

Fig. 44. Telson (dorsal view): *A*, *Hemipagurus ensifer* (Henderson), comb. nov., lectotype; *B*, *H. granulatus* (Edmondson), comb. nov., holotype; *C*, *H. haigae*, sp. nov., holotype; *D*, *H. kosugei*, sp. nov., holotype; *E*, *H. lewinoi*, sp. nov., holotype; *F*, *H. macLaughlinae*, sp. nov., holotype; *G*, *H. albatrossae*, sp. nov., holotype; *H*, *H. japonicus* (Yokoya), comb. nov., NSMT; *I*, *H. hirayamai*, sp. nov., holotype; *J*, *H. toyoshioae*, sp. nov., holotype. Scale bars = 0.5 mm.

medially and subproximally; ventral face with scattered long setae. Fixed finger blunt-tipped; dorsal surface with tufts of long setae; entire cutting edge (Fig. 30B) with small calcareous teeth. Palm as long as carpus; dorsal face flat, nearly smooth medially, tuberculate dorsomesially and granular dorsolaterally; dorsomesial face with tufts of long setae. Carpus as long as merus; dorsal surface flat, dorsolateral margin armed with row of acute spines, dorsomesial margin distinct, nearly straight in mesial view, armed with row of strong spines and row of thick spine-like setae; lateral surface tuberculate. Merus (Fig. 28C, D) with two large spines and few thick long setae on dorsodistal margin, dorsal face with irregular rows of thick long setae; ventral surface glabrous, ventromesial distal angle bearing spine, ventrolateral margin with acute spine subdistally.

Ischium (Fig. 28D) with acute subdistal spine and thick long setae ventrolaterally. Coxa unarmed.

Left cheliped (Fig. 33E–H) slender, 0.85 length of right; palm and carpus 0.55 and 0.50 maximum widths of right respectively. Dactyl length almost equal to palm, terminating in strong corneous claw; entire cutting edge with small corneous teeth; dorsal and mesial faces with tufts of setae. Fixed finger terminating in strong corneous claw; dorsal face with tufts of long setae; cutting edge with numerous corneous teeth on entire margin and widely spaced calcareous teeth on distal half. Palm 0.75 length of carpus; dorsal face granular, with scattered tufts of setae dorsomesially. Carpus as long as merus; dorsal surface flat, dorsolateral and dorsomesial margins distinct, each armed with row of very acute spines and with row of thick spine-like setae mesially; lateral surface granular. Merus (Fig. 33G, H) with dorsal face bearing irregular rows of thick spine-like setae, dorsodistal margin bearing large spine medially and few, thick spine-like setae; ventral face with few, thick spine-like setae, ventrolateral face with scattered spines, ventrolateral and ventromesial distal angles each bearing strong spine. Ischium (Fig. 33H) with acute subdistal spine ventrolaterally. Coxa unarmed.

Second and third pereopods (Fig. 14D, E) very similar; second shorter, 0.90 length of third, especially dactyls of second much shorter (0.80 length of third). Dactyls (Fig. 37B) not blade-shaped; long, 1.40 (second) or 1.50 (third) length of propodi; each terminating in sharp corneous claw; mesial faces nearly flat, each with dorsal and ventral rows of thick spine-like setae and with median row of fine long setae; lateral faces strongly convex longitudinally, with scattered setae. Propodi (Fig. 39B) long, 1.70 (second) or 1.90 (third) length of carpi; tuberculate dorsally; mesial faces each with dorsal and ventral rows of thick long setae. Carpi (Fig. 39B) short, 0.50 (second) or 0.60 (third) length of meri; dorsal face with one (second) or 1–3 (third) irregular rows of strong spines and row of widely spaced thick long setae, dorsodistal angles each with acute spine. Meri (Fig. 41D–E) each with dorsal faces bearing row of tufts of thick long setae, dorsodistal margins each with acute spine flanked by thick long setae; ventral face unarmed (second) or tuberculate (third), ventrolateral distal margin armed with acute spine, ventromesial distal margin unarmed.

Fourth pereopod (Fig. 43C, D) with dactyl bearing three short corneous spines on ventral margin and with small preungual process; propodal rasp along 0.80 length of ventral margin, lateral face covered with setae ventrally; carpus with tiny blunt-tipped spine at dorsodistal angle.

Sternite of third pereopods (Fig. 14F) with anterior lobe subrectangular and setae anteriorly. Sternite of fifth pereopods with very small round projection medially.

Abdomen with well-developed fleshy protuberance anteriorly on ventral portion. Female with (at least) three

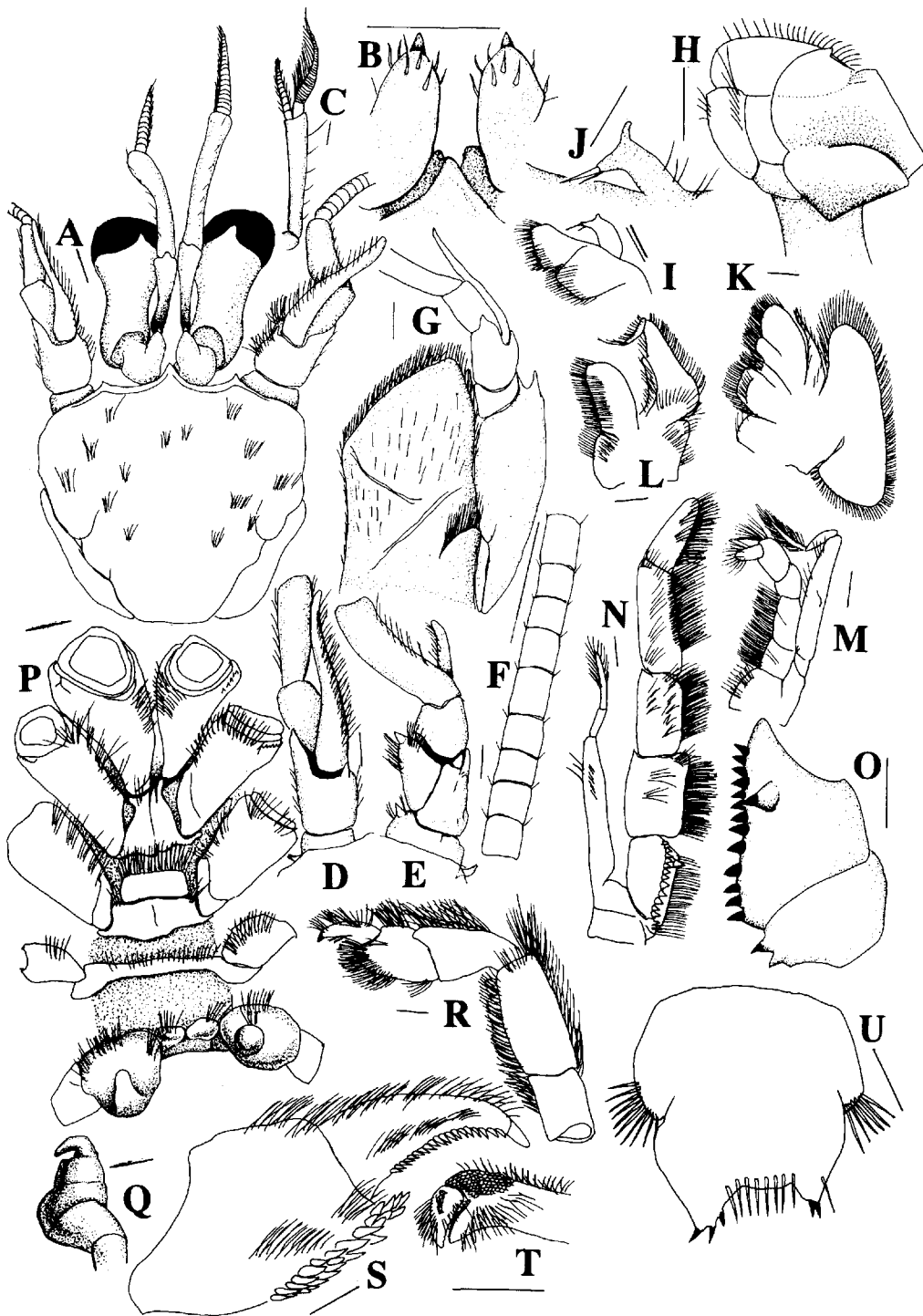


Fig. 45. *Parapagurodes doederleini* (Doflein), comb. nov.: paratype male, SL = 8.60 mm, Sagami Bay, ZSSM 274/1. A, shield; B, distal portion of ocular acicles; C, distal portion of antennule (right, lateral view); D, antenna (left, dorsal view); E, same (left, ventral view); F, antennal flagellum; G, anterior portion of branchiostegite (left). Mouth parts (right): H, mandible (internal view); I, maxillule (external view); J, same, endopod; K, maxilla (external view); L, first maxilliped (external view); M, second maxilliped (external view); N, third maxilliped (internal view); O, same, ischium and basis (external view). P, coxae and sternites of first to fifth pereopods (ventral view); Q, sexual tube on coxa of right fifth pereopod (lateral view); R, fourth pereopod (left, mesial view); S, dactyl and propodus of same (lateral view, enlarged); T, distal portion of fifth pereopod (left); U, telson (dorsal view). Scale bars: A–O, R–U = 1.0 mm; P, Q = 2.0 mm.

