

# A New Species of the Hermit Crab Genus *Discorsopagurus* McLaughlin (Crustacea: Decapoda: Anomura: Paguridae) from Japan

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**Abstract** A fourth species of the pagurid genus *Discorsopagurus* McLaughlin, 1974, *D. tubicola* sp. nov., is described on the basis of five specimens from shallow waters of Uruga Channel and Tokyo Bay, Japan. The new species was found to inhabit tubes of serpulid polychaete *Spirobranchus* sp. It is most similar to *D. cavicola* Komai and Takeda, 1996, but the shorter exopod and endopod of the uropod and more slender dactylus of the second pereopod separate *D. tubicola* from *D. cavicola*. Emended key to the species of *Discorsopagurus* is provided.

**Key words:** *Discorsopagurus tubicola*, new species, Decapoda, Anomura, Paguridae, Japan.

In recent years, although there have been a number of reports on the decapod crustacean fauna of Tokyo Bay and Sagami Bay, central Japan (cf. Doflein, 1902; Balss, 1914; Sakai, 1965; Miyake, 1978), new records and species are still being discovered (Watabe and Ikeda, 1994; Ikeda, 1998; Komai *et al.*, 1999; Komai, 2000a, 2000b, 2001; Nomura and Komai, 2000; Watabe and Iizuka, 2000; Komai and Osawa, 2001; Komai and Takeda, 2002; Komai and Lemaitre, 2002; Okuno and Nomura, 2002). In this paper, a new species of pagurid hermit crab, *Discorsopagurus tubicola*, is described and illustrated on the basis of five specimens from Uruga Channel and Nakanose, Tokyo Bay. The collection was made during the ongoing survey of marine invertebrate fauna of Boso Peninsula carried out by the Natural History Museum and Institute, Chiba, since 1989. The specimens were found to inhabit tubes of serpulid polychaete *Spirobranchus* sp. An emended key to the species of *Discorsopagurus* is provided.

## Materials and Methods

The specimens examined in this study are deposited in the Natural History Museum and Institute, Chiba, Japan (CBM). The shield length, abbreviated as SL, was measured

from the tip of rostrum to the midpoint of the posterior margin of the shield. The general terminology used in the description is that of McLaughlin (1974), with exception of the posterior carapace (see Lemaitre, 1995), fourth pereopod (see McLaughlin, 1997), gill structure (see McLaughlin and de Saint Laurent, 1998) and the numbered thoracic sternites. The submedian grooves on the shield are termed "paragastric grooves" (see Komai and Osawa, 2001). The drawings were made with the aid of a drawing tube mounted on a Leica MZ8 stereomicroscope.

For comparison, the holotype and paratypes of *Discorsopagurus cavicola* were examined: Yunoshima, Asamushi, Mutsu Bay, 40°53.42N, 140°51.16E, 3 m deep, 6 July 1992, coll. S. Tamura and S. Takeda, 1 male sl 2.8 mm (holotype, CBM-ZC 2189); 1 male sl 2.8 mm, 11 females sl 1.9–3.7 mm (paratypes, CBM-ZC 2190); Hakodate Bay, depth unknown, 29 October 1992, associated with rock caught by gill net, coll. T. Komai, 3 males sl 1.1–1.9 mm (paratypes, CBM-ZC 2188).

## Taxonomy

### *Discorsopagurus tubicola* sp. nov.

(Figs. 1-4)

*Material examined.* Uraga Channel off Takeoka, Futtsu, Chiba Prefecture (ca. 35° 11' N, 139° 48' E), 30-40 m deep, 14 February 1997, commercial gill net, coll. T. Komai, 1 male sl 2.4 mm (holotype; CBM-ZC 6470); 3 females sl 1.9-3.2 mm (paratypes; CBM-ZC 6471). Nakanose, Tokyo Bay (ca. 35° 22' N, 139° 45' E), ca. 15 m deep, 10 May 1984, SCUBA diving, coll. T. Furota, 1 male sl 2.5 mm (paratype; CBM-ZC 6472).

*Description.* Eleven pairs of biserial phyllobranchiae.

Shield (Fig. 1A) as long as broad; rostrum triangular, overreaching lateral projections, terminating bluntly or subacutely, partially obscured by tuft of setae; anterior margin between rostrum and lateral projection nearly straight; lateral projections obsolete, each with tiny submarginal spine; anterolateral margins sloping; posterior margin truncate; dorsal surface with 1 median and some lateral pairs of tufts of setae, paragastric grooves inconspicuous. Posterior carapace (Fig. 1B) membranous except for weakly calcified anterior part of posteromedian plate, with paired tufts of setae increasing in length laterally; cardiac sulci divergent posteriorly, not reaching posterodorsal margin of carapace; sulci cardiobranchialis inconspicuous.

