

Redescription of Two Diosaccid Harpacticoid Copepods from the Northern Mariana Islands

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Abstract Two benthic harpacticoid copepods belonging to the family Diosaccidae, *Metamphiascopsis hirsutus* (Thompson and A. Scott) and *Amphiascopsis cinctus* (Claus) were redescribed from the northern Mariana Islands. Both species have a wide distribution in the Indo-Pacific and Atlantic Oceans, but are first recorded from the northern Mariana Islands.

Key words: *Metamphiascopsis hirsutus*, *Amphiascopsis cinctus*, Diosaccidae, Harpacticoida, Copepoda, northern Mariana Islands.

During an expedition to the northern Mariana Islands by the Natural History Museum and Institute, Chiba, in 1992 small collections of shallow-water benthic copepods were made by Dr. Akira Asakura. The presence of the terrestrial harpacticoid *Phyllognathopus rigueri* (Family Phyllognathopodidae) was only preliminarily recorded from the islands (Kikuchi, 1994).

The present paper redescribes two species of the marine harpacticoid copepod family Diosaccidae, *Metamphiascopsis hirsutus* and *Amphiascopsis cinctus*, from the northern Mariana Islands as a preliminary report of the faunistic survey on the islands. The female genital double-somite of *M. hirsutus* is examined with scanning electron microscopy.

Materials and Methods

Copepods were obtained from washings of a green alga, *Dictyota dichotama* (Hudson) collected in the intertidal zones at St. A set up on the southern coast of Uracas Island, the northern Mariana Islands, on 6 June 1992 (cf. Asakura *et al.*, 1994). Specimens were fixed in 10% neutralized formalin sea-water, and then transferred to 70% alcohol. The genital double-somite of *Metamphiascopsis hirsutus* was examined with a scanning electron microscope (JEOL T-20 SEM). The specimens examined in the present study are de-

posited in the Natural History Museum and Institute, Chiba, Japan.

Morphological terminology follows Huys and Boxshall (1991).

Redescription

Order Harpacticoida Sars
Family Diosaccidae Sars
Genus *Metamphiascopsis* Lang
***Metamphiascopsis hirsutus* (Thompson
and A. Scott, 1903)**
(Figs 1–5)

Material examined. 5 ♀♀ & 6 ♂♂, dissected and prepared on glass slides, CBM-ZC-3652, 20 ♀♀ & 20 ♂♂, whole specimens preserved in 70% alcohol, CBM-ZC-3653. From washing of *Dictyota dichotama* in the intertidal zones, Uracas Island; 6 June 1992; leg. A. Asakura.

Body length (measured from rostral base to caudal ramus). ♀ 0.83–1.09 mm (0.95 ± 0.07 mm, $n=20$); ♂ 0.70–0.84 mm (0.76 ± 0.03 mm, $n=20$).

Description. Female (Figs. 1–4). Body (Fig. 1A, B) moderately slender, tapering distally behind posterior end of cephalothorax. Prosoma: cephalothorax slightly longer than wide, with pair of dorsal lenses anteriorly; rostrum (Fig. 1C) defined at base, triangular, rounded at tip, with pair of lateral hairsensilla and middorsal pore subterminally;

