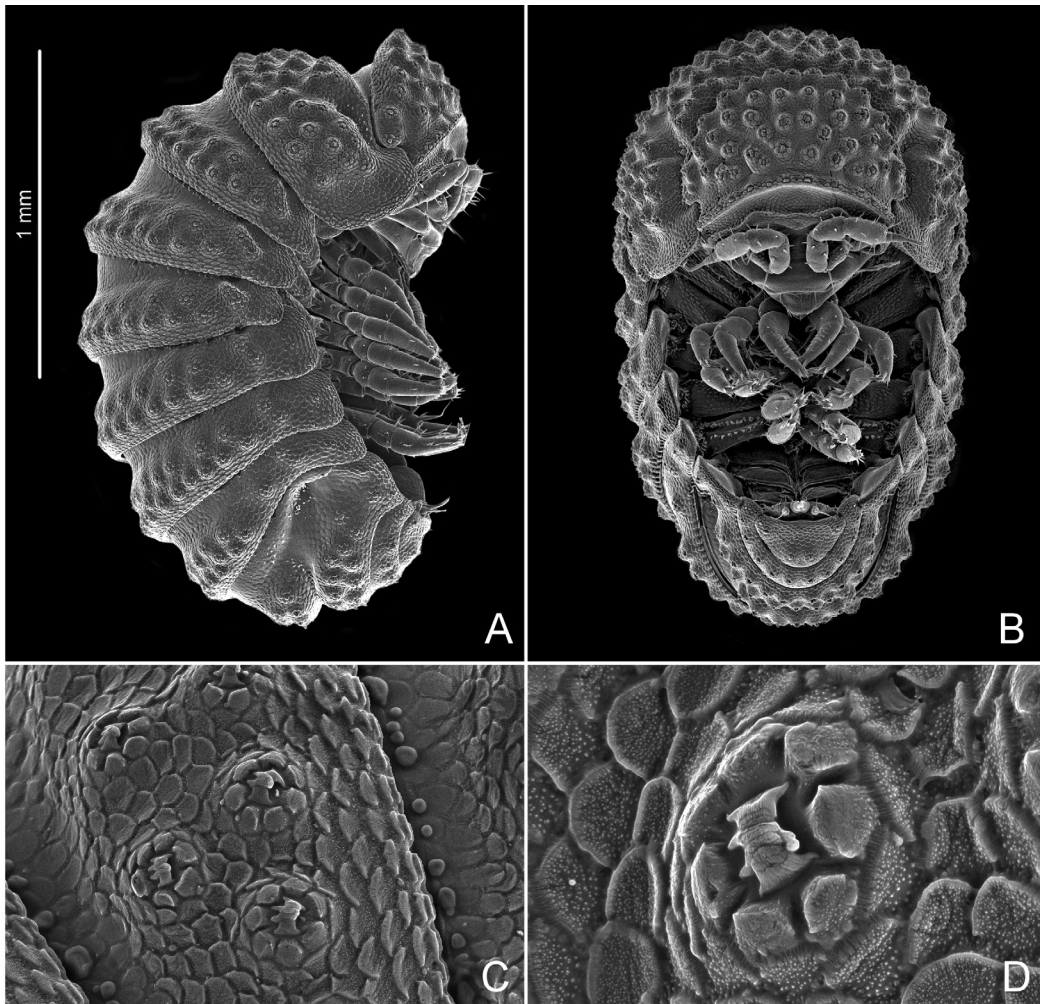


Fig. 3. *Buchnerillo neotropicalis* n. sp. ♀ from Playa Pita. **A.** Adult specimen in lateral view; **B.** Adult specimen in ventral view; **C.** Dorsal tubercles with scale-setae; **D.** Dorsal scale-seta.

5A) of two articles; first article about twice as long as second; second article with two large petaliform aesthetascs at apex. Antenna (Fig. 5B) short and thickset; flagellum of 3 articles, second article bearing 2 aesthetascs. Mandibles (Fig. 5C, D) with molar penicil semidichotomized, left mandible with 2 + 1 free penicils; right mandible with 1 + 1 free penicils. Maxillula (Fig. 5E) inner branch with a few setae at apex but no penicils; outer branch with 4 + 4 teeth, all apically entire, and stalk among outer group of teeth. Maxilla (Fig. 5F) with triangular

distal part bearing thick setae. Maxilliped (Fig. 5G) endite triangular with two subapical stout setae and apical penicil; palp with two setae on first article. Pereopods (Fig. 6A) with one large trifid seta on carpus, long setose dactylar seta and flagelliform unguinal seta; pereopod 7 with water conducting system on basis. Uropod (Fig. 5H) protopod quadrangular; endopod much longer than exopod, both with very long apical setae.

Male: Pereopod 7 (Fig. 6B) with no distinct modifications; ischium sternal margin

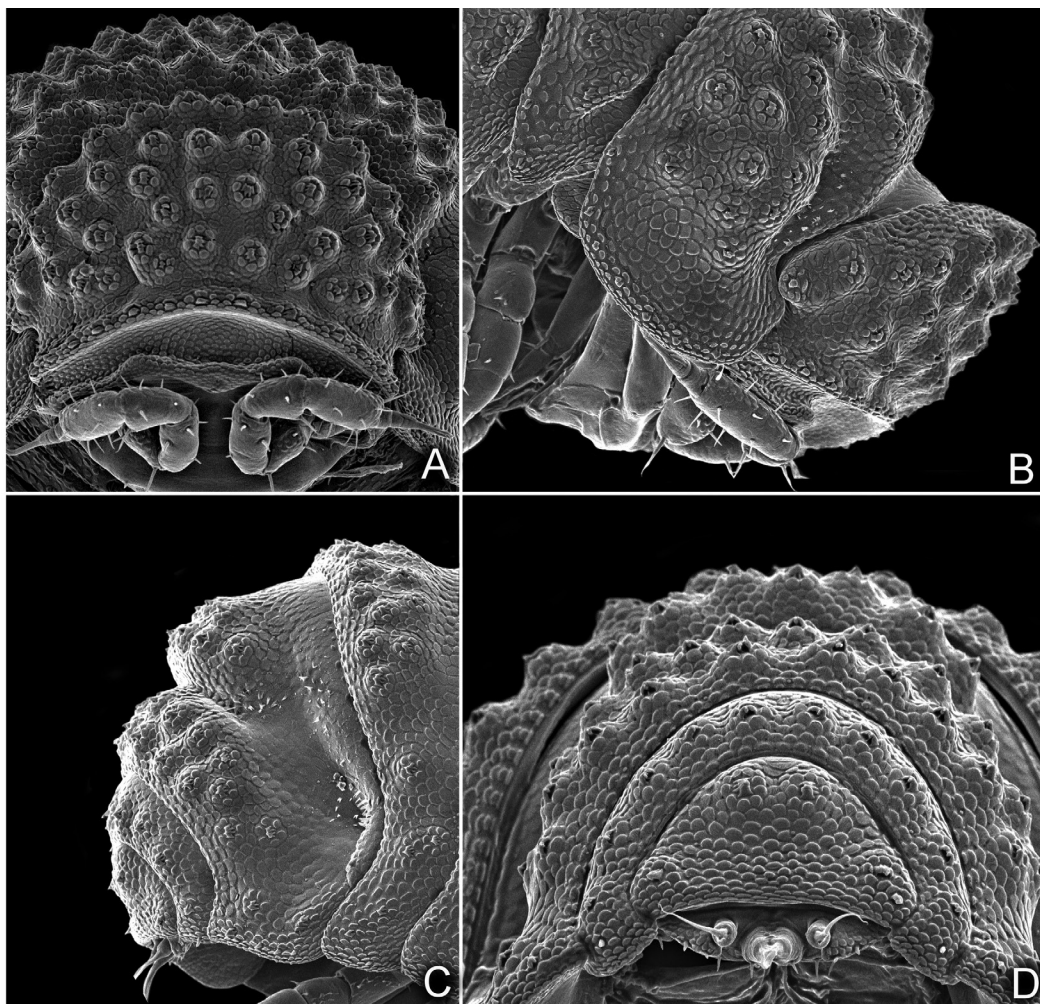


Fig. 4. *Buchnerillo neotropicalis* n. sp. ♀ from Playa Pita. **A.** Cephalon, dorsal; **B.** Cephalon, lateral; **C.** Pereonite 7, pleon and telson, lateral; **D.** Pleon and telson, dorsal.

straight. Pleopod 1 (Fig. 6C) exopod small, ovoidal; endopod very elongated with distal part triangular, straight. Pleopod 2 (Fig. 6D) exopod triangular with one distal hairy seta and some short thin setae on inner and outer margin; endopod of two articles, distal article flagelliform, about 5 times longer than first. Pleopod 3 - 5 exopods as in Fig. 6E-G.

Etymology: The name of the species refers to the localities of collection of the species, the Neotropical Region.