Ocular peduncles (Fig. 1A) moderately long and slender, 0.6-0.8 times as long as shield, weakly inflated basally; dorsomesial surfaces each with row of tufts of setae; corneas not dilated, maximal diameter smaller than basal diameter of ocular peduncle. Ocular acicles (Fig. 1A) subtriangular or subovate, terminating bluntly, narrowly separated basally, each with small submarginal spine; margins with setae; dorsal surfaces slightly concave.

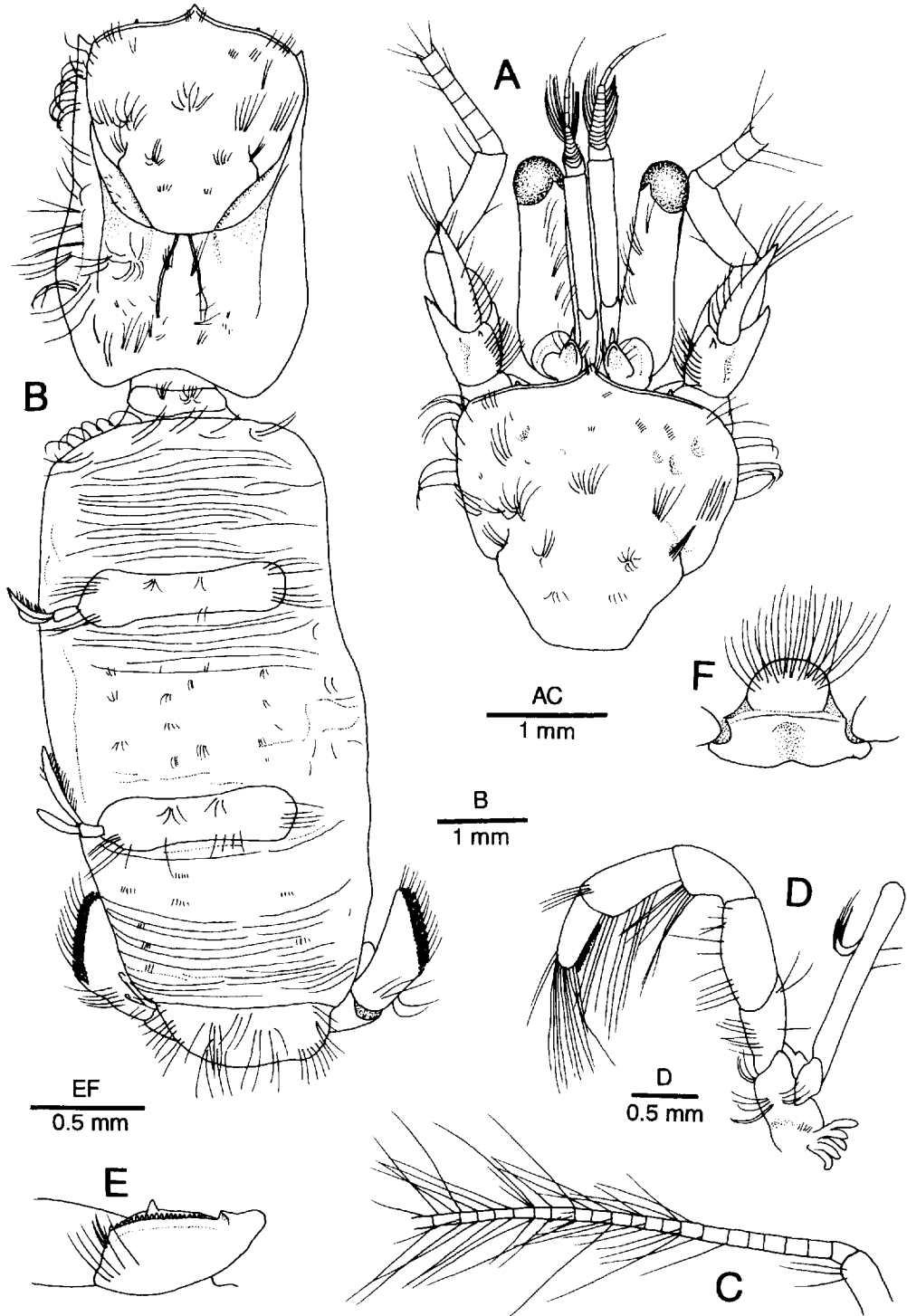
Antennular peduncles (Fig. 1A), when fully extended, overreaching corneas of ocular peduncles by 0.3-0.4 length of ultimate segment. Ultimate segment 1.7-1.8 times as long as penultimate segment, with few very short setae on dorsal surface. Basal segment unarmed on lateral face or distal margin of

statocyst lobe.

