

Rediscovery of *Pagurus imaii* (Yokoya, 1939) (Decapoda: Anomura: Paguridae) from Hokkaido, Japan

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Abstract A rare pagurid hermit crab, *Pagurus imaii* (Yokoya, 1939), is redescribed on the basis of 15 specimens from Usujiri, Pacific coast of southern Hokkaido, Japan. The species is proved to show sexual dimorphism in the armature of the right palm and relative length of the right cheliped and ambulatory pereopods. Relationship of the species is also discussed.

Key words: *Pagurus imaii*, Paguridae, Hokkaido, Japan.

Yokoya (1939) described a new species of pagurid hermit crab, *Eupagurus imaii*, from Shirane-zaki, Miyagi Prefecture, northern Japan, on the basis of a single male specimen. Although the original description was short, it was accompanied by an illustration of the entire animal in dorsal view (Yokoya, 1939: 285–287, fig. 13). No new finds of the species have been reported upon since then. The location of the holotype remains unknown.

During a study of the crustacean fauna around the Usujiri Marine Biological Laboratory, Hokkaido University, 15 specimens referable to Yokoya's (1939) taxon were collected by dredge at depths of 20–30 m. Because of brevity of the original description and of the sexual dimorphism found in the newly obtained specimens, I provide here a more detailed account of this rare species.

The specimens examined are deposited in the Faculty of Fisheries, Hokkaido University (HUMZ) and Natural History Museum and Institute, Chiba (CBM). Abbreviations SL and CL are used to indicate carapace length and shield length respectively. Terminology follows McLaughlin (1974) in general, but Morgan and Forest (1991) is referred to for the carapace sulci.

Family Paguridae

Genus *Pagurus* Fabricius, 1775

Pagurus imaii (Yokoya, 1939)

(Figs. 1–3)

Eupagurus imaii Yokoya, 1939: 285, fig. 13
[type-locality: Siranezaki, Miyagi Prefecture, 34 m]

Pagurus imaii: Gordan, 1956: 330 (list); Miyake, 1978: 72 (key, Japanese), 81 (key, English); 1982: 197 (list), 227 (key).

Material examined.—HUMZ-C 2134: 7 males (SL 2.9–3.6 mm, CL 4.2–6.0 mm) and 4 ovig. females (SL 2.5–2.9 mm, CL 4.3–4.4 mm), Usujiri, Pacific coast of southern Hokkaido, at depths of 20–30 m, dredged, 30 April 1992, coll. T. Komai. CBM-ZC 47: 4 males (SL 2.1–3.0 mm, CL 3.1–4.8 mm), Usujiri, at depths of 20–30 m, June 1990, coll. T. Komai.

Description. Small species. Shield (Fig. 1A, B) 0.96–1.14 times as long as broad, anterior margin between rostrum and lateral projections concave, anterolateral margins sloping or slightly terraced, posterior margin roundly truncate. Rostrum long, acutely triangular, considerably exceeding lateral projections. Lateral projections broadly rounded, with small acute spine. Dorsal surface of shield with several tufts of setae arranged symmetrically; lateral faces with long setae. Posterior carapace (Fig. 1A) membranous except for cardiac region somewhat calcified; cardiac sulci subparallel, not reaching posterior margin of carapace; sulci cardio-branchialis short.

Ocular peduncles (Fig. 1B) 0.67–0.82 times as long as shield, cylindrical, with corneae very slightly dilated. Ocular acicles subtriangular to subovate, terminating in 1 marginal or sub-

marginal spine, separated basally by two-thirds basal width of 1 acicle; interocular lobes weakly developed.

Antennular peduncles (Fig. 1B) overreaching corneae by less than half of ultimate segment. Ultimate segment about 0.5 times as long as shield. Basal segment with 1 acute or blunt spine on dorsolateral margin.

