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## Redescription and taxonomic status of *Paguristes weddellii* (H. Milne Edwards) (Crustacea: Anomura: Paguroidea: Diogenidae) from the eastern Pacific

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### Abstract

The type and additional material of *Paguristes weddellii* (H. Milne Edwards, 1848) were examined. The species is redescribed and illustrated in details. Comparison of *P. weddellii* with the monotypic genus *Tetralobistes* Ayón-Parente & Hendrickx, 2010b, shows many similarities, principally in the armature of the distal margin of the male first pleopod and the shape of the telson, which in both cases feature a tetralobular posterior margin, a character considered unique among the Diogenidae. Consequently, *Pagurus weddellii* is transferred to the genus *Tetralobistes*. *Paguristes hirtus* Dana, 1851, a subjective junior synonym of *Pagurus weddellii* is removed from the synonymy based on lack of direct evidences.

**Key words:** Crustacea, Diogenidae, *Paguristes*, *Tetralobistes*, new combination, eastern Pacific

### Introduction

While examining several species of hermit crabs assigned to *Paguristes* in the collection of the Muséum national d'Histoire naturelle in Paris, Rahayu (2005) discovered species showing tendency of reduction of the gill formula. Consequently, she restricted species with 13 pairs of gills to *Paguristes*, and reinstated *Stratiotes* Thomson, 1899 for species with 12 pairs of gills. Indeed, the type species of *Stratiotes*, *P. setosus* Filhol, 1885 [subjective junior synonym (as in the Abstract) of *Paguristes setosus* (H. Milne Edwards, 1848)], has 12 pairs of gills. At the same time, Rahayu (2005) examined some species with a most advanced gill reduction (8 pairs), and transferred these to *Pseudopaguristes* McLaughlin, 2002. Revision of the genus *Paguristes* has been still ongoing (McLaughlin & Rahayu 2005; Rahayu & McLaughlin 2006; Rahayu 2007; Rahayu & Forest 2009; McLaughlin 2008; Komai 2009, 2010).

*Areopaguristes* was designated as a generic replacement name for *Stratiotes* Thomson, 1899, a substitute name for the preoccupied senior homonym *Stratiotes* Putzeys, 1846 (Rahayu & McLaughlin 2010). While studying members of the family Diogenidae from the Mexican Pacific coast, Ayón-Parente & Hendrickx (2010b) described a new genus, *Tetralobistes*, to accommodate a new species, *T. bicentenarius* Ayón-Parente & Hendrickx, 2010b, very similar to *Paguristes* species (sensu Rahayu 2005) but clearly distinct by the shape of its telson (posterior margin typically divided into four lobes) and other characters.

*Paguristes weddellii* (H. Milne Edwards, 1848) was described from Peru based on a single specimen. The original description is short and without illustrations. The species was figured by Rathbun (1910) and later by Retamal (1981). While consulting these two contributions, our attention was called on the close similarity between *P. weddellii* and both *Areopaguristes mclaughlinae* (Ayón-Parente & Hendrickx, 2006) and *Tetralobistes bicentenarius* from the tropical eastern Pacific. These similarities include the shape of the shield, of the ocular and antennal acicles, and of the antennal flagella. To complete the comparison, a male and a female of *P. weddellii* collected in Valdivia, Chile, were obtained on loan, examined in detail, and a redescription and illustrations are presented herein.

## Material and methods

The specimens utilized in this work were provided by Dr. Fernando Mantelatto (University of São Paulo, Brasil) and were collected in Los Molinos, Valdivia, Chile, and deposited in the Crustacean Collection of the University of São Paulo, Department of Biology (CCDB), Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto (FFCLRP). The type material (one male) of *P. weddellii* is held in the Muséum national d'Histoire naturelle, Paris (MNHN), France, and was examined by Dr. Laure Corbari on our request.

Specimen size is indicated by the shield length (SL in mm), measured from the tip of the rostrum to the midpoint of the posterior margin of the shield. The length of the ocular peduncles has been determined by measuring the left ultimate peduncular segment, including the cornea, along its lateral surface; corneal diameter represents the maximum width of the cornea measured on the dorsal surface. Terminology used in the descriptions generally follows that of McLaughlin (2004).

## Taxonomy

### Diogenidae

#### *Tetralobistes* Ayón-Parente & Hendrickx, 2010b

#### *Tetralobistes weddellii* (H. Milne Edwards, 1848) new combination

*Pagurus weddellii* H. Milne Edwards, 1848: 64 (type locality, shores of Peru).

*Paguristes weddellii*.—Kinahan, 1857: 350.—Alcock 1905: 156.—Rathbun, 1910: 555, 596, pl. 51, fig. 2.—Gordan 1956: 324.—McLaughlin *et al.* 2010: 23.