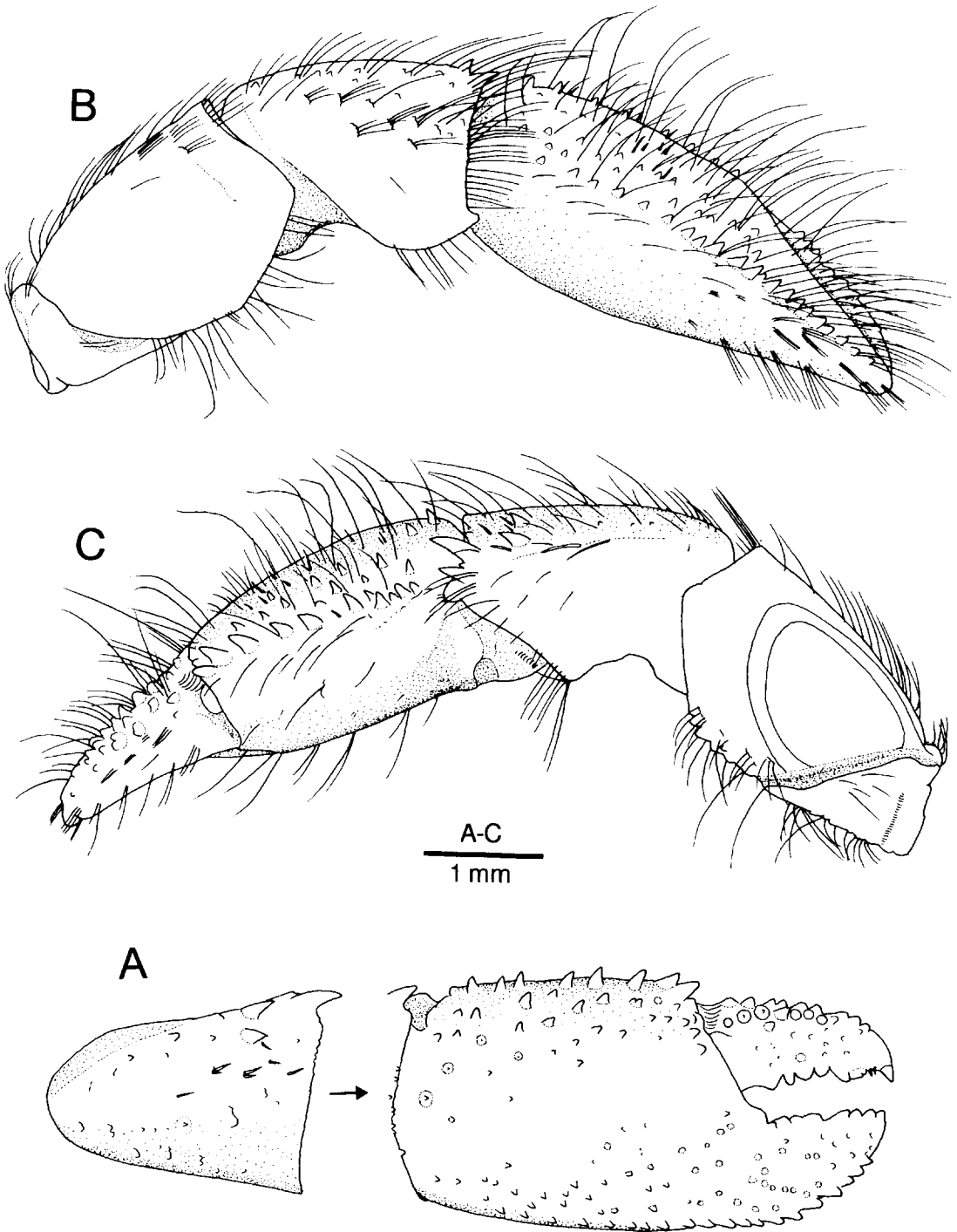
Antennal peduncles (Fig. 1A) reaching or slightly overreaching distal margins of corneas. Fifth, fourth and third segment with few short setae, no spine at ventromesial distal angle of third segment. Second segment with dorsolateral distal angle produced, reaching to midlength of fourth segment, terminating in simple spine; dorsomesial distal angle with small spine; mesial margin with row of setae. First segment with small submarginal spine on lateral surface, ventromesial distal margin weakly produced, with few spinules. Antennal acicle weakly arcuate, slightly overreaching distal margin of fourth segment, slightly broadened basally, terminating in small spine obscured by tuft of long setae; mesial margin with numerous setae. Antennal flagellum (Fig. 1C) not reaching tip of extended right cheliped; entire flagellum showing cast net-like structure, distal 0.8 consisting of articles each bearing moderately long to long setae arising from distal margin.

Mouthparts typical of genus. Third maxilliped (Fig. 1D) with moderately stout endopod; crista dentata (Fig. 1E) on ischium composed of row of small corneous teeth; 1 accessory tooth present (Fig. 1E).