Remarks: The new species is included in *Buchnerillo* since it shows all the characters of the genus: small size; animal able to toll up into a perfect ball; endoantennal conglobation; dorsal surface tuberculated; cephalon with a wide frontal shield; pleonite 3 with epimera reduced; telson semicircular covering the uropods in dorsal view; antenna short and stout with a flagellum of three articles; male pleopod 2 with distal article flagelliform. Up to date, only two species of *Buchnerillo* are known: *B. litoralis*

Verhoeff, 1942 and *B. oceanicus* Ferrara, 1974. The former is known from the shores of the Mediterranean Sea and Madeira (Schmalfuss, 2003); a record of a female specimen from Florida Keys (Paoletti & Stinner, 1989) is very doubtful and the identification needs confirmation. The latter is presently known

from Somalia (Ferrara, 1974) and the Maldives (Taiti, 2014). *Buchnerillo neotropicalis* n. sp. differs from both species in the presence of a schisma on the pereonite 1 with inner lobe distinctly protruding backwards, whereas in *B. litoralis* and *B. oceanicus* a small rounded ventral lobe is present at the postero-lateral corners,

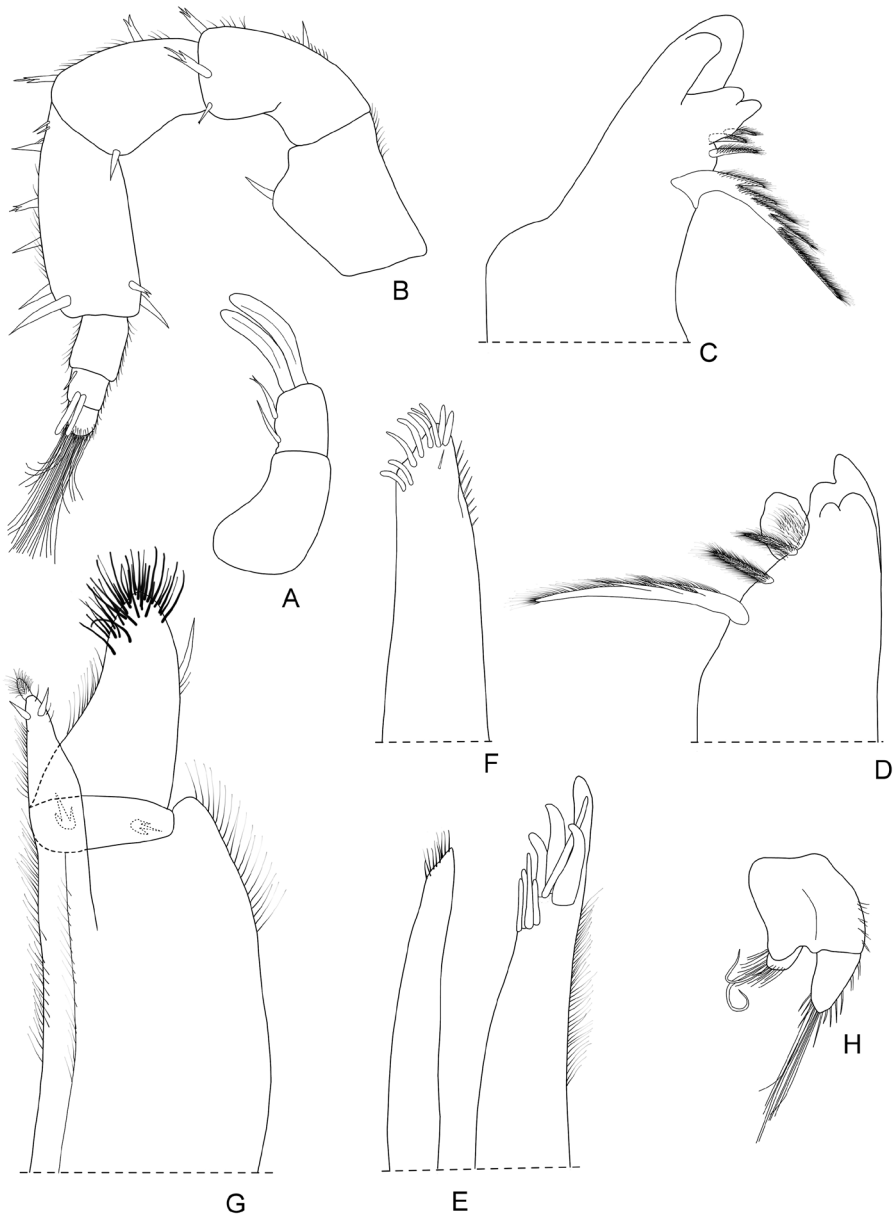


Fig. 5. *Buchnerillo neotropicalis* n. sp. ♀ from Playa Pita. **A.** Antennula; **B.** Antenna; **C.** Left mandible; **D.** Right mandible; **E.** Maxillula; **F.** Maxilla; **G.** Maxilliped; **H.** Uropod.

not protruding backwards. It also differs from *B. litoralis* (see redescription in Vandel, 1960) in having the cephalon with frontal shield grooved, larger eyes (4 ommatidia instead of 1 - 2), dorsal tubercles more prominent and male pleopod 1 endopod with distal part thicker

and straight; from *B. oceanicus* in the frontal shield with lower margin sinuous on both sides instead of regularly curved.

The systematic position of genus *Buchnerillo* is still uncertain. It was included by Vandel (1960) in the section *Synocheta* and family

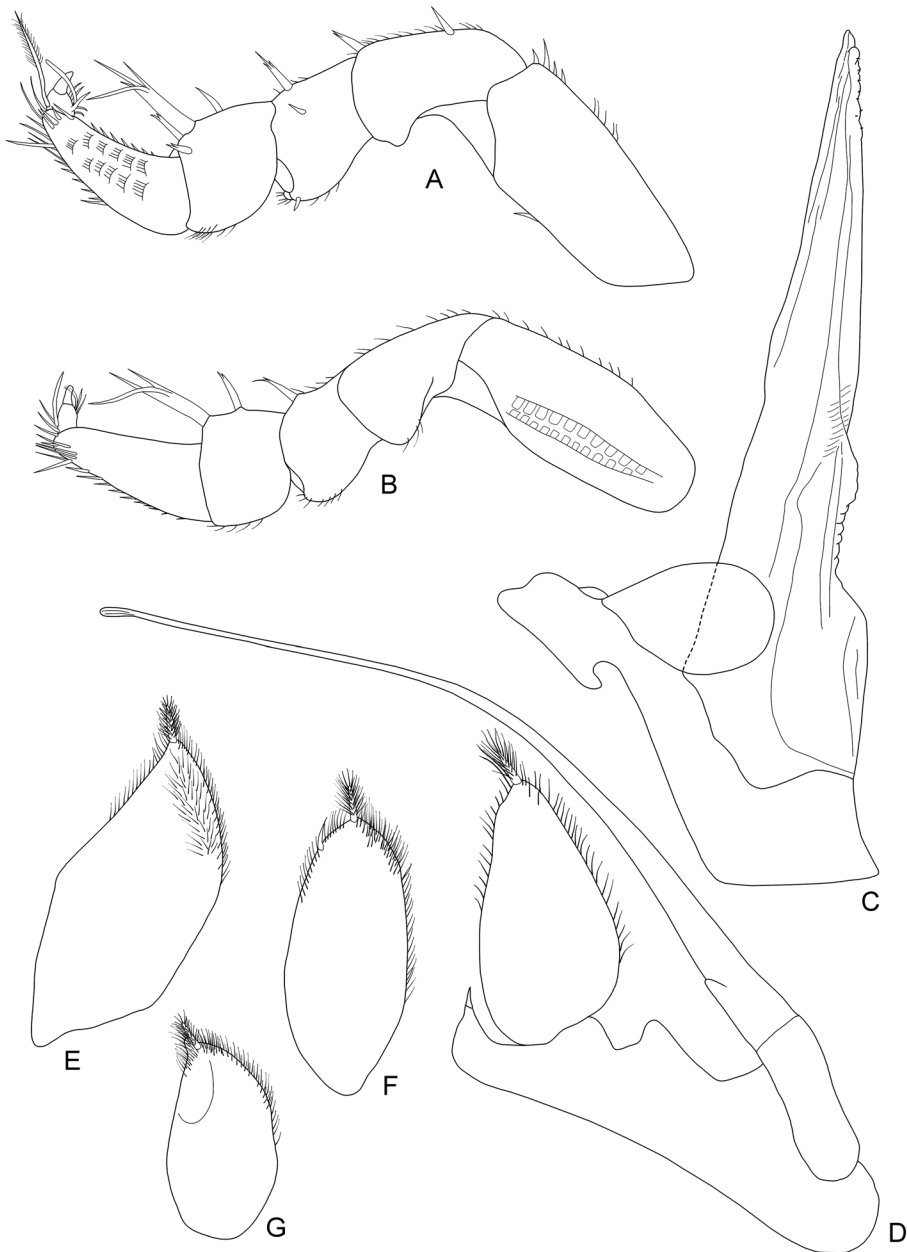


Fig. 6. *Buchnerillo neotropicalis* n. sp. ♂ from Playa Pita. **A.** Pereopod 1; **B.** Pereopod 7; **C.** Pleopod 1; **D.** Pleopod 2; **E.** Pleopod 3 exopod; **F.** Pleopod 4 exopod; **G.** Pleopod 5 exopod.

Buddelundiellidae (now a subfamily of Trichoniscidae). Tabacaru (1993) recognized that the genus does not belong to the Synocheta and Schmalzfuss (2003) included it into the higher Oniscidea (the Crinocheta) and hypothesised that the genus might belong to the family Detonidae, close to the genus *Armadilloniscus*. According to the maxillular endite bearing only some apical setae without penicils, it might also be related to the family Olibrinidae. However, since no safe conclusion can be reached with morphological characters, we still maintain the genus as *incertae sedis* as proposed by Taiti & Ferrara (1991). A molecular analysis might be useful to clarify the family placement of *Buchnerillo*.

Family Detonidae Budde-Lund, 1904
Genus *Armadilloniscus* Uljanin, 1875
Armadilloniscus cf. *caraibicus* Paoletti
& Stinner, 1989
Fig. 7

Material examined: 1 ♀ (MZUF 9687), 1 ♀ used for scanning microscope analysis, Playa Pita, S of Tárcoles, Puntarenas, 9°44'32.9" N and 84°37'53.0" W, beach under logs, 27.XI.2015, leg. S. Taiti, J.A. Vargas & R. Vargas.

Distribution: Venezuela (Paoletti & Stinner (1989). New record for Costa Rica.

Remarks: The two female specimens here examined are morphologically very similar to *Armadilloniscus caraibicus* described by Paoletti & Stinner (1989) for the Caribbean coast of Venezuela. The main characters of the Costa Rican specimens are shown in Fig. 7. They show the same disposition of dorsal tubercles as those from Venezuela (see Figs. 10 and 11 in the original description by Paoletti & Stinner, 1989 and Figs. 32 and 33 in Schmidt, 2002) but they are less developed. Since we have examined only 2 females, we only tentatively identify them as *A. cf. caraibicus*.

