Reprinted from: CRUSTACEANA, Vol. 47, Part 2, 1984

LEIDEN
E. J. BRILL

Crustaceana 47 (2) 1984, E. J. Brill, Leiden

A REVIEW OF *PAGURIXUS* (DECAPODA, ANOMURA, PAGURIDAE) AND DESCRIPTIONS OF NEW SPECIES

BY

PATSY A. McLAUGHLIN
Florida International University, Miami, Florida 33199, U.S.A.

and

JANET HAIG
Allan Hancock Foundation, University of Southern California,
Los Angeles, California 90089-0372, U.S.A.

As a result of a study of pagurid and galatheoid specimens collected in the Japanese Bonin Islands, Melin (1939) subdivided the genus *Pagurus* (as *Eupagurus*) into a number of subgenera, among them the new monotypic subgenus *Pagurixus*. Although *Pagurixus* was established for a single male specimen lacking chelipeds, Melin's subgeneric diagnosis was sufficiently adequate to permit subsequent carcinologists to assign several additional species to this taxon (Forest, 1954a, 1956; Dechancé, 1964; Ball & Haig, 1972; Lewinsohn, 1982). Lewinsohn (1969) redescribed *Pagurus boninensis* (Melin) from five specimens collected in the Red Sea, but noted certain differences between his material and Melin's description. Subsequently he (Lewinsohn, 1982) reported this species from Somalia, but reemphasized his earlier remark, that until more and complete specimens could be obtained from the type locality it would not be possible to be completely certain of the identity of *P. boninensis*. A biological expedition to the Bonin (Ogasawara) Islands was undertaken in 1968, and a list of 210 invertebrate species was compiled (Ooishi, 1970). Among the anomurans cited, Ooishi listed and photographed *Pagurixus boninensis*, but gave no description and no reason for the elevation of *Pagurixus* to generic rank, nor its inclusion in the family Diogenidae. In a subsequent key to the pagurids of Japan, Miyake (1978) cited Melin's species again as *Pagurus boninensis*, and extended its range to include Okinawa, Amami-oshima, and Meshima Islands, as well as the Red Sea.

As pointed out by Ball & Haig (1972), all of the species that have been assigned to *Pagurixus*, i.e., *Pagurus anceps* (Forest), *P. boninensis*, *P. laevimanus* (Ortmann), *P. maorus* (Nobili), *P. tweediei* (Forest), *Pagurus* sp. (Dechancé, 1964: 37), *Pagurus* (*Pagurixus*) sp. (Ball & Haig, 1972: 103), and *Pagurus* sp. (Lewinsohn, 1982: 58) are known from one or very few specimens only, and little is known of the group as a whole. From the collections of the Allan

Hancock Foundation, University of Southern California (AHF), Bernice P. Bishop Museum (BPBM), National Museum of Natural History, Smithsonian Institution (USNM), and the Smithsonian Oceanographic Sorting Center (SOSC), we have been able to gather sufficient material to permit us to review the majority of these species and evaluate the characters that have grouped them together. From this review it is clear that there is ample justification for removing the *Pagurixus*-group from *Pagurus* and elevating this taxon to generic rank. A revised description of the genus can now be presented, together with a more complete description of its type species, *P. boninensis* sensu stricto. The specimens upon which this study is based will be returned or deposited in the aforementioned museums, the Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands (RMNH), the Australian Museum, Sydney (AM), and Florida International University (FIU).

This paper is contribution no. 400 from the Allan Hancock Foundation.

Pagurixus Melin, 1939

Pagurixus Melin, 1939:37. Type species by monotypy: *Eupagurus* (*Pagurixus*) *boninensis* Melin, 1939. Gender: Masculine. Founded as a subgenus of *Eupagurus* Brandt, 1851.

Diagnosis. — Eleven pairs of phyllobranch gills. Rostrum triangular, usually well developed and extending beyond bases of ocular acicles. Lateral projections weakly developed or obsolete. Ocular acicles triangular or subtriangular, often with small submarginal spine; separated basally by width of rostrum or approximately basal width of 1 acicle. Ultimate segment of antennular peduncle with 1 to several long setae near dorsodistal margin laterally and often with ventral row(s) of short setae. Third maxilliped with crista dentata moderately well developed and provided with accessory tooth. Maxillule with 1 or 2 bristles on moderately well developed internal endopodal lobe, external lobe produced, not recurved.

Right cheliped exhibiting considerable sexual dimorphism; dorsal surface of chela smooth, granular, tuberculate or spinose; palm often greatly swollen or extremely elongate in large males. Left cheliped with chela subtriangular in cross-section, usually armed with spines or tubercles.

Sternite of 3rd pereopods with anterior lobe subrectangular or subquadrate. Sternite of 5th pereopods produced into 2 prominent circular or ovate components. Fourth pereopods with propodal rasp consisting of single row of corneous scales; dactyl moderately long and subsemicircular in shape, claw short; no preungual process apparent.

Males with coxae of 5th pereopods often slightly asymmetrical; gonopore of right obscured by tuft of moderate to long stiff setae directed toward left. Left gonopore often with encircling short setae. Abdomen with 3 unpaired, biramous pleopods. Females with paired gonopores or single gonopore on coxa of left 3rd pereopod. Abdomen with 4 unpaired, biramous pleopods.

Uropods asymmetrical. Telson with transverse suture; posterior lobes generally symmetrical or nearly so, terminal margins straight, rounded, or oblique, and armed with spines or spinules.

Distribution. — Hawaiian and Philippine Islands, central and western Pacific, Australia, New Zealand, Indian Ocean, and Red Sea; intertidal to 32 meters.

Discussion. — Forest (1956) and Lewinsohn (1969) both have pointed out that in his key to the subgenera of *Eupagurus* Melin (1939:20) cited the number of pleopods in males of *Pagurixus* as four, but in his description specified three unpaired. The latter number is correct.

As noted by Forest (1954a, 1956, 1957), species assigned to *Pagurixus* exhibit marked sexual dimorphism. The right chelae of females often are armed with well developed spines. Small males tend to resemble females in both the shape and armature of the right chelae, although frequently the armature is weaker. With increasing size and, presumably maturity, the male right chela becomes either markedly swollen or appreciably elongate. Usually much of the armature is reduced or lost, and the surfaces of the chelae become smooth, granular, or at best weakly tuberculate. The angle of articulation of the dactyl and palm often changes in these males from straight to strongly oblique, and the dactyl to palm length ratio is greatly altered. The cutting edge of the dactyl also frequently undergoes change, with the corneous teeth being replaced by strong calcareous teeth. There is a slight tendency toward reduction in the strength and number of spines or tubercles in very large females; however, changes in the shape of the chela and proportions of dactyl to palm have not been observed.

De Saint Laurent (1968) was the first to report variability in the female gonopores of species assigned to *Pagurixus*; however, she was not specific in that report. In the few specimens of *P. boninensis* available for study, both gonopores are present. The same condition has been found in *P. jerviensis* n. sp. Although a single gonopore on the left is the most common in *P. anceps*, some individuals have both well developed, and others appear in a transitional state. In these latter females the left gonopore is fully developed; the right is apparent, but considerably reduced in size. Of the three female specimens of *P. laevimanus* examined, the smaller ovigerous specimen had a single left gonopore, whereas the larger non-ovigerous individuals had both left and right gonopores well developed. In *P. festinus* n. sp. only the left is present. Although single left female gonopores have been reported in a few species of the diogenid genus *Paguristes* (Forest, 1954b; De Saint Laurent, 1968) or single right gonopores in some species of *Diogenes* (Tirmizi & Siddiqui, 1982), to our knowledge, *Pagurixus* is the only genus in which intraspecific variation occurs.

In addition to the distinctive tuft of stiff setae covering the gonopore and crossing from right to left on the coxa of the male 5th right pereopod, species in this genus have been characterized by the form of the rostrum, ocular

peduncles and acicles, chelipeds, and ambulatory legs (Dechancé, 1964). However, none of these structures provide diagnostic characters that are unique to *Pagurixus*. As with specimens of the 'provenzanoi' group of *Pagurus* (McLaughlin, 1975; Lemaitre et al., 1982) the configuration of the sternite of the 5th pereopods provides a more reliable diagnostic character, and must be considered when only female species are available.

Species of *Pagurixus* can be divided into two groups by the presence or absence of row(s) of setae on the ventral surface of the ultimate segment of the antennular peduncle. Dechancé (1964), Ball & Haig (1972), and Lewinsohn (1982) each have assigned single female specimens to *Pagurixus*. Neither Dechancé nor Lewinsohn have mentioned ventral setae on the antennular peduncles in their descriptions of their species; therefore, it must be assumed that if these species are correctly assigned to *Pagurixus* they would be part of the latter group. However, neither species is included in this report because the authors' descriptions are not sufficiently diagnostic to assure correct assignment to *Pagurixus*. Ball & Haig's specimen is *P. laevimanus*.

Key to the species of *Pagurixus*

1. Ultimate antennular segment with distinct row(s) of setae on ventral surface 2
— Ultimate antennular segment without distinct row(s) of setae on ventral surface 5
2. Carpus of left cheliped with longitudinal row of spinules on strongly oblique lateral face ventrally ..... *P. maorus*
— Carpus of left cheliped without longitudinal row of spinules on relatively perpendicular lateral face ventrally 3
3. Dactyls of 2nd pereopods with more than 6 corneous spines on ventral margins *P. boninensis*
— Dactyls of 2nd pereopods with 6 or fewer corneous spines on ventral margins 4
4. Ventrolateral margins of meri of 2nd pereopods with 1 acute spine distally ..... *P. tweediei*
— Ventrolateral margins of meri of 2nd pereopods unarmed or spinose..... *P. festinus* n. sp.
5. Dactyls of 2nd pereopods long, moderately slender, ventral margins with 6 to 8 corneous spines..... *P. laevimanus*
— Dactyls of 2nd pereopods short, stout..... 6
6. Ventral margins of dactyls of 2nd pereopods with 5 or 6 corneous spines ..... *P. anceps*
— Ventral margins of dactyls of 2nd pereopods with 7 to 10 corneous spines 7
7. Dactyl of left chela with dorsal row of spines, telson with terminal margins straight, armed with 2-4 strong spines and sometimes few spinules ..... *P. jarviensis* n. sp.
— Dactyl of left chela without dorsal row of spines, telson with terminal margins concave, armed with 5-10 fine small spines ..... *P. hectori*

Pagurixus boninensis (Melin, 1939) (fig. 1)

Eupagurus (*Pagurixus*) *boninensis* Melin, 1939:38, figs. 16-19 [type locality: Takinoura, Bonin (Ogasawara) Islands]. — Forest, 1954a:73; 1956:52; 1957:1068 (by implication).
Pagurus (*Pagurixus*) *boninensis*: Gordan, 1956:327. — Dechancé, 1964:38. — Ball & Haig, 1972: 103 (by implication).
Pagurixus boninensis: Ooishi, 1970:90, pl. 12 fig. 13.
Pagurus boninensis: Miyake, 1978:79 (in part, see discussion).
not *Pagurus boninensis*: Lewinsohn, 1969:64, fig. 11; 1982:58 [= *Pagurixus anceps* (Forest)].

Material. — 1♂, 1♀ (SL = 1.8, 2.2 mm), Dunidu Island, Male Atoll, Maldive Islands, 19 April 1964, 0.6 m, coll. J. S. Garth, USNM. 1♂, 1♀ (SL = 2.0, 2.6 mm), Medren Island, Enewetak Atoll, Marshall Islands, 25 February 1957, 2.4 m, coll. A. H. Banner, AHF.