*Paguristes weddellii*.—Stimpson, 1858: 236.—Haig, 1955: 16.—Retamal, 1981: 19, 57, fig. 65.—Retamal & Jara, 2002: 205 (list).—Ayón-Parente & Hendrickx, 2010a: 4.

*Paguristes weddellii*.—Mantelatto *et al.*, 2009: 22.

**Material examined.** Male holotype (SL 22 mm), Peru (no specific locality, no date of collection), catalogue number MNHN-Pg. 1699 (photographs); one male (SL 13.82 mm) and one female (SL 8.27 mm), Los Molinos, Valdivia, Chile, May 03 2005, CCDB/FFCLRP/USP # 809.

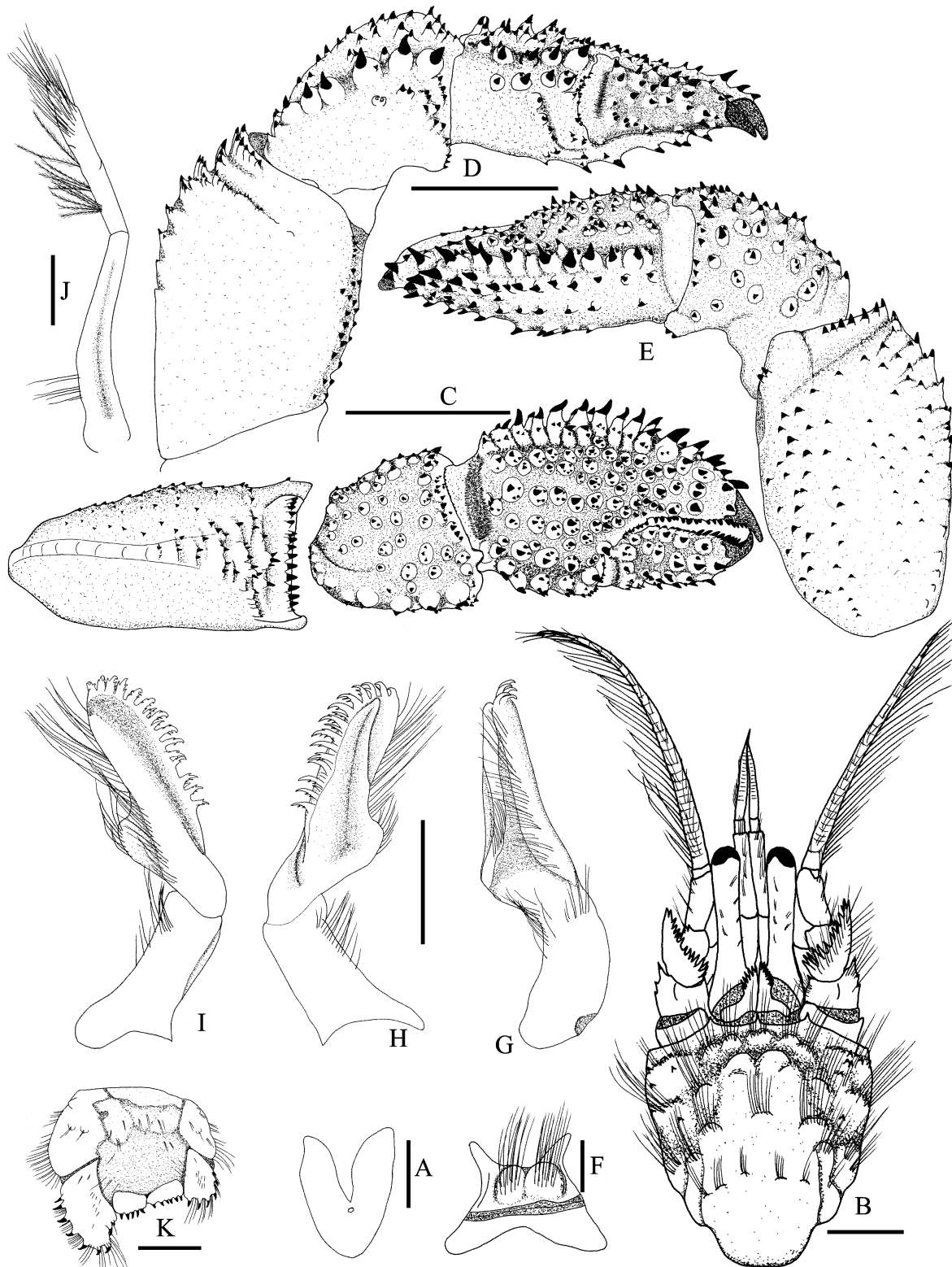
**Redescription.** Thirteen pairs of biserial gills (Fig. 1A). Shield (Figs. 1B, 4A, C) longer than broad; anterolateral margins sloping; anterior margins between rostrum and lateral projections concave to almost straight; posterior margin convex; middle part of dorsal surface smooth with tufts of short setae, middle of anterior surface with tubercles and short transverse rows of spines near to lateral margins, both tubercles and spines accompanied by tufts of long setae. Rostrum short, slender, sharply triangular, equal or slightly exceeding lateral projections, reaching basis of ocular acicles. Lateral projections bluntly triangular, each armed with one small or moderately large marginal spine. Branchiostegites with small spines or spinules on dorsal and distal margins, concealed by tufts of long setae.

