

## Revision of *Ostracotheres* H. Milne Edwards, 1853 (Crustacea: Brachyura: Pinnotheridae)

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**Abstract.** The Indo-West Pacific pinnotherid crab genus, *Ostracotheres* H. Milne Edwards, 1853, was recognised for species with a simple, unadorned carapace without marginal lamellae, and a spatulate maxilliped 3 propodus with a rounded or subtruncate apex. Prior to the present study, the genus included: *O. tridacnae* (Red Sea; type species), *O. affinis* (Mauritius, Djibouti), *O. cynthiae* Nobili, 1906a (Red Sea); *O. spondyli* Nobili, 1905 (Persian Gulf); *O. subglobosus* (Baker, 1907) (southern Australia); *O. holothuriensis* Baker, 1907 (southern Australia); *O. subquadratus* Sakai, 1939 (Japan); and *O. tomentipes* Takeda & Konishi, 1994 (Japan). Reconsideration of species assigned to *Ostracotheres* shows they differ considerably in other aspects such as carapace physiognomy, pereopod article proportions, and gonopod structure (where known), suggesting the genus is not monophyletic. Thus, *Ostracotheres* is revised based on type and other material. *Ostracotheres* sensu stricto is restricted to *O. tridacnae* and *O. cynthiae*. *Ostracotheres tridacnae* is confirmed as a senior synonym of *O. savignyi* H. Milne Edwards, 1853, and appears to be restricted to the Red Sea as a commensal of tridacninae clams; records of *O. tridacnae* from southeast Africa are referred to *Afropinnotheres dofleini* (Lenz in Lenz & Strunck, 1914). Similarly, *O. cynthiae* appears to be restricted to the Red Sea as a commensal of ascidians; the single record of *O. cynthiae* from Indonesia requires confirmation but its published account is not consistent with *O. cynthiae* sensu stricto. A new genus, *Austrotheres*, is proposed for *O. holothuriensis* and a new species from eastern Australia. *Ostracotheres subglobosus* and *O. subquadratus*, considered by some to be conspecific, are shown to be separate valid species, with the identity of the latter fixed by a neotype selection; both are transferred to a new genus, *Discorsotheres*, together with *O. spondyli* and a new species from the tropical western Pacific. *Ostracotheres affinis* and *O. tomentipes* are referred to a new genus *Latatheres*, with the identity of the former fixed by a neotype selection. Keys to the species of the genera studied herein and to pinnotherid genera with a 2-segmented maxilliped 3 palp are provided.

**Key words.** Decapoda, Pinnotheridae, pea crab, Indo-West Pacific

### INTRODUCTION

The segmentation of the palp of maxilliped 3 is a fundamental morphological feature recognised early in the taxonomic history of Pinnotheridae (H. Milne Edwards, 1853; Bürger, 1895). Most pinnotherids have the plesiomorphic 3-segmented maxilliped 3 palp consisting of dactylus, propodus, and carpus, but a small number have a 2-segmented palp through loss of the dactylus. Loss of the maxilliped 3 dactylus has occurred independently multiple times in pinnotherid evolution and is partially reflected in the generic classification (Manning, 1993b; Campos, 1996; Ahyong & Ng, 2005). At present, eight genera include species with a 2-segmented maxilliped 3 palp: *Calyptraeotheres* Campos, 1990, *Dissodactylus* Smith, 1870, *Gemmotheres* Campos, 1996, *Nannothers* Manning & Felder, 1996, *Ostracotheres* H. Milne Edwards, 1853, *Serenotheres* Ahyong & Ng, 2005, *Tunicotheres* Campos, 1996, and *Xanthasia* White,

1846. Although originally diagnosed as 2-segmented, the maxilliped 3 palp of *Abyssotheres* Manning & Galil, 2000 is 3-segmented (Komatsu & Ohtsuka, 2009).

H. Milne Edwards (1853) erected *Ostracotheres* for three Indo-West Pacific species with a 2-segmented palp, a simple, arched, unadorned carapace without marginal lamellae, and a spatulate maxilliped 3 propodus with a rounded or subtruncate apex: *O. affinis* Nobili, 1905, *O. tridacnae* (Rüppell, 1830), and its synonym *O. savignyi* H. Milne Edwards, 1853. Other genera with a 2-segmented maxilliped 3 palp differ from *Ostracotheres* in their elaborate carapace structure (*Serenotheres*, *Calyptraeotheres*, *Dissodactylus*, *Serenotheres*, *Xanthasia*) and/or maxilliped 3 morphology in which the propodal apex strongly tapers distally (*Gemmotheres*, *Tunicotheres*) or is shorter than the carpus (*Nannothers*).

In addition to the three species originally placed in *Ostracotheres*, six other Indo-West Pacific species are assigned to the genus: *O. cynthiae* Nobili, 1906a; *O. spondyli* Nobili, 1905; *O. subglobosus* (Baker, 1907); *O. holothuriensis* Baker, 1907; *O. subquadratus* Sakai, 1939; and *O. tomentipes* Takeda & Konishi, 1994. Reconsideration of species of *Ostracotheres* shows they differ considerably

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in other aspects, such as carapace physiognomy, pereopod article proportions, and gonopod structure (where known), suggesting the group is not monophyletic. As currently composed, *Ostracotheres* is morphologically heterogeneous and is revised herein.

## MATERIAL AND METHODS

Morphological terminology follows Ahyong & Ng (2007) and Ahyong et al. (2012). Carapace length (cl) is measured along the dorsal midline and carapace width (cw) is of the greatest width. Gonopods 1 and 2 are abbreviated as G1 and G2, respectively. Specimens are deposited in the collections of the Australian Museum, Sydney (AM); Florida Museum of Natural History, University of Florida, Gainesville (UF); Muséum national d'Histoire naturelle, Paris (MNHN); Museum Victoria, Melbourne (NMV); Museum für Naturkunde, Berlin (ZMB); National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM); National Science Museum, Tokyo (NSMT); Natural History Museum and Institute, Chiba (CBM); Naturalis Biodiversity Centre, Leiden (RMNH); Naturhistorisches Museum, Wien (NHMW); Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt am Main (SMF); Queensland Museum, Brisbane (QM); the South Australian Museum, Adelaide (SAM); the Western Australian Museum, Perth (WAM); the Zoological Museum, University of Copenhagen (NHMD); and the Zoological Reference Collection, Lee Kong Chian Natural History Museum, National University of Singapore (ZRC).

## SYSTEMATICS

### Pinnotheridae De Haan, 1833

#### *Ostracotheres* H. Milne Edwards, 1853

*Ostracotheres* H. Milne Edwards, 1853: 219 (type species *Pinnotheres tridacnae* Rüppell, 1830, subsequent designation by Schmitt et al., 1973: 28; gender masculine).

**Diagnosis.** *Female:* Carapace subcircular, about as long as wide; weakly sclerotised, firm but not hard; longitudinally vaulted, without epigastric ridge; front slightly produced anteriorly, subtruncate; anterolateral margins well defined, lateral surfaces near vertical; dorsal surface smooth, regions poorly defined, indistinct, covered with fine, short tomentum. Eyes visible in dorsal view. Antennal flagellum reaching to or beyond mid-height of eye but not dorsal margin of orbit. Maxilliped 3 ischiomerus completely fused, without trace of suture; palp 2-segmented; carpus shorter than propodus; propodus spatuliform; exopod flagellum 1- or 2-segmented, distally setose. Chelipeds equal, stout, robust, dactylus and pollex with simple, pointed tips. Pereopods 2–5 symmetrical from left to right, slightly compressed, ovate in cross-section; dactyli with simple, spiniform apices, subequal or pereopod 5 dactylus longer. Pereopod 5 articulating with body at same level as pereopod 4. Abdomen with 6 free somites and telson; in adults, widest at somites 4 and 5, covering bases of walking legs. Gonopore simple, ovate, on sternite 5 near mesial end of sternite 5/6 suture. *Male:* similar to female,

though smaller, carapace less rounded, lateral margins often flatter; G1 dorsoventrally compressed, weakly curved, apex blunt, with short, spine-like papilla directed anterolaterally.

**Composition.** *Ostracotheres tridacnae* (Rüppell, 1830), *O. cynthiae* Nobili, 1906.

**Remarks.** Prior to the present study, *Ostracotheres* comprised a group of Indo-West Pacific species having a spatulate (versus conical) maxilliped 3 propodus and a 'normal' carapace, without marginal lamellae or other elaborate structures (Campos, 1996). Reconsideration of all species in *Ostracotheres* revealed that the genus comprised several disparate groups. *Ostracotheres* is herein restricted to the type species, *O. tridacnae*, and *O. cynthiae*, both of which share a finely setose, relatively weakly sclerotised (firm but not hard) subcircular carapace that is about as long as wide with defined anterolateral margins and near vertical lateral surfaces, robust chelipeds with simple, pointed finger tips, walking legs with left–right symmetry, and a relatively straight G1 with a short, spine-like anterolaterally directed papilla. The remaining species formerly placed in *Ostracotheres* are referred to three new genera: *Austrotheres*, *Discorsotheres* and *Latatheres*. Given that the maxilliped 3 dactylus has been independently lost several times within Pinnotheridae, the new genera recognised for former members of *Ostracotheres* cannot *a priori* be assumed closely related. Of these, *Ostracotheres* s.s. most closely resembles *Austrotheres* from southern Australia in carapace form and pereopod morphology, but differs chiefly in more weakly sclerotised and finely setose carapace (versus hard and glabrous), and the G1 form, in which the apex is blunt, with a short, spine-like, anterolaterally directed papilla, rather than a long lanceolate tip aligned with the main axis of the G1. The G2 exopod is absent in *O. tridacnae* and both species of *Austrotheres*, but remains to be determined in *O. cynthiae*. *Austrotheres* may prove closely related to *Ostracotheres*, but *Discorsotheres* and *Latatheres* probably have their affinities elsewhere. *Discorsotheres* is readily separated from *Ostracotheres* by the subquadrate carapace, slender chelipeds with spatulate finger tips, asymmetrical pereopods 3, and *Latatheres* by its transversely ovate to subrectangular carapace. Unfortunately, males of neither *Discorsotheres* nor *Latatheres* are known.

Species of *Ostracotheres* are unusual in Pinnotheridae in the similarity in form and maximum body size between the sexes, in particular *O. tridacnae*. This contrasts strongly with the significant size and structural disparity between sexes usually seen in Pinnotheridae. Why this should be the case in *Ostracotheres*, especially *O. tridacnae*, is not known, although it may owe to the seemingly minimal constraints on male crab size within the large host *Tridacna* relative to smaller host bivalves of most other pinnotherids. Although few specimens of *O. cynthiae* are available for comparison, the sexes are similar and also live in "spacious" host ascidians (relative to the small body size of the crabs).

Among species of *Ostracotheres* or those formerly placed there, the larvae of only *O. tridacnae* are known. Gohar &

Al-Kholy (1957) reported four zoeal and one megalopal stages in *O. tridacnae*; notably, the maxilliped 3 palp and exopod flagellum are already 2-segmented in the megalopa. Species of *Ostracotheres* occur in the tropical western Indian Ocean and Indonesia (Fig. 1).

#### Key to male and female *Ostracotheres*

1. Pereopod 2–5 dactyli stout, falcate, apices distinctly curved, some turning almost perpendicular to main axis; flexor margins evenly convex, with 1 or 2 rows of minute, stiff setae. Maxilliped 3 exopod flagellum 2-segmented. In tridacnine clams ..... *O. tridacnae*
- Pereopod 2–4 dactyli slender, gently curved, apices weakly curved, to less the 45° to main axis. Pereopod 5 dactylus relatively straight; flexor margin sinuous. Pereopod 2–5 flexor margins with row of stiff, elongated setae. Maxilliped 3 exopod flagellum 1-segmented. In ascidians ..... *O. cynthiae*

#### *Ostracotheres tridacnae* (Rüppell, 1830)

(Figs. 1–3)

Crabes. — Savigny, 1826: pl. 7, fig. 1.1–5, a–e, m–o, i, j, u, v. *Pinnotheres veterum*. — Audouin, 1826: 88. (Not *P. veterum* Bosc, 1802).

*Pinnotheres Tridacnae* Rüppell, 1830: 22–24, pl. 5 fig. 2 (type locality: Red Sea)

*Ostracotheres Savignyi* H. Milne Edwards, 1853: 219, pl. 11 fig. 10 (type locality: Red Sea). — Nobili, 1906b: 300.

*Ostracotheres Tridacnae*. — H. Milne Edwards, 1853: 219. — Heller, 1861a: 20, 32. — Heller, 1861b: 371. — Paulson, 1875: 70. — Kossmann, 1877: 62. — Schmeltz, 1881: 14.

*Ostracotheres tridacnae*. — Adensamer, 1897: 109. — Laurie, 1915: 415. — Tesch, 1918: 262, 287. — Balss, 1924: 14. — Calman, 1927: 215. — Ramadan, 1936: 36–37. — Gohar & Al-Kholy, 1957: 146, 153–160, 175, 176, pl. IV–VII. — Guinot, 1967: 279. — Schmitt et al., 1973: 6, 29–30. — Rablais & Gore, 1985: tab. 1. — Takeda & Konishi, 1989: 1222. — Guinot & Bouchard, 1998: 653. — Guinot et al., 2013: 134, 292, fig. 33B. — Ng et al., 2008: 250.

*Pinnotheres tridacnae*. — Doflein, 1904: 124, 210, 121, 226, 229, fig. 37.

*Ostracotheres tridacnae*. — Nobili, 1906b: 299–300. — Guinot, 1964: 13; 1979: 148–149, fig. 24D.

*Ostracotheres savignyi*. — Takeda & Konishi, 1989: 1222.

Not *Pinnotheres Tridacnae*. — Kraus, 1843: 21, 47. (= *Afropinnotheres dofleini* [Lenz in Lenz & Strunck, 1914]).

Not *Pinnotheres (Ostracotheres) tridacnae*. — Doflein, 1904: 282. (= *Afropinnotheres dofleini* [Lenz in Lenz & Strunck, 1914]).

Not *Ostracotheres tridacnae*. — Stebbing, 1910: 331. — Lenz & Strunck, 1914: 268, 282, 283 (Simons Bay, South Africa). — Barnard, 1950: 82. — Kensley, 1981: 48. — Emmerson, 2016: 414. (= *Afropinnotheres dofleini* [Lenz in Lenz & Strunck, 1914]).

**Type material.** Lectotype: SMF 2719, male (cl 10.8 mm, cw 10.7 mm), Red Sea, from *Tridacna elongata*, coll. E. Rüppell, January–July 1826. Paralectotypes: SMF 2720, 2 males (cl 6.9 mm, cw 6.9 mm; cl 8.0 mm, cw 7.6 mm), 4 females (cl 9.4 mm cw 9.4 mm to cl 12.5 mm cw 13.0 mm), collected with lectotype.

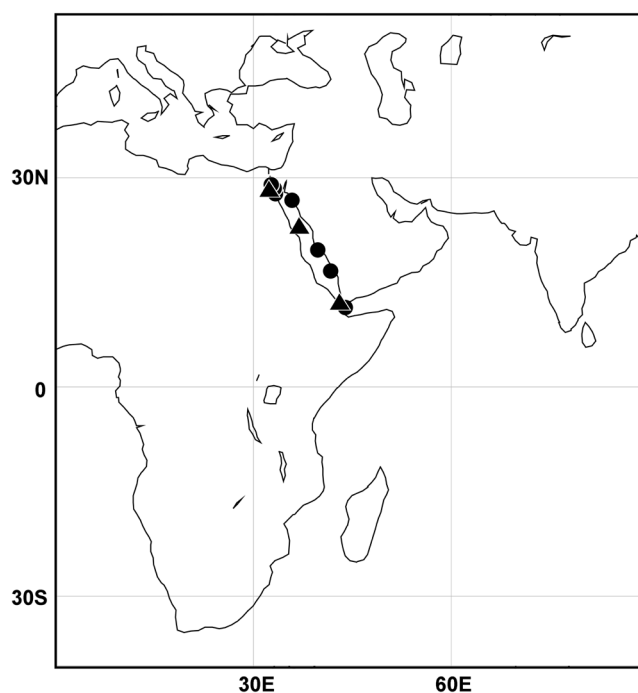


Fig. 1. Distribution of species of *Ostracotheres* H. Milne Edwards, 1853. (▲) *O. cynthiae* Nobili, 1906; (●) *O. tridacnae* (Rüppell, 1830).

**Other material examined.** UF37203–37204, 1 male (cl 8.8 mm, cw 8.7 mm; BDJRS-3214), 1 spent female (cl 12.2 mm, cw 12.0 mm; BDJRS-3215), Tiger Head Island, Farasan Islands, Red Sea, 16°47.46'N, 42°11.92'E, 1–6 m, karstic shore to fringing reef, from *Tridacna squamosina*, SAFA-023, coll. A. Anker, 10 March 2013; MNHN-IU-2017-8381 (B10583), 1 female (cl 8.0 mm, cw 8.1 mm), Abulat Island, Red Sea, 19°58'N, 40°07'E, from *Tridacna*, 0.5–1.0 m, Calypso, stn 9, 1952; NHMW 10066, 3 males (cl 8.1 mm, cw 8.2 mm; cl 9.4 mm, cw 9.2 mm; cl 8.9 mm, cw 8.8 mm), 2 females (cl 10.7 mm, cw 10.7 mm, cl 11.0 mm, 11.0 mm), 1 ovigerous female (cl 10.1 mm, cw 10.0 mm), Noman Island, Red Sea, [27.11°N, 35.76°E], from *Tridacna elongata*, *Pola* Expedition; NHMD-229248, 2 males (cl 12.1 mm, cw 12.1 mm; cl 12.5 mm, cw 12.6 mm), 2 ovigerous females (cl 15.1 mm, cw 14.7 mm; cl 15.4 mm, cw 15.2 mm), Ghardaqa, Red Sea, from *Tridacna*, low water springs, 4 August 1937; ZMB 20024, 3 females (cl 8.7 mm, cw 8.6 mm; cl 11.9 mm, cw 12.3 mm; cl 10.2 mm, cw 10.0 mm), Tor, Gulf of Suez, Red Sea, coll. Hartmeyer; NHMW 10064, 1 ovigerous female (cl 14.0 mm, cw 13.5 mm), Tor, Red Sea, AN: 1862.I.10, coll. Ransonnet; NHMW 10065, 1 male (cl 10.3 mm, cw 10.3 mm), 1 female (cl 12.2 mm, cw 11.9 mm), Tor, Red Sea, from *Tridacna*, *Pola* Expedition, 9 March 1896; MNHN-IU-2016-10946 (B10578), 6 males (cl 5.5 mm, cw 5.5 mm to cl 8.6 mm, cw 8.6 mm), 7 females (cl 9.2 mm, cw 9.0 mm to cl 14.6 mm, cw 14.4 mm), Suez, from branchial cavity of *Tridacna*, coll. Vaillant, 1864; MNHN-IU-2016-10947 (B10578), 1 female (cl 12.7 mm, cw 13.2 mm), same; MNHN-IU-2016-10948 (B10578), 1 female (damaged), same; MNHN-IU-2016-10949 (B10578), 1 female (cl 11.8 mm, cw 11.7 mm), same; MNHN-IU-2016-10950 (B10578), 1 male (cl 8.0 mm, cw 7.6 mm), same; MNHN-IU-2017-8382, B10560, 1 male (cl 10.3 mm, cw 10.3 mm), 1 female (cl 11.8



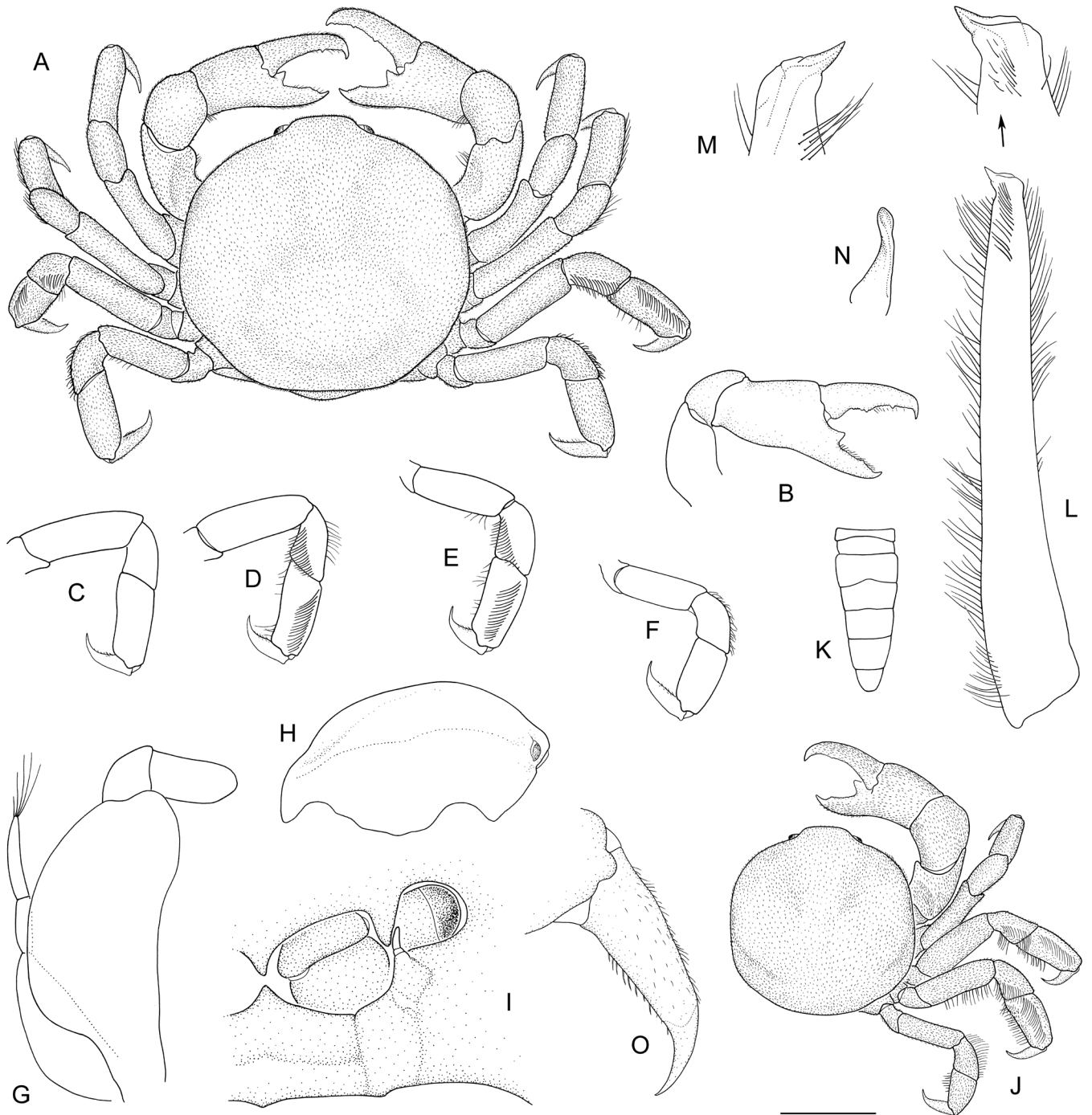


Fig. 2. *Ostracotheres tridacnae* (Rüppell, 1830). A–I, female, cl 11.8 mm, cw 11.7 mm, Red Sea, MNHN-IU-2016-10949; J–K, male, cl 8.0 mm, cw 7.6 mm, Red Sea, MNHN-IU-2016-10950; L–O, male, cl 12.1 mm, cw 12.1 mm, Red Sea, NHMD-229248. A, J, dorsal habitus; B, right cheliped, anterior view; C–F, right pereopods 2–5; G, right maxilliped 3; H, carapace, right lateral view; I, cephalothorax, anterior view; K, male abdomen; L, left G1, sternal view; M, left G1, tip, abdominal view; N, left G2, sternal view; O, right pereopod 5 dactylus. Scale: A–F, H, J, K = 4.0 mm; G, I, L, N, O = 1.0 mm; M = 0.5 mm.