Diagnosis. — Shield approximately as long as broad in males, longer than broad in females. Rostrum well developed, acutely triangular, reaching beyond bases of ocular acicles, with or without terminal spinule. Lateral projections obtusely triangular, with or without marginal or submarginal spine. Ocular peduncles moderately short and stout in males, slightly longer and more slender in females; ocular acicles subtriangular, with small submarginal spine; separated basally by rostrum or slightly less than basal width of 1 acicle. Antennular peduncles with several long setae at dorsolateral distal angle of ultimate segment, ventral surfaces each with 2 rows of equidistantly spaced tufts of moderately short setae in males, or ventromesial row of closely spaced, fine short setae in females. Right cheliped of males with dactyl shorter than palm and usually set at angle of approximately 45°; dactyl and fixed finger strongly sloping ventrally; surfaces of dactyl, fixed finger and palm granular or weakly tuberculate. Palm considerably longer than carpus, dorsal surface

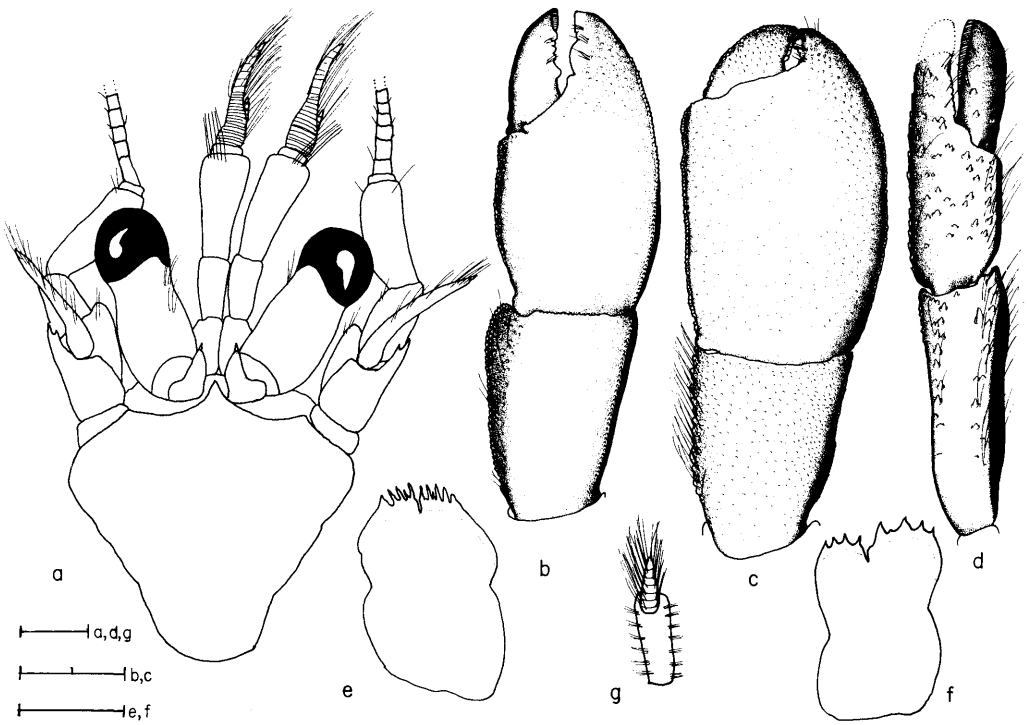

Fig. 1. *Pagurixus boninensis* (Melin). a, shield and cephalic appendages; b, right chela and carpus of female; c, right chela and carpus of male; d, left chela and carpus of male; e, telson of female; f, telson of male; g, ultimate antennular segment of male in ventral view. Scales equal 0.5 mm, a, d, e-g; and 1.0 mm, b, c.

strongly convex, dorsomesial and dorsolateral margins not delimited. Carpus moderately short and broad, approximately equalling merus in length, all surfaces granular, granules strongest on mesial face and accompanied by long setae, dorsolateral margin not delimited. Merus with 1 to several spines or spinules on ventromesial and ventrolateral margins distally, mesial face with scattered long setae, dorsal margin sometimes with low protuberances. Right cheliped of female differing from male in proportions and strength of armature. Dactyl not appreciably shorter than palm, and not set at angle; palm and carpus approximately equal in length, dorsolateral margins of fixed finger, palm and carpus each delimited by row of closely-spaced granules. Merus longer than carpus, dorsal margin with spinulose protuberances or spine at distal margin, ventromesial and ventrolateral margins tuberculate or spinulose. Left cheliped with dactyl and fixed finger spoon-shaped; dactyl somewhat longer than palm, dorsal surface with few low protuberances and long setae. Palm slightly less than half length of carpus, dorsal midline slightly elevated and armed with irregular double row of small spinules or tubercles, extending onto fixed finger as weak single row; dorsomesial surface not appreciably depressed, armed with 2 or 3 irregular rows of low spinules or tubercles, dorsolateral surface strongly sloping, slightly granular, dorsolateral margin weakly tuberculate. Carpus approximately as long as merus, dorsal surface with mesial and lateral margins each with row of small spines or spinules, mesial and lateral faces slightly granular, particularly ventrally. Merus with ventrolateral margin spinulose or tuberculate, at least distally, ventromesial margin crenulate. Second and 3rd pereopods generally similar. Dactyls almost as long as propodi, terminating in strong corneous claws; ventral margins each with row of 7 to 10 corneous spines. Propodi with scattered long setae on dorsal surfaces, ventral margins each with row of small corneous spines and stronger pair at distal margin. Carpi each with small spine at dorsodistal margin. Meri of 2nd pereopods with low protuberances on dorsal surfaces, ventral margins minutely spinulose; meri of 3rd pereopods unarmed. Sternite of 3rd pereopods with anterior lobe subrectangular. Females with paired gonopores. Telson with terminal margins generally straight, armed with 4 or 5 moderately strong spines.

Distribution. — Marshall, Ogasawara, and Maldive Islands; to 2.4 meters.

Discussion. — Although Melin's (1939) diagnoses of *Pagurixus* and *P. boninensis* were relatively detailed, the fact that his solitary male specimen lacked both chelipeds has made recognition of his species difficult. Lewinsohn (1969) redescribed what he believed to be *P. boninensis* from the Red Sea, but noted certain differences between his material and Melin's description. The most significant of these differences was the absence of rows of tufts of setae on the ventral margins of the ultimate antennular segments. Subsequently he (Lewinsohn, 1982) recognized the similarity between his Red Sea and Somalia specimens and Forest's *P. anceps*, and remarked that this latter species might prove to be a synonym of *P. boninensis*. Although we have not examined

Lewinsohn's material, his description agrees with our specimen from the Red Sea and with our extensive collections of *P. anceps*. The specimens that we have interpreted as *P. boninensis* sensu stricto, while not from the type locality, do agree in all respects with Melin's description. *P. boninensis* is one of the largest species of *Pagurixus* known, and the tufts of setae on the ventral margins of the ultimate antennular segments of the males are more easily observed than in any of the other species of this group.

Apparently Ooishi (1970) collected *P. boninensis* s.s. during the Bonin (Ogasawara) Islands expedition of 1968; however, it is impossible to discern any diagnostic characters from her photograph. Miyake (1978) extended the range of *P. boninensis* to three islands of the Ryukyu group, but gave no further information. It is probable, that in accepting Lewinsohn's (1969) interpretation of *P. boninensis*, Miyake actually was reporting *P. anceps* from Okinawa, Amami-oshima, and Meshima Islands.

Pagurixus maorus (Nobili, 1906) (fig. 2)

Eupagurus maorus Nobili, 1906:259 (type locality: Rikitea, Mangareva, Gambier Islands); 1907:371, pl. 1 fig. 9. — Forest, 1954a:73; 1956:52; 1957:1068.
Pagurus maorus: Gordan, 1956:331.
Pagurus (*Pagurixus*) *maorus*: Dechancé, 1964:37. — Ball & Haig, 1972:103. — Lewinsohn, 1982: 58 (by implication).

Material. — 1 ♀ (SL = 1.7 mm), NW side outer reef, Rojoa Island, Enewetak Atoll, Marshall Islands, 28 July 1966, coll. J. W. Knudsen, AHF. 1 ♂, 1 ♀ (SL = 2.3, 2.7 mm), Aniyaanii Island, Enewetak Atoll, 20 August 1966, coll. J. W. Knudsen, AHF. 1 ♀ (SL = 2.5 mm), between Piiraai and Runit Islands, Enewetak Atoll, 27 July 1967, coll. J. W. Knudsen, RMNH. 1 ♀ (SL = 2.5 mm), Enewetak Atoll 11°26′N 162°17.5′E, 24 August 1968, 32 m, coll. J. W. Knudsen, AHF.

Diagnosis. — Shield approximately as broad as long. Rostrum elongate, triangular, terminating acutely. Lateral projections obtusely triangular, with marginal or submarginal spine. Ocular peduncles short, stout, dorsomesial face with row of widely-spaced tufts of setae; ocular acicles broadly triangular, terminating subacutely and with small submarginal spine; separated basally by basal width of 1 acicle. Antennular peduncles with several long setae at dorsolateral distal angle of ultimate segment, ventral surface with 2 rows of setae in both sexes. Right cheliped of male very elongate; dactyl and fixed finger spoon-shaped. Dactyl short, approximately one-third length of palm; dorsal surface convex, granular, dorsomesial margin not distinctly delimited, ventromesial margin serrate or minutely tuberculate, mesial and ventral surfaces granular, and ventral surface with long setae. Palm longer than carpus; dorsomesial margin not delimited, dorsal surface of palm and fixed finger granular or tuberculate, dorsolateral margin with row of small granules; mesial and ventral surfaces granular or tuberculate, and ventral surface with long setae. Carpus with few spines on dorsomesial margin, dorsolateral margin with row of small granules or tubercles, dorsal surface and mesial, lateral and ventral

faces granular. Merus with row of transverse low protuberances on dorsal margin; ventral, lateral, and mesial faces granular, ventromesial and ventrolateral margins each with row of acute spines distally. Right cheliped of female with dactyl approximately equalling palm in length; dorsal surface elevated in midline and armed with row of small spines or spinules, dorsomesial margin with row of small spines. Palm somewhat shorter than carpus; dorsomesial margin not delimited, dorsal surface of palm and fixed finger with scattered small spines, strongest in midline, dorsolateral margin with row of small spines, mesial and ventral faces tuberculate. Carpus with several spines on dorsomesial margin, dorsal surface with scattered spines, mesial, lateral, and ventral surfaces tuberculate. Left cheliped with dactyl equal to or slightly longer than palm; dorsal surface with minutely spinulose median crest proximally. Palm approximately one-half length of carpus; elevated in midline to form spinose (male) or granular (female) crest, extending onto fixed finger as row of small spines or low protuberances, dorsolateral margin with row of

