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A new species of the genus *Discorsopagurus* (Crustacea: Decapoda: Paguridae) from Japan, previously known as *D. schmitti* (Stevens)

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Abstract.—A new species of polychaete tube-living hermit crab, *Discorsopagurus maclaughlinae,* is described and illustrated from Hokkaido, northern Japan. This species has been previously confounded with *Discorsopagurus schmitti* (Stevens, 1925), a species herein considered restricted to the west coast of North America. To include a second species, the generic diagnosis of *Discorsopagurus* McLaughlin, 1974, is emended. Differences between the two species are discussed.

The genus *Discorsopagurus* was proposed by McLaughlin (1974) for *Pylopagurus schmitti* Stevens, 1925, a species described from the state of Washington, west coast of North America. A suite of characters including the symmetrical uropods, flexed abdomen, partial fusion of abdominal tergites, and telson with lateral and posterior margins entire, set *Discorsopagurus* apart from all other pagurid genera lacking paired pleopods in either sex.

During a systematic study of the decapod Crustacea of Hokkaido, northern Japan, I obtained some specimens of a hermit crab living in unidentified polychaete worm tubes, apparently resembling specimens identified as *D. schmitti,* from Wakkanai, Okushiri Island, and Usujiri. Despite being reported as *Orthopagurus schmitti* or *Discorsopagurus schmitti* from the Russian Far East and northern Japan by several authors (Derjugin & Kobjakova 1935; Makarov 1937, 1938a, 1938b; Vinogradov 1950; Kobjakova 1956, 1958a, 1958b; Takeda & Miyauchi 1992), there are no records from other localities. Thus, I was prompted to determine whether or not the Asian specimens were, in fact, conspecific with the American *D. schmitti.*

A comparison of the Japanese specimens, including those reported by Takeda & Miyauchi (1992) as *D. schmitti,* with American representatives of *D. schmitti,* has proved that the former specimens are quite distinct; these are now described and illustrated as a new species. The addition of the new species to *Discorsopagurus* requires minor emendations to McLaughlin's (1974) generic diagnosis. Examination of the literature strongly suggests that *D. schmitti* reported by Russian authors actually refers to the new species. Therefore, *D. schmitti* sensu stricto is considered to be restricted to the west coast of North America.

The holotype and paratypes of *D. maclaughlinae* are deposited in the Natural History Museum and Institute, Chiba (CBM), and additional paratypes are in the Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University (HUMZ), National Science Museum, Tokyo (NSMT), and the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). Terminology used in the description follows McLaughlin (1974), in general, and Morgan & Forest (1991) 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 specimens have been examined:

Discorsopagurus schmitti (Stevens, 1925): USNM 265172, 3 males (SL 2.3–2.8 mm), 3 females (SL 2.5–2.8 mm), Burrows Channel, Fidelgo Island, Anacortes, Washington State, 1 Jan 1993, coll. P. Cassidy.

Orthopagurus minimus (Holmes, 1900): USNM 103772, 1 male (SL 5.6 mm), Corona Del Mar, California, Mar 1954; USNM 170404, 2 males (SL 2.7, 2.9 mm), 2.9 miles off south-east of Dirble Point, Santa Cruz Islands, R/V Velero IV, 34°05′N, 119°43′W, 29–88 m, 27 Apr 1976, trawl, coll. M. K. Wicksten.

Discorsopagurus McLaughlin, 1974

Diagnosis (emended).—Eleven pairs of phyllobranchiae. Shield calcified; posterior carapace membranous. Third segment of antenna with or without spine at ventromesial distal angle. Maxillule with endopodal external lobe moderately well developed, not recurved. First maxilliped with exopodal flagellum well developed. Third maxillipeds widely separated basally; basis-ischium fusion incomplete; crista dentata well developed, with 1 accessory tooth. Chelipeds unequal, right larger than left, not operculate. Fourth pereopods subchelate; propodal rasp well developed; dactyl apparently lacking preungual process at base of claw. Males with paired gonopores; coxae of fifth pereopods equal; no sexual tubes. Females with paired gonopores. No paired pleopods in either sex. Abdomen well developed, straight or slightly flexed, not twisted; tergites of third and fourth somites paired, incompletely fused chitinous plates; fifth tergite strongly calcified, with median suture; sixth tergite strongly calcified. Uropods symmetrical. Telson with or without slight lateral constrictions; posterior margin entire, straight or concave.

Remarks.—As McLaughlin (1974) noted, *Discorsopagurus* appears closest to the monotypic genus *Orthopagurus* Stevens, 1927, represented by *O. minimus* (Holmes, 1900). *Discorsopagurus,* as here emended, is best distinguishable from the latter by the absence of distinct lateral constrictions from the telson, non-operculate right cheliped, and the possession of a median suture on the fifth abdominal tergite.