Family Philosciidae Kinahan, 1957
Genus *Hawaiioscia* Schultz, 1973
Hawaiioscia nicoyaensis n. sp.
Figs. 8-11

Holotype: ♂ (MZUCR-3529-05), Playa Pita, south of Tárcoles, Puntarenas, 9°44'32.9" N and 84°37'53.0" W, beach under logs, 27.XI.2015, leg. S. Taiti, J.A. Vargas & R. Vargas.

Paratypes: 5 ♂♂, 8 ♀♀ (MZUCR-3529-06), 5 ♂♂, 15 ♀♀, 12 juvs (MZUF 9688), same data as holotype.

Additional material examined: 1 ♂, 1 ♀, used for scanning microscope analysis, same data as holotype.

Description: Maximum size: ♂, 5.8 x 2.5 mm; ♀, 6 x 3 mm. Dorsum dark brown with the usual muscle spots; a large pale spot at base of pereon epimera. Body flat, ovoidal, with pleon narrower than pereon (Fig. 8A, B). Dorsal body surface finely granulated with small triangular scale-setae (Fig. 9A). Pereonites with no sulcus marginalis, gland pores absent. Noduli laterales small (Fig. 9B) but clearly visible, inserted on small tubercles and disposed as follows: two on cephalic vertex, one per side on pereonites 1 - 6 with that on fourth pereonite much more distant from lateral margin of segment, and two per side on pereonite 7 (Fig. 9C-E). Cephalon (Figs. 8C, 9E) with short triangular lateral lobes not protruding frontwards compared with obtuse middle lobe; frontal and supra-antennal lines absent; eyes consisting of 19 - 20 ommatidia. Pleon epimera reduced but with distinct posterior points (Fig. 8A, D). Telson (Fig. 8D) triangular, about twice as wide as long, with slightly concave sides and broadly rounded apex. Antennula (Fig. 9F) of 3 articles, second article slightly shorter than first and third; third article bearing two rows of 3 and 5 aesthetascs each, and 2 apical aesthetascs. Antenna (Fig. 9G) long and thin, reaching back rear margin of pereonite 3; flagellum slightly longer than fifth

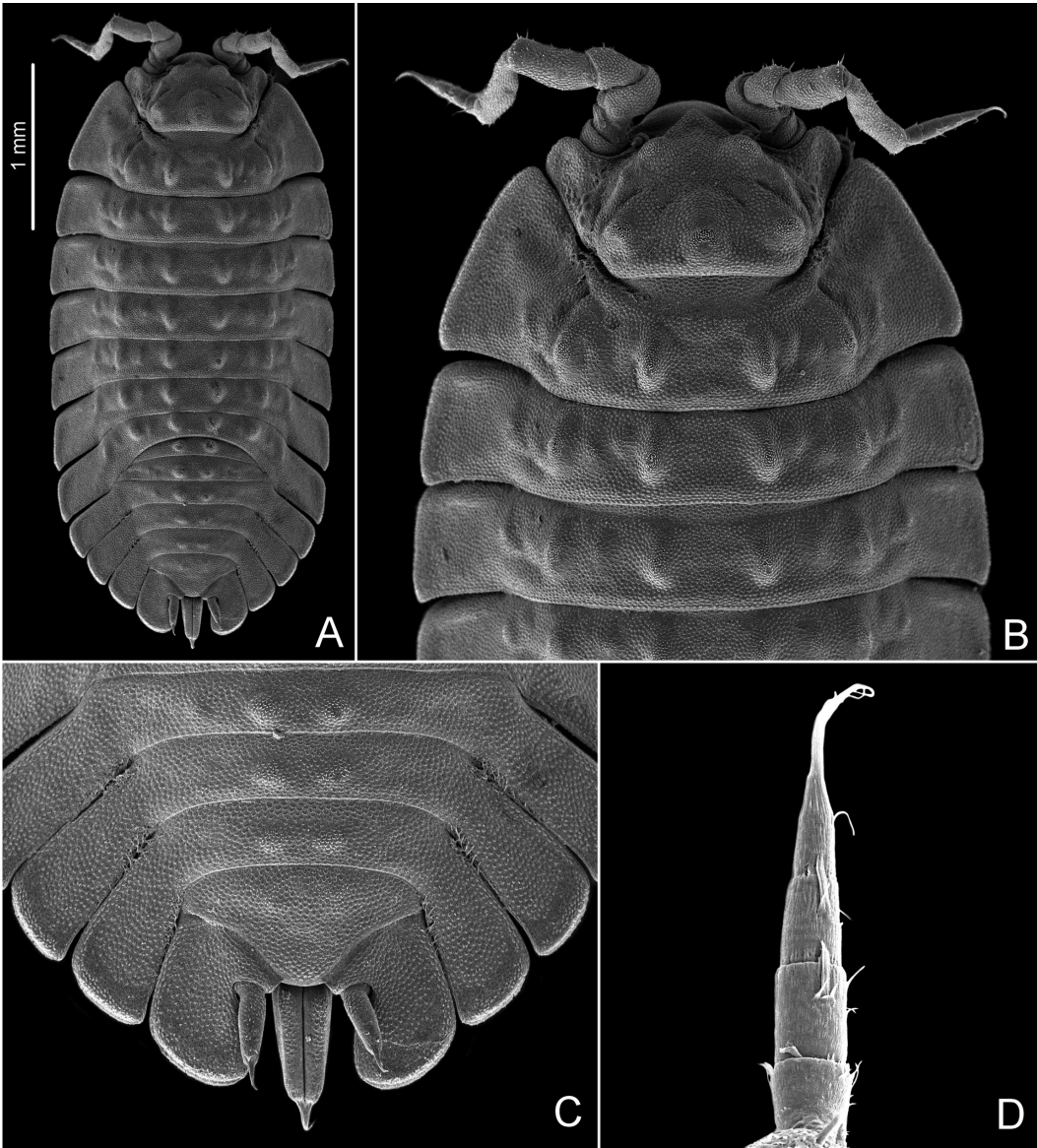


Fig. 7. *Armadilloniscus* cf. *caraibicus* Paoletti & Stinner, 1989. ♀ from Playa Pita. **A.** Adult specimen in dorsal view; **B.** Cephalon and pereonites 1-3, dorsal; **C.** Pleonites 3-5, telson and uropods, dorsal; **D.** Antennal flagellum.

peduncular article, first flagellar article as long as third, second article shortest; one row of 1 - 2 and 3 aesthetascs on each second and third article. Mandibles (Fig. 10A, B) with molar penicil semidichotomized, i.e. consisting of 4 setae on a common stem; left mandible with 2+1 and right mandible with 1+1 free penicils. Maxillula (Fig. 10C) outer branch with 4+6

teeth, all simple and stalk among the outer teeth; inner branch with two stout subequal penicils. Maxilla (Fig. 10D) apically setose and bilobate. Maxilliped (Fig. 10E) endite apically setose and bearing large penicil at medial corner, proximal article of palp bearing 2 strong setae. Pereopods with flagelliform dactylar seta apically slightly enlarged; unguinal seta



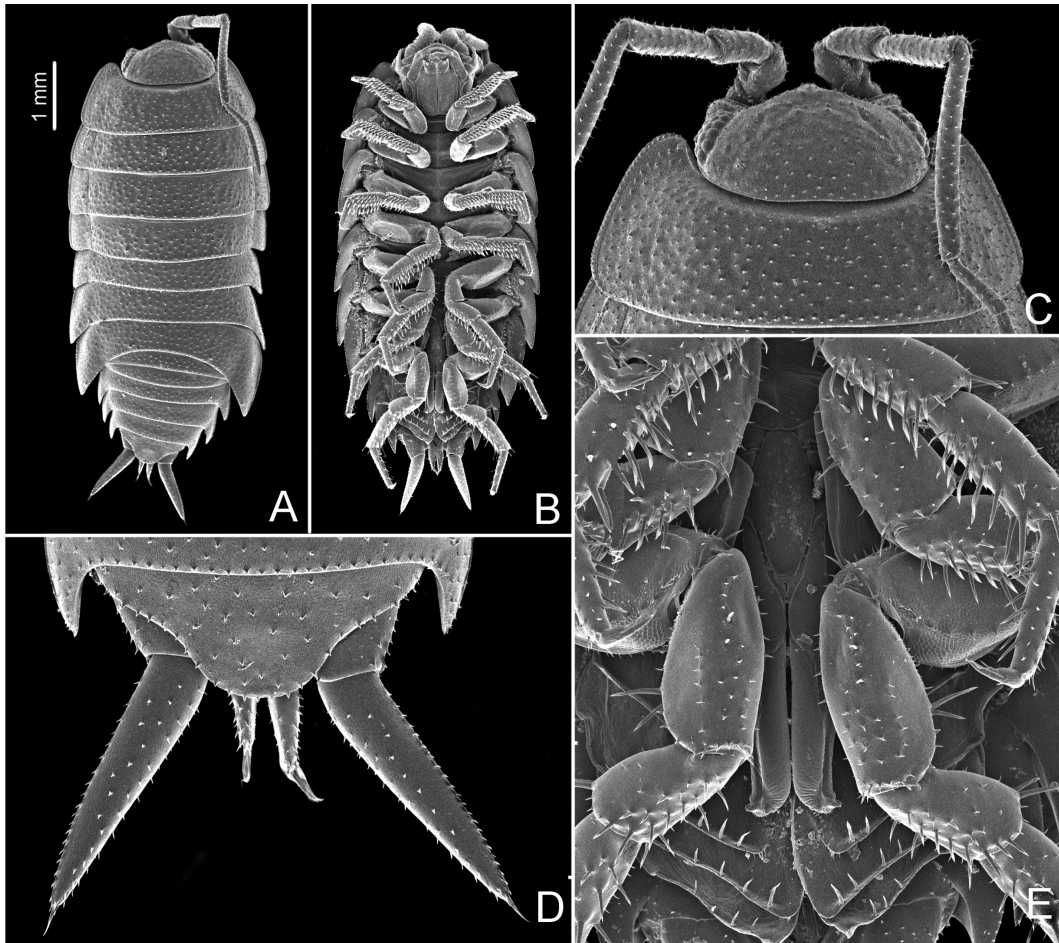


Fig. 8. *Hawaiiioscia nicoyaensis* n. sp. specimens from Playa Pita. **A.** Adult female in dorsal view; **B.** Adult male in ventral view; **C.** Cephalon and pereonite 1, dorsal (♀); **D.** Pleonite 5, telson and uropods, dorsal (♀); **E.** Pleon, ventral (♂).

flagelliform almost reaching tip of outer claw (Fig. 10F). Pleopodal exopods with no trace of respiratory structures. Uropodal protopod grooved on outer margin; insertion of endopod slightly proximal to that of exopod.

