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Cardomanica andersoni n.gen., n.sp. from the Western Tasman Sea with Notes on Species from the Tropical Western Atlantic Ocean (Crustacea: Ascothoracida: Synogogidae)

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ABSTRACT. *Cardomanica andersoni* n.gen., n.sp. is described from the western Tasman Sea where it lives on the gorgonacean *Chrysogorgia orientalis* Versluys. This is the first record of a synagogid ascothoracidan from the South Pacific Ocean. The recently described synogogid, *Isidascus longispinatus* Grygier from the western Atlantic Ocean, is transferred to *Cardomanica* and split into two species, *C. longispinata* (Grygier) and *C. quadricornuta* n.sp.

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KEYWORDS: Ascothoracida, Synagogidae, *Cardomanica*, Tasman Sea, Atlantic Ocean, taxonomy.

During a recent ground fish survey off south-eastern Australia Mr Ken Graham (Division of Fisheries, New South Wales Department of Agriculture) collected sediment and benthic invertebrates from demersal trawls. From this collection, Mr Phil Colman (Malacology, Australian Museum) sorted an interesting bivalved animal which he recognized as a crustacean. These ascothoracidan specimens were living in an inverted orientation on the branches of the small, bushy gorgonacean, *Chrysogorgia orientalis* Versluys. They are described below as a new genus and species, *Cardomanica andersoni*, in the ascothoracidan family Synagogidae. Grygier (1984) recently described *Isidascus longispinatus* from the tropical western Atlantic Ocean. Based on his detailed description I am transferring *I. longispinatus* to *Cardomanica* and splitting his material into two species, *C. longispinata* and *C. quadricornuta* n.sp.

Cardomanica n.gen.

Diagnosis. Based on female. Carapace completely enclosing body, forming a large dorsal brood chamber; ventral margins rounded, opening to the outside through a slit; anterior margin produced into a sleeve-hinge which is sealed from the body by a partition, and which overlaps a branch of the gorgonacean host to form a permanent attachment. Antennules large, obviously 6-articulate and prehensile; article 3 oblong; article 4 with 2 setae; article 5 as long as article 6; article 6 with 2 posterodistal processes close together behind sharp falcate claw. Oral cone bellows-like with styliform tip; mandibles and maxillules complexly armed, maxillae smooth with bifid tip, but no hook, medial languette present. Thoracic segments 2 to 4 or 5 each with a dorsomedial 'horn'. Thoracopods biramous. First thoracopod with 2-articulate exopod and endopod; coxa with lateral seta and with long attenuated filamentary appendage at base. Thoracopods 2 to 5 with 2-articulate exopod and 3-articulate endopod; coxa 2 to 4 with lateral seta. Sixth thoracomere bearing large epaulet; thoracopod small; coxa without lateral seta. Abdomen 5-segmented; first segment with large slender biramous penis; fifth segment with 2 large telsonic spines; furcal rami tapered, blunt and downturned, each with some terminal setae, no ventral setae and many medial setae.

Type-species. *Cardomanica andersoni* n.sp.

Etymology. The generic name is derived from the Latin words 'cardo' (sleeve) 'manica' (hinge) and alludes to the attachment mechanism of the ascothoracidan to its gorgonacean host.

Remarks. *Cardomanica* is most closely related to *Gorgonolaureus* Utinomi, 1962 (redefined, Grygier, 1981), *Isidascus* Moyse, 1983 and *Thalassomembracis* Grygier, 1984. All of these genera have a fused bivalve carapace which completely encloses the body, forming a large dorsal brood chamber in the female, and with a ventral aperture to the outside. In *Cardomanica*, *Gorgonolaureus* and *Isidascus* there is a large dorsomedial 'horn' on at least the second thoracomere. The styliform mouthparts in all three genera are very

similar, as is the setation on the antennules.

Cardomanica differs from all other synagogids in the method of host attachment. Species of *Cardomanica* have a neat sleeve-hinge which clamps around the branches of the gorgonacean host. Species of the other three genera are also attached to the axes of the host by means of the carapace, but in different ways. Probably all species in these genera are covered by host tissue.

Cardomanica differs from *Gorgonolaureus* in having a large ventral aperture on the carapace, multiple rows of setae on the maxillules, no posterior hooks on the maxillae, basal teeth on the mandible, both posterior processes on article 6 of the antennule located distally just behind the claw, a filamentary appendage at the base of coxa 1, tapering furcal rami and well developed telsonic spines.

