

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

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Discorsopagurus cavicola, the third species of the genus, is described and illustrated on the basis of specimens from Mutsu Bay and Hakodate Bay, northern Japan. It strongly resembles *D. schmitti* (Stevens) from the west coast of North America, but shows differences in structure of the fifth abdominal tergite, development of the uropodal exopod and relative length of the ocular peduncle. This new species inhabits boreholes made by the rock-boring clam, *Barnea manilensis inornata* (Bivalvia: Pholadidae) or an uncertain host.

Key Words: *Discorsopagurus cavicola*, new species, Crustacea, Anomura, Paguridae, northern Japan.

Introduction

During a faunal study around the Asamushi Marine Biological Laboratory, Tohoku University, which is located at the interior of Mutsu Bay, northern Japan, specimens of an unusual hermit crab inhabiting boreholes made by the rock-boring clam, *Barnea manilensis inornata* (Pilsbry) (Bivalvia: Pholadidae), were collected and sent to the authors for identification by Dr. Satoshi Takeda. Later, the senior author also collected some additional specimens of the same species from Hakodate Bay, southern Hokkaido, which were found living in empty boreholes made in fragment of rock by uncertain host. These specimens strongly resemble *Discorsopagurus schmitti* known with certainty from the west coast of North America (McLaughlin 1974; Komai 1995). In order to ascertain the identity of our specimens we compared them with six specimens from Washington State in the collection of the National Museum of Natural History, Smithsonian Institution, and concluded that the Japanese specimens represent an undescribed species of *Discorsopagurus*.

The holotype is deposited in the Natural History Museum and Institute, Chiba (CBM), with a code of ZC. The paratypes are deposited in CBM, the National Science Museum, Tokyo (NSMT), and the National Museum of Natural History, Smithsonian Institution (USNM). The terminology used in the description mainly follows that of McLaughlin (1974), but Lemaitre (1995) is referred to for the carapace sulci. The shield length (SL), measured from the tip of the rostrum to the midpoint of the posterior margin of the shield, is used to indicate size of specimens.

For comparative purpose, the following material has been examined: *Discorsopagurus schmitti* (Stevens, 1925): 3 males (SL 2.3-2.8mm), 3 females (SL 2.5-5.8mm), Burrows Channel, Fidelgo Island, Anacortes, Washington State, 1 Jan 1993, coll. P. Cassidy, USNM 103772.

***Discorsopagurus cavicola* sp. nov.**
(Figs 1-4)

Type material. Mutsu Bay (40°53.42'N, 140°51.16'). Yunoshima, Asamushi, 2-3m depth, 6 July 1992, coll. S. Tamura and S. Takeda: male (SL 2.8mm), holotype, CBM-ZC 2189; 1 male (SL 2.8mm), 11 females (SL 1.9-3.7mm), paratypes, CBM-ZC 2190; 3 females (SL 2.8-3.7 mm), paratypes, USNM 275963; 4 females (SL 1.7-3.0mm), NSMT-Cr 3288; 4 males (SL 2.3-3.0mm), 3 females (SL 2.8-3.5mm), paratypes, NSMT-Cr 3289. Hakodate Bay. Irifune Fishery Port, depth unknown, associated with rock caught by gill net, 29 Oct 1992, coll. T. Komai, 3 males (SL 1.1-1.9mm), paratypes, CBM-ZC 2188.

Description. Shield (Fig. 1A) slightly wider than long or as wide as long; anterolateral margins sloping; anterior margins between rostrum and lateral projections straight or slightly concave; anterolateral angle blunt; posterior margin roundly truncate; dorsal surface with scattered tufts of moderately long setae. Rostrum prominent, obtusely triangular, exceeding lateral projections; terminating acutely or subacutely, often with small terminal spine. Lateral projections obtusely triangular or broadly rounded, with submarginal spine, or occasionally unarmed. Posterior carapace (Fig. 1B) membranous except for somewhat calcified postero-median plate; cardiac sulci divergent posteriorly; sulci cardiobranchialis not reaching level of posterior end of cardiac sulci.