Male: Pereopods 1 - 4 (Figs. 8B, 10F) merus and carpus with a brush of trifold spines on sternal margin. Pereopod 7 (Figs. 8E, 11A) ischium with sternal margin slightly convex in middle. Genital papilla as in Fig. 11B. Pleopod 1 (Fig. 11C) exopod cordiform, with broadly rounded apex; endopod with thickset distal part, with bilobed apex. Pleopod 2 (Fig. 11D) exopod triangular, with straight outer margin and very convex medial margin, and bearing 4

setae on outer margin near apex. Pleopods 3 - 5 exopod as in Fig. 11E-G.

Etymology: The name of the species refers to the Gulf of Nicoya, where Playa Pita is located.

Remarks: The new species is included in the genus *Hawaiiioscia* since all the most important characters (number and position of noduli laterales, maxillular teeth, penicil on maxillipedal endite, uropod and shape of male pleopod) correspond to the definition of that genus (see diagnosis in Taiti & Howarth 1997). The genus *Hawaiiioscia* comprises five species from the Hawaiian Islands and Easter Island (Schultz 1973; Taiti & Howarth 1997; Taiti & Wynne,

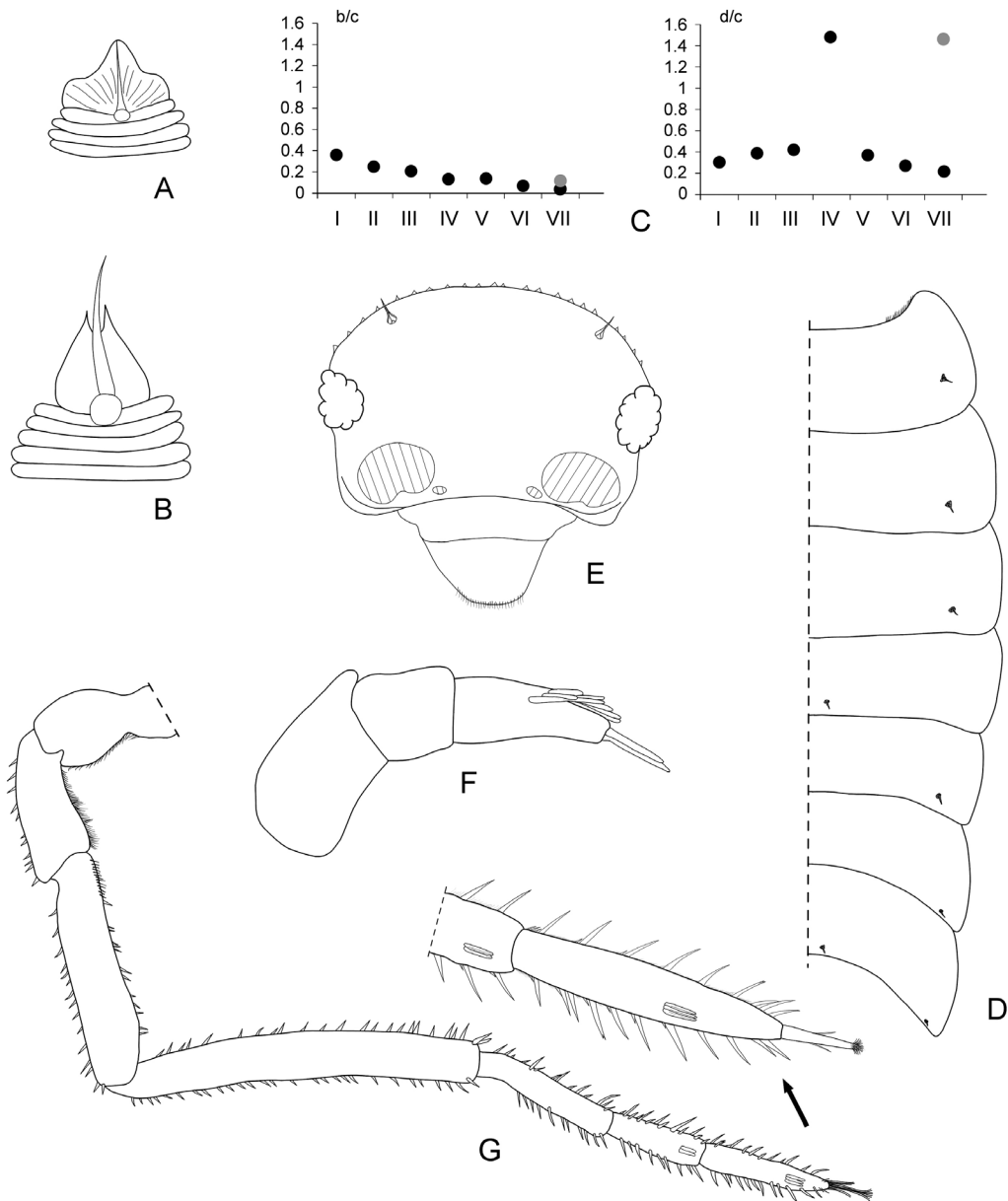


Fig. 9. *Hawaiiioscia nicoyaensis* n. sp. ♀ from Playa Pita. **A.** Dorsal scale-seta; **B.** Nodus lateralis; **C.** B/c and d/c coordinates of noduli laterales; **D.** Pereonites showing position of noduli laterales; **E.** Cephalon, frontal; **F.** Antennula; **G.** Antenna.

2015): *H. parvituberculata* Schultz, 1973 from Maui, *H. microphthalmalma* Taiti & Howarth, 1997 from Oahu, *H. paeninsulae* Taiti & Howarth, 1997 from Molokai, *H. rotundata* Taiti & Howarth, 1997 from Kauai, and *H. rapui* Taiti & Wynne, 2015 from Easter Island. The Hawaiian

species are all cave-dwelling and show troglomorphic traits, such as body depigmentation and eye reduction, while *H. rapui* inhabits cave entrances and does not show distinct troglomorphic traits. *Hawaiiioscia nicoyaensis* is the only littoral halophilic species known so far. The

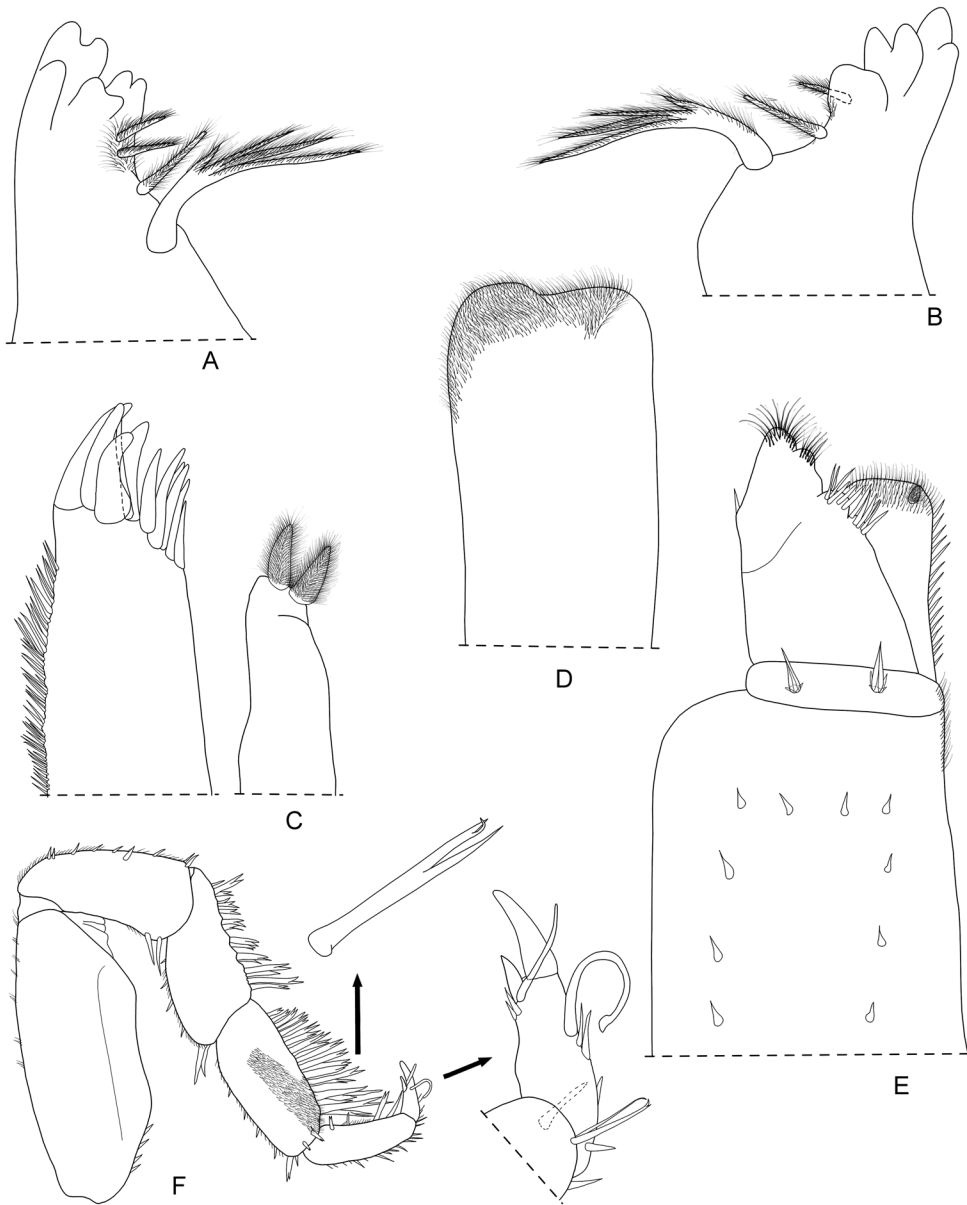


Fig. 10. *Hawaiioscia nicoyaensis* n. sp. ♂ from Playa Pita. **A.** Left mandible; **B.** Right mandible; **C.** Maxillula; **D.** Maxilla; **E.** Maxilliped; **F.** Pereopod 1.