Antennal peduncles (Fig. 1B) overreaching corneae by less than half of fifth segment. Fifth and fourth segments with few setae. Third segment with acute spine at ventrodorsal margin, with few tufts of setae. Second segment with small spine on dorsolateral distal margin, mesial face with tufts of setae. First segment with small spine on lateral face and multifid spine on ventral margin. Antennal acicle somewhat arcuate, terminating in acute spine, mesial margin with moderately long setae. Antennal flagellum with several short setae on distal margin of each article.

Mandible (Fig. 2A) without distinguishing characters. Maxillule (Fig. 2B) with endopod bearing produced external lobule, overreaching internal lobule, not recurved; internal lobule with 1 apical seta. Maxilla (Fig. 2C) with endopod inflated basally, not reflexed, reaching level of anterior margin of scaphognathite. First maxilliped (Fig. 2D) with palp reaching level of anterior margin of distal endite. Second maxilliped (Fig. 2E) without distinctive characters. Third maxilliped (Fig. 2F) with basis-ischium fusion incomplete; basis (Fig. 2G) with 3 spines on mesial margin; ischium (Fig. 2G) with well-developed crista dentata and 1 accessory tooth; merus without dorsodistal spine, but with 1 ventral spine; carpus with dorsodistal spine.

Right cheliped (Figs. 3A, B, C, F) generally short and moderately stout in females and small males, considerably elongate and slender in large males, with tufts of short to long setae on distal 3 segments. Chela 1.7–2.2 times as long as broad and 1.1–1.4 times as long as carpus. Dactyl 0.8–1.0 times as long as palm, tending to become shorter proportionally with growth; cutting edge with 2 strong calcareous teeth and some small teeth on space between 2 strong teeth, short row of corneous spines distally; distal part terminating in small corneous

claw; dorsal surface elevated in midline with single row of small to moderately strong spines and tufts of setae; mesial surface somewhat convex, with single row of small spines; ventral surface without protuberances or spines. Fixed finger with dorsal surface weakly convex; cutting edge with one large, multi-cusped calcareous tooth proximally, somewhat notched just distal to strong tooth to receive distal strong tooth of dactyl, distal part with small subacute teeth, space between each tooth filled with corneous spines. Palm slightly inflated dorsoventrally; dorsal surface convex, with irregular rows of small to moderately strong acute or subacute spines, dorsolateral margin with single row of moderately strong spines, decreasing in size on fixed finger distally, dorso-mesial margin weakly defined by irregular row of moderately strong spines (spines on dorsal surface more acute and dense in females); mesial face with scattered spines; lateral face with low protuberances or tubercles; ventral surface slightly to somewhat depressed proximomesially, with low protuberances. Carpus tending to become relatively narrower with growth, 1.3–1.7 times as long as broad, weakly inflated ventrally; dorsal surface convex, with scattered spines and 2 irregular rows of spines, dorsomesial margin with single or double row of moderately strong spines, dorsodistal mesial angle slightly produced, with assemblage of spines, dorsolateral margin with row of moderately long spines; lateral and mesial face with low protuberances or tubercles; distal margin with small to moderately strong spines; ventral surface with moderately long spines distally. Merus triangular in dorsal view, subequal to carpus in length; dorsal surface with irregular transverse ridges fringed with setae; lateral face with low protuberances; ventrolateral margin with row of strong spines distally and small acute spines, occasionally forming cluster, proximally; mesial face with low protuberances or small spines, ventromesial margin with double rows of strong spines; ventral surface without prominent tubercle. Ischium with row of spines or spinules and sparse setae on ventromesial margin. Basis with one small but prominent tubercle on mesial margin. Coxa unarmed.