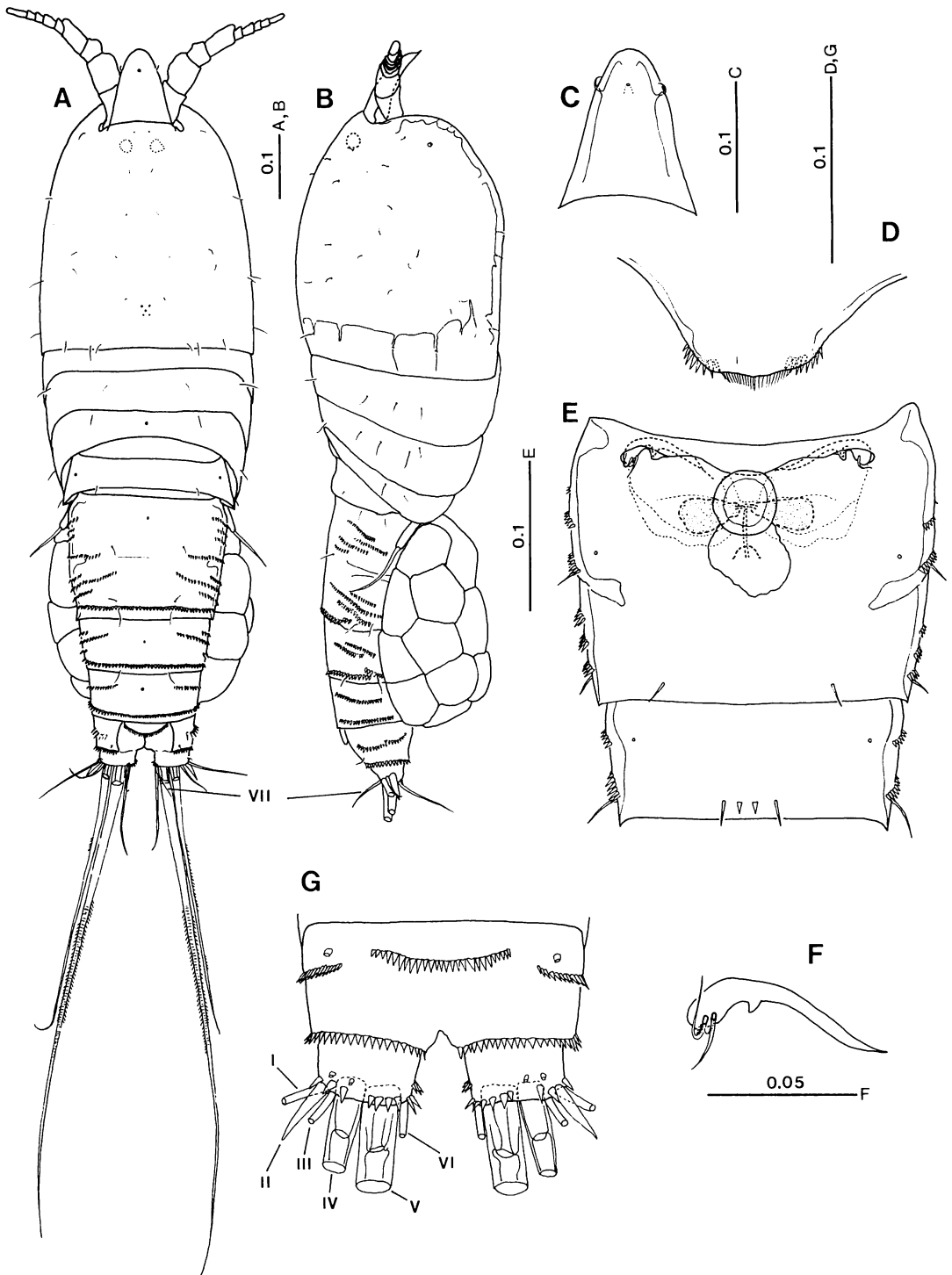


Fig. 1. *Metamphiascopsis hirsutus*, female. A, Habitus of ovigerous ♀, dorsal; B, habitus, lateral; C, rostrum, dorsal; D, labrum; E, genital double-somite and second abdominal somite, ventral; F, leg 6; G, Anal somite and caudal rami, ventral. Scales in mm.

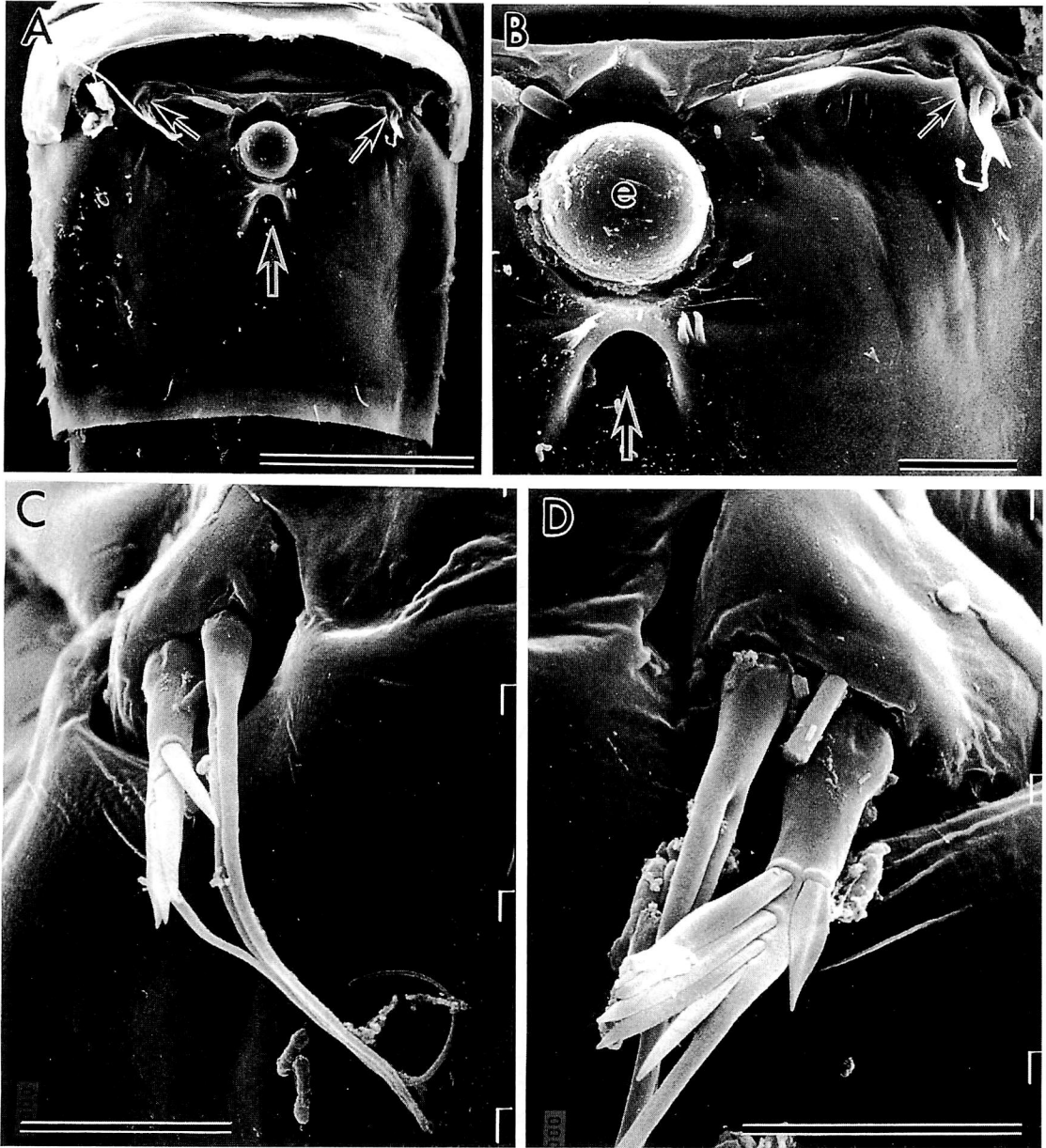


Fig. 2. Micrographs of *Metamphiasopsis hirsutus*, female. A, Genital double-somite, ventral, gonopores indicated by small arrows, copulatory pore by large arrow; B, magnification of A, e: epicopulatory bulb; C, D, leg 6. Scales=0.1 mm (A); 0.02 mm (B); 0.01 mm (C, D).

P4 (fourth leg)-bearing somite broadly rounded posterolaterally. Urosome slightly depressed; P5 (fifth leg)-bearing somite expanded posteriorly in dorsal aspect; genital double-somite (Figs 1E, 2) with internal transverse chitinous rib laterally, meaning original segmentation. Gonopores paired (indicated by small arrows in Fig. 2A, B),

located ventroanteriorly, covered by rudimentary leg 6 (Figs 1F, 2C, D); egg-sacs paired (number of eggs in 1 ovigerous female with 18 eggs on right side and 17 on left); copulatory pore (indicated by large arrow in Fig. 2A, B) located midventrally in anterior half of genital double-somite; circular epicopulatory bulb (e in Fig. 2B) present between

