

A REVISION OF THE PACIFIC SPECIES OF  
GALL CRABS, GENUS *OPECARCINUS*  
(CRUSTACEA: CRYPTOCHIRIDAE)

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A B S T R A C T

Pacific species of the gall crab genus *Opecarcinus* are reviewed. *O. granulatus* (Shen), by having a much less ornate carapace and having the cornea situated anterolaterally on the eyestalk, differs from *O. crescentus* (Edmondson), which has a carapace ornamented with numerous tubercles and the cornea situated terminally on the eyestalk, and is removed from the synonymy of *O. crescentus*. Five new species are described: *O. aurantius*, having a very elongate antennular peduncle; *O. lobifrons*, having the internal orbital angle exceeding the anterolateral angle of the carapace; *O. pellops*, living specimens having a blue-black cornea; *O. pholeter*, having 3 longitudinal depressions on the posterior carapace; and *O. sierra*, having a convex carapace with many larger, subequal, conical tubercles. All of these species were found on agariciid corals. The genus is known from the eastern Indian Ocean, the Pacific Ocean from Asia to Baja California, and from the Atlantic Ocean. A key to all species of the genus is provided.

The cryptochirid genus *Opecarcinus* was defined by Kropp and Manning (1987) to include two species, *O. hypostegus* (Shaw and Hopkins, 1977) found in the Atlantic Ocean and *O. crescentus* (Edmondson, 1925) found in the Pacific Ocean. Species in this genus occur on agariciid and siderastreid corals, where they usually live in tunnels on the coral surface or in crescent-shaped pits in the corallum.

I collected a large suite of material of *Opecarcinus* in the course of research on coral symbionts in Micronesia. Among the crabs collected were many specimens not fitting within the definitions of the two presently known species. These are herein recognized as five new species. Additionally, I examined the type of *Cryptochirus granulatus* Shen, 1936 and found evidence for its removal from the synonymy of *O. crescentus*. A key to all known species of *Opecarcinus* is provided.

MATERIALS AND METHODS

I obtained the type specimens of *Cryptochirus granulatus* Shen from the British Museum (Natural History), London, England (BMNH), the type of *Cryptochirus crescentus* Edmondson from the B. P. Bishop Museum, Honolulu, Hawaii (BPBM), and the type of *Pseudocryptochirus hypostegus* Shaw and Hopkins from the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). Specimens of *C. crescentus* were obtained from the BMNH, the Allan Hancock Foundation, Los Angeles, California (AHF), the Muséum National d'Histoire Naturelle, Paris, France (MNHN), Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands (RMNH), and the Zoological Museum, Copenhagen, Denmark (ZMC). The remainder of the material examined was collected by me (collection numbers denoted by HAP and PHAP) in Micronesia during 1984 and L. G. Eldredge at Johnston Atoll in 1983 and is deposited in the USNM.

Drawings were made with a camera lucida mounted on a Wild M-5 or M-20 microscope. The cheliped was drawn so that the outer surface of the manus is parallel to the plane of the printed page which distorts the other segments somewhat. Setae on the surfaces of the carapace and pereopods are not shown. The carapace length and width of each specimen were measured to the nearest 0.1 mm with an ocular micrometer on a Wild M-5 microscope and are reported in mm as length  $\times$  width. Abbreviations used in the text are: ALA, anterolateral angle of carapace; IOA, internal orbital angle of carapace; km, kilometers; m, meters; MXL, maxilla; MXP, maxilliped; ov, ovigerous; P, pereopod; and PLP, pleopod.

In this study I use the term tubercle to describe several cuticular projections in which the basal width is about  $\frac{1}{2}$  or more than the height; conical tubercles are those having a relatively acute apex



(Fig. 2b); rounded tubercles have a broadly rounded apex (Fig. 2c); and angled tubercles the height of which is much less than the basal width (Fig. 1g). Other cuticular projections include spines, in which the basal width is much less than  $\frac{1}{2}$  the height (Fig. 10a), and granules, generally small, round slightly raised structures (Fig. 1c). Orbits are defined as deep, in which the depth is greater than half the width, and shallow, in which the depth is much less than half the width (Figs. 1a, 5a, respectively). The lateral margin of the female gonopore of some species has a mesial expansion at the anterior end that I refer to as a hood (Fig. 1d). Setal terminology follows that of Kunze and Anderson (1979).

The degree of ornamentation of the carapace varies within species. Many individuals, particularly juveniles, are smoother than others. For this reason degree of tuberculation and granulation are not useful in separating species. Degree of setation on the carapace also seems variable, with a few exceptions. Species accounts are based on the holotype or a representative specimen. Variations occurring among the other material examined are placed within brackets where appropriate. Some proportions appear to be useful in characterizing certain species. These are given for the primary specimen, with the range of variation occurring among the other material examined included within brackets.

Color is based on freshly collected material from Micronesia.

At the first occurrence of a collection locality in the text, the latitude and longitude are given. For some localities new orthographic spellings have been advocated (Motteler, 1986). At the first occurrence of these localities in the text the new orthography is given followed parenthetically by the former spelling. Subsequently, only the new spelling is given. Specific locality names in Micronesia (except Guam) are from Bryan (1971). Guam names are from a United States Geological Survey topographic map. Geographic records from the literature are given in brackets in the synonymies.

