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A NEW SPECIES OF *PSEUDARMADILLO* SAUSSURE, 1857 (ISOPODA: ONISCIDEA: DELATORREIDAE) FROM THE WESTERNMOST POINT OF CUBA

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Abstract: A new species of the woodlice genus *Pseudarmadillo* Saussure, 1857 is described from the Guanahacabibes Peninsula, near the westernmost point of mainland Cuba. It can be readily distinguished from its congeners by its weakly developed ornamentation on pereionite VII, body coloration and differences in external male reproductive organs. This population represents the westernmost record of the family Delatorreidae Verhoeff, 1938 in the Cuban archipelago, being about 78 km from the nearest record.
Key words: Crustacea, Malacostraca, terrestrial isopod, threatened species, Guanahacabibes Peninsula, West Indies.

Una especie nueva de *Pseudarmadillo* Saussure, 1857 (Isopoda: Oniscidea: Delatorreidae) del extremo más occidental de Cuba
Resumen: Se describe una especie nueva de cochinilla del género *Pseudarmadillo* Saussure, 1857 de la Península de Guanahacabibes, próximo al extremo más occidental de la isla de Cuba. Esta especie se puede distinguir fácilmente de sus congéneres por su ornamentación pobremente desarrollada en el pereionito VII, coloración y diferencias en los órganos reproductores externos de los machos. Esta población representa el registro más occidental de la familia Delatorreidae Verhoeff, 1938 en el archipiélago cubano, pues se encuentra alrededor de 78 km del registro más cercano.
Palabras clave: Crustacea, Malacostraca, isópodo terrestre, especie amenazada, Península de Guanahacabibes, Las Antillas.

Taxonomy/Taxonomía: *Pseudarmadillo inornatus* **n. sp.**

Introduction

The family Delatorreidae Verhoeff, 1938 (Isopoda: Oniscidea) comprises some of the most ornamented woodlice of the world (Armas & Juarrero de Varona, 1999; Juarrero de Varona & Armas, 2003a, b; Armas & Rodríguez-Cabrera, 2016). This family contains 18 living species in two genera: *Pseudarmadillo* Saussure, 1857 (16 spp.) and *Cuzcodinella* Armas & Juarrero de Varona, 1999 (2 spp.; Armas & Juarrero de Varona, 1999; Juarrero de Varona & Armas, 2003a, b; Armas & Rodríguez-Cabrera, 2016); although several new species are currently awaiting formal description (L.F. de Armas & T.M. Rodríguez-Cabrera, in prep.). Living representatives of this family are almost exclusive of the Cuban archipelago, with the exception of the widespread *P. carinulatus* Saussure, 1857 which also occurs on Andros Is., Bahamas (Armas & Juarrero de Varona, 1999). Two fossil Hispaniolan species (*P. cristatus* and *P. tuberculatus*) were described by Schmalfuss (1984), however, some characters (*e.g.*, five eye ommatidia instead of six, different morphological pattern of uropods and male pleopods, etc.) suggest that its placement within the genus *Pseudarmadillo* deserves further analysis.

This woodlice group is highly habitat-specific, being restricted to relatively well-preserved wooden conditions on karstic zones; no records outside karstic areas exist. Such characteristics combined with their poor dispersal abilities have favored high species diversification and endemism at local level: 94% are Cuban endemic and about 90% are known only from a single or two localities less than 30 km apart (Armas & Juarrero de Varona, 1999; Juarrero de Varona & Armas, 2003a, b; Armas & Rodríguez-Cabrera, 2016). However, some important karstic areas of this country remain unexplored for delatorreids, particularly in north-central and western Cuba. Herein we report the westernmost occurrence of Delatorreidae in Cuba, near 50 km from the western tip of the main island, which thorough examination allowed us to conclude that this population constitutes a new species of *Pseudarmadillo*.

Materials & methods

All measurements are expressed in millimeters and were taken under a Zeiss stereo microscope with a coupled x10 widefield measuring eyepiece. Photographs of preserved specimens were taken with a Sony Cyber-shot (12.1 Mpx) compact digital camera coupled to an eyepiece. Photographs in life were taken with a Nikon D300 professional digital camera. We made drawings from photographs with help of CorelDRAW X3 (ver. 13.0.0.576, 2005). Photograph bright/contrast adjustments and cutting out of images were made with Adobe Photoshop CS5 Extended (ver. 12.0) and the contours of some structures were touched up with CorelDRAW X3. Nomenclature and other taxonomic procedures largely followed Stachowitsch (1992), Armas & Juarrero de Varona (1999) and Juarrero de Varona & Armas (2003a). Because we did not observe sexual dimorphism in size, we considered the minimum adult size based on the smaller male with well-differentiated pleopods. The examined material is deposited in the zoological collection of the Instituto de Ecología y Sistemática (IES), La Habana, Cuba. Abbreviations are as follows: TL = total length, WLR = width/length ratio.