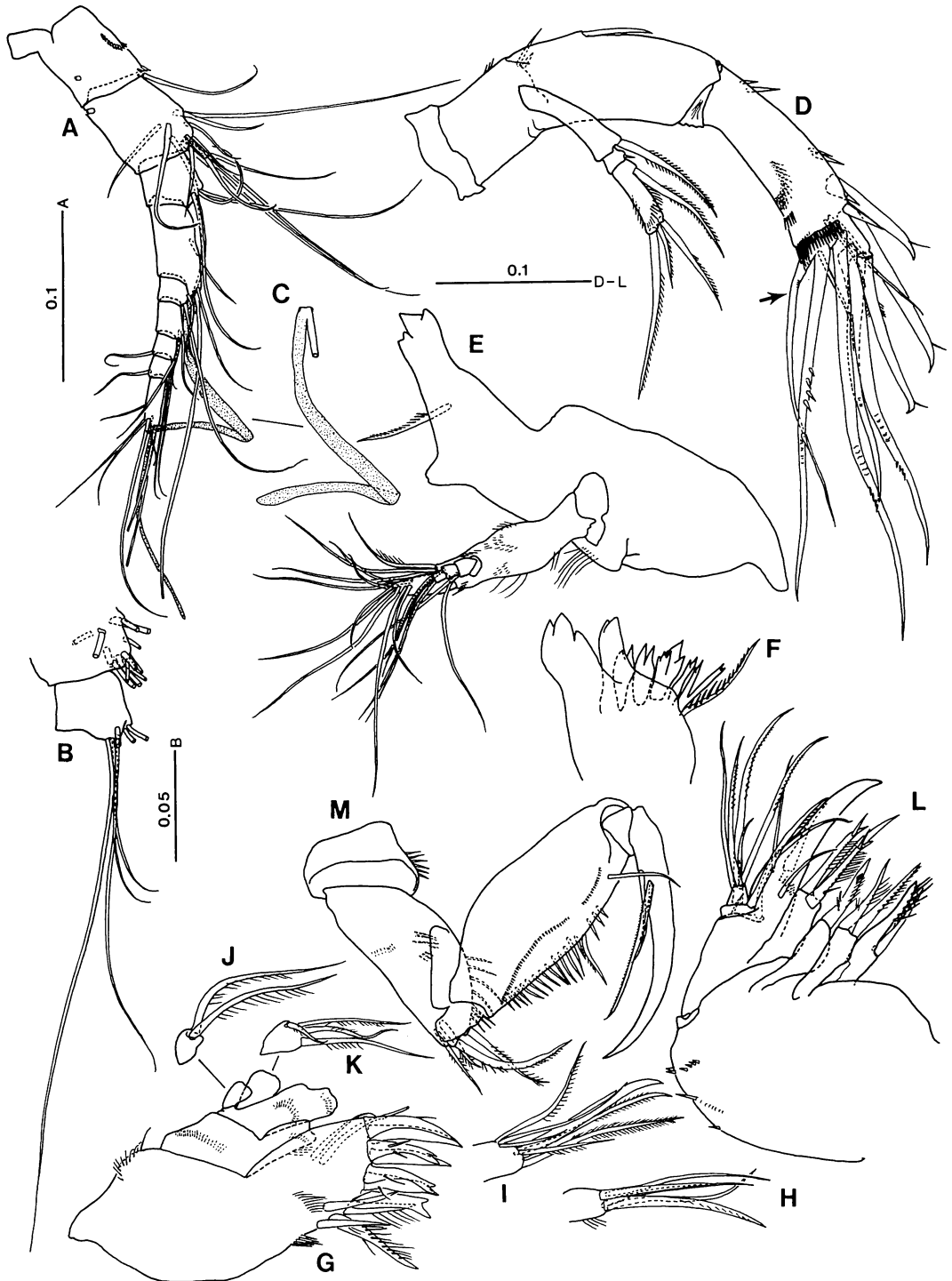


Fig. 3. *Metamphiascopsis hirsutus*, female. A, Antennule; B, second and third segments of antennule; C, aesthetasc on fourth segment of antennule; D, antenna, 2 basally fused setae arrowed; E, mandible; F, mandibular gnathobase; G, maxillule; H, coxal endite of maxillule; I, basal endites of maxillule; J, exopod of maxillule; K, endopod of maxillule; L, maxilla; M, maxilliped. Scales in mm.

gonopores and copulatory pore; paired seminal receptacles connected to copulatory pore by short copulatory duct; genital double-somite and following two urosomal somites fringed with fine spinules around dorsal hind margin; anal somite with round anal operculum (Fig. 1A); caudal ramus (Fig. 1G) shorter than wide, with 7 setae: setae I, III and VI slender; seta II short and spiniform; setae IV and V long and spinulose; dorsal seta VII shorter and tri-articular at base.

Antennule (Fig. 3A-C) 9-segmented; first segment with single seta and spinular rows anteriorly and tubular opening posteriorly; second segment with 12 setae anteriorly and tubular opening posteriorly; third segment with 7 setae (see Fig. 3B), 2 of which extremely elongate; fourth segment with 1 middle and 2 distal setae, one of which basally fused with large aesthetasc (Fig. 3C); fifth and sixth segments with 2 and 3 setae, respectively; seventh and eighth segments each with 1 anterior and 1 posterior seta; ninth segment carrying 6 setae and slender aesthetasc being coalescent at base with distal seta.

Antenna (Fig. 3D) with small coxa unarmed; basis incompletely fused with first endopod segment forming allobasis, original segmentation marked by transverse furrow and by long spinules; exopod 3-segmented, first segment long with spinulose seta, second segment bearing rudimentary seta, third segment bearing 1 proximal and 3 distal setae and transverse row of fine spinules; first endopod segment with spiniform seta medially, second segment having 1 distal and 2 subterminal stout spines each with minute subapical extension, 4 geniculate setae and 3 naked setae, one of which fused with geniculate seta basally (indicated by arrow).

Mandibular gnathobase (Fig. 3E,F) with 8 multicusped teeth and dorsal spinulose seta along cutting edge and subterminal pointed process. Mandibular palp (Fig. 3E) with basis carrying 3 setae at inner distal corner; endopod 1-segmented, relatively broad, bearing 9 setae distally; exopod 3-segmented, first to third segments having 2, 1 and 2 setae, respectively. Labrum (Fig. 1D) truncate, fringed with fine setules medially and coarse spinules bilaterally.

Maxillule bearing well developed praecoxal arthrite (Fig. 3G) bearing 7 strong spines and 4 spinulose setae around distal margin and 2 slender setae on anterior surface, with row of fine setules at inner distal end; coxal endite (Fig. 3H) with 1 spiniform, 1 spinulose and 3 slender setae, furnished with 2 rows of fine spinules, coxal epipodite unarmed; basal endites (Fig. 3I) closely set, proximal endite represented by lobe with 1 spiniform and 3 spinulose setae, distal endite by small lobe with 3 fine setae; exopod (Fig. 3J) 1-segmented, bulbous with 2 plumose setae of almost equal length; endopod (Fig. 3K) 1-segmented, slightly larger than exopod, bearing 1 short and 3 plumose setae.