Cardomanica differs from *Isidascus* in having posterior setae on article 2 of the antennules, basal teeth on the mandibles, bifid maxillary tips, no laterodistal coxal setae on the fifth thoracopod, a biramous penis in adult females, and tapering furcal rami.

Cardomanica differs from *Thalassomembracis* in not having grapnels or a single anteroventral anchor on the carapace, in not having posterior hooks on the maxillae and in having a well developed biramous penis.

Cardomanica andersoni n.sp.

Figs 1–3

Type-material. HOLOTYPE, female (brooding 195 nauplii), carapace 6.4 mm long and 6.5 mm high, body 4.5 mm long, Australian Museum AM P34357; PARATYPE, carapace 7 mm long and 7 mm high, body 4.4 mm long, AM P34356; 8 PARATYPES, at least 2 of which are brooding females AM P34358; off Ulladulla, New South Wales, Australia, 35°39′S 150°52′E, living on the gorgonacean *Chrysogorgia orientalis* Versluys in 950 m depth, K.J. Graham on FRV *Kapala*, 8 September 1983, station K83-11-04.

Additional material. 7 specimens, AM P34359, off Ulladulla, New South Wales, Australia, 35°29′S 150°53′E, living on the gorgonacean, *Chrysogorgia orientalis* in 1000 m depth, K.J. Graham on FRV *Kapala*, 25 October 1983, K83-14-02; 2 specimens, AM P34360, off Shoalhaven Bight, New South Wales, Australia, 34°52′S 151°14′E, living on *C. orientalis* in 1000 m depth, K.J. Graham on FRV *Kapala*, 26 October 1983, K83-14-04; 1 specimen, AM P34361, off Shoalhaven Bight, New South Wales, Australia, 34°53′S 151°14′E, living on *C. orientalis* in 1050 m depth, K.J. Graham on FRV *Kapala*, 26 October 1983, K83-14-05; 2 specimens, AM P34362, off Broken Bay, New South Wales, Australia, 33°37′S 152°06′E, living on *C. orientalis* in 990 m depth, K.J. Graham on FRV *Kapala*, K83-14-08.

Diagnosis. Carapace not papillate, 6.4 mm long x 6.5 mm high (ratio 1:1), ventral margin rounded. Thoracomeres 2 and 3 each with a long, slender, asetose dorsomedial 'horn', thoracomere 4 with a short, asetose dorsomedial 'horn'. Thoracopods 1 to 6 on one side of body with about 250 setae altogether, terminal articles of endopods with about 57 setae, terminal articles of exopods with about 84 setae (Table 1).

Description. Carapace (Fig. 1A–D) 6.1 mm long and 6.8 mm high, formed of 2 partially fused valves completely enclosing body; anterodorsal margins oblique, dorsal and posterodorsal margins evenly rounded, dorsal margins fused to form a large brood chamber in female; ventral margins evenly rounded, not fused, forming a slit. Anterior margins produced into overlapping sleeve-hinge; lower inner margin of sleeve-hinge bearing short cuticular teeth. Internal structure of the cuticle of the carapace gives the false impression of surface papillae under the light microscope.

Body (Fig. 1F–E) attached to carapace by adductor muscles within head. Head fits against anterior partition which separates main body from sleeve-hinge. Antennules attached anteroventrally with antennae immediately adjacent; styliform mouthparts attached ventrally. Thoracic region 6-segmented, first thoracomere completely free from head with fringe of hairs along anterior margin and thoracopods set off from others. Second and third thoracomeres with long dorsomedial 'horns' over 1.5 times as long as thoracomere height. Fourth thoracomere with a short dorsomedial 'horn'. Abdomen 5-segmented with first segment bearing elongate bifurcate penis and sixth segment bearing 2 large, recurved telsonic spines and 2 furcal rami.

Antennules (Fig. 2A) 6-articulate, prehensile, article 6 closing onto article 5; article 2 with a clump of setae along posterior margin; article 3 broader than long with anterior margin about twice as long as posterior margin, surface covered in groups of minute comb setae, anterior margin densely covered with setae; article 4 broader than long, surface covered in minute comb setae, anterior margin with two setae; article 5 about 1.75 times as long as broad, tapering distally and bearing about 10 stout setae along anterior margin; article 6

Table 1. Thoracopodal setal count for holotype of *Cardomanica andersoni*. Positions 1–9 are identified in Figure 3F. Parentheses indicate fused articles in the endopods of thoracopods 1 and 6.