Ocular peduncles (Fig. 1A) moderately long and stout, 0.67-0.79 times as long as shield, slightly inflated basally, corneal region slightly dilated; dorsal or dorsomesial surface with row of tufts of short setae. Ocular acicles subtriangular, terminating acutely or subacutely with strong submarginal spine, separated basally by slightly more than or entire basal width of one acicle; mesial margins usually convex, lateral margins usually straight, dorsal surface with tuft of short setae.

Antennular peduncles (Figs 1A, C) exceeding ocular peduncles by one-fourth to three-fourths length of ultimate segment. Ultimate segment 1.8 times as long as penultimate segment. Basal segment without lateral spine.

Antennal peduncles (Fig. 1A) slightly overreaching ocular peduncles; with supernumerary segmentation. Fifth, fourth and third segments with few tufts of short setae. Second segment with dorsolateral distal angle produced, terminating in small, simple or bifid spine and tuft of stiff setae, mesial margin with 1-4 spinules, lateral margin with tufts of stiff setae; dorsomesial distal angle with small spine often obscured by tuft of stiff setae, mesial margin with tufts of setae. First segment with lateral face unarmed or occasionally with small spine, ventral margin produced, unarmed or with 1-4 spinules laterally. Antennal acicle moderately long, slightly arcuate, reaching or slightly overreaching fourth segment of peduncle, terminating in small spine partially obscured by tuft of stiff setae. Antennal flagella (Fig. 1D) not overreaching tip of right cheliped; each article with several moderately long or long simple setae and bristles.

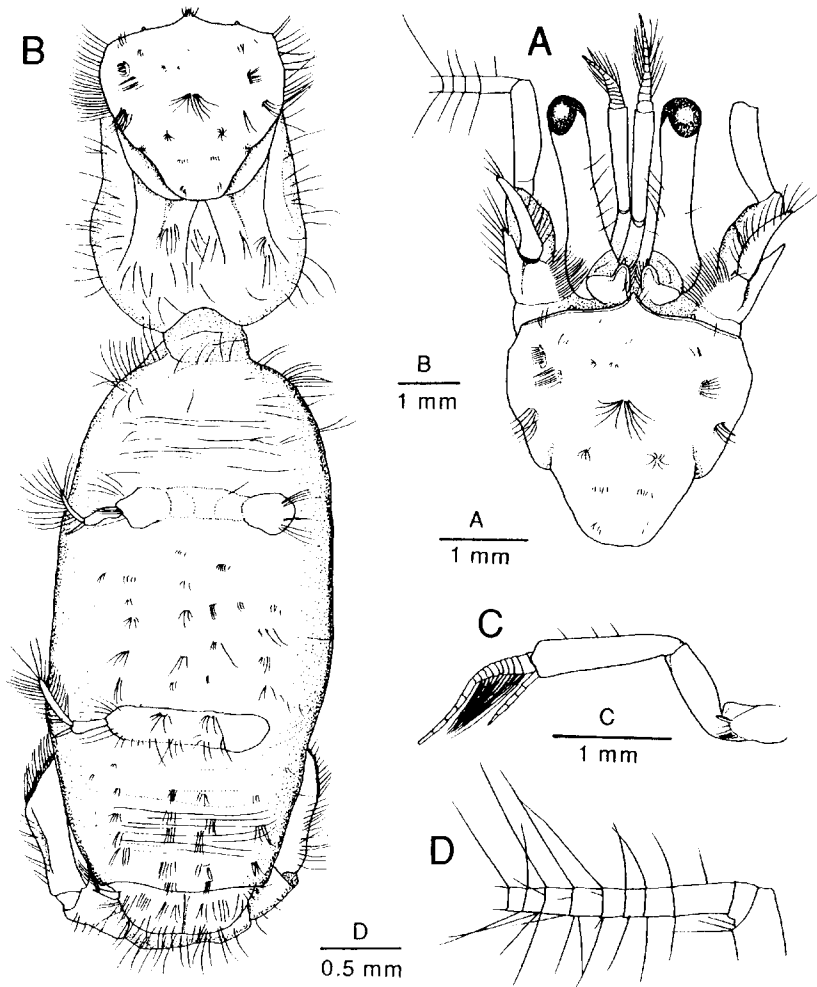


Fig. 1. *Discorsopagurus cavicola* sp. nov. Holotype male (SL 2.8mm), CBM-ZC 2189. A, shield and cephalic appendages, dorsal; B, carapace and abdomen, dorsal, cephalic and thoracic appendages omitted; C, left antennule, lateral; D, basal part of left antennal flagellum, dorsal.

