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41 ***Petrolisthes eldredgei*, A New Porcellanid Crab From The Indo-West Pacific, with Redescription of Two Related Species¹**

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Abstract—*Petrolisthes bispinosus* Borradaile, *P. decacanthus* Ortmann and *P. eldredgei* n. sp. are closely related crabs (Anomura: Porcellanidae) which inhabit coral reefs in the Indo-West Pacific. They differ from other Indo-West Pacific *Petrolisthes* species by having two epibranchial spines on each carapace margin combined with unarmed mesobranchial margins. All three species occur from French Polynesia westward to the southern Mariana Islands, and the range of *P. decacanthus* extends to the western Indian Ocean. Their closest allies are *P. rosariensis* Werding and *P. columbiensis* Werding from the Western Atlantic region and *P. glasselli* Haig from the Eastern Pacific.

Introduction

In several Indo-West Pacific members of the porcellanid genus *Petrolisthes* the carapace is decorated with a transverse series of striations and bears two spines on each epibranchial region. Of this group of species, *P. decacanthus* Ortmann and *P. bispinosus* Borradaile are further characterized by the absence of marginal spinules on the mesobranchial areas of the carapace. The only published illustration of *P. decacanthus* consists of a drawing of one cheliped of a type specimen. *P. bispinosus* was very inadequately described and has never been illustrated. Neither has been reported from more than a few localities. Our studies have revealed that both species are widely distributed on coral reefs in the western and central Pacific Ocean, and that a closely related but undescribed form occupies the same range. In this paper we redescribe *P. decacanthus* and *P. bispinosus*, describe the allied species, and present illustrations of each.

Materials and Methods

Material from a number of sources was examined by J. Haig during general studies on Porcellanidae of the Indo-West Pacific. R. K. Kropp made collections in the Mariana Islands and provided photographs and the live color and habitat notes that are included in the account of each species.

The material from Enewetak Atoll, Marshall Islands, in the collections of C. Allan Child (CAC) and Jens W. Knudsen (JWK) is cited under Material Examined by station

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number only; in an appendix at the end of the paper, locality data for these stations are given in full.

Depositories of specimens are cited by the following abbreviations:

AHF—Allan Hancock Foundation, University of Southern California, Los Angeles

BMNH—British Museum (Natural History), London

BPBM—Bernice P. Bishop Museum, Honolulu

CNHM—Natural History Museum, Cambridge University, Cambridge

NTM—Northern Territory Museum, Darwin

USNM—National Museum of Natural History, Smithsonian Institution, Washington

ZMH—Zoologisches Museum, Hamburg

Account of Species

Petrolisthes bispinosus Borradaile

Figs. 1, 2

Petrolisthes bispinosus Borradaile, 1900: 422 (type locality: Lifu, Loyalty Islands).—Kropp, *et al.*, 1981: 39 (Guam, Mariana Islands; listed).

DIAGNOSIS: Front trilobate, median lobe only moderately produced. Two epibranchial spines; no supraocular, outer orbital, or hepatic spine. Merus of chelipeds with small lobe or low tooth on inner margin. Dorsal surface of carpus flattened, without longitudinal row of projecting tubercles. Dactyl of walking legs with four spines on posterior margin.

DESCRIPTION: Carapace about as long as broad, or slightly longer. Front trilobate; median lobe moderately produced beyond laterals; frontal area somewhat deflexed, with shallow median groove extending to protogastric lobes. Orbits deep; no supraocular spine; outer orbital angle sometimes produced into a small tooth. Hepatic margin unarmed. Two epibranchial spines. Dorsal surface of carapace with transverse rugae, except on metabranchial regions; rugae widely set on gastric and anterior branchial regions, usually strongest there and on posterior branchial regions, and with anterior margin minutely beaded and fringed with fine, closely set setae.

Basal segment of antennules transversely rugose, and with several spines and denticles anteriorly. First movable segment of antennae with spine-tipped lobe on anterior margin; second with small tubercle anteroproximally and sometimes with spinule anterodistally; third smooth; flagellum non-setose. Outer maxillipeds rugose.

Merus of chelipeds transversely rugose dorsally, with subproximal spine near outer margin; spine frequently present on outer part of distal margin; inner margin with small, triangular, crenulated lobe, this sometimes developed into low tooth; ventral surface faintly rugose, with two strong spines on inner distal margin. Carpus, not including inner marginal teeth, less than twice as long as broad; dorsal surface flattened, with oblique rows of distinct, widely set rugae, their distal margin beaded and fringed with fine setae; toward inner margin these rugae broken up into flattened tubercles; inner margin with four strong, serrated, spine-tipped teeth, one or more of which is occasionally divided into