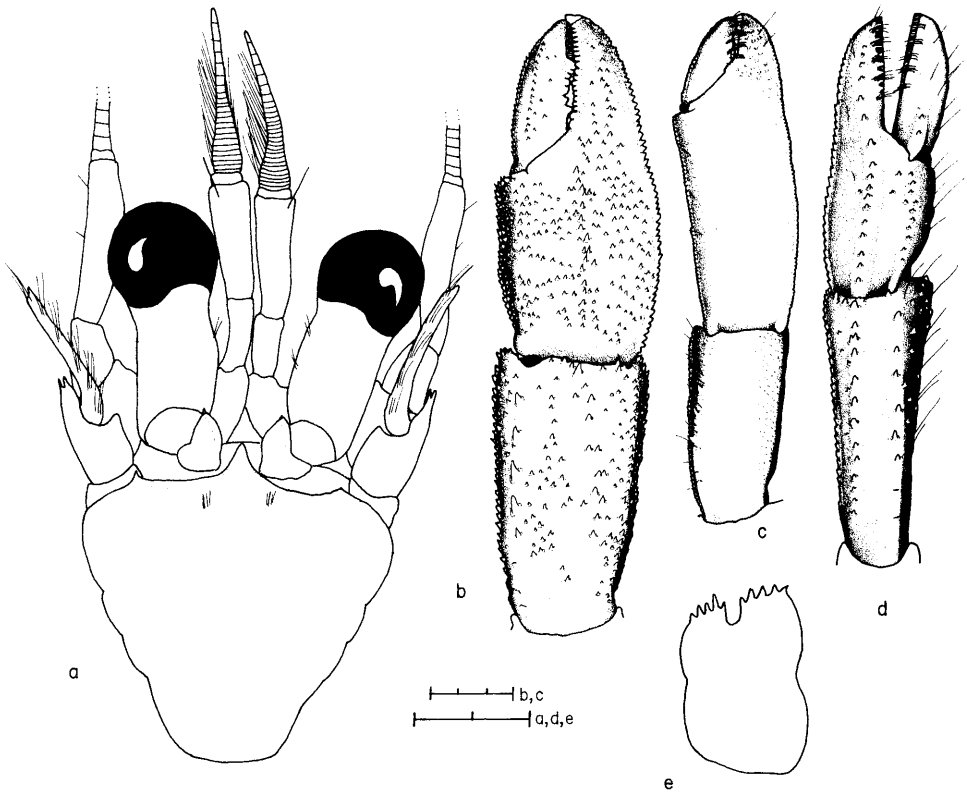

Fig. 2. *Pagurixus maorus* (Nobili). a, shield and cephalic appendages; b, right chela and carpus of female; c, right chela and carpus of male; d, left chela and carpus of male; e, telson. Scales equal 3.0 mm, b, c; and 1.0 mm, a, d, e.

small spines or tubercles, dorsal surface granular and with single or double row of small spinules or tubercles mesially; ventral surface with granules or tubercles and long setae, more pronounced in males. Carpus approximately equalling length of merus; dorsomesial and dorsolateral margins each with row of spines or spinules, latter row appearing as continuation of median crest of palm; lateral face strongly sloping, particularly distally, and armed with longitudinal row of spines or spinules; ventral and mesial faces granular. Merus with low protuberances or granules on dorsal margin; ventral margins spinulose or tuberculate, ventral surface with tubercles and tufts of long setae, more pronounced in males. Second and 3rd pereopods with dactyls equalling or slightly longer than propodi; ventral margins each with row of 6 to 9 strong corneous spines, mesial faces sometimes also with row of corneous spinules. Propodi with dorsal surfaces often with low protuberances and tufts of setae; ventral surfaces each with row of corneous spinules, at least distally and 1 or 2 stronger spinules at distal angle. Carpi each with dorsodistal spine or spinule, sometimes absent in females. Meri with low protuberances and setae on dorsal and ventral margins. Sternite of 3rd pereopods with anterior lobe subrectangular. Females with paired gonopores. Telson with posterior lobes separated by shallow median cleft; terminal margins almost straight, each armed with 4 or 5 strong spines.

Color (from recently preserved material). — Base color white. Ultimate segment of antennular peduncle with narrow, longitudinal red stripe near dorsolateral and dorsomesial margins. Ultimate segment of antennal peduncle with each margin edged in red; flagella banded red and white. Right chela orange, dactyl white; lateral and mesial margins and mesial margin of dactyl each with narrow red longitudinal band. Carpus orange, with broad white longitudinal band on dorsal and lateral faces, each of these bands with narrow red stripe centrally. Merus similar to carpus. Ambulatory legs with white base color overlaid with narrow longitudinal red stripes in patterns as follow: merus and carpus with 1 stripe each on dorsal and ventral margins and 4 stripes on lateral face; propodus with 1 stripe each on dorsal and ventral margins and 3 stripes on lateral face; dactyl with 1 stripe each on dorsal and ventral margins and 2 on lateral face. Mesial faces of dactyls and propodi with stripes similar to those on corresponding lateral faces; stripes present, but reduced and incomplete on carpi and meri. Left cheliped with lateral, median, and mesial longitudinal stripes on dorsal surfaces of palm, carpus, and merus; lateral faces with pattern of stripes almost identical to those of ambulatory legs.

Distribution. — Polynesia and Enewetak Atoll, Marshall Islands, to 32 meters.

Discussion. — Forest (1954a) and subsequent authors have cited the date of the description of *P. maorus* as 1907; however, in his 1907 paper, Nobili clearly referred to his 1906 paper for the original description of this species. The 1906 description, although without accompanying illustrations, is an adequate

description under the Rules of Zoological Nomenclature (1964), and therefore, the correct date for this species.

As *P. maorus* was described from a single female specimen and *P. laevimanus* from a single male, and the illustrations and brief descriptions of each bore some resemblance to one another, Forest (1954a, 1956, 1957) suggested that sexual dimorphism might account for the differences between the two species. However, since he had seen only the holotype of *P. maorus*, he refrained from formally synonymizing the taxa. We have been able to examine males and females of both *P. maorus* and *P. laevimanus* and have found them to be distinct and valid species.

P. maorus, like *P. boninensis*, attains a much larger size than most species of *Pagurixus*. *P. maorus* resembles females of *P. boninensis* in the presence of continuous rows of setae on the ventral surfaces of the ultimate antennular segments; however, 2 rows are present in both sexes of *P. maorus* in contrast to the single row in *P. boninensis* females. As previously mentioned, males of *P. boninensis* have 2 rows of equidistantly spaced tufts of setae. Additional characters that distinguish *P. maorus* from the other species of the group bearing ventral antennular setae are the prominent crest on the palm of the left chela and the oblique lateral face of the carpus of the left cheliped, which is armed above its ventral margin by a longitudinal row of small spines or spinules.

Pagurixus festinus new species (fig. 3)

Material. — Holotype: ♂ (SL = 1.7 mm), station 6B, Kaha Point, Oahu, Hawaii (22°22′N 158°08′W), 13 July 1977, 5 m, coll. S. L. Coles, BPBM S.10334. Paratypes: 3♂ (SL = 1.2-1.4 mm), Oahu, coll. C. H. Edmondson, BPBM S4713, S3483. 1♂ (SL = 1.4 mm), Hanauma Bay, Oahu, December 1929, coll. C. H. Edmondson, BPBM S4716. 17♂, 23♀, 11 ovigerous (SL = 1.0-1.6 mm), stations 6B, 7B, C, D, 10C, Kahe Point, Oahu, 6 April 1976-5 August 1977, 2.5-8.0 m, coll. S. L. Coles, AHF 776, BPBM, FIU, RMNH, USNM. 9♂, 1♀ (SL = 1.3-1.8 mm) Kahala, Oahu, January 1930-May 1931, coll. C. H. Edmondson, BPBM S4714, S4715, S3200. 1♂ (SL = 1.3 mm), Kaneohe Bay, Oahu, 20 November 1964, coll. S. Berry. 1♂ (SL = 1.3 mm), north end Kaneohe Bay, Oahu, ESR station 17, 19 March 1961, coll. E. S. Reese, AHF 6141.

Description. — Shield length equalling or exceeding width; anterior margin between rostrum and lateral projections straight or somewhat concave; anterolateral margins sloping or slightly rounded; posterior margin truncate; dorsal surface with few tufts of setae. Rostrum usually well developed, triangular, reaching well beyond bases of ocular acicles, occasionally obtusely triangular and not reaching bases of ocular acicles, distally depressed and terminating in small spine or spinule. Lateral projections obtusely triangular or nearly obsolete, marked by small spine or spinule.

Ocular peduncles short and stout, basally somewhat inflated, corneae dilated in larger individuals; ocular acicles subtriangular, mesial margins often strongly convex, terminating subacutely and with submarginal spine; separated basally by slightly more than basal width of 1 acicle.

Antennular peduncles overreaching ocular peduncles by approximately one-half length of ultimate segment. Ultimate segment with few long setae at dorsolateral distal angle, ventral surface with 2 rows of tufts of short setae. Penultimate segment unarmed. Basal segment with acute spine on dorsolateral margin.

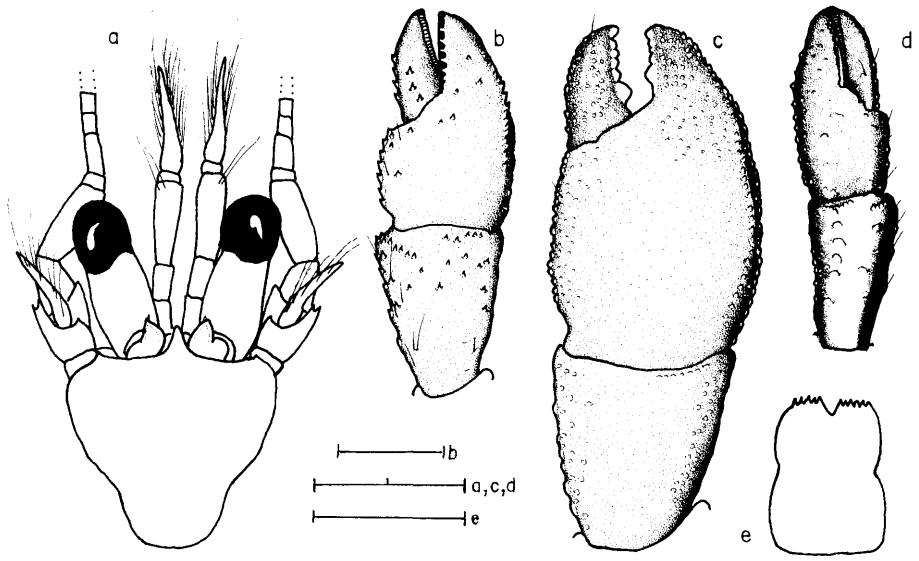

Fig. 3. *Pagurixus festinus* new species. a, shield and cephalic appendages; b, right chela and carpus of female; c, right chela and carpus of male; d, left chela and carpus of male; e, telson. Scales equal 1.0 mm, a, c, d; and 0.5 mm, b, e.

Antennal peduncles moderately short, slightly overreaching ocular peduncles. Fifth and fourth segments with scattered setae. Third segment with small spine and tuft of setae at ventrodistal margin. Second segment with dorsolateral distal angle produced and terminating in strong, acute, usually bifid spine, mesial and lateral margins with few setae; dorsomesial distal angle unarmed or with small spinule, mesial margin with few setae. First segment with ventral margin produced, unarmed. Antennal acicle arcuate, and with dorsal row of setae. Antennal flagella moderately long, each article usually with few to several short setae, and 1 or 2 longer setae every 4 to 8 articles.

Mandible without distinguishing characters. Maxillule with 1 bristle on moderately well developed internal endopodal lobe, external lobe produced, not recurved. Maxilla with scaphognathite moderately slender. First maxilliped with endopod moderately elongate, basal segment of exopod slender. Second maxilliped without distinguishing characters. Third maxilliped with crista dentata moderately well developed, 1 accessory tooth; merus unarmed. Sternite of 3rd maxillipeds with broad median depression, margins armed or unarmed.