Discorsopagurus maclaughlinae, new species

Figs. 1–4

Orthopagurus schmitti: Derjugin & Kobjakova, 1935:142; Makarov, 1937:65, fig. 19; Makarov, 1938a:420; Makarov, 1938b:228, pl. 2 fig. 1; Makarov, 1962: 217, pl. 2, fig. 1. Not *Pylopagurus schmitti* Stevens, 1925 (see remarks).

?Orthopagurus schmitti: Vinogradov, 1950: 230 (key), fig. 129; Kobjakova, 1956:51; Kobjakova, 1958a:233; Kobjakova, 1958b:252.

Discorsopagurus schmitti: McLaughlin, 1974:354 (in part); Takeda & Miyauchi, 1992:144, fig. 2.

Material examined.—Holotype: CBM-ZC 603, male (SL 5.6 mm), Usujiri, Pacific coast of southern Hokkaido, Japan, 25–30 m deep, 13 Nov 1992, dredge, coll. T. Komai. Paratypes: HUMZ-C 976, 1 male (SL 5.0 mm), 1 ovig. female (SL 4.3 mm), off Nosappu-misaki, Wakkanai, northern Hokkaido, depth unknown, 28 Mar 1991, gill net; HUMZ-C 1114, 1 female (SL 3.8 mm), Usujiri, 30–40 m deep, 10 Sep 1989, dredge, coll. T. Komai; HUMZ-C 1129, 1 female (SL 4.0 mm), Usujiri, 10–20 m deep, 15 Nov 1989, dredge, coll. T. Komai; USNM 270044, 1 male (SL 4.8 mm), Okushiri Island, Sea of Japan off Hokkaido, depth unknown, 27 Apr 1991, gill nets, coll. T. Komai; USNM 270045, 1 female (SL 3.8 mm), data as for USNM 270044; NSMT-Cr 1811, 5 males (SL 5.0–6.5 mm), 3 ovig. females (SL 5.1–5.8 mm), Soya Strait, 1991, coll. T. Miyauchi.