Maxilla (Fig. 3L) compact; syncoxa with 4 semi-cylindrical endites; proximal endite with 2 spinulose setae, one of which completely fused with endite; second to fourth endites carrying 2, 1 and 3 spinulose setae, respectively; allobasis produced into strong curved claw, with 2 thin and 1 spinulose seta; endopod incompletely 3-segmented, first reduced, with 1 long and 1 short seta, second bearing 2 spinulose setae, third carrying 2 spinulose and 2 naked setae.

Maxilliped (Fig. 3M) pedestal; praecoxa with row of minute spinules distally; coxa having 2 subterminal and 2 terminal spinulose setae at inner corner and long setular row along outer distal margin; basis directed almost at right angle relative to coxa, expanded medially, bearing 1 medial and 1 subterminal thin seta and 2 spinular rows along inner margin; endopod 2-segmented, first small, unarmed, second scythe-like, curved inward, with 3 accessory setae at one-fourth distance of claw length.

Leg 1 (Fig. 4A, B) with praecoxa represented by small sclerite; coxa with five spinular rows on anterior surface. Intercoxal sclerite wider than long, bare. Basis with stout spine at inner and outer distal corners. Endopod 3-segmented, prehensile; first segment longer than exopod, slightly narrower medially, with spinular row sparsely distributed along inner margin and densely along outer margin, and seta present near inner distal corner; second segment small, bearing rudimentary inner seta and coarse outer spinules; third segment short, carrying 2 serrate claws

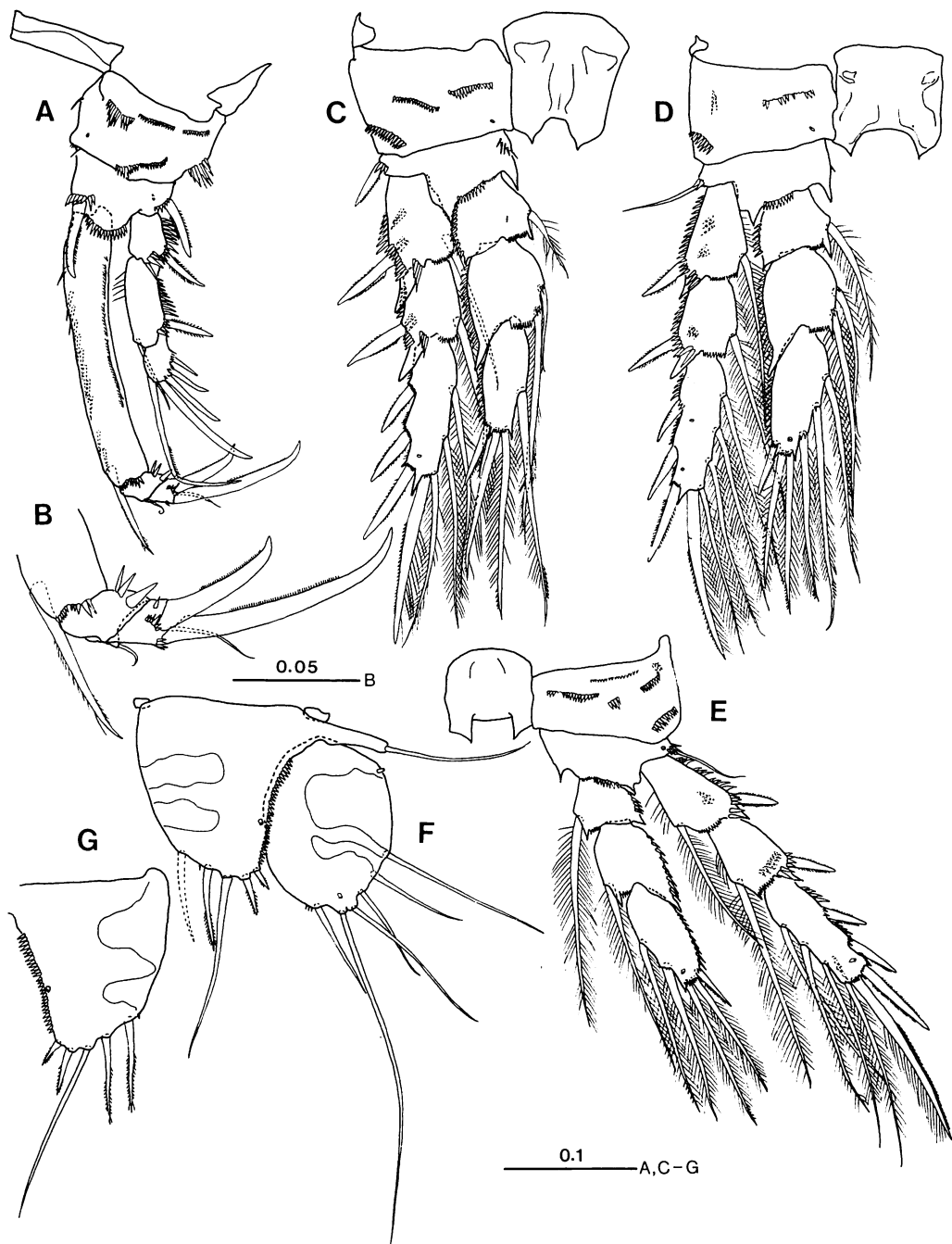


Fig. 4. *Metamphiascopsis hirsutus*, female. A, Leg 1, anterior; B, terminal portion of endopod of leg 1, anterior; C, leg 2, anterior; D, leg 3, anterior; E, leg 4, anterior; F, leg 5, anterior; G, endopodal lobe of leg 5, anterior. Scales in mm.

and naked seta terminally (Fig. 4B). Exopod 3-segmented; first segment with serrate outer spine, fringed with stout spinules; second segment longest, bearing serrate outer spine

and inner seta distally; third segment with 4 spines, gradually increasing in length distally, and geniculate terminal seta. Legs 2 to 4 all with 3-segmented rami. Armature for-