Systematics

Family Delatorreidae Verhoeff, 1938

Genus *Pseudarmadillo* Saussure, 1857

Subgenus *Pseudarmadillo* Saussure, 1857

TYPE SPECIES: *Pseudarmadillo carinulatus* Saussure, 1857

***Pseudarmadillo inornatus*, new species**
Figures 1-5. Table I

HOLOTYPE. Adult male (IES) from about 100 m eastward of the meteorological radar station at La Bajada (21°55'21" N, -84°28'35" W; 10 m elevation), Sandino municipality, Guanahacabibes Peninsula, Pinar del Río province; collected by T. M. Rodríguez-Cabrera and S. Rodríguez, on 28 March 2016.

PARATYPES (N=29). 15 males, 7 females, 4 juveniles (IES); same data as the holotype. — 1 male, 2 females (IES); about 20 m N of the biological station of the Guanahacabibes National Park at La Bajada (21°55'21" N, -84°28'41" W; 10 m elevation); collected by T. M. Rodríguez-Cabrera and R. Teruel, on 17 December 2013.

ETYMOLOGY. The specific epithet is derived from the Latin prefix *in-* (meaning "not", "without") and *ornatus* (meaning "adorned", "ornate"), referring to the weekly developed ornamentation of this species in comparison with its living congeners, particularly on its pereionite VII.

DISTRIBUTION (Fig. 1). Known only from the type locality, within a radius of less than 400 m around the meteorological radar station at La Bajada (21°55'18"N, -84°28'35"W), Sandino municipality, Pinar del Río province, Cuba, at 10 m elevation.

DIAGNOSIS. Body tuberculate (belonging to the tuberculate species group: *sensu* Armas & Juarrero de Varona, 1999) (Figs. 2 and 3), with cuticle covered by transversal rows of poorly developed tubercles and ridges; this is the least ornamented species of *Pseudarmadillo*. Cephalon and tergites dorsally covered by small and more or less homogeneous tubercles; cephalon without dorsal protuberances; pereionite VII with posteromedian tubercles hardly differentiated from the rest; pleon-tergites with weekly developed medial tubercles. Higher number of setae on exopodites of male pleopods I and II, many of them in submarginal position. Dorsal ground coloration dark bluish gray, with lateral margin of pereion-tergites and five basalmost segments of second antenna yellowish (although see Variation).

DESCRIPTION (adult male holotype, except for mouthparts, male pleopods, antennae and pereiopods, which are based on paratypes). Main body measurements are summarized in Table I.

Table I. Main body measurements of the male holotype of *Pseudarmadillo inornatus* **n. sp.** L/W = length/width.

Character	Measurements (mm)
Total length	9.8
Cephalon L/W	0.6/2.4
I Pereionite L/W	1.4/4.2
II Pereionite L/W	1.1/4.5
VII Pereoionite L/W	1.5/4.1

Color in life (Fig. 2). Dorsal ground coloration dark bluish gray, with lateral edges of pereion-tergites yellowish brown; pereion-tergites with blurred yellowish brown dorsolateral spots; second antennae with the segments from coxa to carpus and basalmost portion of propodus pale yellowish; distalmost part of propodus and flagellum dark gray; pereion-tergites with blurred yellowish brown dorsolateral spots (see also Variation).

Color in alcohol. Basic color pattern persists for some time, but eventually it becomes paler and yellowish pigmentations disappear.

Cephalon (Fig. 3 G-H). Nearly four times as wide as long, with three pairs of tubercles on the medial region and four oblique supraocular ridges decreasing in size toward the center; frontal and lateral lobes poorly developed; frontal lobe subrectangular. Eyes with six ommatidia.

Pereion (Fig. 3 A-F). Pereionite I three times as wide as long and 2.3 times as long as the cephalon, with wide lateral expansions, 2-3 longitudinal dorsolateral rows of ridges, three more or less defined transverse rows of tubercles on the posterior half and an anterior "pronotum-like" area with diffuse tuberculation; tergites II-IV similar, about four times as wide as long, with 2-3 dorsolateral rows of ridges, and 2-3 transverse rows of small tubercles; tergites V-VII with two dorsolateral rows of ridges and three transverse rows of small tubercles; segment VII with hardly differentiated and scarcely pronounced posteromedial tubercles. Epimeron I with a wide and deep groove, ending in a wide bifurcate inner process; epimeron II with a well-developed inner lobe and wide schisma.

Pleon (Fig. 3 A-B). Tergites I and II without tubercles; tergites III-V with one row of weekly developed rounded tubercles along the posterior margins, being medial tubercles slightly larger and increasing in size posteriorly.

Pleo-telson (Fig. 3 A, I). Subtriangular with truncated apex, with one small oval medial tubercle on its basal half and two smaller medial tubercles below it forming a triangle, and two additional smaller lateral rounded tubercles.

Uropods (Fig. 3 J). Protopodite nearly as wide as long; endopodite club-like with truncated apex and slightly surpassing the posterior margin of protopodite, but not the apex of pleo-telson; exopodite nearly reaching the apex of pleo-telson.