Description.—Shield (Fig. 1A) some-

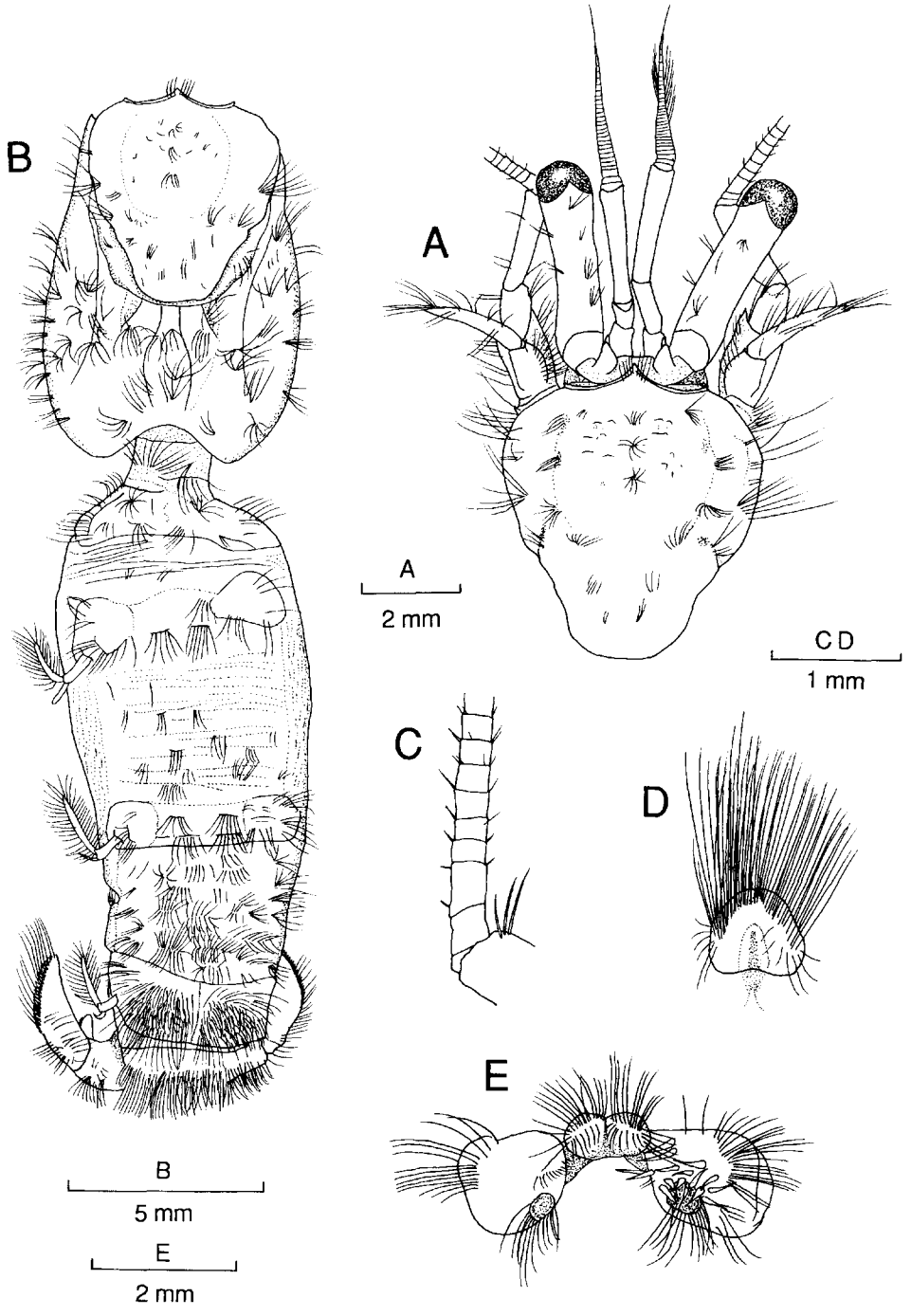

Fig. 1. *Discorsopagurus maclaughlinae,* new species. Holotype, male (CBM-ZC 603, SL 5.6 mm). A, shield and cephalic appendages, dorsal; B, carapace and abdomen, dorsal (sixth somite partially visible); C, proximal part of left antennal flagellum, dorsal; D, anterior lobe of sternite of third pereopods, ventral; E, coxae and sternal lobes of fifth pereopods, ventral.

what longer than broad; anterolateral margins sloping; anterior margins between rostrum and lateral projections moderately concave; posterior margin roundly truncate; dorsal surface with scattered tufts of setae laterally; anterolateral angle rounded. Rostrum moderately prominent, obtusely triangular with acute or subacute apex, distinctly overreaching lateral projections, partially obscured by tufts of setae. Lateral projections obtusely triangular, with prominent submarginal spine.

Posterior carapace (Fig. 1B) membranous except for somewhat calcified cardiac region, with scattered tufts of moderately long stiff setae; cardiac sulci sinuous, slightly falling short of posteromedian margin of carapace; sulci cardiobranchialis very short, somewhat diverging posteriorly; lineae anomurica curved, not reaching posterolateral margin of carapace.

Ocular peduncles (Fig. 1A) moderately long, 0.7–0.8 times as long as shield, 4.2 times as long as breadth of cornea, slightly inflated basally; cornea slightly dilated; dorsal or dorsomesial surface with row of tufts of moderately short setae. Ocular acicles subtriangular, terminating acutely with strong submarginal spine; mesial margin somewhat expanded, lateral margin slightly convex, dorsal surface lacking setae.

Antennular peduncles (Fig. 1A) moderately short, exceeding ocular peduncles by ⅓ to ¼ length of ultimate segment. Ultimate segment approximately half length of shield. Basal segment unarmed.

Antennal peduncles (Fig. 1A) moderately short, reaching or slightly overreaching ocular peduncles; with supernumerary segmentation. Fifth, fourth and third segments with few tufts of short or moderately short setae; third segment with ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in bifid spine, mesial margin sometimes with 1 additional spine distally; dorsomesial distal angle with small spine obscured by tuft of setae, mesial margin with tufts of setae. First segment with lateral face unarmed or occasionally with spinule, ventral margin produced, with few spinules. Antennal acicle falling short of fifth segment of peduncle, terminating in small spine partially obscured by tufts of stiff setae. Antennal flagellum long, far overreaching tip of right cheliped; each article with short bristles (Fig. 1C).

Mandible (Fig. 2A) with 3-segmented palp. Maxillule (Fig. 2B) with proximal endite subquadrate; endopod with 1 bristle on moderately produced inner lobe, outer lobe well developed, not recurved. Maxilla broken during dissection (not illustrated); endopod with lateral margin strongly expanded basally. First maxilliped (Fig. 2C) with endopod equaling distal endite in distal extension; exopod with lateral margin slightly expanded basally. Second maxilliped (Fig. 2D) with basis-ischium fusion incomplete. Third maxilliped (Fig. 2E) with basis-ischium fusion incomplete; basis with some spinulose tubercles or spines; ischium (Fig. 2F) with crista dentata well developed, proximal tooth not much stronger than remaining teeth, bearing 4 movable spinules at distomesial angle and 1 accessory tooth; merus with dorsodistal and ventromesial spines; carpus with dorsodistal spine. Sternite of third maxilliped with 1 acute spine on either side of midline.