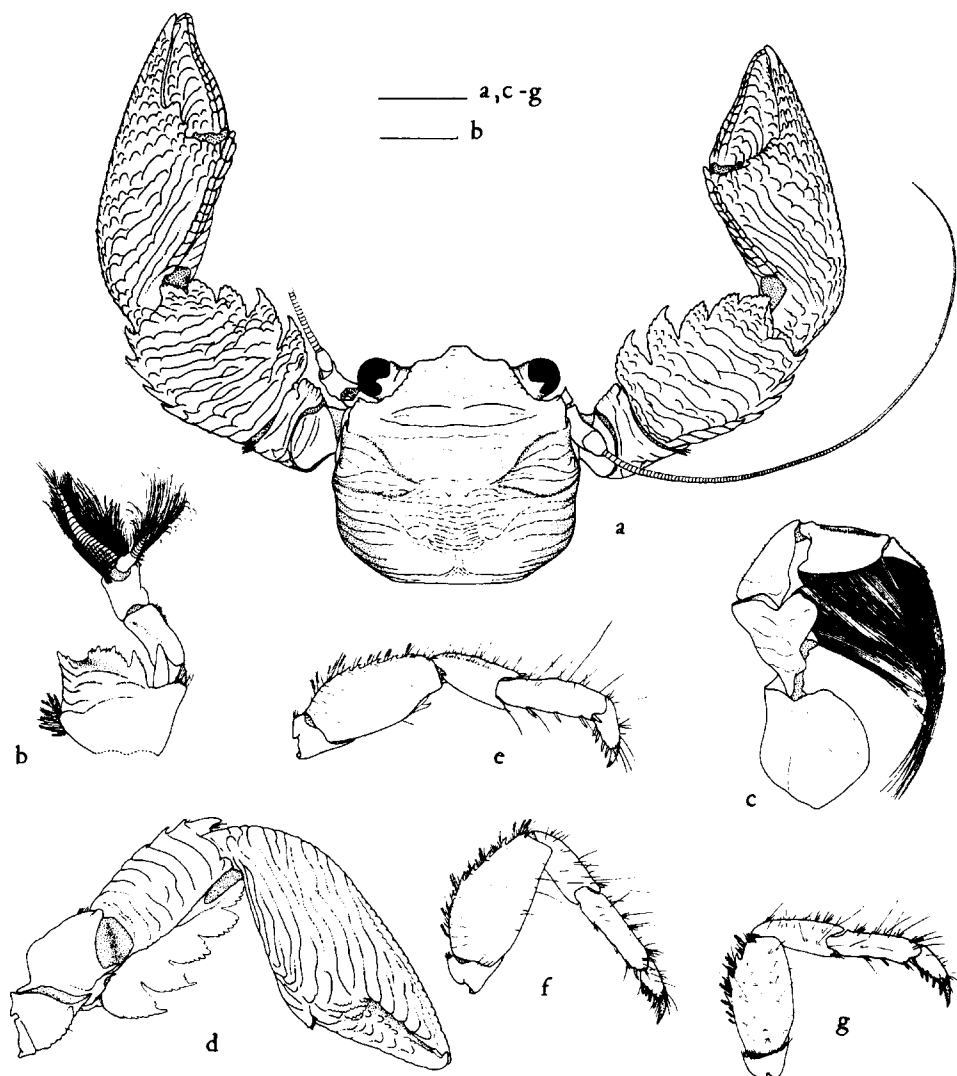


Fig. 1. *Petrolisthes bispinosus* Borradaile. (Enwetak Atoll, Marshall Islands, JWK-407.)
 a, carapace and chelipeds; b, right antennule; c, right 3d maxilliped; d, right cheliped,
 ventral view; e, f, g, right walking legs 1, 2, and 3. Scales: 3 mm (a, d-g), 1 mm (b),
 and 2 mm (c). [Short fringe of setae on rugae of carapace and chelipeds not shown.]

two; outer margin rugose, with row of five or six spines including one at distal end; ventral surface with transverse rugae, these faint or obsolete proximally. Palm with oblique rugae on dorsal surface, these distally beaded and setose as in carpus; rugae broken up into flattened tubercles toward outer margin and on fingers; ventral surface with oblique rugae. Gape of fingers with trace of pubescence.