	Position on limb								
Thoracopod	1	2	3	4	5	6	7	8	9
T1	1	0	0	18	15	(1)		0	0
T2	1	0	0	14	8	3	4	13	10
T3	1	0	1	13	8	3	4	12	12
T4	1	0	1	15	8	3	4	12	10
T5	0	0	1	13	9	2	2	4	0
T6	0	0	0	11	9	(1)		2	0

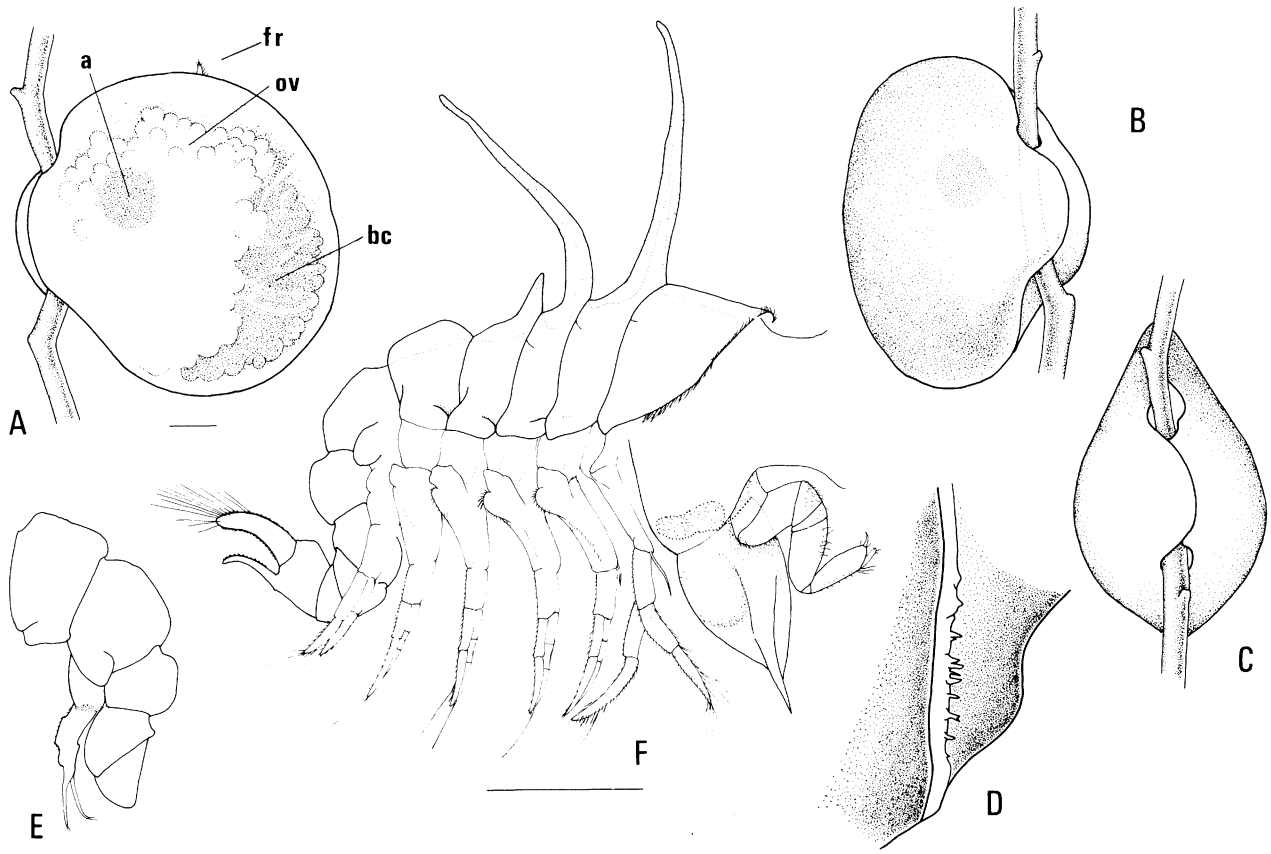

Fig. 1 *Cardomanica andersoni* n.gen., n.sp., holotype female AM P34357. Off Ulladulla, NSW, Australia, 950 m depth. **A**, lateral view of carapace attached to gorgonacean host *Chrysogorgia orientalis* Versluys. **B**, foreshortened lateral view showing sleeve-hinge attachment to host. **C**, anterior view of sleeve-hinge attachment to host. **D**, inner margin of sleeve-hinge partition showing cuticular teeth. **E**, left side of abdomen showing penial process. **F**, right side of whole animal extracted from carapace. a, adductor muscle; bc, brood chamber; fr, furcal ramus; ov, ovaries. Scales represent 1 mm.

more than 3 times as long as broad and subequal in length to article 5, posterior margin with several rows of comb setae, process just proximal to claw guard on posterodistal margin bears a basally arising aesthetasc and 3 terminal setae, claw guard broad, concave with 3 large and 1 small terminal setae and an articulating tip covered in short hairs; claw smooth, sickle-shaped. Antenna (Fig. 2B) small, not well developed, not articulate and bearing a number of small distal setae.

Oral cone bellows-like; mouthparts, surrounded by labrum, long and styliform together forming a piercing and sucking mechanism. Mandibles (Fig. 2C) broad basally and tapering to a stylet tip, inner margin bearing a row of many curved teeth which become setose distally, curved outer margin with short setae distally and sparse long hairs proximally. Maxillule (Fig. 2E) similar