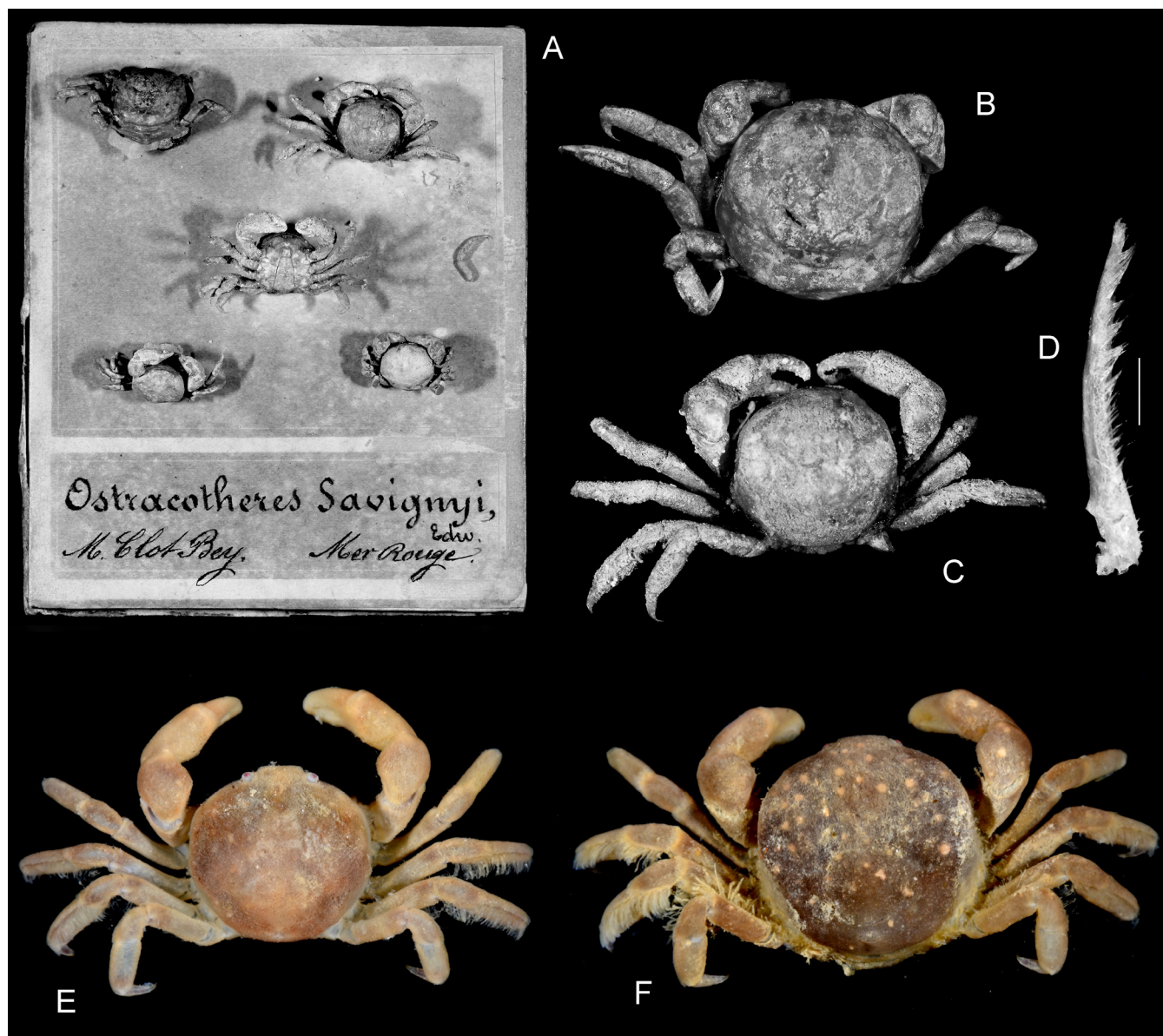


Fig. 3. *Ostracotheres tridacnae* (Rüppell, 1830). A–D, type material of *Ostracotheres savignyi* H. Milne Edwards, 1853, Red Sea; E–F, colour in life, male (cl 8.8 mm, cw 8.7 mm) and female (cl 12.2 mm, cw 12.0 mm), Farasan Islands, Red Sea, UF37023–37024. A, from left to right and upper to lower, lectotype female (cl 12.1 mm, cw 11.3 mm, MNHN-IU-2000-3066), paralectotype male (cl 9.5 mm, cw 9.4 mm, MNHN-IU-2000-1120), paralectotype male (cl 9.5 mm, cw 9.7 mm, MNHN-IU-2000-1121), paralectotype male (cl 7.7 mm, cw 7.9 mm, MNHN-IU-2000-1122), paralectotype male (cl 7.9 mm, cw 7.6 mm, MNHN-IU-2000-1123); B, lectotype female, cl 12.1 mm, cw 11.3 mm, MNHN-IU-2000-3066; C, paralectotype male, cl 12.1 mm, cw 11.3 mm, MNHN-IU-2000-1120; D, same, right G1, scale = 1.0 mm. (Photos: A–D, Noémy Mollaret and Marie Hennion; E–F, Arthur Anker).

mm, cw 12.5 mm), Red Sea, from *Tridacna elongata*, coll. Jousseume, 1903; MNHN-IU-2000-3069 (B3069), 3 females (not measured; dry), Red Sea, coll. M. Beaudouin, 864.66; MNHN-IU-2000-3066, 1 female (cl 12.1 mm, cw 11.3 mm; dry; lectotype of *O. savignyi*), Red Sea, coll. M. Clot Bey, 864.66; MNHN-IU-2000-1120–1123, 4 males (cl 7.6 mm cw 8.1 mm to cl 9.5 mm cw 9.7 mm; dry; paralectotypes of *O. savignyi*), Red Sea, coll. M. Clot Bey, 864.66.

**Description.** *Female*: Carapace (Fig. 2A, H) subcircular, about as long as wide, entire surface finely but densely tomentose; strongly vaulted longitudinally, rounded in lateral view; front slightly produced, subtruncate to weakly concave; anterolateral margins defined; dorsal surface smooth, regions weakly indicated, near absent.

Epistome (Fig. 2I) with broad triangular interantennular septum; median buccal margin with obtuse median point. Antennular sinus larger than orbit; antennules folded slightly obliquely. Antenna short, free antennal articles not extending dorsally beyond eye; antennal articles 1 and 2 fused to epistome. Eyes filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 2G) ischiomerus length about  $2.5 \times$  width; surface finely setose; inner margin sinuous, proximal two-thirds weakly concave, distomesial margin rounded, produced slightly beyond palp articulation; outer margin strongly convex. Carpus half propodus length. Propodus spatulate, length about twice width, gently tapering to blunt, round apex. Exopod margins convex; flagellum 2-segmented.



Cheliped (pereopod 1) (Fig. 2A, B) surface finely, densely tomentose. Dactylus and pollex relatively straight, apices crossing distally, without gape, irregular, setose. Dactylus longer than dorsal margin of propodus palm, occlusal margin with 1 or 2 small teeth. Pollex occlusal margin weakly crenulate, with small, low distal tooth and large, triangular proximal tooth; inner ventral margin with row of setae. Propodus palm dorsal margin length about  $1.1\text{--}1.2 \times$  height; ventral margin distinctly sinuous, concave at base of pollex. Carpus mesial margin with setal tuft, unarmed; merus unarmed, stout, shorter than propodus.

Walking legs (pereopods 2–5) similar (Fig. 2C–F) stout; relative lengths: pereopod 2  $\approx$  pereopod 3 > pereopod 4 > pereopod 5; surfaces finely but densely tomentose; pereopod 3–4 propodus with scattered setae on flexor margin and row of long natatory setae near extensor margin, extending onto dorsal surface of carpus; pereopod 5 carpus usually with row of setae on extensor margin. Meri unarmed, length  $3.5\text{--}3.8 \times$  height (pereopod 2–4), about  $3.0 \times$  height (pereopod 5). Propodi unarmed,  $2.7\text{--}2.8 \times$  height. Dactyli similar, stout, sparsely setose, strongly curved, falcate, evenly tapering, apices spiniform, corneous; flexor margin with 1 or 2 rows of minute, stiff, simple setae; pereopod 2–4 dactyli  $0.6\text{--}0.7 \times$  propodus length; pereopod 5 dactylus  $0.9 \times$  propodus length.

Egg diameter  $0.6\text{--}0.7$  mm (in preservative).

**Male:** Similar to female but smaller maximum size (Fig. 2J); carapace slightly more flattened laterally; chelipeds slightly more inflated; pereopods 2–5 articles stouter than in female. Pereopod 2–4 dactylus  $0.6 \times$  propodus length; propodus length  $2.0 \times$  height; merus length  $2.8\text{--}3.0 \times$  height. Pereopod 5 dactylus  $0.9 \times$  propodus length; propodus length  $1.7 \times$  height; merus length  $4.4 \times$  height. Abdomen narrow (Fig. 2K), distally tapering, widest at somite 3; somite 6 trapezoid, slightly wider than long, longer than telson; telson as long as or slightly wider than long, apex bluntly rounded. G1 apex with short, conical, spine-like papilla, directed anterolaterally; distal surface lateral margin fully setose; mesial margin setose along distal half (Fig. 2L, M). G2 short, simple, about one-fifth G1 length; exopod absent (Fig. 2N).

**Hosts.** Giant clams, Cardiidae: *Tridacna maxima* (Röding, 1798) (see Ruppell, 1830, as *T. elongata* Lamarck, 1819) and *T. squamosina* Sturany, 1899. Ramadan (1936) and Gohar & Al-Kholy (1957) consistently observed single male-female pairs in the host clams.

**Remarks.** Ruppell (1830) hesitantly named *Pinnotheres tridacnae* as a new species from the Red Sea, noting the strong similarity to Savigny's (1826: pl. 7, fig. 1.1–5) figures (incorrectly attributed by Audouin [1826] to *Pinnotheres veterum* Bosc, 1802), but apparently differing in having marginal setae on pereopod 5. Kraus (1843) went further and identified Savigny's (1826) form as *P. tridacnae*. Subsequently, Henri Milne Edwards (1853) erected *Ostracotheres* and formally named *O. savignyi*, again based

on Savigny's (1826) figures, separating his new species from *O. tridacnae* on the setation of the pereopod 5 extensor margin (said to be absent in the former, present in the latter). Paulson (1875), however, synonymised *O. savignyi* with *O. tridacnae*, citing variable pereopod 5 setation in his Red Sea material. Most subsequent authors followed Paulson (see Schmitt et al., 1973) although Pregonzer (1988) resurrected *O. savignyi*, erroneously treating *O. tridacnae* as glabrous rather than tomentose. The present specimens, including the type series of *O. tridacnae* and *O. savignyi*, have a dorsal tomentum and a setose pereopod 5, corroborating Paulson's (1875) synonymisation of the two species. The pereopod 5 setation within the wider series of specimens examined is variable, though usually present but sometimes easily overlooked.

The type series of *O. tridacnae* comprises three males and four females, from which Schmitt et al. (1973) selected a male lectotype (SMF 2719). The original type series of *O. savignyi* consisted of specimens figured by Savigny (1826) and additional material available to H. Milne Edwards (1853: pl. 11 fig. 10). Savigny's (1826) material is now lost (Guinot pers. com.). Two dry lots from the Red Sea labelled as *O. savignyi*, however, are present in the old collections of the MNHN, collected by Beaudouin and M. Clot Bey, respectively, and clearly referable to *O. tridacnae*. The Beaudouin specimens (MNHN-IU-2000-3069) postdate 1853 and cannot be type material (Guinot & Cleva, 2009). Clot Bey (Antoine Barthélémy Clot, 1793–1868), however, was based in Egypt from 1825–1849 (Aboul-Enein & Puddy, 2016) during which he provided many specimens to the MNHN. These include the series of four males and one female labelled as *O. savignyi* (MNHN-IU-2000-3066, 2000-1120–1123; Fig. 3), which were available to H. Milne Edwards, and can thus be considered syntypic. Of these, the largest syntype (female, cl 12.1 mm, cw 11.3 mm; MNHN-IU-2000-3066), selected on the advice of Danièle Guinot, is designated as the lectotype to fix the identity of the species. The sexes in *O. tridacnae* are largely similar, differing in primary sexual features and maximum body size (females to cl 15.4 mm, males to cl 12.1 mm).

Schmitt et al. (1973) (citing Ruppell, 1830) listed *Pinna* sp. as a host of *O. tridacnae*, but Ruppell (1830) was in fact referring to secondary observations on a Mediterranean pinnotherid in *Pinna*, and clearly stated that his new species was only from *Tridacna*. Adensamer (1897) recorded pinnotherids from the Red Sea in *Tridacna* and ascidians, which he identified as *O. tridacnae* and *O. savignyi*, respectively. H. Milne Edwards (1853), however, did not record the host of the types of *O. savignyi* (= *O. tridacnae*); Adensamer (1897) presumably simply 'matched' the two species names to the specimens from the two hosts. Reexamination of Adensamer's (1897) material revealed that the specimens reported as *O. savignyi* from ascidians are referable to *O. cynthiae*. Thus, *O. tridacnae* is confirmed only from *Tridacna*. In the Red Sea area, *O. tridacnae* is the only pinnotherid hosted by *Tridacna*, but elsewhere in the Indo-West Pacific, is apparently replaced by *Xanthasia murigera* White, 1846 or *Tridacnatheres whitei* (De Man, 1888) (Ahyong & Ng,

2005). *Xanthasia murigera* and *T. whitei* differ considerably from *O. tridacnae* in carapace ornamentation and presence of a G2 exopod (absent in *O. tridacnae*); *T. whitei* further differs by its 3- rather than 2-segmented maxilliped 3 palp (Ahyong & Ng, 2005).

Outside the Red Sea area, *O. tridacnae* has been reported only from two South African localities: the Natal coast (Kraus, 1843, as *P. tridacnae*) and Simons Bay (Lenz & Strunck, 1914), with no new records since then. Subsequent literature records of *O. tridacnae* from southern Africa (Stebbing, 1910; Barnard, 1950; Schmitt et al., 1973; Kensley, 1981; Emmerson, 2016) derive from Krauss (1843) and Lenz & Strunck (1914). The Simons Bay material, reexamined herein (ZMB 17923, 1 male, cl 2.6 mm, cw 2.7; 1 juvenile male, cl 2.3 mm, cw 2.5 mm and cl 2.6 mm, cw 2.7 mm), is referable to *Afropinnotheres dofleini* (Lenz in Lenz & Strunck, 1914) (see Ng, 2018). *Ostracotheres tridacnae* and juvenile *A. dofleini* have a superficially similar habitus and body setation, making small specimens easily confounded unless the maxilliped 3 palp is examined carefully. Unfortunately, Krauss' (1843) material from Natal, perhaps the basis of Lenz & Strunck's (1914) identification, could not be traced, but his record is probably also based on *A. dofleini*, which is common on the Natal coast (Emmerson, 2016). South African records of *O. tridacnae* are herein referred to *A. dofleini*. Neither Lenz & Strunck nor Krauss indicated the South African host of their material, although the male paralectotype of *A. dofleini* from Simon's Bay was reported from an ascidian (Lenz & Strunck, 1914).

*Ostracotheres tridacnae* is distinguished from its congener, *O. cynthiae* [type locality: Djibouti], by its larger maximum size (females to cl 15.4 mm versus cl 7.8 mm), more densely tomentose carapace (versus sparse), and features of pereopods 2–5, as discussed further under the account of *O. cynthiae*.

In life, *O. tridacnae* has red corneas and is pale tan brown overall, with the carapace and upper surfaces of the pereopods darker reddish brown (Fig. 3E, F). The pale spots on the carapace of the figured specimens are artefacts of small sediment deposits and not the actual colour of the crabs.

**Distribution.** Western Indian Ocean: presently known only from the vicinity of the Red Sea, from Djibouti (Obock) to the Gulf of Suez; shore to shallow subtidal depths.

#### *Ostracotheres cynthiae* Nobili, 1906a (Figs. 1, 4)

*Ostracotheres savignyi*. — Adensamer, 1897: 108. — Heller, 1861a: 20, 32. (Not *O. savignyi* H. Milne Edwards, 1853).

*Ostracotheres Tridacnae*. — Heller, 1861a: 20, 32; 1861b: 371. (Not *O. tridacnae* [Rüppell, 1830]).

*Ostracotheres cynthiae* Nobili, 1906a: 409; 1906b: 299, 300, 301–302, fig. 9.

*Ostracotheres cynthiae*. — Laurie, 1915: 465–466, text-fig. 3, pl. 45 fig. 3, 3a, 3b, tab. 3. — Tesch, 1918: 262, 287. — Monod, 1938: 145–146, fig. 25, 26A. — Guinot, 1967: 279. — Schmitt et al., 1973: 6, 28. — Takeda & Konishi, 1989: 1222. — Ng et al., 2008: 250.

NOT *Ostracotheres cynthiae*. — Tesch, 1918: 263 (= probable undescribed species).

**Type material.** Lectotype: MNHN-IU-2014-11992 (B10561), female (cl 6.8 mm, cw 8.0 mm), Djibouti, coral reef, from branchial cavity of *Cynthia*, coll. Gravier, 1904. Paralectotype: MNHN-IU-2014-11992 (B10561), juvenile female (cl 3.5 mm, cw 4.3 mm), collected with lectotype.

**Other material examined.** ZRC 2017.0223, 1 ovigerous female (cl 3.9 mm, cw 4.2 mm), Djibouti, in *Herdmania* sp., coll. Coutiere, 1897; ZRC 2017.0227, 2 spent females (cl 4.0 mm, cw 4.1 mm; cl 5.6 mm, cw 5.7 mm), Gulf of Suez, in ascidian *Herdmania momus* (Savigny, 1816), coll. C. Monniot, March 2001; MNHN B10562, 1 ovigerous female (cl 7.8 mm, cw 8.4 mm), Gulf of Suez, 28°36–45'N, 32°52–54'E, 18–30 m, sand and rocks, Sta. XIII, coll. Dollfus, 9 December 1928; NHMW 10062, 1 female (cl 3.8 mm, cw 3.8 mm), Red Sea, coll. G. Frauenfeld, 1855, don. Frauenfeld estate, AN: 1896.XI.39; NHMW 10063, 1 ovigerous female (cl 4.0 mm, cw 4.0 mm), Red Sea, from ascidian, don. Koelbel estate, AN: 1893.III.130.

**Description.** *Female*: Carapace subcircular (Fig. 4A), as long as wide or slightly wider than long, surface with short, sparsely scattered setae; strongly vaulted longitudinally, rounded in lateral view (Fig. 4M); front slightly produced (more prominent in smaller specimens), convex to subtruncate (Fig. 4A, N, O); anterolateral margins defined; dorsal surface smooth, regions weakly indicated, near absent.

Epistome (Fig. 4C) with narrow interantennular septum; buccal margin with short triangular median point. Antennular sinus larger than orbit; antennules folded slightly obliquely. Antenna short, free antennal articles not extending dorsally beyond eye; antennal articles 1 and 2 fused to epistome. Eyes filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 4I, D) ischiomerus length about 2.2 × width; surface finely and sparsely tomentose; inner margin sinuous, proximal two-thirds weakly concave, almost straight, distomesial margin rounded, produced slightly beyond palp articulation; outer margin strongly convex. Carpus longer than half propodus length. Propodus spatulate, length about twice width, subquadrate, apex rounded. Exopod margins convex; flagellum 1-segmented.

Cheliped (pereopod 1) (Fig. 4A, B) surface finely tomentose. Dactylus and pollex curved, apices crossing distally, without gape, irregular, setose distally. Dactylus longer than dorsal margin of propodus palm; with low, irregular occlusal teeth along proximal half. Pollex occlusal margin weakly crenulate, with small, distal tooth and large, triangular proximal tooth; inner ventral margin with row of setae. Propodus palm dorsal margin length about as long as high; outer surface with irregular shallow pits; ventral margin distinctly sinuous, concave at base of pollex. Carpus mesial margin with setal tuft, unarmed; merus unarmed, stout, shorter than propodus.

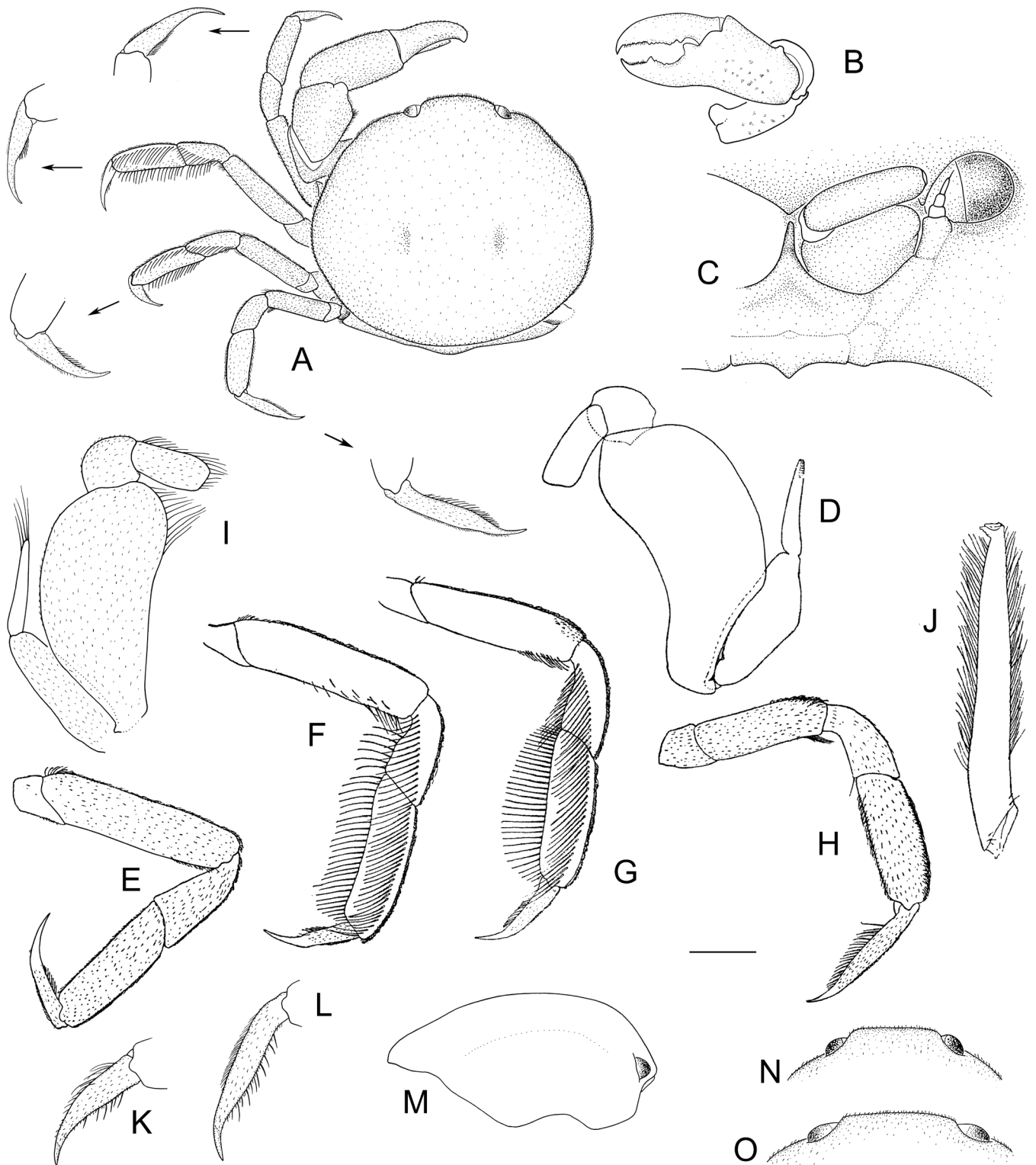


Fig. 4. *Ostracotheres cynthiae* Nobili, 1906. A–H, ovigerous female, cl 7.8 mm, cw 8.4 mm, Gulf of Suez, MNHN B10562; I, female lectotype, cl 6.8 mm, cw 8.0 mm, Djibouti, MNHN-IU-2014-11992; J, male, Gulf of Suez; K–N, female, cl 3.8 mm, cw 3.7 mm, Red Sea, NHMW 10062; O, ovigerous female, cl 4.0 mm, cw 4.0 mm, Red Sea, NHMW 10063. A, dorsal habitus; B, left chelipid, anterior view; C, cephalothorax, anterior view; D, left maxilliped 3; E–H, right pereopods 2–5; I, right maxilliped 3; J, left G1, sternal view; K, left pereopod 4 dactylus; L, left pereopod 5 dactylus; M, carapace, right lateral view; N–O, carapace front, dorsal view. (D–H, J, after Monod, 1938: fig. 25). Scale: A, B = 2.0 mm; C, D, I, J, = 0.5; E–H, M–O = 1.0 mm; K–L = 0.5 mm.