Right cheliped of large males markedly stronger than left. Dactyl two-thirds to three-fourths length of palm; cutting edge with row of strong calcareous teeth, and frequently with proximal hiatus between dactyl and fixed finger; surfaces granular to weakly tuberculate, dorsomesial margin not delimited. Palm elongate, exceeding carpus by one-fourth to one-third, swollen; dorsomesial margin not delimited, dorsal surface tuberculate, dorsolateral margin marked by stronger tubercles, particularly on fixed finger; mesial, lateral, and ventral surfaces granular or tuberculate. Carpus moderately long, approximately equal to length of merus; dorsal, lateral, mesial, and ventral surfaces all covered with low tubercles, strongest near weakly delimited dorsomesial margin. Merus subtriangular, dorsal margin frequently with row of low protuberances; ventrolateral and ventromesial margins spinulose or tuberculate, latter also with row of long setae, often forming tuft proximally, ventral surface tuberculate. Ischium with row of granules or very small tubercles and few setae on ventromesial margin.

Right cheliped of females and small males with dactyl equalling or slightly longer than palm; cutting edge with row of corneous teeth; dorsal surface slightly elevated in midline and armed with row of small tubercles; dorsomesial margin with row of blunt spines. Palm two-thirds to three-fourths length of carpus; dorsomesial margin with row of tubercles or blunt spines, dorsolateral margin with row of prominent tubercles, dorsal surface with scattered tubercles, 1 row of moderately strong spines near mesial margin, and 2 rows of spines or spinulose tubercles in midline, all becoming obsolete with increasing size; mesial, lateral, and ventral surfaces tuberculate or granular. Carpus approximately equalling length of merus, dorsal surface with 2 or 3 irregular rows of blunt spines, simple or bifid tubercles, or low protuberances; dorsomesial margin with few low protuberances and stiff, moderately long setae.

Left cheliped with dactyl and fixed finger spoon-shaped. Dactyl usually longer than palm, dorsal surface slightly elevated in midline, minutely granular; cutting edge with row of corneous teeth. Palm two-thirds to three-fourths length of carpus; dorsal midline somewhat elevated and armed with irregular row of tubercles or blunt spines, tending to become obsolete in larger individuals, dorsomesial margin not depressed, usually armed with irregular row of tubercles or blunt spines, dorsolateral surface strongly sloping, usually armed with 2 widely-spaced rows of low tubercles, becoming obsolete on fixed finger, dorsolateral margin with row of tubercles or blunt spines. Carpus slightly shorter than merus; dorsal surface with mesial and lateral row of spines or spinulose tubercles, strongest mesially; mesial, lateral, and ventral surfaces with scattered tubercles, and frequently also appearing granular. Merus with 1 to several acute spines on ventrolateral margin, ventromesial margin unarmed or with row of low tubercles, ventral surface weakly tuberculate and with scattered long setae. Ischium unarmed or with row of low tubercles on ventral margin.

Right 2nd and 3rd pereopods longer than left in large males, approximately equal in smaller males and females. Dactyls of 2nd pereopods shorter than propodi, dactyls of 3rd slightly shorter to slightly longer than propodi; ventral margins each with row of 3 to 5 strong corneous spines. Propodi with few scattered setae on dorsal surfaces, ventral margins each with widely-spaced corneous spinules, strongest distally. Carpi each with spine at dorsodistal margin, 2nd right sometimes also with few spinules or spinulose protuberances on dorsal margin. Meri with ventral margins unarmed, or with row of spinules or spines (2nd right); dorsal surfaces with scattered setae. Ischia unarmed. Sternite of 3rd pereopods with anterior lobe subrectangular.

Females with single left gonopore.

Telson with posterior lobes separated by moderately deep median cleft; terminal margins generally rounded, each with 4 to 6 small spines.

Distribution. — At present known only from Hawaii; to 8 meters.

Discussion. — This species has been recognized, but has remained undescribed, for many years. As early as 1929, Charles Edmondson collected it, but identified it only as *Eupagurus* sp., with the notation that it might be new. Brian Hazlett collected it, along with several other undescribed shallow-water hermit crabs, in the late 1960's and sent the collection to the Muséum National d'Histoire Naturelle, Paris, where J. Forest and M. de Saint Laurent confirmed that it was an undescribed species of the *Pagurixus* group (M. de Saint Laurent, pers. comm.). Through his studies of hermit crab behavior, Ernst Reese became familiar with this species and typified its behavior with the code-name "fast crab". Subsequently this species appeared in relatively large numbers in collections made for an environmental survey for the Hawaiian Electric Company, Oahu. One of us (PMcL) served as a consultant in that survey.

In general morphology, particularly in the changes observed in the male right cheliped, *P. festinus* most closely resembles *P. anceps*. However, the presence of 2 rows of tufts of setae on the ventral surface of the ultimate antennular segment in *P. festinus* immediately distinguishes this species from *P. anceps*. Of the four species with row(s) of setae on the ultimate antennular segment, the armature of the left chelipeds of *P. boninensis* and *P. maorus* will distinguish these species from *P. festinus*. Both *P. boninensis* and *P. maorus* also reach much larger size. *P. tweediei* was described by Forest (1956) from only two males and one female. We have a single male specimen that we believe to be referrable to Forest's taxon, and it, like the syntypes described, differs from *P. festinus* in the armature of the chelipeds and in the presence of a spine on the distolateral margins of the meri of the 2nd pereopods. In view of the fact that Forest did not mention the absence of the right gonopore in his female of *P. tweediei*, we assume that this species at least sometimes has paired gonopores. At present, *P. festinus* females are known to have only the left gonopore developed.

Etymology. — In naming this species, we have taken the liberty of capitalizing on Ernst Reese's observations; *festinus* is a Latin adjective meaning rapidly moving, quick, or speedy.

Pagurixus cf. **tweediei** (Forest, 1956) (fig. 4)

Eupagurus (*Pagurixus*) *tweediei* Forest, 1956:50, pl. 4 figs. 1-8 (type locality: Cocos-Keeling Islands) (by implication).

Pagurus (*Pagurixus*) *tweediei*: Dechancé, 1964:38. — Ball & Haig, 1972:103. — Lewinsohn, 1982:58 (by implication).

Material. — 1♂ (SL = 1.4 mm), station SP-32-2, Philippine Islands 10°09′16″N 118°45′51″E, 10 July 1978, 9-15 m, coll. SOSC, USNM.

Diagnosis. — Shield slightly longer than broad. Rostrum well developed, triangular, terminating in small spine. Lateral projections broadly triangular but weakly developed, with submarginal spinule. Ocular peduncles short,

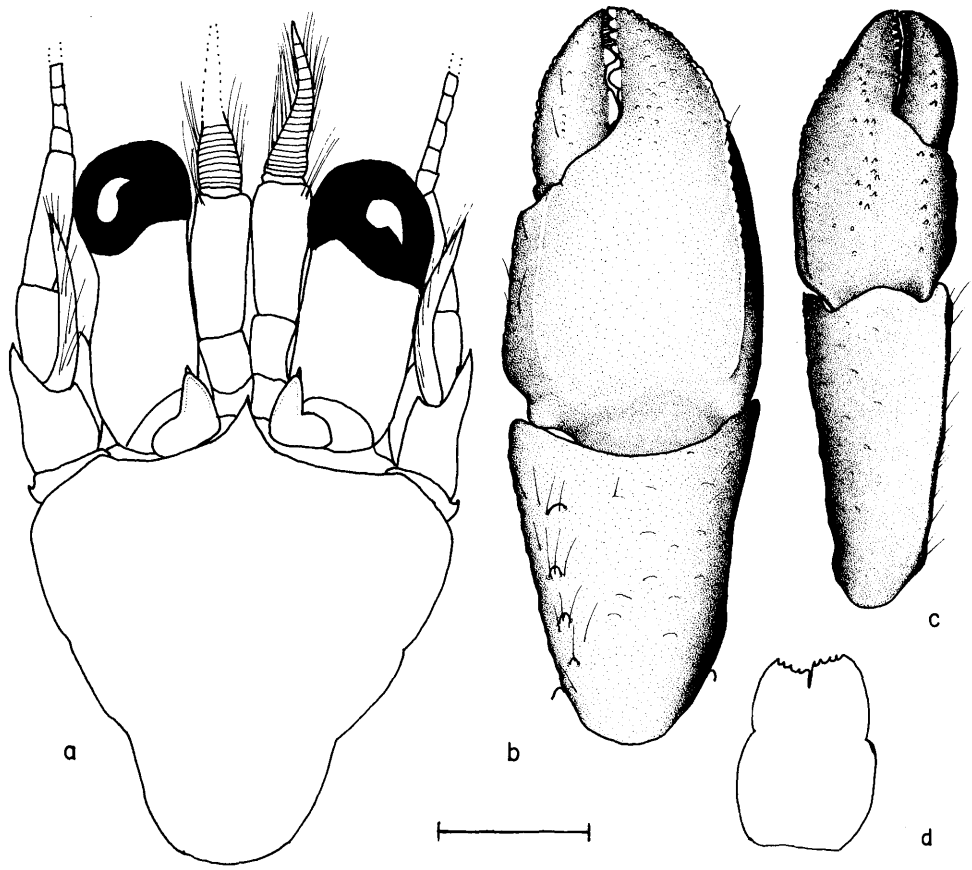

Fig. 4. *Pagurixus* cf. *tweediei* (Forest). a, shield and cephalic appendages; b, right chela and carpus of male; c, left chela and carpus of male; d, telson. Scale equals 0.5 mm.

stout, with corneae slightly dilated; ocular acicles ovately triangular, separated basally by slightly more than basal width of 1 acicle. Antennular peduncles with tuft of long setae on dorsodistal angle of ultimate segment, ventral surface with row of setae. Right cheliped with dactyl elevated in midline, dorsomesial margin crenulate. Palm with dorsomesial and dorsolateral margins weakly crenulate, dorsal surface granular and with mesial and median rows of somewhat stronger granules. Carpus with tuberculate dorsal surface. Merus with 1 prominent and 2 smaller spines on ventrolateral margin distally. Left cheliped with few low protuberances on dorsomesial margin of dactyl. Palm with dorsomesial margin not depressed, armed with row of low tubercles, dorsal midline with row of weak tubercles, extending onto fixed finger; dorsolateral margin crenulate. Carpus with dorsomesial and dorsolateral row of spinulose tubercles, surfaces granular, ventral surface with low protuberances and long setae. Merus with row of spines on ventrolateral margin distally. Dactyls of 2nd and 3rd pereopods shorter than propodi; ventral margins each with row of corneous spines, 5 or 6 on 2nd, 7 on 3rd. Propodi each with row of corneous spinules, strongest distally. Carpi each with small spine at dorsodistal margin. Ventral margins of meri of 2nd pereopods with low protuberances and acute spine on ventrolateral margin distally. Meri of 3rd pereopods unarmed. Sternite of 3rd pereopods subrectangular. Telson with posterior lobes separated by moderately deep median cleft; terminal margins somewhat oblique, each with 4 very small spinules.

Distribution. — Known from type locality and presumably Philippine Islands; to 15 meters.

Discussion. — Our Philippine specimen is considerably smaller than the syntypes, but agrees in most aspects with Forest's description of *P. tweediei.* Differences such as the length-width relationship of the shield, proportions of chelae to carpi, and delineations of dorsomesial and dorsolateral margins of the right chela, with accompanying stronger surface armature, are attributed to size, and fall within the ranges of variation observed in other species of *Pagurixus.* The spine on the dorsodistal margin of the merus of the right cheliped described for the syntypes of *P. tweediei* is not present on our specimen. However, in many pagurid species this is a variable character. Consequently we do not believe that this difference alone would exclude our Philippine specimen from Forest's taxon.