Ocular peduncles (Figs. 1B, 4A, C) cylindrical, long, 0.67 shield length, broader basally; cornea weakly dilated, corneal diameter 0.10 length of peduncles. Ocular acicles long, subtriangular or subrectangular, broader basally, contiguous along their mesial margin and terminating in large spines, lateral margin armed with 6 or 7 spines, mesial margin unarmed.

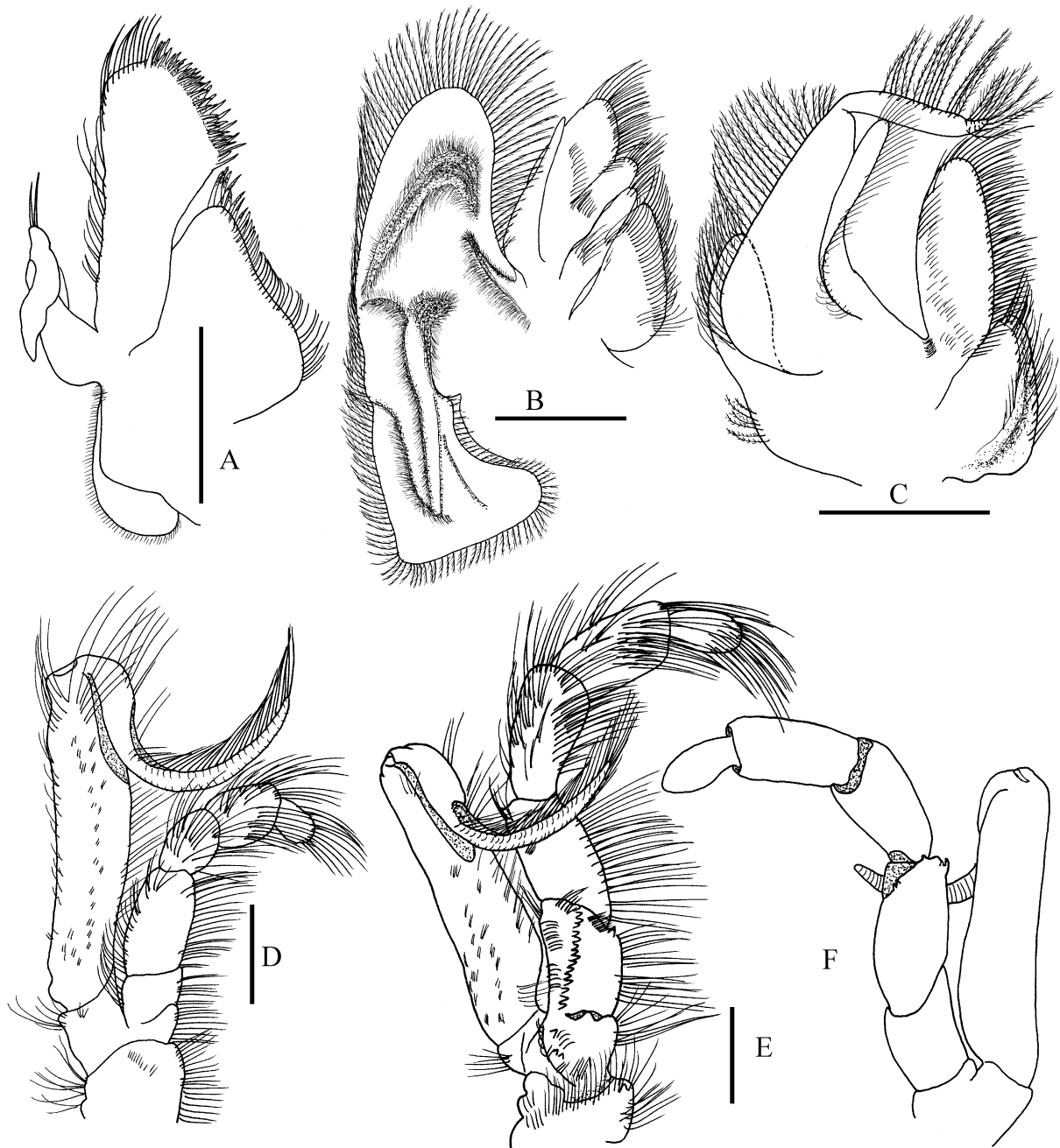
Antennular peduncles (Fig. 1B, 4A, C) long, when totally extended exceeding by 0.33 length of ocular peduncles; ultimate and penultimate segments unarmed, with few tufts of long setae; basal segment with small spine at ventrodistal margin, lateral face with moderately strong spine on middorsal margin, distal margin with small spine concealed by long setae.