Walking legs (pereopods 2–5) similar (Fig. 4E–H), stout; relative lengths: pereopod 3 > pereopod 2 > pereopod 4 > pereopod 5; surfaces finely and sparsely setose; pereopods 2–5 with row of short setae along extensor margins of propodus to merus and short distal row of longer setae on distal flexor meral margin; pereopod 3–4 propodus with row of long natatory setae near extensor margin, extending onto dorsal surface of carpus; each article with row of natatory setae on flexor margin. Meri unarmed, length 3.9–4.2 × height (pereopods 2–4), about 3.2 × height (pereopod 5). Propodi unarmed, length 3.4–3.9 × height (pereopods 2–5). Dactyli (pereopods 2–4) similar, slender, lengths subequal; gently curved, evenly tapering, apices spiniform, corneous; surfaces and extensor margin sparsely setose; one- to two-thirds of flexor margin lined with elongated, stiff, simple setae; 0.6–0.7 × propodus length. Pereopod 5 dactylus slender, gently curved, as long as or longer than propodus; proximal three-fourths of flexor margin straight or broadly convex resulting in sinuous flexor margin; apex spiniform, corneous; setation similar to that of pereopod 2–4.

Egg diameter 0.7–0.8 mm (in preservative).

**Male:** (Based on Laurie, 1915; Monod, 1938). Similar to female but smaller maximum size. Carapace slightly more flattened laterally. Abdomen narrow, distally tapering, widest at somite 3; somite 6 trapezoid, slightly wider than long, shorter than telson; telson slightly longer than wide, apex rounded. G1 apex with short, anterolaterally directed papilla; lateral and mesial margins setose along distal three-fourths (Fig. 4J). G2 not known.

**Hosts.** Ascidians, Pyuridae: *Cynthia* sp. (Nobili, 1906a), *Herdmania momus* (Savigny, 1816). Given taxonomic changes since 1906, the identity of *Cynthia* sp. reported by Nobili (1906a) is uncertain, although it could apply to *Herdmania* spp.

**Remarks.** *Ostracotheres cynthiae* closely resembles *O. tridacnae* in carapace shape but is readily distinguished by the morphology of the pereopod 2–5 dactyli and the less pronounced carapace and pereopod setation (relatively sparsely distributed versus finely but densely tomentose in *O. tridacnae*). The pereopod 2–5 dactyli are slender and almost linear in *O. cynthiae* rather than stout and falcate as in *O. tridacnae*. The pereopod 5 dactylus of *O. cynthiae* is also distinctly longer (versus subequal) than that of pereopod 4, with a straight to sinuous flexor margin (versus evenly curved) (Fig. 4A, G, H). In addition, the setation patterns of the pereopod 2–5 flexor margins differ: *O. tridacnae* has one or two rows of short, stiff simple setae whereas *O. cynthiae* always has only a single row and the setae are much longer (Fig. 2C–F, O, 4A, E–H, K, L). The two species also differ significantly in maximum known body size (*O. tridacnae* to cl 15.4 mm; *O. cynthiae* to cl 7.8 mm), commensurate with the disparate sizes of their respective hosts.

Nobili's (1906a) original syntypes of *O. cynthiae*, a female and a much smaller female (erroneously reported as a male by Nobili), are both extant, of which Schmitt et al.

(1973) designated the larger female as lectotype. Although now in delicate condition, the lectotype and paralectotype preserve the diagnostic pereopod and maxilliped 3 features, and rounded carapace, clearly evident also in the other Red Sea material examined here. Nobili's (1906b) reference to the carapace of the larger female as quadrangular is a misinterpretation of the specimen based on damage; the carapace in all specimens is rounded. No males of *O. cynthiae* were available for the present study, but based on Laurie's (1915: text-fig. 3, pl. 45 fig. 3, 3a, 3b) account and stylised figures of a male from the Red Sea, the carapace front is more pronounced and the chelipeds more inflated than in females, as in most other male pinnotherids. The distinctive walking leg dactyli of female *O. cynthiae* is evident also in males, as figured by Laurie (1915: pl. 45 fig. 3). The G1 of a male *O. cynthiae* from Djibouti figured by Monod (1938: fig. 25F) (Fig. 4J) has the distinctive anterolaterally directed tip present also in *O. tridacnae*. Monod (1938) referred to the specimen as a juvenile, though the G1 is apparently well developed; unfortunately, the specimen is no longer extant and additional material is required to fully document male morphology. Monod (1938) did not indicate the size of his specimens but Laurie (1915) reported an apparently mature male at 6 mm cl and cw. Females are recorded here to cl 7.8 mm but are ovigerous by cl 4.0 mm.

*Ostracotheres cynthiae* is known only from ascidians, whereas all confirmed hosts of *O. tridacnae* are bivalve molluscs (*Tridacna* spp.). As discussed under the account of *O. tridacnae*, Adensamer's (1897) Red Sea record of *O. savignyi* (= *O. tridacnae*) from ascidians is based on *O. cynthiae*.

Tesch (1918) attributed an ovigerous female from the Kai Islands, Indonesia, to *O. cynthiae* (host *Styela pneumonodes* Sluiter, 1895 = *Polycarpa aurata* [Quoy & Gaimard, 1834]: Styelidae), though described as having a dense dorsal tomentum and "strongly hooked" dactyli of pereopods 2–4, which contrast with the much more "straightened" dactylus of pereopod 5. The pereopod 2–5 dactyli of *O. cynthiae* sensu stricto, however, are all weakly curved and the dorsal setation short and sparse. Tesch's (1918) specimen requires restudy and probably represents an undescribed species; it is herein excluded from *O. cynthiae*. As such, *O. cynthiae* is confirmed only from the western Indian Ocean: Djibouti and the Gulf of Suez, Red Sea.

**Distribution.** Western Indian Ocean: vicinity of the Red Sea, from Djibouti to the Gulf of Suez; 18–35 m (Monod, 1938).

#### *Austrotheres* new genus

**Diagnosis.** *Female:* Carapace subcircular to sub-hexagonal, as long as or slightly longer than wide, posterior margin rounded, slightly projecting; sclerotised, hard; longitudinally vaulted, with weak to distinct epigastric ridge; front slightly produced anteriorly, subtruncate; anterolateral margins well defined, lateral surfaces near vertical; dorsal surface smooth or granulated, regions poorly to moderately defined, glabrous. Eyes visible in dorsal view. Antennal flagellum reaching

beyond mid-height of eye but not dorsal margin of orbit. Maxilliped 3 ischiomerus completely fused, without trace of suture; palp 2-segmented; carpus shorter than propodus; propodus spatuliform, widened distally; exopod flagellum 2-segmented, distally setose. Chelipeds equal, stout, robust, dactylus and pollex with simple, pointed tips. Pereopods 2–5 symmetrical from left to right, slightly compressed, ovate in cross-section; dactyli with simple, spiniform apices, subequal or pereopod 5 dactylus longer. Pereopod 5 articulating with body at same level as pereopod 4. Abdomen with 6 free somites and telson; in adults, widest at somites 4 and 5, covering bases of walking legs. Gonopore simple, ovate, on sternite 5 near mesial end of sternite 5/6 suture. *Male*: similar to female, though smaller, carapace posterior margin flattened; G1 straight, flattened, distinctly narrowing at distal 1/4, with distinct step followed by lanceolate tip oriented along main axis; G2 without exopod.

**Type species.** *Austrotheres pregenzeri* new species, by present designation.

**Etymology.** An arbitrary combination of of the Latin, *australis*, southern, and the suffix *-theres*, alluding to the southern distribution of the species of the genus. Gender: masculine.

**Composition.** *Austrotheres holothuriensis* (Baker, 1907) new combination, *A. pregenzeri* new species.

**Remarks.** *Austrotheres* closely resembles *Ostracotheres* in overall carapace shape (rounded to ovate, as long as wide or slightly longer than wide, with well-defined anterolateral margins and near vertical lateral surfaces), the 2-segmental maxilliped 3 flagellum, and similar, left–right symmetrical walking legs, but differs in having a relatively hard (versus firm but poorly sclerotised) carapace with an epigastric ridge, glabrous (versus finely setose) carapace surface, and the form of the G1. Whereas the G1 apex in *Ostracotheres* is blunt with a short, sharp, anterolaterally directed papilla (Fig. 2L, M, 4J), the G1 in *Austrotheres* is distally lanceolate, and approximately in line with the G1 axis (Fig. 6O, P, 7O, P). *Austrotheres* also similar to the monotypic ascidian associate, *Tunicotheres* Campos, 1996 (type species: *T. moseri* (Rathbun, 1918) from the western Atlantic. Species of both genera have natatory setae on pereopods 3–4 and a somewhat polygonal carapace, but *Tunicotheres* is readily separated by having pereopod 5 articulating above the level of pereopod 4, rather than at the same level as in *Austrotheres*.

Unlike most other pinnotherids, in which females rarely or never leave the host and have weakly sclerotised exoskeletons, both sexes in *Austrotheres* have a comparatively hard carapace, natatory setae on the walking legs, and apparently frequently venture outside judging from the provenance of material reported below. Such morphology and behaviour in *Austrotheres* is consistent with reproductive strategies exhibited by a number of other pinnotherids, such as *Tumidotheres* Campos, 1989 and *Fabia subquadrata* Dana, 1851 from the eastern Pacific, which temporarily leave their host for copulatory swarming (Campos, 1989, 2016).

Species of *Austrotheres* may also have similar reproductive strategies, but too little is presently known of their biology to make reliable inferences about behaviour. Both species of *Austrotheres* occur in the southern half of Australia (Fig. 5).

#### Key to male and female *Austrotheres*

1. Carapace surface smooth, without tubercles or granules.....  
.....*A. holothuriensis*
- Carapace surface rugose, especially on anterior half, with tubercles, rugosities and granules.....*A. pregenzeri*

#### *Austrotheres pregenzeri* new species

(Figs. 5, 6)

*Ostracotheres holothuriensis*. — Pregenzer, 1988: 21–28, figs. 10–16, 12a, 17–19. — Poore, 2004: 484, 486, fig. 154c, g, pl. 26H. — Ng et al., 2008: 250. (Not *O. holothuriensis* [Baker, 1907]).

*Pinnotheres holothuriensis*. — Davie, 2002: 433. (Not *P. holothuriensis* Baker, 1907).

**Type material (all New South Wales, Australia).** Holotype: AM P72226, female (cl 10.5 mm, cw 10.2 mm), S of Point Stephens lighthouse, Port Stephens, 32°45'02"S, 152°11'35"E, 14 m, from *Herdmania* sp., NSW1488, coll. S. Keable et al., 31 May 1998. Paratypes: AM P80529, 1 ovigerous female (cl 10.4 mm, cw 9.1 mm), SW side Boodelbah Island, E of Port Stephens, 32°42.4998'S, 152°13.5258'E, 10–13 m, from *Herdmania* sp. encrusted with hydroids, sloping boulder reef meeting flat sand bottom, NSW2905 (photo 16), coll. S. Keable et al., 10 March 2006; AM P63040, 1 male (cl 4.9 mm, cw 4.6 mm), 1 ovigerous female (cl 8.6 mm, cw 7.7 mm), Kurnell Pier, Botany Bay, 34°00.2'S, 151°12.5'E, 7 m, from pylons/pilings, BB KP1 P2-7, NSW Fisheries/CRIMP Survey, 21 Oct 1998.

**Other material examined (all Australia).** QUEENSLAND: MNHN-IU-2008-12984 (B9780), 1 ovigerous female (cl 9.8 mm, cw 9.0 mm), Heron Island, coll. A.J. Bruce, 1968.

NEW SOUTH WALES: QM W18368, 1 male (cl 6.1 mm, cw 5.6 mm), 'The Needles', Julian Rocks, Byron Bay, 28°36'08"S, 153°37'07"E, 12 m, fringing reef, from *Herdmania grandis*, coll. J. Kennedy, 2 February 1993; AM P101806, 1 ovigerous female (cl 8.5 mm, cw 7.7 mm), NW end South Solitary Island, 30°12.116'S, 153°15.978'E, 17.4 m, steep incline with large drab boulders encrusted with fixed growth, from *Herdmania* sp. NSW2808, coll. R. Springthorpe, 1 February 2005; AM P58218, 1 juvenile female (cl 3.9 mm, cw 3.7 mm), bulk liquids berth, Botany Bay, 33°58.5'S, 151°12.6'E, 3 m, from pylons/pilings, BB KP1 P1-3, NSW Fisheries/CRIMP Survey, 19 October 1998; AM P63041, 1 spent female (cl 7.2 mm, cw 6.2 mm), Channel Marker 4, Botany Bay, 33°59.3'S, 151°12.6'E, 3 m, from pylons/pilings, BB CH4 P1-3, NSW Fisheries/CRIMP Survey, 21 October 1998; AM P58219, 1 ovigerous female (cl 8.4 mm, cw 7.8 mm), Kurnell Pier, Botany Bay, 34°00.0'S, 151°12.5'E, 7 m, from pylons/pilings, BB KP1 P3-7, NSW Fisheries/CRIMP Survey, 21 October 1998; AM P63135, 1 juvenile female (cl 4.6 mm, cw 4.2 mm),

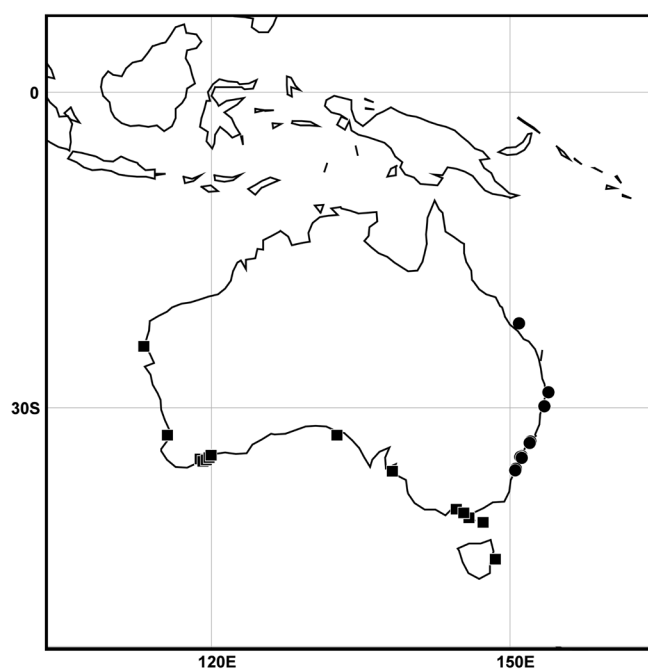


Fig. 5. Distribution of species of *Austrotheres* new genus. (■) *A. holothuriensis* (Baker, 1907) new combination; (●) *A. pregenzeri* new species.

Port Kembla, 34°28.3'S, 150°57.5'E, outer side of eastern breakwater, 7 m, from pylons/pilings, PK EBO Qual, NSW Fisheries/CRIMP Survey, 16 May 2000; NMV J13221, 3 ovigerous females (cl 6.4 mm, cw 5.7 mm; cl 9.9 mm, cw 8.9 mm; cl 11.5 mm, cw 10.6 mm), Shellharbour, 34°35'S, 150°52'E, coll. J.E. Watson, 1975; AM P101807, 1 ovigerous female (cl 7.8 mm, cw 7.2 mm), NW of Bass Point, under gravel loader jetty, Shellharbour, 34°35'29.91"S, 150°53'07.53"E, 10 m, scrapings including small *Herdmania grandis* and small encrusting orange bryozoan, NSW3908, 2 May 2010; ZRC 2018.1067, 1 male (cl 2.9 mm, cw 2.8 mm), 1 ovigerous female (cl 8.6 mm, cw 7.6 mm), NW of Bass Point, under gravel loader jetty, Shellharbour, 34°35'29.91"S, 150°53'07.53"E, 10.6 m, from *Herdmania grandis*, NSW3924, 2 May 2010.

**Description.** *Female*: Carapace (Fig. 6A, B) subcircular to longitudinally subovate, slightly longer than wide, lateral margins rounded to slightly flattened, longitudinally vaulted, profile rounded in lateral view; front slightly produced, subtruncate, broadly rounded, medially straight or weakly emarginated; anterolateral margins defined, coarsely irregular; dorsal surface rugose, regions weakly inflated across anterior half of carapace, demarcated by shallow grooves, surfaces rugose, irregularly, coarsely tuberculate, granulate, most pronounced in largest specimens; epigastric region slightly raised, anterior ridge prominent, transverse, anteriorly divided into four by short emarginations; posterior half of surface smooth or with scattered granules.

Epistome (Fig. 6C) with broad triangular interantennular septum; median buccal margin with obtuse median point. Antennular sinus larger than orbit; antennules folded slightly obliquely. Antenna short, free antennal articles not extending

dorsally beyond eye; antennal articles 1 and 2 fused to epistome. Eyes filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 6D) margins and surface with short setae; ischiomerus length about  $2.3 \times$  width; inner, proximal two-thirds weakly concave, distomesial angle obtusely rounded; distal margin produced slightly beyond palp articulation; outer margin strongly convex. Carpus half propodus length. Propodus spatulate, length about twice width, distally widened, apex blunt, rounded. Exopod margins convex.

Cheliped (pereopod 1) (Fig. 6A, E) outer surface largely glabrous. Dactylus and pollex relatively straight, crossing distally, without gape, with row of short setae. Dactylus as long as dorsal margin of propodus palm, occlusal margin with 2 small teeth; surfaces smooth. Pollex occlusal margin irregular, crenulate, with low blunt tooth at midlength; inner ventral margin setose; inner surface of palm with short scattered setae. Propodus palm dorsal margin length  $1.3\text{--}1.5 \times$  height; ventral margin distinctly weakly concave at base of pollex. Carpus mesial margin with brush of setae, unarmed; merus unarmed, stout, shorter than propodus.

Walking legs (pereopods 2–5) similar (Fig. 6F–I); relative lengths: pereopod 2  $\approx$  pereopod 3 > pereopod 4 > pereopod 5; smooth, sparsely setose; pereopod 2 propodus with row of short flexor marginal setae; pereopod 3–4 propodus with row of long natatory setae near extensor margin, extending onto dorsal surface of carpus, each article with row of natatory setae on flexor margin, with short row of distal flexor marginal setae; pereopod 5 propodus flexor margin and distal meral flexor margin setose. Meri unarmed, length  $3.5\text{--}3.9 \times$  height (pereopods 2–4), about  $3.4 \times$  height (pereopod 5). Propodi unarmed,  $3.2\text{--}3.8 \times$  height. Dactyli similar, stout, strongly curved, falcate, evenly tapering, apices spiniform, corneous; flexor margin sparsely setose proximally; pereopod 2–4 dactyli  $0.6 \times$  propodus length; pereopod 5 dactylus  $0.7 \times$  propodus length.

Egg diameter 0.3–0.4 mm (in preservative).

*Male*: Similar to female but smaller maximum size, carapace tuberculation less pronounced (Fig. 6K). Cheliped palm with shallow, irregular pitting; palm dorsal margin length  $1.2\text{--}1.3 \times$  height. Abdomen narrow (Fig. 6N), distally tapering, widest at somite 3; somite 6 weakly trapezoid, slightly wider than long, about as long as telson; telson slightly wider than long, apex rounded to subtruncate. G1 with long setae along central one-third of margins, small tuft of short setae on step proximal to gently sinuous, glabrous, finely tapering, lanceolate tip (Fig. 6O, P). G2 short, simple, about one-fourth G1 length; exopod absent (Fig. 6Q).

**Hosts.** Ascidiaceae, Pyuridae: confirmed from *Herdmania grandis* (Heller, 1878) but reported from *H. momus* (Savigny, 1816) (Pregenzer, 1988). Kott (2002), however, showed that *H. grandis* in temperate Australia has been mistaken for the tropical *H. momus*. Pregenzer's (1988) host records of *H. momus* are probably based on *H. grandis*.