Right cheliped (Fig. 3A, B) longer than left. Chela moderately broad, greatest breadth across level of mesial base of dactyl, 1.6–1.8 times as long as broad, 1.4 times as long as carpus. Dactyl moderately short, slightly shorter than palm, moderately deep; cutting edge with row of strong calcareous teeth almost over entire length, row of small corneous teeth distally, terminating in small corneous claw; dorsomesial margin with row of moderately strong to strong spines decreasing in size distally and few tufts of short stiff setae, dorsal surface with row of moderately strong spines or tubercles and few tufts of stiff setae, mesial face slightly spinulose, ventral surface with scattered tufts of long stiff setae. Palm slightly inflated; dorsomesial margin with

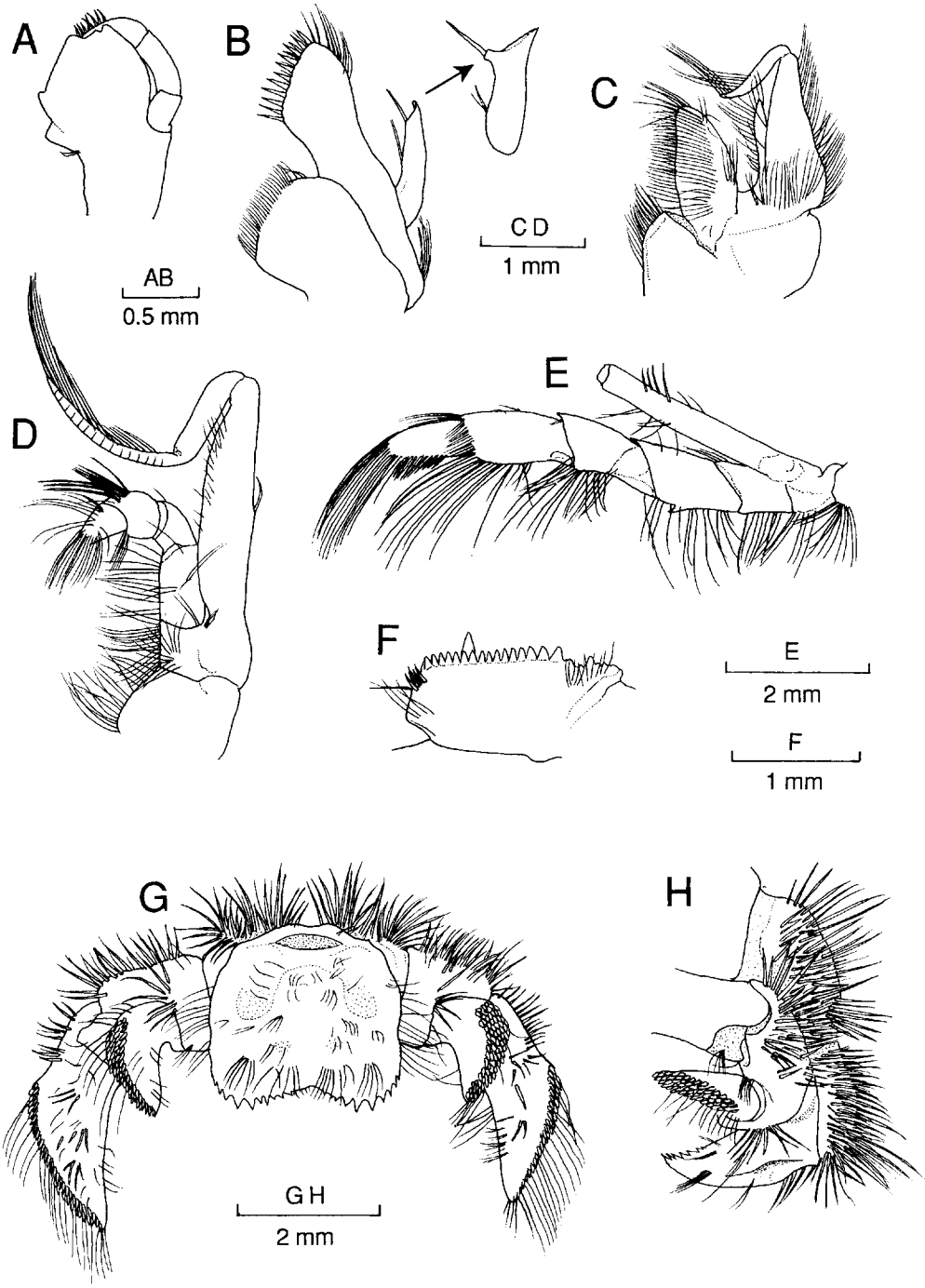

Fig. 2. *Discorsopagurus maclaughlinae*, new species. Holotype, male (CBM-ZC 603, SL 5.6 mm). Mouthparts, left, external view. A, mandible; B, maxillule (inset is endopod in lateral view); C, first maxilliped; D, second maxilliped; E, third maxilliped, lateral, exopod bent medially; F, ischium of same, internal; G, telson and uropods, dorsal; H, sixth abdominal somite, telson and uropods, lateral (distal part of uropodal exopod omitted).