Mouthparts (Fig. 4). Left mandible (in the distal-proximal order) with a narrow bifurcate incisor process, *lacinia mobilis* with spine row on proximal side, and a lobe ending in a tuft of penicillae. Right mandible (in the distal-proximal order) with a wider trilobed incisor process, a small subrectangular to subtriangular sclerotized hyaline process with 1-2 penicillae on its proximal side, and a lobe ending in a tuft of penicillae. Maxillula-exopodite with one considerably enlarged and stouter tooth-like seta externally, three medium-sized medially, and 3-4 smaller and slender internally, with a comb-like row of setae bordering the external margin and a more irregular row of setae bordering the internal margin on the distal half. Maxillula-endopodite with short subtriangular laterodistal margin and two subapical thickset penicilli. Maxilla apically bilobed and setose; outer lobe wide, lamellate, with a medial longitudinal row of differentiated setae and two enlarged setae on the inner margin; inner lobe smaller, rounded and densely hirsute. Maxilliped basis with a scaly texture on external surface, sparsely covered by small spines, with a lateral narrow lamella distally; basal segment of palp with two large and curved spines, being the most internal about one-third longer; distal segments of palp fused, with two large proximal spines, one medial tuft of 4-5 thin small and medium

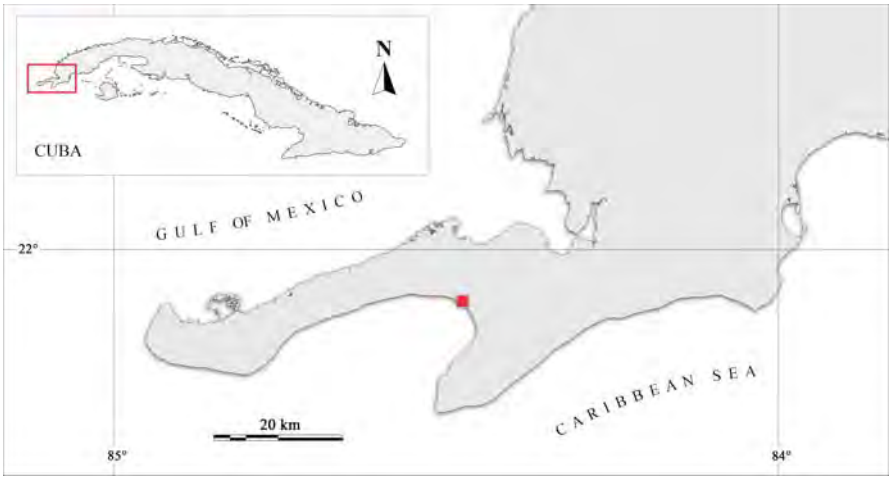


Fig. 1. Type locality (red square) of *Pseudarmadillo inornatus* **n. sp.** at La Bajada, Guanahacabibes Peninsula, Pinar del Río province, western Cuba.