Mandible (Fig. 2A) without distinguishing characters. Maxillule (Fig. 2B) with proximal endite subquadrate; endopod with 1 bristle on well differentiated internal lobe, external lobe well developed, not recurved. Maxilla (Fig. 2C) with endopod basally expanded, not reaching anterior margin of scaphognathite. First maxilliped (Fig. 2D) with endopod approximately two-thirds length of exopod. Second maxilliped (Fig. 2E) with basis-ischium fusion incomplete. Third maxilliped (Fig. 2F) with incomplete basis-ischium fusion; basis with 1 or 2 denticles; ischium (Fig. 2G) with 1 accessory tooth, crista dentata well developed, proximal-most tooth not noticeably longer than remaining teeth; merus and carpus unarmed. Third thoracic

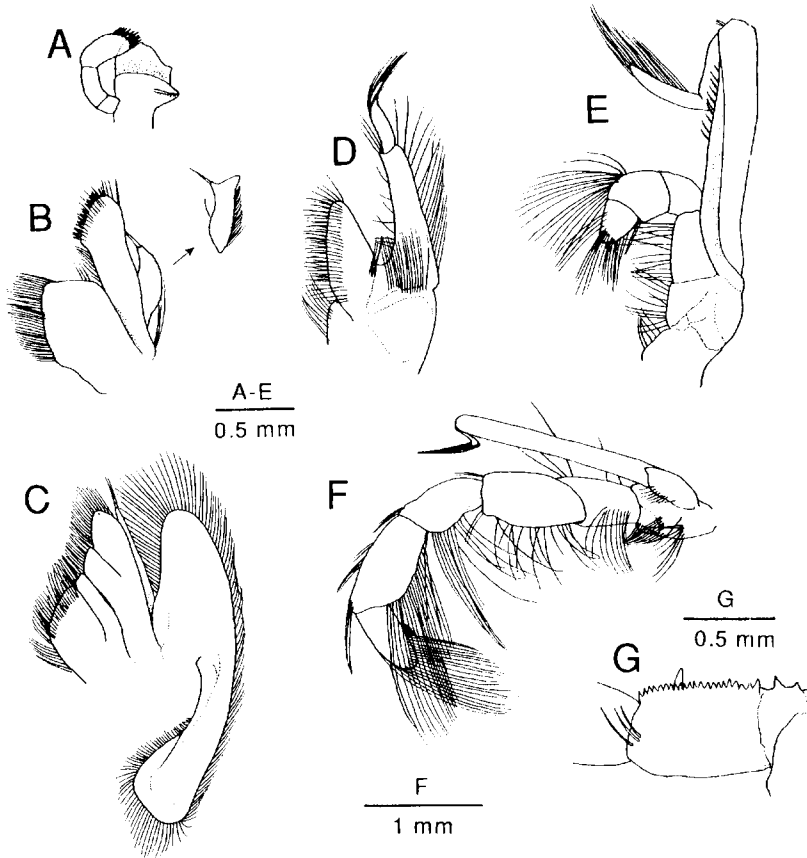


Fig. 2. *Discorsopagurus cavicola* sp. nov. Holotype male (SL 2.8mm), CBM-ZC 2189, left mouthparts. A, mandible, internal; B, maxillule, external; inset, endopod, lateral; C, maxilla, external; D, first maxilliped, external; E, second maxilliped, external; F, third maxilliped, lateral; G, ischium of third maxilliped, internal, setae omitted.

sternite usually with 1 acute spine on either side of median notch.