Antennal peduncles (Fig. 1B) with supernumerary segment, long, usually reaching basis of cornea; fifth segment with scattered tufts of setae on dorsal and ventral surfaces; fourth segment with 2 very small or minute spines at dorsodistal margin; third segment with ventrodistal margin rounded, not produced, with 1 small spine at inner distal margin; second segment with laterodistal angle produced, terminating in large corneous-tipped spine, lateral margin usually with 2 minute corneous spines; mesiodistal angle with large corneous-tipped spine, mesial margin setose; first segment unarmed. Antennal acicles triangular, reaching proximal third of ultimate antennal

segment, terminating in simple or bifid spines and with spines on mesial margin; mesial margin armed with row of 11–13 large, corneous-tipped spines, partially concealed by long setae, lateral margin unarmed. Antennal flagella (Fig. 1B) short, slightly longer than shield; each article with very long, paired setae ventrally.

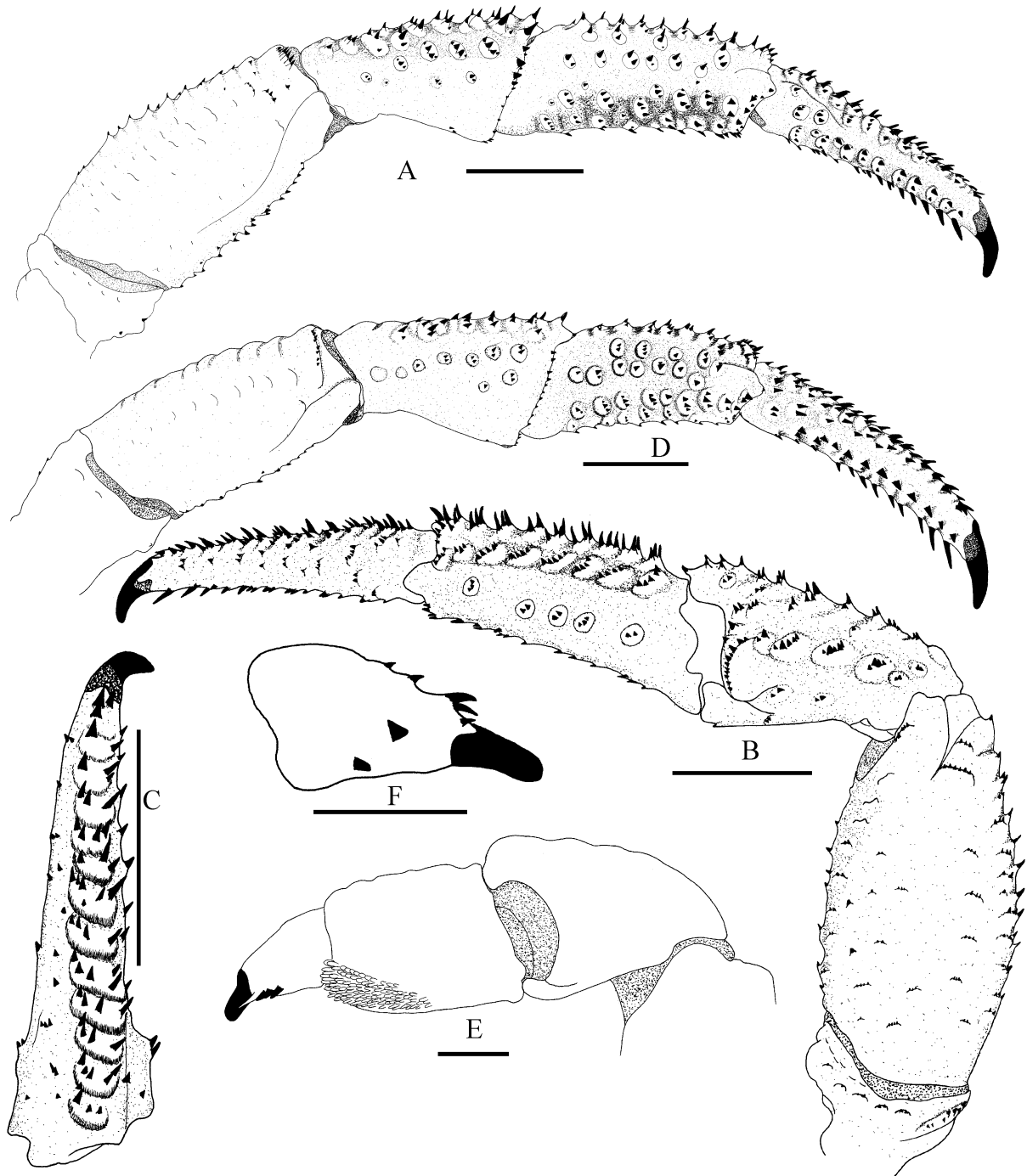


**FIGURE 1.** *Tetralobistes weddellii* (H. Milne Edwards, 1848) n. comb. Female (SL 8.27 mm) A, B; male (SL 13.82 mm) C–K (CCDB/FFCLRP/USP # 809). A, gill lamella showing biserial condition; B, shield and cephalic appendages, dorsal view; C, left cheliped, dorsal view, setae omitted; D, left cheliped, mesial view, setae omitted; E, left cheliped, lateral view, setae omitted; F, plate on sternite XII (third pereopods); G, male left first pleopod, inner view; H, male left first pleopod, mesial view; I, male left first pleopod, lateral view; J, male left second pleopod; K, telson, dorsal view. Scale bars: A, 1 mm, B, F–K 2 mm; C–E 5 mm.



**FIGURE 2.