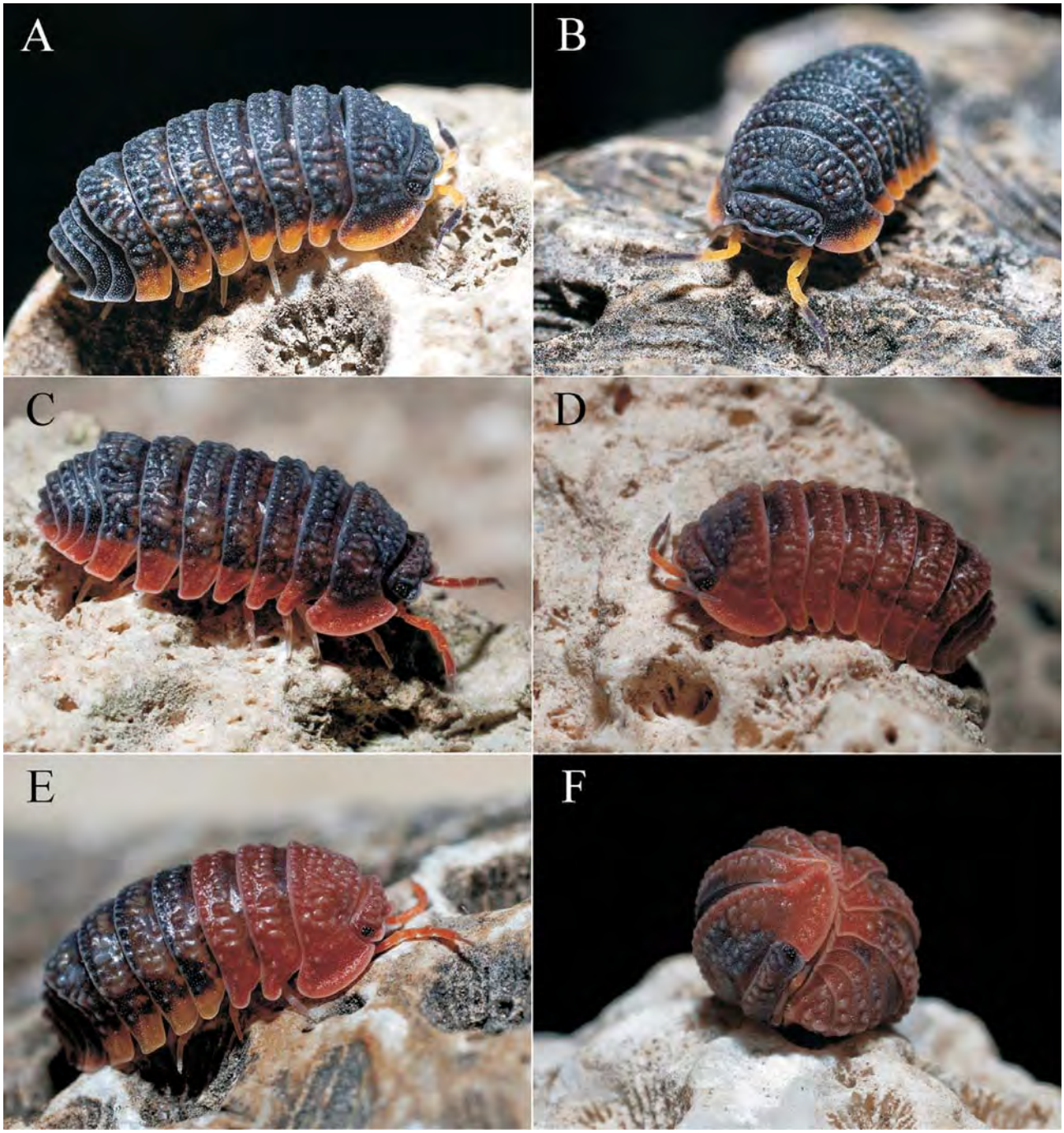
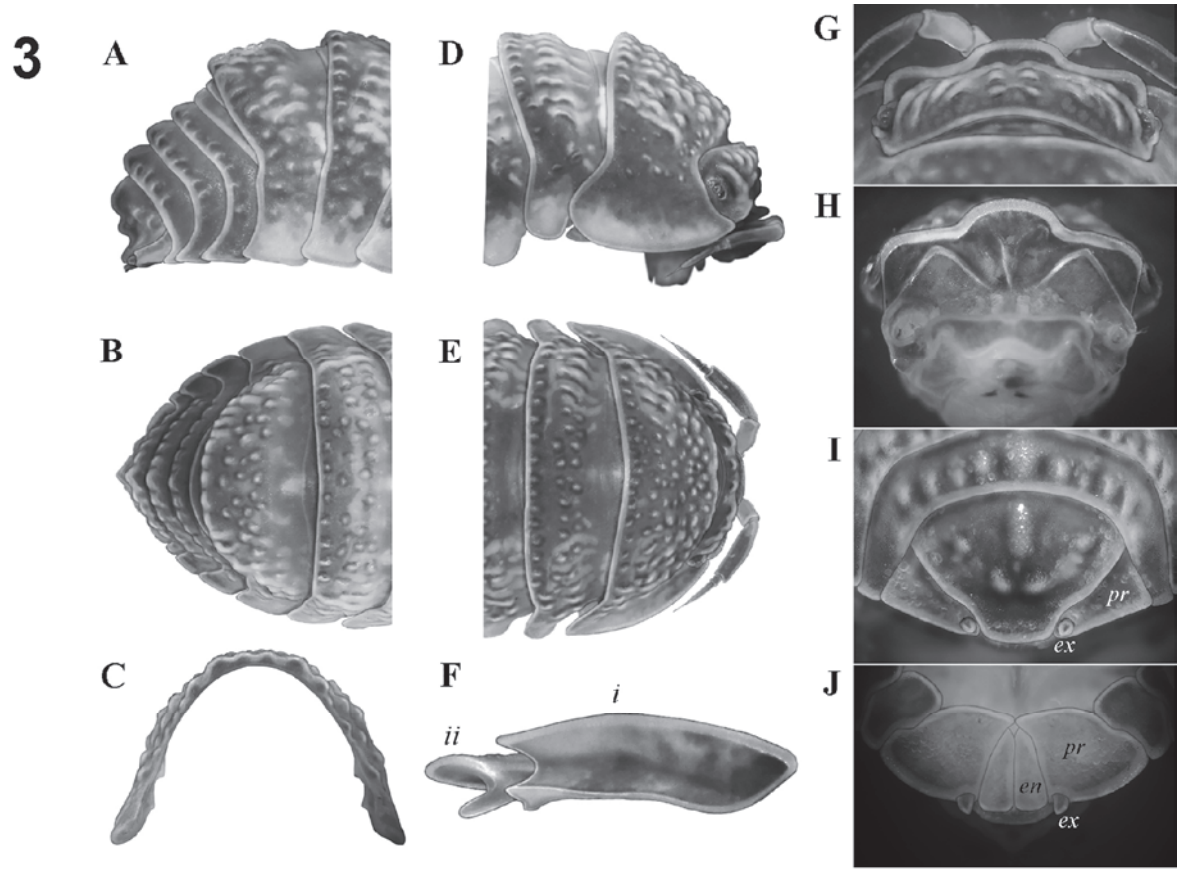


Fig. 2. Habitus of *Pseudarmadillo inornatus* **n. sp.** in life: A-B) male holotype showing typical coloration, C) intermediate-colored paratype specimen, D) reddish freshly-molted paratype specimen, E) half-molted paratype specimen showing both reddish coloration anteriorly and the old exoskeleton with typical coloration posteriorly, and F) freshly-molted paratype specimen displaying balling behavior (photos by R. López-Silvero).