Right cheliped (Figs 3A, B) somewhat longer than left. Chela with greatest width at about mid-length, 1.7-1.8 times as long as wide, approximately 1.7 times as long as carpus. Dactyl moderately short, slightly less than length of palm measured along mesial margin, with narrow hiatus when closed; cutting edge with row of calcareous teeth proximally, row of small corneous teeth distally, terminating in small corneous claw; dorsomesial margin with row of small spines or spinulose tubercles and tufts of stiff setae, dorsal surface with few scattered spines or tubercles near mesial margin and scattered tufts of stiff setae, mesial and ventral surfaces smooth, but with tufts of stiff setae. Palm with row of moderately strong conical spines and tufts of stiff setae on dorsomesial margin; dorsal surface slightly convex, with irregular row of small spines or tubercles near mesial margin and usually with 1 prominent median or submedian conical, occasionally curved spine near base, remaining area often slightly spinulose; dorsolateral margin with row of small spines

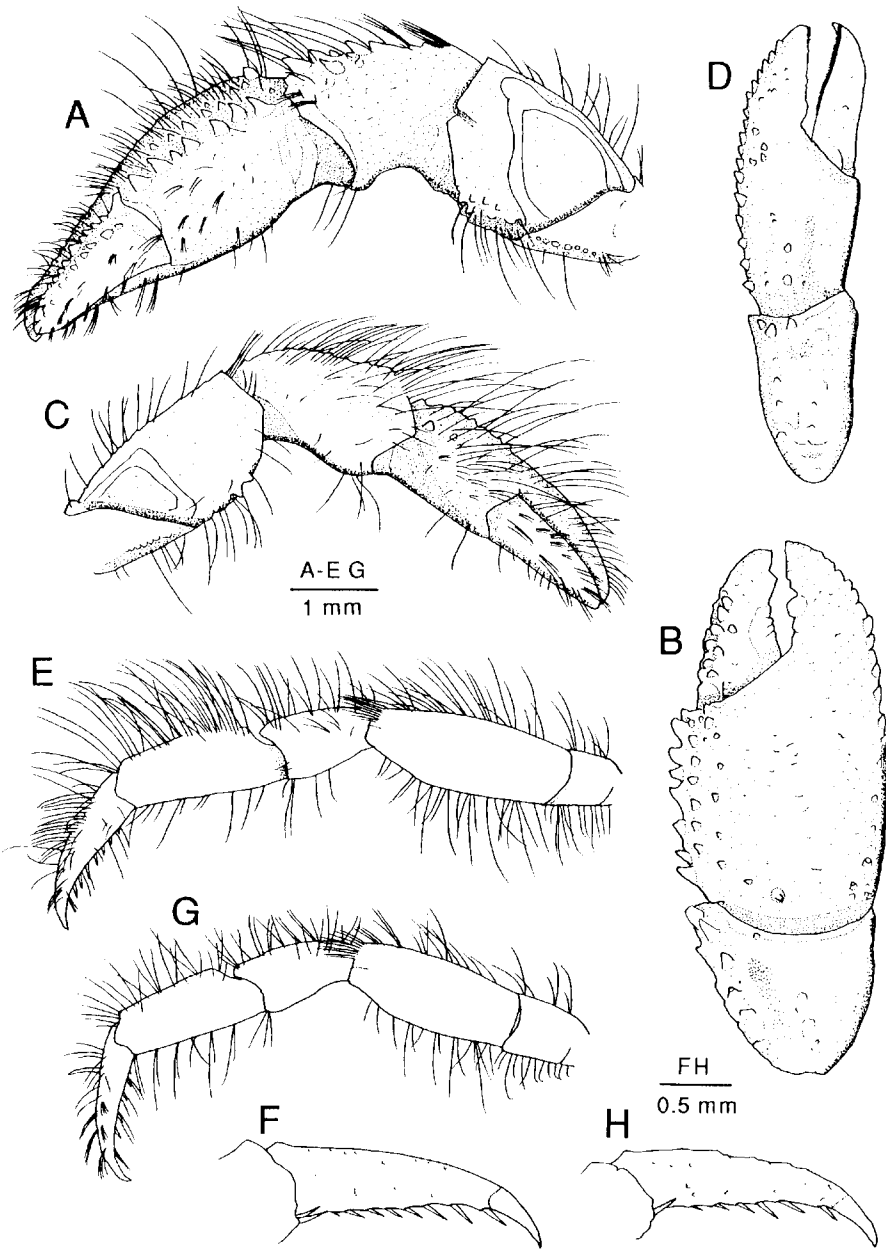


Fig. 3. *Discorsopagurus cavicola* sp. nov. Holotype male (SL 2.8mm), CBM-ZC 2189. A, right cheliped, mesial; B, same, chela and carpus, dorsal, setae omitted; C, left cheliped, mesial; D, same, chela and carpus, dorsal, setae omitted; E, left second pereopod, lateral; F, same, dactyl, mesial; G, third pereopod, lateral; H, same, dactyl, mesial.

increasing in size distally, delineation becoming obscure proximally; lateral face occasionally slightly spinulose, with scattered tufts of stiff setae; ventral and mesial surfaces with tufts of short stiff setae. Carpus short, widened distally; dorsomesial margin with single or double row of moderately strong spines, increasing in size distally, dorsal surface with irregular rows of small spines mesially and scattered small spinules or spinulose protuberances laterally, distal margin occasionally with row of small spines; dorsolateral margin not delimited, lateral face slightly spinulose and with scattered tufts of short setae; ventrolateral margin nearly smooth or slightly denticulate, ventral and mesial surfaces with few tufts of moderately long setae. Merus subtriangular in cross section; dorsal surface with row of low protuberances and tufts of long setae, distal margin with row of stiff setae; mesial and lateral faces somewhat spinulose ventrally, ventromesial margin with single or double row of small spines or denticulate tubercles proximally, ventrolateral margin with row of low protuberances and tufts of long setae. Ischium with row of small denticles on ventromesial margin. Coxa with tufts of long setae on distal margin.