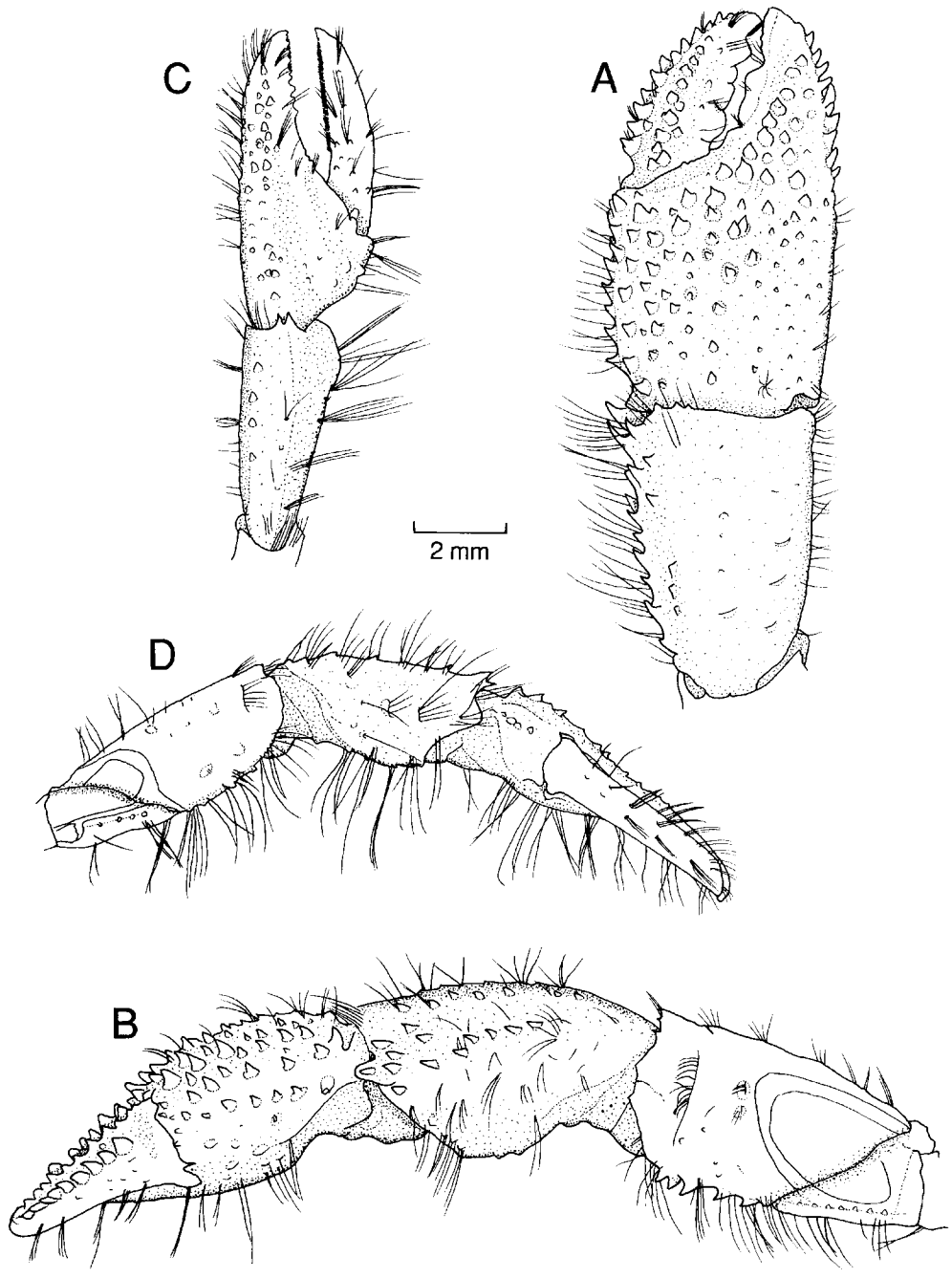

Fig. 3. *Discorsopagurus maclaughlinae*, new species. Holotype, male (CBM-ZC 603, SL 5.6 mm). A, right chela and carpus, dorsal; B, right cheliped, mesial; C, left chela and carpus, dorsal; D, left cheliped, mesial.

row of moderately strong conical spines and tufts of moderately long stiff setae; dorsal surface with several irregular rows of small or moderately strong spines extending to fixed finger; dorsolateral margin of fixed finger clearly delimited with row of moderately strong spines and dorsolateral margin of palm weakly delineated; lateral, mesial and ventral surfaces with scattered tufts of long stiff setae. Carpus slightly broadened distally, 1.4–1.5 times as long as distal breadth (excluding distolateral spines), almost as long as merus, somewhat inflated ventrally; dorsomesial margin with single or double row of moderately strong spines, increasing in size distally, and tufts of moderately strong stiff setae, dorsal surface sometimes with small spines medially or short transverse rows of moderately long stiff setae, distal margin with few small spines medially; dorsolateral margin not sharply delimited, lateral face with scattered tufts of short setae; ventrolateral margin with row of small tubercles and tufts of short stiff setae, lateral face with scattered tufts of short or moderately short setae; ventromesial margin with row of low tubercles and tufts of short to moderately long setae, mesial face with scattered tufts of short to moderately long setae; ventral surface with small spinulose tubercles. Merus subtriangular in cross section; dorsal surface with short transverse ridges bearing stiff setae, distal margin with 3 or 4 acute spines and stiff setae; mesial face sometimes with vertical ridge with stiff setae and scattered tufts of short stiff setae, ventromesial margin with single row of moderately strong spines and tufts of long stiff setae; lateral face with scattered tufts of short setae, ventrolateral margin with small spines or spinulose tubercles and tufts of long stiff setae. Ischium with row of small denticles on ventromesial margin. Coxa with tufts of long setae on distal margin.