** *Tetralobistes weddellii* (H. Milne Edwards, 1848) n. comb. Male (SL 13.82 mm) (CCDB/FFCLRP/USP # 809). A, left maxillule, inner view; B, left maxilla, inner view; C, left first maxilliped, inner view; D, left second maxilliped, inner view; E, left third maxilliped, inner view; F, left third maxilliped, lateral view, setae omitted. Scale bar: 2 mm.

Mandible without distinguishing characters. Maxillule (Fig. 2A) with proximal endite subquadrated, distal endite subrectangular, enlarged distally; endopod with 2 apical bristles on weakly produced internal lobe, external lobe well developed, recurved, approximately 0.67 length of endopod. Maxilla (Fig. 2B) with endopod moderately long, not exceeding scaphognathite in distal extension. First maxilliped (Fig. 2C) with endopod large, reaching distal end of basal segment of exopod; proximal segment of exopod subtriangular, tapering distally; flagellum very short; epipod well developed. Second maxilliped (Fig. 2D) with basis-ischium fusion incomplete. Third maxilliped (Fig. 2E, F) with basis-ischium fusion incomplete; basis with 3 spines, partially obscured by tufts of setae; ischium with crista dentata well developed, 1 small spine at ventrolaterodistal margin, without accessory tooth; merus with 2 minute spines on ventrolateral distal margin, dorsodistal margin with 2 small or minute spines; carpus, propodus and dactyl unarmed.



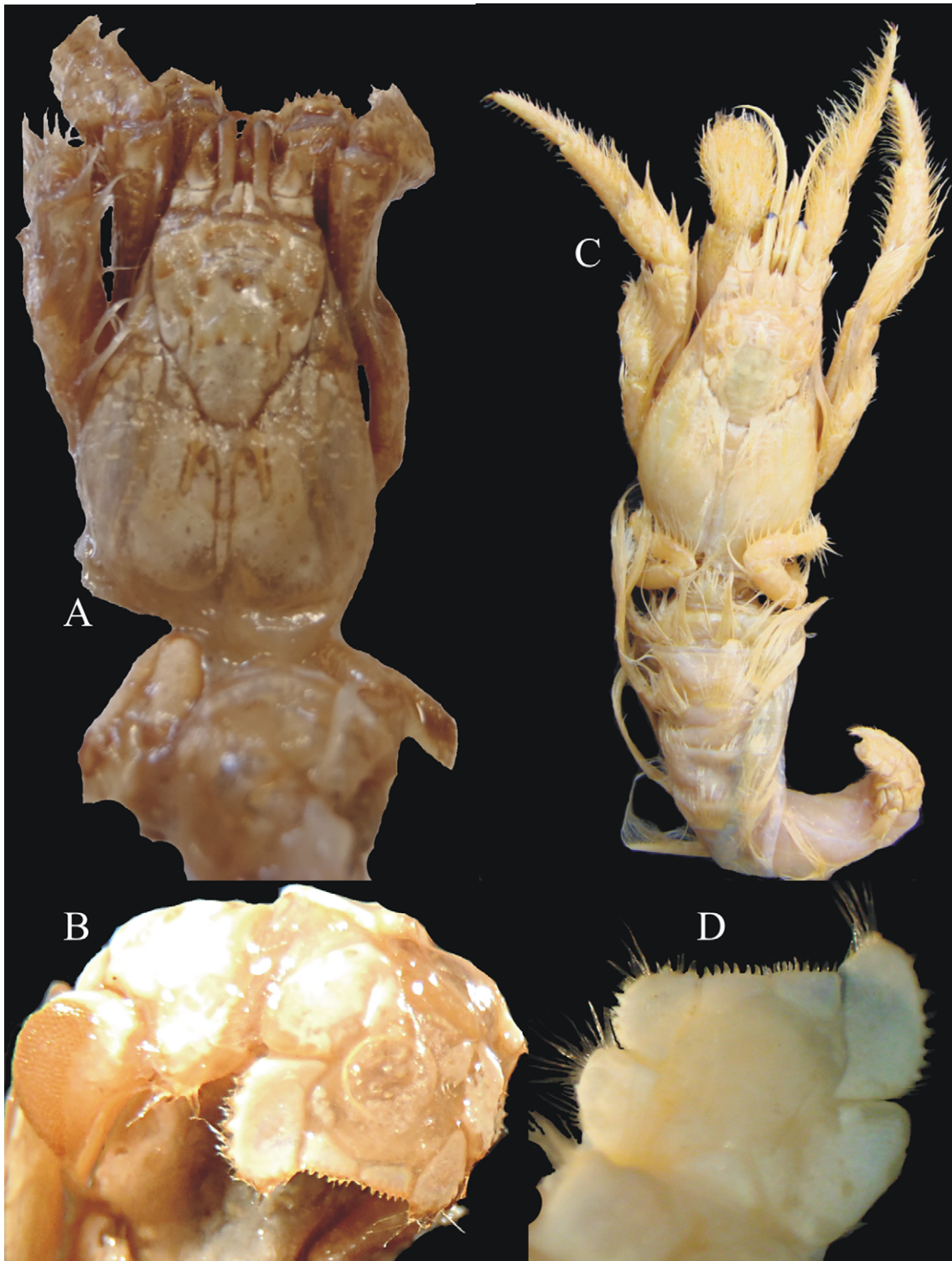
**FIGURE 3.** *Tetralobistes weddellii* (H. Milne Edwards, 1848) n. comb. Male (SL 13.82 mm) (CCDB/FFCLRP/USP # 809). A, left second pereopod, mesial view, setae omitted; B, left second pereopod, lateral view, setae omitted; C, dactyl of the left second pereopod, dorsal view, setae omitted; D, left third pereopod, mesial view, setae omitted; E, dactyl, pereopod and carpus of left fourth pereopod, lateral view, setae omitted; F, dactyl of left fourth pereopod, mesial view, setae omitted. Scale bars: A–D 5 mm; E, F 2 mm.