Left cheliped (Figs 3C, D) reaching to or beyond base of dactyl of right. Chela with greatest width at base of dactyl, 2.4 times as long as broad, approximately 1.6 times as long as carpus. Carpus-palm articulation with slight degree of clockwise torsion. Dactyl slightly longer than palm measured along mesial margin; cutting edge with row of small corneous teeth, terminating in small corneous claw; slightly overlapped by fixed finger; dorsomesial margin not delimited, sometimes with row of few small spines or spinulose tubercles and tufts of stiff setae; dorsal surface with scattered small spines or spinulose tubercles; mesial face slightly spinulose, with scattered tufts of moderately long setae; ventral surface with few tufts of stiff setae. Palm with single or double row of small spines on dorsolateral margin, dorsal surface slightly convex, with shallow longitudinal sulcus near base, and few small spines and numerous tufts of stiff setae; dorsomesial margin not delimited, mesial face slightly tuberculate, with tufts of long setae; ventral surface with few tufts of moderately long setae; lateral face sometimes slightly tuberculate, with few tufts of stiff setae. Carpus with distomesial margin somewhat produced; dorsal surface with 2 rows of small spines or tubercles, mesial row occasionally irregular, with numerous tufts of long setae, distal margin with 3 or 4 moderately strong spines laterally and tufts of long setae; ventrolateral distal margin slightly denticulate, ventral surface with few tufts of stiff setae; lateral and mesial faces slightly spinulose or tuberculate, with tufts of moderately short setae dorsally. Merus subtriangular in cross section; dorsal surface with low, somewhat spinulose protuberances or ridges and tufts of long setae; mesial and lateral faces with few tufts of short setae; ventromesial margin with row of small spines, ventrolateral margin with irregular row of small spines or denticulate protuberances, both margins with tufts of long setae. Ischium with row of small spinules or tubercles on ventromesial margin. Coxa with tufts of long setae on ventromesial distal angle and ventromesial margin.