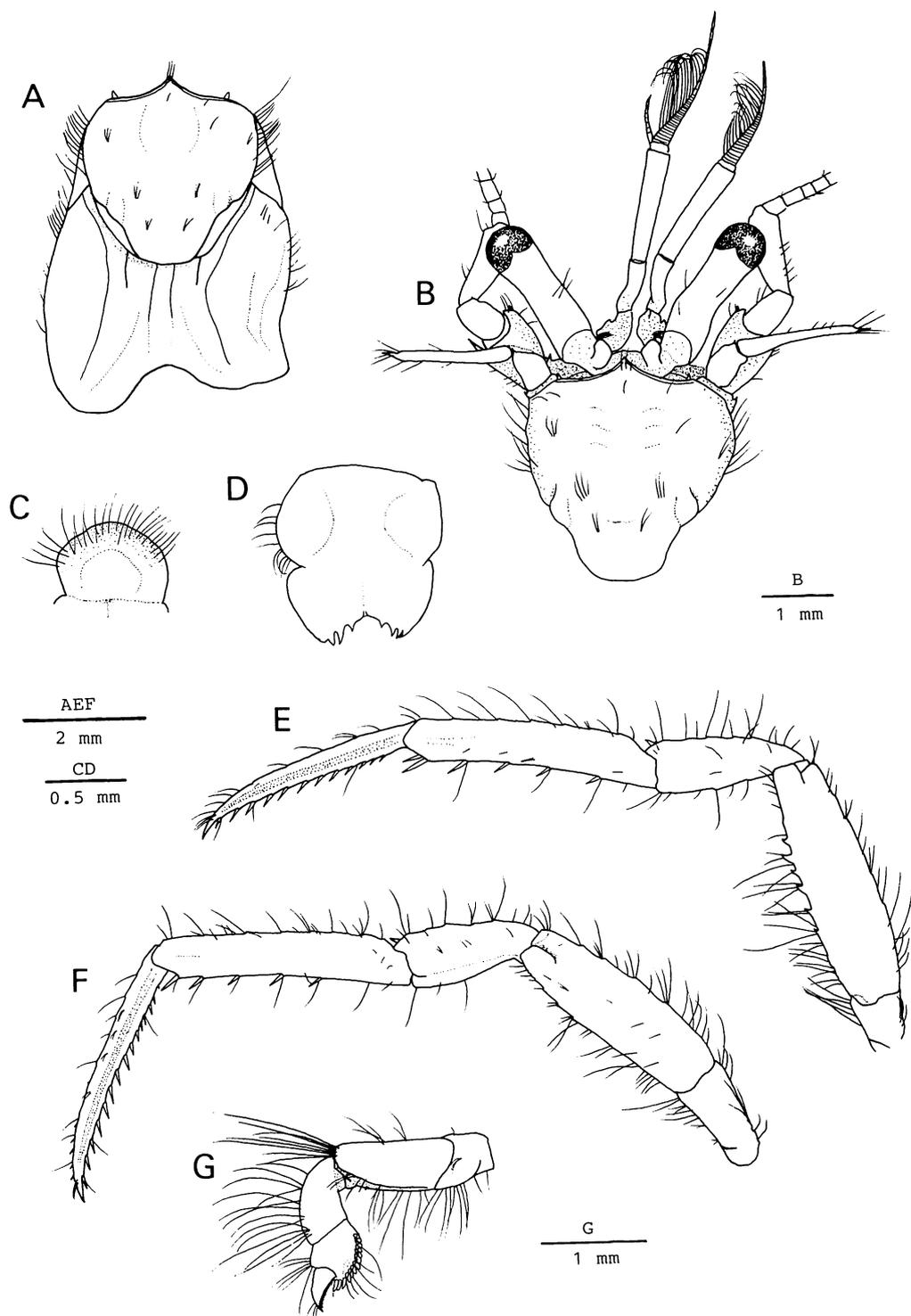


Fig. 1. *Pagurus imaii* (Yokoya, 1939). Male (HUMZ-C 2134, SL 3.1 mm, CL 4.6 mm). A, carapace, dorsal; B, shield and cephalic appendages, dorsal; C, anterior lobe of sternite of third pereopod, ventral; D, telson, dorsal; E–G, left second to fourth pereopods, lateral.