#### KEY TO THE SPECIES OF *OPECARCINUS* (BASED ON FEMALES)

1a. Cornea anterolateral .....	2
1b. Cornea terminal .....	4
2a. Distal margin of antennule longer than lateral margin (ventral view) .....	3
2b. Distal margin of antennule shorter than lateral margin (ventral view) .....	<i>O. hypostegus</i>
3a. P-5 carpus smooth .....	<i>O. pholeter</i>
3b. P-5 carpus tuberculate dorsally .....	<i>O. granulatus</i>
4a. Sternite of P-2 smooth laterally; antennule base oblique .....	5
4b. Sternite of P-2 tuberculate laterally; antennule base transverse .....	6
5a. IOA extends beyond ALA; distal margin of antennule shorter than lateral margin ...	<i>O. lobifrons</i>
5b. IOA not extending beyond ALA; distal margin of antennule longer than lateral margin .....	<i>O. aaurantius</i>
6a. Dorsal margin of P-2 notched distally; dorsal margin of cornea irregularly sinuous ....	<i>O. peliops</i>
6b. Dorsal margin of P-2 not notched distally; dorsal margin of cornea evenly concave .....	7
7a. Carapace strongly convex; anterior depression restricted to protogastric region .....	<i>O. sierra</i>
7b. Carapace relatively flat; anterior depression extending to epibranchial region .....	<i>O. crescentus</i>

#### SYSTEMATIC ACCOUNT

##### *Opecarcinus crescentus* (Edmondson, 1925)

##### Figures 1, 2

- Cryptochirus crescentus* Edmondson, 1925: 33, fig. 6a-i, pl. 1B-C [Johnston Atoll]; 1933a: 16, pl. 4C-D [Teraina = Washington Is.]; 1933b: 233 [Hawaii].—Shen, 1936: 23.—Hiro, 1937: 142; 1938: 149.—Utinomi, 1944: 688.—Edmondson, 1946: 273 [Hawaii].—Fize and Serène, 1957: 9 [Vietnam].—Serène, 1962: 30.—Garth, 1974: 398.—Takeda and Tamura, 1980b: 138; 1980c: 46.
- Pseudocryptochirus crescentus*.—Utinomi, 1944: 701, figs. 5D, 6D, 7C, 7F, 10, 11H, 12C, 14B, 15C, 15G, 16C, 16D, 17.—Serène, 1966: 396.—Garth and Hopkins, 1968: 41.—Garth, 1974: 401.—Serène et al., 1974: 20 [Indonesia].—Shaw and Hopkins, 1977: 179.—Monod and Serène, 1976: 26.—McCain and Coles, 1979: 85.—Takeda and Tamura, 1980a: 57; 1980b: 138; 1980c: 47; 1981: 14, fig. 1, pl. 2 [Japan]; 1983: 1; 1986: 63, fig. 4.
- Troglocarcinus crescentus*.—Fize and Serène, 1957: 5, figs. 10, 11C, 11D, 12B, pl. 3; figs. 4-7, pl. 5; fig. 2.—Serène, 1962: 31.—Garth and Hopkins, 1968: 41 [Mexico].—Maragos, 1977: 186.
- Opecarcinus crescentus*.—Kropp and Manning, 1987: 9.

*Material Examined*.—Holotype: JOHNSTON ATOLL; "Tanager" 1923; on *Pavona duerdeni* Vaughan, 1907; ♀ (ov); BPBM S1805. Other material: VIETNAM: Nhatrang [12°14'N, 109°12'E]; Rte. 1588; [no specific locality or host recorded]; 1 ♂; Rte. 1644 (Bai Suot); 31 Mar 1956; [no host recorded]; 1 ♀ (ov); BMNH 1958.10.20.3-4. THAILAND: Ko Kaeo [07°45'N 98°18'E], Phuket; 12 Nov 1972;