Second and third pereopods (Figs 3E, G) moderately long, strongly compressed, second pair equaling or slightly exceeding length of right cheliped, third pair somewhat shorter; both pairs similar in armature, but differing in pilosity, second pair with more numerous, longer setae. Dactyls (Figs 3F, H) moderately stout, subequal in length to propodi; in lateral view, slightly curved ventrally; in dorsal view, straight or slightly curved mesially; terminating in strong corneous claws; dorsal surfaces each with single or double row of tufts of long plumose setae; lateral

faces each with scattered tufts of long plumose setae dorsally, without longitudinal sulcus; mesial faces each with scattered tufts of moderately short plumose setae, without longitudinal sulcus; ventral margins each with 6-8 strong corneous spines and row of stiff setae. Propodi usually slightly longer than carpi; dorsal surfaces slightly spinulose in second pair, nearly smooth in third pair, partially obscured by tufts of long plumose setae; lateral and mesial surfaces almost naked; ventral margins each with row of long setae and usually with 1-3 corneous spines distally. Carpi each with dorsal surface slightly spinulose, partially obscured by tufts of long plumose setae; lateral and mesial faces with scattered tufts of long setae dorsally. Meri each with dorsal surfaces not particularly spinulose or denticulate, sometimes with row of low protuberances, partially obscured by tufts of long plumose setae; lateral and mesial faces nearly naked; ventral margins almost smooth, each with row of tufts of long plumose setae. Ischia each with row of long plumose setae on ventral and dorsal margins. Coxae slightly longer in second than in third pair, each with rows of setae in ventromesial and ventrodistal margins.

Fourth pereopods subchelate (Fig. 4D). Dactyl apparently without preungual process. Propodus with well-developed rasp composed of irregular rows of scales. Carpus and merus with dense setae at dorsodistal margins.

Fifth pereopods chelate, thickly setose. Coxae in males (Figs 4E, F) each with slightly protruded vas deference.

Anterior lobe of sixth thoracic sternite (Fig. 4G) semicircular, anterior surface obscured by long setae; fifth thoracic sternite (Fig. 4E) with 2 anterior lobes, each bearing tuft of setae on anterior surface.

Abdomen (Fig. 1B) well developed, very large and inflated in fully matured specimens, not twisted but slightly flexed. Third somite with tergite composed of paired, incompletely fused plates. Fourth somite with tergite in form of single weakly calcified plate. Fifth somite (Figs 4A, C) with strongly calcified plate bearing median suture, dorsal surface with scattered tufts of short to moderately long setae, posterolateral angle often strongly produced posteriorly. Sixth tergite (Figs 4A, C) strongly calcified, subdivided into two sections by transverse suture; dorsal surface slightly sculptured, with scattered tufts of long setae; margins sloping; posterior section with posterior margin slightly sinuous. Males with unpaired pleopods on third to fifth somites (Fig. 1B), each with strongly reduced endopod. Females with unpaired pleopods on second to fifth somites, second to fourth pereopods with well-developed rami, fifth with reduced endopod.

Telson (Fig. 4B) with lateral margins regularly convex, with row of long setae; terminal margin entire or very slightly concave, with 3 or 4 small spines increasing in size toward posterolateral angle. Uropods (Figs 4B, C) symmetrical; exopod strongly elongate, exceeding twice length of telson, slightly curved; endopod stout, strongly curved mesially.

Coloration in life. Chelipeds mottled brown. Ocular peduncles uniformly pale brown.

Habitat. According to Dr. S. Takeda, the specimens from Asamushi, Mutsu Bay, were exclusively found living in boreholes made by the rock-boring clam, *Barnea manilensis inornata* at subtidal depths, and the shells frequently remained in the holes. On the other hand, the specimens from Hakodate Bay occupied empty holes bored in rock fragments by an unknown host.