in shape to mandible but stronger, tip forming a concave inner surface with stiff hairs along the raised margins and softer hairs medially. Maxillae (Fig. 2F) fused proximally, bearing thin lateral flanges distally, and terminating in a bifurcate tip. Medial languette (Fig. 2D) triangular, bearing numerous minute hairs near medial margin.

Thoracopod 2 (Fig. 3B) with 3 seminal receptacles, thoracopods 3 to 5 (Fig. 3A) each with 6 seminal receptacles in coxae. Thoracopod 1 (Fig. 3E) separated from others, protopod slender; coxa with distolateral seta; inner surface of basis covered in long hairs; exopod 2-articulate, covered in long hairs, second article with about 8 stout setae covering inner surface and 3 long terminal plumose setae; endopod 2-articulate, covered in long hairs with several surface setae, 4 terminal plumose setae and 8 plumose setae along outer margin on article 2, article 1 with 1 distolateral plumose seta. Thoracopods 2–5 (Fig. 3F) similar, 2-articulate exopod and 3-articulate endopod; coxa broad with distolateral seta except in thoracopod 5, long hairs along lateral margin, and comb setae and long plumose setae along medial margin; exopod slightly longer than endopod with long hairs along lateral margins and plumose setae along inner margins of article 2 of exopod and all 3 articles of endopod. Thoracopod 6 (Fig. 3C) smaller than the rest; protopod narrow, fused with some hairs along inner margin; exopod longer than endopod, articles nearly fused, with long marginal hairs, 4 long plumose setae terminally and 3 to 4 long plumose setae distomedially; endopod, articles nearly fused with rows of comb setae along surface, 2 long plumose setae terminally and 5 along margin.