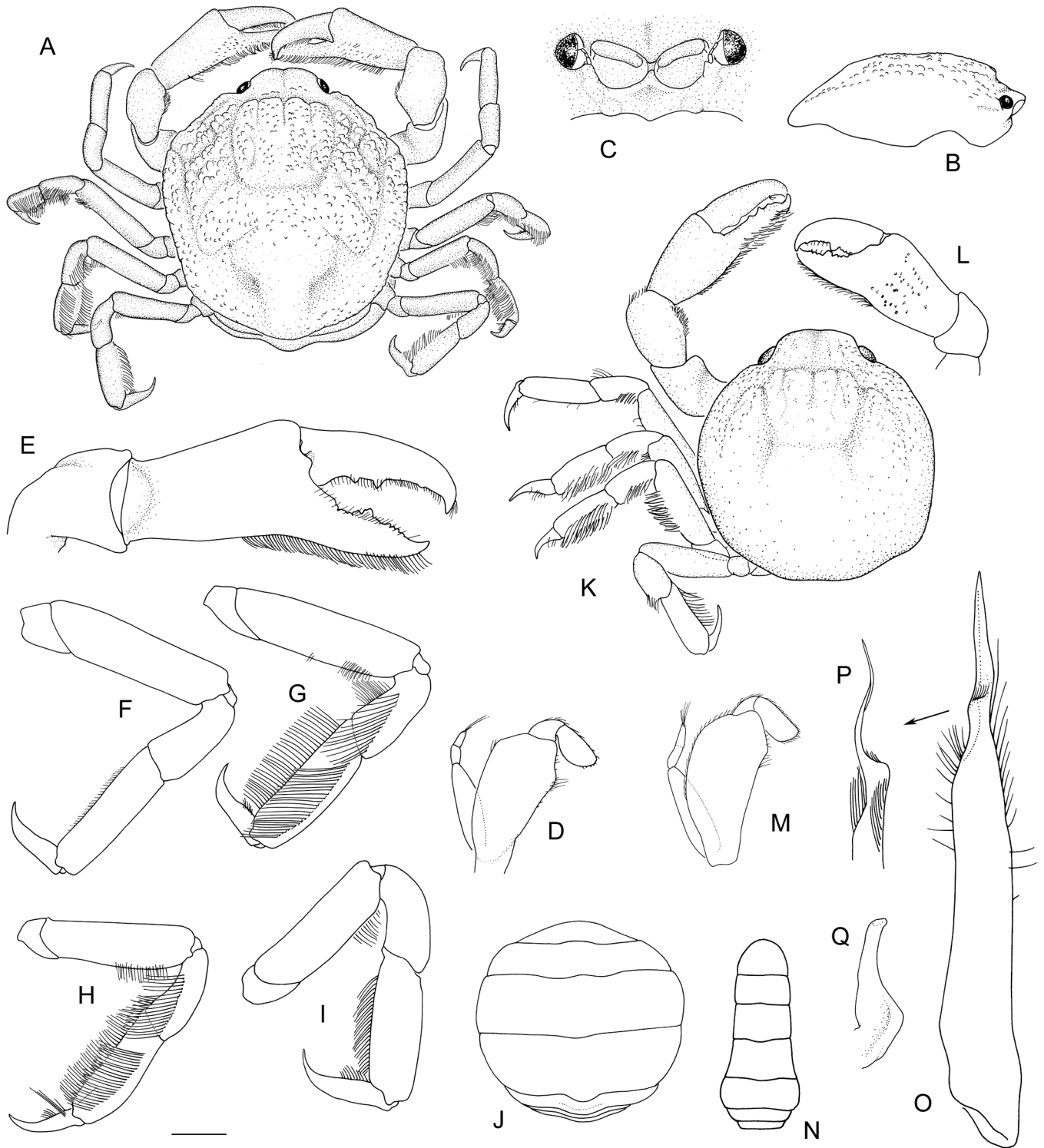


Fig. 6. *Austrotheres pregenzeri* new species. A–J: female holotype, cl 10.5 mm, cw 10.2 mm, Port Stephens, AM P72226. K–Q: male paratype, cl 4.9 mm, cw 4.6 mm, Botany Bay, AM P63040. A, K, dorsal habitus; B, carapace, right lateral view; C, cephalothorax, anterior view; D, M, right maxilliped 3; E, right cheliped, anterior view; F–I, right pereopods 2–5; J, female abdomen; L, left cheliped, anterior view; N, male abdomen; O, right G1, sternal view; P, right G1 tip, mesial view; Q, right G2, sternal view. Scale: A–B, J = 2.0 mm; C–I, K, L, N = 1.0 mm; M = 0.5 mm; O–Q = 0.25 mm.

**Etymology.** Named after Charles Pregonzer, for his contributions to the knowledge of Australian pinnotherids. Charles was the first to report specimens of this new species, albeit under the name *A. holothuriensis*.

**Remarks.** Review of type and other material of *A. holothuriensis* shows that the species is restricted to southern Australia between Victoria and Western Australia. Previous records of *A. holothuriensis* from New South Wales (Pregonzer, 1988) are referable to *A. pregenzeri* new species, presently known only from eastern Australia between southern Queensland central New South Wales. The two species thus have discrete distributions (Fig. 5), with that of *A. pregenzeri* encompassing the Peronian and Solanderian provinces, and *A. holothuriensis* corresponding largely to the Flindersian Province and extending slightly into the Solanderian Province at Shark Bay, Western Australia (Ahyong, 2017).

*Austrotheres pregenzeri* differs from *A. holothuriensis* in carapace ornamentation. In contrast to the smooth carapace with weakly indicated epigastric ridges of *A. holothuriensis*, the carapace surface of *A. pregenzeri* is rugose and epigastric ridges marked (Fig. 6A, B, K). The carapace of male *A. pregenzeri* is irregularly rugose and granular, with shallow demarcations between regions, but in females, ornamentation is much more elaborate. Female *A. pregenzeri* have pronounced carapace regions on the anterior half, covered in granules or irregular nodules. Surface ornamentation tends to be nodulose and isolated in smaller specimens, becoming increasingly coalesced and also more granular in the largest specimens. Small scattered granules are also present on the posterolateral and posterior margins of the carapace in the largest specimens. Although the rugose carapace ornamentation is most pronounced in the largest specimens, the smallest juvenile female examined (cl 3.9 mm, AM P58218) already has low irregular granules and weakly developed rugosities on the anterolateral surfaces of the carapace; by cl 4.6 mm (AM P63135), the distinctive carapace ornamentation is well developed. Likewise, carapace rugosity is evident in the smallest male examined (cl 2.9 mm, ZRC 2018.1067).

Morphological variation is slight in *A. pregenzeri* apart from the allometric changes in carapace ornamentation. Juvenile females have a more prominent front than adults, somewhat resembling that of males, and up to about 4 mm cl, have a narrow, male-form abdomen. Females are ovigerous by at least cl 6.4 mm, with a rounded, expanded abdomen. The smallest male examined (cl 2.9 mm, AM P101808) is sexually mature, with fully developed gonopods.

*Austrotheres pregenzeri* is commensal with ascidians, but a number of specimens were collected in the open, amongst algae and other biofouling. *Austrotheres pregenzeri* probably frequently spends time outside of the host as is probably also the case for *A. holothuriensis*.

**Distribution.** Known only from eastern Australia, from scattered localities between Heron Island, Queensland, and Shellharbour, New South Wales; 3–17.4 m.

***Austrotheres holothuriensis* (Baker, 1907)**

(Figs. 5, 7)

*Pinnotheres holothuriensis* Baker, 1907: 177, 178, pl. 23: fig 3 (type locality: Gulf St. Vincent, South Australia).

*Pinnotheres obesa*. — Fulton & Grant, 1906: 18 (Not *P. obesa* Dana, 1852).

*Pinnotheres obesus*. — Schmitt et al., 1973: 60. — Davie, 2002: 433–434. (Not *P. obesa* Dana, 1852).

*Ostracotheres* (?) (*Pinnotheres*?) *holothuriensis*. — Tesch, 1918: 287 (list).

*Pinnotheres holothuriensis*. — Tesch, 1918: 262. — Hale, 1927a: 173, 174, fig. 175. — Silas & Alagarwami, 1967: 1192, 1200. — Schmitt et al., 1973: 6, 14, 49–50. — Davie, 2002: 433.

*Ostracotheres holothuriensis*. — Takeda & Konishi, 1989: 1222. — Berggren, 1999: 187. — Ahyong & Brown, 2003: 11–12. — Ng et al., 2008: 250.

**Type material.** Lectotype: SAM C1389, female (cl 8.3 mm, cw. 7.2 mm; dry), Gulf St. Vincent, 12 fathoms [22 m], in holothurians, coll. J.C. Verco. Paralectotypes: SAM C12652, 1 male (cl 6.2 mm, cw 6.5 mm; dry), Gulf St. Vincent, 12 fathoms [22 m], in holothurians, coll. J.C. Verco; SAM C1388, 1 male (cl 4.3 mm, cw 4.3 mm), 1 juvenile male (cl 3.6 mm, cw 3.5 mm), 1 female (cl 5.3 mm, cw 4.9 mm), 1 juvenile female (cl 3.1 mm, cw 3.6 mm), Gulf St. Vincent, 5 fathoms [9 m], in ascidians, coll. J.C. Verco.

**Other material examined (all Australia).** VICTORIA: AM G5724, 1 male (cl 5.5 mm, cw 5.2 mm), Shoreham, Victoria, dredged, coll. F. Grant, 1900; NMV J58309, 1 female (cl 5.4 mm, cw 5.2 mm), Popes Eye, Port Phillip Bay, 38°17'S, 144°41'E, 6–10 m, from algal sample, coll. J. Watson, 22 March 2008; NMV J10682, 1 ovigerous female (cl 11.6 mm, cw 11.4 mm), eastern Bass Strait, S of Waratah Bay, 39°10'S, 145°59.8'E, 69 m, polyzoa bottom, HMAS Kimbla, K7/73-65, 26 November 1973.

TASMANIA: AM P4047, 1 female (cl 13.6 mm, cw 12.6 mm), E of Schouten Island, 73–92 m, coll. C. Harrison, 1910; NMV J10739, 1 male (cl 3.3 mm, cw 3.0 mm), Little Squally Cove, Deal Island, Bass Strait, 39°29'S, 147°21'E, 20 m, 3 May 1974; NMV J10740, 1 juvenile male (cl 2.4 mm, cw 2.2 mm), Little Squally Cove, Deal Island, Bass Strait, 39°29'S, 147°21'E, 20 m, 3 May 1974.

SOUTH AUSTRALIA: NMV J10684, 1 female (cl 9.2, cw 8.4 mm), Point Sinclair, 32°06'S, 132°59'E, coll. D.C. Pearsons, 26 June 1973; NMV J10737, 2 females (cl 8.1 mm, cw 7.3 mm; cl 7.1 mm, cw 6.6 mm), Point Sinclair, 32°06'S, 132°59'E, coll. D.C. Pearsons, 10 May 1973; SAM C1506, 1 male (cl 4.1 mm, cw 4.3 mm), 1 female (cl 10.3 mm, cw 9.4 mm), South Australia.

WESTERN AUSTRALIA: WAM C23501, 1 ovigerous female (cl 11.8 mm, cw 10.4 mm), Port Jackson Cove, Fitzgerald River National Park, 34°31.064'S, 119°15.911'E, 9

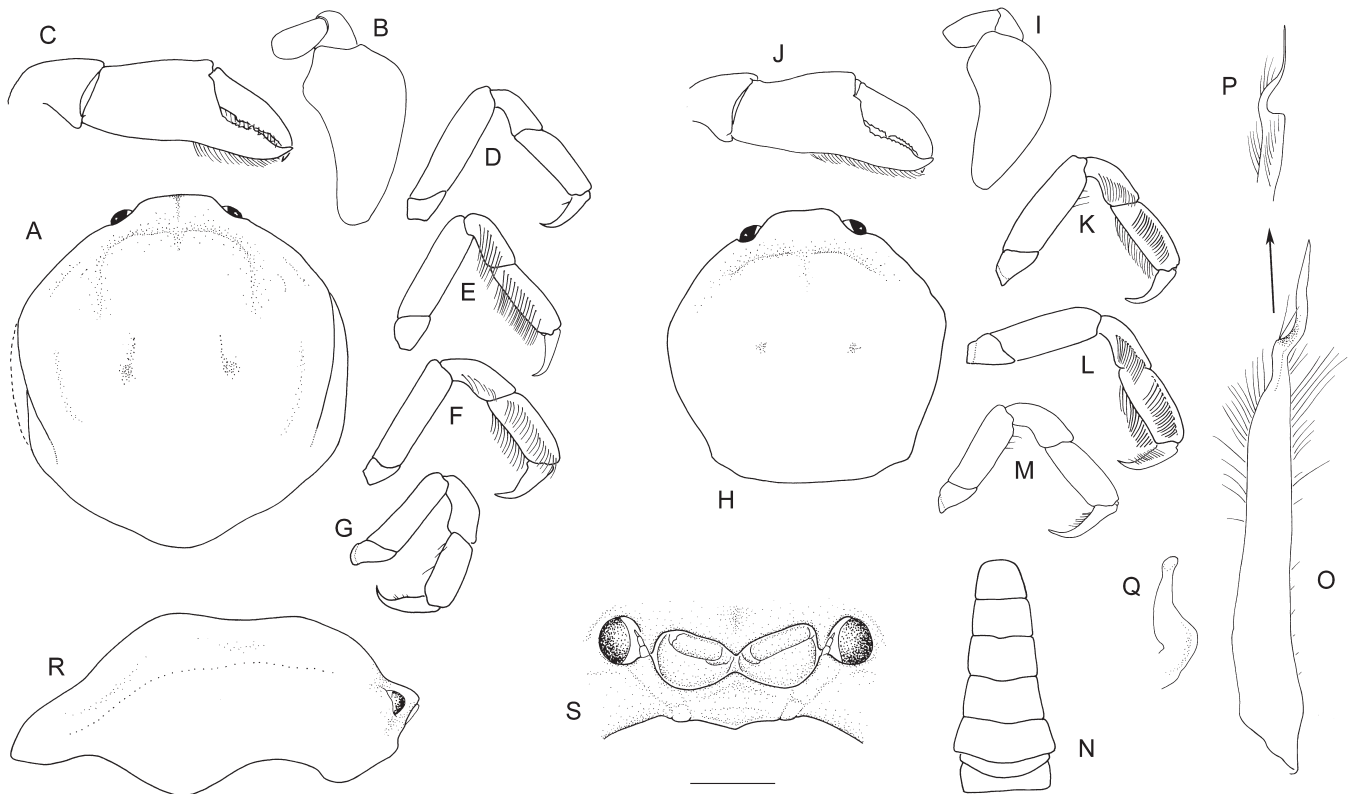


Fig. 7. *Austrotheres holothuriensis* (Baker, 1907) new combination. A–G, female lectotype, cl 8.3 mm, cw 7.2 mm, Gulf St. Vincent, SAM C1389; H–N, male paralectotype, cl 6.2 mm, cw 6.5 mm, Gulf St. Vincent, SAM C1389; O–Q, male, cl 5.5 mm, cw 5.2 mm, Shoreham, AM G5724; R–S, female, cl 13.6 mm, cw 12.6 mm, Tasmania, AM P4047. A, H, carapace, dorsal view; B, I, left maxilliped 3; C, J, right cheliped, anterior view; D, right pereopod 2; E, K, right pereopod 3; F, L, right pereopod 4; G, M, right pereopod 5; N, male abdomen; O, right G1, sternal view; P, right G1 tip, mesial view; Q, right G2, sternal view; R, carapace, right lateral view; S, cephalothorax, anterior view. A, C–H, J–M = 2.0 mm; B, I, N = 1.0 mm; O–Q = 0.5; R = 2.8 mm; S = 1.4 mm.

m, inside *Herdmania momus*, large boulders, mostly covered in brown algae, stn F38, coll. M. Berggren, 20 March 1997; WAM C23495, 1 ovigerous female (cl 9.7 mm, cw 9.1 mm), 1 spent female (cl 11.6 mm, cw 11.0 mm), Stream Beach, CALM Fitzgerald Reserve, 34°29.69'S, 119°17.01'E, 12 m, inside *Herdmania momus* with *Notopontonia platycheles*, granite reef, stn F12, coll. M. Berggren, 13 March 1997; WAM C23500, 1 male (cl 4.4 mm, cw 4.0 mm), 1 ovigerous female (cl 13.6 mm, cw 13.0 mm), NW side Horatio Island, CALM Fitzgerald Reserve, 34°30.365'S, 119°17.283'E, 18 m, inside *Herdmania momus*, granite reef, brown algae, under large boulder covered with sponges & a few tunicates, stn F37, coll. M. Berggren, 20 March 1997; WAM C23499, 1 male (cl 6.4 mm, cw 6.0 mm), James Cove, CALM Fitzgerald Reserve, 34°22.394'S, 119°26.835'E, 9 m, inside *Herdmania momus*, limestone reef covered in brown algae, stn F32, coll. M. Berggren, 18 March 1997; WAM C23493, 1 ovigerous female (cl 11.0 mm, cw 9.9 mm), Peppermint Beach South, CALM Fitzgerald Reserve, 34°24.028'S, 119°28.704'E, 12 m, granite reef, inside *Herdmania momus* with *Notopontonia platycheles*, stn F12, coll. M. Berggren, 11 March 1997; WAM C23494, 1 male (cl 7.8 mm, cw 7.6 mm), 1 ovigerous female (cl 11.0 mm, cw 10.5 mm), 1 juvenile female (cl 3.8 mm, cw 3.6 mm), Peppermint Beach South, CALM Fitzgerald Reserve, 34°24.028'S, 119°28.704'E, 12 m, granite boulders covered in algae, 9–12 m, inside *Herdmania momus* together with shrimps, stn F10, coll. M. Berggren, 10 March 1997; WAM C23498, 1 ovigerous female (cl 9.0 mm, cw 8.3 mm),

Whalebone Point, CALM Fitzgerald Reserve, 34°21.891'S, 119°31.597'E, 12 m, inside *Herdmania momus*, granite reef, some boulders, dense brown algae cover, stn F28, coll. M. Berggren, 18 March 1997; WAM C23497, 1 male (cl 7.3 mm, cw 7.0 mm), 1 ovigerous female (cl 14.8 mm, cw 13.6 mm), 1 female (cl 10.5 mm, cw 10.3 mm), Doubtful Islands (middle), 34°22.335'S, 119°36.241'E, 18 m, inside *Herdmania momus* with *Notopontonia platycheles*, rocky reef, dense cover of brown algae on free surfaces, stn F26, coll. M. Berggren, 17 March 1997; WAM C23496, 1 male (cl 9.2 mm, cw 8.8 mm), 1 ovigerous female (cl 11.5 mm, cw 10.3 mm), Red Island Point, CALM Fitzgerald Reserve, 34°01.617'S, 119°46.889'E, 12 m, inside *Herdmania momus* with *Notopontonia platycheles*, granite reef, high ridge on moderate slope, boulders, brown algae cover, stn F23, coll. M. Berggren, 16 March 1997; WAM C17302, 1 male (cl 5.5 mm, cw 5.4 mm), between Rottneest Island and Fremantle, triangle dredge, RV *Flinders* stn 11, coll. M. Clark, 27 June 1975; WAM C23502, 1 female (cl 10.0 mm, cw 9.2 mm; with rhizocephalan externa), N of Wedge Rock, outside Hospital Bay, Bernier Island, Shark Bay, 24°47.60'S, 113°10.26'E, 8–9 m, inside *Herdmania momus* with shrimp, stn SB214, coll. M. Berggren, 17 April 1997.

**Description.** *Female:* Carapace (Fig. 7A, R) subcircular to longitudinally subovate, slightly longer than wide in adults, slightly wider than long to slightly longer than wide in juveniles, lateral margins rounded to slightly flattened,



longitudinally vaulted, profile rounded to sinuous in lateral view; front slightly produced, subtruncate, broadly rounded, medially straight or weakly emarginated; anterolateral margins defined; dorsal surface smooth, without tubercles, regions not indicated; epigastric ridge blunt.

Epistome (Fig. 7S) with broad triangular interantennular septum; median buccal margin with obtuse median point. Antennular sinus larger than orbit; antennules folded slightly obliquely. Antenna short, free antennal articles not extending dorsally beyond eye; antennal articles 1 and 2 fused to epistome. Eyes filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 7B) margins and surface with short setae; ischimerus length about  $1.8 \times$  width; inner, proximal two-thirds concave, distomesial angle obtusely rounded; distal margin produced slightly beyond palp articulation; outer margin strongly convex. Carpus half propodus length. Propodus spatulate, length about twice width, distally widened, apex blunt, rounded. Exopod margins convex.

Cheliped (pereopod 1) (Fig. 7C) outer surface largely glabrous. Dactylus and pollex relatively straight, crossing distally, without gape, with row of short setae. Dactylus as long as dorsal margin of propodus palm, occlusal margin with 2 small teeth. Pollex occlusal margin irregular, crenulate, with low blunt tooth at midlength; inner ventral margin setose; inner surface of palm with short scattered setae. Propodus palm dorsal margin length  $1.3\text{--}1.5 \times$  height; ventral margin distinctly weakly concave at base of pollex. Carpus mesial margin with brush of setae, unarmed; merus unarmed, stout, shorter than propodus.

Walking legs (pereopods 2–5) similar (Fig. 7D–G); relative lengths: pereopod 2  $\approx$  pereopod 3  $>$  pereopod 4  $>$  pereopod 5; smooth, sparsely setose; pereopod 2 propodus with row of short flexor marginal setae; pereopod 3–4 propodus with row of long natatory setae near extensor margin, extending onto dorsal surface of carpus, each article with row of natatory setae on flexor margin, with short row of distal flexor marginal setae; pereopod 5 propodus flexor margin and distal meral flexor margin setose. Meri unarmed, length  $3.7\text{--}4.0 \times$  height (pereopods 2–4), about  $3.0 \times$  height (pereopod 5). Propodi unarmed,  $2.5\text{--}3.2 \times$  height. Dactyli similar, stout, strongly curved, falcate, evenly tapering, apices spiniform, corneous; flexor margin sparsely setose proximally; pereopod 2–4 dactyli  $0.7 \times$  propodus length; pereopod 5 dactylus  $0.9 \times$  propodus length.

Egg diameter 0.3–0.4 mm (in preservative).

*Male*: Similar to female but smaller maximum size (Fig. 7H–Q). Cheliped (Fig. 7J) palm dorsal margin length  $1.2\text{--}1.3 \times$  height. Abdomen narrow (Fig. 7N), distally tapering, widest at somite 3; somite 6 weakly trapezoid, slightly wider than long, about as long as telson; telson slightly wider than long, apex rounded to subtruncate. G1 with long setae along central one-third of lateral and mesial margins, small tuft of short setae on step proximal to gently sinuous, glabrous,

finely tapering, lanceolate tip (Fig. 7O, P). G2 short, simple, about one-fourth G1 length; exopod absent (Fig. 7Q).

**Hosts.** Holothurians and the ascidians, *Herdmania grandis* (Heller, 1878) and *H. momus* Savigny, 1816 (Pyuridae). As is the case with the ascidian host of *A. pregenzeri*, host records of *A. holothuriensis* as *H. momus* may referable to the similar species, *H. grandis*, given that the latter apparently does not occur in southern Australia (Kott, 2002). In Western Australia, *A. holothuriensis* was frequently observed sharing the branchial chamber of its ascidian host with the caridean shrimp, *Notopontonia platycheles* Bruce, 1991 (Palaemonidae); the crabs lived close to the inhalant siphon whereas the shrimps lived among the folds within the branchial chamber (Berggren, 1999). Crabs were often found in male-female pairs, singly or in some cases with three crabs (male, two females) in the same ascidian.

**Remarks.** *Austrotheres holothuriensis* occurs only in southern Australia, ranging from Western Australia to Victoria and Tasmania. Previous records of *A. holothuriensis* from eastern Australia (Pregenzer, 1988) are based on *A. pregenzeri* new species. Features distinguishing *A. holothuriensis* from *A. pregenzeri* are discussed under the account of the latter.

The type series of *A. holothuriensis* was collected from both ascidians and holothurians, of which the specimens from the latter host are larger (Baker, 1907). Whether host type affects crab size remains to be determined, although *A. pregenzeri* from eastern Australia, hosted by similar ascidians, attains a similar maximum size to *A. holothuriensis*. The largest female type specimen (cl 8.3 mm, cw. 7.2 mm; SAM C1389; Fig. 7A–G) is herein selected as the lectotype to fix the identity of the species.