Right cheliped (Fig. 2A-C) larger than left cheliped. Chela with general outline in dorsal view subovate, 1.9-2.0 times as long as wide. Dactylus shorter than palm, with 2 rows of small tubercles on dorsomesial margin; dorsal, mesial and ventral surfaces all with tufts of short to long setae; cutting edge bearing row of calcareous teeth and few subdistal corneous teeth, terminating in small corneous claw. Palm slightly longer than carpus; dorsal surface weakly convex, with small spines or tubercles laterally and mesially (spines adjacent to dorsomesial margin larger than others) and 1 small but conspicuous spine on midline proximally, and with numerous tufts of long setae and short spiniform setae, dorsolateral margin delimited by row of small spines or tubercles, dorsomesial margin with row of moderately large spines increasing in size distally; lateral, mesial and ventral surfaces unarmed, but with sparse tufts of setae, ventral surface not inflated. Cutting edge of fixed finger bearing



**Fig. 1.** *Discorsopagurus tubicola* sp. nov. Holotype male, sl 2.4 mm (CBM-ZC 6470). A, shield and cephalic appendages, dorsal; B, carapace and abdomen, dorsal (setae on carapace omitted on right side); C, proximal half of left antennal flagellum, dorsal; D, left third maxilliped, lateral; E, ischium of left third maxilliped, dorsal; F, sixth thoracic sternite, ventral.



**Fig. 2.** *Discorsopagurus tubicola* sp. nov. Holotype male, sl 2.4 mm (CBM-ZC 6470). Right cheliped. A, chela and carpus, dorsal (setae omitted); B, entire right cheliped, lateral; C, same, mesial.

row of calcareous teeth, terminating in tiny corneous claw. Carpus nearly as long as merus, widened distally in dorsal view; dorsal surface sloping to lateral face, with tufts of long setae and some short spiniform setae; dorsomesial margin weakly delimited, with 2 large spines distally; dorsodistal margin minutely denticulate; lateral face with some low protuberances and tufts of long setae; mesial face with few setae; ventral surface not inflated. Merus with moderately long setae on dorsal surface, dorsodistal margin unarmed; lateral and mesial faces with few setae dorsally, ventrolateral margin smooth, ventromesial margin with some small tubercles; ventral surface nearly flat, with scattered tufts of long setae. Ischium with row of small tubercles on ventromesial margin; surfaces each with sparse setae.

Left cheliped (Fig. 3A–C) reaching to or beyond base of dactylus of right cheliped. Chela 2.3–2.5 times as long as greatest width at base of dactylus. Dactylus 1.2–1.3 times as long as palm, without delineation of dorsomesial margins, all surfaces with tufts of setae; cutting edge bearing row of small, subacute calcareous teeth, terminating in small corneous claw. Cutting edge of fixed finger bearing row of small corneous teeth, terminating in small corneous claw. Palm shorter than carpus; dorsal surface nearly flat, with irregular rows of small spines or tubercles laterad of midline extending onto fixed finger and numerous long setae; dorsolateral margin weakly convex in dorsal view, distinctly delimited by row of small spines decreasing in size distally; dorsomesial margin not delimited; lateral surface with few short setae; mesial face with scattered long setae; ventral surface slightly convex, with few setae. Propodal-carpal angle of articulation rotated clockwise about 10–15° from horizontal plane. Carpus with 3 or 4 spines (distal-most spine large) on weakly delimited dorsolateral margin; dorsomesial margin not delimited; dorsodistal margin with small tubercles; dorsal, lateral and mesial faces with short to long setae; ventral surface slightly convex, with few setae. Merus with tufts of moderately long setae on dorsal surface, dorsodistal margin unarmed; lateral and mesial faces with few setae, ventrolateral margin

smooth, ventromesial margin with few small tubercles at midlength; ventral surface nearly flat, with scattered tufts of long setae. Ischium with row of small tubercles on ventromesial margin; surfaces with sparse setae.