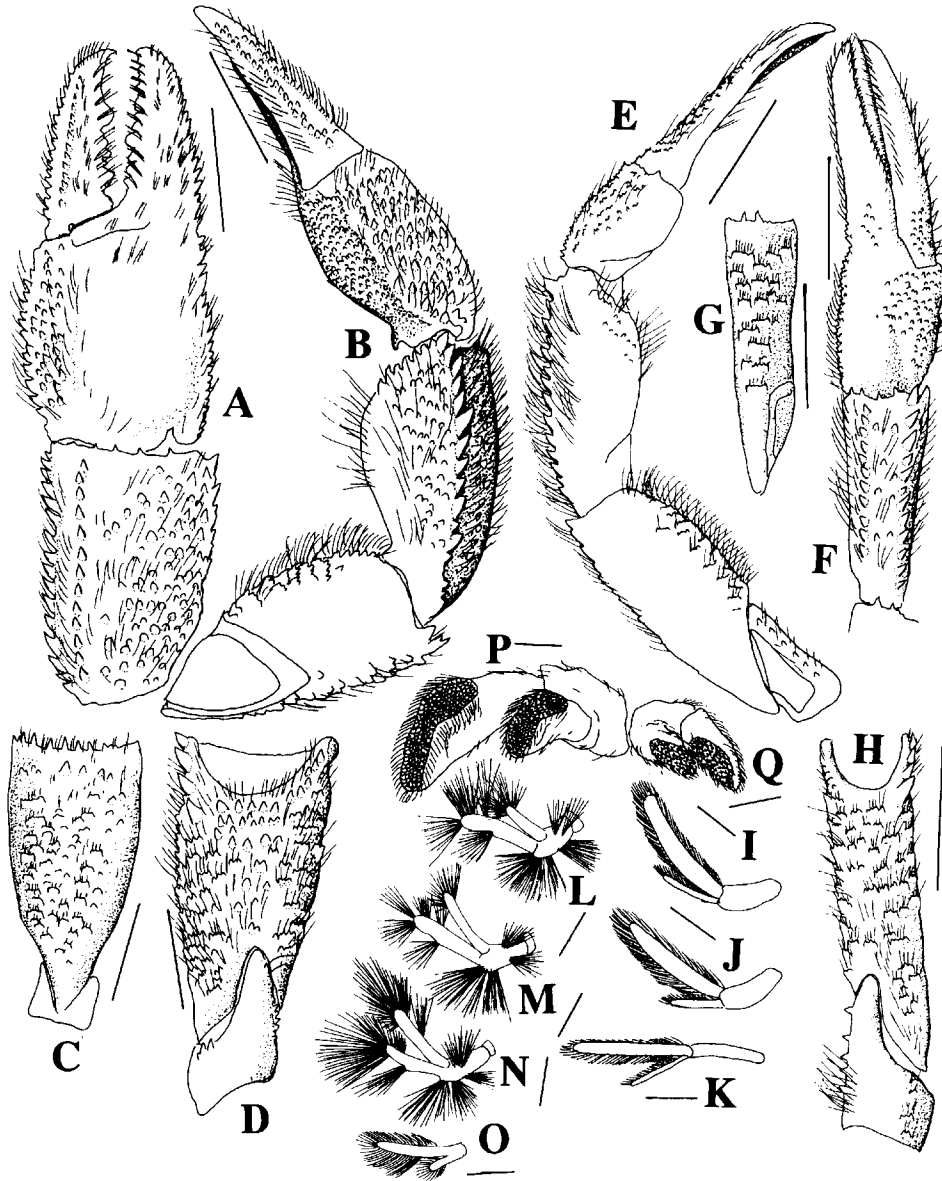


Fig. 46. *Parapagurodes doederleini* (Doflein), comb. nov. *A–K, P, Q*, paratype male, SL = 8.60 mm, Sagami Bay, ZSSM 274/1; *L–O*, paratype female, SL=9.25 mm, Sagami Bay, ZSSM 274/1. Right cheliped: *A*, chela and carpus (dorsal view); *B*, mesial view; *C*, merus and ischium (dorsal view); *D*, same (ventral view). Left cheliped: *E*, mesial view; *F*, chela and carpus (dorsal view); *G*, merus (dorsal view); *H*, merus and ischium (ventral view). Pleopods: *I–K*, male first to third pleopods; *L–O*, female first to fourth pleopods. Uropods: *P*, left; *Q*, right. Scale bars: *A–H* = 5.0 mm; *I–P* = 2.0 mm.

unpaired left biramous pleopods from second to fourth abdominal somites (fifth and sixth abdominal somites, uropods and telson missing).

Sexual dimorphism

Male unknown.

Colouration

Not known.

Shell

The specimen was in a sand tube made by a sea anemone-like coelenterate (species unknown).

Etymology

This species is named to honour the imperial status of the late Japanese Emperor Hirohito, who collected the specimen.

Distribution

Known only from the type locality, Sagami Bay, Japan, 200 m.

Affinities

This species is distinguishable from all other members of the *japonicus*-group in having unarmed dorsal surfaces (except for the dorsodistal spine) of the meri of the third pereopods

(Fig. 41D, E). The other species have one or two strong spines on that surface (Fig. 41A–C, F–M). This species is similar to *Hemipagurus japonicus* (Yokoya). See also 'Affinities' of that species.

Remarks

The specimen was collected in 1973 from Sagami Bay, brought to the Imperial Household, and incorrectly identified as *Catapagurus japonicus* by Sadayoshi Miyake. Since he was careful not to include this specimen in the redescription of *C. japonicus* in his large monograph of anomuran crustaceans of the Sagami Bay (Miyake 1978), he probably doubted the identity of the specimen. Although male specimens are not known for this species, there can be no doubt as to the accuracy of its assignment to genus.

Since the holotype has the fifth and sixth abdominal somites missing, the correct number of the pleopods is unknown.

Hemipagurus hirayamai, sp. nov.

(Figs 15A–E, 18D, 20E, 21S–T, 22J, 28E–H, 30C, 33I–L, 35C, 37C, 39C, 41F–J, 43E–F, 44I, 51)

Material examined

Holotype. **Suruga Bay**: ♂, SL = 1.85 mm, off Urishima, Numazu-shi, Shizuoka-ken, coll. Show Hirayama, 11.v.1994, CBM-ZC 6208.

Paratypes. **Suruga Bay**: 2 ♂, SL = 1.95, 2.00 mm, same data as holotype, CBM-ZC 6209; **Kagoshima-ken**: 1 ♂, SL = 2.15 mm, Mukai-shima, Uji-group, 20 m, coll. staff of Faculty of Fisheries, Kagoshima University, 7.vi.1967, KMNH 16160; **Ogasawara Islands**: 1 ♀, SL = 1.70 mm, Tsuru-hama, Chichi-jima, sandy bottom, 5 m, coll. Hiroyuki Tachikawa, 28.i.1995, CBM-ZC 6210.

Description

Shield (Fig. 15A) as long as broad, nearly circular in dorsal outline; anterior margin between rostrum and lateral projections rather deeply concave; lateral and posterior margins rounded; dorsal surface convex, with pair of short longitudinal rows of setae tufts anteriorly near midline, additional pair of long longitudinal rows of setae tufts laterally, and transverse rows of setae tufts anteriorly and posteriorly; rostral lobe (Fig. 18D) broad, round, almost reaching level of lateral projections; lateral projections (Fig. 18D) triangular, each with small submarginal spine. Posterior carapace (Fig. 15A) with very narrow posterolateral plates; posteromedian plate vestigial. Branchiostegites (Fig. 15B) not calcified, unarmed.

Ocular peduncles (including corneas) (Figs 15A, 18D) 0.75–0.85 length of shield, with lateral constriction; dorsal surface with few tufts of short setae; distal margins of dorsomesial faces each fringed with thick setae. Corneas (Fig. 18D) only slightly dilated or not dilated. Ocular acicles (Fig. 18D) moderately long, narrowly triangular, acute;

mesial margin fringed with several very long setae; lateral margin fringed with few very long setae; separated basally by breadth of rostral lobe.

Antennular peduncles (Figs 15A, 20E) moderately long, when fully extended second peduncular segment exceeding corneas by approximately 0.30–0.40 own length; ultimate segment with dorsolateral margin bearing several very long setae distally but dorsomesial margin without setae; penultimate segment unarmed; basal segment with acute spinule at ventrodistal angle. Antennal peduncles (Figs 15A, 21S, T) moderately long, when fully extended slightly exceeding corneas; fifth, fourth and third segments unarmed; second segment with dorsolateral distal angle terminating in acute tip accompanied by subdistal spine ventrally, dorsomesial distal angle with acute spine; first segment with strong spine laterally and strong acute spine at ventrodistal margin mesially. Antennal acicles (Fig. 21S) short, broad. (Antennal flagella missing).