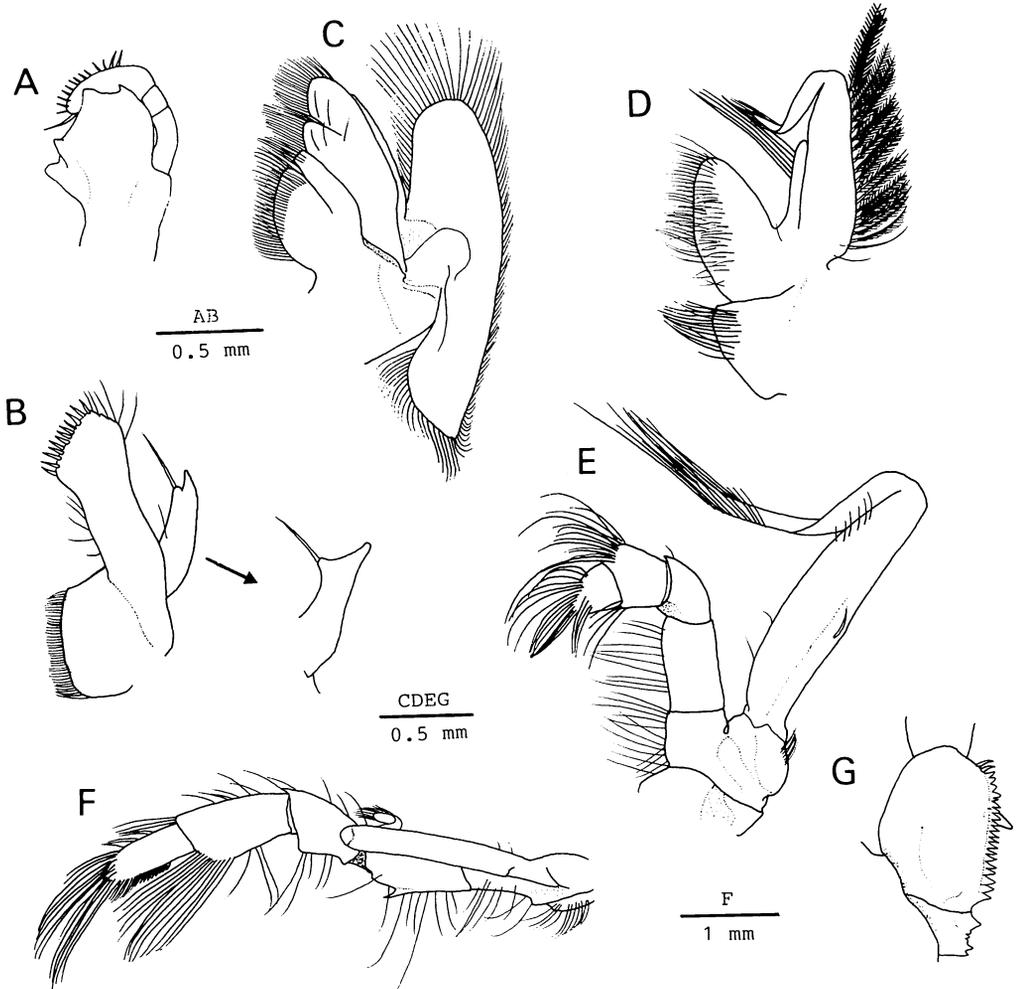


Fig. 2. *Pagurus imai* (Yokoya, 1939). Male (HUMZ-C 2134, SL 3.1 mm, CL 4.6 mm), left mouthparts. A, mandible; B, maxillule (inset, palp in lateral view); C, maxilla; D, first maxilliped; E, second maxilliped; F, third maxilliped, lateral; G, same, basis and ischium, dorsal.