Chelipeds (Fig. 1C–E) short, similar in shape, equal or slightly unequal, pilose. Dactyls moderately long, 1.33 times as long as palms, terminating in moderately large or large corneous-tipped claw overlapped by fixed finger; cutting edge with row of corneous teeth; dorsomesial margin not well defined, with 2 irregular rows of large corneous-tipped spines and tufts of long setae; dorsal surface with 2 irregular longitudinal rows of large simple or bifid spines, accompanied by tufts of long setae; mesial surface with irregular vertical rows of corneous-tipped

spines; ventromesial margin with row of large, corneous-tipped spines accompanied by tufts of long setae. Palm with row of 4 to 5 moderate to prominent spines accompanied with 1 to 2 smaller spines and tufts of long plumose setae on dorsomesial margin, dorsolateral margin arcuate with row of prominent spines extending on fixed finger, each spines accompanied by 1 to 2 smaller spines and tufts of long plumose setae; weakly convex dorsal surface with 5 to 6 irregular rows of large spines, each spine fringed anteriorly with small corneous spines forming a semi-crown and tufts of long plumose setae, 3 rows extending nearly entire length of fixed finger; lateral surface with 2 rows of spines and tufts of setae; mesial face with row of moderately large spines near dorsomesial margin, distal and subdistal margins with corneous-tipped spines, ventral surface with rows of spine-like tubercles and tufts of setae, one row extending the entire length of fixed finger; cutting edge of fixed finger with row of corneous teeth, terminating in large, corneous-tipped claw. Carpus with row of 6 to 7 prominent spines on dorsomesial margin, dorsal surface with irregular, longitudinal rows of smaller spine-like tubercles bearing 1 to 3 corneous spines, distal margin spiny, lateral margin weakly delimited with row of small to moderately large spines, each accompanied by tuft of long plumose setae; lateral surface with several spine-like tubercles accompanied by tufts of setae, ventrolateral angle with 2 moderately large spines; mesial surface with numerous distal spines. Merus subtriangular in dorsal view; dorsal face with row of small spines increasing in size and becoming transverse rows of moderately large spines distally, often corneous-tipped spines distally, accompanied by tufts of long setae, distal margin with row of moderately large, corneous-tipped spines extending on lateral and mesial margins; lateral surface spinulose, larger spines near ventral margin, ventromesial and ventrolateral margins each with double irregular row of small spines and long setae, smallest usually laterally, ventral surface with scattered small spines and tufts of long setae. Ischium with 1 to 2 small spines on ventromesial margin; laterodistal and dorsolaterodistal margins spiny.