Third maxilliped with crista dentata of ischium (Fig. 22J) reduced, composed of four or five widely separated teeth and with accessory tooth; basis (Fig. 22J) with two or three acute teeth; merus with strong dorsodistal spine.

Right cheliped (Fig. 28E–H) of male large, stout, chela flattened dorsoventrally. Dactyl short, 0.60–0.70 length of palm; terminating in strong corneous claw; dorsal face strongly convex, with tufts of long setae; cutting edge (Fig. 30C) with large, blunt-tipped calcareous teeth medially and numerous minute corneous teeth in distal half. Fixed finger terminating in strong corneous claw; cutting edge (Fig. 30C) with numerous, irregularly sized calcareous teeth. Palm as long as carpus, with dorsal, lateral and mesial surfaces densely granular; dorsal face strongly convex, dorsomesial face with tufts of long setae. Carpus approximately as long as merus; dorsal, lateral and mesial surfaces densely granular; dorsal surface flat, dorsolateral and dorsomesial margins distinct, each armed with large granules or tubercles. Merus (Fig. 28G, H) with whole surface except dorsomesial face granular; dorsodistal margin with large spine medially and few thick long setae, dorsal face with distinct subdistal, short oblique ridge fringed anteriorly with thick long setae and proximally adjacent irregular rows of thick long setae; ventromesial and ventrolateral distal angles each with strong spine. Ischium (Fig. 28H) with very large, blunt-tipped subdistal spine ventrolaterally. Coxa unarmed.

Left cheliped (Fig. 33I–L) long and slender. Dactyl long, 1.25–1.35 length of palm, terminating in strong corneous claw; slightly granular dorsally; entire cutting edge (Fig. 35C) with small corneous teeth. Fixed finger with dorsal face slightly granular, with tufts of long setae; terminating in strong corneous claw; entire cutting edge (Fig. 35C) with numerous corneous teeth and widely spaced calcareous teeth. Palm short, 0.60–0.70 length of palm; dorsal, mesial and lateral surfaces granular, dorsal face slightly convex. Carpus

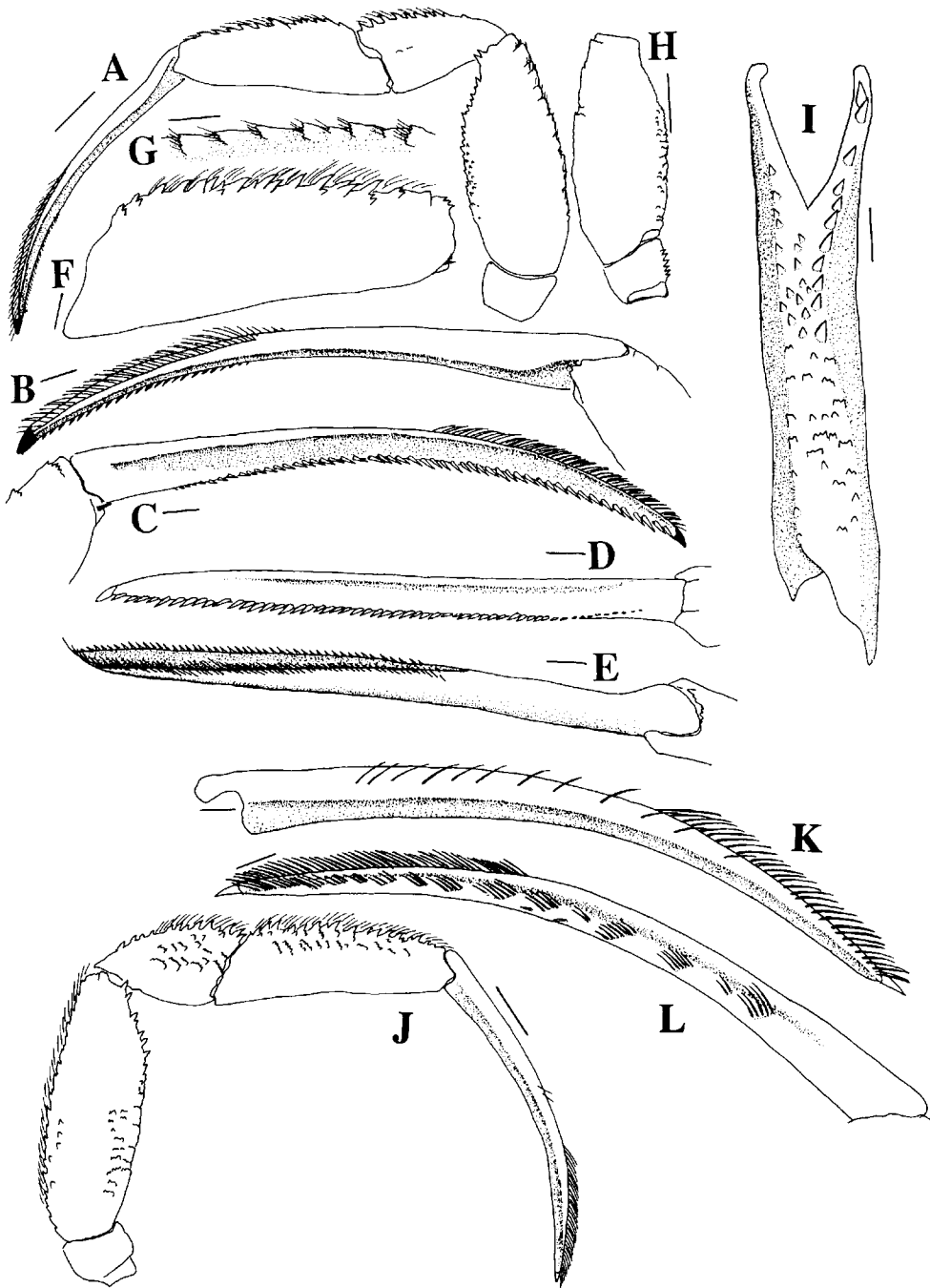


Fig. 47. *Parapagurodes doederleini* (Doflein), comb. nov.: paratype male, SL = 8.60 mm, Sagami Bay, ZSSM 274/1. Second pereopod (left): *A*, lateral view; *B*, dactyl (dorsolateral view); *C*, same (mesial view); *D*, same (ventromesial view); *E*, same (dorsomesial view); *F*, propodus (mesial view); *G*, dorsal portion of merus (lateral view); *H*, merus and ischium (mesial view); *I*, merus (ventral view). Second pereopod (right): *J*, lateral view; *K*, dactyl (lateral view); *L*, same (mesial view). Scale bars: *A*, *H*, *I*, *J* = 3.0 mm; *B*–*G*, *K*, *L* = 2.0 mm.

elongate, as long as merus; dorsal surface flat, with numerous granules, dorsolateral and dorsomesial margins distinct, each armed with numerous granules or tubercles; ventral face granular. Merus (Fig. 33*K*, *L*) with dorsal and lateral surfaces

slightly granular; dorsodistal margin with large spine medially and few thick long setae, dorsal face with irregular rows of thick long setae; ventral surface covered with numerous granules, ventromesial angle protruding, bearing

acute spine, ventrolateral distal angles protruding, unarmed. Ischium (Fig. 33L) with strong subdistal spine ventrolaterally. Coxa unarmed.

Second and third pereopods (Fig. 15C, D) morphologically similar except for armature of meri; second shorter (0.85–0.95) third, particularly dactyls (0.75 length). Dactyls (Fig. 37C) not blade-shaped; long, 1.05–1.15 (second) or 1.15–1.25 (third) length of propodi, each terminating in sharp corneous claw; lateral face strongly convex longitudinally; mesial faces flat, each with dorsal and ventral rows of thick, spini-form bristles and median row of fine long setae. Propodi (Fig. 39C) 2.05–2.20 (second) or 2.20–2.35 (third) length of carpi, minutely granular dorsally and laterally; mesial faces each with dorsal row of 3–5 (second) or 3–6 (third) and ventral row of 6–7 (second) or 2–4 (third) thick, spine-like setae and dorsodistally with pair of strong spine-like setae. Carpi (Fig. 39C) 0.40–0.50 (second) or 0.45–0.55 (third) length of meri; dorsal faces with few irregular rows of tubercles or large granules, dorsodistal spine vestigial. Meri (Fig. 41F–J) granular dorsally and laterally, strongly compressed laterally in second, but swollen laterally in third; each with dorsodistal margin bearing acute spine and one or two spine-like setae, dorsal face of second with large subdistal spine (Fig. 41F), dorsal face of third with large subdistal spine followed posteriorly by additional large spine slightly displaced laterally (Fig. 41H, J), these dorsal spines of second and third each often flanked by one or two spine-like setae, remainders of dorsal faces with tufts of spine-like setae; ventrolateral distal margin armed with acute spine, ventromesial distal margin unarmed; ventral face tuberculate.