Left cheliped (Fig. 3D, E) moderately short, reaching proximal 1/3 of palm of right cheliped in large males, reaching beyond level of base of dactyl of right cheliped in females and small males, hairy with tufts of long setae. Chela subequal to or slightly longer than carpus. Dactyl 1.4–1.5 times as long as palm; cutting edge with row of corneous spines over entire length, terminating in small corneous claw; surfaces without spines, but with scattered small granules. Palm moderately broad; dorsal surface strongly sloping laterally, elevated in midline, with 2 rows of strong acute or subacute spines, lateral row extending onto fixed finger, dorsomesial face sloping, unarmed or

with some spines or spinulose tubercles; mesial margin with row of moderately strong spines; ventral surface without spines, but with low protuberances. Carpus narrow; dorsal surface flattened, with 2 rows of strong spines, distal margin usually with a few strong and small spines; mesial and lateral faces with low protuberances or small tubercles; ventrolateral margin with some moderately strong spines distally; ventral surface with scattered spines or spinulose tubercles. Merus laterally compressed; dorsal surface with transverse ridges fringed with setae, distal margin unarmed; lateral face with spinulose tubercles ventrally, without tufts of setae, ventrolateral margin

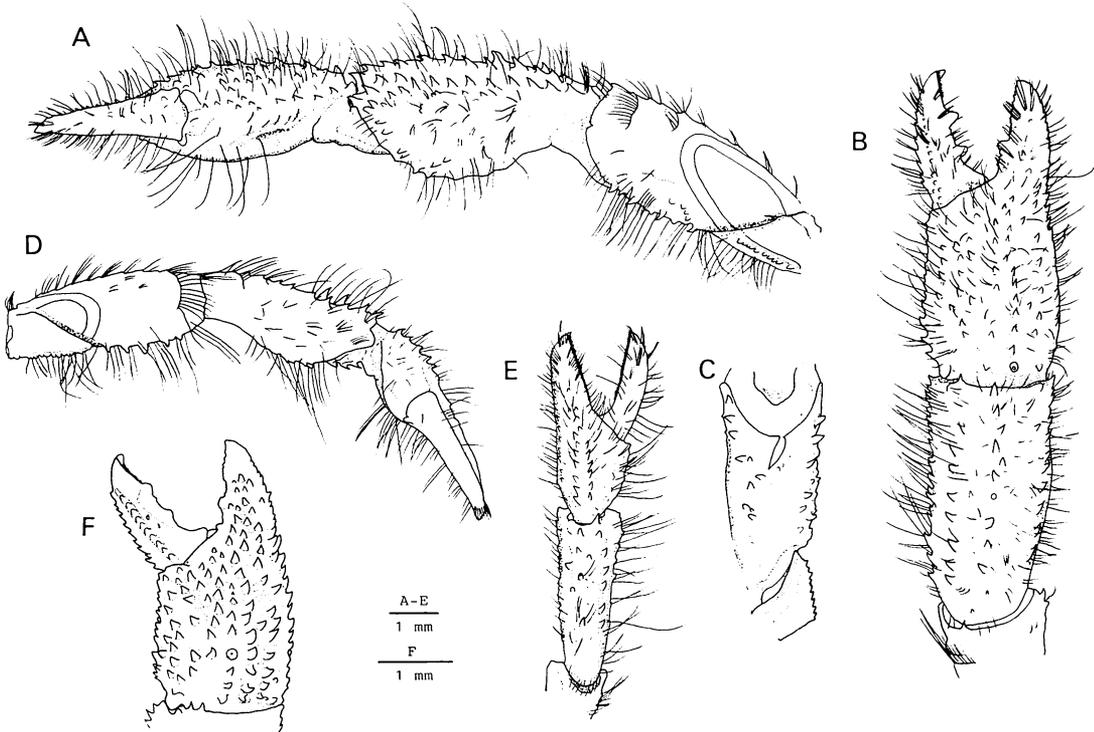


Fig. 3. *Pagurus imaii* (Yokoya, 1939). Chelipeds, A–E, male (HUMZ-C 2134, SL 3.1 mm, CL 4.6 mm), F, female (same lot, SL 2.9 mm, CL 4.4 mm). A, right cheliped, mesial; B, same, chela and carpus, dorsal; C, same, merus, ventral; D, left cheliped, mesial; E, same, chela and carpus, dorsal; F, chela of right cheliped, dorsal, setae omitted.