Variations. Although McLaughlin (1974) noted variability in the presence or

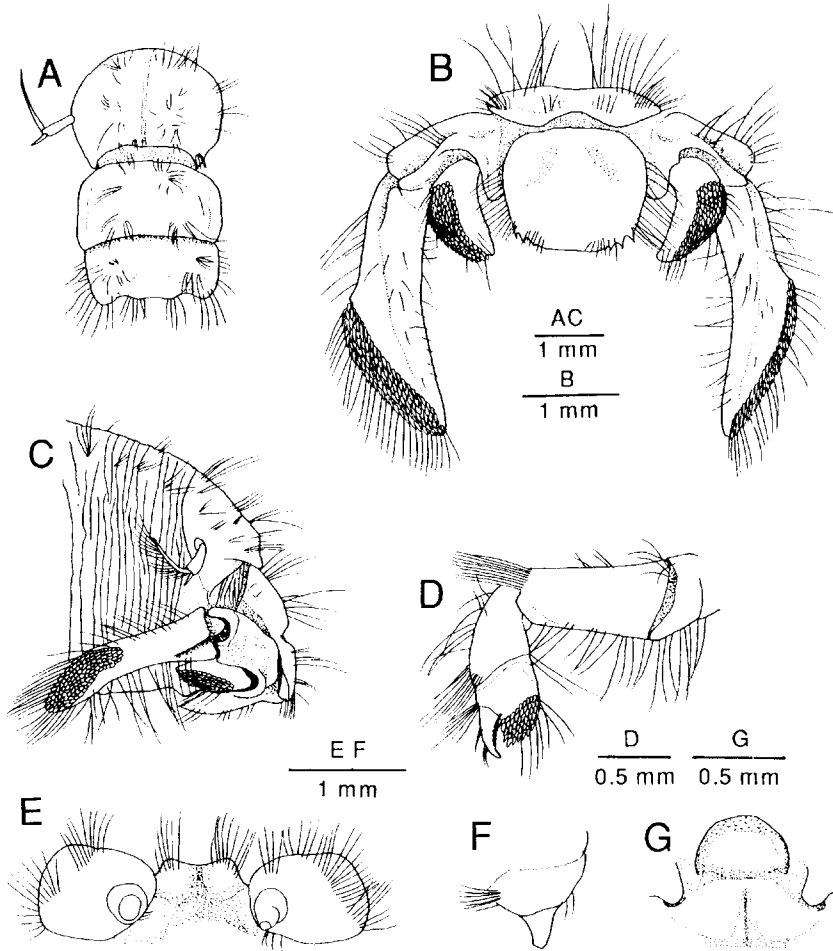


Fig. 4. *Discorsopagurus cavicola* sp. nov. Holotype male (SL 2.8mm), CBM-ZC 2189. A, tergites of fifth and sixth abdominal somite, dorsal; B, telson and uropods, dorsal; C, posterior part of abdomen, lateral; D, fourth pereopod, lateral; E, coxae of fifth pereopods and eighth thoracic sternite, ventral; F, ventral part of left coxa of fifth pereopod, lateral; G, sixth thoracic sternite, ventral, setae omitted.

absence of the pleopod on the second abdominal somite in adult males of *Discorsopagurus schmitti*, in the 12 male specimens of the new species the second pleopod is always absent.

In the new species, pilosity of the chelipeds and pereopods is subject to a considerable variation. This variation seems to be associated with growth; in larger specimens, setae on these appendages are denser and longer than in smaller specimens.

Distribution. Asamushi, Mutsu Bay, northern Honshu; Hakodate Bay, southern Hokkaido.