Coll. Serène and Lundøer; [no host recorded]; 6 ♀ (ov), 3 ♂; ZMC. INDONESIA: Moluccas; Expedition Rumphius I; 11 Jan 1973; CB 307; [no host recorded]; 1 ♀ (ov), 1 ♂; MNHN B.12667. BELAU (Palau): Ulong (Aulong) Is. [07°16'N, 134°17'E]; fringing reef on west coast of island; 1 m; 28 Jun 1984; PHAP 035; on *Pavona venosa* (Ehrenberg, 1834); 1 ♀ (ov), 3 ♂; USNM 234254. Ngeruktabel (Urukthapel) Is. [07°15'N, 134°24'E]; patch reef in bay on northeast coast, facing Ngemelachel (Malakal) Pass; 1 m; 5, 20 Jul 1984; PHAP 068, 071, 141; on *P. cactus* (Forsk., 1775), *P. venosa*; 13 ♀ (7 ov), 5 ♂; USNM 234255. Ngeruktabel Is.; north shore, at west end of rock islands; 2 m; 22 Jul 1984; PHAP 165; on *P. explanulata* (Lamarck, 1816); 1 ♀ (ov), 1 ♂; USNM 234256. Ngemelachel Is. [07°20'N, 134°28'E]; south of Marine Mariculture Demonstration Center (MMDC); 2 m; 18 Jul 1984; PHAP 126; on *P. explanulata*; 3 ♀ (ov). GUAM: Double Reef [13°36'N, 144°50'E]; fringing reef; 3 m; 7 Feb 1984; HAP 073; on *P. varians* Verrill, 1864; 2 ♀ (ov), 1 ♂; from main patch reef; 6 m; 24 Feb 1984; HAP 121; on *P. duerdeni*; 2 ♀ (1 ov, 1 with cryptoniscine isopod attached to inside of abdominal pouch), 1 ♂; USNM 234257. Agaña Bay [13°29'N, 144°46'E]; reef front off Alupat Is.; 8 m; 20 Feb 1984; HAP 108; on *P. duerdeni*; 1 ♀, 1 ♂; reef flat north of boat basin channel; 1 m; 5 Mar 1984; HAP 145; on *P. venosa*; 2 ♀ (1 ov), 1 ♂. Piti Bay [13°29'N, 144°42'E]; north side of bay at mid reef flat; 1 m; 26 Jan 1984; HAP 038; on *P. decussata* (Dana, 1846); 5 ♀ (3 ov); USNM 234258. Luminao Reef [13°28'N, 144°39'E]; reef flat; 1 m; 13, 27 Oct 1984; HAP 319, 361; on *P. varians*, *Pavona* sp.; 6 ♀ (ov), 2 ♂. Calalan Bank [13°27'N, 144°38'E]; reef front near Magundas; 10 m; 16 Oct 1984; HAP 334; on *P. duerdeni*; 2 ♀ (ov). Apra Harbor [13°27'N, 144°38'E]; patch reef at Western Shoals; 21 m; 15 Mar 1984; HAP 170; on *P. divaricata* (Lamarck, 1816); 3 ♀ (2 ov); USNM 234259. Agat Bay [13°24'N, 144°39'E]; 0.8 km north of Nimitz Beach; reef front; 14 m; 29 Mar 1984; HAP 186; on *Gardineroseris planulata* (Dana, 1846); 4 ♀ (3 ov), 2 ♂; reef flat; 1 m; 29 Mar 1984; HAP 187; on *Pavona* sp.; 3 ♀ (1 ov), 1 ♂. Fouha Bay [13°18'N, 144°39'E]; south wall of channel; 8 m; 26 Apr 1984; HAP 214; on *P. explanulata*; 1 ♀ (ov). TRUK: off Moen Is. [07°26'N, 151°52'E]; 11 Apr 1981; HAP 084; on *P. maldiviensis* (Gardiner, 1905); 1 ♀ (ov); USNM 234260. JOHNSTON ATOLL: Pres. R. Gurney; on *P. duerdeni*; 1 ♀, 1 ♂; BMNH 1949.v.4.1-2; East, North Islands; 1 m; 24 Oct 1983; HAP 052, 053; Coll. L. G. Eldredge; on *Pavona* sp.; 4 ♀ (ov); USNM 234261. HAWAII: Oahu; Waikiki [21°17'N, 157°50'W]; reef off Waikiki Aquarium; 1.5 m; 18 Dec 1984; HAP 429; on *P. varians*; 2 ♀ (1 ov); USNM 234262. MEXICO: Baja California; El Tule Ranch, 6 km east of Cabo San Lucas [22°53'N, 109°54'W]; Jun 1965; Coll. G. F. Crozier; [host not recorded, but listed as *P. gigantea* Verrill, 1869 by Garth and Hopkins (1968)]; 2 ♀ (1 ov); AHF 2776-01.

*Size Range.*—Females, 1.4 × 1.2 to 4.4 × 3.8; ovigerous females, 2.1 × 1.8 to 4.0 × 3.3; males, 1.5 × 1.2 to 3.6 × 2.9.

*Type Data.*—Holotype: ♀ (ov), 2.1 × 1.8; BPBM S1805. Type locality: Johnston Atoll [16°45'N, 169°32'W]. Other types: Edmondson (1925) only designated a "type specimen," the holotypic female. He also described males, but the whereabouts of these specimens is not known. The BMNH material (a male and female) from Johnston Atoll listed among the material examined is accompanied by a note reading "may be type material," but Edmondson did not mention depositing any types in the BMNH. That the material was deposited in 1949 reduces the likelihood that these specimens are types.