Fourth pereopod (Fig. 43E, F) with dactyl bearing two or three short corneous spines on ventral margin and with prominent preungual process; propodal rasp 0.70–0.80 length of ventral margin; carpus with blunt-tipped spine at dorsodistal angle. Male with right coxa of fifth pereopods bearing very long sexual tube with forked tip curving over dorsal surface of abdomen toward left side (Fig. 15A); left coxa with gonopore and dense setae.

Sternite of third pereopods (Fig. 15E) with anterior lobe subrectangular, with setae anteriorly. Sternite of fifth pereopods with pair of very small round projections medially.

Abdomen with well-developed fleshy protuberance anteriorly on ventral portion. Male with at least two unpaired left uniramous pleopods, but existence of other pleopod uncertain because of damaged abdomen.

Uropodal protopods each with 1–3 small tubercles posteriorly.

Telson (Fig. 44I) with posterior lobes separated by very broad, deep median cleft, each with one or two thick long setae laterally and many short fine setae mesially; terminal margins each with corneous spine ventrally, not visible from dorsal.

Sexual dimorphism

Female unknown.

Colouration

Colour slide of living animal by Hiroyuki Tachikawa: generally semi-transparent whitish; shield with mottled brown on posterior half; pair of dark brown patches on anterior portions of posterior carapace; chelipeds with faint brown longitudinal stripes on dorsal faces of palms and carpi; propodi of ambulatory legs with brown bands medially and proximally.

Shell

Not known.

Etymology

This species is named for Mr Show Hirayama, who collected the specimens.

Distribution

Japan: Suruga Bay; Uji-group, Kagoshima-ken; Chichijima, Ogasawara Islands; 5–20 m.

Affinities

This species is easily distinguished from all other members of the *japonicus*-group in having ocular peduncles not broadened distally and non-dilated corneas (Fig. 18D). The other species of the *japonicus*-group have the ocular peduncles broadened distally and dilated corneas (Fig. 18B, C, E; see also McLaughlin 1997: figs. 17a, 18a, b, 19a, b).

Remarks

The abdomens of all the specimens examined were damaged, so that the correct number of pleopods cannot be determined.

Among the S. Miyake crustacean collection deposited at KMNH, one male of this species, which was collected from Uji Group, Kagoshima-ken, is included (KMNH 16160). It was incorrectly identified as *Catapagurus japonicus* Yokoya, 1933, by S. Miyake. He did not use this specimen in any publication.

Hemipagurus toyoshioae, sp. nov.

(Figs 16, 18E, 20F, 21U–V, 22K, 28I–L, 30D, 33M–P, 35D, 37D, 39D, 41K–M, 43G–H, 44J, 51)

Material examined

Holotype. **Amami-oshima Island**: 1 ♂, SL = 1.10 mm, St. 10 of R/V Toyoshio-maru No.95–26 cruise, east of the Island, 28°09'60"N 129°25'40"E, dredge, 117 m, coll. A. Asakura, 11.xii.1995, CBM-ZC 6203.

Paratypes. **Amami-oshima Island**: 2 ovi. ♀, SL = 1.60, 1.70 mm, same data as holotype, CBM-ZC 6204.

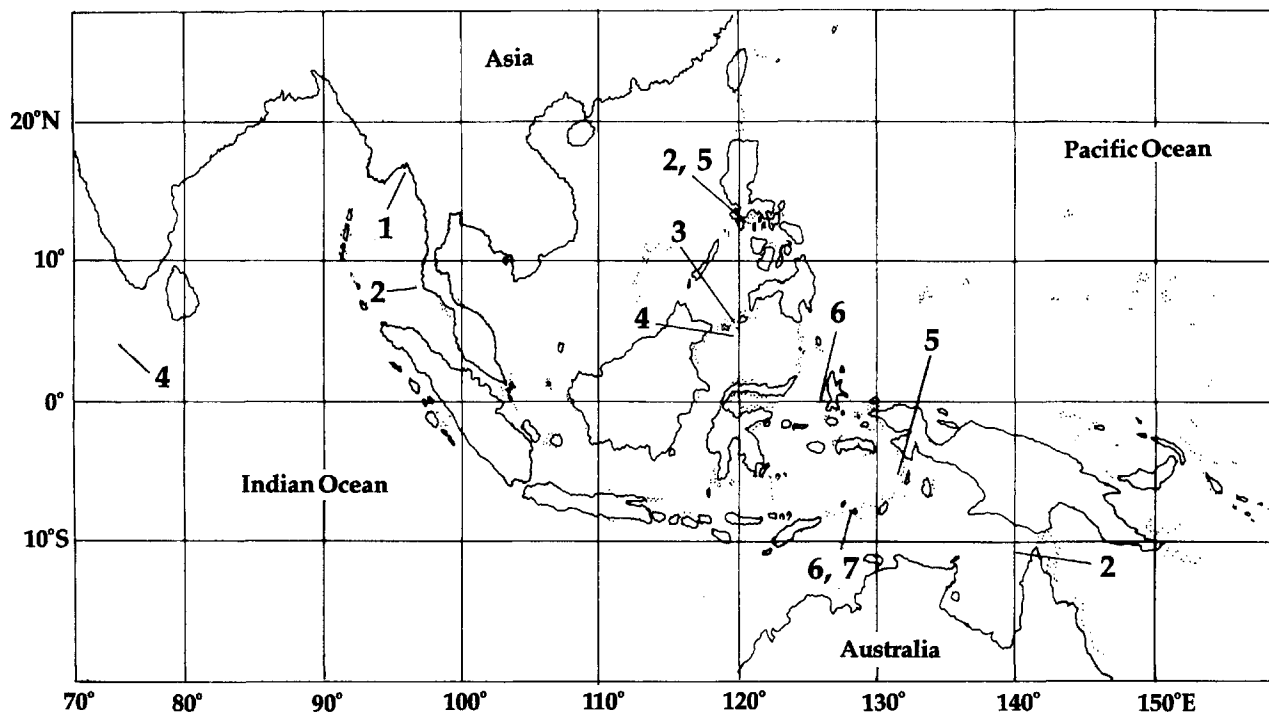


Fig. 48. Geographical distribution of *Hemipagurus* in the West Pacific and eastern Indian Oceans. 1: *H. ensifer* (Henderson), comb. nov. 2: *H. haigae*, sp. nov. 3: *H. alcocki* (McLaughlin), comb. nov. 4: *H. albatrossae*, sp. nov. 5: *H. holthuisi* (McLaughlin), comb. nov. 6: *H. oculocrassus* (McLaughlin), comb. nov. 7: *H. tanimbarensis* (McLaughlin), comb. nov.

Additional material. Amami-oshima Island: 1 glaucothoe, sex unknown, same data as holotype, CBM-ZC 6205.

Description

Shield (Fig. 16A) 1.10–1.15 times broader than long; anterior margin between rostrum and lateral projections shallowly concave, anterolateral margins rounded; dorsal surface of shield slightly convex, with two pairs of longitudinal rows of setae tufts; rostral lobe (Fig. 18E) very broad, beyond level of lateral projections; lateral projections (Fig. 18E) small and angular, with acute submarginal spine. Posterior carapace (Fig. 16A) with very narrow posterolateral plates and very short posteromedian plate. Branchiostegites (Fig. 16B) not calcified, unarmed.

Ocular peduncles (including corneas) (Figs 16A, 18E) approximately 0.65–0.75 times as long as shield; dorsal surfaces bearing several long stiff setae, distal margins of dorsomesial faces fringed with long stiff setae. Corneas (Fig. 18E) dilated. Ocular acicles (Fig. 18E) moderately short, slender triangular, acute; widely separated basally by breadth of rostral lobe.

Antennular peduncles (Figs 16A, 20F) long, when fully extended penultimate segments overreaching corneas; ultimate and penultimate segments unarmed; basal segment

with acute spine at ventrodistal mesial angle. Antennal peduncles (Figs 16A, 21U, V) short, when fully extended exceeding distal margins of corneas by approximately 0.30–0.40 length of fifth segments; fifth and fourth segments unarmed; third segment with ventrodistal angle produced; second segment with dorsolateral distal angle produced, terminating in sharp spine, dorsomesial distal angle with strong spine; first segment with strong hook-shaped spine laterally and strong spine at ventrodistal margin. Antennal acicles (Fig. 21U) moderately short, reaching level of distal margins of corneas, subacute.

Third maxilliped with merus bearing strong acute dorsodistal spine; ischium (Fig. 22K) with reduced crista dentata, composed of 9–10 teeth and strong accessory tooth; basis (Fig. 22K) with 3–5 acute teeth.