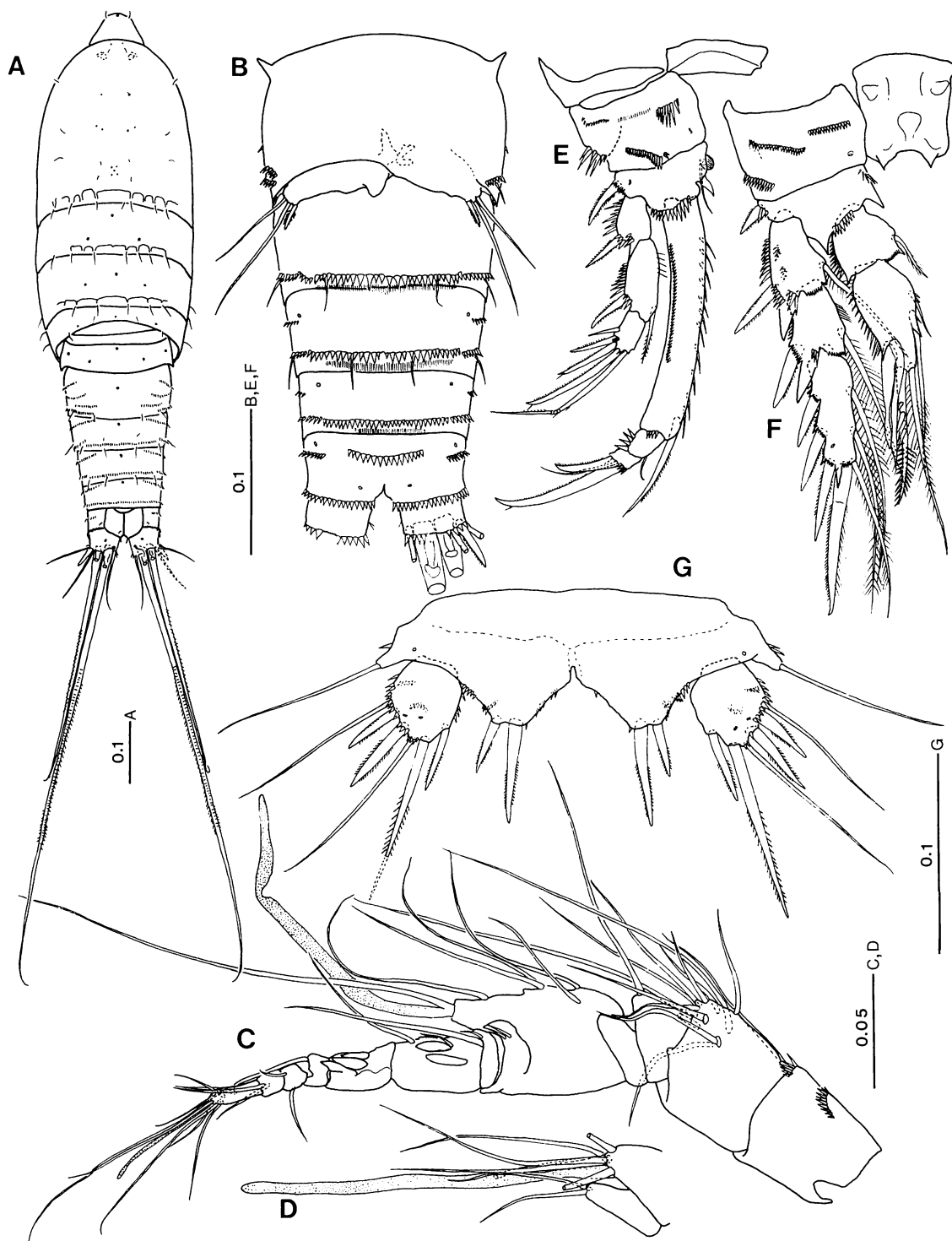


Fig. 5. *Metamphiascopsis hirsutus*, male. A, Habitus, dorsal; B, urosome excluding P5-bearing somite, ventral; C, antennule; D, third and fourth segments of antennule; E, leg 1, anterior; F, leg 2, anterior; G, leg 5, anterior. Scales in mm.

mula as follows:

	exopod			
coxa	basis	1	2	3
Leg 2	0-0	I-0	I-1; I-1; III, I+1, 2	
Leg 3	0-0	1-0	I-1; I-1; III, I+1, 3	
Leg 4	0-0	1-0	I-1; I-1; III, I+1, 3	
	endopod			
	1	2	3	
Leg 2	0-1; 0-2; I, 2, 1			
Leg 3	0-1; 0-2; I, 2, 3			
Leg 4	0-1; 0-1; I, 2, 3			

Leg 2 (Fig. 4C) with coxa bearing 3 spinular rows on anterior surface; intercoxal sclerite with pair of spinous processes distally; basis acutely produced at inner distal corner, with outer pinnate spine; second endopod segment produced at outer distal corner reaching half third segment; first and second exopod segments sharply pointed at outer distal corner. Leg 3 (Fig. 4D) essentially similar to leg 2, but outer basal seta present instead of spine; intercoxal sclerite wider than in leg 2. Leg 4 (Fig. 4E) bearing intercoxal sclerite smaller than in legs 2 and 3; basis with outer seta.

Leg 5 (Fig. 4F, G) phyllopodial; minute intercoxal sclerite present; baseoendopod with 2 serrate spines along inner subterminal margin and 2 spines plus naked seta terminally, fringed with row of minute spinules along outer margin of endopodal lobe, bearing outer cylindrical process with long seta; exopod semi-circular, bearing 6 setae of unequal length and outer proximal tube-pore. Leg 6 (Figs 1F, 2C, D) symmetrical, with rigid stied bifurcate seta and pinnate outer spine (see Fig. 2C, D).

Male. Body (Fig. 5A) similar to that of female. Urosome (Fig. 5B): gonopore covered by lamellar leg 6. First to fourth abdominal somites (Fig. 5B) each fringed with spinules along distal margin both dorsally and ventrally.

Antennule (Fig. 5C, D) 12-segmented, with geniculation between seventh and eighth segments; first segment with 1 seta at anterior distal corner and 2 rows of spinules medially and distally; second segment with 12 setae terminally and subterminally; third segment (Fig. 5D) with long aesthetasc and 5 setae; fourth segment (Fig. 5D) with 2 setae;

fifth segment partly subdivided, expanded anteriorly, with 6 anterior setae, distalmost of which located on cylindrical process and fused basally to large aesthetasc basally, and 2 minute setae distally; sixth segment with 2 unequal setae; seventh segment with 2 setae of unequal length and 2 scale-like elements; eighth segment with 2 scale-like elements medially and pointed process distally; armature elements of ninth to 12th segments as follows: 1, 1+1, 1+1, 7+aesthetasc.