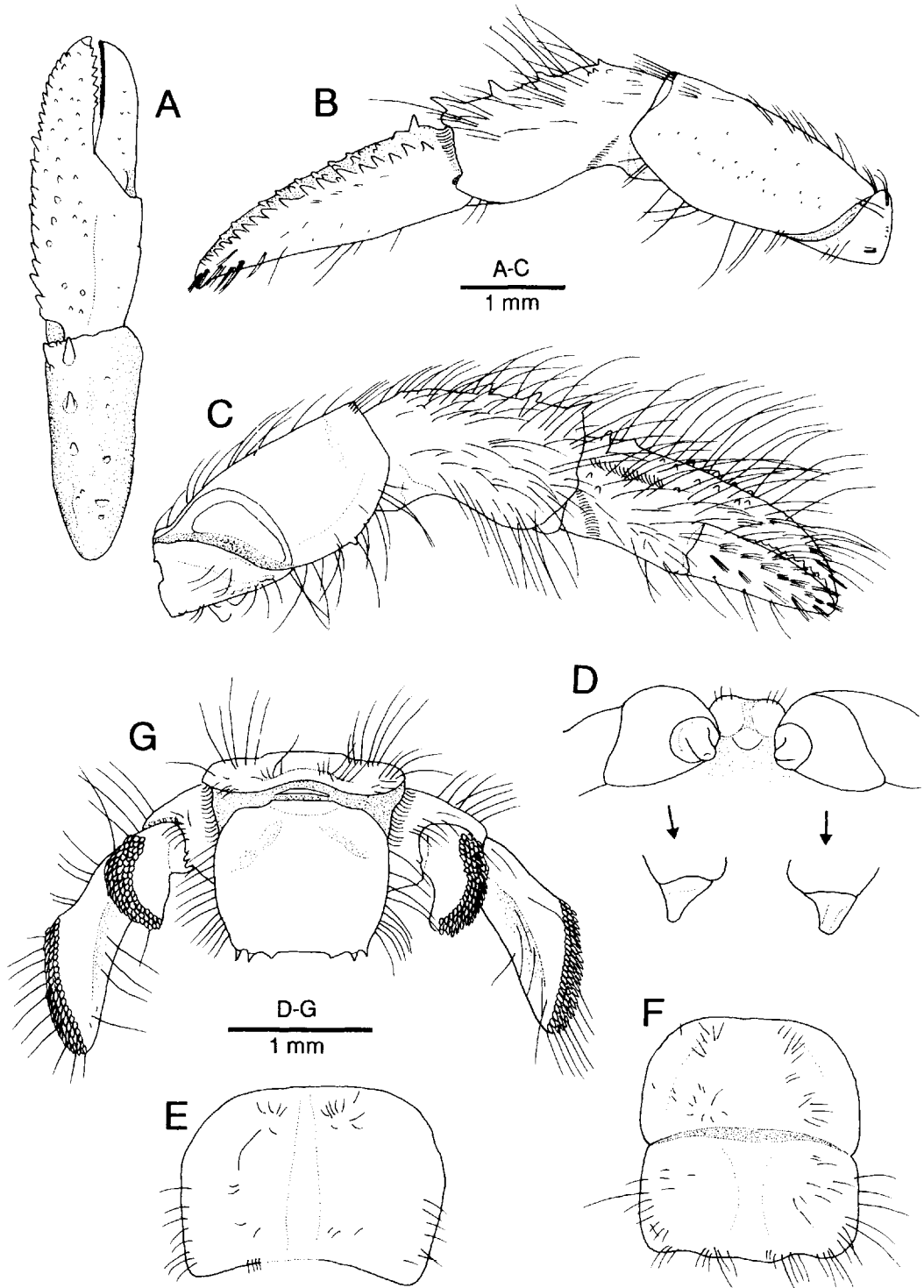
Second and third pereopods (Fig. 4A, C) stout. Dactyli subequal in length to propodi, 4.4–4.9 times as long as high in second pereopod, terminating in large corneous claw; dorsal margins each with short to moderately long setae; lateral and mesial faces each with several setae, mesial faces unarmed (Fig. 4B, D); ventral margins each with 7 or 8 long corneous spines. Propodi distinctly longer than carpi, with numerous long setae on dorsal surfaces (setae less dense in third than in second); lateral faces each with row of tufts of short setae ventrally; ventral surfaces each with row of sparse long setae and distally with corneous spinules. Carpi with long setae on dorsal surface (less dense in third than in second), but unarmed; lateral faces each with setae dorsally. Meri each with row of tufts of long setae on dorsal margin; lateral faces with only few short setae; ventral margins unarmed, but with sparse long setae. Ischia each with setae on dorsal and ventral margins. Paired gonopores present in females.

Fourth pereopod (Fig. 4E) semichelate. Dactylus weakly curved, terminating in small corneous claw, with row of small corneous teeth on ventral margin. Propodus with strongly convex ventral margin, propodal rasp consisting of 5 or 6 rows of scales. Carpus with sparse row of tufts of long setae on dorsal margin. Merus increasing in depth proximally, with long setae on dorsodistal margin and shorter setae on ventral margin.