Left cheliped (Fig. 3C, D) slightly overreaching base of dactyl of right. Chela distinctly longer than carpus; without torsion. Dactyl considerably elongated, approximately twice length of palm, slightly curved; with hiatus between fixed finger when closed; cutting edge with row of small corneous teeth, terminating in small corneous claw; dorsomesial margin with only few low tubercles and tufts of moderately long stiff setae; dorsal surface with few spinulose tubercles and row of tufts of moderately long stiff setae; mesial surface faintly tuberculate, with row of tufts of moderately long stiff setae; ventral face with few tufts of long stiff setae. Palm slightly inflated ventrally; dorsal and lateral surfaces with irregular rows of small spines and spinulose tubercles, and scattered tufts of stiff setae, dorsolateral margin not delimited; dorsomesial margin abruptly convergent posteriorly, weakly delineated, mesial face slightly tuberculate, with tufts of long stiff setae; ventral surface with tufts of long stiff setae. Carpus slightly shorter than merus; dorsal surface with 2 rows of moderately strong spines, distal margin with 2 or 3 acute spines and stiff setae laterally; mesial face with short obliquely vertical ridges bearing long stiff setae; lateral face with scattered tufts of short stiff setae; ventrodistal margin not denticulated; ventral face with tufts of long stiff setae. Merus subtriangular in cross section; dorsal surface with ridges bearing long tiff setae; mesial and lateral faces with few tufts of short setae; ventral surface with row of moderately strong spines medially, and tufts of long stiff setae. Ischium with row of small tubercles on ventromesial margin. Coxa similar to that of right cheliped.

Second and third pereopods (Fig. 4A, C) differing slightly in armature of dactyls and shape of ischia; moderately long, second pair slightly exceeding tip of right cheliped, third pair slightly shorter. Dactyls (Fig. 4B, D) relatively long and moderately slender, 1.2–1.3 times as long as propodi, not twisted; apex terminating in strong corneous claw; dorsal surfaces each with single or double row of long stiff setae; lateral faces each with scattered tufts of short setae, and with shallow longitudinal sulcus; mesial