Right cheliped of male (Fig. 28I–L) large and stout, chela flattened dorsoventrally. Dactyl moderately long, 0.70–0.75 length of palm; cutting edge (Fig. 30D) with irregularly sized calcareous teeth on proximal half and row of alternating calcareous and corneous teeth on distal half. Fixed finger with cutting edge (Fig. 30D) bearing minute calcareous teeth on proximal 0.60–0.70 and few corneous teeth on distal 0.20–0.30. Palm long, 1.25–1.35 length of carpus; dorsomesial surfaces covered by minute granules or tubercles.

Carpus long, 0.65–0.70 length of merus; dorsal surface flat, dorsolateral and dorsomesial margins each armed with row of very strong spines; lateral and mesial surfaces covered with tubercles. Merus (Fig. 28*K, L*) long, dorsodistal margin with medial strong spine flanked by thick long seta; lateral and mesial faces granular or tuberculate; ventral surface with scattered tubercles, ventromesial and ventrolateral distal angles each with strong spine, ventromesial margins with few spines distally. Ischium and coxa unarmed.

Left cheliped (Fig. 33*M–P*) slender. Dactyl long, 1.20–1.30 length of palm, with tufts of long setae; terminating in strong corneous claw; entire cutting edge (Fig. 35*D*) with minute corneous teeth. Fixed finger nearly smooth, with tufts of long setae; terminating in strong corneous claw; cutting edge (Fig. 35*D*) with widely separated calcareous teeth inter-spersed with several corneous teeth. Palm 0.65–0.70 length of carpus, dorsolateral and dorsomesial faces slightly granular. Carpus elongate, 0.75–0.85 length of merus; dorsolateral and dorsomesial margins each armed with row of very strong spines. Merus (Fig. 33*O, P*) with dorsodistal angle bearing acute spine flanked by thick long seta, dorsal surface with row of several long stiff setae; ventromesial and ventrolateral distal angles each with strong spine. Ischium (Fig. 33*P*) and coxa unarmed.

Second and third pereopods (Fig. 16*D–E*) morphologically similar; third appreciably longer than second, particularly dactyls and propodi (1.30–1.40 and 1.20–1.25 length respectively). Dactyls (Fig. 37*D*) not blade-shaped; long, 1.05 (second) or 1.15–1.20 (third) length of propodi; each terminating in strong corneous claw; mesial faces each with ventral row of short spine-like setae and dorsal row of long spine-like setae on distal half and short spine-like setae on proximal half; lateral faces slightly convex, scattered with short setae. Propodi (Fig. 39*D*) long, 2.45–2.50 (second) or 2.80–2.90 (third) length of carpi; mesial faces each bearing dorsal and ventral rows of thick long setae. Carpi (Fig. 39*D*) short, 0.35–0.45 (second) or 0.45–0.50 (third) length of meri; dorsal surfaces granular, with several very long setae, dorsodistal angles each with 1–3 strong spines. Meri (Fig. 41*K–M*) each with dorsodistal margin with large medial spine, dorsal face subdistally with second large spine followed posteriorly by third large spine slightly displaced laterally, each flanked by one or two thick long setae, remainder of dorsal surface with few thick, long setae; ventrolateral and ventromesial distal margins unarmed; ventral faces only slightly tuberculate.

Fourth pereopod (Fig. 43*G–H*) with dactyl bearing 1–3 short corneous spines on ventral margin and with prominent preungual process covered by dense short setae apically; propodal rasp 0.65–0.75 length of ventral margin; carpus with tiny, blunt-tipped spine at dorsodistal angle. Male with right coxa of fifth pereopods bearing very long sexual tube with forked tip curving over dorsal surface of abdomen

toward left side (Fig. 16*A*); gonopore of left coxa with vas deferens only slightly protruding and with long setae laterally.

Sternite of third pereopods (Fig. 16*C*) with broad, semi-rectangular anterior lobe with setae anteriorly. Sternite of fifth pereopods with very small projection.

Uropodal protopods unarmed.

Telson (Fig. 44*J*) with posterior lobes separated by very broad median cleft, each terminating in strong corneous spine, lateral margins each with two thick long setae.

Sexual dimorphism

Although two females were collected, all chelipeds had been lost and sexual dimorphism could not be evaluated.

Colouration

Not known.

Etymology

This species was collected during R/V Toyoshio-maru (Faculty of Applied Biological Science, Hiroshima University) No.95–26 cruise to the Amami Islands in December 1995, and is named for this vessel.

Distribution

Known only from the type locality, Amami-oshima Island; 117 m.

Affinities

Individuals of *Hemipagurus toyoshioae*, sp. nov. are very small, measuring only 1.10–1.70 mm. The species is easily distinguished from the other species of the *japonicus*-group in having a very broad median telsonal cleft and bearing a very sharp terminal spine on each posterior lobe (Fig. 44*J*). This species is also characterised by short ocular acicles that are 0.3–0.4 length of the ocular peduncles (Fig. 18*E*). In contrast, all other species except for *H. hirayamai*, sp. nov. and *H. tanimbarensis* (McLaughlin 1997) have long ocular acicles that reach or overreach the base of the corneas (Fig. 18).

Hemipagurus toyoshioae differs from *H. hirayamai* in having dilated corneas (Fig. 18*E*) and rows of very strong spines on the dorsolateral and dorsomesial margins of the chelipeds (Figs 28*I, J*; 33*M, N*). *Hemipagurus hirayamai* has non-dilated corneas (Fig. 18*D*) and only tuberculate rows on the same portions of the chelipeds (Figs 28*E, F*; 33*I, J*). *Hemipagurus tanimbarensis* differs from *H. toyoshioae* in having a very narrow median cleft of the telson (McLaughlin 1997: 501, fig. 18*k–m*) and very poor development of the dorsal and ventral rows of corneous spines on the mesial faces of the ambulatory dactyls (Fig. 37*F*).

Hemipagurus holthuisi (McLaughlin), comb. nov.

(Fig. 37E)

Catapagurus holthuisi McLaughlin, 1997: 501, fig. 19, 39e–f.**Material examined**

Holotype. **Indonesia:** ovi. ♀, SL = 2.8 mm, St. CP 77 of Karubar Expedition, Tanimbar Islands, 08°57'S, 131°27'E, 332–346 m, 3.xi.1991, MNHN Pg-5291 (not examined).

Paratype. **Indonesia:** 1 ♂, SL = 1.50 mm, St. DW 27 of Karubar Expedition, Kai Islands, 5°33'S 132°51'E, 304–314 m, 26.x.1991, MNHN Pg-5290.

Additional material. **Philippines:** 1 ♀, SL = 2.80 mm, St. 5409 of Albatross Expedition, west of Pacijan Island, Camotes Islands, Cebu, Philippines, Camotes Sea, 10°38'N 124°13'08"E, 346 m, 18.iii.1909, USNM 291239.

Distribution

Kai and Tanimbar Islands, Indonesia, and now Luzon Island, Philippines: 61–346 m.

Affinities

The species is most closely related to *Hemipagurus holthuisi* is *H. japonicus*. See 'Affinities' under *H. japonicus* for differences. This species is distinguished from all the other species of the *japonicus*-group except for *H. toyoshioae* in having very long setae on the dorsal and ventral portions of the mesial faces of the ambulatory dactyls (Fig. 37E). *Hemipagurus toyoshioae* has a much broader and deeper median cleft in the telson (Fig. 44J) and much more slender chelipeds (Figs 28I–L, 33M–P) and ambulatory legs (Fig. 16D–E) than *H. holthuisi*. In the right chelipeds of males, the maximum widths of the palm and the carpus are 0.60–0.65 and 0.45–0.50 times of the lengths respectively in *H. toyoshioae*, whereas they are 0.70–0.75 and 0.60–0.65 in *H. holthuisi*. Similarly, in the propodi of the third pereopods, the lengths are 8.7–8.8 times of the height in *H. toyoshioae*, but 5.2–5.4 in *H. holthuisi*.

McLaughlin (1997) documented the differences between this species and *Hemipagurus* (as *Catapagurus*) *tanimbarensis* and *H.* (as *Catapagurus*) *oculocrassus*.

Hemipagurus oculocrassus (McLaughlin), comb. nov.*Catapagurus oculocrassus* McLaughlin, 1997: 495, fig. 17, 39a–b.**Material examined**

Holotype. **Indonesia:** ♂, SL = 3.1 mm, St. CP 38 of Karubar Expedition, Kai Islands, 07°40'S, 132°27'E, 620–666m, 28.x.1991, MNHN Pg-5286 (not examined).

Paratypes. **Indonesia:** 1 ♂, SL = 1.70 mm, 2 ovi. ♀, SL = 2.30, 2.30 mm, 1 ♀, SL = 2.10 mm, St. CC 57 of Karubar Expedition, Tanimbar Islands, 8°19'S 131° 53'E, 603–620 m, 31.x.1991, USNM 276016.