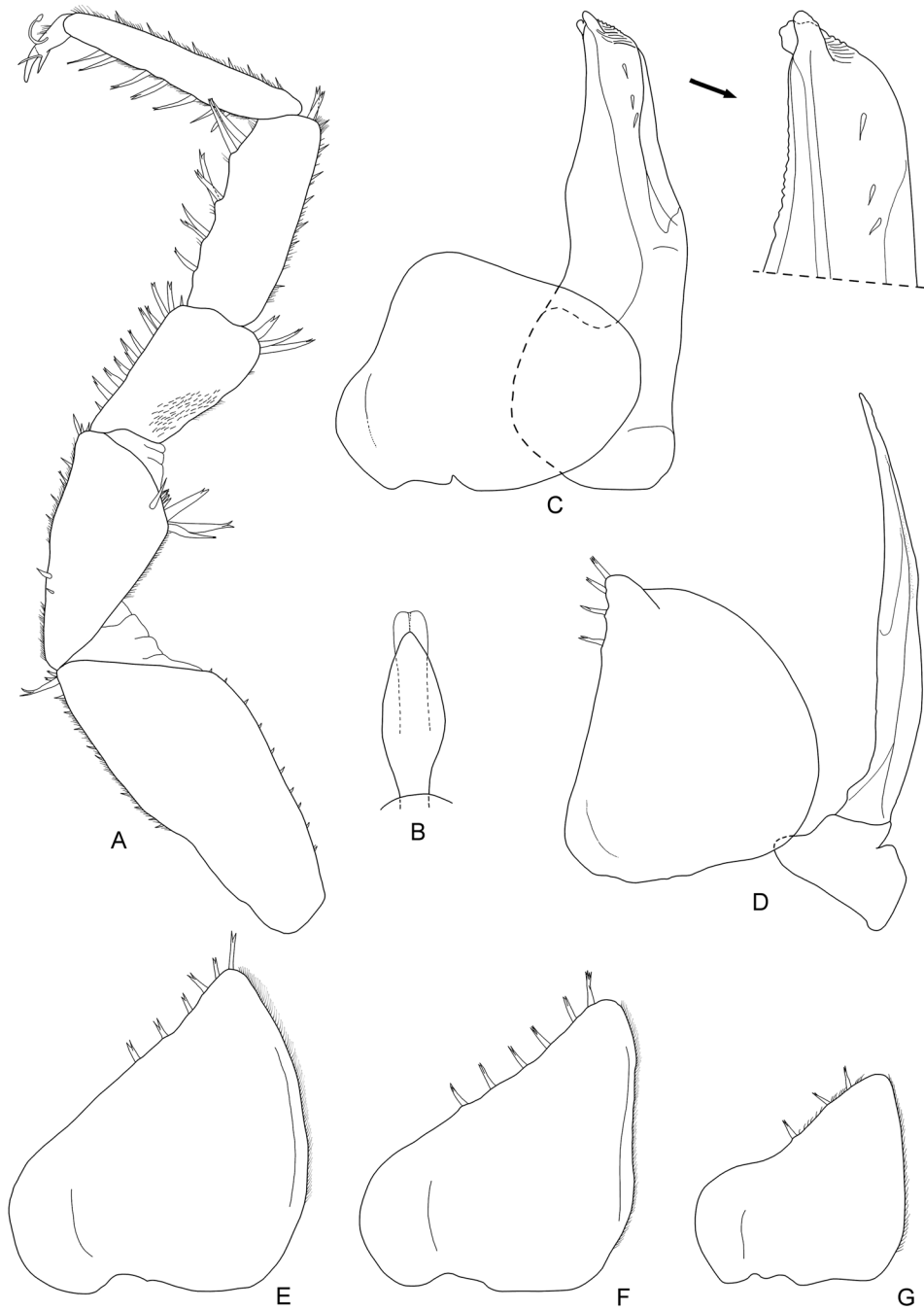


Fig. 11. *Hawatioscia nicoyaensis* n. sp. ♂ from Playa Pita. **A.** Pereopod 7; **B.** Genital papilla; **C.** Pleopod 1; **D.** Pleopod 2; **E.** Pleopod 3 exopod; **F.** Pleopod 4 exopod; **G.** Pleopod 5 exopod.

new species is readily distinguishable from the Hawaiian species by the pigmented body, the eye well developed and in having the molar penicil of the mandible semidichotomized, instead of simple. For this last character, the new species shows closest affinities with *H. rapui* from which it mainly differs in having larger eyes (19 - 20 instead of 8 ommatidia) and in the shape of the male pleopods 1 and 2.

Family Platyarthridae Verhoeff, 1949

Genus *Trichorhina* Budde-Lund, 1908

Trichorhina biocellata n. sp.

Figs. 12-16

Holotype: ♂ (MZUCR-3529-01), Playa Pita, S of Tárcoles, Puntarenas, 9°44'32.9" N and 84°37'53.0" W, beach under logs, 27.XI.2015, leg. S. Taiti, R. Vargas & J.A. Vargas.

Paratypes: 15 ♂♂, 25 ♀♀, 8 juvs (MZUF 9693), same data as holotype; 14 ♂♂, 17 ♀♀ (MZUCR-3529-02), same locality and date, leg. R. Vargas; 7 ♂♂, 10 ♀♀ (MZUCR-3529-03), 8 ♂♂, 13 ♀♀ (MZUF 9694), Bahía de Caldera, Puntarenas, 9°55'26.7" N and 84°42'53.7" W, beach under logs, 27.XI.2015, leg. S. Taiti, R. Vargas & J.A. Vargas; 2 ♂♂ (MZUF 9695), Manuel Antonio, Playa Espadilla, Puntarenas, 9°23'19" N and 84°08'48" W, beach margin, under dead wood, 18.VII.2013, leg. S. Taiti.

Additional material examined: 1 ♂, 1 ♀, used for scanning microscope analysis, same data as holotype.

Description: Maximum size: ♂, 3.5 x 1.5 mm; ♀, 3.2 x 1.5 mm. Dorsum pale brown. Body flat, ovoidal, without interruption between pereon and pleon (Fig. 12A, B). Dorsal body surface covered with spatuliform scale-setae (Fig. 12C). Pereonites with no sulcus marginalis, gland pores absent. Noduli laterales small (Fig. 14A, C), inserted on posterior margin of pereonites, one per side on pereonites 1 - 6 and two per side on pereonite 7. Cephalon (Figs. 12D, 14B) with short rounded lateral lobes not protruding frontwards compared with obtuse middle lobe; frontal and supra-antennal lines absent; eyes consisting of two ommatidia

of same size (Fig. 13A). Pleon epimera well developed, falciform, directed backwards (Fig. 13B). Telson (Fig. 13B) triangular, about twice as wide as long, with slightly concave sides and narrowly rounded apex. Antennula (Fig. 14D) of 3 articles, second article much shorter than first and third; third article bearing tuft of about 8 aesthetascs at apex. Antenna (Figs. 13C, 14E) short, reaching back rear margin of pereonite 2; flagellum as long as fifth peduncular article, second flagellar article almost 3 times longer than first, bearing 2 aesthetascs. Mandibles (Fig. 14F, G) with molar penicil semidichotomized, i.e. consisting of 3 - 4 setae on a common stem; left mandible with 2+1 and right mandible with 1+1 free penicils. Maxillula (Fig. 14H) outer branch with 4+5 (4 slightly cleft) teeth; inner branch with two thin subequal penicils. Maxilla (Fig. 14I) distinctly bilobed, outer lobe slightly smaller than inner lobe, bearing a row of sensilla. Maxilliped (Fig. 15A) endite apically with 2 triangular setae, proximal article of palp bearing 2 strong setae. Pereopods with flagelliform dactylar seta apically slightly enlarged; unguis flagelliform reaching tip of outer claw (Fig. 15B). Pleopodal exopods with no trace of respiratory structures. Uropod: insertion of endopod slightly proximal to that of exopod.

Male: Pereopods 1 - 4 (Figs. 12B, 15B) merus and carpus with a brush of trifid spines on sternal margin. Pereopod 7 (Fig. 15C) ischium with sternal margin slightly sinuous. Genital papilla as in Fig. 16A. Pleopod 1 (Fig. 16B) exopod rounded, about twice as wide as long; endopod with distal part slightly bent medially, with triangular apex. Pleopod 2 (Fig. 16C) exopod triangular, with straight outer margin bearing 3 setae; endopod distinctly longer than exopod. Pleopods 3 - 5 exopod as in Fig. 16D-F.

Etymology: Latin: *bi* = double + *ocellatus* = having eyes. The name refers to the eye consisting of two ocelli of the same size.