A number of specimens of *A. holothuriensis* were collected outside the host, corroborating Baker's (1907: 178) observation that the "crab is able to swim, and probably does not spend all its time within the host". It is unusual for the range of hosts occupied by pinnotherid species to span phyla. Whereas *O. tridacnae* was thought to infect both molluscs (*Tridacna* sp.) and ascidians, the single record from the latter host (Adensamer, 1897) is based on a misidentification (see Remarks for *O. tridacnae* and *O. cynthiae*). *Austrotheres holothuriensis*, however, is confirmed from both holothurians and ascidians. Known obligate holothurian associates are conspicuously tomentose: *Alain* Manning, 1998, *Buergeres* Ng & Manning, 1998, *Holotheres* Ng & Manning, 1998, *Holothuriophilus* Nauck, 1880, and *Trichobezoares* Ng, 2018. That these taxa are probably not all closely related suggests that the dense setation might be adaptive for holothurian occupation. *Austrotheres holothuriensis*, however, has setose pereopod margins typical of other pinnotherids, but is otherwise largely glabrous. Notably, most records of *A. holothuriensis* are from ascidians or outside of the host. *Austrotheres holothuriensis* has only once been recorded from holothurians (Baker, 1907) and the lack of subsequent holothurian records may be an observational artefact given that ascidians are more routinely dissected

for taxonomic identification than holothurians. Alternatively, *A. holothuriensis* may be only a facultative holothurian associate, accounting for both the low relative frequency of host records and differences in body setation compared to known obligate holothurian commensals. The American *Opisthopus transversus* Rathbun, 1893, a temporary associate of holothurians, also lacks the body tomentum (Campos & Manning, 2000).

Males mature by cl 3.3–3.6 mm. The cl 2.4 mm male (NMV J10740) is a juvenile: pleopods 3–5 are absent but the G1 is incompletely developed; by cl 3.3 mm (NMV J10739), the gonopods are fully developed. Juvenile females to about cl 5.4 mm have a narrow, male form abdomen. The smallest ovigerous female *A. holothuriensis* examined is comparatively large (cl 9.0 mm, WAM C23498), but as in *A. pregenzeri*, female *A. holothuriensis* appear to be mature by about cl 6 mm judging from abdominal and pleopodal development. The northernmost specimen of *A. holothuriensis* (WAM C23502, Shark Bay) and one reported from Edithburgh, South Australia (Hale, 1927a), has a rhizocephalan parasite.

**Distribution.** Southern and western Australia, from Tasmania and Port Phillip Bay, Victoria, to Shark Bay, Western Australia; 6–92 m.

#### *Discorsotheres* new genus

**Diagnosis.** *Female:* Carapace weakly sclerotised, glabrous, cuticle thin, soft to firm; subquadrate in dorsal view, slightly wider than long, widest posteriorly, glabrous; longitudinally vaulted; front usually slightly produced anteriorly, subtruncate to broadly rounded in dorsal view; anterolateral margins defined, slightly produced anteriorly, forming bluntly rounded rim; dorsal surface smooth to slightly rugose, regions undefined, gently raised medially, forming low to distinct broad, blunt median prominence. Eyes small, usually visible in dorsal view. Antennal flagellum not reaching beyond mid-height of eye. Maxilliped 3 ischiomerus completely fused, without trace of suture; palp 2-segmented; carpus shorter than propodus; propodus spatulate; exopod flagellum 1-segmented, distally setose. Chelipeds equal, slender, smooth, largely glabrous; carpus length about twice width; dactylus and pollex occlusal surfaces broadened in distal half, forming flattened, slightly hollowed occlusal surfaces, margined by low, thin, corneous rim and/or minute denticles. Pereopod 2 and pereopods 4–5 symmetrical from left to right, similar, subcylindrical to ovate in cross-section; dactyli falcate, with simple spiniform apices. Pereopods 3 asymmetrical in length and dactyl-propodal form, usually left side the longer; shorter pereopod 3 similar to pereopod 2; longer pereopod 3 with propodus usually slightly widened distally, dactylus less curved and more elongate than on other side. Pereopod 5 articulating with body at level of pereopod 4. Abdomen with 6 free somites and telson; in adults, widest at somites 4 and 5, covering bases of walking legs. Gonopore simple, ovate, on sternite 5 near mesial end of sternite 5/6 suture. Male: unknown.

**Type species.** *Pinnotheres subglobosus* Baker, 1907, by present designation.

**Etymology.** An arbitrary combination of the Latin, *discors*, at variance with, and the suffix *-theres*, alluding to left-right asymmetry of pereopod 3. Gender: masculine.

**Composition.** *Discorsotheres camposi* new species, *D. subglobosus* (Baker, 1907) new combination, *D. spondyli* (Nobili, 1905) new combination, *D. subquadratus* (Sakai, 1939) new combination.

**Remarks.** Species herein referred to *Discorsotheres* new genus are removed from *Ostracotheres* on the basis of the subquadrate (versus rounded) carapace, the slender (versus robust) chelipeds with broadened occlusal surfaces, and asymmetrical pereopod 3 (versus symmetrical in length and structure). An asymmetrical pereopod 3 is also known from *Amussiotheres* Ng & Ho, 2016 (Indo-West Pacific), *Enigmatheres* Campos, 2009 (eastern Pacific), some American species currently assigned to *Fabia* Dana, 1851 (see Campos, 1996), *Solenotheres* Ng & Ngo, 2010 (Vietnam), and *Zaops* Rathbun, 1900 (western Atlantic) – all genera with a 3-segmented maxilliped 3 palp. Among pinnotherids with a 2-segmented maxilliped 3 palp, however, pereopod 3 asymmetry is unique to *Discorsotheres*. In *Discorsotheres*, the pereopod 3 of one side (usually the right) is similar in form to pereopods 2 and 4. The opposite pereopod 3, however, is typically more elongated, with the propodus usually slightly expanded distally and with the dactylus more elongated and with a less curved, sometimes reduced tip. The flexor margin of the propodus and dactylus of the longer pereopod 3 is distinctly more setose than on the opposite pereopod 3 (e.g., Fig. 9H–M, 10H, L, P, Q). The function of such asymmetry is not known, although a similar asymmetry is also exhibited by *Solenotheres*. Aside from the 2- rather than 3-segmented maxilliped 3 palp, the proportionally narrower carapace, and broadened rather than narrow cheliped finger tips, *Discorsotheres* is very similar to *Solenotheres*. Although *Zaops* (host *Crassostrea virginica* (Gmelin, 1791): Ostreidae) and *Amussiotheres* (host *Amusium* spp., *Ylistrum japonicum* (Gmelin, 1791): Pectinidae) also have an asymmetrical pereopod 3, the asymmetry is expressed principally in significant elongation of the leg of one side, with a straight, largely glabrous dactylus; both of these genera have a 3-segmented maxilliped 3 palp and show little similarity to either *Discorsotheres* or *Solenotheres*. All species of *Discorsotheres* occur in the Indo-West Pacific and have discrete distributions in the Persian Gulf (*D. spondyli*), southern Australia (*D. subglobosus*), northeastern Asia (*D. subquadratus*) and the tropical western Pacific (*D. camposi*) (Fig. 8).

Identification of species of *Discorsotheres* relies in part on the dorsal carapace ornamentation. Owing to the soft carapace of most species of the genus, poor preservation can overaccentuate the prominence of the median swelling, so care should be taken in identifying such specimens.

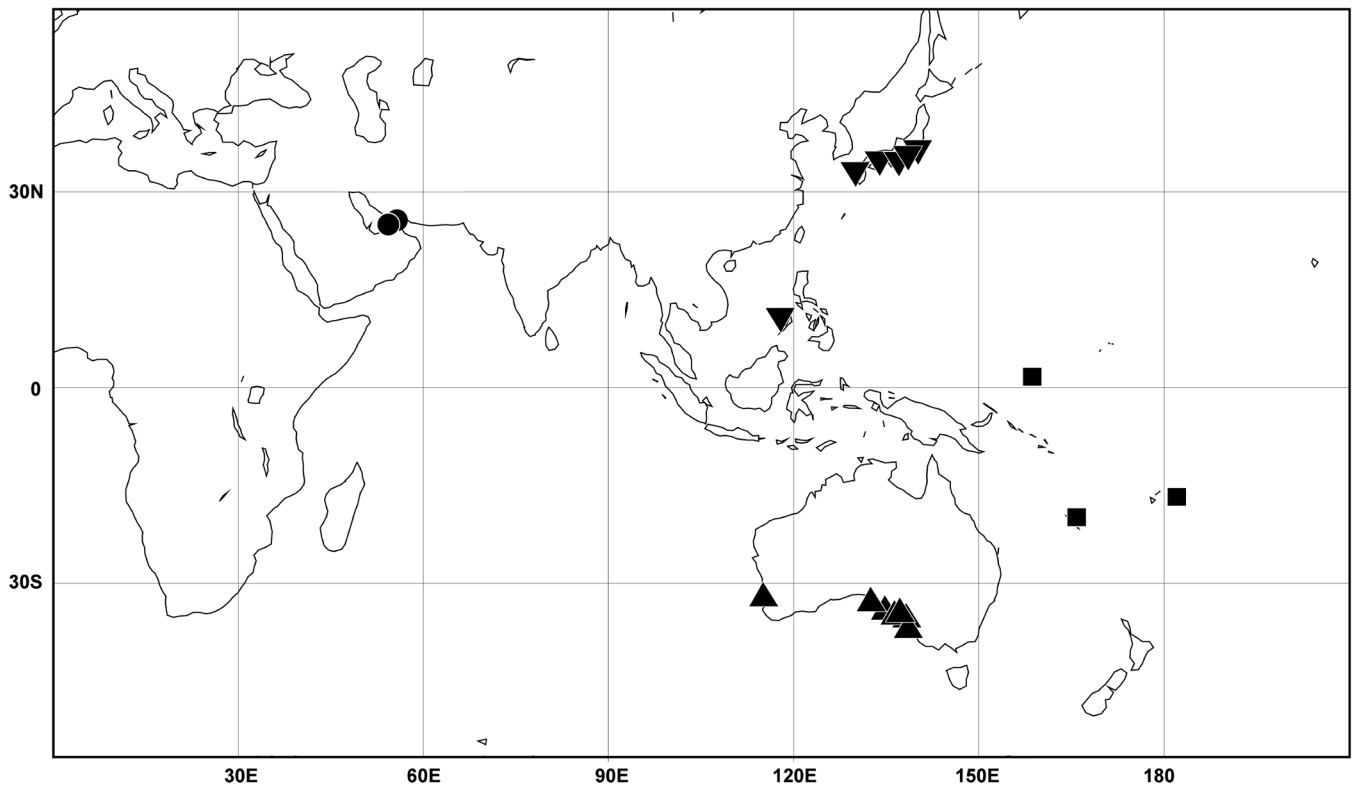


Fig. 8. Distribution of species of *Discorsotheres* new genus. (■) *D. camposi* new species; (●) *D. spondyli* (Nobili, 1905) new combination; (▲) *D. subglobosus* (Baker, 1907) new combination; (▼) *D. subquadratus* (Sakai, 1939) new combination.

**Key to female *Discorsotheres***

1. Distomesial angle of maxilliped 3 evenly rounded .....  
.....*D. spondyli* (tropical western Indian Ocean)
- Distomesial angle of maxilliped 3 obtusely angled.....2
2. Carapace longitudinal median swelling most pronounced in gastric and cardiac regions, giving distinctly sinuous, “hunched” lateral profile. Pereopod 3 propodus without row of long setae on distoflexor margin. Pereopod 4–5 dactyli 0.4 × propodus length .....*D. camposi* (tropical western Pacific Ocean)
- Carapace longitudinal median swelling low, indistinct, lateral profile rounded. Pereopod 3 propodus with long, unevenly arranged row of setae on distoflexor margin. Pereopod 4–5 dactyli 0.5 × propodus length.....3
3. Orbit and antennular fossa aligned almost transversely in anterior view. Pereopod 2 dactylus weakly curved. Pereopod 3 merus length 1.4–1.5 (usually 1.5) × pereopod 4 merus length.....*D. subglobosus* (southern Australia)
- Orbit and antennular fossa aligned distinctly obliquely in anterior view. Pereopod 2 dactylus strongly curved. Pereopod 3 merus length 1.4 × pereopod 4 merus length.....*D. subquadratus* (Japan and Nansha Islands, South China Sea)

***Discorsotheres subglobosus* (Baker, 1907)**

(Figs. 8, 9)

*Pinnotheres subglobosa* Baker, 1907: 179 (type locality: Gulf St. Vincent, South Australia).  
*Ostracotheres* (?) (*Pinnotheres*?) *subglobosus*. — Tesch, 1918: 287 (list).  
*Pinnotheres subglobosa*. — Rathbun, 1923: 96–97, fig. 1, pl. 16 fig 1. — Hale, 1927a: 173–174, fig. 174; 1927b: 312. — Silas & Alagarwarmi, 1967: 1186, 1191, 1210–1211. — Springthorpe & Lowry, 1994: 113.

*Pinnotheres subglobosus*. — Tesch, 1918: 262. — Schmitt et al., 1973: 6, 8, 9, 88. — Davie, 2002: 434.

*Ostracotheres subglobosus*. — Pregonzer, 1988: 17–21, figs. 1–9. — Takeda & Konishi, 1989: 1222. — Ahyong & Brown, 2003: 12. — Poore, 2004: 484, 486, fig. 154d, pl. 26H. — Ng et al., 2008: 250. — McDermott, 2009: tab. 1.

*Ostracotheres subglobosa*. — An et al., 2014: tab. 1.

**Type material.** Lectotype: AM P151, female (cl 10.6 mm, cw 12.4 mm), Gulf St. Vincent, South Australia, 34°53'17"S, 138°08'14"E, 17 fm [31 m], dredged, in pectens, coll. J.C. Verco. Paralectotypes: AM P102300, 1 ovigerous female (cl 8.7 mm, cw 9.9 mm), collected with lectotype; SAM C1390, 4 ovigerous females (cl 7.8 mm, cw 9.3 mm to cl 8.9 mm, cw 10.4 mm), 1 parasitised female (cl 7.8 mm, cw 10.3 mm), collected with lectotype.

**Other material examined (all Australia).** SOUTH AUSTRALIA: AM P64674, 2 ovigerous females (cl 8.6 mm, cw 10.6 mm; cl 9.5 mm, cw 11.7 mm), off Grange, Gulf St. Vincent, 34°54'S, 138°30'E, 15–20 m, inside scallops, 22 December 1971; SAM C7190, 1 spent female (cl 8.4 mm, cw 9.5 mm), Glenelg, Gulf St. Vincent, 35°00'S, 138°30'E, on reef in *Spondylus tenellus*, 37 ft [11 m], coll. N.N. Holmes, 21 September 1985; SAM C12812, 2 ovigerous females (cl 6.9 mm, cw 8.8 mm; cl 7.8, cw 9.5 mm), 2 spent females (cl 6.7 mm, cw 7.9 mm; cl 7.0 mm, cw 8.4 mm), 1 female (cl 7.2 mm, cw 8.5 mm; with rhizocephalan parasite), Seacliff Reef, Gulf St. Vincent, 35°01.8'S, 138°30.6'E, from 57 scallops, coll. F. Anderson, 1 April 1982; SAM C12813, 3 ovigerous females (cl 5.4 mm, cw 6.4 mm to cl 6.8 mm, cw 8.0 mm), 2 spent females (cl 5.1 mm, cw 6.0 mm; cl 6.0 mm, cw 6.7 mm), 1 female (cl 5.9 mm, cw 7.1 mm; with pair of



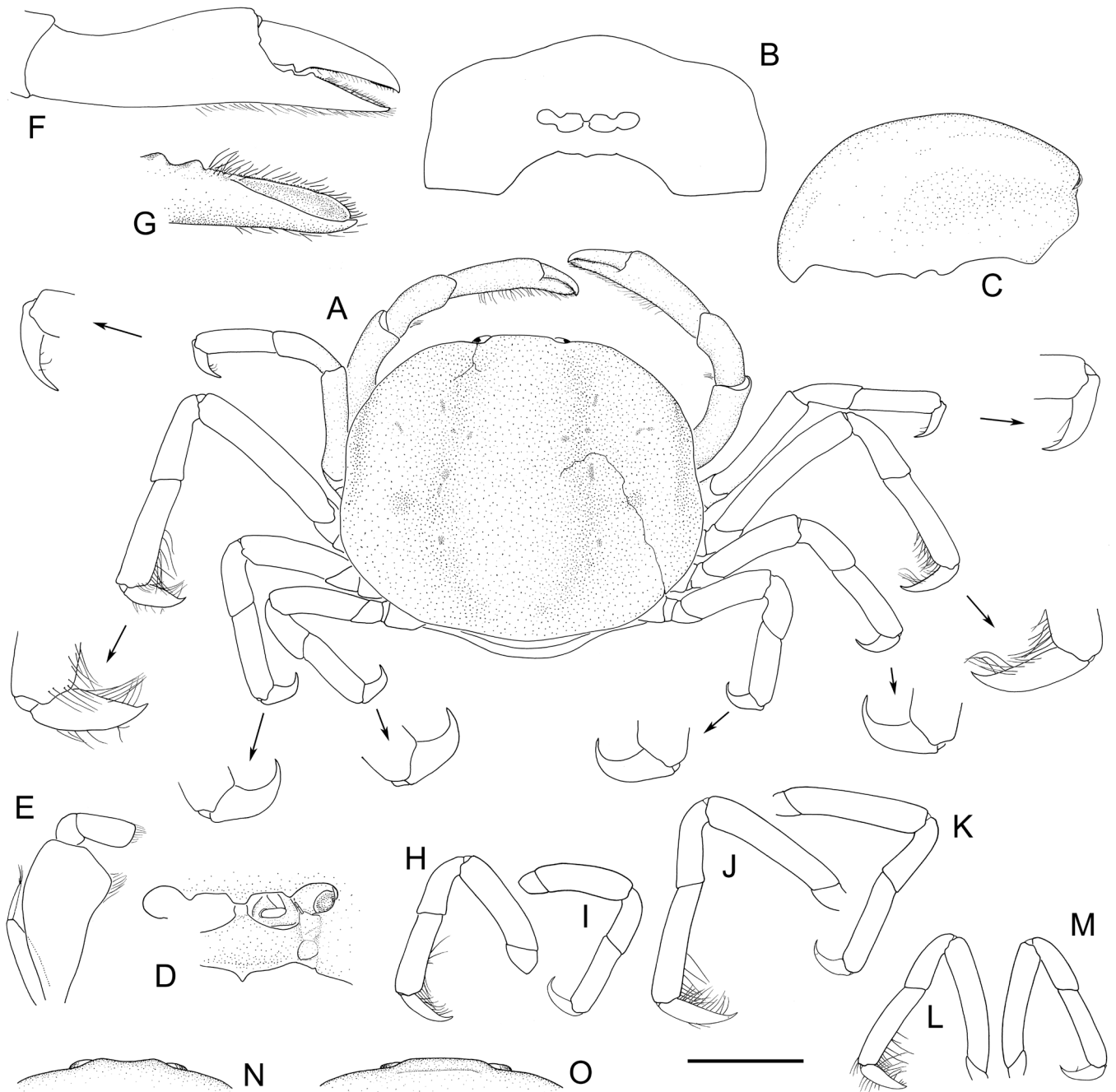


Fig. 9. *Discorsotheres subglobosus* (Baker, 1907) new combination. A–G, female lectotype, cl 10.6 mm, cw 12.4 mm, Gulf St. Vincent, AM P151; H–I, ovigerous female paralectotype, cl 8.7 mm, cw 9.9 mm, Gulf St. Vincent, AM P102300; J–K, ovigerous female, cl 8.6 mm, cw 10.5 mm, Edithburgh, AM P64673; L–M, ovigerous female, cl 7.3 mm, cw 8.9 mm, Edithburgh, AM P64673; N–O, females, cl 7.8 cw 8.4, cl 7.8 cw 9.5 mm, Seacliff reef, SAM C12812. A, dorsal habitus; B, carapace, anterior view; C, carapace, right lateral view; D, cephalothorax, anterior view; E, right maxilliped 3; F, right chela, anterior view; G, right cheliped pollex, oblique anterior view; H, J, L, left pereopod 3; I, K, M, right pereopod 3; N, O, carapace frontal margin, dorsal view. Scale: A–C, H–M = 4.0 mm; D–F, N, O = 2.0 mm; G = 1.0.

epicaridean isopods), Gulf St. Vincent, in scallop (*Pecten bifrons*), 40 ft [12 m], coll. N. Holmes, June 1982; AM E4519, 1 ovigerous female (cl 7.3 mm, cw 9.4 mm), off Marsden Point, Kangaroo Island, 35°34'S, 137°38'E, 17 fathoms [31 m], FIS *Endeavour*; SAM C11032, 1 ovigerous female (cl 6.9 mm, cw 8.2 mm), Hardwicke Bay, Yorke Peninsula, 34°53'29"S, 137°27'12"E, from scallop, coll. L. Brake, 11 February 1983; USNM 205905, 2 ovigerous females (cl 7.3 mm, cw 8.8 mm; ~7.1 mm, cw ~7.9 mm), Port Giles, Yorke Peninsula, 35°00'S, 137°46'E, from *Equichlamys bifrons*, coll.

A.J. Butler, 25 November 1978; AM P64673, 4 ovigerous females (cl 7.1 mm, cw 8.4 mm to cl 8.6 mm, cw 10.5 mm), off Edithburgh, Yorke Peninsula, 35°05'S, 137°45'E, 9 m, broken rubble & sponges, coll. N. Coleman, 16 December 1970; SAM C11037 (PCO455 photo), 1 ovigerous female (cl 6.3 mm, cw 7.2 mm), Edithburgh, Yorke Peninsula, 35°05'05"S, 137°44'45"E, 45 m, in *Equichlamys bifrons*, coll. K. Gowlett-Holmes, 18 April 2005; WAM C15774, 1 spent female (cl 5.2 mm, cw 6.0 mm), Edithburgh, Yorke Peninsula, 35°05'S, 137°44'E, jetty area, from Queen Scallop, coll. N.

Beach, 4 March 1985; AM P13500, 2 ovigerous females (cl 5.5 mm, cw 7.2 mm; cl 6.5 mm, cw 7.9 mm), Backy Point, near Whyalla, Spencer Gulf, 32°55'S, 137°48'E, from purple pecten, coll. B. Flounders; SAM C7092, 1 ovigerous female (cl 8.2 mm, cw 9.8 mm), opposite Nicholas Bay, between Reevesby & Partney Islands, Sir Joseph Banks Group, Spencer Gulf, 34°30'S, 136°16'E, 20 ft [6 m], sand and *Posidonia*, in scallop, coll. W. Zeidler, 8 January 1984; SAM C12814, 1 ovigerous female (cl 8.1 mm, cw 10.1 mm), Sir Joseph Banks Group, N Point, Marum Island, Spencer Gulf, 34°30.6'S, 136°15.0'E, 15–25 ft [4.5–7.5 m], reef, rubble, sand, sparse *Posidonia*, coll. K. Gowlett-Holmes & N. Holmes, 19 January 1986; AM P19997, 1 ovigerous female (cl 7.2 mm, cw 8.7 mm), Cape Donington, Spencer Gulf, 34°44'S, 136°00'E, 8 fathoms [15 m], rough bottom, coll. N. Coleman, 21 December 1970; SAM C11038, 1 ovigerous female (cl 7.9 mm, cw 9.3 mm), N side of St Francis Island, Nuyts Archipelago, 32°29'35"S, 133°17'06"E, 20–30 m, in *Spondylus tenellus*, coll. D. Howlett, December 1979.

WESTERN AUSTRALIA: WAM C12228, 1 spent female (cl 7.6 mm, cw 9.0 mm),  $\frac{3}{4}$  mile S of City Beach Groin, 31°56'S, 115°45'E, in living *Spondylus* shell, coll. J. Brouwer, 29 July 1961.