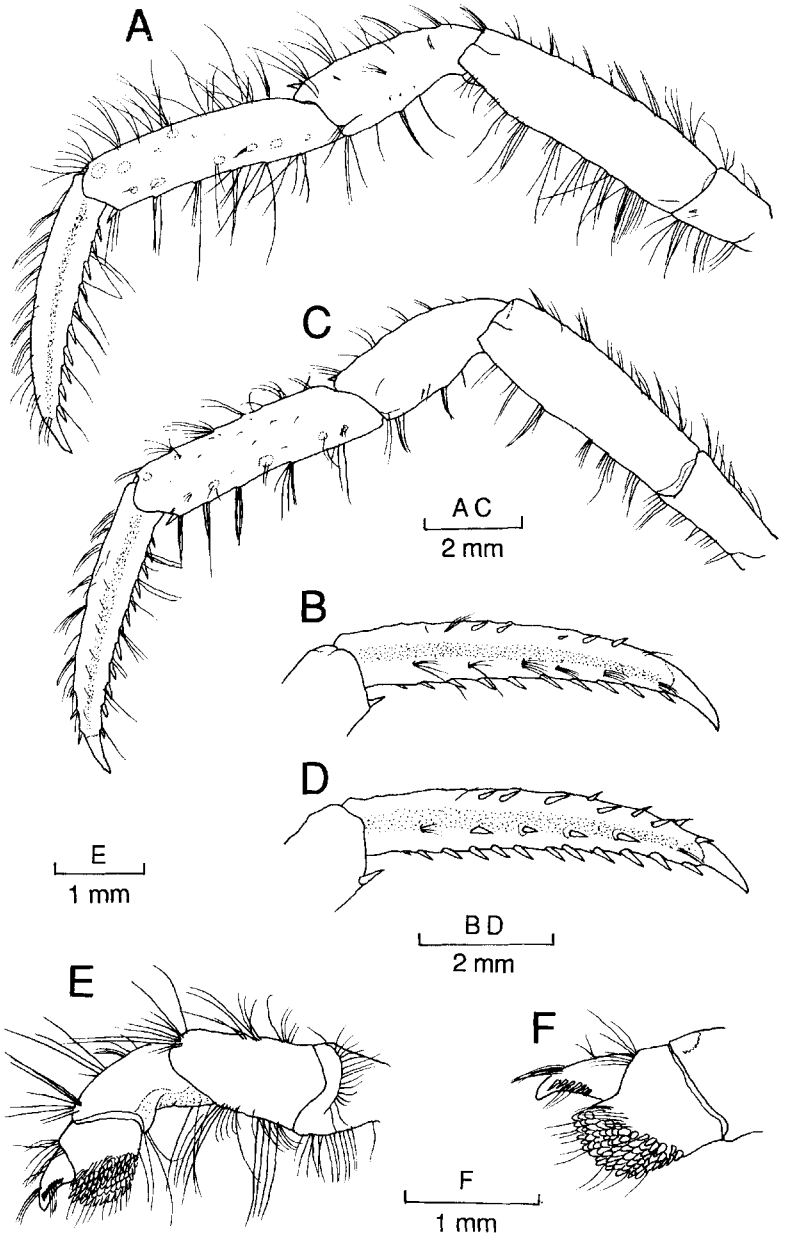

Fig. 4. *Discorsopagurus maclaughlinae,* new species. Holotype, male (CBM-ZC 603, SL 5.6 mm). Left pereopods: A, second, lateral; B, dactyl of same, mesial; C, third, lateral; D, dactyl of same, mesial; E, fourth pereopod, lateral; F, propodus and dactyl of same.

faces each with shallow longitudinal sulcus flanked by rows of tufts of short setae and rows of corneous spines in third, with row of corneous spines only along dorsal margin in second; ventral margins each with 10–12 strong corneous spines over entire length. Propodi distinctly longer than carpi; dorsal surfaces each with tufts of long stiff setae; lateral and mesial faces each with scattered tufts of short to moderately long

setae; ventral margins each with row of tufts of long stiff setae and with few corneous spines distally. Carpi moderately short; dorsal surfaces unarmed in left second and third pair, with few small spines in right second, each with tufts of long stiff setae; lateral, mesial and ventral surfaces with scattered tufts of stiff setae. Meri laterally compressed; dorsal surfaces each with row of low spinulose protuberances and tufts of long setae; lateral and mesial faces nearly naked; ventral margins slightly protuberant, each with tufts of long stiff setae. Ischia with dorsal and ventral margin bearing tufts of stiff setae; ischium of third pair somewhat longer than that of second, with slightly sinuous ventral margin. Coxae of third pereopods with gonopore in females.

Sternite of third pereopods (Fig. 1D) semicircular, not skewed, with numerous long setae on anterior surface.

Fourth pereopods (Fig. 4E) subchelate, relatively stout, dorsal and ventral surfaces with tufts of long setae. Dactyls (Fig. 4F) strongly curved, without preungual process; cutting edge with relatively long corneous teeth laterally. Propodus (Fig. 4F) strongly inflated ventrally, rasp composed of 5 or 6 irregular rows of numerous scales.

Fifth pereopods chelate. Male coxae (Fig. 1E) each with gonopore obscured by stiff setae or pointed scales. Sternite (Fig. 1E) developed as paired rounded protuberances, obscured by long stiff setae.

Abdomen (Fig. 1B) well developed, straight or slightly flexed, not twisted. Fourth somite with tergite in form of paired, incompletely fused, chitinous plates. Fifth somite with tergite strongly calcified, possessing median suture, thickly covered with stiff setae except in midline. Sixth somite (Fig. 2H) with tergite strongly calcified, subrectangular in shape, separated into 2 sections by transverse groove at level of midlength; dorsal surface with dense stiff setae, margins sloping; posterior margin slightly concave, with moderately deep sinus followed by shallow sulcus either side of median concavity.

Pleopods of males (Fig. 1B) unpaired, third to fifth pleopods with exopod moderately well developed, endopod reduced. Pleopods in females unpaired, second to fourth pleopods with both rami moderately well developed; fifth pleopod with exopod moderately well developed, endopod reduced. Uropods (Fig. 2G) stout, symmetrical.

Telson (Fig. 2G) with weak median constriction; posterior lobes separated by shallow median notch, each terminal margin with 10 or more corneous spines increasing in size toward posterolateral angle.

Coloration in life.—Chelipeds and ambulatory pereopods generally brown; spines or tubercles on palm of right cheliped white. Shield mottled brown. Ocular peduncles and antennal flagella uniformly brown. In preservative, color fading to straw.

Habitat.—The specimens from Usujiri, Pacific coast of southern Hokkaido, were dredged from rubble bottom at depths of 10–40 m. This species was never encountered in the intertidal zone in the surveyed area. All of the specimens examined were found using detached tubes of serpulid polychaetes.

Distribution.—Northern part of the western Pacific: Russian coast of the Sea of Japan, Saghalien, southern Kurile Islands, Hokkaido; 6–220 m.