Remarks: The new species belongs to the *tomentosa*-group of *Trichorhina* characterized by the presence of two noduli laterales per side on the pereonite 7. This group includes with

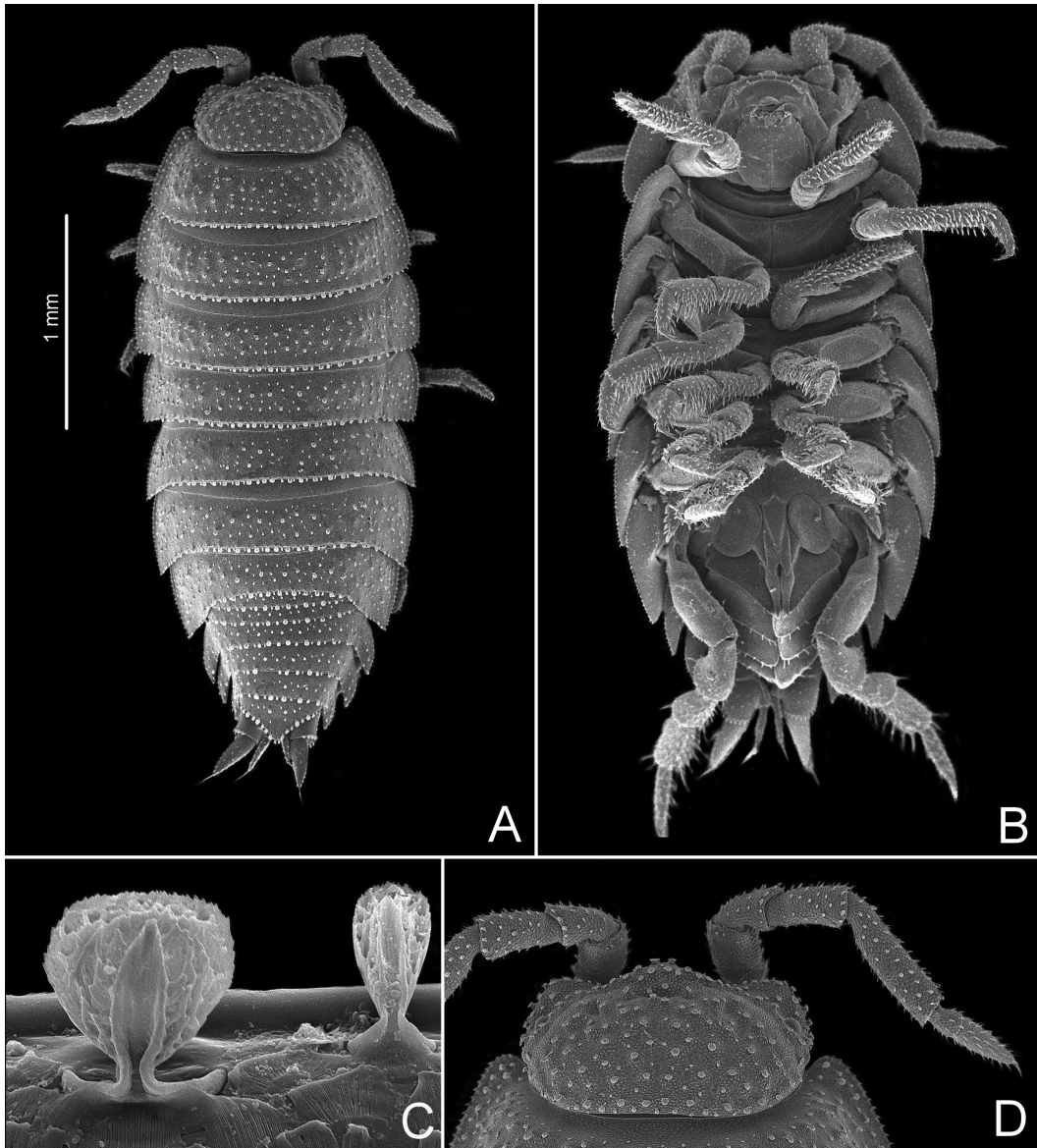


Fig. 12. *Trichorhina biocellata* n. sp. specimens from Playa Pita. **A.** Adult female in dorsal view; **B.** Adult male in ventral view; **C.** Dorsal scale-setae (♀); **D.** Cephalon, dorsal (♀).

certainly *T. tomentosa* (Budde-Lund, 1893), *T. heterophthalma* Lemos de Castro, 1964, both widespread in the tropics, and *T. guanophila* Souza-Kury, 1993 from Brazil. The new species is readily distinguished from all these species by the eye consisting of two ommatidia of equal size (one in *T. tomentosa*, two unequal ommatidia in *T. heterophthalma*, and five in

T. guanophila); from *T. guanophila* also in the male pleopod 1 exopod wider than long.

Two more species of *Trichorhina* are recorded from Costa Rica by Arcangeli (1930): *T. giannellii* Arcangeli, 1929, known also from Cuba, and *T. marianii* Arcangeli, 1930. From their original descriptions no information is present on the number and position of the

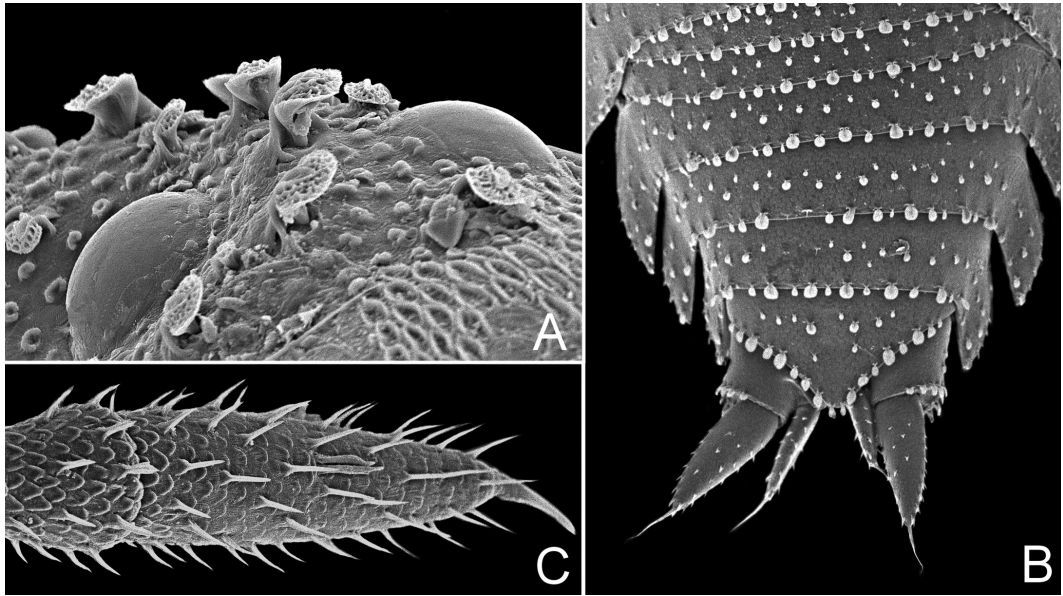


Fig. 13. *Trichorhina biocellata* n. sp. ♀ from Playa Pita. **A.** Eye; **B.** Pleon, telson and uropods, dorsal; **C.** Antennal flagellum.

noduli laterales, so we do not know if they belong to the *tomentosa*-group. *Trichorhina biocellata* n. sp. differs from these two species in the eye with only two ommatidia (four or five in *T. giannellii* and 10 in *T. marianii*).

DISCUSSION

In the present study seven species of terrestrial isopods are recorded from sandy and rocky shores of both coasts of Costa Rica. Three species (*Buchnerillo neotropicalis*, *Hawaiioscia nicoyaensis* and *Trichorhina biocellata*) are described as new and two species (*Tylos niveus* and *Armadilloniscus* cf. *caraibicus*) represent new records for Costa Rica. The total number of Oniscidean species presently known from Costa Rica increases from 25 to 30 (Table 1).

Six species are strictly littoral, halophilic: *L. baudiniana*, *T. wegeneri*, *T. niveus*, *B. neotropicalis* n. sp., *A.* cf. *caraibicus*, and *H. nicoyaensis* n. sp. All these species, with the exception of *H. nicoyaensis* and *B.*

neotropicalis, occur on both the Pacific and Caribbean coasts of Costa Rica or in other countries along the Atlantic coast of the Americas. No morphological differences could be detected from the Pacific and Caribbean populations of these species; only *A.* cf. *caraibicus* from Playa Pita on the Pacific coast showed small differences in the less developed dorsal ornamentation, even if of the same type, from the original specimens described from the Caribbean coast of Venezuela. It will be quite interesting to check both the Pacific and Caribbean populations of these five species with molecular markers to see if there is a cryptic diversity between them, as revealed in other littoral isopods, e.g. in *Excirolana braziliensis* Richardson, 1912, Cirolanidae (Hurtado et al., 2016), considering that the isthmus of Panama was definitely closed 2.8 Ma (O’Dea et al., 2016).

An interesting discovery was the new species of *Hawaiioscia* inhabiting the sandy shore of the Pacific side. The genus was previously known only from troglomorphic cave-dwelling