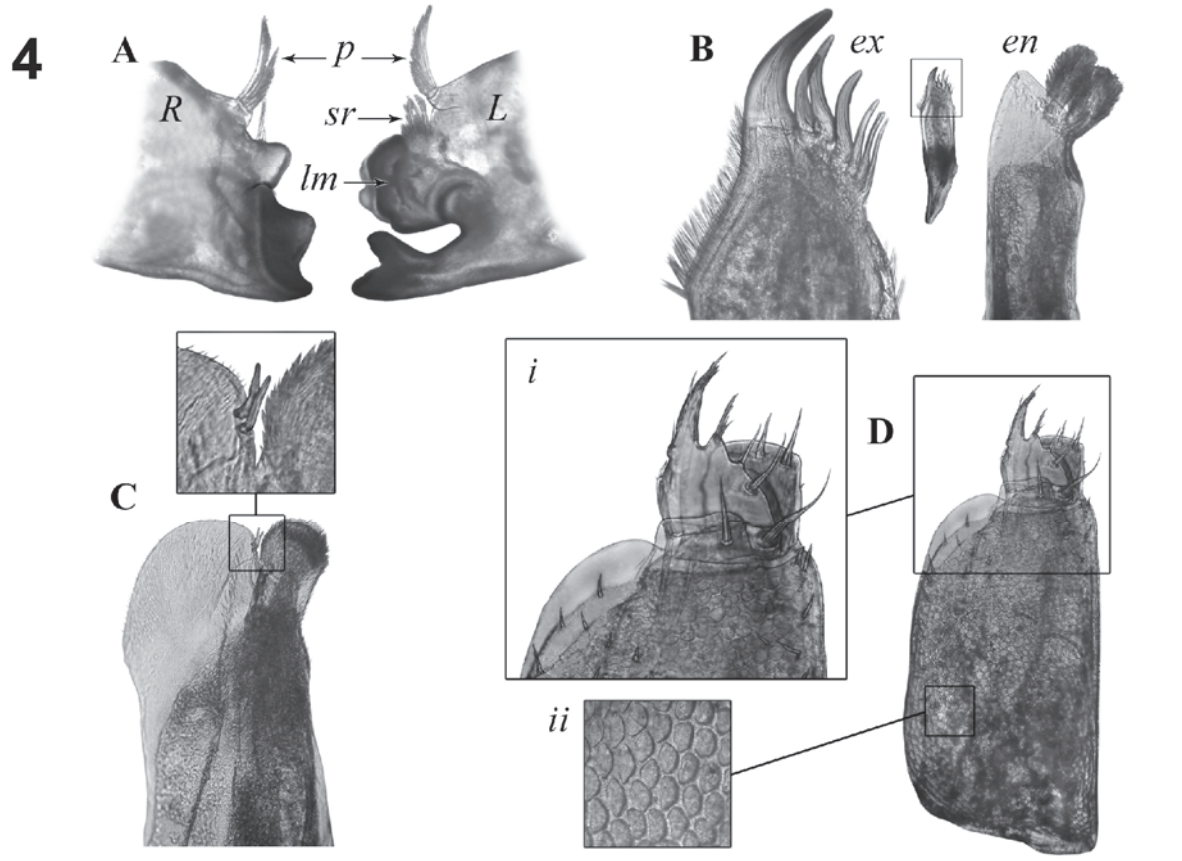


Fig. 3. Male holotype of *Pseudarmadillo inornatus* **n. sp.**: posterior region of the body in lateral (A) and dorsal (B) views; pereionite VII in posterior view (C); anterior region of the body in lateral (D) and dorsal (E) views; right pereon-epimerae *i* and *ii* (F); cephalon in dorsal (G) and ventral (H) views; pleo-telson and uropods in dorsal (I) and ventral (J) views. Abbreviations: protopodite (*pr*), endopodite (*en*), and exopodite (*ex*). **Fig. 4**. Mouthparts of *Pseudarmadillo inornatus* **n. sp.**: A) distal portion of right (*R*) and left (*L*) mandibles, showing *lacinia mobilis* (*lm*), spine row (*sr*), and penicillae tuft (*p*); B) maxillula, with detail of distal portion of exopodite (*ex*) and endopodite (*en*); C) distal portion of maxilla, with detail of the two enlarged setae on the inner margin of outer lobe (square above); D) maxilliped, with detail of the distal portion (*i*) and the scaly texture of basis (*ii*).