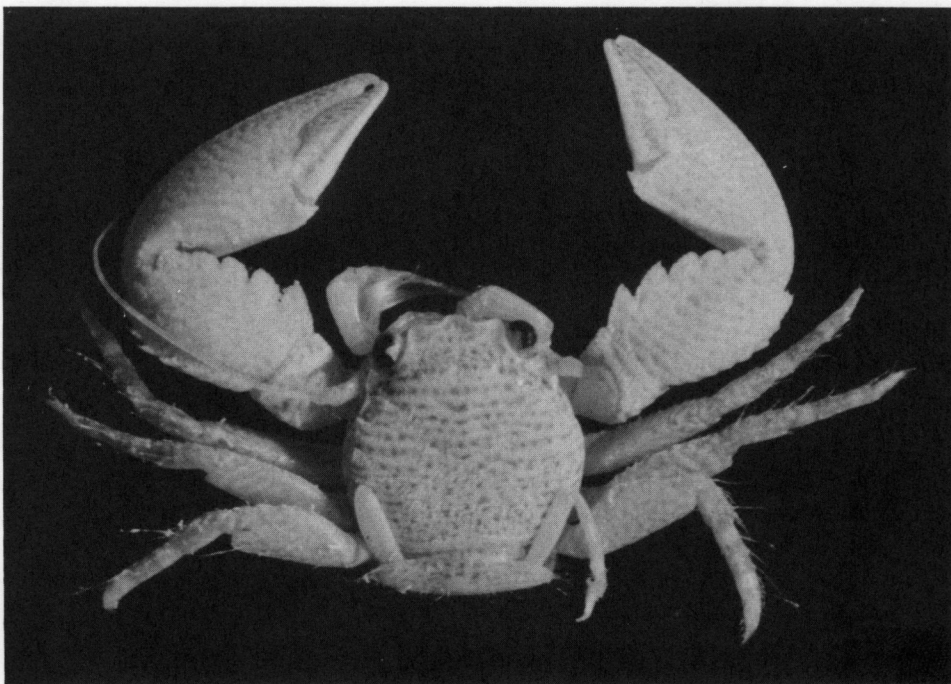


Fig. 2. *Petrolisthes bispinosus* Borradaile. (Enewetak Atoll, Marshall Islands, coll. C. A. Child.) Scale in millimeters.

First walking leg with merus transversely rugose on outer surface, anterior margin with four to six spines, posterodistal angle usually with very small spine, inner surface with strong spine on distal fourth of posterior margin; carpus with anterodistal spine; propodus with three movable spinules on posterior margin, in addition to distal pair; dactyl with four movable spinules on posterior margin. Leg 2 with merus transversely rugose, anterior margin with four to six spines, posterodistal angle usually with small spine; carpus sometimes with anterodistal spine; propodus and dactyl armed as in leg 1. Leg 3 with merus punctate, anterior margin with three to six spines, posterodistal angle unarmed; carpus with anterodistal angle unarmed; propodus and dactyl armed as in leg 1. Setation: Meri with fringe of short plumose setae on anterior margin; all segments with scattered long, non-plumose setae on margins and outer surface.

Abdomen rugose. Telson with seven plates.

VARIATIONS: Occasionally the rugae on the carpus and palm of the chelipeds are broken up over the entire dorsal surface into flattened, imbricated tubercles.

MATERIAL EXAMINED: Mariana Islands. Saipan; from coral head; 1945; A. H. Banner; 6♂, 9♀, USNM 222334.—Lagoon W. of Saipan; 6 May 1949; P. E. Cloud and party (Loc. D-6); 2♀, USNM 222333.—Guam, Luminao; 1 m, reef flat on rubble; 28 Mar. 1980; R. K. Kropp; 1♂, USNM 210530.—Guam, Luminao; 6 m, reef front under rock; 8 Sept. 1980; V. Tyndzyk; 1♀, AHF 2592-01.—Guam, Pago Bay; 3 m, on

reef rock; 16 Oct. 1979; R. K. Kropp; 2♂, AHF 2597-01.—Guam, Piti Bay; intertidal under rock, outer reef flat near margin S. of Camel Rock; 3 June 1981; R. K. Kropp; 1♂, BMNH 000000.—Guam, Piti Bay; ca. 0.75 m down into sponge-consolidated rubble, total depth ca. 1.25 m; outer reef flat near channel; 8 Oct. 1984; R. K. Kropp; 1♂, USNM 222553.—Guam, Toguan Bay; (1 m on rubble; reef margin to right of bay; 14 Feb. 1984; J. H. Dominguez; 1♀, 2 juv., USNM 222554.

Caroline Islands. Ifaluk Atoll, N. end Falarik Id.; outer reef flat, in mostly dead knobs of coralline algae; 22 Sept. 1953; Bayer team (# 372); 1 juv., USNM 222337.—Kapingamarangi Atoll, Tewawaelal; outer reef flat, surge zone; 14 July 1954; R. R. Rofen (Sta. 41); 1♂, 1♀, USNM 222335.—Kapingamarangi Atoll, Sokoro; 9 Aug. 1954; C. Hand (# 665); 1♂, USNM 222336.

Marshall Islands. Enewetak Atoll, JWK-56, 1♂, 2♀, AHF 2525-01; JWK-196, 2♀, AHF 2726-01; JWK-333, 1♂, AHF 2227-01; JWK-396, 1♂, 2♀, AHF 2728-01; JWK-407, 1♀, AHF 2729-01; JWK-615, 1♂, AHF 2730-01.—Enewetak Atoll, CAC 021-69, 1♀, USNM 222331; CAC 038-69, 1♀, USNM 222330.—Bikini Atoll, Namu Id.; outer reef; 7 Aug. 1947; J. P. E. Morrison (# 3168); 1♂, USNM 222332.