Pagurixus anceps (Forest, 1954) (fig. 5)

Eupagurus (*Pagurixus*) *anceps* Forest, 1954a:72, figs. 15-19 (type locality: Hikuéru Island, Tuamotu Archipelago); 1956:52; 1957:1067 (by implication).

Pagurus (*Pagurixus*) *anceps*: Dechancé, 1964:38. — Ball & Haig, 1972:103. — Lewinsohn, 1982:58 (by implication).

Pagurus boninensis: Lewinsohn, 1969: 64, fig. 11; 1982:58. Not *Pagurus boninensis* (Melin, 1939).

?*Pagurus boninensis*: Miyake, 1978:79 (in part; see discussion under *P. boninensis*).

Pagurus anceps: Baba, 1982:66, fig. 1.

Material. — 1♂, paratype (SL = 1.4 mm), Hikuéru Island, Tuamotu Archipelago, 1952, intertidal, coll. M. G. Ranson, BPBM 6845. 15♂, 18♀, 9 ovigerous (SL = 0.7-1.6 mm), Enewetak Island, Enewetak Atoll, Marshall Islands, 3-13 August 1967, coll. J. W. Knudsen, AHF. 1♂, 1♀ ovigerous (SL = 1.1, 1.1 mm), Enewetak Island, Enewetak Atoll, 20 May 1975, coll. S. Brunenmeister, FIU. 1♂ (SL = 1.4 mm), Rojoa Island, Enewetak Atoll, 15 July 1967, 1.5 m, coll. J. W. Knudsen, AHF. 1♂ (SL = 1.3 mm), Bogallua Island, Enewetak Atoll, 6 August 1968, coll. J. W. Knudsen, AHF. 1♀ ovigerous (SL = 1.1 mm), Bokandretok Island, Enewetak Atoll, 3 August 1967, coll. J. W. Knudsen, AHF. 1♂ (SL = 1.5 mm), reef between Enewetak and Bokandretok Islands, Enewetak Atoll, 16 August 1967, coll. J. W. Knudsen, AHF. 1♂ (SL = 1.1 mm), Igurin Island, Enewetak Atoll, 11 July 1959, intertidal, coll. J. S. Garth, AHF. 2♂, 2♀ ovigerous (SL = 1.1-1.6 mm), Medren Island, Enewetak Atoll, 22 July 1957, 3-4.5 m, coll. T. Goreau & R. Neshida, RMNH. 42♂, 23♀, 4 ovigerous (SL = 0.8-1.4 mm), Torongahai, Kapingamarangi, Caroline Islands, 29 June 1954, coll. C. Hand, USNM 104952. 18♂, 14♀, 1 ovigerous (SL = 0.9-1.5 mm), Touhow Island, Caroline Islands, 2 July 1954, coll. C. Hand, USNM 106620. 5♂, 1♀ ovigerous (SL = 0.8-1.8 mm), station SP-17-1H, 09°26′00″N 123°23′24″E (Philippine Islands), 17 June 1978, intertidal, coll. SOSC, USNM. 1♀ (SL = 0.8 mm), station SP-11-3, 10°48′N 121°02′36″E, 25 May 1978, 5 m, coll. SOSC, USNM. 7♂, 1♀ (SL = 0.9-1.5 mm), station SP-11-1, 11°00′N 120°56′54″E, 23 May 1978, 2-3 m, coll. SOSC, USNM. 1♂ (SL = 1.2 mm), Agumi Shima, Ryukyu Islands, August 1945, coll. E. R. Tinkham, AHF. 1♂ (SL = 1.2 mm), Shora al Manqata, Sinai Peninsula, Gulf of Aqaba, 17 April 1975, coll. R. M. Overstreet, FIU.

Diagnosis. — Shield longer than broad. Rostrum triangular, usually well developed, distally depressed and often terminating in small spine or spinule, occasionally not extending beyond bases of ocular acicles. Lateral projections obtusely triangular, with marginal or submarginal spine. Ocular peduncles short and stout in small individuals, increasing in length with increased size; ocular acicles usually subtriangular, acute or subacute, with submarginal terminal spine; separated basally by approximately basal width of 1 acicle. Antennular peduncles with 1 or 2 long setae at dorsolateral distal angle of ultimate segment, ventral margins naked or with 4 or 5 very short setae. Right cheliped in large males becoming markedly swollen; dactyl usually set at angle of 30° to 45°, shorter than palm, dorsal and mesial faces usually tuberculate. Palm equalling or slightly longer than carpus, dorsal and ventral surfaces strongly convex, dorsolateral and dorsomesial margins each with row of spinulose granules or small tubercles, tending to become obsolete in large individuals, dorsal surface smooth, granular or weakly tuberculate, armature strongest on fixed finger, dorsomesial proximal angle sometimes produced and with stronger tubercle; ventral surface with scattered setae. Carpus approximately equalling length of merus; dorsomesial margin with irregular row or double row of small spines or spinules, tending to become reduced with increased size of individuals, dorsal surface granular or with low protuberances and scattered setae, dorsolateral margin not delimited; ventral surface often weakly tuberculate. Merus with 1 to several spines or spinules on ventrolateral margin, ventromesial margin crenulate or spinulose distally. Right cheliped of female with dactyl equalling or slightly longer than palm; dorsomesial margin with row of granules or spinules, surfaces spinulose or granular. Palm equalling or slightly shorter than carpus; dorsal surface with several irregular

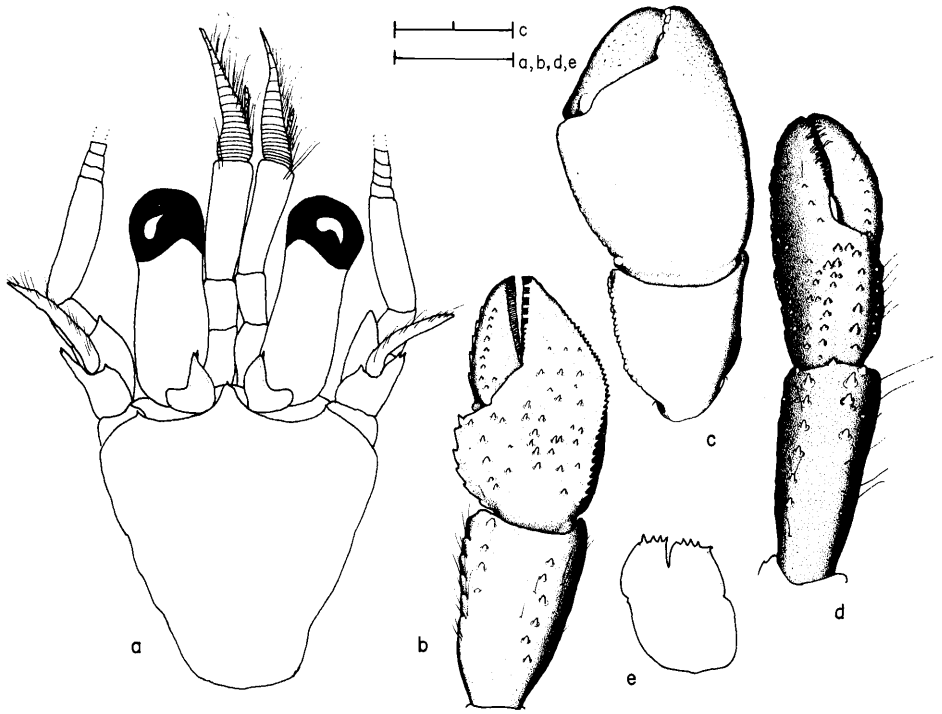

Fig. 5. *Pagurixus anceps* (Forest). a, shield and cephalic appendages; b, right chela and carpus of female; c, right chela and carpus of male; d, left chela and carpus of male; e, telson. Scales equal 1.0 mm, c; and 0.5 mm, a, b, d, e.

rows of small spines or spinules, dorsomesial margin with 1 or 2 rows of small spines, dorsolateral margin with row of spinules, dorsal surface of fixed finger often only granular or weakly tuberculate; ventral surface with low protuberances and moderately long setae. Carpus approximately equalling length of merus; dorsomesial margin with single or double row of spines, strongest distally, dorsolateral margin with spinulose protuberances, occasionally not well delimited; ventrolateral margin sometimes spinulose or with 1 or 2 small spines. Merus with ventrolateral margin sometimes spinulose or with row of acute spines distally. Left cheliped with dactyl one-fifth to one-third longer than palm, together with fixed finger, spoon-shaped; dorsomesial margin or dorsal surface proximally with short row of spinulose protuberances or small spines, mesial face with low protuberances and scattered setae. Palm one-half to three-fourths length of carpus; dorsomesial margin slightly depressed, armed with row of weak to strong spines, dorsal midline with 2 irregular single or double rows of small spines, sometimes extending onto fixed finger proximally, dorsolateral face strongly sloping, and like fixed finger, armed with irregular rows of spinules or tubercles; occasionally spines of chela reduced, obsolete, or rarely absent. Carpus slightly shorter to slightly longer than

merus; dorsomesial margin with row of acute or subacute spines, dorsolateral margin with row of spines at least distally, dorsal surface frequently slightly protuberant and with long setae, often also with 1 or 2 spines at distal margin; ventrolateral margin usually with 1 to several acute spines, ventromesial margin sometimes with 1 spine distally. Merus with row of weak to strong spines on ventrolateral margin distally, ventromesial margin sometimes spinulose. Second pereopods with dactyls shorter than propodi, dactyls of 3rd slightly shorter to approximately equal to length of propodi, stout; ventral margins with 5 to 8 strong corneous spines (2nd with 5 or 6). Propodi somewhat longer than carpi; ventral margins each with row of corneous spinules. Carpi each with small spine at dorsodistal angle. Meri with small spine on dorsolateral distal margin of 2nd pereopods, 3rd unarmed. Sternite of 3rd pereopods with anterior lobe subquadrate or subrectangular. Females with paired gonopores or with single gonopore on left coxa. Telson with terminal margins straight or slightly concave, each with 3 to 5 spines or spinules.

Color (from preserved material). — Antennal peduncles with basal red band. Ambulatory legs with base color white, with broad red rings; chelipeds white. The red bands on the legs are light tan in life (S. Brunenmeister, pers. comm.). The differences in color from those reported by Forest (1954a) and Baba (1982) may be attributable to differing color losses due to preservation.

Distribution. — Central Pacific, Philippine, Ryukyu, Palau, and Caroline Islands, Indian Ocean, and Red Sea; to 5 meters.

Discussion. — The first description of *P. anceps* was presented by Forest in a paper given at the Eighth Pacific Science Congress in November, 1953. This paper was subsequently published, without figures, in the Proceedings of that Congress (1957). In the interim, Forest (1954a) published the identical description of this species, but with figures, in one of a series of papers dealing with the decapods of Tahiti and the Tuamotu Islands. Thus two descriptions of *P. anceps* sp. nov. appear in the literature.

As previously indicated, Lewinsohn (1969) redescribed *P. boninensis* from species he collected from the Red Sea. He did not compare his material to *P. anceps* at that time, but has since recognized the similarities between the two taxa (Lewinsohn, 1982:58). *P. anceps* has proven to be a species with a wide range of morphological variability, and *P. boninensis* (sensu Lewinsohn) clearly falls within that range.

P. anceps is the smallest of the group of *Pagurixus* species that lack distinct row(s) of setae on the ventral surfaces of the ultimate antennular segments. Although there are a number of characters that distinguish this species from *P. laevimanus* and *P. jerviensis* n. sp., the most reliable are the shape and armature of the dactyls of the 2nd pereopods. Both *P. anceps* and *P. jerviensis* have short, stout dactyls, in contrast to the long and relatively slender dactyls of *P. laevimanus*; however, *P. anceps* has only 5 or 6 corneous spines on the ventral margins. The dactyls of *P. jerviensis* have 7 to 10 spines on those margins.