Abdomen (Fig. 1E, F) 5-segmented; segment 1 with

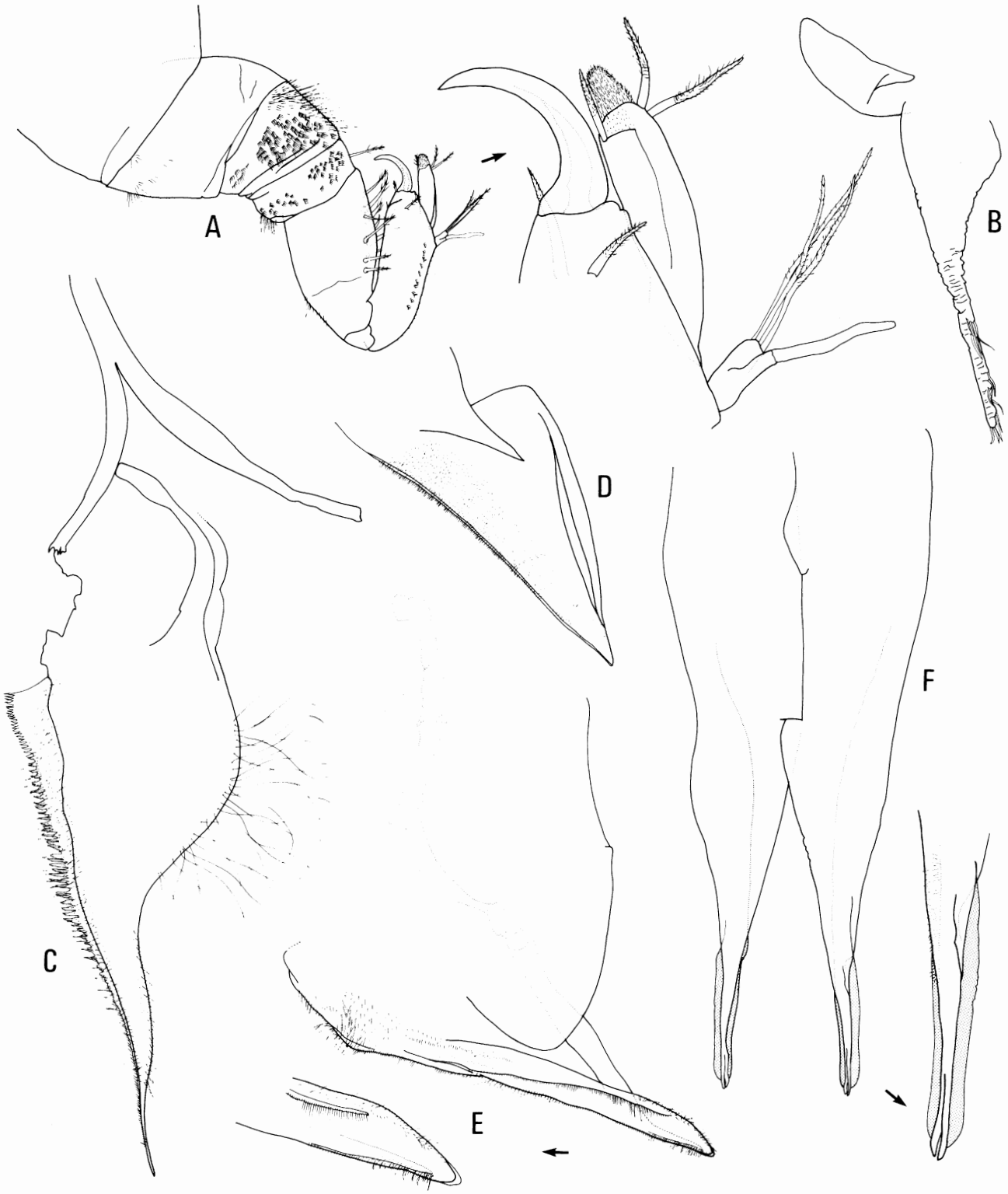

Fig. 2. *Cardomanica andersoni* n.gen., n.sp., paratype AM P34356. Off Ulladulla, NSW, Australia, 950 m depth. **A**, antennule with detail of tip. **B**, antenna. **C**, mandible. **D**, medial languette. **E**, maxillule with detail of tip. **F**, maxilla with detail of tip.