Loyalty Islands. Lifu, Sandal Bay; 1896–97; A. Willey; 1♂ (holotype), CNHM.

Howland Island. No further locality data; Sept. 1924; "Whippoorwill" Expedition; 1♂, BPBM; 1♀, USNM 222339.

Phoenix Islands. McKean Id.; on SW fringing reef, under rocks; Oct. 1968; P. M. Nielsen; 1 juv., AHF 2731-01.

Samoa. American Samoa; 1937; W. Harris; 1♂, AHF 2732-01.

Society Islands. Moorea, Nuarei Bay; reef; 11 May 1957; Bredin Expedition (Sta. 126–57); 1♀, USNM 222338.—Tahiti; 1925–26; C. Crossland; 5♀, BMNH.

MEASUREMENTS: Males, 2.6 to 8.0 mm; non-ovigerous females, 3.0 to 5.1 mm; ovigerous females, 3.2 to 7.7 mm.

LIVE COLORATION: Carapace, chelipeds, and walking legs reticulated dark olive-green with an overlay of many burgundy spots (these often persisting for quite some time in alcohol); rugae and cristate lateral margins of carapace lined with light blue; epibranchial spines burgundy. Propodus of walking legs dark olive green proximally, then with blue band followed by burgundy band distally; dactyl red proximally, light orange distally.

The specimens from Toguan Bay were quite different in color from the rest of the material from Guam. The overall color of the carapace, chelipeds, and walking legs was white, marked with light brown-orange as follows: anterior part of carapace with transverse lines, posterior carapace behind epibranchials with irregular spots; carpus of chelipeds with short transverse lines and spots, dactyl with one longitudinal stripe at upper and one at lower margin; legs with transverse bands.

HABITAT: Intertidal to a depth of 6 m. Generally found under small blocks and boulders or on pieces of dead coral rubble. Found in the intertidal rarely and only at very low tides. Not one of the "usual" intertidal species.

REMARKS: The original description of *Petrolisthes bispinosus* is not detailed enough to permit positive identification of our material with that taxon, even though no carapace spines other than the two epibranchials were mentioned and the merus of the chelipeds was said to have a "blunt lobe" on its inner margin. However, one of us

(J. Haig) examined the holotype in the collections of the Natural History Museum of Cambridge University and confirmed the identity of our specimens to Borradaile's species.

Petrolisthes bispinosus is less closely related to *P. decacanthus* and the new species than the latter two are to each other. It differs from them in its smaller size, less produced frontal region, lack of an outer orbital spine, presence of a small lobe rather than a strong tooth on the merus of the chelipeds, and possession of four movable spinules, instead of three, on the posterior margin of the dactyl of the walking legs.

Petrolisthes decacanthus Ortmann

Figs. 3, 4

Petrolisthes decacanthus Ortmann, 1897; 283, 285, pl. 17 fig. 2 (type locality: Tahiti, Society Islands).—Laurie, 1926: 141 (Praslin Id., Seychelles).—Haig, 1966: 45, 46 (in key to porcellanids of SW Indian Ocean; no new records).—Kropp *et al.*, 1981: 39 (Guam, Mariana Islands; listed).—Haig, 1983: 282 (Seychelles).

DIAGNOSIS: Front trilobate, median lobe strongly produced. Supraocular, outer orbital, hepatic, and two epibranchial spines present. Merus of chelipeds with well developed tooth on inner margin. Dorsal surface of carpus flattened, without longitudinal row of projecting tubercles. Dactyl of walking legs with three spines on posterior margin.

DESCRIPTION: Carapace usually slightly broader than long. Front trilobate, lobes with minutely crenulate margins; median lobe strongly produced beyond laterals; distinct median groove extending to protogastric lobes. Orbits deep; orbital margin armed with distinct supraocular spine; outer orbital angle produced into strong spine. Hepatic margin with well developed spine anteriorly, and occasionally with a more posteriorly placed spinule. Two epibranchial spines. Dorsal surface of carapace with transverse rugae, except on punctate metabranchial regions; rugae widely set on gastric regions, strongest there and on posterior branchial regions, appearing as granules or short rugae on anterior branchials; elsewhere usually faint, closely set, and broken up into short transverse lines. Rugosities with anterior margin minutely beaded, fringed with fine, closely set setae.

Basal segment of antennules with transverse rugae, and with several spines and denticles anteriorly. First movable segment of antennae with spine-tipped lobe on anterior margin; second with small tubercle anteroproximally; third smooth; flagellum non-setose. Outer maxillipeds rugose.