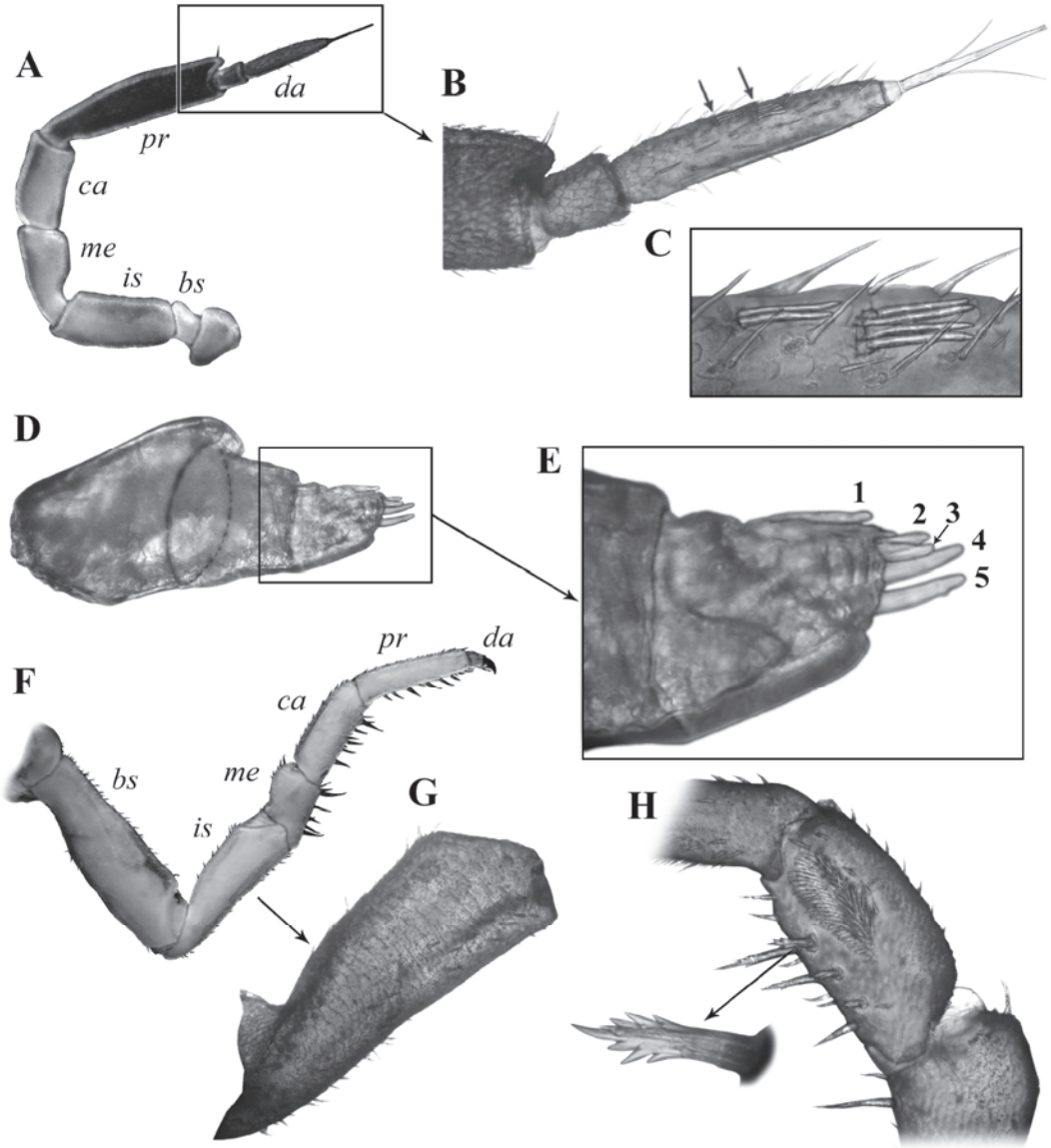


Fig. 5. Other appendages of *Pseudarmadillo inornatus* **n. sp.**: A) second antenna; B) detail of flagellum (dactylus) of second antenna depicting position of aesthetasc groups (arrows); C) close up of aesthetascs of second antenna; D) first antenna; E) detail of apical zone of first antenna and the five aesthetascs; F) male pereiopod VII; G) detail of ischium of male pereiopod VII; H) carpus of male pereiopod I (inner surface), showing the area covered by the cleansing apparatus and detail of a multi-apex setae (arrow). Abbreviations: basis (*bs*), ischium (*is*), merus (*me*), carpus (*ca*), propodus (*pr*), and dactylus (*da*).

sized spines; distalmost portion of palp narrow and sharp-pointed, ending in a tuft of small spines, one of them projecting twice from the rest; with three additional subapical small spines along the external margin of palp; endite subrectangular, with two enlarged, straight, subapical spines.

Antennae (Fig. 5 A-E). First antenna with five aesthetascs: four on top and one on the inner margin, in subapical position. Second antenna with a large seta near the apex of propodus; distal segment of flagellum 2.55 times larger than the basal one, with two aesthetasc groups in medial position (formula: 2-4); apical cone 1.56 times smaller than the distal segment of flagellum, with two visible free sensilla inserted on the basalmost third and nearly reaching the apex; merus and carpus subequal, merus with a strong basal constriction; ischium slightly longer than merus (1.2 times) and carpus (1.3 times); propodus two times as long as carpus and 1.15 times as long as flagellum.

Male pereiopods (Fig. 5 F-H). Pereiopod I with a dorsal ridge on the distal half of basis; carpus ventral surface with 5-6 multi-apex setae (5-8 tips), the medial one duplicating the size of the others, and a few additional spine-like setae; cleansing apparatus covering almost one quarter of the carpus internal surface; merus inner-anterior margin with a single serrate seta near the end; basal half of propodus inner-anterior margin with a row of very small undifferentiated setae. Pereiopod VII with nine multi-apex setae on the inner-posterior margin of carpus, the three distalmost aligned diagonally and decreasing in size proximodistally; propodus inner margin with five multi-apex setae decreasing in size proximodistally, two of them paired up near the middle region; merus inner margin with a single multi-apex seta near the end; ischium narrow and sub-conical, three times as long as wide.