with strong acute teeth; mesial face unarmed and without setae, ventromesial margin with moderately strong spines; ventral surface without prominent tubercle, but with scattered spines. Ischium with row of small spines or tubercles and long setae on ventromesial margin. Basis with 1 small but prominent tubercle on mesial margin. Coxa unarmed.

Second and third pereopods relatively long and thin particularly in large males. Second right pereopod (Fig. 1E) overreaching tip of right cheliped, shorter in left. Dactyl 0.88–1.05 times as long as propodus in right and 0.90–1.20 times as long in left, about 10 times as long as proximal depth, slightly curved ventrally in lateral view and barely twisted in dorsal view; terminating in moderately strong corneous claw; dorsal surface with 2 rows of long to moderate, rather sparse setae; lateral face with weak longitudinal sulcus, devoid of setae except for few tufts situated along ventral margin; mesial face with row of small cor-

neous spines in distal part along dorsal margin; ventral margin with 10–18 moderately strong corneous spines arranged in single row and few setae. Propodus with row of 3–7 widely spaced spines and sparse tufts of long setae on ventral surface; ventrodistal margin usually with 2 corneous spines; dorsal surface with 1 or 2 irregular rows of low protuberances and tufts of long to short setae. Carpus 0.6–0.8 times as long as propodus; dorsal surface with row of low, occasionally spinulose protuberances and long to short setae, with subterminal spine; lateral and mesial faces unarmed, with scattered tufts of setae; ventral margin with row of low protuberances and setae. Merus about 3.8 times as long as maximum depth, dorsal margin with 1 or 2 rows of low occasionally spinulose protuberances and tufts of long setae; lateral and medial faces almost naked; ventral margin convex, with 1 row of several acute spines and tufts of long setae. Ischium with row of small spinules and tufts of long

dense setae on ventral margin. Coxa unarmed.

Third pereopods (Fig. 1F) generally similar to second pair, and slightly longer, overreaching tip of right cheliped in right and slightly falling short of it in left. Dactyli 0.96–1.19 times as long as propodus in right and 1.04–1.27 times as long as in left. Ventrodistal margin of propodus usually armed 1 (rarely 2) spine. Merus with ventral margin slightly sinuous in proximal half, left with row of low protuberances. Both coxae with gonopore in females.

Fourth pereopod (Fig. 1G) subchelate, lacking preungual process on lateral face of dactyl; propodal rasp composed of corneous scales arranged in 2 or 3 rows.

Fifth pereopod typical. Coxae without sexual tubes in males.

Sternite of third maxilliped with 1 small spine on each side of midline. Sternite of third pereopod (Fig. 1C) with anterior plate subcircular or subovate, slightly skewed to left, anterior surface obscured by long setae.

Abdomen with 3 unpaired pleopods in males and 4 unpaired in females.

Telson (Fig. 1D) with posterior lobes slightly asymmetrical, left slightly larger than right, separated by broad median cleft, terminal margin of both lobes with 3 or 4 moderately strong spines, lateral margins with only few setae.

Eleven pair of phyllobrachiate gills present (2 pairs of arthrobranchs on each of third to seventh thoracic somites and 1 pair of pleurobranchs on seventh somite).

Coloration. In life, entire body brown in general. Ocular peduncles pale brown, without band or stripe. Antennal flagella uniformly yellowish brown. Ambulatory pereopods obscurely banded with dark and pale brown. Eggs dark violet in early stage.