*Description.*—Adult female (Holotype, Fig. 1): Carapace 1.2 [1.1–1.3] times longer than wide. Anterior 1/3 of carapace moderately deflected, not sharply set off from posterior carapace, with transverse depression extending from frontal margin, across protogastric region, to anterolateral angles (ALA) and epibranchial margin of carapace. Posterior 2/3 of carapace with elongate H-shaped depression extending from gastric to cardio-intestinal region. Transverse section of carapace at mid-length convex overall, median 1/3 slightly [markedly] concave, with few conical tubercles, scattered setae longer [much longer] than tubercles. Carapace surface ornamented with many rounded and conical tubercles, largest, most numerous at midlength, diminishing slightly in size and number posteriorly. Anterolateral margins of carapace with few conical tubercles, ALA lacking prominent tubercle. Inner orbital angles (IOA) marked with tubercle, slightly inflated, totally elevated above level of and extending to or just beyond apex of ALA. Front concave with few smaller tubercles, lacking prominent median tubercle, width 0.5 [0.4–0.5] that of carapace at ALA, latter 0.7 [0.5–0.7] that of greatest carapace width. Orbit deep, broadly V-shaped, margin with few tubercles.

Basal segment of antennular peduncle transverse, slightly inflated mesially, with distal projection having apex of angled lateral lobe extending beyond eyestalk;

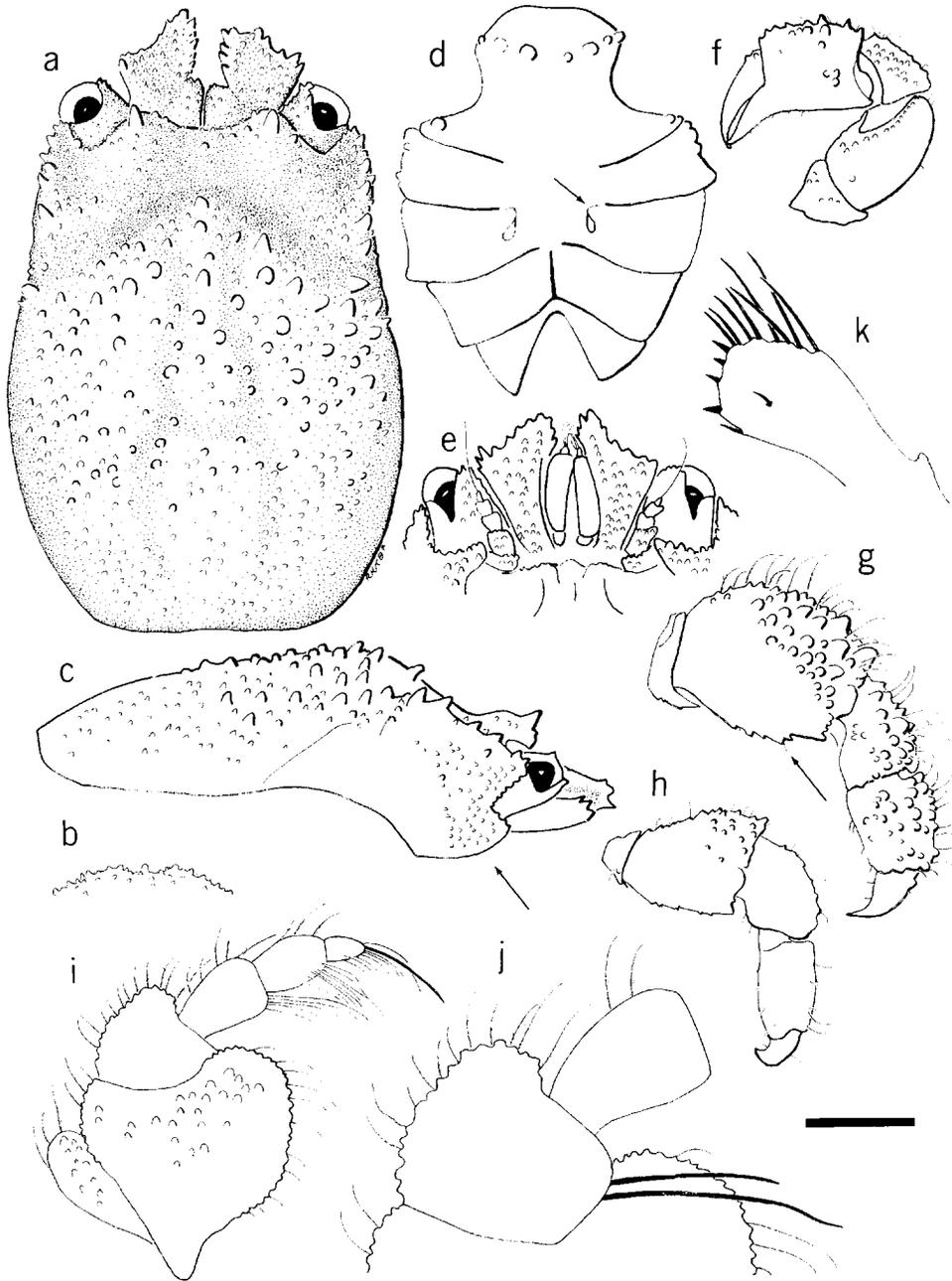


Figure 1. *Opecarcinus crescentus* (Edmondson), ♀, Holotype. (Johnston Atoll: BPBM S1805): a, carapace (dorsal view); b, carapace (transverse section at midlength); c, carapace (lateral view, arrow points to granules); d, thoracic sternites (arrow points to gonopore hood); e, eyes, antennules (ventral view); f, left P-1; g, right P-2 (arrow points to angled tubercles); h, right P-5; i, MXP-3 (outer view); j, MXP-3 (inner view of merus); k, MXL-1 (outer view). Scale: a, c-h = 0.5 mm; b = 1 mm; i, k = 0.3 mm; j = 0.2 mm.

dorsal surface concave with few scattered smaller tubercles; margin with 6–10 subequal spines. In ventral view, basal segment broadening distally, length 2.2 [2.0–2.5] times width; distal margin shorter than lateral margin; surface convex with scattered granules.