Merus of chelipeds transversely rugose dorsally, usually with subproximal spine near outer margin; distal margin with small spine near outer margin and another on outer third; inner margin with well developed, crenulated tooth, this tipped with one or two small spines; ventral surface rugose or nearly smooth, with two or three strong spines on inner distal margin. Carpus, not including inner marginal teeth, less than twice as long as broad; dorsal surface flattened, covered with large imbricated tubercles, these beaded on their distal margin and fringed with fine setae; tubercles frequently replaced by granules toward inner and outer margins; inner margin with four strong, serrated, spine-tipped teeth, their dorsal surface granulate; outer margin with row of seven or eight spines including one at distal end; ventral surface with transverse rugae and with inner margin strongly crenulate. Palm with low, submedian, longitudinal ridge; dorsal surface to inside of this ridge with

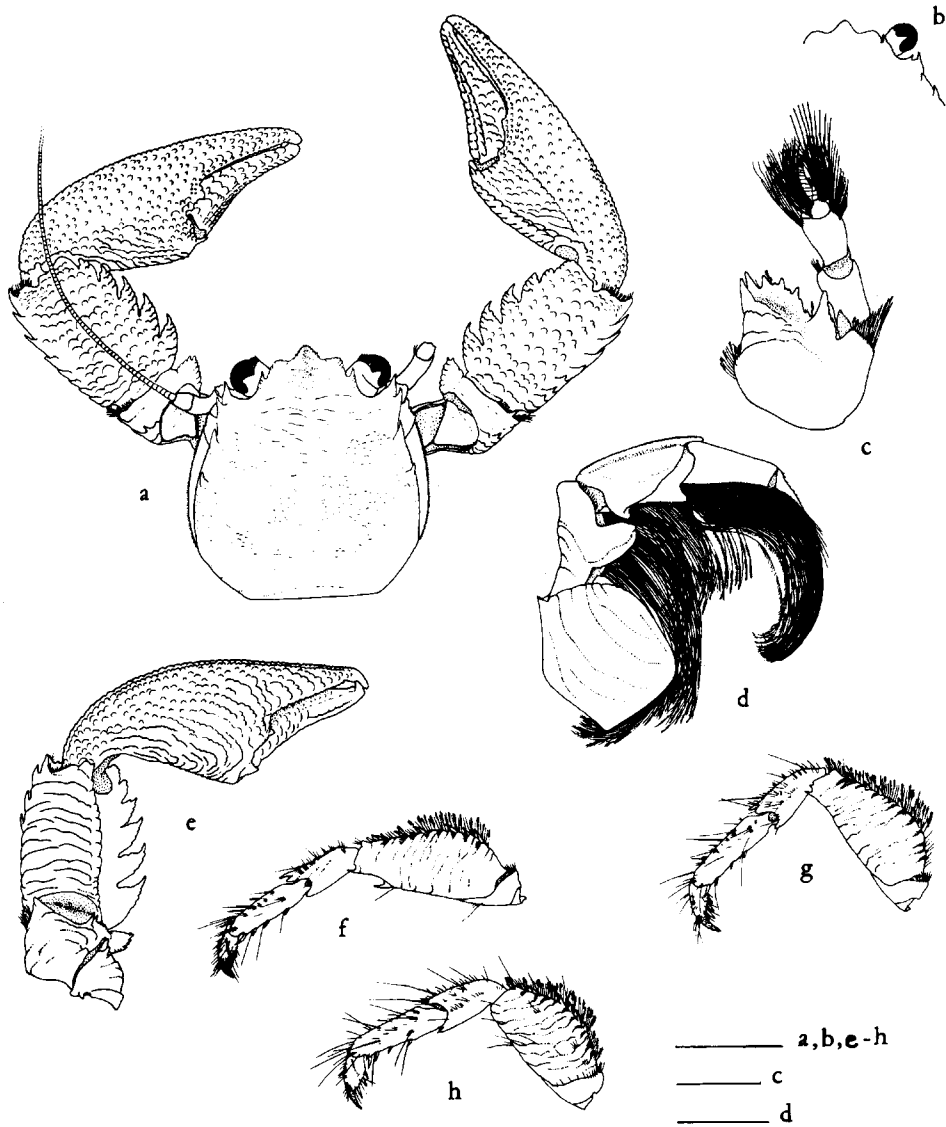


Fig. 3. *Petrolisthes decacanthus* Ortmann. (a, c-h, Saipan, Mariana Islands, coll. A. H. Banner; b, Ngaremediu reef, Palau Islands, Sta. 111-1172.) a, carapace and chelipeds; b, anterior part of carapace; c, right antennule; d, right 3d maxilliped; e, right cheliped, ventral view; f, g, h, left walking legs 1, 2, and 3. Scales: 4 mm (a, e-h), 3 mm (b), 1 mm (c), and 2 mm (d). [Short fringe of setae on rugae of carapace and chelipeds not shown.]