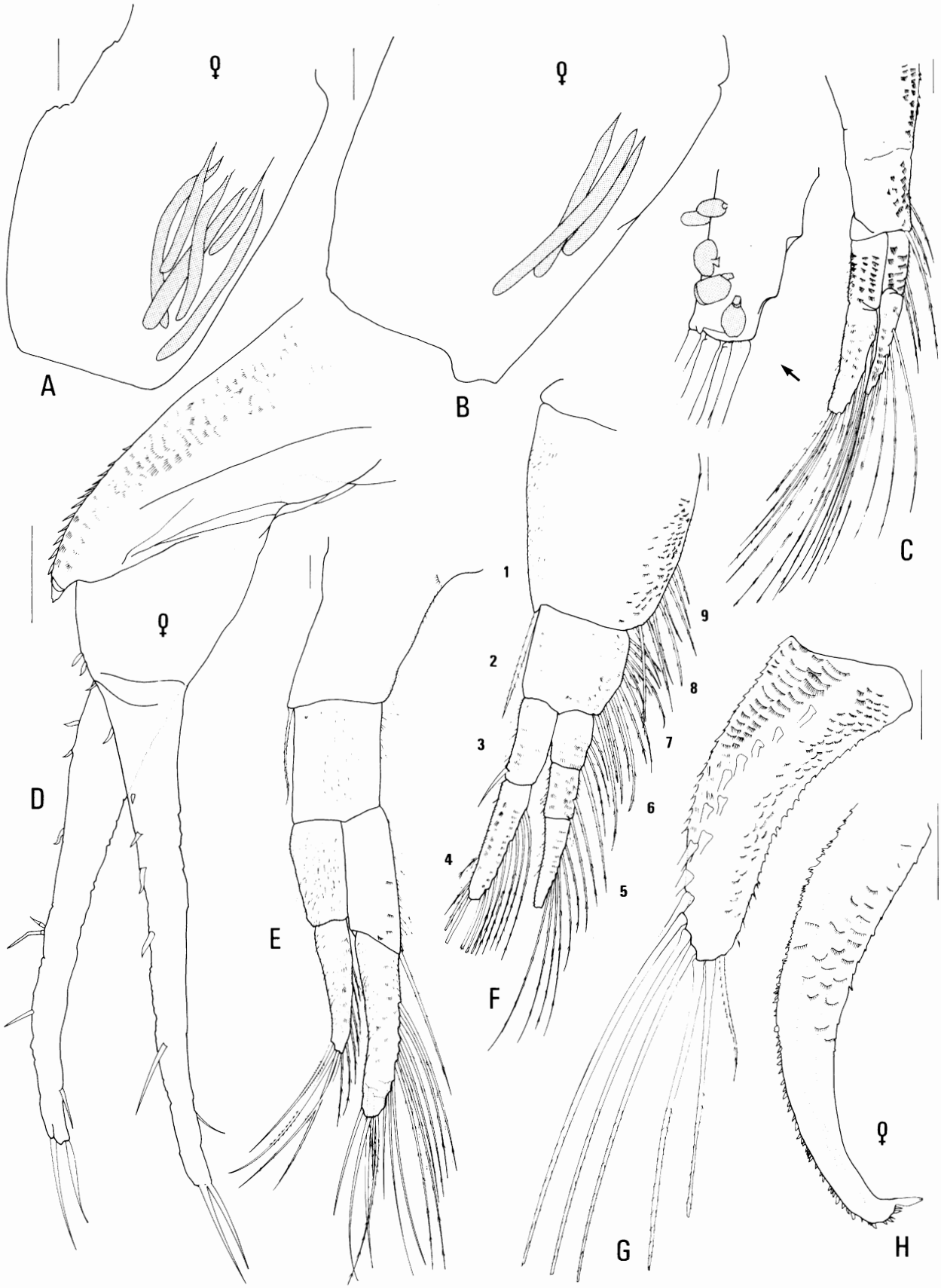

Fig. 3. *Cardomanica andersoni* n.gen., n.sp., holotype AM P34357 and paratype AM P34356. Off Ulladulla, NSW, Australia. **A**, coxa of thoracopod 4 containing 6 seminal receptacles. **B**, coxa of thoracopod 2 containing 3 seminal receptacles. **C**, thoracopod 6, enlargement of distal end of endopod showing chonotrich commensals. **D**, penial process. **E**, thoracopod 1. **F**, thoracopod 2. **G**, furcal ramus. **H**, telsonic spine.

Table 2. Characters differentiating species of *Cardomanica*.

	Carapace	Thoracomere 'horns'	Thoracopods 1 to 6, sete on terminal articles	
			endopods	exopods
C. andersoni	not papillate	2 to 4, naked	57	84
C. longispinata	not papillate	2 to 4, setose	42	74
C. quadricornuta	papillate	2 to 5, setose	62	86

well developed biramous penis; segment 5 with 2 large telsonic spines (Fig. 3H), subequal in length to furcal rami but narrower, recurved distally and bearing minute denticles along dorsal margin; furcal rami (Fig. 3G) recurved distally with ventral and dorsal margins serrate, and comb setae over much of surface, 1 short and 2 long terminal plumose setae and 15 medial plumose setae.

Etymology. This species is named for Professor D.T. Anderson in recognition of his contribution to the biology of Crustacea.