Eyestalk partially exposed dorsally. Cornea terminal, in dorsal view, occupying about ½ length of stalk, dorsal margin evenly concave, lateral margin just reaching ALA.

Mesial margin of ischium of MXP-3 coarsely crenulated; lateral margin of merus strongly produced distally, mesial margin with 2 plumo-denticulate setae. Mesial margin of MXL-1 with 4 stout simple setae, lower margin with 1 stout simple seta; outer surface with 1 serrate seta, not extending beyond mesial margin.

Sternite of cheliped (P-1) with transverse row of 7 [5–8] rounded [conical] tubercles at midlength, none posteriorly. Sternite of first walking legs (P-2) smooth, with tubercles at lateral margin. Gonopore elliptical, lateral margin having [lacking in some specimens] anterior hood.

Manus of P-1 1.8 [2.1–2.3] times longer than high. Dactylus subequal in length to dorsal margin of palm, with proximal tubercle dorsally; cutting edges of fingers entire. Dorsal margin of palm with few scattered conical tubercles along entire length, few rounded tubercles; outer surface of palm flat with few granules proximally. Dorsal margin of carpus lacking [present in some specimens] prominent tubercle distally. Merus shorter, taller than manus, ventral margin granular.

Merus of P-2 1.2 [1.3–1.4] times longer than high; dorsal margin moderately convex with larger conical tubercles on distal half; ventral margin convex, tuberculate, moderately emarginate distally; distoventral angle produced into prominent tubercle; outer surface with many larger rounded tubercles on distodorsal half, with elevated transverse row of rounded tubercles distoventrally. Propodus 1.0 [1.1] times longer than high, dorsal margin as long as that of carpus.

Merus of last walking leg (P-5) 1.4 [1.7–1.9] times longer than high; dorsal margin with tubercles along entire length; ventral margin straight, with few angled tubercles; distoventral angle formed into blunt tubercle; outer surface with many tubercles dorsodistally. Dorsal margin of carpus with few tubercles. Propodus 1.6 [2.5–2.9] times longer than high; dorsal margin entire.

Adult male (Vietnam, BMNH 1958.10.20.3, Fig. 2): Carapace ornamentation similar to female; posterior carapace with slight median H-shaped depression. IOA marked with tubercle, extending to or just exceeding ALA. Eyestalk similar to female; cornea terminal, lateral margin extending just beyond ALA. P-1 slightly more robust than female, manus length 1.7 times height. Dorsal margin of dactylus with few conical tubercles proximally, cutting edge with low tooth proximally, dactylus slightly shorter than dorsal margin of palm, latter with subequal conical tubercles along entire margin; ventral margin of palm entire. Dorsal margin of merus of P-2 convex, with conical tubercles on distal half; ventral margin scarcely convex, with few angled tubercles at midlength. Dorsal margin of merus of P-5 with angled tubercles; ventral margin with few tubercles distally; dorsal margin of carpus with few tubercles. Sternite of P-1 with 7 conical tubercles at midlength, 12 granules posteriorly. PLP-1 (Guam, USNM) with plumose seta at proximo-mesial angle.

*Color.*—Adult female: Carapace overall off-white; posterior carapace with 4 longitudinal black bands, similar transverse band at apex of carapace; anterior depression red-brown. Cornea dark red, may have white spot.

*Comparisons.*—See “Discussion” section.