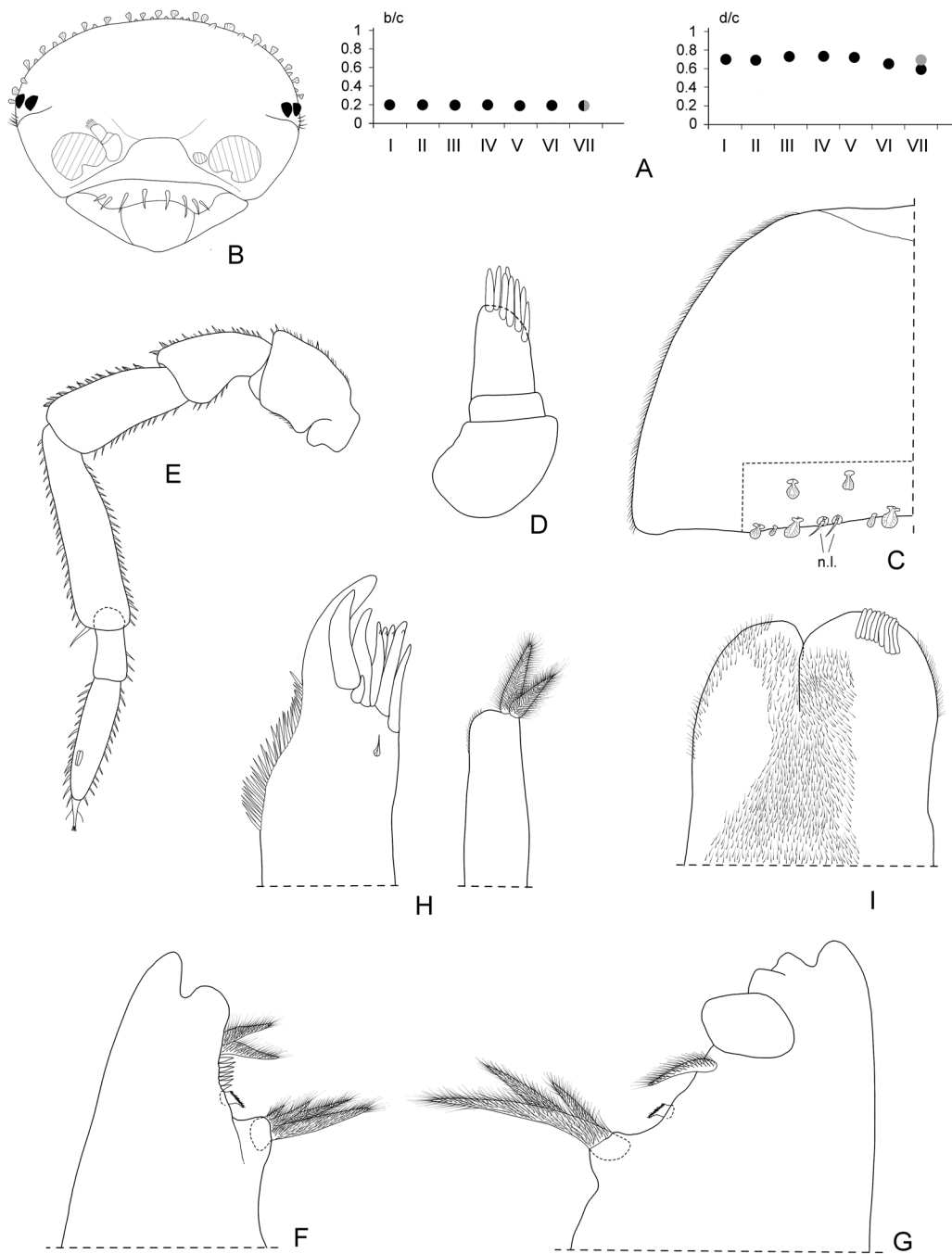


Fig. 14. *Trichorhina biocellata* n. sp. ♂ from Playa Pita. **A.** B/c and d/c coordinates of noduli laterales; **B.** Cephalon, frontal; **C.** Epimeron of pereonite 7 showing noduli laterales (n.l.); **D.** Antennula; **E.** Antenna; **F.** Left mandible; **G.** Right mandible; **H.** Maxillula; **I.** Maxilla.

species in the Hawaiian Islands and a troglomorphic species from Easter Island. The number of species of Oniscidea from littoral areas of

Costa Rica will certainly increase as soon as all the coasts on both sides of the country will be properly investigated.

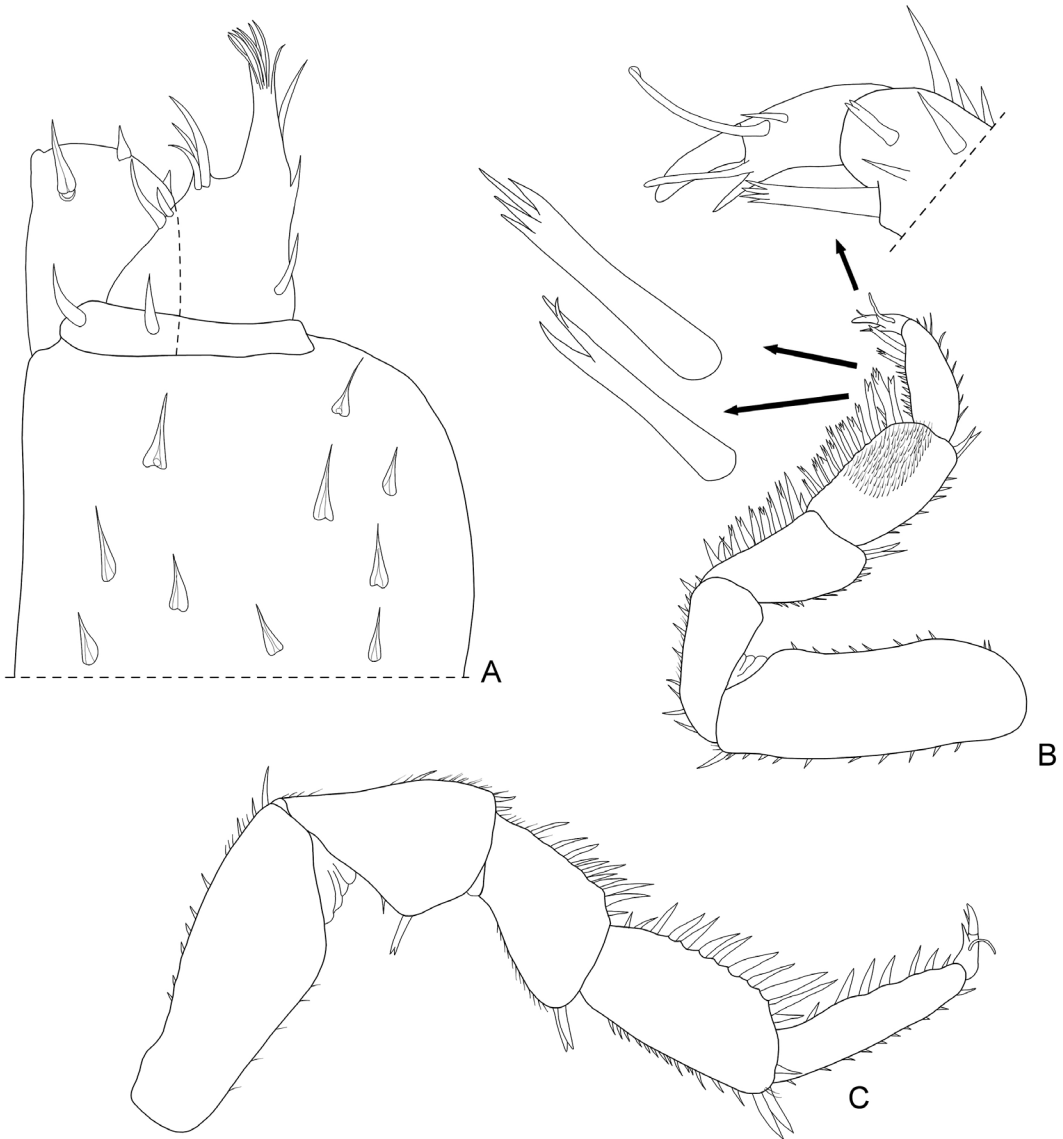


Fig. 15. *Trichorhina biocellata* n. sp. ♂ from Playa Pita. A. Maxilliped; B. Pereopod 1; C. Pereopod 7.

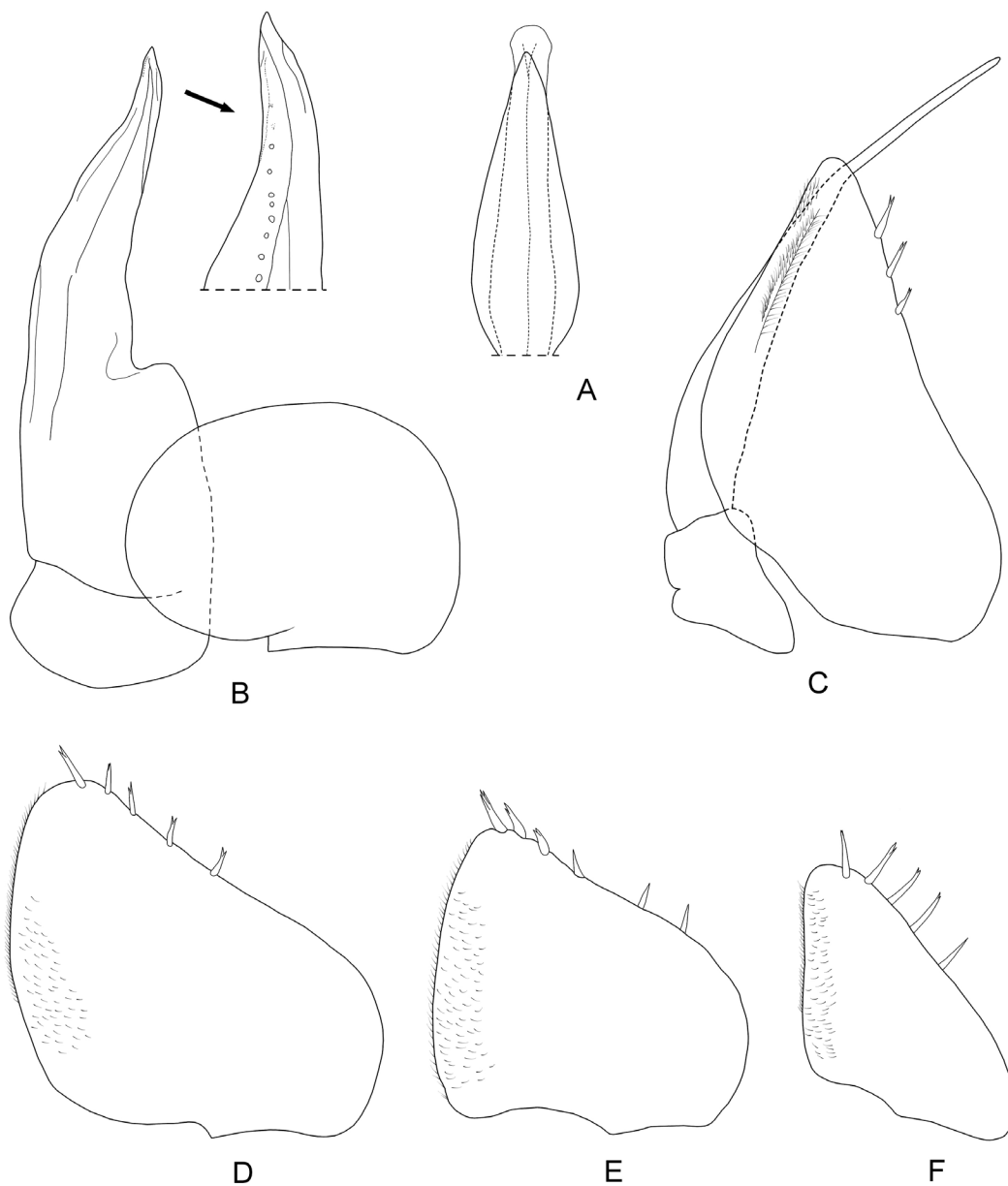


Fig. 16. *Trichorhina biocellata* n. sp. ♂ from Playa Pita. **A.** Genital papilla; **B.** Pleopod 1; **C.** Pleopod 2; **D.** Pleopod 3 exopod; **E.** Pleopod 4 exopod; **F.** Pleopod 5 exopod.