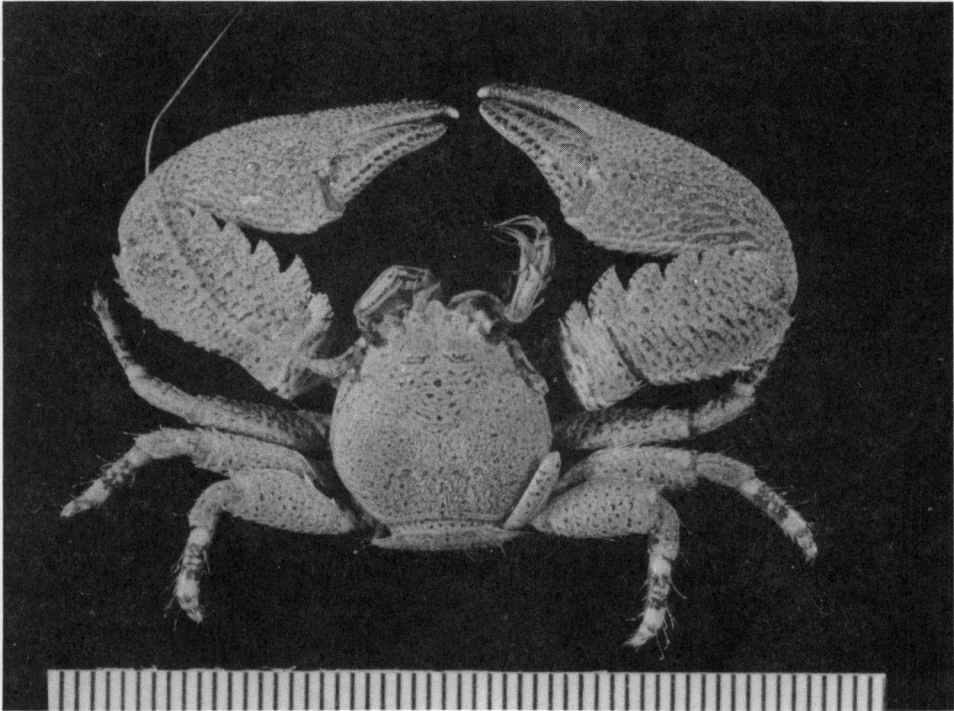


Fig. 4. *Petrolisthes decacanthus* Ortmann. (Enewetak Atoll, Marshall Islands, coll. C. A. Child.) Scale in millimeters.

flattened imbricated tubercles or small, widely set granules; surface to outside of ridge, and surface of fixed finger, with small, widely spaced granules; surface of dactyl with longitudinal row of flattened imbricated tubercles; ventral surface of chela with oblique rugae, these strongly beaded on edge, and sometimes broken up toward outer margin and on fixed finger into small groups of widely set granules. Gape of fingers with trace of pubescence.

First walking leg with merus transversely rugose on outer surface, anterior margin with five to eight spines, a distinct posterodistal spine, inner surface with strong spine (rarely two) on distal fourth of posterior margin; carpus with anterodistal spine; propodus with three movable spinules on posterior margin in addition to distal pair; dactyl with three movable spinules on posterior margin. Leg 2 with merus transversely rugose, anterior margin with five to seven spines, a distinct posterodistal spine; carpus with anterodistal spine; propodus and dactyl armed as in leg 1. Leg 3 with merus transversely rugose, anterior margin with four or five spines, posterior margin unarmed or with minute spinule distally; carpus unarmed anterodistally; propodus and dactyl armed as in leg 1. Setation: Meri with dense fringe of short plumose setae on anterior margin, rugae of outer surface fringed with fine, closely set setae; carpi with tufts of short plumose setae near anterior

margin; carpi, propodi, and dactyli with scattered long, non-plumose setae on margins and outer surface.

Abdomen smooth; dorsally visible articles occasionally with a transverse groove. Telson with seven plates.

VARIATIONS: In some of our material the hepatic spine is as large as, or larger than, the outer orbital spine and the two extend to about an equal distance anteriorly, giving the appearance of a bispinate outer orbital angle (fig. 3b). This condition occurs in our specimens from the Glorioso Islands, West Coral Sea, and Samoa, and in part of the material from the Palau Islands and Enewetak Atoll, as well as in several individuals from the Seychelles (Haig, 1983). It appears to be a function of size, since it was observed in specimens with the carapace length 3.2 to 6.2 mm in males, 4.6 to 5.8 mm in non-ovigerous females, 4.4 to 7.5 mm in ovigerous females, and to 4.3 mm in juveniles; whereas specimens with a "typical" hepatic spine measure 6.0 to 12.2 mm in males, 5.2 to 11.1 mm in non-ovigerous females, and 9.2 to 12.8 mm in ovigerous females. In a 3.0 mm specimen from Pago Bay, Guam, there is no outer orbital spine and the hepatic spine is very small.

MATERIAL EXAMINED: Glorioso Islands. Grande Glorieuse; intertidal zone; 30 Jan. 1971; A. Crosnier; 2 ♀, AHF 2734-01.