Biological notes. The present specimens came from a volcanic pebble bottom at depths of 20–30 m off Usujiri, Pacific coast of southern Hokkaido. As the species was not collected from the intertidal zone, it is indicated to be a sublittoral species.

Material collected in April contained the ovigerous females. The duration of incubation remains unknown. Some specimens collected in April were kept alive in an aquarium and

showed a precopulatory guarding in that males grasp the outer lip of the shell housing a female with the left cheliped.

Main gastropod shells used by *P. imaii* were those of *Homalopoma amussitatum* (Gould), and they were usually covered with colonies of unidentified hydractiniid hydrozoa.

Among 11 specimens of HUMZ-C 2134, four specimens, all males, were infested by a unidentified bopyrid isopod.

Distribution. Siranezaki, Miyagi Prefecture, at depth of 34 m (Yokoya, 1939); Usujiri, Pacific coast of southern Hokkaido, at depths of 20–30 m (present study).

Remarks. Yokoya (1939) compared *Eupagurus imaii* with *E. anomalus* Benedict, 1892, which has been assigned to the genus *Labidochirus* by McLaughlin (1974). Subsequent authors who cited Yokoya's taxon have been placed it in the genus *Pagurus* (see synonymy). The discovery of additional specimens of this species, in particular of the females, enables its systematic position to be assessed more precisely than was possible with the original description. Examination of the female specimens confirms that this species belongs to *Pagurus*. The large male specimens agree in general with the original description and figure, but the females differ from the males in much stronger armature of the right palm (Fig. 2F), and relatively shorter chelipeds and ambulatory pereopods. It is indicated that the reduction of armature and elongation of the right cheliped and ambulatory pereopods are the result of marked sexual dimorphism.

Pagurus imaii appears close to the species of the "capillatus"-group of *Pagurus* proposed by McLaughlin (1974), and the group includes four American species, *P. arcuatus* Squires, 1964, *P. capillatus* (Benedict, 1892), *P. kenneerlyi* (Stimpson, 1864), and *P. setosus* (Benedict, 1892). It has some characteristic features not shared by any other species of the group, such as the elongate right cheliped in the males, the possession of large differentiated teeth on the cutting edges of the right chela, the relatively slender ambulatory pereopods, or the posterior lobes of the telson armed with 3 or 4 relatively strong spines. Also these characters distinguishes *P. imaii* from the Japanese close rel-

atives, *P. pectinatus* (Stimpson, 1858), *P. pilosipes* (Stimpson, 1858), and *P. sagamiensis* Miyake, 1978, all of which may be referable to the "capillatus"-group.

In view of the variation in armature of the right palm of the species, it is necessary to partly revise the key to the Japanese species of *Pagurus* provided by Miyake (1978). At present, however, it is difficult to devise a revised key, since many Japanese species of *Pagurus* remain inadequately described.

Acknowledgments

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イマイホンヤドカリ (十脚目: 異尾下目: ホンヤドカリ科) の北海道からの再発見

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ホンヤドカリ科のホンヤドカリ属に属するイマイホンヤドカリ *Pagurus imaii* (Yokoya, 1939) を、北海道南部臼尻から採集された 15 個体の標本に基づき再記載した。本種は宮城県で採集された雄 1 個体だけに基づいて記載され、その後の採集例がなかったが、今回、雌が採集されたことにより、ホンヤドカリ属に所属することが改めて確認された。さらに、右鉗の掌部背面の棘の状態や、歩脚の長さにより性的二形が認められた。分類学的には "capillatus" グループの種に近縁であるが、右鉗の指部咬合縁に大きな歯を持つこと、雄の右鉗脚が伸長すること、歩脚が細いこと、および尾節の後縁に 3 あるいは 4 本の比較的大きな棘を持つことにより、他種から区別される。