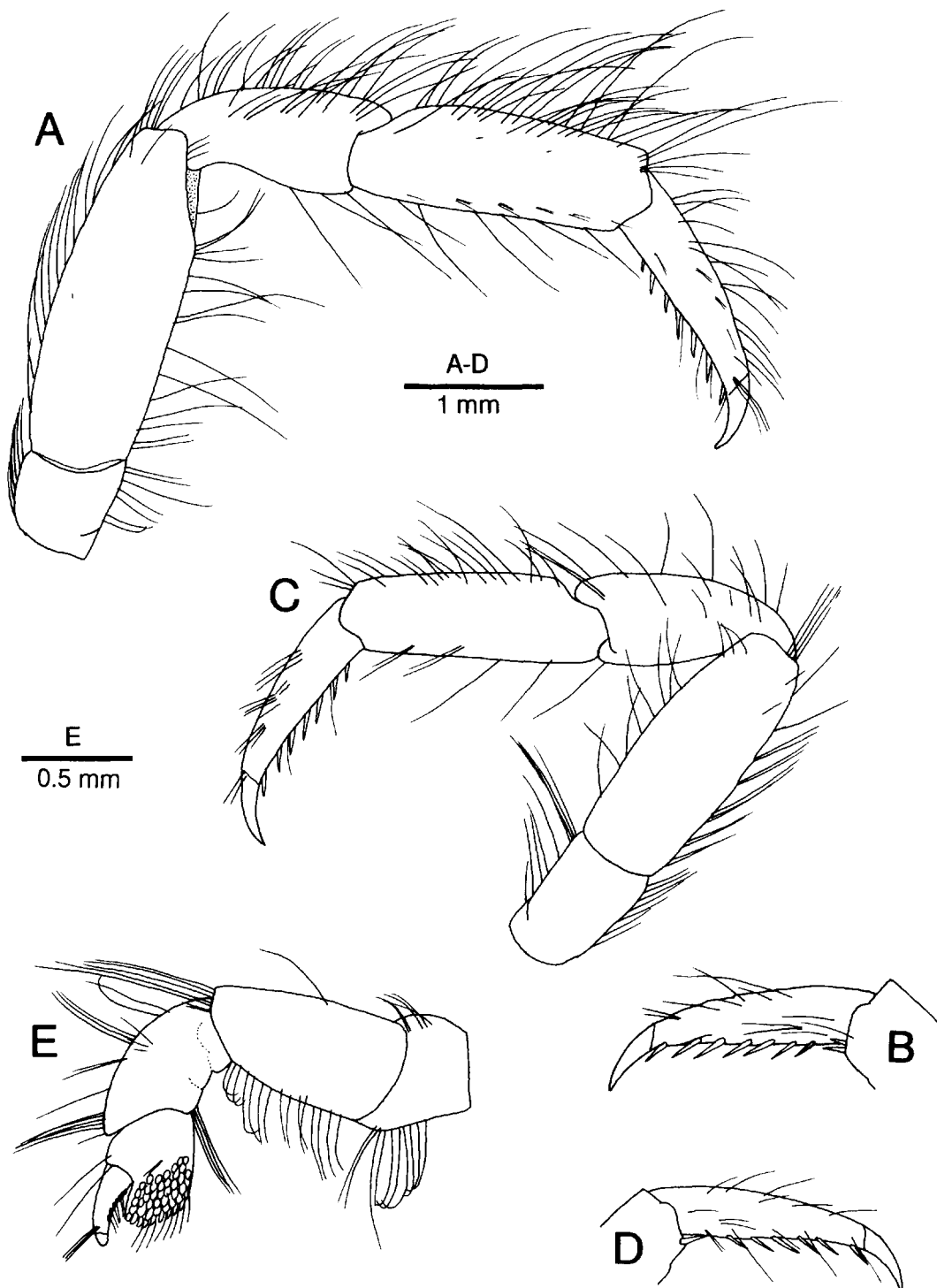
Fifth pereopods chelate. Coxae (Fig. 3D) each with short sexual tube in males.

Anterior lobe of sixth thoracic sternite (Fig. 1F) oval, with numerous long setae on anterior surface. Eighth thoracic sternite (Fig. 3D) with two rounded anterior lobes.

Abdomen (Fig. 1B) large, sometimes slightly inflated, straight or slightly flexed, with scattered tufts of very short setae on dorsal surface. Third and fourth tergites in form of single plate consisting of weakly calcified lateral parts and non-calcified, membranous median part; dorsal surfaces of tergites each



**Fig. 3.** *Discorsopagurus tubicola* sp. nov. Holotype male, sl 2.4 mm (CBM-ZC 6470). A, chela and carpus of left cheliped, dorsal (setae omitted); B, entire left cheliped, lateral (setae partially omitted); C, same, mesial; D, coxae of fifth pereopods and eighth thoracic sternite, ventral (setae partially omitted); insets, sexual tubes, lateral; E, fifth abdominal tergite, dorsal; F, sixth abdominal tergite, dorsal; G, telson and uropods, dorsal.



**Fig. 4.** *Discorsopagurus tubicola* sp. nov. Holotype male, sl 2.4 mm (CBM-ZC 6470). A, right second pereopod, lateral; B, dactylus of right second pereopod, mesial (only setae arising from mesial surface depicted); C, left third pereopod, lateral; D, dactylus of left third pereopod, mesial (only setae arising from mesial surface depicted); E, left fourth pereopod, lateral.

with tufts of setae submedially and row of setae laterally. Fifth tergite (Fig. 3E) subrectangular in general outline, broader than long, with slightly produced posterolateral angles, somewhat calcified except for uncalcified medial area; dorsal surface with very short setae. Sixth tergite (Fig. 3F) strongly calcified, subdivided in 2 parts by deep transverse groove; dorsal surface only slightly uneven, with short to moderately long setae laterally, margins sloping, not upturned; posterior margin slightly uneven. Males with 3 unpaired left pleopods; females with 4 unpaired left pleopods.

Telson (Fig. 3G) nearly quadrate with slightly convex lateral margins; dorsal surface naked; posterior margin entire or with shallow median notch, with 2 or 3 small spines adjacent to each lateral corner. Uropods (Fig. 3G) symmetrical; exopod moderately long, 1.3–1.6 times as long as telson; endopod stout, not reaching to posterior margin of telson.