**Description.** *Female:* Carapace (Fig. 9A–C) soft, thin, rounded-subquadrate, slightly wider than long, glabrous, surface smooth, appearing polished; strongly vaulted longitudinally, evenly rounded in lateral view; front, transverse, straight or weakly concave, slightly produced, with or without shallow transverse groove on dorsal surface immediately behind front (Fig. 9A, N, O); anterolateral margins, unarmed, forming bluntly rounded rim; lateral surface almost vertical; dorsal surface smooth, gently raised medially forming broad, low, rounded ridge.

Epistome (Fig. 9D) with narrow interantennular septum; median buccal margin with short median point. Antennular sinus slightly larger than orbit, almost transversely aligned in anterior view; antennules folded slightly obliquely. Antenna short, free antennal articles to about mid-height of eye; antennal articles 1 and 2 fused to epistome. Eyes visible in dorsal view, filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 9E) ischiomerus surface glabrous, length about twice width; inner proximal two-thirds sinuous to weakly concave, distomesial angle obtuse, blunt; distal margin not produced beyond palp articulation; outer margin convex. Carpus slightly shorter than half propodus length. Propodus spatulate, length about twice width, distally widened, apex blunt, subtruncate. Exopod margins gently convex.

Cheliped (pereopod 1) (Fig. 9A, F) dactylus gently curved to straight, pollex relatively straight, apices crossing distally, without gape, irregularly, setose. Dactylus almost  $0.8 \times$  length of dorsal margin of propodus palm; outer occlusal margin with triangular proximal tooth and row of short corneous denticles and short setae extending to about midlength of dactylus, otherwise smooth; inner occlusal margin with row

of short corneous denticles and short setae. Pollex (Fig. 9G) outer occlusal margin weakly crenulate, with 2 small, blunt triangular proximal teeth; inner occlusal margin setose, with row of small corneous denticles along proximal three-fourths; inner ventral margin with row of setae. Propodus palm dorsal margin length  $1.9\text{--}2.2 \times$  height; ventral margin gently sinuous, slightly concave at base of pollex. Carpus mesial margin with setal tuft, unarmed. Merus unarmed, about as long as propodal palm.

Walking legs (pereopods 2–5) slender, smooth, similar in form (Fig. 9A, H–M); relative lengths: pereopod 3(both) > pereopod 4 > pereopod 2 > pereopod 5. Pereopod 2, 4, 5 merus to propodus unarmed, glabrous; propodus flexor and extensor margins subparallel, not widening distally; dactyli stout, half propodus length, glabrous or with few isolated setae; pereopod 2 dactylus curved, apex spiniform, slightly longer than pereopod 4–5 dactyli; pereopod 4–5 dactyli subequal, strongly falcate, apices spiniform, turning almost perpendicular to main axis. Pereopod 3 asymmetrical in length and dactyl-propodal form; “normal” pereopod 3 with merus to dactylus usually glabrous, dactylus and propodus occasionally with setose disto-flexor margin; dactylus apex spiniform, usually falcate. Longer pereopod 3  $1.1\text{--}1.2 \times$  length of “normal” pereopod 3; merus  $1.4\text{--}1.5$  (usually  $1.5$ )  $\times$  length of pereopod 4 merus; propodus usually slight expanded distally, distoflexor margin irregularly setose; dactylus usually longer, stouter but with shorter apex than dactylus of opposite side, setose.

Egg diameter 0.2–0.3 mm.

**Hosts.** Bivalves molluscs. Pectinidae: *Equichlamys bifrons* (Lamarck, 1819), *Pecten fumatus* Reeve, 1852 (as *Notovola meridionalis* [Tate, 1887]); Mytilidae: *Modiolus areolatus* (Gould, 1850) (as *Modiolaria australis* [Gray, 1826]); Spondylidae: *Spondylus tenellus* Reeve, 1856 (Hale, 1927a, b; Pregonzer, 1988).

**Remarks.** Pregonzer (1988) synonymised *D. subglobosus* (Baker, 1907) (South Australia) and *D. subquadratus* (Sakai, 1939) (Japan), although most subsequent authors have either questioned or not accepted the synonymy (Davie, 2002; Poore, 2004; Ng et al., 2008); both species are regarded here as valid based on comparison of Australian and Japanese material. In overall appearance, the two species are very similar, including carapace shape and morphology of the pereopod and maxilliped 3; they differ chiefly in the shape of the antennular fossa. In *D. subglobosus*, the upper margins of the antennular fossa are essentially transverse in anterior view, with the orbits and antennular fossae approximately transversely aligned (Fig. 9D). The upper margins of the antennular fossae in *D. subquadratus*, however, are oblique and slope downwards toward the midline, meeting at an obtuse angle, and the orbits are positioned at a distinctly higher level than the antennular fossae (Fig. 12D). Also, pereopod 3 is usually proportionally more elongate in *D. subglobosus* than in *D. subquadratus* with the longer pereopod 3 merus  $1.4\text{--}1.5$  (usually  $1.5$ ) times the length of the pereopod 4 merus (versus  $1.4$ ). Males of neither *D.*

*subglobosus* nor *D. subquadratus* are presently known. The smallest examined specimen of *D. subglobosus* is mature (cl 5.2 mm, cw 6.0 mm; WAM C15774), and the largest specimen (cl 10.6 mm, cw 12.4 mm; AM P151) considerably outsizes the largest known specimen of *D. subquadratus* (cl 7.5 mm, cw 9.2 mm; CBM ZC5989).

Like *D. subquadratus*, the carapace of *D. subglobosus* is weakly sclerotised and gently inflated longitudinally, forming a low, broad dorsomedian swelling, being broadest slightly posterior to the midlength. The swelling is much more prominent in *D. camposi* and absent in *D. spondyli*. Note that the dorsomedian prominence in *D. subglobosus* may appear artificially prominent in poorly preserved specimens in which the branchial carapace surfaces are partially collapsed.

In most specimens of *D. subglobosus*, the shorter pereopod 3 has a glabrous propodus and the typical falcate dactylus with one or two setae on the flexor margin; the longer pereopod 3 has a distally setose, often slightly expanded propodus and a straighter, blunt tipped, strongly setose dactylus (Fig. 9H–M). Some specimens, however, have setose propodi and dactyli on both pereopods 3 (as in the lectotype, AM P151; Fig. 9A), although other aspects of asymmetry remain. As in the lectotype, in about 75% of specimens, the left pereopod is the longer.

Of the known species of *Discorsopagurus*, *D. subglobosus* appears to be most closely related to *D. subquadratus* from East Asia, despite their wide geographic separation. This strongly anti-tropical distribution of this presumed cognate species pair in southern Australia and East Asia, is independently paralleled in other major marine groups, including fishes and molluscs (Randall, 1981; Norman & Kubodera, 2006; Gill & Mooi, 2017).

Two specimens from Gulf St. Vincent are parasitised, one with a rhizocephalan (SAM C12812), and another with a pair of epicaridean isopods, apparently *Rhopalione* sp. (SAM C12813).

**Distribution.** Gulf St Vincent, Spencer Gulf and the Nuyts Archipelago, South Australia; Perth, Western Australia; 6–45 m.

***Discorsotheres camposi* new species**  
(Fig. 8, 10)

**Type material.** Holotype: ZRC 2003.0299, spent female (cl 10.8 mm, cw 10.3 mm), near Toulavilla Village, SE coast of Vava'u Island, Tonga, 18°41'S, 173°59'W, 88–016, 5–30 m, from large oval clams, coll. T. Iliffe & S. Sarbu, 17 March 1988. Paratypes: CBM ZC13153, 1 ovigerous female (cw cl 13.6 mm, cw 15.5 mm), 2 spent females (cl 10.8 mm, cw 11.5 mm; cl 12.0 mm, cw 13.3 mm), Vava'u, Tonga, 10 March 1992; MNHN-IU-2017-11712, 1 ovigerous female (cl 12.9 mm, cw 14.0 mm), in front of Peng Beach, Sandal Bay, Loyalty Islands, 20°54.0'S, 167°07.3'E, 12 m, between coral heads, from *Spondylus* Bi77, LIFOU Stn 1423, 14 November 2000; USNM 104989, 2 spent females (cl 15.3

mm, cw 16.4 mm; cl 14.9 mm, cw 16.4 mm), Thokotamon Coral Knoll, Kapingamarangi, Caroline Islands, 01°04'N, 154°46'E, 9 m, No. 191, Pacific Science Board, coll. C. Hand, 12 July 1954.

**Description.** *Female:* Carapace (Fig. 10A–C) firm but not hard; subquadrate, slightly wider than long, glabrous, surface finely rugose under magnification; strongly vaulted longitudinally, bluntly polygonal in lateral view; front rounded, usually distinctly produced, with or without shallow transverse groove on dorsal surface immediately behind front (Fig. 10A, O, R, U); anterolateral margins, unarmed, forming bluntly rounded rim; lateral surface almost vertical; dorsal surface finely rugose, distinctly raised medially forming broad, rounded, longitudinal ridge, with peaks in gastric and cardiac regions; cardiac peak extending laterally onto branchial regions forming broad blunt transverse swelling; combined transverse and longitudinal swellings appearing cross-like in dorsal view.

Epistome (Fig. 10D) with narrow interantennular septum; median buccal margin with short median point. Antennular sinus size subequal to orbit, aligned distinctly obliquely in anterior view; antennules folded obliquely. Antenna short, free antennal articles extending to about one-third height of eye; antennal articles 1 and 2 fused to epistome. Eyes usually visible in dorsal view, filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 10E) ischiomerus surface glabrous, length about twice width; inner proximal two-thirds weakly concave, distomesial angle obtuse, blunt; distal margin not produced beyond palp articulation; outer margin convex. Carpus about half propodus length. Propodus spatulate, length about twice width, distally widened, apex blunt, subtruncate. Exopod margins straight to gently convex.

Cheliped (pereopod 1) (Fig. 10A, F, N) dactylus gently curved to straight, pollex relatively straight, apices crossing distally, without gape, irregularly, setose. Dactylus 0.7–0.8 × length of dorsal margin of propodus palm, outer occlusal margin with triangular proximal tooth, and row of short corneous denticles and setae extending to distal two-thirds of margin; inner occlusal margin with row of short setae, margin smooth. Pollex (Fig. 10N) outer occlusal margin weakly crenulate, with 2 small, blunt triangular proximal teeth; inner occlusal margin setose, with row of small denticles along proximal three-fourths; inner ventral margin with row of setae. Propodus palm dorsal margin length 2.0–2.5 × height; ventral margin gently sinuous, slightly concave at base of pollex. Carpus mesial margin with setal tuft, unarmed. Merus unarmed, about as long as propodal palm.

Walking legs (pereopods 2–5) slender, smooth, similar in form (Fig. 10A, G–M); relative lengths: pereopod 3(both) > pereopod 4 > pereopod 2 > pereopod 5. Pereopods 2, 4, 5 merus to dactylus unarmed, glabrous; propodus flexor and extensor margins subparallel, not widening distally; dactyli stout, length subequal, strongly falcate, apices spiniform, turning perpendicular to main axis, pereopod 2 dactylus 0.5 × propodus length, pereopod 4–5 dactylus 0.4



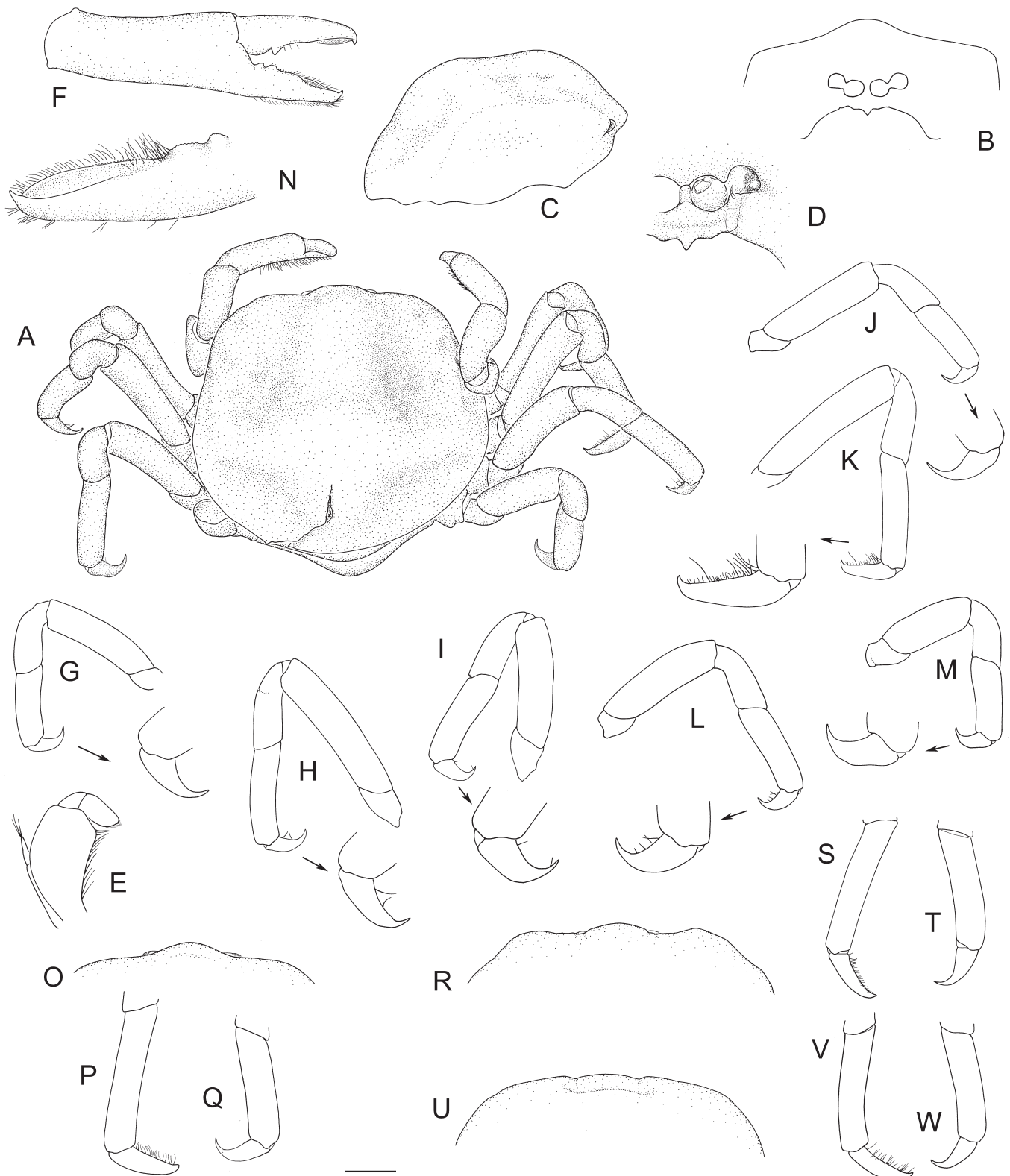


Fig. 10. *Discorsotheres camposi* new species. A–M, female holotype, cl 10.8 mm, cw 10.3 mm, Tonga, ZRC 2003.0299; N–Q, ovigerous female paratype, cl 12.9 mm, cw 14.0 mm, Lifou, MNHN-IU-2017-11712; R–T, ovigerous female paratype, cl 15.3 mm, cw 16.4 mm, Caroline Islands, USNM 104989; U–W, ovigerous female paratype, cl 14.9 mm, cw 17.5 mm, Caroline Islands, USNM 104989. A, dorsal habitus; B, carapace, anterior view; C, carapace, right lateral view; D, cephalothorax, anterior view; E, right maxilliped 3; F, right chela, anterior view; G–I, left pereopods 2–4; J–M, right pereopods 2–5; N, left cheliped pollex, oblique anterior view; O, R, U, carapace anterior margin, dorsal view; P, S, V, left pereopod 3 dactylus & propodus; Q, T, W, right pereopod 3 dactylus & propodus. Scale: A–C, G–M, O–W = 2.0 mm; D–F = 1.0 mm; N = 0.5 mm.

× propodus length. Pereopod 3 asymmetrical in length and dactyl form; “normal” pereopod 3 with merus to dactylus glabrous; dactylus apex spiniform, strongly falcate, similar to but slightly longer than pereopod 2 dactylus. Longer P3 1.1–1.2 × length of “normal” pereopod 3; merus 1.3 × length of pereopod 4 merus; propodus not expanded distally, glabrous; dactylus with blunt, often apex, longer, stouter than dactylus of opposite side, setose.

Egg diameter 0.2–0.3 mm (in preservative).

**Hosts.** Spondylidae: *Spondylus* spp.

**Etymology.** Named after Ernesto Campos for his extensive contributions to pinnotherid taxonomy.

**Remarks.** *Discorsotheres camposi* is the first species of the genus to be recorded from the tropical western Pacific. Of the four species of *Discorsotheres*, *D. camposi* has the most pronounced median longitudinal swelling on the carapace in which the gastric and cardiac regions are most swollen. These swollen gastric and cardiac regions present two blunt peaks, which in lateral view appear as low humps giving a “hunched” profile (Fig. 10C). The cardiac peak also extends laterally as a low blunt swelling. The median longitudinal swelling on the carapace of *D. camposi* is further accentuated by the broad, depressed anterior branchial surfaces on either side of the midline, and to a lesser extent on the posterior branchial surfaces. The blunt longitudinal and transverse swellings on the carapace, together appear cross-like in dorsal view (Fig. 10A). As a result, the carapace of *D. camposi* has a somewhat angular appearance, having a more prismatic than the rounded-subcuboid form in other congeners. The carapace of *D. camposi* is also comparatively firm and rugose compared to the soft, very smooth carapace of other species of the genus. In addition, the pereopod 4–5 dactyli of *D. camposi* are proportionally shorter than in congeners (0.4 versus 0.5 × propodus length).

The propodus of the longer pereopod 3 (usually the left side) of *D. camposi* is at most scarcely widened distally, although the dactylus has a distinctly setose flexor margin and a short, blunt apex. The relative length of the longer pereopod 3 propodus varies slightly, with the dactylus length ranging from slightly less to slightly more than half the propodus length. The dorsal outline of the anterior margin of the carapace also ranges from sinuous to almost transverse according to the prominence of the front. As with *D. subglobosus* and *D. subquadratus*, a shallow groove or crease may be present on the carapace surface immediately behind the frontal margin (Fig. 10A, O, R, U). As in congeners, the cheliped palm becomes more slender with increasing body size.

*Discorsotheres camposi* is presently known only from coral reefs of the western Pacific from *Spondylus* sp. and “large oval clams”.

**Distribution.** Tropical western Pacific from Tonga, Lifou and the Caroline Islands; 9–12 m depth.

### *Discorsotheres spondyli* (Nobili, 1905)

(Figs. 8, 11)

*Ostracoteres spondyli* Nobili, 1905: 164. — Nobili, 1906b: 300, 301; 1906c: 149–150, pl. 5 fig. 24, pl. 6 fig. 33.

*Ostracoteres spondyli*. — Tesch, 1918: 262, 263, 287. — Pérez, 1920: 1615. — Stephensen, 1945: 185–186, 198, 210. — Schmitt et al., 1973: 6, 29. — Page, 1985: 199. — Takeda & Konishi, 1989: 1222. — Springthorpe & Lowry, 1994: 113. — Ng et al., 2008: 250. — McDermott, 2009: tab. 1, 2. — An et al., 2014: tab. 1. — Naderloo, 2017: 423–424, fig. 38.3.

**Type material (all Persian Gulf, Abu Dhabi).** Lectotype: AM P5412, ovigerous female (cl 7.5 mm, cw 8.8 mm), bank NE of Arzana Island, collections among corals, inside *Spondylus*, stn LIII, coll. J. Bonnier & Ch. Perez, 1901. Paralectotypes: MNHN IU-2014-8621 (B10577), 32 females (cl 3.2 mm, cw 3.1 mm to cl 10.0 mm, cw 10.5 mm), 8 miles NNW of Arzana Island, 5 fms [9 m], stn LIV, in *Spondylus*, dredge, coll. J. Bonnier & Ch. Perez, 1901; MNHN IU-2014-11993 (B10576), 80 females (cl 2.0 mm, cw 2.4 mm to cl 9.5 mm, cw 10.5 mm), bank NE of Arzana Island, collections among corals, inside *Spondylus*, stn LIII, coll. J. Bonnier & Ch. Perez, 1901; RMNH D22681, 1 female (not measured), 8 miles NNW of Arzana Island, 5 fms [9 m], stn LIV, in *Spondylus*, dredge, coll. J. Bonnier & Ch. Perez, 1901.

**Description.** *Female:* Carapace (Fig. 11A–C) soft, thin, rounded-subquadrate, slightly wider than long, glabrous, surface smooth, appearing polished; strongly vaulted longitudinally, evenly rounded in lateral view; front weakly convex to straight, not produced; anterolateral margins, unarmed, forming bluntly rounded rim; lateral surface almost vertical; dorsal median surface without low, rounded longitudinal ridge, evenly outline evenly rounded in anterior view.

Epistome (Fig. 11D) with narrow interantennular septum; median buccal margin broadly obtuse. Antennular sinus slightly larger than orbit, aligned distinctly obliquely in anterior view; antennules folded obliquely. Antenna short, free antennal articles extending to about one-third to almost one-half height of eye; antennal articles 1 and 2 fused to epistome. Eyes visible in dorsal view, filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 11E) ischiomerus surface glabrous, length about twice width; inner proximal two-thirds weakly concave, distomesial margin produced mesially, evenly rounded, not forming angle; distal margin not produced beyond palp articulation; outer margin convex. Carpus slightly shorter than half propodus length. Propodus spatulate, length about twice width, distally widened, apex blunt, subtruncate. Exopod margins gently convex to slightly sinuous.