Additional material. **Indonesia:** 2 ♂, SL = 2.65, 2.80 mm, Stn. 5618 of Albatross Expedition, off Mareh Island, Molucca Passage, 0°37'00"N 127°15'00"E, 762 m, 27.xi.1909, USNM 291235.

Distribution

Kai and Tanimbar Islands, and now Mareh Islands, Indonesia; 552–809 m.

Affinities

As has been stated by McLaughlin (1997), this species bears a much more striking similarity to *Icelopagurus crosnieri* McLaughlin, 1997 than to other species of *Hemipagurus* in having noticeably setose shields, very short, stout ocular peduncles, elongate antennular peduncles and a comparable tubular preungual process of the fourth pereopod. However *H. oculocrassus* has a very slender and elongate male sexual tube, a diagnostic character of the genus *Hemipagurus*.

This species is distinguished from all other species of the *japonicus*-group in having comparatively long antennules and antennae that are over three times and twice the lengths respectively, of the ocular peduncles (McLaughlin 1997: 496, fig. 17a, b). In contrast, all other species of the *japonicus*-group have antennule peduncles about twice the length of the ocular peduncles and antennal acicles reaching or slightly extending the distal ends of the ocular peduncles.

McLaughlin (1997) documented the differences between this species and *Hemipagurus* (as *Catapagurus*) *tanimbarensis* and *H.* (as *Catapagurus*) *holthuisi*.

Hemipagurus tanimbarensis (McLaughlin), comb. nov.

(Fig. 37F)

Catapagurus tanimbarensis McLaughlin, 1997: 498, fig. 18, 39c–d.**Material examined**

Holotype. **Indonesia:** ovi. ♀, SL = 2.1 mm, St. 49 of Karubar Expedition, Tanimbar Islands, Indonesia, 08°00'S, 132°59'E; 206–210 m, 29.x.1991, MNHN Pg-5288 (not examined).

Paratypes. **Indonesia:** 1 ♂, SL = 1.90 mm, 1 ovi. ♀, SL = 2.10 mm, St. 49 of Karubar Expedition, Tanimbar Islands, 8°00'S 132°59'E, 206–210 m, 29.x.1991, MNHN-Pg 5289.

Distribution

Kai and Tanimbar Islands, Indonesia.

Affinities

This species is distinguished from all other species of the *japonicus*-group in having very poor development of the dorsal and ventral rows of setae on the mesial faces of the ambulatory dactyls (Fig. 37F) and a narrow V-shaped median cleft in the telson (see McLaughlin 1997: 500, fig. 18k–m). McLaughlin (1997) documented the differences between this species and *Hemipagurus* (as *Catapagurus*) *holthuisi* and *H.* (as *Catapagurus*) *oculocrassus*.

Genus *Parapagurodes* McLaughlin and Haig

Parapagurodes McLaughlin & Haig, 1973: 115. – McLaughlin & Jensen, 1996: 842.

Catapagurus Miyake, 1978: 78 (key), 141 (in part, not *Catapagurus* A. Milne-Edwards, 1880, see remarks). – Miyake, 1982: 224 (key, in part, as *Catapaguanus*, typographic error), 232 (in part, see remarks).

Type species: *Parapagurodes makarovi* McLaughlin & Haig, 1973. Gender: masculine.

Remarks

Since Miyake (1978, 1982) considered both *Parapagurodes* (as *Catapagurus*) *doederleini* and *Hemipagurus* (as *Catapagurus*) *japonicus* to be in the same genus, his generic diagnoses of *Catapagurus* and couplets of *Catapagurus* in the key to Japanese pagurid genera were based on the characters shared by both species.

Parapagurodes doederleini (Doflein), comb. nov.

(Figs 45–47)

Catapagurus doederleini Doflein, 1902: 624, 646, pl. 6, figs 4, 5, text fig. c. – Alcock, 1905b: 185; Terao, 1913: 359; Balss, 1913: 68, text fig. 41; Yokoya, 1933: 91; Gordan, 1956: 306 (list); Miyake, 1960: 90, pl. 45, fig. 1; Miyake, 1975: 256, pl. 116, two unnumbered figures; Miyake, 1978: 78 (key), 142, 185 (list), pl. 1, fig. 4; Miyake & Imafuku, 1980: 63; Miyake, 1982: 122, 199 (list), 232 (key), pl. 41, fig. 6; Takeda, 1982: 19 (key), 72; Baba, 1986: 12 (list), 199, 302, fig. 147.

Material examined

Holotype. Sagami Bay: ZSSM (not examined).

Paratypes. **Sagami Bay**: 3 ♂, SL = 8.60, 8.75, 6.90 mm, 1 ♀, SL = 9.25 mm, 1 ovi. ♀, SL = 7.30 mm, 1901, ZSSM 274/1.

Additional material. **Sagami Bay**: 1 ♂, ZSSM 274/2; 1 ovi. ♀, west of Kamekishou, NSMT-Cr R 1732; 1 ♂, east of Nakabukari, off Nagai, NSMT-Cr R 600; 1 ♂, Minami Amadaiba, NSMT-Cr R 1406; 1 ♀, SL = 8 west of the Jyoga-shima, HSM Cra 106; 2 ♀, south of the Jyoga-shima, HSM Cra 0062; **Mie-ken**: 2 ♂, off Owase, OMNH Ar. 1881–1882, file no. Z80-02; 1 ♀, off Mie, OMNH Ar. 1946, file no. Z80-02.

Redescription

Shield (Fig. 45A) as long as broad; anterior margins between rostrum and lateral projections concave, anterolateral margins sloping; lateral margins convex; posterior margin truncate; dorsal surface slightly rugose, convex, with scattered tufts of setae; pair of short incisions posterolaterally; rostrum prominent, acute, well-exceeding lateral projections, terminating in spinule; lateral projections broadly triangular, each with small terminal spinule. Accessory portions of shield calcified, unarmed. Branchiostegites not calcified, unarmed, with fringe of setae.

Ocular peduncles (including corneas) (Fig. 45A) 0.50–0.60 length of shield, broader distally and proximally. Corneas dilated. Ocular acicles (Fig. 45A, B) prominent, subovate, terminating acutely, with strong submarginal spine.

Antennular peduncles (Fig. 45A, C) long, when fully extended exceeding ocular peduncles by approximately 0.20–0.40 length of ultimate segment; ultimate segment with long setae dorsally; penultimate segment unarmed; basal segment with ventromesial distal angle acute. Antennal peduncles (Fig. 45A, D, E) moderately long, when fully extended exceeding ocular peduncles by approximately 0.60–0.80 length of ultimate segments; with supernumerary segmentation; fifth segment with row of setae ventrolaterally and mesially; fourth segment with few scattered setae; third segment with strong spine at ventrodial angle; second segment with dorsolateral distal angle produced, terminating in strong spine, mesial and lateral margins with few scattered setae, dorsomesial distal angle with acute spine; first segment with strong spine on ventrodial mesial margin. Antennal acicle (Fig. 45D) long, unarmed, arcuate, terminating bluntly; dorsomesial margin with row of moderately long setae. Antennal flagella (Fig. 45F) long, 7–8 times length of shield, comprised of about 150–180 articles, each with very short setae distolaterally and distomesially; articles much longer distally.

Mandible (Fig. 45H) without distinguishing characters. Maxillule (Fig. 45I, J) with endopod bearing moderately well developed external lobe; internal lobe with one apical bristle accompanied ventrally by one long seta. Maxilla (Fig. 45K) with very broad scaphognathite. First (Fig. 45L) and second (Fig. 45M) maxillipeds without distinguishing characters.

Third maxilliped (Fig. 45N) with merus and carpus each with acute dorsodistal spine; ischium (Fig. 45O) with well developed crista dentata, composed of 12–16 strong corneous teeth and with strong accessory tooth; basis (Fig. 45O) with one or two acute, corneous-tipped teeth.

Sternite of third maxillipeds unarmed, with long setae on either side of midline.