Maldives. Gan Id.; 25 Aug. 1964; P. Davis; 1 ♀, BMNH 1966:2:1:23.

Palau Islands. E. side of Urukthapel, Ngaremediu reef, 7°13'09"N, 134°26'40"E; reef flat; 19 Aug. 1955; Bayer team (Sta. 111-1172); 1 ♂, 1 ♀, USNM 222341.—No further locality data; 19 Nov. 1908; C. Grethe; 1 ♀, ZMH.

Mariana Islands. Saipan; from coral head; 1945; A. H. Banner; 1 ♀, USNM 222343.—Guam, Togcha Bay; reef flat, tidepool; 23 Sept. 1967; R. S. Jones; 1 ♂, AHF 2586-02.—Guam, Pago Bay; 3 m, reef front on coralline algae and rubble; 16 Oct. 1979; R. K. Kropp; 1 ♂, 1 ♀, USNM 210534.

Caroline Islands. Yap, NE side; from coral head on sand flat; 1950; R. W. Hiatt (# Y-249N); 1 ♀, USNM 222342.—Kapingamarangi Atoll, Tewawaelal; outer reef flat, surge zone; 14 July 1954; R. R. Rofen (Sta. 41); 1 ♀, USNM 222340.

West Coral Sea. Marion Reef, south cay, 19°17'S, 152°13'E; reef flat at low water; 12 May 1979; N. L. Bruce, R/V "Lady Basten" (Sta. LB-10); 1 ♀, NTM.

Marshall Islands. Enewetak Atoll; no further data; J. W. Knudsen; 1 ♀, AHF 2733-01.—Enewetak Atoll, JWK-396; 1 ♂, 3 ♀, AHF 2728-02.—Enewetak Atoll, CAC 021-69, 2 ♂, 2 ♀, USNM 222344; CAC 038-69, 12 ♂, 16 ♀, 2 juv., USNM 222321.

Samoa. American Samoa; 1937; W. Harris; 1 ♀, AHF 2732-02.

MEASUREMENTS: Males, 3.0 to 12.2 mm; non-ovigerous females, 4.6 to 11.1 mm; ovigerous females, 4.4 to 12.8 mm; juveniles, 4.1 and 4.3 mm.

LIVE COLORATION: No information is available.

HABITAT: Subtidal to 3 m; on large blocks of reef rock having many crevices among them, or on coralline algae.

REMARKS: Several years ago J. Haig examined six syntypes of this species, which are housed in the Academy of Natural Sciences of Philadelphia. They proved to be badly fragmented and quite useless for purposes of identification—an observation recently confirmed for us by R. H. Gore. Fortunately, however, the species can be recognized from the

original description (Ortmann, 1897: 285–6). In particular, Ortmann mentioned the supraocular spine, the spiniform outer orbital angle, a spine behind the latter and anterior to the cervical groove (i.e. the hepatic spine), and two epibranchial spines behind the cervical groove.

In a key to several species of *Petrolisthes* with rugose carapaces (p. 283), Ortmann erroneously stated that *P. decacanthus* has two spines on the posterior side of the carapace in addition to the epibranchials (“Zwei Epibranchialdörnchen auf jeder Seite. Ferner stehen an der hintern Seite 2 Dörnchen”). It is unlikely that he was referring to spines on the lateral carapace margin behind (i.e. posterior to) the epibranchials, because no such spines were mentioned in the description. Probably “hintern Seite” was a lapsus on the part of the author, and he meant the two spines (outer orbital and hepatic) on the anterior part of the lateral margin.

Petrolisthes eldredgei, n. sp.

Figs. 5, 6

Petrolisthes n. sp. 4.—Kropp *et al.*, 1981: 39 (Guam, Mariana Islands; listed).—Kropp and Eldredge, 1982: 125 (Guam, Mariana Islands; listed).

DIAGNOSIS: Front trilobate, median lobe strongly produced. Outer orbital and two epibranchial spines; no supraocular or hepatic spine. Merus of chelipeds with well developed tooth on inner margin. Dorsal surface of carpus with longitudinal row of prominent, projecting tubercles. Dactyl of walking legs with three spines on posterior margin.

DESCRIPTION: Carapace usually slightly broader than long. Front trilobate; median lobe strongly produced beyond laterals; distinct median groove extending to proto-gastric lobes. Orbits deep; no supraocular spine on orbital margin; outer orbital angle produced, usually into strong spine. Hepatic margin unarmed. Two epibranchial spines. Dorsal surface of carapace with transverse rugae; these widely set on gastric regions, elsewhere closer together; broken up into transversely elongate tubercles on anterior branchial regions, fainter and appearing as rows of small flattened granules on frontal and metabranchial regions, elsewhere forming distinct transverse lines interrupted only at grooves separating regions. Anterior margin of rugae minutely beaded, and fringed with fine, closely set setae.