TABLE 1
Species of terrestrial isopods recorded from Costa Rica

	Species	Family	Costa Rican records	Distribution
1	<i>Ligia baudiniana</i> Milne-Edwards, 1840	Ligidae	Puntarenas (Schultz, 1974). Corcovado, Punta Salsipuedes; Punta Cahuita; Isla San Lucas (Leistikow, 1997a). Manuel Antonio, Playa Espadilla, Puntarenas; Manuel Antonio, Quepos, Aguirre, Puntarenas; Playa Pita, S of Tárcoles, Puntarenas; Isla San José, Islas Muriélago, Guanacaste; Sámara, Guanacaste; Reserva de Cabo Blanco, sector San Miguel; Playa Blanca, Punta Morales, playa Arenosa; Isla Cabuya, Cabo Blanco (new records)	Atlantic and Pacific shores of America from Florida to Ecuador, including Galapagos Islands
2	<i>Tylos wegeneri</i> Vandel, 1952	Tyloidae	Puntarenas (Schultz, 1983)	Florida; Costa Rica; Lesser Antilles; Trinidad; Tobago; Venezuela
3	<i>Tylos niveus</i> Budde-Lund, 1885	Tyloidae	Boca Coronado, manglar Terraba-Sierpe (new record)	Florida; Bahamas; Bermudas; Cuba and other Caribbean islands; Mexico; Belize; Venezuela; Puerto Rico; Colombia; Brazil
4	<i>Clavigeroniscus riquieri</i> (Arcangeli, 1930)	Stylonomiscidae	Puente de Las Mulas; Orijinaco; San José (Arcangeli, 1930)	Panropical
5	<i>Buchnerillo neotropicalis</i> n. sp.	Incertae sedis	Playa Pita, S of Tárcoles, Puntarenas; Tortuguero, Limón (new records)	Costa Rica
6	<i>Armadilloniscus</i> cf. <i>carabicus</i> Paoletti & Stummer, 1989	Detonidae	Playa Pita, S of Tárcoles, Puntarenas (new record)	Venezuela; Costa Rica
7	" <i>Chaetophiloscia</i> " <i>gatunensis</i> (Van Name, 1926)	Philosciidae	Apaican (Arcangeli, 1930)	Costa Rica; Panama; ? Brazil
8	<i>Hawaiioscia nicoyensis</i> n. sp.	Philosciidae	Playa Pita, S of Tárcoles, Puntarenas (new record)	Costa Rica
9	<i>Ischioscia cadaoangelis</i> Leistikow, 2000	Philosciidae	Heredia, Caida el Angel, Vara Blanca; Cartago, Tapanti (Leistikow, 2000a)	Costa Rica
10	<i>Ischioscia elongata</i> Leistikow, 1997	Philosciidae	Planton (Richardson 1913; Leistikow, 1997a). Alajuela, Volcán Poás (Leistikow, 2000a)	Costa Rica
11	<i>Ischioscia marmorata</i> Leistikow, 2000	Philosciidae	Guanacaste, Volcán Tenorio (Leistikow, 2000a)	Costa Rica
12	<i>Ischioscia martiniae</i> Leistikow, 1997	Philosciidae	Cordillera de Talamanca, Valle de Coto Bruz, Altamira; Cordillera de Tilarán, Monteverde Cloud Forest Reserve; San Isidro de El General, Coronado (Leistikow, 1997a), Monteverde (Leistikow, 2000a)	Costa Rica
13	<i>Ischioscia muelleri</i> Leistikow, 1997	Philosciidae	Cervantes (Leistikow, 1997a). San Isidro, Coronado, Heredia, Cerro Zurquí; Alajuela, Volcán Poás (Leistikow, 2000a)	Costa Rica
14	<i>Ischioscia plurimaculata</i> Leistikow, 2000	Philosciidae	Guanacaste, Santa Rosa, Braulio Carrillo; Cartago, Orosi, El Cedral; Cartago, Turrialba (Leistikow, 2000a)	Costa Rica
15	<i>Ischioscia quadrispinis</i> Leistikow, 2000	Philosciidae	Heredia, Cerro Zurquí (Leistikow, 1997b)	Costa Rica
16	<i>Mirrana costaricensis</i> Leistikow, 1997	Philosciidae	Heredia, Cerro Zurquí (Leistikow, 1997b)	Costa Rica

TABLE 1 (Continued)

	Species	Family	Costa Rican records	Distribution
17	<i>Pentoniiscus pruinosus</i> Richardson, 1913	Philoosciidae	La Estrella; La Mica, south of Orosí; Pithaya, south of Cartago (Richardson, 1913). San José; San Juan; Apaican; Volcán Irazú; Puente de las Mulas; Tuis (Arcangeli, 1930)	Costa Rica
18	<i>Pentoniiscus vargasae</i> Leistikow, 1998	Philoosciidae	San José, Parque Nacional Braulio Carrillo (Leistikow, 1998)	Costa Rica
19	<i>Colomboniscus tristani</i> (Arcangeli, 1930)	Scleropactidae	Puente de Las Mulas (Arcangeli, 1930; Van Name, 1936). San José; San Juan; La Palma; Orjuaico; Apaican; Volcán Irazú; faldas Volcán Irazú (Arcangeli, 1930). San José; Orjuaico (= Orjuaico); "Fed. Hort. Board" (Schmidt, 2007)	Costa Rica; Venezuela
20	<i>Globopactes talamancensis</i> (Leistikow, 1997)	Scleropactidae	Cordillera de Talamanca, Valle de Coto Bruz, Altamira (Leistikow, 1997a; Schmidt, 2007). Corte Punta Burca; Corcovado, Sirena (Leistikow, 1997a)	Costa Rica
21	" <i>Scleropactes</i> " <i>esherae</i> Arcangeli, 1930	Scleropactidae	La Palma (Arcangeli, 1930)	Costa Rica
22	<i>Navamundoniscus baldonii</i> (Arcangeli, 1930)	Dubioniscidae	San José (Arcangeli, 1930)	Costa Rica
23	<i>Trichorhina giannellii</i> Arcangeli, 1929	Platyarthridae	Puente de Las Mulas; San José; Orjuaico; Apaican; faldas Volcán Irazú; San Juan (Arcangeli, 1930)	Cuba; Costa Rica
24	<i>Trichorhina mariani</i> Arcangeli, 1930	Platyarthridae	Puente de Las Mulas; San José; faldas Volcán Irazú; San Juan (Arcangeli, 1930)	Costa Rica
25	<i>Trichorhina biocellata</i> n. sp.	Platyarthridae	Playa Pita, S of Tárcoles, Puntarenas (new record)	Costa Rica
26	<i>Nagurus cristatus</i> (Dollfus, 1889)	Trachelipodidae	Puerto Limón (Budde-Lund, 1908; Arcangeli, 1930). San José; Puente de Las Mulas (Arcangeli, 1930)	Panropical; greenhouses in temperate climates
27	<i>Porcellionides pruinosus</i> (Brandt, 1833)	Porcellionidae	Turrubales (Richardson, 1910). San José; Apaican (Arcangeli 1930)	Cosmopolitan species of Mediterranean origin
28	<i>Synarmadillo tristani</i> (Richardson, 1910)	Armadillidae	Road between Juan Vías and Reventazón; Turrialba (Richardson, 1910). San José (Arcangeli, 1930)	Costa Rica
29	<i>Venezillo grenadensis</i> (Budde-Lund, 1893)	Armadillidae	San José (Arcangeli, 1930)	Grenada; Costa Rica; Cuba; Colombia; Venezuela
30	<i>Venezillo gigas</i> (Miers, 1877)	Armadillidae	San José (Leistikow, 1997a)	Nicaragua; Costa Rica; ? Colombia

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RESUMEN

Isopoda terrestre (Crustacea, Oniscidea) de las costas de Costa Rica, con descripciones de tres nuevas especies. Siete especies de isópodos terrestres están documentadas para las costas del Pacífico y Caribe de Costa Rica. Tres especies nuevas (*Buchnerillo neotropicalis*, *Hawaiioscia nicoyaensis* y *Trichorhina biocellata*) son descritas en este estudio y dos especies (*Tylos niveus* y *Armadilloniscus cf. caraibicus*) son nuevos hallazgos para Costa Rica. Se ilustra la poco conocida *T. niveus*. En el presente el número total de isópodos terrestres registrados para Costa Rica es de 30 especies. Es interesante que las cuatro especies típicas litorales halofílicas (*Ligia baudi-niana*, *Tylos wegeneri*, *T. niveus* y *A. cf. caraibicus*) están presentes en la costa Pacífica de Costa Rica y también en el Caribe de Costa Rica y de otros países. Con excepción de *A. cf. caraibicus*, no se encontró diferencias morfológicas en poblaciones de estas especies entre el Pacífico y el Caribe de Costa Rica.

Palabras clave: Crustacea, Isopoda, Oniscidea, biodiversidad, playas, *Buchnerillo*, *Hawaiioscia*, *Trichorhina*, América Central.

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