Leg 1 (Fig. 5E) remarkably different from that of female: basal inner spine much smaller than that of female, not serrated, and inner medial margin produced into bulbous prominence with long setule. Leg 2 (Fig. 5F) with highly modified 2-segmented endopod: first segment not modified; second segment with concavity along distal outer margin, bearing 2 chitinized spiniform elements, terminal one of which irregularly curved; apex with 1 coarsely spinulose and 1 plumose seta; inner margin with 1 plumose and 1 short seta. Legs 3 and 4 with the same segmentation and armature elements as in female.

Leg 5 (Fig. 5G) lamellar; right and left baseoendopods fused medially; triangular endopodal lobe with 2 serrate spines terminally, both sides irregularly fringed with minute spinules; exopod 1-segmented, carrying 4 serrate spines, second innermost of which twice as long as others, and 2 slender naked setae. Sixth pair of legs (Fig. 5B) asymmetrical; functional right leg represented by articulating plate bearing 1 short inner spine and 2 setae at outer distal corner; left leg fused to genital somite with the same armature as in right leg.

Variation. The number of eggs contained in an egg-sac varied from 13 to 19 and in some cases varied between the right and left egg-sacs of single individual. The number of elements and the ornamentation of the female leg 5 were invariable; in all dissected specimens the outer margin of the inner lobe of the baseoendopod bears larger spinules on the proximal half and smaller on the distal.

In the terminal endopod segment of the male leg 2, the outer subterminal element was slightly shorter than the inner element in all dissected specimens.

Gut contents. Guts of both sexes were often

full of pennate diatom fragments.

Remarks. *Metamphiascopsis hirsutus* is widely distributed in the tropical and temperate regions of the Indo-Pacific and Atlantic Oceans (Wells and Rao, 1987). Willey (1931) established a subspecies *M. hirsutus bermudae* based on specimens from Bermuda. The subspecies was subsequently re-described by Yeatman (1976) from Jamaica. Both Willey (1931) and Yeatman (1970) considered that the following characters were reliable to distinguish these two subspecies: 1) the outer margin of the baseoendopod of the female leg 5 is fringed with a row of setules in the nominotypical subspecies, while in *M. h. bermudae* it bears a row of spinules; 2) two outer subterminal spines on the second segment of the male leg 2 are unequal in length and is separated from each other in the nominotypical subspecies, whereas in *M. h. bermudae* these are equal in length and connected by a spur distal to the mid-point. Wells and Rao (1987), however, pointed out that these differences were not important enough to maintain two distinct subspecies. The specimens from the northern Mariana Islands show an intermediate condition between the nominotypical subspecies and *M. h. bermudae*: a spinular row present along the outer margin of the baseoendopod of female leg 5; two inner subterminal spines almost equal in length and separate from each other. With regard to these characters, the specimens collected from Andamans by Wells and Rao (1987) agree well with our material, which leads further support to their suggestion to subsume both subspecies.

The distribution of this species has been reported by Thompson and Scott (1903), Vervoort (1964) and Wells and Rao (1987): the Mediterranean Sea, the Atlantic Ocean (Bermuda), and the Indian Ocean (Andaman Islands, Madras, Maldive Islands, Sri Lanka, western Australia). In the Pacific Ocean, this species is recorded from the Aru Islands (Scott, 1909), Caroline Islands (Vervoort, 1964), Fukuoka, Japan (Tanaka and Hue, 1966), and the Mariana Islands (present study).

Some specimens of the species were washed out of weeds, pearl oysters, sponges

and corals (Thompson and Scott, 1903; Sewell, 1940; Vervoort, 1964; Yeatman, 1976; present study).

Genus *Amphiascopsis* Gurney
Amphiascopsis cinctus (Claus, 1866)
 (Figs 6 and 7)

Material examined. 1 ♀, dissected and prepared on glass slides, CBM-ZC-3654. From washing of *Dictyota dichotoma* in the intertidal zones of Uracas Island; 6 June 1992, leg. A. Asakura.

Body length. 0.75 mm (from rostral base to caudal ramus).

Description. Oviparous female (Figs 6, 7). Body (Fig. 6A) moderately slender; 1-segmented lobate exopod of leg 5 partly covering egg mass containing 10 eggs. Rostrum (Fig. 6C) relatively elongate, defined at base, rounded at tip, with pair of long hair-sensilla and medial pore. Urosome (Fig. 6B) slightly depressed; genital double-somite with distinct internal transverse chitinous rib visible ventrolaterally, anteroventral pair of gonopores covered by vestigial legs 6 (lost during dissection); first and second abdominal somites carrying spinular row ventromedially, latter somite with additional transverse row of prominences along posteroventral margin; anal somite fringed with spinules posteriorly; caudal ramus with 2 coarse spinules along inner margin. Caudal setae damaged during dissection, seta III relatively slender, IV and V thick.

Antennule (Fig. 6C) 8-segmented; first to eighth segments bearing 1, 10, 7, 4, 2, 4, 4, 5 setae, respectively; fourth segment with large aesthetasc reaching beyond antennular tip; terminal segment also carrying aesthetasc fused basally with terminal seta. Antenna (Fig. 6D): coxa small, unarmed; basis fused to first endopod segment forming allobasis, original segmentation marked by transverse suture, with spiniform abendopodal seta; exopod 3-segmented, first segment elongate, as long as the following 2 segments combined, with 1 seta; second segment very short, bearing normal seta, third segment with 4 setae of unequal length terminally and laterally; free endopod with 2 stout curved spines and 2 slender setae laterally and 4 geniculate plus 2 naked setae and