Second (Figs 3A, B, 4C) and third (Figs 3D, 4C) pereopods similar, somewhat different in armature. Dactyls 1.34–1.56 length of propodi; dorsal margins each with row of semi-circular, flattened tubercles crowned with sharp spines (Fig. 3C) decreasing in size distally and concealed by tufts of long setae; mesial faces each with few spine-like tubercles accompanied by tufts of long setae, dorsomesial and ventromesial margins each with longitudinal rows of irregular, flattened tubercles bearing 1–3 corneous-tipped spines and tufts of long setae, ventral margins each with 11–13 corneous spines increasing in size distally; lateral faces each with few flattened, spine-like tubercles proximally, an oblique row of flattened tubercles bearing 2–4 corneous-tipped spines, beginning proximally on middle surface and ending distally on dorsolateral margin, ventrolateral margins each with longitudinal row of flattened tubercles bearing 1–4 triangular, corneous-tipped spines and tufts of long setae; ending in large corneous claw. Propodi each with row of semi-circular, flattened tubercles, crowned with sharp spines (larger on second) concealed by tufts of long setae; mesial faces each with numerous spine-like tubercles bearing 1–4 triangular, corneous-tipped spines and tufts of long setae, lateral faces each with longitudinal row of spine-like tubercles (larger on second), dorsolateral margins each with longitudinal row of semi-circular, flattened tubercles crowned with sharp spines, spines larger on second pereopods, ventral faces each with 2–3 longitudinal rows of irregular spine-like tubercles bearing 1–3 triangular, corneous-tipped spines. Carpi each with 2 irregular longitudinal rows of spine-like tubercles bearing 2–4 corneous-tipped spines (larger on second) concealed by tufts of long setae, mesial faces each with few spine-like tubercles near dorsal margin, accompanied by tufts of long setae, distal margin with small, corneous-tipped spines extending on ventral margin, lateral surfaces each with few spine-like tubercles accompanied by tufts of long setae, ventrolateral margins each with row of semi-circular, flattened tubercles crowned with sharp spines, spines larger on second pereopods, ventral surfaces each with spiny tubercles and spine-like tubercles on distal two-thirds. Meri each with dorsal row of spine-like tubercles proximally, becoming spines distally, and tufts of long setae, dorsosubdistal margin with corneous-tipped spines extending on mesial face, ventromesial margins each with corneous-tipped spines (larger on second) and tufts of plumose setae, ventrolateral margins each with only tufts of long plumose setae (third) or with low, spine-like tubercles and tufts of long plumose setae, lateral faces each with numerous low tubercles bearing small, corneous-tipped spines and tufts of long setae. Ischia each with 1–4 small corneous-tipped spines on ventromesial margin concealed by tufts of long plumose setae, lateral face with tubercles accompanied by tufts of long setae (third) or with small corneous spines and tufts of long setae (second), dorsal surface with low tubercles bearing small corneous spines and tufts of long setae.

Sternite XII (third pereopods) (Fig. 1F) with anterior lobe subrectangular, bearing pair of protuberances and tufts of long setae.



**FIGURE 4.** *Tetralobistes weddellii* (H. Milne Edwards, 1848) n. comb. Male holotype (SL 22 mm) (Pg. 1699) A, B; female (SL 8.27 mm) (CCDB/FFCLRP/USP # 809) C, D. A, anterior part of abdomen, carapace, shield, cephalic and thoracic appendages, dorsal view; B, left uropod and telson, dorsal view; C, dorsal view; D, telson, dorsal view.

Fourth pereopods (Fig. 3E, F) setose. Dactyls each with long, slender preungual process at base of claw; 3 large corneous spines on ventrolateral margin posterior to claw; inner face with two large scale-like spines; dorsal margin with 3 large corneous spines distally preceded by 2 smaller spines on distal third. Propodi with several rows of ovate scales in propodal rasp. Carpi and meri unarmed.

Pleopods of male with first and second pairs modified as gonopod (Fig. 1G–J). Basal lobe with tufts of setae on mesial and outer margins; inferior lamella with row of setae on outer margin, distal margin with row of bifid and



multifid corneous, curved spines extending down mesial face; internal lobe with marginal setae. Second pleopods with elongate basal segment, with few setae; endopod with few plumose setae on inner margin; appendix masculina with long setae marginally and on inner face. Third to fifth left pleopods without endopods. Female with paired gonopores, without first paired pleopods, second to fourth pleopods with both rami well developed, fifth pleopod as in male; brood pouch represented by row of setae.

Telson (Figs. 1K, 4B, D) with posterior margin divided in 4 lobes; outer left lobe longer than outer right, subrectangular, armed with 3 or 4 distal spines and 5 lateral spines; middle lobes subquadrate, each with 5–7 small spines; outer right lobe subtriangular, distal margin with 3 spines, lateral margin with 3–5 strong spines; anterior section of telson separated from posterior section by indentation, weakly bilobate, lobes unarmed with tufts of long setae.