Basal segment of antennules transversely rugose, and with several spines and denticles anteriorly. First movable segment of antennae with spine-tipped lobe on anterior margin; second with small tubercle or blunt spine anteroproximally; third smooth; flagellum non-setose. Outer maxillipeds rugose.

Merus of chelipeds transversely rugose dorsally, usually with subproximal spine near outer margin; distal margin with one or two spines on outer third; inner margin with strong, crenulated tooth; ventral surface rugose, with two or three prominent spines on inner distal margin. Carpus, not including inner marginal teeth, less than twice as long as broad; dorsal surface with median longitudinal row of prominent tubercles, these strongly raised and beaded at their distal end; elongate rugae, widely set granules, or small imbricated tubercles to outside of this row, and small, widely set granules and a few tubercles to inside; inner margin with four strong, serrated, spine-tipped teeth, their dorsal surface granulate; outer margin with row of six or seven spines including one at distal end; ventral

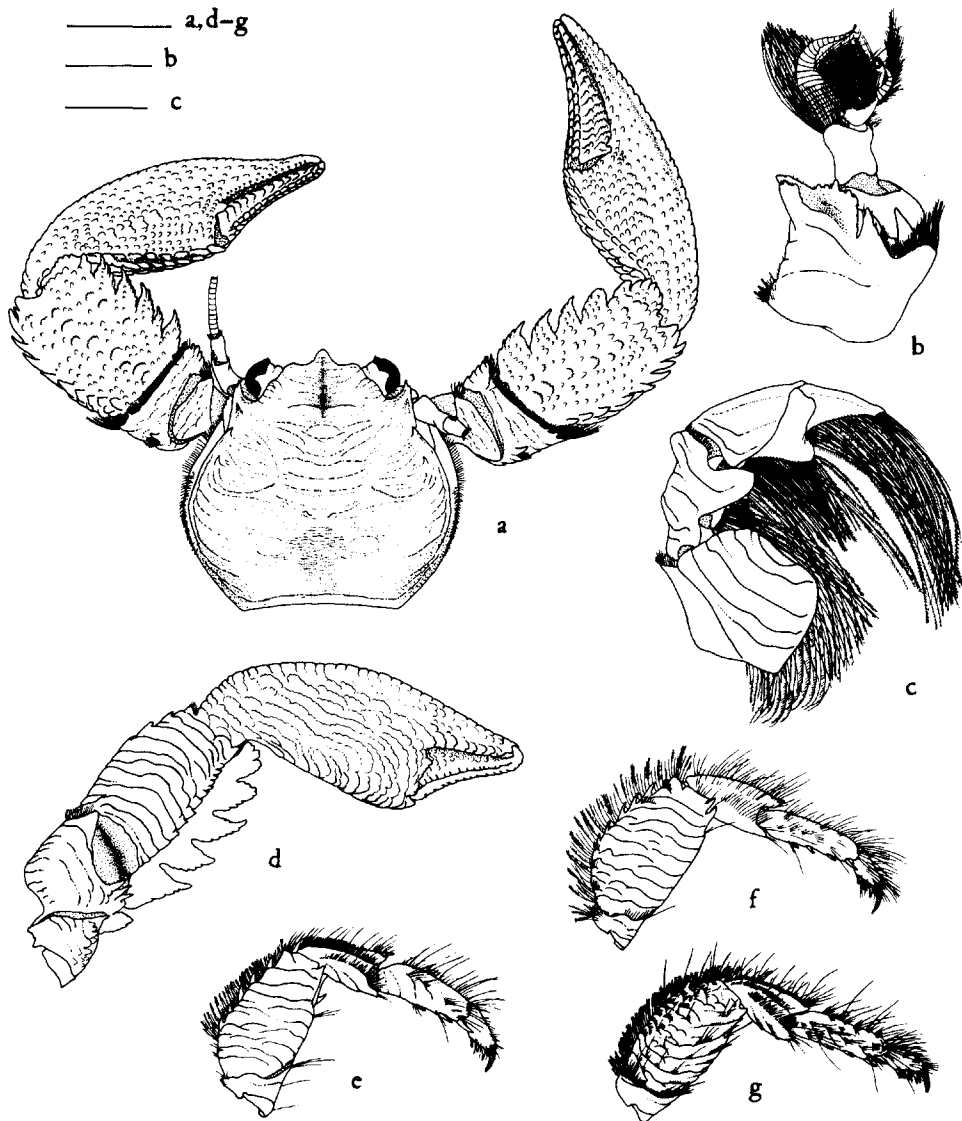


Fig. 5. *Petrolisthes eldredgei*, new species. (Enewetak Atoll, Marshall Islands, CAC 038-69.) a, carapace and chelipeds; b, right antennule; c, right 3d maxilliped; d, right cheliped, ventral view; e, f, g, right walking legs 1, 2, and 3. Scales: 4 mm (a, d-g), 1 mm (b), and 2 mm (c). [Short fringe of setae on rugae of carapace and chelipeds not shown.]