Right cheliped (Fig. 46A–D) very stout. Dactyl 0.90–1.00 length of palm; compressed dorsoventrally, terminating in corneous claw; dorsal face flat, with row of acute spines mesially and with dense tufts of long setae, dorsomesial margin armed with row of strong spines; cutting edge with calcareous teeth of various sizes medially and proximally and with evenly sized tiny corneous teeth distally; ventral face smooth, with tufts of setae mesially and laterally. Fixed finger with dorsal surface flat, with dense tufts of long setae; terminating in small corneous claw; cutting edge with variously sized calcareous teeth along entire length and interspersed with few short corneous teeth distally. Palm approximately as long as carpus; dorsal surface slightly convex, covered with dense tufts of long setae and with numerous small spines mesially, dorsolateral margin of palm and fixed finger armed with very strong spines and setae, dorsomesial margin with irregular row of spines; ventral surface strongly convex, generally smooth, spinulose mesially. Carpus 0.75–0.90 length of merus; trapezoidal in

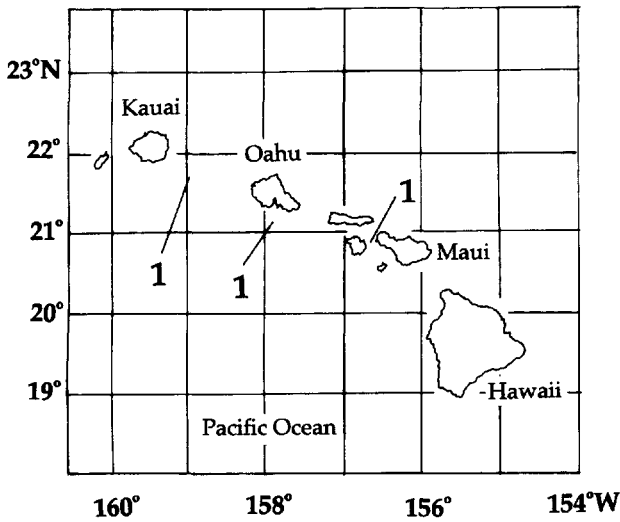


Fig. 49. Geographical distribution of *Hemipagurus* in Hawaii. 1: *H. granulatus* (Edmondson), comb. nov.

mesial view; dorsal surface covered with spines or spinulose tubercles and dense tufts of long setae, spines larger laterally, sometimes with additional longitudinal row of acute spines mesially, dorsomesial margin armed with very strong spines, dorsodistal margin with few widely spaced tiny spines; ventral face strongly convex, generally smooth but with tubercles mesially, ventrolateral and ventromesial distal margins armed with several strong spines. Merus with dorsal and dorsolateral surfaces bearing low, transverse spinulose or multidenticulate protuberances and tufts of long setae, dorsodistal margin armed with several widely spaced strong spines; ventral surface covered with numerous conical spines and dense short setae, spines larger laterally, ventrolateral margin armed distally with very strong spines, ventromesial margins with few small spines distally. Ischium with tiny spinules on ventromesial face medially and ventrolateral face distally.

Left cheliped (Fig. 46E-H) 0.80–0.90 length of right, very slender; palm, carpus and merus 0.40–0.50, 0.50–0.60, 0.45–0.55 maximum widths respectively, of those of right. Dactyl long, 1.75–1.80 length of palm, terminating in strong corneous claw; dorsal face covered with dense tufts of long setae and with scattered tubercles proximally; mesial margin unarmed; entire cutting edge with evenly sized acute corneous teeth. Fixed finger terminating in strong corneous claw; dorsal surface slightly convex, with dense tufts of long setae; cutting edge with widely spaced calcareous teeth interspersed with several corneous teeth. Palm short, 0.60–0.70 length of carpus; dorsal face covered with dense tufts of long setae and with scattered tubercles

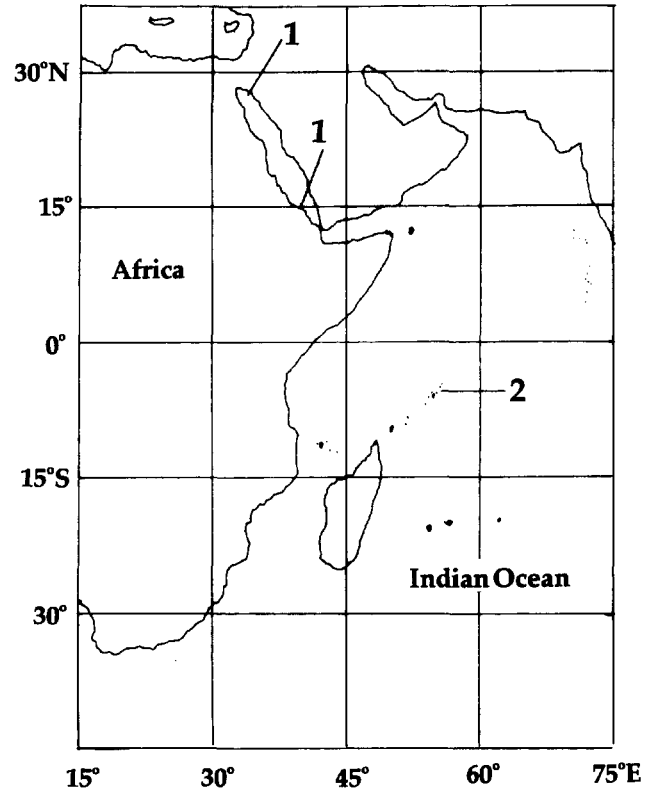


Fig. 50. Geographical distribution of *Hemipagurus* in the Western Indian Ocean and Red Sea. 1: *H. lewinoehni*, sp. nov. 2: *H. maclaughlinae*, sp. nov.

mesially, dorsolateral margin with few irregular rows of small tubercles, distal margin armed with few widely spaced spines. Carpus 0.70–0.80 length of merus; dorsal surface flat, with scattered tubercles and dense tufts of long setae, dorsolateral margin with row of strong spines, dorsomesial margin with row of spiniform tubercles; lateral surface covered dorsally with low, spinulose or multidenticulate protuberances accompanied with long setae. Merus long; dorsal and ventral faces covered with transverse low, spinulose or multidenticulate protuberances, accompanied by long setae on dorsal face; ventrolateral margin with few very strong spines distally. Ischium with row of small spines on ventromesial margin and tiny spinules on ventrolateral face.

Second pereopods (Fig. 47) morphologically dissimilar from left to right. Dactyls long, 1.55–1.65 (left) (Fig. 47B-E) or 1.30–1.60 (right) (Fig. 47K-L) length of propodi, each terminating in strong corneous claw; strongly twisted in dorsal view; each with distal half of dorsal face bearing distinct row of very long setae traversing from mesial face proximally to lateral face distally, setae shorter proximally; mesial faces strongly concave distally; lateral faces convex distally; ventral

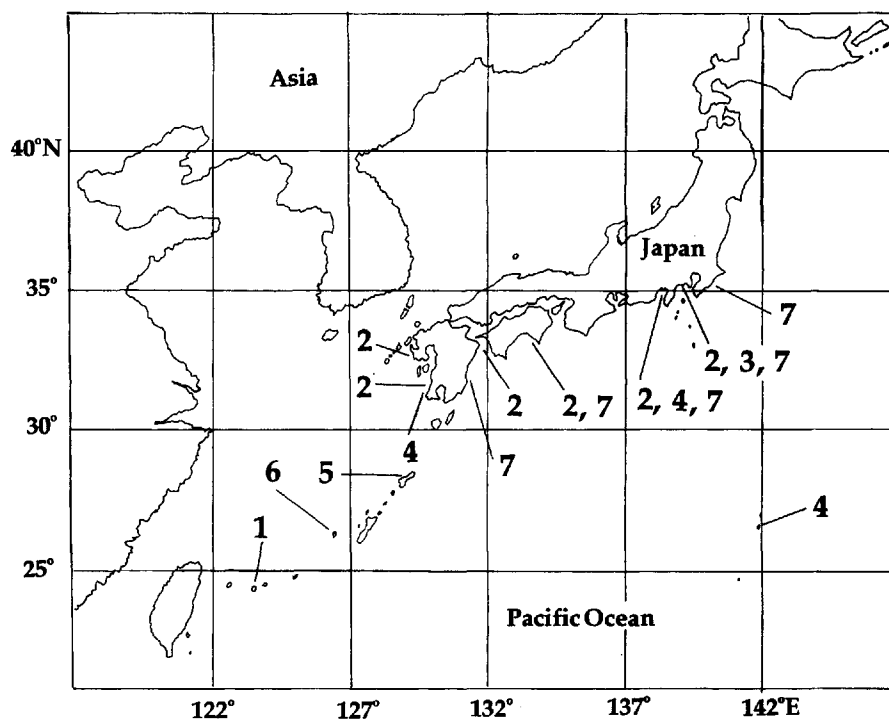


Fig. 51. Geographical distribution of five species of *Hemipagurus*, *Catapagurus tuberculatus* and *Parapagurodes doederleini* in Japanese and adjacent waters. 1: *H. kosugei*, sp. nov. 2: *H. japonicus* (Yokoya), comb. nov. 3: *H. imperialis*, sp. nov. 4: *H. hirayamai*, sp. nov. 5: *H. toyoshioae*, sp. nov. 6: *Catapagurus tuberculatus*. 7: *Parapagurodes doederleini*.

margin of left (Fig. 47B–E) with row of 40–60 strong corneous spines, spines longer distally; ventral margin of right (Fig. 47L) with several short oblique rows of long setae. Propodi long, 1.40–1.50 (left) or 1.90–2.00 (right) length of carpi; dorsal faces (Fig. 47F) each with single or sometimes double rows of spines and, in right, accompanied laterally and mesially by row of short spines, spines more numerous and stouter in right; lateral face of right with short, oblique spinulose or multidenticulate protuberances dorsally; ventromesial distal angles each with acute corneous spine. Carpi 0.50–0.60 (left) or 0.35–0.45 (right) length of meri; dorsal face with row of strong spines; lateral face of right with short, oblique spinulose or multidenticulate protuberances. Meri with ventral faces (Fig. 47I) bearing scattered strong spines, ventrolateral margins each with row of strong spines distally, ventrolateral distal angles each with one or two strong spines, ventromesial distal angles (Fig. 47H) unarmed; dorsal faces (Fig. 47G) with low, transverse spinulose or multidenticulate protuberances accompanied anteriorly by long setae. Ischia each with row of acute spines on ventromesial margin (Fig. 47H).