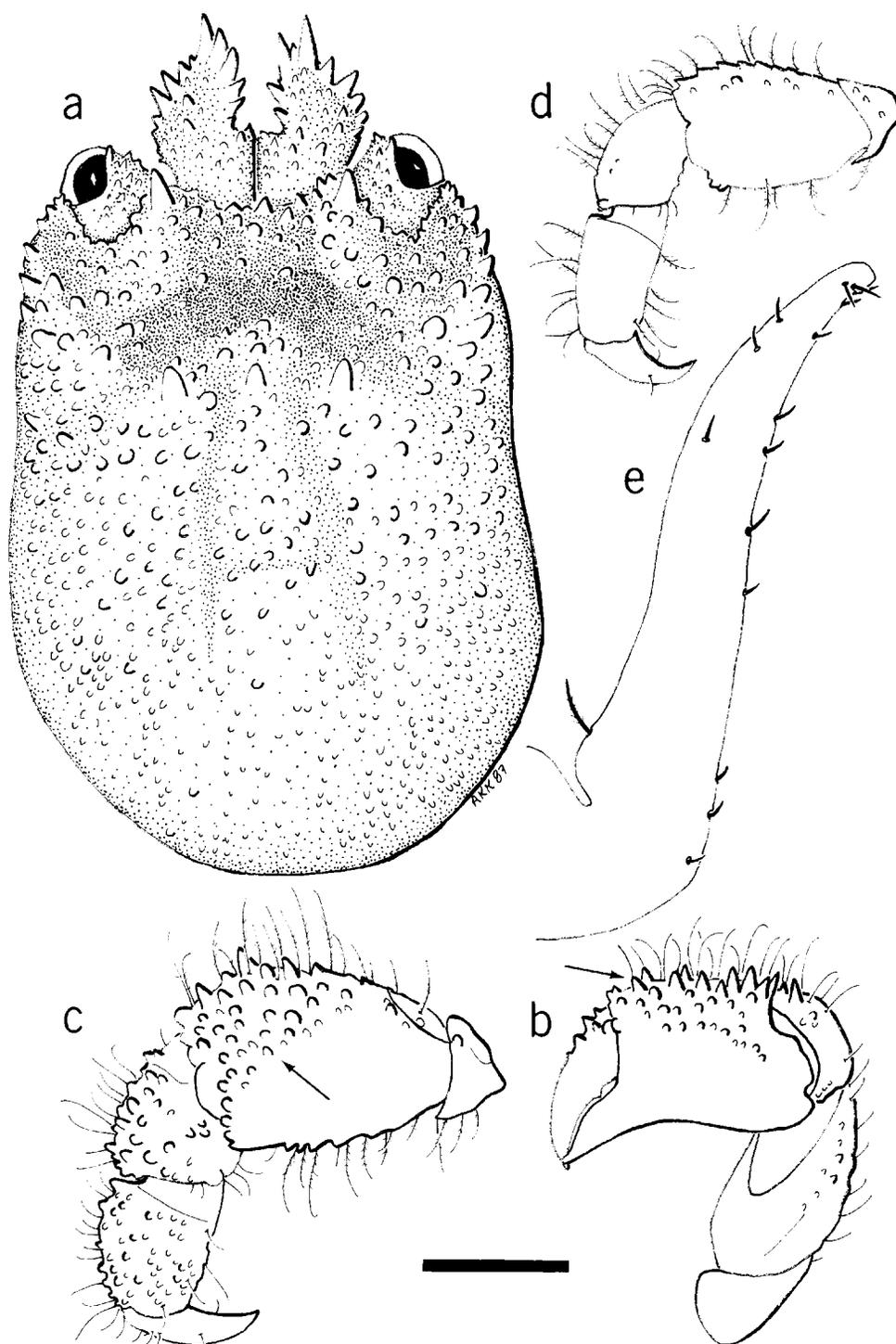


Figure 2. *Opecarcinus crescentus* (Edmondson), ♂. (Vietnam: BMNH 1958.10.20.3-4): a, carapace (dorsal view); b, left P-1 (arrow points to conical tubercles); c, left P-2 (arrow points to rounded tubercles); d, right P-5; e, PLP-1 (outer view). Scale: a-d = 0.5 mm; c = 0.2 mm.

*Hosts/Habitats.*—Agariciidae: *Pavona cactus*, *P. duerdeni*, *P. venosa*, *P. explanulata*, *P. varians*, *P. divaricata*, *P. maldiviensis*, *P. decussata*, and *Gardineroseris planulata*. Material on which this report is based was collected at depths of < 1 m to 14 m from a variety of reef habitats ranging from the open coast to protected embayments.

Several literature host records need to be clarified. Four species listed by Fize and Serène (1957) are now recognized as junior synonyms of species listed above (Veron and Pichon, 1980). These are *P. venusta* Dana, *P. formosa* Dana, and *P. praetorta* Dana (misspelled as *proetorta* by Fize and Serène), all of which are synonyms of *P. cactus*. Fize and Serène listed *P. muelleri* Milne Edwards and Haime as a possible synonym of *P. cactus*, but I have not been able to verify this. Also listed is *P. lata* Dana, a synonym of *P. decussata*. Veron and Pichon (1980) also listed *P. duerdeni* as a synonym of *P. clavus* Dana. Other coral taxonomists prefer to separate the two (Randall and Myers, 1983) and I have done so in order to avoid obscuring the host records. Takeda and Tamura (1983) recorded *O. crescentus* as occurring on corals of the genus *Coscinastrea* of the family Agariciidae. Their record is uncertain because the name *Coscinastrea* is actually a printing error for *Coscinarea* Milne Edwards and Haime of the family Siderastroidae (see Veron and Pichon, 1980). The genus *Opecarcinus* occurs on siderastroid corals in the Atlantic (Scott, 1985; 1987).

*Distribution.*—Known from Vietnam to Baja California.

*Opecarcinus granulatus* (Shen, 1936), new combination  
Figures 3, 4

*Cryptochirus granulatus* Shen, 1936: 23, pl. 2 [Christmas Is., Indian Ocean].—Utinomi, 1944: 688.—Fize and Serène, 1957: 54.

*Pseudocryptochirus granulatus.*—Takeda and Tamura, 1981: 14.