Etymology.—This interesting species is named in honor of Dr. Patsy A. McLaughlin, for her great contributions to systematics of the Paguridea.

Relationship.—Although this new species has been confounded with *Discorsopagurus schmitti,* the differences between them are numerous: Each article of the antennal flagellum possesses some short bristles in *D. maclaughlinae,* while in *D. schmitti* it bears long setae, giving a cast net-like appearance to the entire flagellum; in *D. maclaughlinae,* the third segment of the antennal peduncle is armed with a spine at the ventromesial distal angle. Such a

spine is absent in *D. schmitti*; in the new species, the tergite of the fifth abdominal somite is not particularly sculptured; its dorsal surface is obscured by dense stiff setae. However, in *D. schmitti,* it is somewhat sculptured with upturned margins and elevated central region; its dorsal surface bears scattered long setae; the shape of the telson is remarkably different in the two species. In *D. maclaughlinae,* the lateral margins of the telson is slightly constricted, and the posterior margins are concave, each with a row of 10 or more spines. In *D. schmitti,* the lateral margins are not constricted, and the posterior margins are nearly straight or slightly convex, each with 3 or 4 spines; the merus of the third maxilliped is armed with the dorsodistal and ventromesial spines in *D. maclaughlinae,* but in *D. schmitti* it is unarmed; the articulation between the palm and the carpus of the left cheliped does not show a slight degree of clockwise torsion in *D. maclaughlinae*; the dactyl of the left chela is much longer in *D. maclaughlinae* than in *D. schmitti,* and; the dactyls of the second and third pereopods are relatively longer and slenderer in *D. maclaughlinae* than in *D. schmitti* (1.2–1.3 times as long as propodus in the former, 0.9–1.1 times as long in the latter). In the new species, the mesial surface of each dactyl bears a single or double row of corneous spines, which is absent in the American species.

Remarks.—Derjugin & Kobjakova (1935) included *Discorsopagurus schmitti* (as *Orthopagurus*) in their list of Decapoda from the Russian coast of the Sea of Japan. Makarov (1937, 1938b) first presented a somewhat detailed account of *Discorsopagurus schmitti* (as *Orthopagurus*) from Vladimir and Olga Bays. His description agrees in general with the present new species, though it lacks some important information, such as morphology of the telson. Vinogradov's (1950:307, pl. 22, fig. 129A, B) figure of *Orthopagurus schmitti,* showing the dorsal views of whole body of both sexes, is rather diagrammatic and uninformative. However, it is very likely that his illustration represents *D. maclaughlinae,* since the figure shows smooth antennal flagella. Although Kobjakova (1956, 1958a, 1958b) did not present detailed accounts of her materials, it is likely that her records from southern Saghalien and Kurile Islands by Kobjakova (1956, 1958a, 1958b) were actually this new species. As McLaughlin's (1974) distribution of *Discorsopagurus schmitti* was based on Russian literature, her report is considered partially to refer to the new species. In a recent report of anomuran Crustacea of Soya Strait, northern Hokkaido, Takeda & Miyauchi (1992) gave a brief account under the name of *Discorsopagurus schmitti,* together with photographs of a specimen living in a polychaete tube. I have reexamined their specimens (NSMT-Cr 1811; 5 males, 3 ovig. females) and confirmed its identity as *D. maclaughlinae.* At present, there is no evidence indicating the existence of the true *D. schmitti* in the western Pacific.

The minor emendations made to the generic diagnosis pertain to such intraspecifically variable characters as the presence or absence of a spine at the ventromesial distal angle of the third antennal segment, the sculpture of the sixth abdominal somite, and the shape of the telson. Although McLaughlin (1974) suggested some relationship between *Discorsopagurus* and the Parapaguridae in reference to the partially fused abdominal tergites and the telson with entire lateral and posterior margins, the presence of distinct posteromedian concavity of the telson in the new species seems to link *D. schmitti* to other pagurid genera. It is very likely that the similarity displayed by *Discorsopagurus* and parapagurids is superficial and the character states found in the former may be related to adaptation to worm tube usage. The difference in development of the posteromedian concavity of the telson may reflect degree of adaptation to the specialized habitats. The adaptation to worm tube usage seems to be more highly advanced in *D. schmitti* than in *D. maclaughlinae. Discorsopagurus schmitti*

nearly exclusively inhabits attached tubes of the honeycomb worm *Sabellaria cementarium* Moore (Gherardi & Cassidy 1994); the antennal flagellum, of which each article carries long setae, suggests that feeding is accomplished, at least partially, by antennal filtering in *D. schmitti*, as is also the case in members of *Paguritta* (McLaughlin & Lemaitre, 1993). As previously mentioned, *D. maclaughlinae* uses detached polychaete tubes. Observation of specimens kept alive in aquarium has shown that the new species is a deposit feeder, as in usual pagurid.

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