Third pereopods morphologically similar to second right, but dactyls appreciably longer, 1.55–1.65 length of propodi;

armatures of propodi, carpi and meri much weaker than those in second right; ischia unarmed.

Fourth pereopods (Fig. 45R, S) subchelate; dactyl terminating in strong corneous claw, with short row of corneous teeth along ventral margin laterally, no preungual process; propodal rasp composed of three or four irregular rows of strong corneous scales, scales sharp proximally and blunt-tipped distally; carpus with dorsodistal angle bearing blunt-tipped spine mesially. Fifth pereopods (Fig. 45T) chelate; rasper of dactyls composed of one or two irregular rows of corneous scales; propodal rasp well-developed. Male with short sexual tube directed anteriorly on right coxa (Fig. 45P, Q); gonopore of left coxa with vas deferens slightly protruding or not (Fig. 45P).

Sternite of second pereopods (Fig. 45P) narrow; subdivided into two lobes by deep longitudinal median groove. Sternite of third pereopods (Fig. 45P) with anterior lobe rectangular, large; perpendicular posterior plate very broad, with setae anteriorly; subdivided into two lobes by longitudinal shallow median groove. Sternite of fourth pereopods (Fig. 45P) as transverse rod, with setae anteriorly. Sternite of fifth pereopods (Fig. 45P) reduced to very narrow transverse rod with pair of round projections on anterior

margin, with setae anteriorly and laterally; widely separated from preceding sternal plates.

Abdomen large, dextrally twisted; with well-developed fleshy protuberance anteriorly on ventral portion. Male with third to fifth pleopods (Fig. 46I–K) each with very elongate endopod fringed with long finely-plumose setae and short exopod with setae laterally. Female with second to fifth pleopods (Fig. 46L–O); second to fourth pleopods each with both endopod and exopod elongate, with tufts of long setae; fifth with elongate endopod and short exopod fringed with fine setae. Tergite of first abdominal somite small, somewhat calcified; sixth well calcified, subrectangular, unarmed, indistinctly divided into anterior and posterior lobes by shallow transverse groove, pair of short curved rows of setae on anterior lobes.

Uropods strongly asymmetrical, left (Fig. 46P) distinctly larger than right (Fig. 46Q); raps of exopods and endopods well developed; protopods unarmed.

Telson (Fig. 45U) asymmetrical, left larger than right, with lateral constriction; posterior lobes separated by wide median cleft, posterolateral angles bearing 1–3 (right) or 2–5 (left) strong corneous spines.

Sexual dimorphism

Chelipeds similar in both sexes.

Colouration

Generally yellowish brown or orange; both chelae lighter; dorsal faces of the carpi and propodi of the second and third pereopods whitish. Miyake (1975, 1982) and Baba (1986) depict colour photographs of this species.

Shell

Ginebis argenteonitens (Lischke), *Benthindsia magnifica* (Lischke), *Glossaulax reiniana* (Dunker), *Micantapex luehdorfi* (Lischke) and *Musashia hirasei* (Sowerby).

Distribution

From central Honshu to east coast of Kyushu: Boso Peninsula, Sagami Bay, Suruga Bay, Tosa Bay, and Hyuganada (Fig. 51); sandy-mud or gravel bottoms; 90–400 m.

Affinities

The combination of the dactyl of the left second pereopod with a row of numerous (40–60) corneous spines on the ventral margin (Fig. 47B–D) and the unarmed dactyls (except for the terminal claw) of the right second (Fig. 47K, L) and both the third pereopods set *Parapagurodes doederleini* apart from all the described species of *Parapagurodes*, i.e. *P. makarovi* McLaughlin & Haig, 1973, *P. laurentae* McLaughlin & Haig, 1973, *P. hartae* McLaughlin & Jensen, 1996, *P. gracilipes* (Stimpson, 1858), and *P. nipponensis* (Yokoya, 1933). All of the latter species have morphologically similar dactyls in the second and third pereopods.

Remarks

Since Doflein's (1902) original description, all of the subsequent references to the species have retained it in *Catapagurus*. However as mentioned before, *Parapagurodes* greatly differs from *Catapagurus* and also *Hemipagurus* in having a strong submarginal spine on each ocular acicle, the very stout chelipeds and ambulatory legs, and the very short right sexual tube in males. In both *Catapagurus* and *Hemipagurus*, submarginal spines are absent on ocular acicles, chelipeds and ambulatory legs are slender and the male sexual tube is elongate.

I have confirmed the accurate identification of the specimens assigned to *Catapagurus doederleini* by Miyake (1978) from the Sagami Bay (NSMT-Cr R 600, 1406, 1732) and by Miyake and Imafuku (1980) from the Kii Peninsula (OMNH Ar. 1881, 1882, 1946).

Miyake (1960) provided an illustration and a brief diagnosis of *C. doederleini*, and later Miyake (1975) depicted an excellent photograph of this species accompanied by a very short explanation. Miyake (1982) and Baba (1986) provided brief descriptions for this species with clear colour photographs. Although the whereabouts of these specimens depicted are unknown, precluding their examination, it is clear that they are *Parapagurodes doederleini*.

Discussion

The present study reveals that *Hemipagurus* is a predominantly warm temperate and tropical water genus. All of the *ensifer*-group species were collected from tropical waters, i.e. *H. kosugei* and *H. albatrossae* from the tropical west Pacific, *H. ensifer* and *H. maclaughlinae* from the Indian Ocean, *H. haigae* and *H. alcocki* from both the Indian and west Pacific Oceans, *H. granulatus* from Hawaii in the central Pacific and *H. lewinsohni* from the Red Sea (Figs 48–51).

The Sagami Bay of Japan appears to be the northern limit of the range of the genus. In the *japonicus*-group, *H. japonicus* is distributed from Sagami Bay to Kyushu, and it is the only exclusively warm temperate representative of the genus in the Indo-West Pacific and is almost certainly endemic to Japan (Fig. 51). Although *H. imperialis* is also found only in Sagami Bay, there is insufficient material to make a firm conclusion concerning its distribution. The Sagami Bay experiences warmer water temperatures than is to be expected at this latitude due to the influence of the large oceanic current, Kuroshio. The Kuroshio is the northern extension of the North Equatorial Current and transfers warm seawaters from tropical areas to central Japan. Of the other species of the *japonicus*-group, *H. toyoshioae*, *H. holthuisi*, *H. oculocrassus* and *H. tanimbarensis* were collected from the tropical west Pacific, and *H. hirayamai* was recorded from warm temperate to tropical Japan (Fig. 51).

The distribution area of each species of *Hemipagurus* is rather restricted. Some of these species may be endemic to the locality that the species was collected, such as *H. granulatus* from Hawaii (Fig. 49) and *H. lewinoehni* from the Red Sea (Fig. 50). But in other cases, this probably reflects the low sampling intensity and difficulties in collecting such tiny species from considerable depths.

The ecology of *Hemipagurus* is largely unknown. Although habitats of all species have not been recorded, they probably prefer a soft bottom. According to Haig and Ball (1988), *Hemipagurus* (as *Catapagurus*) was a leaper crab, found on a sandy bottom. All of the species of *Hemipagurus* have laterally flattened dactyls of the ambulatory pereopods, which may be considered to have an adaptive significance for digging in sandy or muddy habitats. No information is available on how males use their extremely long sexual tubes when they copulate.

The only Indo-West Pacific representative of *Catapagurus*, *C. tuberculatus*, is known only from Okinawa, Japan (Fig. 51).

The genus *Parapagurodes* currently consists of three east and three west Pacific species, all distributed in temperate waters. From the east Pacific, two deep-water California species, *P. makarovi* and *P. laurentae* and one British Columbia species, *P. hartae* are known. All three west Pacific species are recorded around Japanese waters, i.e. *P. gracilipes* from northern Japan and Russian Far East (Komai 1998), *P. nipponensis* from the Pacific coast of central through south-western Japan to Taiwan (Komai 1998), and *P. doederleini* from central to southern Japan (Fig. 51). The geographical distributions of *P. gracilipes* and *P. nipponensis* are separated for the most part, but those of *P. nipponensis* and *P. doederleini* overlap extensively. The recorded depth ranges of these two species also overlap: *P. nipponensis* from 30 to 300 m and *P. doederleini* from 90 to 400 m.

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