*Material Examined.*—Holotype: CHRISTMAS IS. (Indian Ocean); 45 fathoms (82 m); no host recorded; Pres. R. Kirkpatrick; ♂; BMNH 1911.8.15.2. Other material: GUAM: Fouha Bay; south wall of channel; 8 m; 26 Apr 1984; HAP 215; on *Leptoseris* sp.; 1 ♀ (ov), 1 ♂; USNM 234263. Cetti Bay [13°19'N, 144°39'E]; patch reef in middle of bay; 13–14 m; 30 Nov 1984; HAP 407, 410; on *Gardineroseris planulata*, *Pavona explanulata*; 2 ♀; USNM 234264/5.

*Size Range.*—Females, 1.9 × 1.6 to 2.4 × 2.2; ovigerous female, 2.4 × 2.2; males 1.9 × 1.7 to 2.2 × 2.0.

*Type Data.*—Holotype: ♂, 2.2 × 2.0; BMNH 1911.8.15.2. Type locality: Christmas Island (Indian Ocean) [10°30'S, 105°40'E]. No other types were described.

*Description.*—Adult female (Guam, USNM 234263, Fig. 3): Carapace 1.1 [1.2] times longer than wide. Anterior 1/3 of carapace slightly deflected, sharply set off from posterior carapace, with transverse depression extending from frontal margin, across protogastric region, to ALA and epibranchial regions. Posterior 2/3 of carapace with broad, shallow inverted U-shaped central depression. Transverse section of carapace at midlength angularly convex overall, median 1/3 slightly concave, with scattered variously sized tubercles, moderately setose with unequal setae longer than tubercles. Carapace surface ornamented with various granules and conical tubercles, largest at midlength, diminishing considerably in size and number posteriorly. Anterolateral margins of carapace having conical tubercles, ALA lacking prominent tubercle. IOA marked with tubercle, inflated, totally elevated above level of and extending to apex of ALA. Front concave with subequal tubercles, lacking prominent median tubercle, width 0.5 that of carapace at ALA, latter 0.7 greatest carapace width. Orbit deep, broadly V-shaped, margin granulate.