Male pleopods (Fig. 6). First pleopods with endopodites slightly curved outward distally and with 6 subapi-

cal spines along the spermatic furrow, the three distalmost nearly three times as long as the three basalmost; exopodite suboval, bearing a row of 16-22 setae bordering the posterior margin and about 20 irregularly distributed submarginal setae; WLR = 1.47. Second pleopod exopodite very wide at the base, with 21-25 marginal setae and several (*ca*. 30) submarginal setae; distal half slender; endopodite surpassing the exopodite by nearly one quarter.

VARIATION. Adult size varied from 7.6-10.5 mm, with no apparent sexual dimorphism. Freshly-molted individuals show a more or less homogeneous reddish-brown ground coloration (including most antennal segments), becoming darker progressively. This last allows the observation of a complete color gradient in the population, from reddish to dark bluish gray, even both patterns in half-molted individuals (Fig. 2).

COMPARISONS. *Pseudarmadillo inornatus* **n. sp.** must be compared with species within the tuberculate species group of the subgenus *Pseudarmadillo*, from which it can be easily distinguished by having: 1) very poorly differentiated posteromedian tubercles on pereionite VII (Fig. 2 and 3 A-C) and 2) higher number of setae on exopodites of male pleopods I and II (Fig. 6). The general color pattern in life has proved to be very different among some species within this group (*e.g.*, *P. carinulatus* and *P. holguinensis* Armas and Juarrero de Varona, 1999), which could be a strong diagnostic character, but the lack of information on the remaining species doesn't allows a thorough comparison. The species that most closely resemble *P. inornatus* **n. sp.** are *P. carinulatus, P. jaumei* Armas and Juarrero de Varona, 1999, from southern Guantánamo province, and *P. holguinensis*, from near Holguín city. *Pseudarmadillo carinulatus* has very different body color pattern, exopodites of male pleopods I and II without submarginal setae, and well-differentiated posteromedian tubercles on pereionite VII. *Pseudarmadillo jaumei* and *P. holguinensis* have cephalon with two large tooth-like tubercles and male exopodite of the pleopod I dome-shaped (WLR = 1.31-1.33 vs 1.47 in *P. inornatus* **n. sp.**); furthermore, *P. holguinensis* has a general color pattern light brown densely spotted on dark brown, with second antennae reddish (T. M. Rodríguez Cabrera and L. F. de Armas, unpublished data). Also, the male pleopod I in *P. jaumei* has endopodite almost straight and very narrow at the base, with a row of small setae along the internal marginal on the distal third (vs six subapical spines in *P. inornatus* **n. sp.**).

NATURAL HISTORY

The region where *P. inornatus* **n. sp.** inhabits is characterized by a seasonal xerochimenic winter dry tropical climate, subtype *4 b Th*: winter dry tropical climate 5-6 dry months (*sensu* Borhidi, 1991). According to data recorded by the meteorological station No. 310 at San Antonio Cape during the 1990-2013 period, mean air temperatures vary from 27.6°C in warmer months (July-August), to a mean of 22.8-23.4°C in cooler months (January-February); mean rainfall vary from 36-63.5 mm in the dry season (November-April) to 152–266 mm in the rainy season (May-October), getting a maximum mean of up to 681 mm (*i.e*., September 1995) (data provided by the Instituto de Meteorología of Cuba at the request of authors). Guanahacabibes is a karstic peninsula with predominant exposed coral limestone and shallow ferralitic soils, covered by seasonal semi-deciduous forest (Fig. 7; phytogeographic district "Guanahacabibense": *sensu* Borhidi, 1991).

All specimens of *P. inornatus* **n. sp.** were found associated to shaded rocky soil in primary forest. The species is apparently nocturnal: by day they remain hidden under coralline rocks (Fig. 7) or deep inside rock crevices, and at night they come out and can be observed active foraging either on the limestone or less frequently on exposed horizontal tree roots covered by microalgae, moss and lichens. Despite the species can be relatively abundant, it has extremely patchily and aggregated distribution across its habitat, being most specimens found associated to a single pile of coralline rocks of less than 4 m^2 (Fig. 7). These observations are consistent with those made by Rodríguez Cabrera and Armas (2016) on *P. spinosus* Armas and Juarrero de Varona, 1999 from northern Sancti Spíritus province.

CONSERVATION STATUS

Despite *P. inornatus* **n. sp.** occurs within one of the most important protected areas of western Cuba (Guanahacabibes Biosphere Reserve), its known range is about 300 m outside the Guanahacabibes National Park. The semi-deciduous forest where the only known population occurs is fragmented by a road, being found most specimens less than 10 m from such a road and some of them just about 20 m from human buildings. Moreover, feral and semi-feral pigs are relatively abundant in the area, which can heavily alter the soil microhabitat of this woodlouse. Hurricanes are a natural threating event with truly detrimental effects on the forest coverage in the region every few years (data provided by the Instituto de Meteorología of Cuba at the request of the authors). However, the species evolved under the direct incidence of this phenomenon, which we consider dangerous only in combination with the other human-induced threatening factors mentioned above. Because of its restricted distribution (known from a single location), the inferred reduction in the extend and/or quality of its habitat because of human activity (road construction, advance of the nearest human settlement), the apparent highly specific habitat requirements and the natural threats currently facing the only known population, *P. inornatus* **n. sp.** qualify for the IUCN criterion B2ab(iii) in the category of Critically Endangered (IUCN, 2012; IUCN Standards and Petitions Subcommittee, 2014).