*Coloration in life.* Carapace and abdomen brown or reddish brown. Ocular peduncles transparent, each with 2 brown longitudinal stripes on dorsal surface. Antennular peduncles transparent, each with brown median stripe on dorsal surface of ultimate and penultimate segments. Antennal peduncles transparent generally, each with brown longitudinal stripes on lateral and mesial faces of fifth segment. Chelipeds mottled with brown and cream; fingers each with brown band. Ambulatory legs banded with brown and cream.

*Size.* Males: sl 2.4–2.5 mm; females sl 1.9–3.2 mm.

*Distribution.* So far known only from Uraga Channel and Tokyo Bay, at depths of 15–40 m.

*Biological note.* The present specimens were found to occupy tubes of serpulid polychaete *Spirobranchus* sp. However, it is unknown whether the tubes were originally fixed on bottom substrates or free, as the tubes inhabited by the hermit crabs were all detached when collected. Nevertheless, it is possible that the tubes were originally fixed on substrates, because numerous tubes occupied by live polychaete worms were mixed in the same haul.

One specimen (not preserved) was kept alive for a few days in an aquarium. It was found that the animal sometimes moved actively. The cast net-like structure of the antennal flagellum suggests that feeding is accomplished, at least in part, by antennal filtering in *D. tubicola*. However, only deposit feeding was observed during the observation.

*Etymology.* Named from the Latin *tubis* (= tube) and *cola* (=to inhabit), in reference to the housing of the new species. The name is considered as a noun in apposition.

*Remarks.* The genus *Discorsopagurus* was erected by McLaughlin (1974) for *Pylopagurus schmitti* Stevens, 1925, a distinctive hermit crab species assigned at that time to the genus *Orthopagurus* Stevens, 1927. A suite of characters, including the straight or flexed abdomen with third and fourth tergites each in form of single plates, the lack of paired first pleopods in females, the symmetrical uropods, and the telson lacking lateral indentations set *Discorsopagurus* apart from all other members of the Paguridae. Since the erection of the genus, two species, *D. maclaughlinae* Komai, 1995 and *D. cavicola* Komai & Takeda, 1996, have been described from Japanese waters.

The present specimens are very similar to *D. cavicola*. However, morphological and habitat differences seem to warrant full specific status for the former specimens. The new species can be distinguished primarily by the morphology of the uropods. In *D. tubicola*, the uropodal exopod is not particularly elongate, 1.3–1.6 times (1.4 on average,  $N=5$ , sl 1.9–3.2 mm) as long as the telson, while in *D. cavicola* this segment is greatly elongate, 2.0–2.7 times (2.3 on average,  $N=15$ , sl 1.1–3.7 mm) as long as the telson. The uropodal endopod does not reach the posterior margin of the telson in *D. tubicola*, rather than overreaching in *D. cavicola*. Gherardi and McLaughlin (1995) indicated that while microhabitats influence uropod orientation, the uropod symmetry and pleopod asymmetry in *Discorsopagurus schmitti* are independent phenomena. The present examination suggests that the shape of the uropods is constant specifically in *Discorsopagurus*. Furthermore, the dactylus of the second pereopod



**Table 1.** Known housing of the species of *Discorsopagurus*.

Species	Housing	References
<i>D. schmitti</i>	fixed tubes of sabellarid polychaete <i>Sabellaria cementarium</i> Moore	Gherardi and Cassidy (1994)
<i>D. maclaughlinae</i>	detached tubes of unidentified polychaete	Komai (1995)
<i>D. cavicola</i>	boreholes made on clay rock by rock-boring clam <i>Barnea manilensis</i> (Philippi) or on hard rock made by unknown host	Komai and Takeda (1996)
<i>D. tubicola</i> sp. nov.	tubes of serpulid polychaete <i>Spirobranchus</i> sp.	present study

pod is more slender in *D. tubicola* than *D. cavicola*, although this character is not useful in distinguishing small specimens (<sl 2.0 mm). The ratio "length/greatest height" of the dactylus of the second pereopod ranges from 4.4 to 4.9 (4.7 on average, N=5) in the new species, while from 3.5 to 4.4 (4.0 on average, N=10) in *D. cavicola*. In the three small specimens of *D. cavicola* from Hakodate Bay (sl 1.1–1.9 mm), the ratio is 4.7–4.8, included within the variation range of *D. tubicola*. The abdomen appears more slender in *D. tubicola* than in *D. cavicola*. However, the difference of the abdomen may reflect only the shape of the inside of the housing (see below).

The less sculptured sixth abdominal tergite without elevated median area and margins immediately distinguishes the new species from *D. schmitti*. *Discorsopagurus maclaughlinae* is distinctive within the genus in the antennal flagellum lacking long setae, the possession of corneous spinules on the mesial faces of the dactyli of the third pereopods, and the distinctly concave posterior margin of the telson.