Cheliped (pereopod 1) (Fig. 11A, F, G) dactylus gently curved to straight, pollex relatively straight, apices crossing distally, without gape, irregularly, setose. Dactylus about 0.8 × length of dorsal margin of propodus palm; outer occlusal margin with triangular proximal tooth and row of short corneous

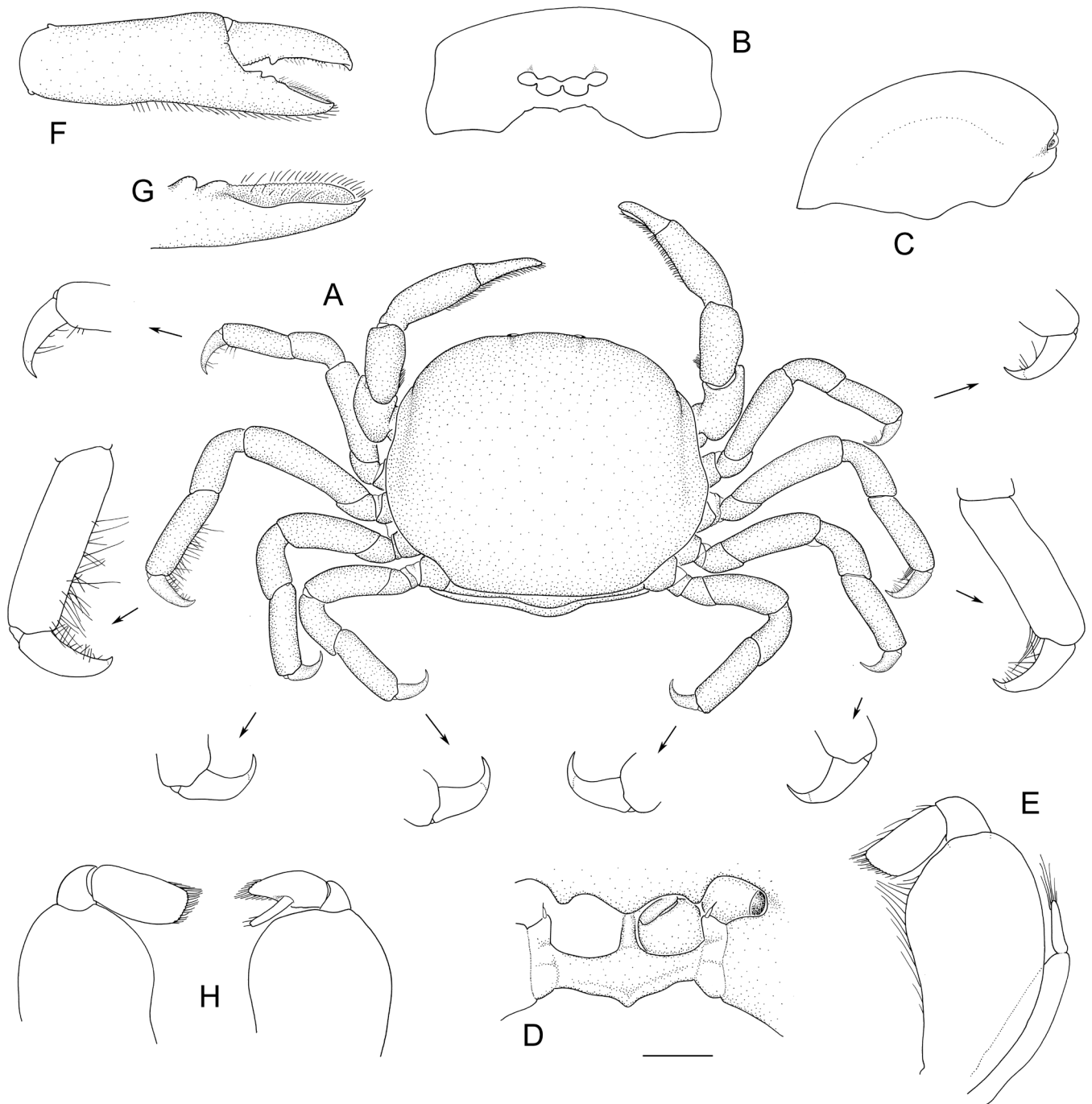


Fig. 11. *Discorsotheres spondyli* (Nobili, 1905) new combination. A–G, ovigerous female lectotype, cl 7.5 mm, cw 8.8 mm, Persian Gulf, AM P5412; H, female paralectotype, cl 9.0 mm, cw 10.9 mm, Persian Gulf, MNHN IU-2014-11993. A, dorsal habitus; B, carapace, anterior view; C, carapace, right lateral view; D, cephalothorax, anterior view; E, left maxilliped 3; F, right chela, anterior view; G, right cheliped pollex, oblique anterior view; H, right and left maxillipeds 3. Scale: A–C = 2.0 mm; D = 0.7 mm; E, G, H = 0.5; F = 1.0 mm; G = 0.5 mm.

denticles and short setae extending length of margin; inner occlusal margin with row of short short setae, margin smooth. Pollex (Fig. 11G) outer occlusal margin weakly crenulate, with blunt triangular and rounded proximal teeth; inner occlusal margin setose, weakly dentate along proximal three-fourths; inner ventral margin with row of setae. Propodus palm dorsal margin length 1.9–2.0 × height; ventral margin gently sinuous, slightly concave at base of pollex. Carpus mesial margin with setal tuft, unarmed. Merus unarmed, about as long as propodal palm.

Walking legs (pereopods 2–5) slender, smooth, similar in form (Fig. 11A); relative lengths: pereopod 3(both) > pereopod 4 > pereopod 2 > pereopod 5. Pereopods 2, 4, 5 merus to dactylus unarmed, glabrous; propodus flexor and extensor margins subparallel, not widening distally; dactyli stout, length subequal, half propodus length, apices spiniform, pereopod 2 dactylus moderately to strongly falcate, pereopod 4–5 dactyli strongly falcate, apices turning perpendicular to main axis. Pereopod 3 asymmetrical in length and dactyl form, merus and carpus glabrous; “normal” pereopod 3 propodus setose on distal one-third or less of flexor margin; dactylus



apex spiniform, falcate, similar to but slightly longer than pereopod 2 dactylus, flexor margin setose. Longer pereopod 3  $1.1 \times$  length of “normal” pereopod 3; merus  $1.4\text{--}1.5 \times$  length of pereopod 4 merus; propodus at most slightly expanded distally, distoflexor margin irregularly setose along distal two-thirds; dactylus longer, stouter but with slightly shorter, often blunter apex than dactylus of opposite side, setose.

Egg diameter 0.2–0.3 mm (in preservative).

**Hosts.** Bivalve molluscs: *Spondylus* sp. (Nobili, 1905; Naderloo, 2017). Schmitt et al. (1973) regard the host species as *S. exilis* Sowerby, 1895, on the basis of geographic distribution.

**Remarks.** *Discorsotheres spondyli*, known only from the Persian Gulf, differs from all other species of the genus in the evenly rounded rather than obtusely angled inner distal margin of the maxilliped 3 ischiomerus. It also has the simplest carapace ornamentation, having a smooth surface without a median longitudinal swelling (Fig. 11A–C). Note that the thin carapace cuticle in *D. spondyli*, if poorly preserved, can partially collapse creating a slight dorsomedian prominence, artificially resembling *D. subglobosus* or *D. subquadratus*. In *D. spondyli* and *D. subglobosus*, the flexor margin of the pereopod 2 dactylus is sparsely setose rather than glabrous as in *D. subquadratus* and *D. camposi*. The left pereopod 3 is longer than the right in about two-thirds of specimens examined.

The type material of *D. spondyli* examined here consists of 114 specimens from the vicinity of Arzana Island, Persian Gulf, in the collections of the AM, MNHN, and RMNH. One female is also deposited in the Zoological Survey of India (C253/1, not examined; Schmitt et al., 1973). A female (cl 7.5 mm, cw 8.8 mm; AM P5412) from station LIII is herein selected as the lectotype to fix the identity of the species. A strikingly abnormality in one paralectotype (female, cl 9.0 mm, cw 10.9 mm; MNHN IU-2014-8621; Fig. 11H) is the presence of a dactylus on the left maxilliped 3. The right maxilliped 3 is normal, but the left side propodus is distally tapered and slightly excavated on the ventral margin to which a digitiform dactylus inserts near the midlength. The present abnormality is extraordinary given the significance of the maxilliped 3 palp at all levels of the pinnotherid system and the stability observed in its segmentation. The loss of the maxilliped 3 dactylus is a derived condition in pinnotherids, indicating the unusual presence of the right dactylus in the specimen of *D. spondyli* is atavistic.

Pérez (1920) described the bopyrid isopod parasite, *Rhopalione uromyzon*, from *D. spondyli*.

**Distribution.** Presently known only from the Persian Gulf; shallow water to at least 9 m.

### *Discorsotheres subquadratus* (Sakai, 1939)

(Figs. 8, 12)

*Ostracotheres spondyli*. — Sakai, 1933: 981, fig. 5a, b. (Not *O. spondyli* Nobili, 1905).

*Ostracotheres subquadrata* Sakai, 1939: 596–597, fig. 82. — Sakai, 1940: 57. — Cheng, 1967: 333. — Schmitt et al., 1973: 6, 8, 29.

*Ostracotheres subquadratus*. — Sakai, 1965: 179, pl. 87 fig. 4. — Sakai, 1976: 577, fig. 316, pl. 201 fig. 4. — Pregoner, 1988: 24, 27. — Takeda & Konishi, 1989: 1222. — Marumura & Kosaka, 2003: 67. — Ng et al., 2008: 250.

*Ostracotheres subglobosus*. — Konishi, 1996: 15. — Yang et al., 2008: 808. (Not *O. subglobosus* [Baker, 1907]).

**Type material.** Neotype: NSMT Cr10028, female (cl 7.1 mm, cw 8.6 mm), Osezaki, Suruga Bay, Japan, 35°00'N, 138°47'E, coll. I. Soyama, 25 October 1988.

**Other material examined (all Japan).** NSMT Cr1036, 1 female (cl 7.2 mm, cw 8.2 mm), Ohseto-cho, Nagasaki, coll. T. Habe; CBM ZC5989, 1 ovigerous female (cl 7.5 mm, cw 9.2 mm), off Hota, Boso Peninsula, 20–30 m, from *Spondylus cruentus* Lischke, 1868, gill net, coll. T. Komai, 19 August 1998.

**Description.** *Female:* Carapace (Fig. 12A–C) soft, thin, rounded-subquadrate, slightly wider than long, glabrous, surface smooth, appearing polished; strongly vaulted longitudinally, evenly rounded in lateral view; front broadly rounded to straight, transverse, slightly produced, with or without shallow transverse groove on dorsal surface immediately behind front (Fig. 12A, E, J); anterolateral margins, unarmed, forming bluntly rounded rim; lateral surface almost vertical; dorsal surface smooth, gently raised medially forming broad, low, rounded ridge.

Epistome (Fig. 12D) with narrow interantennular septum; median buccal margin broadly obtuse. Antennular sinus size subequal to orbit, aligned distinctly obliquely in anterior view; antennules folded obliquely. Antenna short, free antennal articles extending to about one-third height of eye; antennal articles 1 and 2 fused to epistome. Eyes visible in dorsal view, filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 12F) ischiomerus surface glabrous, length about twice width; inner proximal two-thirds sinuous to weakly concave, distomesial angle obtuse, blunt; distal margin not produced beyond palp articulation; outer margin convex. Carpus slightly shorter than half propodus length. Propodus spatulate, length about twice width, distally widened, apex blunt, subtruncate. Exopod margins gently convex.

Cheliped (pereopod 1) (Fig. 12A, G, H) dactylus gently curved to straight, pollex relatively straight, apices crossing distally, without gape, irregularly, setose. Dactylus  $0.8\text{--}0.9 \times$  length of dorsal margin of propodus palm, outer occlusal margin with triangular proximal tooth, and row of short corneous denticles and short setae extending to about distal three-fourths of dactylus, otherwise smooth; inner occlusal margin with row of short corneous denticles and short

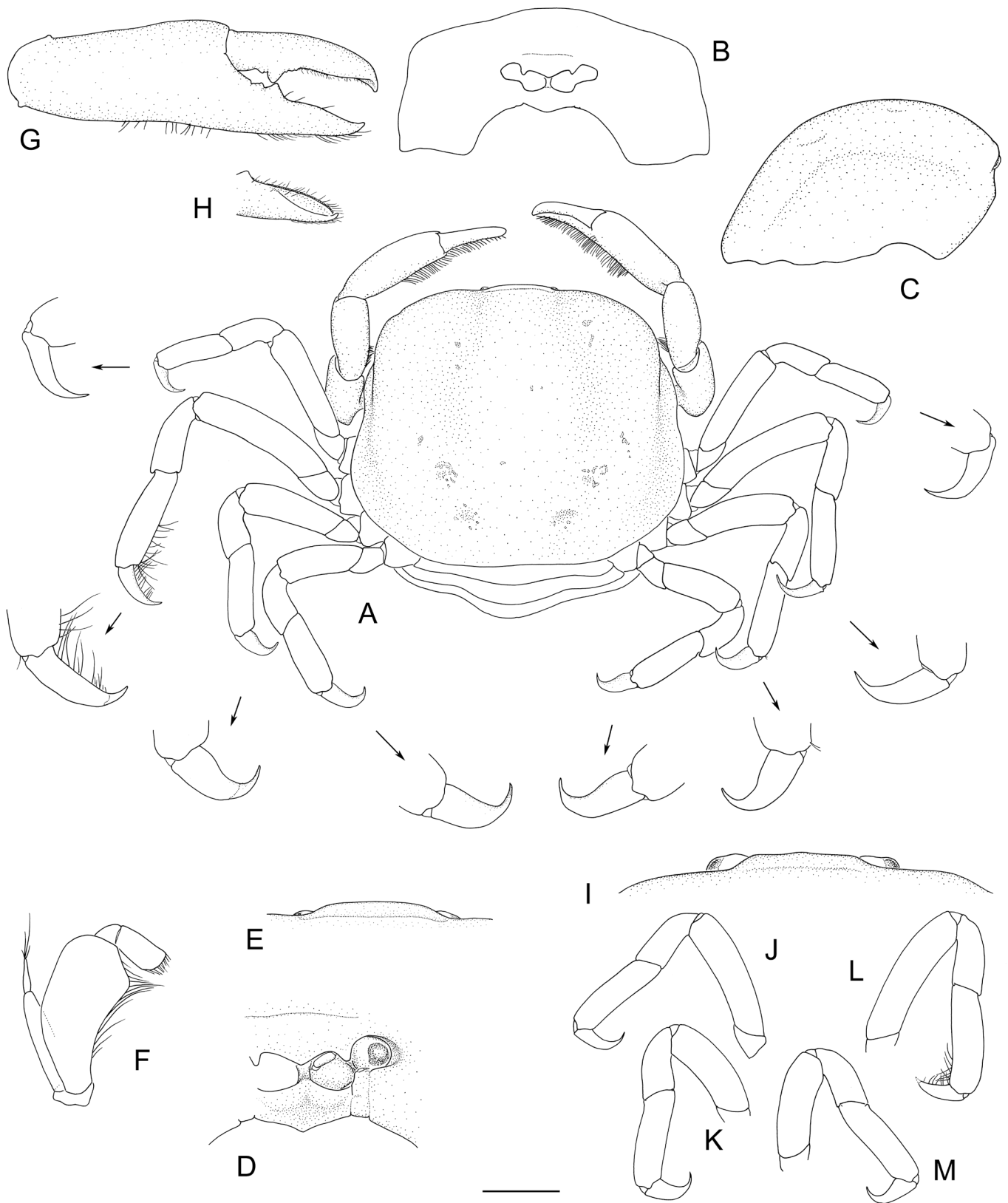


Fig. 12. *Discorsotheres subquadratus* (Sakai, 1939) new combination. A–H, female neotype, cl 7.1 mm, cw 8.6 mm, Suruga Bay, NSMT Cr10028; I–M, ovigerous female, cl 7.5 mm, cw 9.2 mm, Boso Peninsula, CBM ZC5989. A, dorsal habitus; B, carapace, anterior view; C, carapace, right lateral view; D, cephalothorax, anterior view; E, I, carapace frontal margin, dorsal view; F, right maxilliped 3; G, right chela, anterior view; H, right cheliped pollex, oblique anterior view; J–K, left pereopods 3–4; L–M, right pereopods 3–4. Scale: A–C, J–M = 2.0 mm; D–I = 1.0 mm.

setae along proximal half to two-thirds. Pollex (Fig. 12H) outer occlusal margin weakly crenulate, with small, 2 blunt triangular proximal teeth; inner occlusal margin setose, with row of small denticles along proximal three-fourths; inner ventral margin with row of setae. Propodus palm dorsal margin length  $1.7\text{--}2.1 \times$  height; ventral margin gently sinuous, slightly concave at base of pollex. Carpus mesial margin with setal tuft, unarmed. Merus unarmed, about as long as propodal palm.

Walking legs (pereopod 2–5) slender, smooth, similar in form (Fig. 12A, J–M); relative lengths: pereopod 3(both) > pereopod 4 > pereopod 2 > pereopod 5. Pereopods 2, 4, 5 merus to dactylus unarmed, glabrous, propodus occasionally with few scattered setae distally; propodus flexor and extensor margins subparallel, not widening distally; dactyli stout, length subequal, half propodus length, strongly falcate, apices spiniform, those of pereopods 4–5 turning perpendicular to main axis. Pereopod 3 asymmetrical in length and dactyl-propodal form; “normal” pereopod 3 with merus to dactylus glabrous; dactylus apex spiniform, strongly falcate, similar to but slightly longer than Pereopod 2 dactylus. Longer pereopod 3  $1.1\text{--}1.2 \times$  length of “normal” pereopod 3; merus  $1.4 \times$  length of pereopod 4 merus; propodus usually slight expanded distally, distoflexor margin irregularly setose; dactylus longer, stouter but with slightly shorter apex than dactylus of opposite side, setose.

Egg diameter 0.2–0.3 mm.

**Hosts.** Bivalve molluscs: *Crassostrea nippona* (Seki, 1934) (Ostreidae) and *Mytilus edulis* Linnaeus, 1758 (Mytilidae) (Sakai, 1976), and *Spondylus cruentus* Lischke, 1868 (Spondylidae) (this study).

**Remarks.** Sakai (1933) reported material from Momotori, Ise Bay, Japan, as *Ostracotheres spondyli* Nobili, 1905, recognising it as new species in 1939. Sakai (1939) described *D. subquadratus* based on the holotype and two other females, all from Momotori, distinguishing his new species from the Australian *D. subglobosus* by the supposedly shorter carpus and distally broader propodus of maxilliped 3, and elongate dactylus of pereopod 3. Pregonzer (1988), however, observed Sakai’s (1939) diagnostic features to be invalid and synonymised the two species because the pereopod 3 dactylus is elongated in both species and the maxilliped 3 indistinguishable. Present comparison of Australian and Japanese material, however, revealed additional distinguishing features separating two, albeit similar species. The Japanese form is here referred to *D. subquadratus* on the basis of geography. Unfortunately, the two species are indistinguishable based on Sakai’s (1939) account and brief figures of the holotype and his original specimens may have been lost from early on. Sakai (1965) lists specimens of *D. subquadratus*, but none from Ise Bay, and his 1976 monograph cites specimens from Ise Bay, but only as “reported in 1939” suggesting that he did not have had access to the material. Sakai’s carcinological collections are distributed among several institutions/collections (Ng et al. 2017), but searches of Japanese and overseas museum

collections over the past 15 years, including the Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt am Main, which now holds much of Sakai’s material, failed to locate any of his original specimens of *D. subquadratus*; they are considered lost. Given the strong similarity between *D. subquadratus* and *D. subglobosus*, and inadequacy of the type description to distinguish the two species, a neotype is herein designated to fix the identity of *D. subquadratus*. In the absence of specimens from the original type locality (Ise Bay, Japan), an ovigerous female from the adjacent Suruga Bay (cl 7.1 mm, cw 8.6 mm, NSMT Cr10028), approximately 170 km east of the original type locality, is selected as the neotype. Features distinguishing *Ostracotheres subquadratus* from *O. subglobosus* are discussed under the account of the latter.

The present specimens of *D. subquadratus* agree well in most respects. Pereopod 3 is longer on the left side in two specimens, and longer on the right in one (CBM ZC5989; Fig. 12J, L); the specimens otherwise differ only in the presence of a shallow transverse groove or crease on the carapace immediately behind the frontal margin in two specimens (NSMT Cr10028, CBM ZC5989; Fig. 12A, E, I), absent in the third (NSMT Cr1036). All examined specimens of *D. subquadratus* are mature but the largest (cl 7.5 mm, cw 9.2 mm; CBM ZC5989) is notably smaller than the largest recorded *D. subglobosus* (cl 10.6 mm, cw 12.4 mm; AM P151). Comparatively few records of *D. subquadratus* are known, so further sampling is required to determine whether these size differences are artefacts or actual.

Yang et al. (2008) listed *Ostracotheres subglobosus* from the Nansha Islands, South China Sea, presumably following Pregonzer (1988) in treating *O. subquadratus* as its synonym. The record requires verification but given that both nominal species are herein regarded as valid, the Nansha Islands record is here referred to *D. subquadratus*.

**Distribution.** Presently known from localities around Japan (Sagami Bay, Suruga Bay, Ise Bay, Onomichi, Nagasaki), and the Nansha Islands, South China Sea; 10–30 m (Marumara & Kosaka, 2003; present study).

#### *Latatheres* new genus

**Diagnosis.** Female: Carapace transversely ovate to rounded-subquadrate, wider than long; weakly sclerotised, soft, thin; longitudinally vaulted; front transverse in dorsal view, not produced; anterolateral margins undefined; dorsal surface smooth, regions undefined. Eyes small, scarcely visible in dorsal view. Antennal flagellum not reaching dorsal margin of orbit. Maxilliped 3 ischiomerus completely fused, without trace of suture; palp 2-segmented; carpus shorter than propodus; propodus spatuliform, gently tapering distally; exopod flagellum 1-segmented, distally setose. Chelipeds equal, stout, robust, dactylus and pollex with simple, pointed tips. Pereopods 2–5 symmetrical from left to right, subcylindrical; dactyli with sharp simple apices, pereopod 3 dactylus longer than pereopod 4–5 dactyli. Pereopod 5 articulating with body at or above level of pereopod 4.



Abdomen with 6 free somites and telson; in adults, widest at somites 4 and 5, covering bases of walking legs. Gonopore simple, ovate, on sternite 5 near mesial end of sternite 5/6 suture. Male: unknown.

**Type species.** *Ostracotheres tomentipes* Takeda & Konishi, 1994, by present designation.

**Etymology.** An arbitrary combination of of the Latin, *latus*, broad, and the suffix *-theres*, alluding to proportionally wide carapace of species of the genus. Gender: masculine.

**Composition.** *Latatheres affinis* (H. Milne Edwards, 1853) new combination, *L. tomentipes* (Takeda & Konishi, 1994) new combination.

**Remarks.** *Latatheres* is unique among pinnotherid genera with a 2-segmented maxilliped 3 palp in the transversely ovate-subrectangular carapace (rather than subcircular to polygonal and about as long as wide). Of the genera revised herein, *Latatheres* is perhaps nearer to *Discorsotheres* than to either *Austrotheres* or *Ostracotheres*, sharing subcylindrical walking legs and a 1-segmented maxilliped 3 exopod flagellum. Apart from carapace form, however, *Latatheres* differs from *Discorsotheres* in numerous features including the setose versus glabrous carapace and the left–right symmetrical walking legs with moderately curved dactyli (versus pereopod 3 asymmetrical and strongly curved dactyli). The maxilliped 3 of *Latatheres* approaches that of *Gemmotheres* Campos, 1996 (from bivalve molluscs) and *Tunicotheres* Campos, 1996 (from ascidians) in the tapering propodus and absence of the inner angle on the ischiomerus.

One species of *Latatheres*, *L. affinis*, has pereopod 5 articulating dorsad to pereopod 4 as in *Tunicotheres*, but these genera are otherwise dissimilar. *Latatheres* shows few obvious similarities to other pinnotherid genera, although the slender maxilliped 3 ischiomerus, with the rounded distomesial margin extending distally beyond the palp articulation resembles that of the monotypic *Epulotheres* Manning, 1993a (host *Brachidontes modiolus* [Linnaeus, 1767]), and *Nannotheres* Manning & Felder, 1996 (host *Malleus candeanus* [d'Orbigny, 1853]), both from the Caribbean Sea. Species of each of these genera also have a thin, membranous carapace, albeit subcircular (*Nannotheres*) or subhexagonal (*Epulotheres*), rather than transversely ovate-subrectangular as in *Latatheres*. Other features of the maxilliped 3 palp, however, distinguish the three genera: the propodus of the palp is shorter than the carpus in *Nannotheres*, and in *Epulotheres*, the palp is 3-segmented. Unfortunately, males of *Latatheres*, *Epulotheres* and *Nannotheres* are presently unknown.

One species each of *Latatheres* is known from the Indian and Pacific oceans (Fig. 13). Both species mature at less than 9 mm carapace width; the hosts for neither species are known.