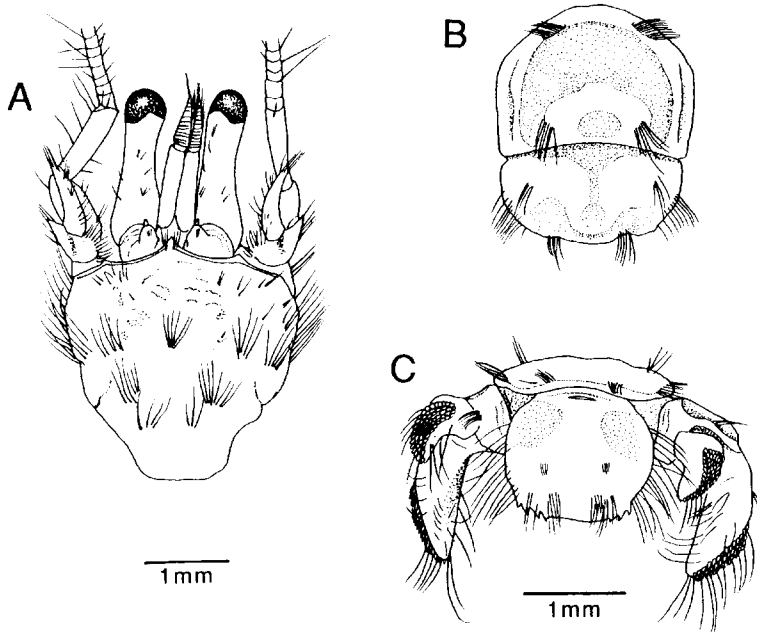


Fig. 5. *Discorsopagurus schmitti* (Stevens, 1925). Male (SL 2.9mm) from Burrows Channel, Washington State, USNM 265172. A, shield and cephalic appendages, dorsal; B, tergite of sixth abdominal somite, dorsal; C, telson and uropods, dorsal.

Etymology. The specific name is a noun in apposition from the Latin *cavum* (hole), and *cola* (to inhabit), in reference to the habitat of the new species.

Remarks. The genus *Discorsopagurus* has been represented by two species: *D. schmitti* (Stevens 1925) from the west coast of North America and *D. maclaughlinae* Komai, 1995, from northern Japan and Russian Far East. The third species, *D. cavicola*, is more closely allied to *D. schmitti*. These two species share a number of characters, *viz.*, a cast net-like antennal flagellum, mesially unarmed dactyls of the ambulatory pereopods, slightly twisted left cheliped and shape of the telson. The most reliable character to differentiate these two species is the structure of the dorsal surface of the fifth abdominal tergite. In the new species, the anterior plate of the sixth abdominal tergite is weakly sculptured with its margins sloping (Fig. 4A), while it is strongly sculptured with a prominent median elevation and with raised lateral and anterior margins in *D. schmitti* (Fig. 5B). The strongly elongated exopod of the uropods also distinguishes *D. cavicola* from *D. schmitti* (ratios of the exopod length/basal width are 5.4 in *D. cavicola* and 3.0 in *D. schmitti* (see Fig. 4B and Fig. 5C). The available material suggests that the ocular peduncle is relatively longer in the new species than in *D. schmitti* (ratios of the ocular peduncle length/shield length are 0.7-0.8 in *D. cavicola* and 0.6-0.7 in *D. schmitti*) (see Fig. 1A and Fig. 5A). *Discorsopagurus maclaughlinae* is readily separated from the two species by the thickly setose fifth abdominal tergite, distinctly concave posterior margin of the telson armed with more numerous spines and simple antennal flagellum.

We have found that the mature males of the new species, of which a total of nine

specimens has been examined, possess a slightly protruded vas deference on each coxa of the fifth pereopods. This protrusion might not be a function of preservation, but potential sexual tube development. In the previously described species of *Discorsopagurus*, the vas deference is not protruded.

Habitat differences may support our belief that our taxon is distinct from *D. schmitti*. *Discorsopagurus cavicola* has been found occupying boreholes made on rock by the rock-boring clam, *Barnea manilensis inornata* or an unknown host. According to Gherardi and Cassidy (1994), *D. schmitti* nearly exclusively inhabits tubes of the honeycomb worm, *Sabellaria cementarium* Moore. Specific differences of habitat have also been shown in species of the genus *Paguritta* by McLaughlin and Lemaitre (1993).

Key to species of *Discorsopagurus*

1. Posterior margin of telson distinctly concave; fifth abdominal tergite with dense setae dorsally; antennal flagellum simple; dactyls of third pereopods armed with corneous spines on mesial surfaces.....*D. macLaughlinae* Komai, 1995
- . Posterior margin of telson entire or with trace of median notch; fifth abdominal tergite almost naked; antennal flagellum showing cast net-like structure; dactyls of third pereopods unarmed mesially2
2. Sixth abdominal tergite strongly sculptured with elevated median area and lateral and anterior margins; exopod of uropod not elongate; ocular peduncle 0.6-0.7 times as long as shield*D. schmitti* (Stevens, 1925)
- . Sixth abdominal tergite feebly sculptured, median area not elevated, lateral and anterior margins sloping; exopod of uropod greatly elongate; ocular peduncle 0.7-0.8 times as long as shield*D. cavicola* sp. nov.

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