Pagurixus jerviensis new species (fig. 6)

Eupagurus lacertosus: Pope, 1947: 131, figs. 3, 4. — Dakin, et al., 1948:209, 219; 1953:199, pl. 44 fig. 7; 1960:199, pl. 44 fig. 7. Not *Eupagurus lacertosus* Henderson, 1888.
Pagurus lacertosus: Gordan, 1956:311 (in part). — Griffin, 1967:306. — Healy & Yaldwyn, 1970:72, fig. 35. Not *Pagurus lacertosus* (Henderson, 1888).

Material. — Holotype: ♂ SL = 2.6 mm), north face Bowen Island, Jervis Bay, NSW, Australia, 24 May 1980, 18 m, coll. P. Berents, AM P33836. Paratypes: 2♂, 5♀, 2 ovigerous (SL = 1.0-2.0 mm), north face Bowen Island, Jervis Bay, 24 May 1980, 18 m, coll. P. Berents, AHF 808. 2♂, 1♀ ovigerous (SL = 2.0-2.6 mm), Boat Harbour, Jervis Bay, 25 May 1980, 12-15 m, coll. J. C. Markham, RMNH. 1♂ (SL = 3.0 mm), Shell Harbour, NSW, 1925, intertidal, USNM 64618. 5♂ (SL = 3.1-4.3 mm), open outer coast, NSW, intertidal, coll. S. Kellner, USNM 98839. 4♂, 1♀ ovigerous (SL = 1.9-2.6 mm), Long Reef, Collaroy, N.S.W., 26 January 1964, intertidal, coll. J. S. Garth & F. Ziesenhenne, AHF 647, FIU. 3♂, 2♀ ovigerous (SL = 1.5-2.6 mm), Erscott's Hole, Lord Howe Island, Australia, December 1979, 18 February 1980, 3-5 m, coll. N. Coleman, Australasian Marine Photographic Index 966, 1029. 2♂ (SL = 2.6, 2.7 mm), Deacon's Reef, Lord Howe Island, 30 November 1979, 22 m, coll. N. Coleman, AMPI 986, 988.

Description. — Shield longer than broad; anterior margin between rostrum and lateral projections straight or concave; anterolateral margins sloping; posterior margin roundly truncate. Rostrum usually well developed, reaching well beyond bases of ocular acicles, dorsally convex and terminating in acute spine. Lateral projections obtusely triangular, with marginal or submarginal spine.

Ocular peduncles short and stout, slightly inflated basally and with corneae weakly dilated, dorsomesial surface with row of widely-spaced sparse tufts of setae; ocular acicles subtriangular, usually with small submarginal terminal spine; separated basally by basal width of 1 acicle.

Antennular peduncles moderately short, overreaching ocular peduncles by approximately one-half length of ultimate segment. Ultimate segment with tuft of setae at dorsolateral distal angle, ventral surface naked. Penultimate segment unarmed. Basal segment with acute spine on lateral face distally.

Antennal peduncles moderately short, not overreaching antennular peduncles. Fifth and fourth segments with scattered setae. Third segment with spine at ventrodistal margin. Second segment with dorsolateral distal angle produced and terminating in pair of spines and tuft of setae, mesial and lateral margins with few setae; dorsomesial distal angle with acute spine, mesial margin with few setae. First segment with ventromesial distal angle produced and with 1 small spine laterally. Antennal acicle somewhat arcuate, terminating in small spine, partially obscured by tuft of setae, mesial margin with row of setae. Antennal flagella moderately long; articles often with 1 or 2 short setae.

Mandible without distinguishing characters. Maxillule with internal lobe of endopod well developed and with 1 terminal bristle; external lobe produced, not recurved. Maxilla with scaphognathite moderately slender. First maxilliped with basal segment of exopod slender. Second maxilliped without

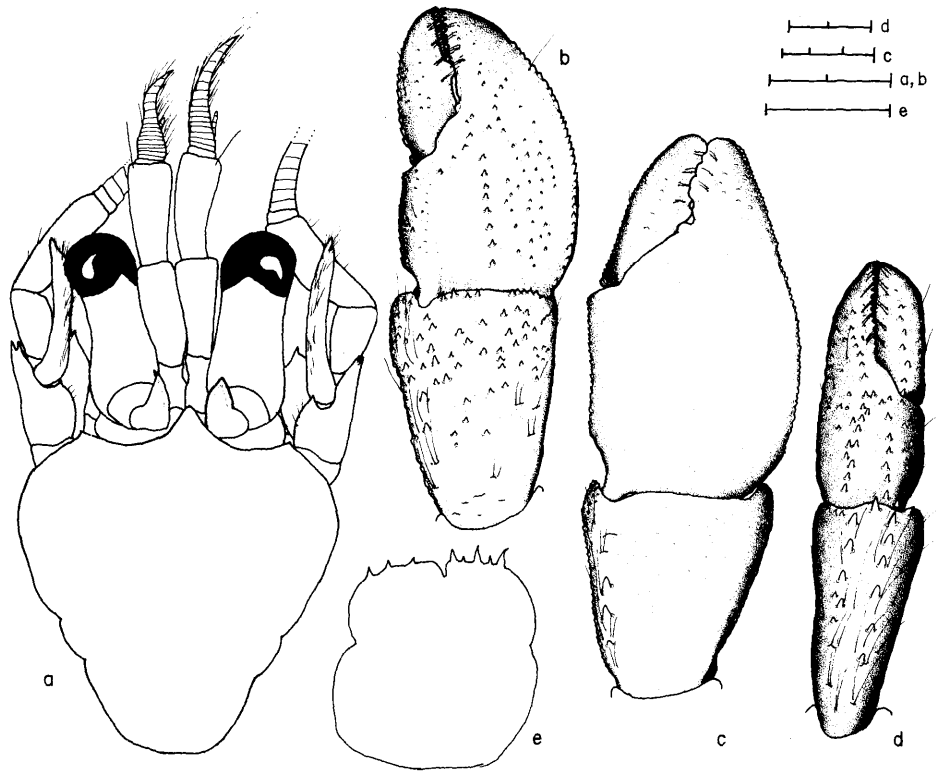

Fig. 6. *Pagurixus jerviensis* new species. a, shield and cephalic appendages; b, right chela and carpus of female; c, right chela and carpus of male; d, left chela and carpus of male; e, telson. Scales equal 3.0 mm, c; 1.0 mm, a, b, d; and 0.5 mm, e.

distinguishing characters. Third maxilliped with crista dentata well developed, 1 accessory tooth; merus unarmed. Sternite of 3rd maxillipeds unarmed.

Right cheliped of large males markedly swollen; considerably larger than left. Dactyl slightly shorter than palm; cutting edge with row of calcareous teeth, terminating in calcareous tooth and slightly overlapped by fixed finger; dorsal surface slightly elevated in midline and minutely granular, dorsomesial and ventromesial margins minutely spinulose or granular. Palm approximately two-thirds length of carpus, somewhat operculate in outline; dorsomesial margin only weakly delimited, dorsal surface minutely granular, dorsolateral margin crenulate; cutting edge of fixed finger with calcareous teeth; lateral, mesial, and ventral surfaces of palm and fixed finger smooth or minutely granular. Carpus slightly shorter than merus, strongly inflated ventrally; dorsomesial margin with irregular row of low protuberances, granules or spines, strongest proximally, and with few short stiff setae, dorsal surface with few low tubercles proximally adjacent to dorsomesial margin, and scattered granules distally, remainder of surface minutely granular and with few short

setae; mesial, lateral, and ventral surfaces granular, margins very weakly crenulate, at least distally. Merus with weak transverse ridges and few short setae on dorsal margin, distal margin with 1 or 2 spines; ventrolateral margins each with row of spines, strongest laterally.

Right cheliped of females with palm not appreciably operculate in outline; dorsal midline frequently with low tubercles or small spines and row of spines or spinulose tubercles approximating dorsomesial margin. Carpus with spines on dorsomesial margin stronger, dorsal surface with numerous small tubercles or blunt spines. Merus with ventromesial margin sometimes crenulate or smooth, dorsodistal margin sometimes unarmed.

Left cheliped with dactyl and fixed finger somewhat spoon-shaped. Dactyl slightly longer than palm; cutting edge with row of corneous teeth; terminating in corneous claw; dorsal surface elevated in midline and armed with row of low protuberances or spines and scattered setae; dorsomesial margin spinulose or not delimited. Palm approximately one-half length of carpus; dorsal midline elevated and armed with 2 rows of small blunt or acute spines, extending onto fixed finger proximally as row of very small tubercules, dorsomesial margin sometimes depressed and often armed with row of small spines or tubercles; dorsolateral surface minutely granular or spinulose, and strongly sloping to crenulate margin; ventral surface with scattered tufts of setae, and occasionally also with spinulose protuberances. Carpus shorter than merus; dorsomesial and dorsolateral margins each with row of small spines, often more irregular and smaller laterally, distal margin often with 1 or 2 strong spines; mesial and ventral surfaces with tufts of long setae, ventrolateral margin with row of small tubercles or spines proximally, increasing in size and strength distally. Merus with row of sparse tufts of short setae on dorsal margin; ventromesial margin with row of spinules and long setae, ventrolateral margin with row of moderate to strong spines. Ischium with row of small tubercles on ventromesial margin.

Second and 3rd pereopods moderately short; generally similar. Dactyls two-thirds to three-fourths length of propodi, stout; in lateral view, straight or very slightly curved ventrally; in dorsal view, slightly twisted; dorsal surfaces with few scattered setae; ventral margins each with row of 7 to 10 strong corneous spines. Propodi slightly longer than carpi; dorsal surfaces with tufts of setae, ventral surfaces with few corneous spinules. Carpi shorter than meri; dorsal surfaces with low protuberances and tufts of setae, distal margins each with small spine. Meri with low protuberances and tufts of setae on dorsal and ventral margins. Sternite of 3rd pereopods with anterior lobe subrectangular, anterior margin often with long setae.

Females with paired gonopores.

Telson with posterior lobes separated by shallow median cleft; terminal margins generally straight, each with 2 to 4 moderately strong spines and 2 or 3 spinules.

Color (in preserved material). — Ocular peduncles with patch of light orange on dorsomesial surface proximally; mesial margins of ocular acicles edged in dark red-orange. Shield very faintly orange tinted, with scattered small patches of darker orange; anterior margin edged in dark orange. Basal segments of antennular peduncles light orange. Antennal peduncles with light orange persisting on 2nd and 3rd segments; 5th segment with dark orange on dorsal and ventral margins; antennal acicles with distal band of orange; antennal flagella with every 3 or 4 articles orange colored, interrupted by 1 or 2 clear articles. Chelipeds orange, except for dactyls and fixed fingers which are white. Ambulatory legs with dark orange dorsal and ventral longitudinal stripes, and additional orange bands distally on meri, medianly on propodi, and proximally on dactyls.

Distribution. — Southeastern Australia; Lord Howe Island; intertidal to 22 meters.

Discussion. — Although Henderson's (1888) description and illustration of the deep-water Australian species, *Pagurus lacertosus*, are quite good, a number of popular accounts in recent years have reported this species as a common shallow-water and intertidal representative of the Australian coast (e.g., Pope, 1947; Dakin et al., 1948, 1953, 1960; Griffin, 1967; Healy & Yaldwyn, 1970). During a collecting trip to Jervis Bay, New South Wales, one of us (JH) was able to obtain specimens of this common species and determined that it was an undescribed species of the *Pagurixus* group. It bears only a very superficial resemblance to Henderson's species. The true *P. lacertosus* was assigned to the genus *Lophopagurus* by McLaughlin (1981).