**Key to female *Latatheres***

- 1 Pereopod 2 merus length < 4.5 × maximum height; dactylus gently curved. Pereopod 5 articulating with body above level of pereopod 4 ..... *L. tomentipes*
- Pereopod 2 merus length > 5 × maximum height; dactylus strongly falcate. Pereopod 5 articulating with body on same plane as pereopod 4 ..... *L. affinis*

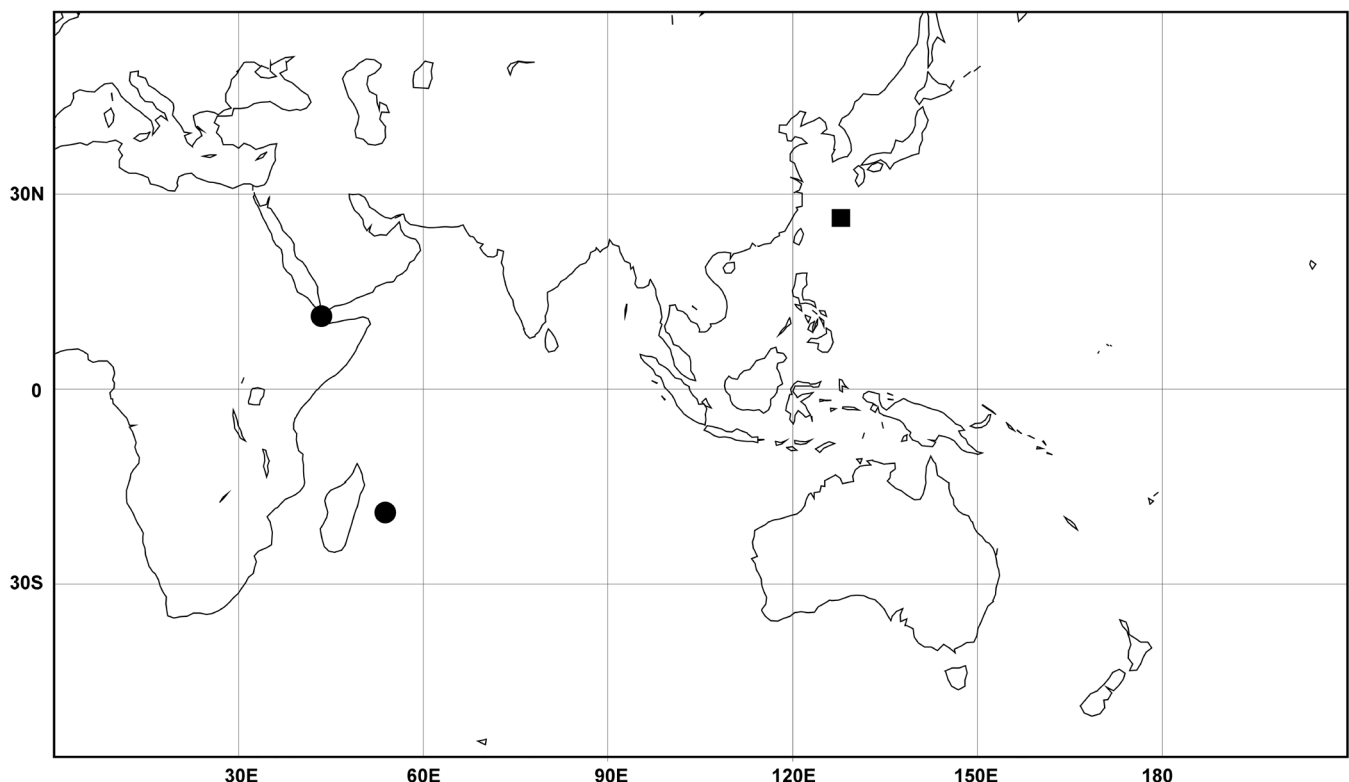


Fig. 13. Distribution of species of *Latatheres* new genus. (●) *L. affinis* (H. Milne Edwards, 1853) new combination; (■) *L. tomentipes* (Takeda & Konishi, 1994) new combination.

***Latatheres tomentipes* (Takeda & Konishi, 1994)  
new combination**  
(Figs. 13, 14)

*Ostracotheres* sp. — Takeda & Konishi, 1989: 1222; 1992: 1305.  
— Konishi, 1996: 15.

*Ostracotheres tomentipes* Takeda & Konishi, 1994: 20–23, fig. 1,  
2. — Ng et al., 2008: 250.

**Type material.** Holotype: NSMT Cr11350, ovigerous female (cl 3.8 mm, cw 4.7 mm), Sesoko-jima Islet, Okinawa, Ryukyu Islands, Japan, coll. S. Kubota, 17 September 1986.

**Description.** *Female:* Carapace subrectangular (Fig. 14A, B), wider than long, anterior and lateral surfaces finely and sparsely setose, otherwise glabrous, smooth; strongly vaulted longitudinally, rounded in lateral view; front transverse, straight, weakly produced, frontal width about 1/3 carapace width; anterolateral margins undefined, rounded; dorsal surface smooth, regions not indicated.

Epistome (Fig. 14C) with broadly triangular interantennular septum; median buccal margin with obtuse median point. Antennular sinus larger than orbit; antennules folded slightly obliquely. Antenna short, free antennal articles extending to about mid-height of eye; antennal articles 1 and 2 fused to epistome. Eye filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 14D) ischiomerus length about  $2.5 \times$  width; surface and margins sparsely, setose; inner margin weakly concave, distomesial margin rounded, produced

slightly beyond palp articulation; outer margin strongly convex. Carpus almost as long as propodus. Propodus spatulate, gently tapering, apex bluntly rounded. Exopod margins sinuous, widest proximally.

Cheliped (pereopod 1) densely covered in short setae (Fig. 14A, E). Dactylus relatively straight, pollex curved, apices crossing distally, without gape. Dactylus shorter than dorsal margin of propodus palm, occlusal margin with triangular tooth proximally. Pollex occlusal margin weakly crenulate, with small, triangular tooth near midlength; inner ventral margin with row of setae. Propodus palm dorsal margin length  $1.2 \times$  height; ventral margin distinctly evenly convex. Carpus and merus unarmed; merus stout, longer than propodal palm but shorter than total propodus length.

Walking legs (pereopods 2–5) similar, slender (Fig. 14A, F–I); relative lengths: pereopod 2 > pereopod 3 > pereopod 4 > pereopod 5; densely covered in short setae; pereopod 5 articulating slightly dorsad to pereopod 4. Meri unarmed, length  $4.2\text{--}4.4 \times$  height (pereopods 2–4),  $3.2 \times$  height (pereopod 5). Propodi with row of short disto-flexor spinules, length  $3.2\text{--}4.1 \times$  height (pereopods 2–4),  $2.4 \times$  height (pereopod 5). Dactyli simple, surface finely setose, flexor margins of pereopods 2–3 fully setose, of pereopods 4–5 sparsely setose; pereopod 2–3 dactyli equal, weakly curved, longer than pereopod 4–5 dactyli; pereopod 2 and pereopod 4 dactylus  $0.6 \times$  propodus length; pereopod 3 and pereopod 5 dactylus  $0.8 \times$  propodus length.

Egg diameter 0.2–0.3 mm (in preservative).

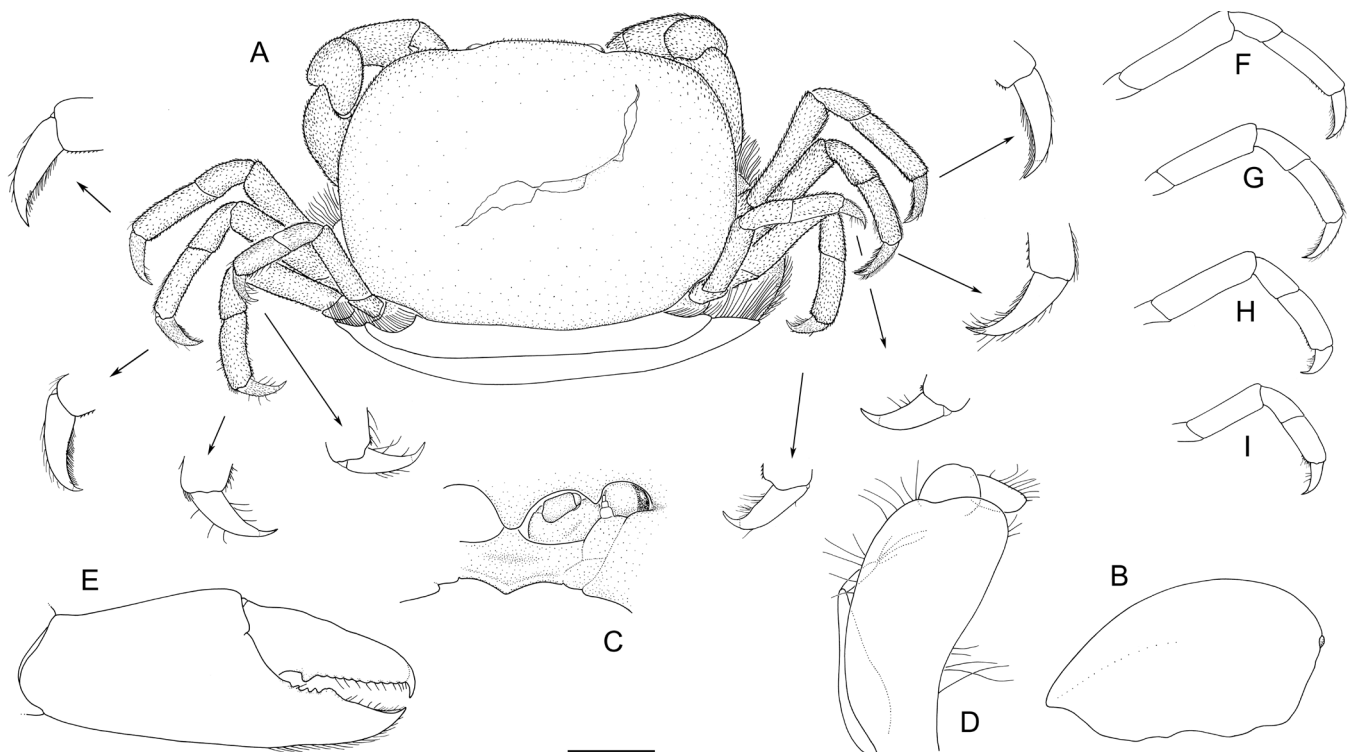


Fig. 14. *Latatheres tomentipes* (Takeda & Konishi, 1994) new combination, ovigerous female holotype, cl 3.8 mm, cw 4.7 mm, Okinawa, NSMT Cr11350. A, dorsal habitus; B, carapace, right lateral view; C, cephalothorax, anterior view; D, right maxilliped 3; E, right chela, anterior view (tomentum omitted); F–I, right pereopods 2–5. Scale: A, B, F–I = 1.0 mm; C, E = 0.5 mm; D = 0.25 mm.

**Hosts.** Unidentified bivalve mollusc (Takeda & Konishi, 1994).

**Remarks.** *Latatheres tomentipes* (Takeda & Konishi, 1994) new combination is known only from the type material collected from unidentified bivalve molluscs. It is readily distinguished from *L. affinis* by the proportionally shorter, stouter walking legs (pereopod 2 merus length  $<4.5 \times$  height versus length  $>5 \times$  height), the position of pereopod 5 (articulating with body above level of pereopod 4, versus on same plane) and the morphology of the walking leg dactyli. In *L. tomentipes*, the pereopod 2–4 dactyli are weakly curved and the pereopod 5 dactylus falcate, whereas in *L. affinis*, the pereopod 2 dactylus is strongly falcate and the pereopod 3–5 dactyli, weakly curved. Both species of *Latatheres* are otherwise very similar, particularly in the maxilliped 3, in which the ischiomerus is comparatively slender, with an evenly rounded distomesial angle that is produced distally beyond the level of the palp articulation. *Latatheres tomentipes* is probably also more setose than *L. affinis*, although confirmation must await collection of new material of the latter species.

**Distribution.** Presently known only from Sesoko-jima Islet, Okinawa, Japan; bathymetric range not known.

***Latatheres affinis* (H. Milne Edwards, 1853)**

**new combination**

(Figs. 13, 15)

*Ostracotheres affinis* H. Milne Edwards, 1853: 220, pl. 11 fig. 11. — Paulson, 1875: 70. — Tesch, 1918: 262, 263, 287. — Guinot, 1967: 279. — Silas & Alagarswami, 1967: 1195. — Schmitt et al., 1973: 6, 7, 28. — Takeda & Konishi, 1989: 1222. — Ng et al., 2008: 250.

*Ostracotheres affinis*. — Nobili, 1906b: 299, 300–301. — Michel, 1964: 10.

**Type material.** Neotype: MNHN IU-2016-10944 (B10570), ovigerous female (cl 4.5 mm, cw 5.8 mm), Djibouti, coll. Jouseaume, 1891.

**Other material examined.** MNHN IU-2016-10945 (B10571), 1 ovigerous female (cl 6.5 mm, cw 8.2 mm), Djibouti, coll. Jouseaume, 1891.

**Description.** *Female*: Carapace ovate (Fig. 15A), wider than long, surface finely and sparsely setose; strongly vaulted longitudinally, rounded in lateral view; front transverse, straight, not produced, frontal width about 1/4 carapace width; anterolateral margins undefined, rounded; dorsal surface smooth, regions not indicated.

Epistome (Fig. 15B) with narrowly triangular interantennular septum; median buccal margin with obtuse median point. Antennular sinus larger than orbit; antennules folded obliquely. Antenna short, free antennal articles extending to about 3/4 height of eye; antennal articles 1 and 2 fused to epistome. Eye filling orbit, cornea pigmented.

Maxilliped 3 (Fig. 15C) ischiomerus length about  $2.5 \times$  width; surface sparsely, finely setose; inner margin weakly concave, distomesial margin rounded, produced slightly beyond palp articulation; outer margin strongly convex. Carpus about half propodus length. Propodus spatulate, gently tapering, apex narrowly rounded. Exopod margins straight to weakly convex.

Cheliped (pereopod 1) very sparsely setose (Fig. 15A, D). Dactylus and pollex curved, apices crossing distally, without gape. Dactylus shorter than dorsal margin of propodus palm, occlusal margin with triangular tooth proximally. Pollex occlusal margin weakly crenulate, with small, triangular tooth near midlength; inner ventral margin with row of setae. Propodus palm dorsal margin length  $1.4 \times$  height; ventral margin distinctly evenly convex. Carpus and merus unarmed; merus slender, as long as propodus.

Walking legs (pereopods 2–5) similar, slender (Fig. 15A, E–H); relative lengths: pereopod 3 > pereopod 2 > pereopod 4 > pereopod 5; surfaces very sparsely setose; P5 articulating with body at same level as pereopod 4. Meri unarmed, length  $4.9\text{--}5.6 \times$  height (pereopods 2–4),  $4.6 \times$  height (pereopod 5). Propodi unarmed,  $4.6\text{--}4.7 \times$  height. Dactyli simple, sparsely setose, that of pereopod 3 longest; pereopod 2 dactylus strongly falcate, apex spiniform, perpendicular to main dactylar axis; pereopod 3–5 dactyli similar, stout, weakly curved; pereopod 2–3 dactyli  $0.5 \times$  propodus length; pereopod 4 dactylus  $0.4 \times$  propodus length; pereopod 5 dactylus  $0.6 \times$  propodus length.

**Hosts.** Not known.

**Remarks.** *Latatheres affinis* new combination, originally described from Mauritius, was neither well illustrated nor well described by H. Milne Edwards (1853), who provided only a figure of maxilliped 3 and minimal indications of appendage differences relative to *O. savignyi* (= *O. tridacnae*). As a result, it is not possible to determine the identity of H. Milne Edwards' species with any degree of confidence based on the type description. The current concept of *L. affinis* is based on Nobili's (1906b) account of specimens from Djibouti, examined here, which presumably were identified based on the similar maxilliped 3 to that figured by H. Milne Edwards (1853: pl. 11 fig. 11). Although Nobili (1906b: 300) referred to the carapace and walking legs of the present specimens as "légèrement duveteuses" [slightly furry], they are largely glabrous. Only very few, short, sparsely scattered setae are now present on the carapace, pereopods and margins of the abdomen of the extant specimens. Much of the original setation was doubtless lost over time, possibly during past specimen preparation, although the original degree of setation was in any case probably sparse and much less extensive than possibly implied by Nobili (1906b). Nobili's description of the setation in *L. affinis* may have been made with other pinnotherids from the region in mind, such as *O. tridacnae*, which is tomentose overall, and *D. spondyli*, with its glabrous carapace and near glabrous walking legs.



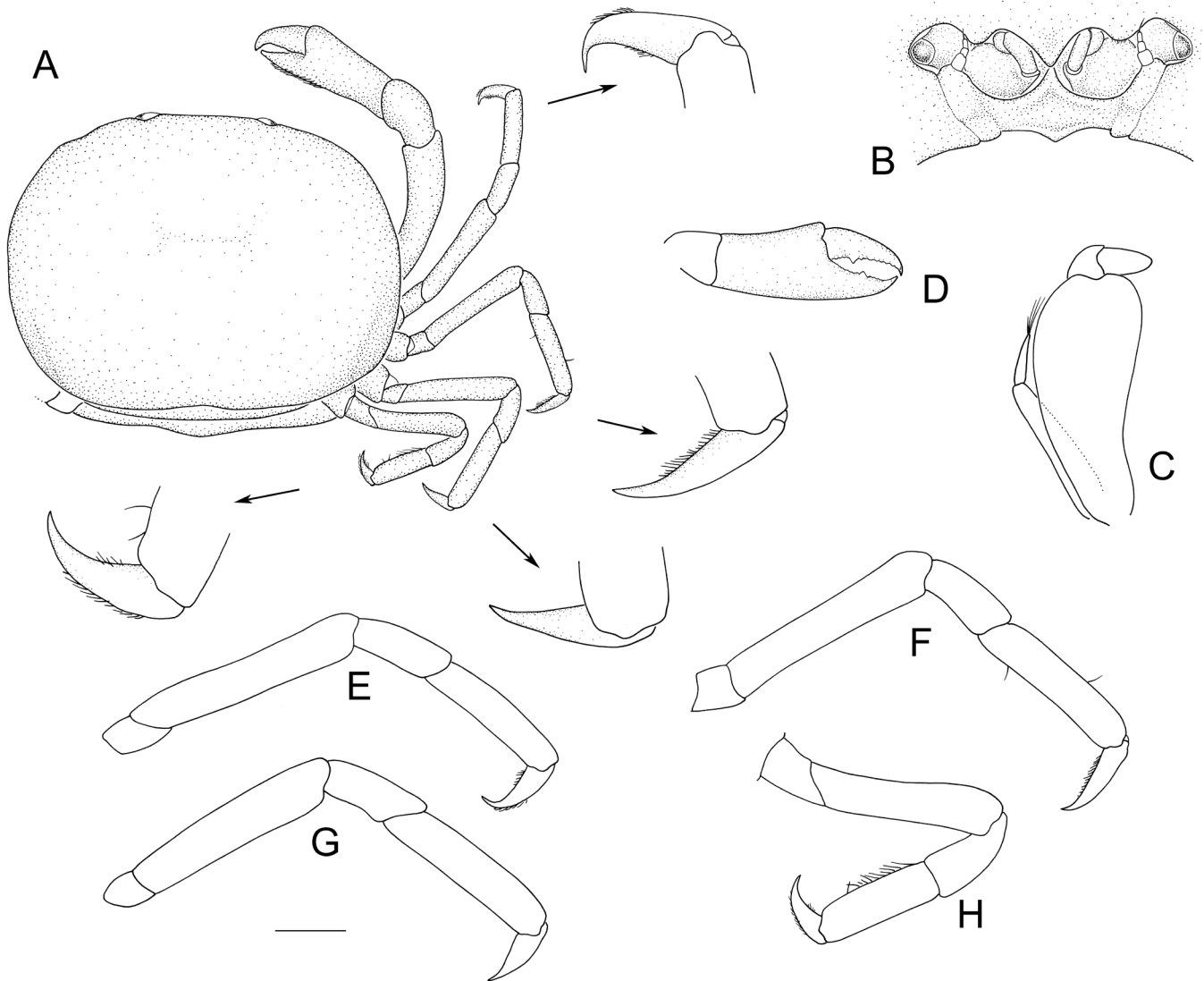


Fig. 15. *Latatheres affinis* (H. Milne Edwards, 1853) new combination, ovigerous female neotype, cl 4.5 mm, cw 5.8 mm, Djibouti, MNHN IU-2016-10944. A, dorsal habitus; B, cephalothorax, anterior view; C, right maxilliped 3; D, right chela, anterior view; E–H, right pereopods 2–5. Scale: A, D = 1.0 mm; B, C, E–H = 0.5 mm.

The original type material of *L. affinis* is now lost (Schmitt et al., 1973; Guinot pers. com.), and no material from Mauritius is available for study. Given the ambiguous identity of the species and lack of extant type material, one of Nobili's Djibouti specimens (ovigerous female, cl 4.5 mm, MNHN IU-2016-10944) is herein designated as the neotype to fix the identity of *L. affinis*.

Differences between *L. affinis* and *L. tomentipes* are outlined under the account of the latter.

**Distribution.** Western Indian Ocean, from Djibouti and Mauritius; bathymetric range not known.

**Key to pinnotherid genera with a 2-segmented maxilliped 3 palp**

- 1. Pereopod 2–4 dactyli bifurcate ..... *Dissodactylus*
- Pereopod 2–4 dactyli simple, undivided ..... 2
- 2. Carapace, at least anteriorly, with broad, thin lamella or upturned margins ..... 3
- Carapace without anterior lamella or upturned margins ..... 4

- 3. Carapace margins upturned, with prominent median tubercle ..... *Xanthasia*
- Carapace with broad, upraised anterior lamella, without median tubercle ..... *Serenothers*
- 4. Carapace with sharp anterolateral margins and two dorsal longitudinal grooves ..... *Calyptraeothers*
- Carapace with blunt anterolateral margins; without dorsal longitudinal grooves ..... 5
- 5. Carapace widest posteriorly. Pereopod 3 asymmetrical from left to right. Cheliped fingers distally spatulate on occlusal surface ..... *Discorsothers*
- Carapace widest at or near midlength. Pereopod 3 symmetrical from left to right. Cheliped fingers distally pointed, not spatulate on occlusal surface ..... 6
- 6. Carapace subpentagonal ..... *Tunicothers*
- Carapace rounded or transversely ovate to subrectangular .. 7
- 7. Carapace wider than long, transversely ovate to subrectangular ..... *Latatheres*
- Carapace about as long as wide, subcircular ..... 8
- 8. Maxilliped 3 propodus shorter than carpus ..... *Nannothers*
- Maxilliped 3 propodus longer than carpus ..... 9
- 9. Carapace soft, weakly sclerotised, anterolateral margins undefined. Eyes not visible in dorsal view. Maxilliped 3 propodus tapering to narrow but blunt point ..... *Gemmothers*

- Carapace firm to hard, anterolateral margins well-defined. Eyes visible in dorsal view. Maxilliped 3 propodus spatulate, apex blunt, subtruncate to rounded ..... 10
- 10. Carapace dorsal surface glabrous. G1 with lanceolate tip.....  
..... *Austrotheres*
- Carapace dorsal surface finely setose. G1 tip blunt, with short spine-like, anterolaterally directed papilla ..... *Ostracotheres*

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