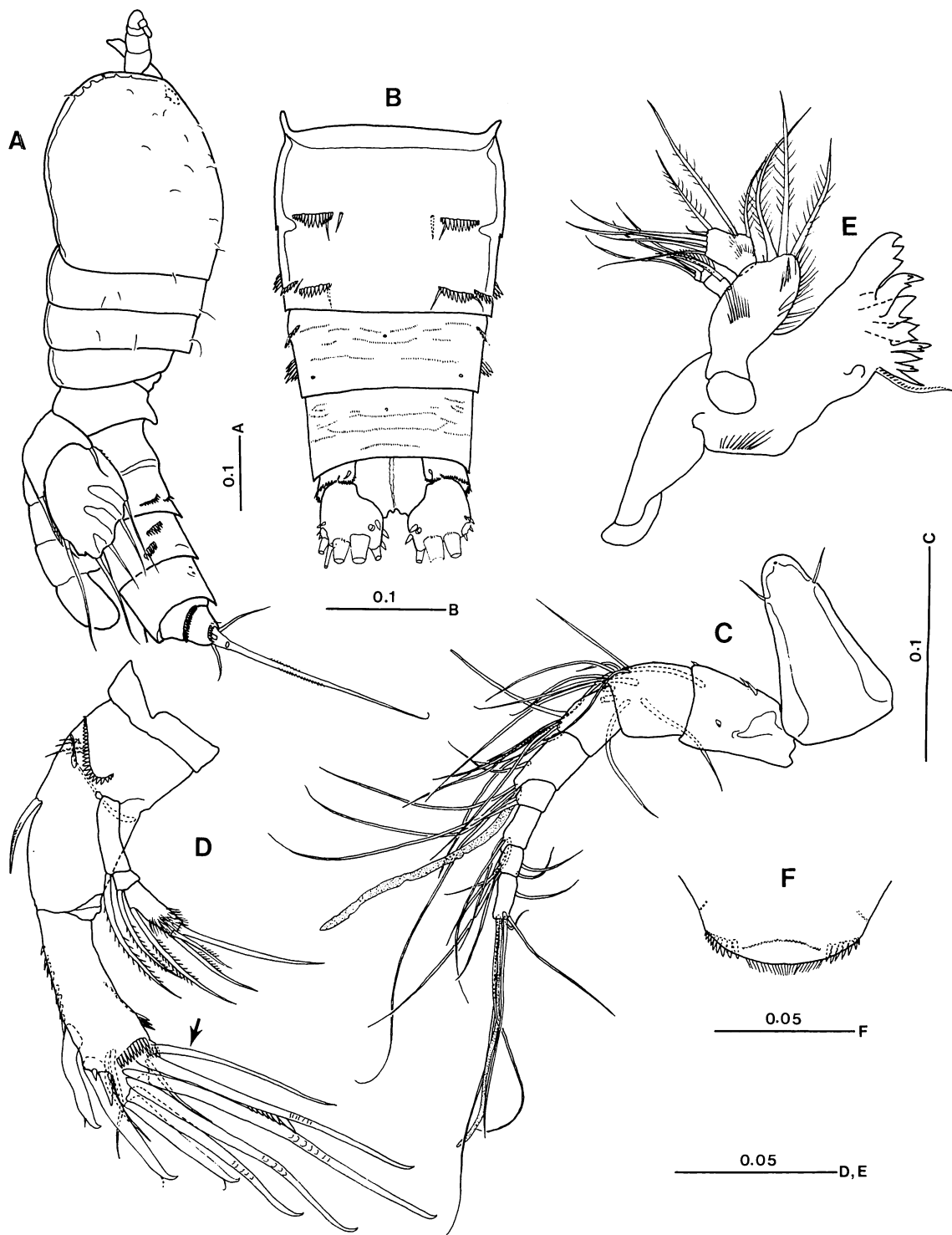


Fig. 6. *Amphiascopsis cinctus*, female. A, Habitus of ovigerous ♀, lateral; B, urosome excluding P5-bearing somite, dorsal; C, rostrum and antennule; D, antenna, 2 basally fused setae arrowed; E, mandible; F, labrum. Scales in mm.