It is very unlikely that Yaldwyn's (1975) report of *Pagurus* cf. *lacertosus* refers to *P. jerviensis*, since the Auckland Islands are subantarctic. Since he remarked that it was collected from shallow water it is probably not *L. lacertosus* either, but *Pagurixus hectori.*

As previously indicated, the shape of the dactyls of the ambulatory legs and the large number of corneous spines on their ventral margins immediately distinguish *P. jerviensis* from *P. laevimanus* and *P. anceps.*

Etymology. — The specific name of this species has been derived from its type locality, Jervis Bay, New South Wales, Australia.

Pagurixus laevimanus (Ortmann, 1892) (fig. 7)

Eupagurus laevimanus Ortmann, 1892:302, pl. 12 fig. 13 (type locality: Tahiti). — Alcock, 1905: 176. — Forest, 1954a:74; 1956:52; 1957:1069.
Pagurus laevimanus: Holthuis, 1953:49. — Gordan, 1956:331. — Minei, 1973:45.
Pagurus (*Pagurixus*) sp.: Ball & Haig, 1972:103.
Pagurus (*Pagurixus*) *laevimanus*: Ball & Haig, 1972:103 (by implication).
not *Pagurus laevimanus* Randall, 1840:135 [= *Calcinus laevimanus* (Randall)].

Material. — 1 ♀ ovigerous (SL = 1.2 mm), Pago Bay, Guam, Mariana Islands, 10 December 1966, coll. L. G. Eldredge, AHF. 1♂, 1 ♀ (SL = 1.6, 2.1 mm), Pt. Inarahae, Guam, 9 March 1966, coll. D. A. Aderkin, AHF. 4♂ (SL = 1.2-1.6 mm), Saipan, 30 January, 4-6 April 1949,

coll. U.S. Geological Survey, USNM 93843-45. 1 ♀ (SL = 1.4 mm), 35 miles north of Maiwara, New Guinea, 19 October 1969, 7.5 m, coll. E. E. Ball, RMNH.

Diagnosis. — Shield longer than broad. Rostrum triangular, reaching beyond bases of ocular acicles, depressed distally and terminating acutely. Lateral projections obtusely triangular, usually unarmed. Ocular peduncles moderately short and stout, with corneae slightly dilated; ocular acicles ovately triangular, with very small submarginal terminal spine; separated basally by approximately basal width of 1 acicle. Antennular peduncles with 1 or 2 long setae at dorsodistal angle of ultimate segment; no ventral setae. Right cheliped of large males with dactyl usually much shorter than palm, set at slight angle; dorsal, mesial and ventral surfaces weakly tuberculate. Palm elongate, dorsal surface convex; dorsolateral margin with tiny blunt tubercles, strongest on fixed finger, dorsomesial margin similarly delimited and with 1 stronger tubercle at proximal angle; surfaces granular or weakly tuberculate. Carpus approximately equal in length to palm and merus; dorsomesial margin with irregular row of spines, dorsal surface with granules or tubercles; mesial,

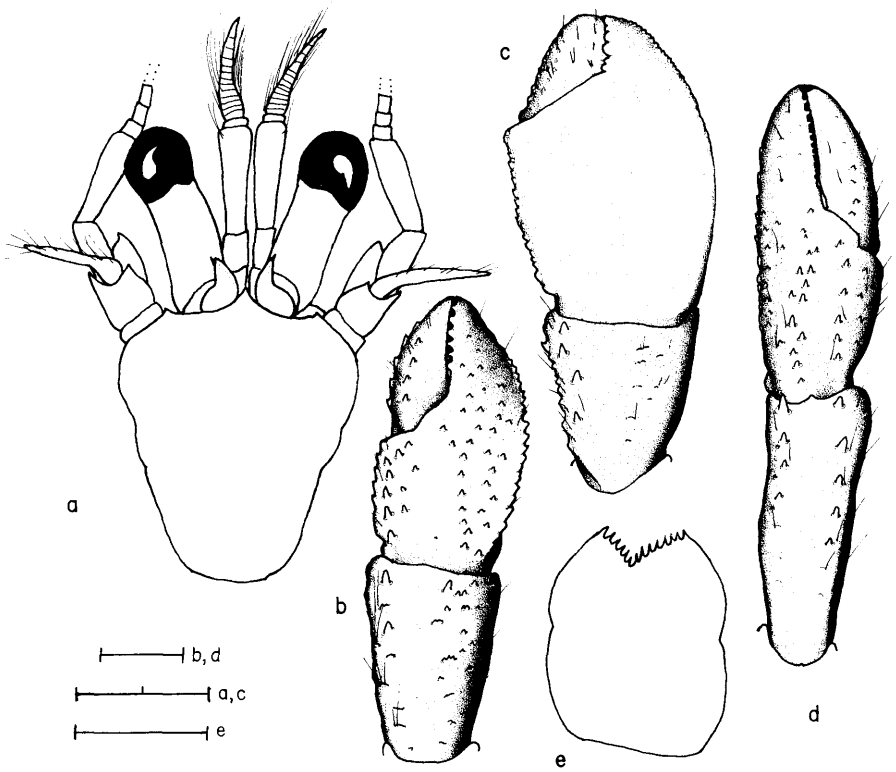

Fig. 7. *Pagurixus laevimanus* (Ortmann). a, shield and cephalic appendages; b, right chela and carpus of female; c, right chela and carpus of male; d, left chela and carpus of male; e, telson. Scales equal 1.0 mm, a, c; and 0.5 mm, b, d, e.

lateral, and ventral surfaces granular. Merus unarmed or with low tubercles on ventral margin proximally. Right cheliped of females with dactyl longer than palm, dorsal midline with row of small spines, dorsomesial margin with irregular row of spines. Palm with double row of acute spines on dorsomesial margin, dorsolateral margin with row of small spines, dorsal surface with scattered spines or spinules and stronger double row in midline; lateral face spinulose, ventral and mesial surfaces tuberculate. Carpus with irregular row of strong spines on dorsomesial margin, row of smaller spines on dorsolateral margin, dorsal surface spinulose. Left cheliped with few low protuberances on dactyl. Palm triangular in cross-section; dorsomesial margin with 2 rows of spines, dorsal midline with double row of small spines or spinules proximally becoming single row distally, but not extending down fixed finger, dorsolateral face with scattered spinules; lateral margin with row of spinulose protuberances. Carpus with dorsomesial and dorsolateral rows of strong spines. Merus unarmed. Second and 3rd pereopods similar. Dactyls slightly shorter or equal to length of propodi, relatively slender; ventral margins each with row of 6-8 corneous spines, dorsal surfaces with scattered setae. Propodi with corneous spinules on ventral margins. Carpi each with dorsodistal spine. Meri unarmed. Sternite of 3rd pereopods with anterior lobe subrectangular. Females with paired gonopores or only left gonopore. Telson with posterior lobes separated by deep median cleft; terminal margins oblique, each with row small spines.

Distribution. — Tahiti, Mariana and Ryukyu Islands, New Guinea; to 7.5 meters.

Discussion. — The name *Pagurus laevimanus* was first assigned by Randall (1839) to a species later transferred to the genus *Calcinus*. Although Ortmann's *Pagurus laevimanus* (as *Eupagurus*) is a secondary junior homonym, the two species have never been considered congeneric, and no replacement name has ever been proposed for Ortmann's species. Therefore, according to Article 59 of the International Code of Zoological Nomenclature (1964:57) Ortmann's name is valid.

In the tendency toward elongation of the right cheliped in males, *P. laevimanus* resembles *P. boninensis* and *P. maorus*; however, it lacks the row(s) of setae on the ventral surface of the ultimate antennular segment. Although the number of corneous spines on the ventral margins of the dactyls of the ambulatory legs is intermediate between *P. anceps* and *P. jerviensis*, the longer and more slender dactyls themselves serve to quickly distinguish *P. laevimanus*.

Pagurixus hectori (Filhol)

Eupagurus hectori Filhol, 1883: 67; 1885: 419, pl. 51 fig. 1.—Thomson, 1899: 177.—Lenz, 1901: 447.—Alcock, 1905: 176.—Thompson, 1930: 269.
Pagurus hectori: Gordan, 1956: 330.
Pagurixus hectori: Schembri & McLay, 1983: 34, fig. 26a, b.

Material. — 1♂, 1♀ (SL = 3.3, 5.8), Lyall Bay, Wellington, New Zealand, intertidal, coll. C. L. McLay, FIU.

Diagnosis.—Shield longer than broad. Rostrum acutely triangular, well developed, terminating in small spine. Lateral projections obtusely triangular, with marginal or submarginal spine. Ocular peduncles short and moderately stout in small individuals, increasing in length with increased size; ocular acicles subovate to subtriangular, with submarginal terminal spinule; separated basally by slightly less to slightly more than basal width of 1 acicle. Antennular peduncles with 1 to several long setae at dorsolateral distal angle of ultimate segment, ventral margins naked or with 1 or 2 short setae. Right cheliped in large males elongate, swollen; dactyl almost as long as palm, dorsal surface slightly pitted. Palm slightly shorter than carpus, dorsal and ventral surfaces convex, smooth, dorsomesial and dorsolateral margins unarmed. Carpus approximately equalling length of merus, dorsomesial margin with irregular row of spinulose or blunt tubercles, in this specimen, not reaching to distal margin, dorsal surface with few low granules, dorsomesial margin with row of larger granules. Merus with 3 spines on distal margin dorsally, dorsal margin with low protuberances and tufts of short setae; ventral margin granular, ventrolateral margin with strong spines on distal half. Right cheliped of female with dactyl approximately one and one-half times length of palm; dorsal and mesial faces granular, granules strongest on dorsomesial margin. Palm slightly more than half length of carpus, all surfaces minutely granular, with stronger granules on dorsomesial and dorsolateral margins. Carpus approximately equal to merus in length; dorsomesial margin with irregular, almost double row of small spinulose tubercles, smallest near distal margin; all surfaces granular or spinulose, armature strongest on dorsal surface. Merus with 2 spines on dorsodistal margin, dorsal margin with row of low protuberances and short setae, ventrolateral margin with row of small spines, strongest distally, ventromesial margin granular. Left cheliped with dactyl somewhat longer than palm, together with fixed finger spoon-shaped, dorsal surface proximately with few minute spinules, mesial and ventral surfaces with tufts of setae. Palm less than one-half length of carpus, dorsomesial margin not particularly depressed, armed with numerous very small spinules, dorsal surface elevated in midline and armed with irregular, double row of small spinules, extending onto fixed finger proximally; dorsolateral surface strongly sloping, ventral surface of palm and fixed finger with tufts of setae and few low tubercles laterally. Carpus approximately equalling merus in length, dorsomesial and dorsolateral margins each with row of small spines. Merus with ventromesial margin minutely spinulose, ventrolateral margin with row of small spines, strongest distally. Dactyls of 2nd and 3rd pereopods short and moderately stout, ventral margins each with 8 or 9 corneous spines. Propodi longer than dactyls and somewhat longer than carpi, ventral margins each with row of corneous spines. Carpi each with small spine at dorsodistal angle. Meri

with (2nd) or without (3rd) small spine at ventrolateral distal angle. Sternite of 3rd pereopods with anterior lobe subrectangular. Female with paired gonopores. Telson with terminal margins straight or slightly concave, each with 5 to 10 small, slender spines.