It has been reported that species of *Discorsopagurus* show differences in the housing as summarized in Table 1 (Gherardi and Cassidy, 1994; Komai, 1995; Komai and Takeda, 1996). As mentioned previously, the present specimens of *D. tubicola* were found to inhabit tubes of serpulid polychaete *Spirobranchus* sp. It is also known that *D. schmitti* and *D. maclaughlinae* use polychaete tubes for housing. *Discorsopagurus cavicola* lives exclusively inside boreholes on rock (Komai and Takeda, 1996).

Komai and Takeda (1996) remarked that there is slightly produced vas deference on

both coxae of the fifth pereopods in males of *D. cavicola*. Similar short protrusions are found in the two male specimens of *D. tubicola*. The protrusions are here considered as short sexual tubes, because the development is constant in the specimens of the two species. No sexual tube development has been reported in the other two species, *D. schmitti* and *D. maclaughlinae*. Although the development and form of the sexual tubes have had major impact on classification at the generic level in the family Paguridae (e.g. de Saint Laurent-Dechancé 1966; de Saint Laurent, 1968, 1970a, 1970b; McLaughlin, 1997), these four species are considered congeneric, as they share all important characters enumerated above.

The key to the species of *Discorsopagurus* proposed by Komai and Takeda (1996) is emended to accommodate the present new species.

#### Key to species of *Discorsopagurus* (emended)

1. Posterior margin of telson deeply concave; antennal flagellum without long setae; dactyli of third pereopods armed with corneous spinules on mesial faces ..... *D. maclaughlinae* Komai, 1995  
[southern Hokkaido, Sea of Japan]
- Posterior margin of telson straight or convex (occasionally with trace of median notch); antennal flagellum with long setae arising from anterior margins of articles, showing cast net-like structure; dactyli of third pereopods devoid of corneous spinules on mesial faces ..... 2
2. Sixth abdominal tergite sculptured with elevated median area and lateral and posterior margins; no sexual tubes in

- males ..... *D. schmitti* (Stevens, 1925) [British Columbia to Straits of Juan de Fuca, Washington States]
- Sixth abdominal tergite not sculptured, median are and margins not elevated; males with short sexual tubes ..... 3
3. Exopod of uropod less than twice length of telson; endopod of uropod not reaching posterior margin of telson ..... *D. tubicola* sp. nov. [Tokyo Bay and Uraga Channel, central Japan]
- Exopod of uropod twice or more than twice length of telson; endopod of uropod slightly overreaching posterior margin of telson ..... *D. cavicola* Komai and Takeda, 1996 [Mutsu Bay and Hakodate Bay, northern Japan]

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日本産キタカンザシヤドカリ属  
(甲殻上綱: 十脚目: 異尾下目:  
ホンヤドカリ科) の 1 新種

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千葉県富津市竹岡沖浦賀水道および東京湾中の瀬から採集された合計 5 個体の標本に基づき、キタカンザシヤドカリ属 *Discorsopagurus* の 1 新種 *D. tubicola* (新称: ゴカイノクダヤドカリ) を記載した。本新種は、陸奥湾と函館湾から記載されたアナヤドカリ *D. cavicola* Komai and Takeda にもっとも近縁であると考えられるが、尾肢外肢が明らかに短い、尾肢内肢が尾節の後縁に届かない、第 2 胸脚の指節が比較的細いという点で識別される。さらに、本新種は生時にはカンザシゴカイ属ゴカイ類の棲管に寄居するのが観察されたが、アナヤドカリでは、穿孔性動物が岩にあげた穴(主に穿孔性二枚貝のニオガイが泥岩に掘った穴)に寄居することが報告されており、生態的な相違も種差を反映している可能性がある。東京湾やその周辺海域の海産動物相は比較的良好に研究されてきたと考えられるが、近年においても大形甲殻類の新種記載や新記録が相次いでおり、今後の調査が期待される。

Note added to proofs

After this paper was accepted for publication, additional specimens of this new species were collected.

*Additional specimens.* Uruga Channel off Takeoka, Futtsu, Chiba Prefecture, 20 m deep, gill net, 27 March 2003, coll. T. Komai, 10 males (sl 2.4-2.9 mm), 6 females (sl 2.1-3.1 mm) (CBM-ZC 6813); same data, 2 males (sl 2.4, 2.8 mm), 2 females (sl 2.2, 2.5 mm) deposited at Coastal Branch of Natural History Museum and Institute, Chiba, CMNH ZC 1169).

In the morphology of the uropods, the additional specimens are well consistent with the type specimens of *D. tubicola*. The dactylus of the second pereopod is 4.1-5.1 times as long as high (4.7 on average, N=16). There-

fore, the shape of the dactylus of the second pereopod is not reliable in distinguishing *D. tubicola* from *D. cavicola* because of a partial overlap of the ranges between the two. Nevertheless, the average value is still greater in the new species than in *D. cavicola* (4.7 in *D.*

*tubicola*, 4.0 in *D. cavicola*).

Short sexual tubes are present in all male specimens.

The additional specimens were found to inhabit tubes of *Spirobranchus* sp. as well as the type specimens.