**Color.** H. Milne Edwards (1848) described the color of this species as “couleur rouge-brun foncée”. Perhaps this description was based on preserved specimen, because Zúñiga-Romero (2002) mentioned that (fresh) specimens are white-grayish, with chelipeds yellow. The preserved specimens examined herein present an orange-yellowish color, but in life they present a mixing of white and brown colors, with abundant pilosity.

**Habitat.** Collected on sandy substrate, 5–18 m depth; adults are found on estuarine shallow waters, but no information on juvenile is available (Haig 1955; Zagal & Hermosilla 2007; LM Pardo & FL Mantelatto, pers. com.)

**Distribution.** From Sechura Bay, Peru, to Smith Channel, Territory of Magallanes, Chile (Haig 1955; Retamal 1981).

**Notes on *Paguristes hirtus* Dana, 1851.** *Paguristes weddellii* was originally described by H. Milne Edwards (1848) from “shores of Peru” (as *Pagurus*). *Paguristes hirtus* was described by Dana (1851) from “shores of Chile”. In the same contribution, Dana (1851) also described the genus *Paguristes* but failed to designate a type species for it. It is only seven years later that Stimpson (1858: 235) subsequently designated *P. hirtus* as the type of *Paguristes*. While the type material of *P. weddellii* is still available and in excellent conditions, the specimen used by Dana to describe *P. hirtus* has long been lost. In her monograph on the Anomura of Chile, Haig (1955: 16) considered the latter as a subjective junior synonym of *P. weddellii*. In order to justify her proposal, she requested the opinion of Prof. J. Forest, member of the staff of the MNHN at that time, who examined the type of *weddellii* (see Haig, 1955: 17) and came to the conclusion that *P. hirtus* was identical to *weddellii*. However, considering that none of these two carcinologists were able to examine the type material of *hirtus* and that the original description of both “*Paguristes weddellii*” and *P. hirtus* is very short and imprecise compared to present day species descriptions, we believe that the proposal of Haig lacked sustainment and we therefore remove *Paguristes hirtus*, the type species of *Paguristes*, from the synonymy of “*Pagurus weddellii*”.

**Remarks.** The present specimens from Valdivia, Chile, agreed well with short descriptions of *Paguristes weddellii* by H. Milne Edwards (1848; as *Pagurus*) and Rathbun (1910). The type of *Paguristes weddellii* from Peru was not available for direct examination, but Laure Corbari (MNHN) sent us photographs of it (Fig. 4A, B). While comparing the holotype photographs with our material from Chile, it became obvious that the shield, the ocular acicles and peduncles, the antennal acicles (Fig. 4A) and, above all, the telson (Fig. 4B) (tetralobular as in the type species of the genus *Tetralobistes*) of our specimens perfectly match the holotype, and we became confident that the Chilean specimens are conspecific with the holotype.

Examination of the specimens from Chile has disclosed that *Paguristes weddellii* shares many characteristic with *Tetralobistes bicentenarius*, including a short rostrum, ocular acicles with mesial margins contiguous, antennal flagella with long setae ventrally, chelipeds with fingertips acuminate, and modified male first pleopods with distal margin of the inferior lamella bearing a row of simple, bifid and multifid, corneous, curved spines. In addition, in female *T. weddellii* the first pleopods and the brood pouch are absent (represented by a row of long setae), as in *T. bicentenarius*. The characteristic telson is strikingly similar, with a posterior margin divided into four lobes, a character unique among the genera of Diogenidae (see Ayón-Parente & Hendrickx 2010b). Consequently, we transfer *Paguristes weddellii* to *Tetralobistes*.

When Rahayu (2005) divided *Paguristes* s.l. into three genera, she indicated the presence of 13 pairs of gills in the type specimen of *T. weddellii* (as *Paguristes*), but without further details. Mantelatto *et al.* (2009) revised the taxonomy of *Pagurus forceps* H. Milne Edwards, 1836 and *P. comptus* White, 1847, and presented an analysis of 16S ribosomal gene sequences of these two species and of a series of species of Diogenidae, including *Paguristes weddellii*. Their results show all species of Diogenidae forming a single clade, with *P. weddellii* close to two pairs



of *Paguristes*, yet clearly separated from these four species. This supports our proposal to withdraw *P. weddellii* from *Paguristes*.

*Tetralobistes bicentenarius* and *T. weddellii* n. comb., can be separated by the following characters: in *T. bicentenarius* the antennal acicles each with 3–6 spines on mesial margin, in lieu of 11–13 spines; antennular peduncles proportionally longer (0.75–0.80 versus 0.33); telson with middle lobes bearing 11–13 versus 5–7 spines. Armature of chelipeds and walk legs, just as the colour also showing differences between these two species. In *Tetralobistes bicentenarius* the second pleopods are absent but are present in *T. weddellii*, thus increasing the variability of the genus *Tetralobistes* (“second pleopods present or absent in males”) as diagnosed by Ayón-Parente & Hendrickx (2010b).

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