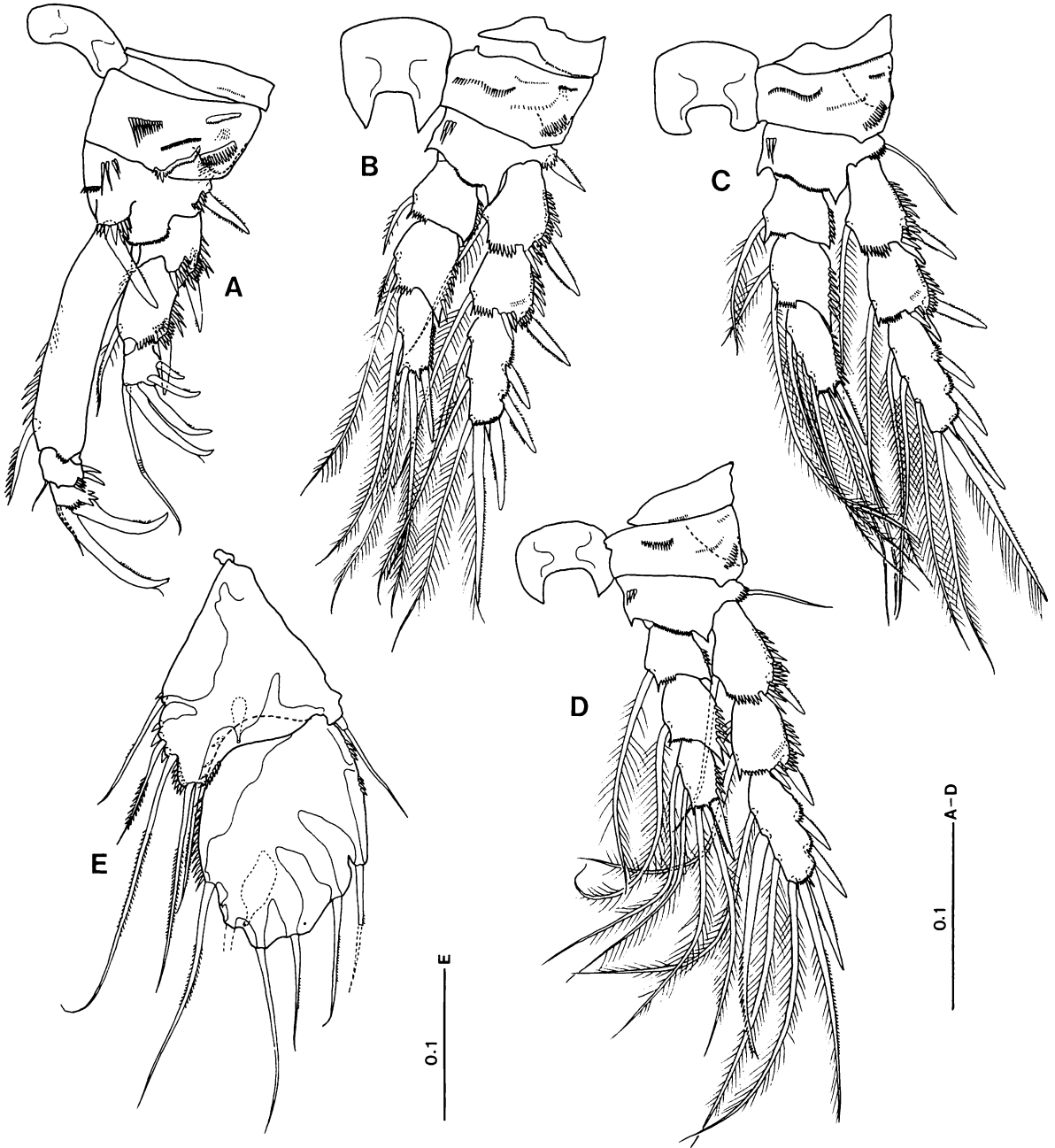


Fig. 7. *Amphiascopsis cinctus*, female. A, Leg 1, anterior; B, leg 2, anterior; C, leg 3, anterior; D, leg 4, anterior; E, leg 5, anterior. Scales in mm.

curved spine terminally; outermost geniculate seta fused with naked one at base (indicated by arrow).

Mandibular gnathobase (Fig. 6E) with 8 teeth and spinulose seta along cutting edge; basis protruded at inner distal corner bearing

3 plumose setae; exopod small, 3-segmented, setal formula 2, 1, 2; endopod broad, 1-segmented carrying 3 lateral setae and 5 distal setae, one of which being minute. Labrum (Fig. 6F) fringed with distal row of spinules on each side. Mouthpart appendages partly

damaged during dissection, and neither described nor illustrated here.

Leg 1 (Fig. 7A) highly modified; coxa bearing numerous spinules on both surfaces; basis with 1 outer and 1 inner serrate spine; endopod 3-segmented, first segment longer than exopod, slightly curved outward, bearing serrate inner spine subterminally, second segment small with inner short seta distally, third segment as long as penultimate segment, carrying 2 well-developed hooked spines terminally; exopod 3-segmented, first segment with outer spine terminally, second segment with outer spine and inner spinulose seta, third segment furnished with geniculate seta and 4 outwardly curved spines increasing in size distally. Legs 2 to 4 all with 3-segmented rami. Armature formula as follows:

	coxa	basis	exopod		
			1	2	3
Leg 2	0-0	1-0	I-1; I-1; III, I+1, 2		
Leg 3	0-0	1-0	I-1; I-1; III, I+1, 3		
Leg 4	0-0	1-0	I-1; I-1; III, I+1, 3		
	endopod				
			1	2	3
Leg 2	0-1;	0-2;	I, 2, 1		
Leg 3	0-1;	0-2;	I, 2, 3		
Leg 4	0-1;	0-1;	I, 2, 2		

Intercoxal sclerite produced into acute processes distally in legs 2 (Fig. 7B) and 4 (Fig. 7D) and rounded lobes in leg 3 (Fig. 7C); basis protruded into sharply pointed process at inner subterminal corner, bearing round lobe near outer margin on posterior surface.

Leg 5 (Fig. 7E) lamellar: intercoxal sclerite rudimentary; baseoendopod with 3 inner and 2 distal spinulose setae on endopodal lobe reaching one-third length of exopod and single naked seta at outer corner; exopod ovoid, bearing 6 spinulose setae on both right and left legs. Leg 6 partly damaged, missing element(s); represented by plate with 2 processes, outer process perhaps bearing at least one element on tip.

Remarks. The present single specimen is assignable to *Amphiascopsis cinctus*, but apparently differs from the specimens from Monterey Bay, California, described in detail by Lang (1965) as follows: 1) the rostrum is less protruded, bearing longer rostral fila-

ments; 2) the distal segment of antennary exopod bears 3, rather than 2, terminal setae; 3) the distal segment of the antennary endopod bears 2, rather than 1, subterminal setae near the base of the second lateral spine; 4) the setal formula of mandibular exopod is 2, 1, 2 versus 1, 1, 3; 5) the first endopod and the first 2 exopod segments of the former's leg 1 are relatively shorter; 6) the exopod of the leg 5 of the former is more elongate; 7) the left exopod of leg 5 bears 6, rather than 7, setae.

Some of the above-mentioned differences, in particular, fewer setae on the appendages, seem not to be true variabilities, and may have been caused by Lang's (1965) imperfect observation. For example, rudimentary elements on the antenna seem to be overlooked in Lang's (1965) description. *Amphiascopsis cinctus* has been relatively well described by several authors (Sewell, 1940; Noodt, 1964; Vervoort, 1964; Pallares, 1970; Hicks, 1971; Wells and Rao, 1987). According to these descriptions, *A. cinctus* is characterized by the following features: the distal exopod segment of the antenna bearing 3 setae; the mandibular endopod with 5 normal setae terminally; the maxillulary praecoxal arthrite bearing 10 elements; the first and second syncoxal endites of the maxilla with 4 and 3 setae, respectively; the left and right exopods of female leg 5 each with 6 setae. Pending the discovery of males from this locality the taxonomic position of the present female specimen has to be considered tentative.

This species is widely distributed in the shallow waters from tropical to temperate regions (Sewell, 1940; Vervoort, 1964; Pallares, 1970; Hicks, 1971): the Mediterranean Sea, the Red Sea, the Atlantic Ocean (Bermuda, Helgoland, Irish and Norwegian coasts, North American coast, Santa Cruz, southwestern Africa), and the Indian Ocean (Andaman Islands, Nicobar Islands, St. Vincent and Spencer Gulf). In the Pacific Ocean it occurs in California (Lang, 1965), the Calorine Islands (Vervoort, 1964), Fiji (Wells, 1978), and New Zealand (Hicks, 1971).

Specimens of the species were collected from washings of weeds and sponges (Sewell, 1940; Lang, 1965; Pallares, 1970; Yeatman, 1970; Hicks, 1971; present study).

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北マリアナ諸島産ハルパクチクス目 2種の再記載

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ミクロネシア北マリアナ諸島からハルパクチクス目カイアシ類で Diosaccidae に属する *Metamphiascopsis hirsutus* (Thompson and A. Scott) と *Amphiascopsis cinctus* (Claus) の 2 種を再記載した。これら 2 種は三大洋に広く分布するが、北マリアナ諸島からは初記録である。