Remarks. The three known species of *Cardomanica* appear to be closely related (Table 2). The antennules, mouthparts, thoracopods, furcal rami and telsonic spines are almost identical between the species. *Cardomanica andersoni* and *C. longispinata* both have two long and one short dorsomedial 'horns', but in *C. andersoni* the two long 'horns' are much longer, more slender and without setae. The thoracopods of *C. andersoni* are more setose than those of *C. longispinata*, particularly the terminal articles of the endopods and exopods. The length to height ratios of the carapaces in both species are also similar (about 1 x 1), but the carapace of *C. andersoni* has a more rounded ventral margin and is about 1.5 times as large as the carapace of *C. longispinata*.

Cardomanica andersoni and *C. quadricornuta* are very similar in the number and arrangement of thoracopodal setae. The carapace of each species is of similar size although the length to height ratios differ, 1 x 1 in *C. andersoni* and 1 x 1.3 in *C. quadricornuta*. But *C. quadricornuta* differs in having a papillate carapace and four setose dorsomedial 'horns' on thoracopods 2 to 5.

Cardomanica andersoni is currently known only from the deep continental slope (about 1000 m) of the western Tasman Sea off New South Wales. It lives attached to the gorgonacean, *Chrysogorgia orientalis* Versluys.

Cardomanica longispinata (Grygier, 1984) new combination

Isidascus longispinatus Grygier, 1984: 143 (in part, figs 1A-C, E, G-I and 2A-I, M, O-Q, table 1), remainder = *C. quadricornuta*.

Diagnosis. Carapace not papillate, 4.6 mm long x 4.3 mm high (ratio 1.1:1), ventral margin straight. Thoracomeres 2 to 4 each with a short, thick, setose dorsomedial 'horn' becoming progressively shorter posteriorly. Thoracopods 1 to 6 on one side of body with about 200 setae altogether, terminal articles of endopods with 42 setae, terminal articles of exopods with 74 setae (Grygier, 1984, table 1).

Remarks. *Cardomanica longispinata* was originally placed in *Isidascus* Moyse, 1983. But *C. longispinata* is excluded from *Isidascus* in the ways outlined earlier. *Cardomanica longispinata* differs from *C. andersoni* in the ways discussed under that species (Table 2). It differs from *C. quadricornuta* in having a smaller, non-papillate carapace with a different length to height ratio, only three dorsomedial 'horns', and fewer setae on the thoracopods, particularly the terminal articles of the endopods and exopods.

Cardomanica longispinata is currently known from off Colombia and in the Gulf of Mexico, western Atlantic Ocean living on *Chrysogorgia elegans* Verrill and another undetermined species of *Chrysogorgia* in depths of 366 to 567 m.

Cardomanica quadricornuta n.sp.

Isidascus longispinatus Grygier, 1984: 143 (in part, figs 1D, F and 2J-L, N, table 1), remainder = *C. longispinata*.

Type-material. HOLOTYPE female USNM 191231 on *Chrysogorgia* cf. *elegans* USNM 344508; north of Bahamas, 26°06'N 77°08'W, 1023-1153 m, R. Carney on RV *Columbus Iselen*, 21 October 1980, Cr. 8007, stn 063.

Diagnosis. Carapace papillate, 6.7 mm long x 8.7 mm high (ratio 1:1.3), ventral margin straight. Thoracomeres 2 to 5 each with a setose dorsomedial 'horn' becoming progressively shorter posteriorly. Thoracopods 1 to 6 on one side of body with about 250 setae altogether, terminal articles of endopods with 62 setae, terminal articles of exopods with 86 setae (Grygier, 1984, table 1).

Etymology. This species is named for the four dorsomedial 'horns' on thoracomeres 2 to 5.

Remarks. In the original description of *C. longispinata* Grygier (1984) described differences between his material from Colombia and the Gulf of Mexico and his material from north of the Bahamas. At the time he did not think the evidence warranted establishing separate species. But with the discovery of another, closely related species in the Tasman Sea the differences between the Colombia/Gulf of Mexico material and the Bahaman material become significant. The Bahaman material must be considered a separate species which differs from other species of *Cardomanica* in the ways discussed earlier (Table 2).

Cardomanica quadricornuta is currently known from

only one specimen collected on *Chrysogorgia* cf. *elegans* Verrill north of the Bahamas, western Atlantic Ocean, in about 1000 m depth.

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