GENERAL REMARKS

Pseudarmadillo inornatus **n. sp.** represents by far the westernmost occurrence of the family Delatorreidae in Cuba. The nearest record through the main island belongs to a species identified by Vandel (1973) as *P. gillianus* Richardson, 1902 from "*Cueva Oscura; (…) Hoyo de Potrerito*" (22°25'28" N, -83°56'24" W), Los Órganos Range, Minas de Matahambre municipality, Pinar del Río province, about 78 km northeastward.

With the present addition the delatorreids are represented in western mainland Cuba by four species: *P. carinulatus* (all the western provinces), *P. buscki* Boone, 1934 (only known from the type locality in Artemisa province, but not collected and/or observed for nearly 90 years, since 1928), *P. inornatus* **n. sp.** (Pinar del Río province) and *P gillianus* (recorded from localities in Pinar del Río, Artemisa, and Mayabeque provinces, but pending of confirmation, because no voucher specimens are available and at least some of those records might be misidentifications).

Due to the possible threats on *P. inornatus* **n. sp.**, future efforts must be directed to locate it within the Guanahacabibes National Park and/or to expand the boundaries of this

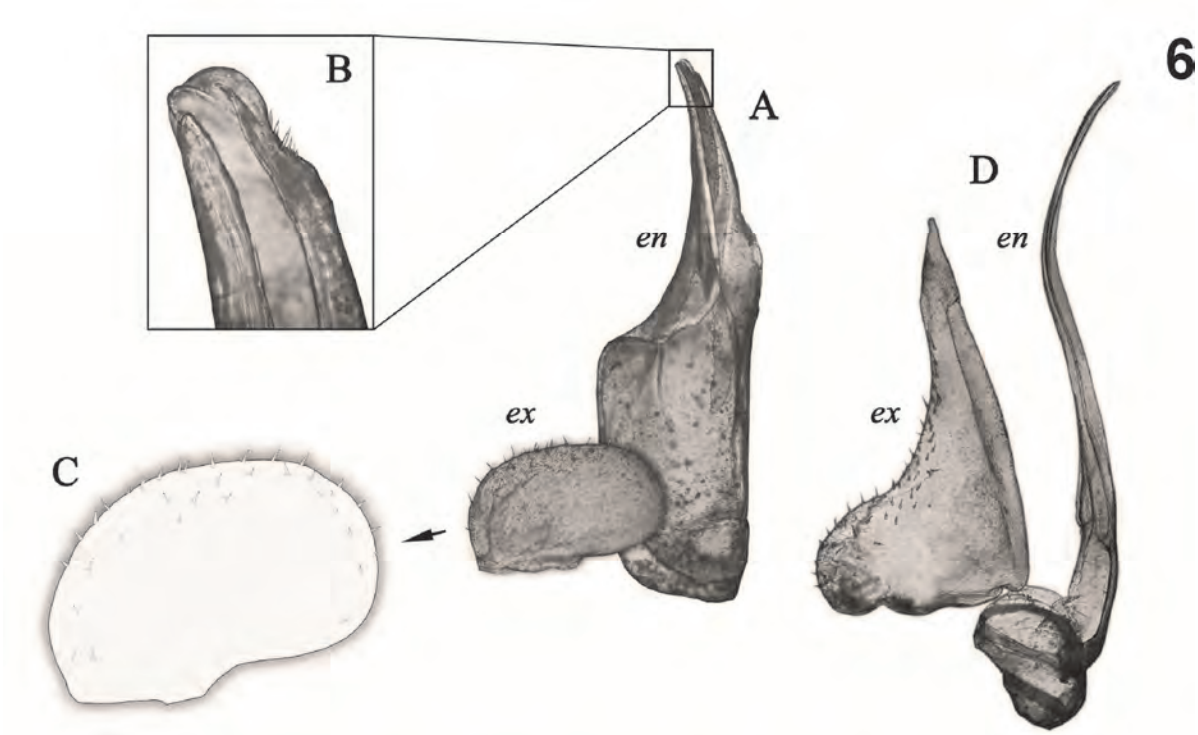


Fig. 6. Pleopods of a male paratype of *Pseudarmadillo inornatus* **n. sp.**: A) first pleopod; B) detail of first pleopod endopodite tip showing subapical spines; C) drawing of first pleopod exopodite; D); second pleopod. Abbreviations: endopodite (*en*) and exopodite (*ex*). **Fig. 7**. Habitat (semi-deciduous forest) of *Pseudarmadillo inornatus* **n. sp.** at La Bajada, Guanahacabibes Peninsula, Cuba. (photo by T.M. Rodríguez-Cabrera).

protected area so that the only known population of this species can be included. This would allow addressing more focused and effective management actions to guarantee its long-term conservation.

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