Color (in life).—Chelipeds dark brown, with narrow blue band at base of carpus, dactyls and fixed fingers pale blue; ambulatory legs with pale blue, dark brown and pale orange bands distally on each segment (Schembri & McLay, 1983).

Distribution.—Campbell Island and southeastern New Zealand, including Stewart Island, intertidal.

Discussion.—In their key, Schembri & McLay (1983) reported *Pagurixus hectori*, presumably on the basis of an identification made earlier by M. de Saint Laurent, not realizing that *Pagurixus* had not at that time been formally elevated to generic rank. The diagnosis of *P. hectori*, and its inclusion in the key to species of the genus, in the present paper has been added in gally proof, thus it has not been possible to include illustrations of this species. As noted by Schembri & McLay, the illustration given by Filhol (1885) is inaccurate, particularly in showing this species to have paired pleopods. *P. hectori* appears most closely related to *P. jerviensis*, but it may be distinguished from the latter species by its generally weaker armature of both chelae, the absence of a row of spines on the dactyl of the left chela, and by the shape and armature of the telson.

P. hectori is the first cold-water representative of an otherwise generally subtropical-tropical genus. Because of its superficial resemblance to *Lophopagurus lacertosus*, it is quite possible that the shallow-water species reported by Yaldwyn (1975) as *Pagurus* cf. *lacertosus* from the Auckland Islands was really *P. hectori.*

Acknowledgements

We are particular indebted to Drs. Dennis M. Devaney, Gordon Hendler, and Raymond B. Manning for putting the collections of their institutions at our disposal. We are also most grateful to Dr. Susan Brunenmeister, National Marine Fisheries Service, for providing specimens from Enewetak Atoll, Marshall Islands; to Mr. Nelville Coleman, Sydney for specimens from Lord Howe Island; to Dr. Robin M. Overstreet, Gulf Coast Research Laboratory for specimens from the Red Sea; to Dr. Ernst Reese, University of Hawaii, for specimens from the Hawaiian Islands; and to Dr. Colin L. McLay, University of Canterbury, for specimens from New Zealand.

ZUSAMMENFASSUNG

Eine Überarbeitung der Arten, die in die Untergattung *Pagurixus* gestellt werden, hat gezeigt, daß sie eine homogene Gruppe bilden, die klar von anderen Arten der Gattung *Pagurus* abgegrenzt werden kann. *Pagurixus* wird deshalb in den Rang einer Gattung erhoben, und es werden zwei neue Arten beschrieben. Charakteristisches Kennzeichen der Gattung ist im männ-

lichen Geschlecht das Vorhandensein eines Büschels mediad gerichteter steifer Borsten, unter denen sich der rechte Gonoporus verbirgt. Die Vorwölbung des Sternits der 5. Pereiopoden in zwei eiähnliche Gebilde und das Vorhandensein nur einer Schuppenreihe auf der Reibefläche der 4. Pereiopoden sind zusätzliche Kennzeichen, die das Erkennen von Arten dieser Gattung erleichtern. Wesentliche Geschlechtsunterschiede bestehen in der Form und Bewehrung des rechten Chelipeden. Bei den Weibchen gibt es intra- und/oder interspezifische Variabilität hinsichtlich der Zahl der Gonoporen.

LITERATURE CITED

ALCOCK, A., 1905. Anomura. Fasc. I. Pagurides. — Catalogue of the Indian decapod Crustacea in the collection of the Indian Museum, **2**: 1-197. (Calcutta: Indian Museum).

ANONYMOUS, 1964. International code of zoological nomenclature adopted by the XV International Congress of Zoology: 1-176 (London: International Trust for Zoological Nomenclature).

BABA, K., 1982. Galatheids and pagurids of the Palau Islands (Crustacea: Anomura). Proc. Jap. Soc. syst. Zool., **23**: 56-70.

BALL, E. E., Jr. & J. HAIG, 1972. Hermit crabs from eastern New Guinea. Pacific Sci., **26**: 87-107.

BRANDT, F., 1851. Krebse. In: A. T. VON MIDDENDORFF, Reise in den äussersten Norden und Osten Sibiriens während der Jahre 1843 und 1844, **2** (1) (Zoologie): 77-148.

DAKIN, W. J., I. BENNETT & E. POPE, 1948. A study of certain aspects of the ecology of the intertidal zone of the New South Wales coast. Australian Journ. sci. Res., (B) **1**: 176-230.

——, 1953. Australian seashores. A guide for the beachlover, the naturalist, the shore fisherman, and the student: 1-372. (Sydney: Angus & Robertson Pty Ltd).

——, 1960. Australian seashores. A guide for the beachlover, the naturalist, the shore fisherman, and the student, (revised edition): 1-372. (Sydney: Angus & Robertson, Pty Ltd).

DECHANCÉ, M., 1964. Sur une collection de Crustacés Pagurides de Madagascar et des Comores. Cahiers ORSTOM, **2** (2): 27-45.

FILHOL, H., 1883. Note sur quelques espèces nouvelles d'Eupagurus recueillis en Nouvelle-Zélande. Bull. Soc. Philom. Paris, (7) **8**: 66-68

——, 1885. Catalogue des Crustacés de la Nouvelle-Zélande, des Iles Auckland et Campbell. Passage de Vénus sur le soleil du 9 décembre, 1874. Mission de l'Ile Campbell, **3** (2): 352-510.

FOREST, J., 1954a. Crustacés Décapodes Marcheurs des îles de Tahiti et des Tuamotu. — I. Paguridea (suite). Bull. Mus. natn. Hist. nat., (2) **26** (1): 71-79.

——, 1954b. Les Paguristes des côtes occidentales et méridionales d'Afrique. Ann. South African Mus., **41** (4): 159-213.

——, 1956. La faune des îles Cocos-Keelings Paguridea. Bull. Raffles Mus., **27**: 45-55.

——, 1957. Crustacés Décapodes Paguridae d'Océanie Française. Proc. 8th Pacific Sci. Congr., **3** (A): 1053-1076.

GORDAN, J., 1956. A bibliography of pagurid crabs, exclusive of Alcock, 1905. Bull. Amer. Mus. nat. Hist., **108** (3): 253-352.

GRIFFIN, D. J. C., 1967. Hermit crabs. Aust. nat. Hist., **15** (10): 305-309.

HEALY, A. & J. YALDWYN, 1970. Australian crustaceans in colour: 1-112. (Sydney: Reed).

HENDERSON, J. R., 1888. Report on the Anomura collected by H.M.S. Challenger during the years 1873-1876. Scientific Results Explor. Voyage HMS Challenger, (Zoology) **27**: 1-221.

HOLTHUIS, L. B., 1953. Enumeration of the decapod and stomatopod Crustacea from Pacific coral islands. Atoll Res. Bull., **24**: 1-62.

LEMAITRE, R., P. A. MCLAUGHLIN & J. GARCÍA-GÓMEZ, 1982. The Provenzanoi group of hermit crabs (Crustacea, Decapoda, Paguridae) in the western Atlantic. Part IV. A review of the group, with notes on variations and abnormalities. Bull. mar. Sci., **32**: 670-701.

LENZ, H., 1901. Crustaceen. Ergebnisse einer Reise nach dem Pacific (Schauinsland, 1896-1897). Zool. Jahrb. Syst., **14** (5): 429-482.

LEWINSOHN, Ch., 1969. Die Anomuren des Roten Meeres (Crustacea Decapoda: Paguridea, Galatheidea, Hippidea). Zool. Verhandel. Leiden, **104**: 1-213.

——, 1982. Researches on the coast of Somalia. The shore and the dune of Sar Uanle. 33. Diogenidae, Paguridae and Coenobitidae (Crustacea Decapoda Paguridea). Monit. zool. Ital., (n.s.) (suppl.) **16** (2): 35-68.

McLaughlin, P. A., 1975. On the identity of Pagurus brevidactylus (Stimpson) (Decapoda: Paguridae), with the description of a new species of Pagurus from the western Atlantic. Bull. mar. Sci., **25**: 359-376.

——, 1981. Revision of Pylopagurus and Tomopagurus (Crustacea: Decapoda: Paguridae), with the descriptions of new genera and species. Part I. Ten new genera of the Paguridae and a redescription of Tomopagurus A. Milne Edwards and Bouvier. Bull. mar. Sci., **31**: 1-30.

Melin, G., 1939. Paguriden und Galatheiden von Prof. Dr. Sixten Bocks Expedition nach den Bonin-Inseln 1914. K. Svenska. Vetensk. Akad. Handl., **18** (2): 1-119.

Minei, H., 1973. Studies on the hermit crabs (Anomura, Paguridea) of the Ryukyu Islands. Biól. Mag. Okinawa, **10**: 43-56.

Miyake, S., 1978. The crustacean Anomura of Sagami Bay: 1-200 (English), 1-161 (Japanese). (Tokyo: Hoikusha Publishing Co.).

Nobili, G., 1906. Diagnoses préliminaires de Crustacés, Décapodes et Isopodes nouveaux recueillis par M. le Dr. Seurat aux îles Touamotou. Bull. Mus. Hist. nat. Paris, **12**: 256-270.

——, 1907. Ricerche sui Crostacei della Polinesia. Decapodi, stomatopodi, anisopodi e isopodi. Mem. R. Accad. Sci. Torino, (2) **57**: 351-429.

Ooishi, S., 1970. Marine invertebrate fauna of the Ogasawara and Volcano Islands collected by S. Ooishi, Y. Tomida, K. Izawa and S. Manabe. In: Report on the marine biological expedition to the Ogasawara (Bonin) Islands, 1968: 75-104.

Ortmann, A., 1892. Die Abtheilungen Galatheidea und Paguridea. Die Decapoden-Krebse des Strassburger Museums. IV. Zool. Jb. Syst., **6**: 241-326.

Pope, E. C., 1947. The endless house-hunt. Aust. Mus. Mag. Sydney, **9** (4): 129-132.

Randall, J. W., 1840. Catalogue of the Crustacea brought by Thomas Nuttall and J. K. Townsend, from the west coast of North America and the Sandwich Islands, with descriptions of such species as are apparently new, among which are included several species of different localities, previously existing in the collection of the Academy. Journ. Acad. nat. Sci., Philadelphia, **8**: 106-147.

Saint Laurent, M. de, 1968. Révision des genres Catapaguroides et Cestopagurus et description de quatre genres nouveaux. II. Cestopagurus Bouvier (Crustacés Décapodes Paguridae). Bull. Mus. natn. Hist. nat. Paris, (2) **40**: 539-552.

Schembri, P. J. & C. L. McLay, 1983. An annotated key to the hermit crabs (Crustacea: Decapoda: Anomura) of the Otago region (southeastern New Zealand). New Zealand Journ. mar. freshwater Res., **17**: 27-35.

Thompson, E. F., 1930. Contributions for a revision of the New Zealand Crustacea of the family Paguridae. Rec. Canterbury Mus., **3** (4): 263-273.

Thomson, G. M., 1898. A revision of the Crustacea Anomura of New Zealand. Trans. Proc. New Zealand Inst., **31**: 169-197.

Tirmizi, N. M. & F. A. Siddiqui, 1982. The marine fauna of Pakistan: 1 Hermit crabs (Crustacea, Anomura): 1-103. (Karachi: Saad Publications).

Yaldwyn, J. C., 1975. Checklist of decapod and stomatopod Crustacea from Auckland and Campbell Islands, New Zealand Subantarctic. In: J. C. Yaldwyn (ed.), Preliminary results of the Auckland Islands expedition 1972-1973. Dept. Lands & Survey, Wellington (Reserve Ser. 1975/3), **10** (8): 360-363.

Received for publication 11 December 1982.