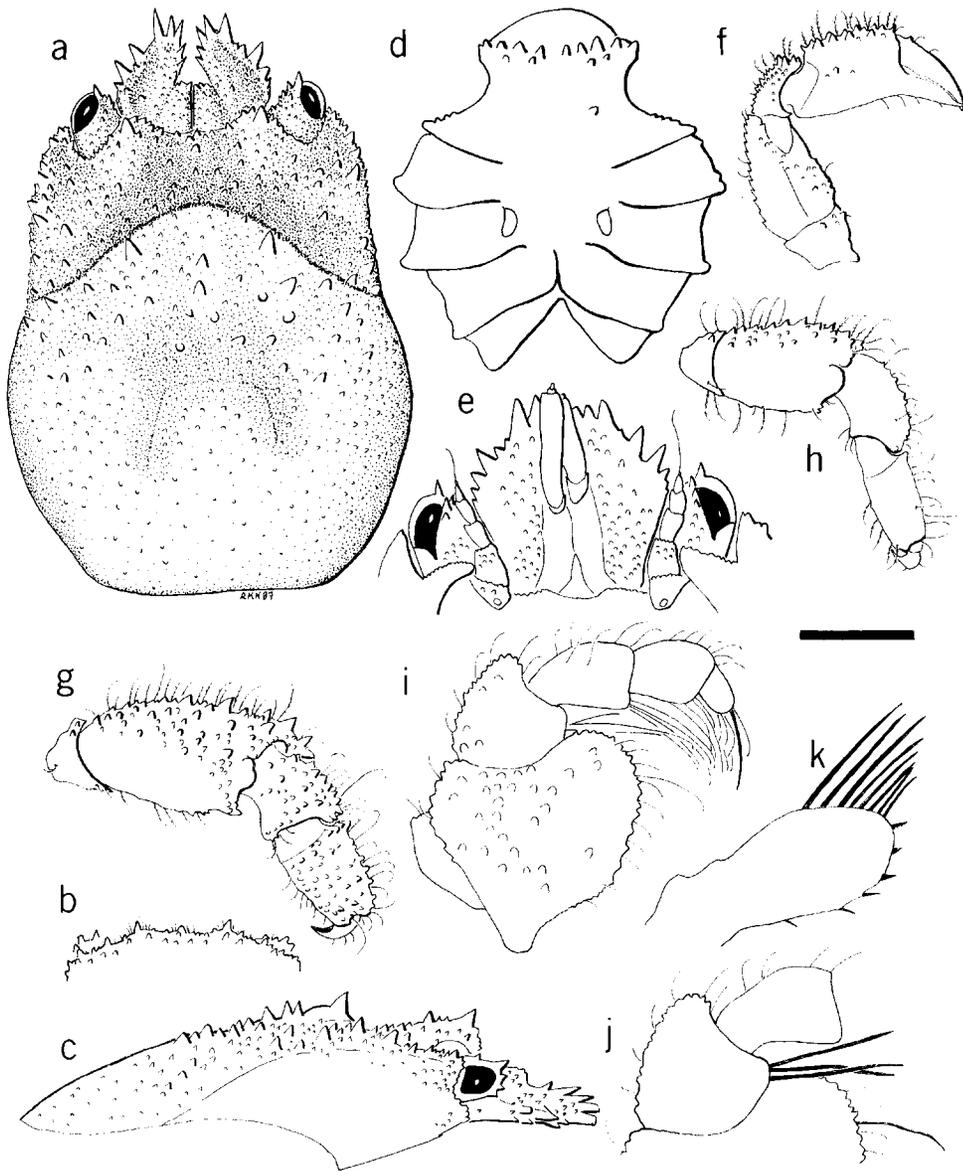


Figure 3. *Opecarcinus granulatus* (Shen), ♀. (Guam: USNM 234263): a, carapace (dorsal view); b, carapace (transverse section at midlength); c, carapace (lateral view); d, thoracic sternites; e, eyes, antennules (ventral view); f-h, right P-1, P-2, P-5; i, MXP-3 (outer view); j, MXP-3 (inner view of merus); k, MXL-1 (outer view). Scale: a, c, d, f-h = 0.5 mm; b = 0.8 mm; e, j = 0.4 mm; i = 0.3 mm; k = 0.2 mm.

Basal segment of antennular peduncle slightly oblique, scarcely inflated mesially, with distal projection having apex of angled lateral lobe not reaching tip of eyestalk; dorsal surface flat with few scattered granules; margin with 8–9 spines, those of distal margin larger than those of mesial margin. In ventral view, basal segment

tapering anteriorly, length 2.3 [2.6] times width; distal margin longer than lateral margin; surface convex with scattered granules.

Eyestalk mostly exposed dorsally. Cornea anterolateral, in dorsal view, occupying  $\frac{1}{2}$  length of stalk, dorsal margin evenly concave, lateral margin not extending beyond ALA.

Mesial margin of ischium of MXP-3 coarsely crenulated; lateral margin of merus strongly produced distally, mesial margin with 2 plumo-denticulate setae. Mesial margin of MXL-1 with 3 stout simple setae, lower margin with 3 stout simple setae; outer surface without setae.

Sternite of P-1 with transverse row of 9 conical tubercles, 4 smaller, rounded tubercles at midlength, 1 granule posteriorly. Sternite of P-2 smooth, lacking tubercles at lateral margin. Gonopore oval, lateral margin lacking anterior hood.

Manus of P-1 2.3 times longer than high. Dactylus subequal in length to dorsal margin of palm, with proximal tubercle dorsally; cutting edges of fingers entire. Dorsal margin of palm with conical tubercles along entire length; outer surface of palm flat with few granules proximally. Dorsal margin of carpus with prominent tubercle distally. Merus shorter, taller than manus, ventral margin with few tubercles.

Merus of P-2 1.7 [1.5] times longer than high; dorsal margin convex proximally, straight distally, having various acute conical tubercles, largest on distal  $\frac{1}{2}$ , ventral margin convex, with angled tubercles, moderately emarginate distally; distoventral angle produced into prominent tubercle; outer surface with many granules, tubercles on distodorsal  $\frac{1}{2}$ , with elevated transverse row of tubercles distoventrally. Propodus 1.2 [1.3] times longer than high, dorsal margin as long as that of carpus.

Merus of P-5 1.4 [1.3] times longer than high; dorsal margin with angled tubercles along entire length; ventral margin convex, with few angled tubercles; distoventral angle with 2 tubercles; outer surface with few smaller conical tubercles dorsally. Dorsal margin of carpus with rounded tubercles. Propodus 1.6 [1.5] times longer than high; dorsal margin entire.

Adult Male (Holotype, Fig. 4): Similar to female in general form. Carapace smoother, but showing same pattern of depressions. IOA lacking prominent tubercle, extending to level of ALA. Eyestalk proportionally larger than in female, cornea anterolateral, lateral margin just exceeding ALA. P-1 more robust than in female; manus length 1.6 times height. Dorsal margin of dactylus with few conical tubercles proximally; cutting edge with low tooth proximally; dactylus longer than dorsal margin of palm, latter with several sharp tubercles on proximal half; ventral margin of palm entire. Dorsal margin of merus of P-2 relatively straight with variously sized conical tubercles along entire length; ventral margin convex, entire. Dorsal margin of merus of P-5 bearing tubercles along entire length; ventral margin entire; carpus having tubercles on dorsal margin. Sternite of P-1 with 10 various granules. PLP-1 with plumose setae on proximomesial angle.

*Color.*—Adult female: Carapace opaque, covered with many small black chromatophores posteriorly, with much larger black chromatophores anteriorly, latter overlain with white, giving a gray hue. Eyestalk clear with black chromatophores, cornea red-orange. Meri of P-2 to P-5 opaque with fine orange line network. Distal merus, carpus, and propodus of P-2 and P-3 grayish with scattered bright blue spots. Male: Generally similar to female, cornea more orange, some fine red chromatophores on P-1.

*Comparison.*—See "Discussion" section.

*Remarks.*—Utinomi (1944) synonymized this species with *Cryptochirus crescen-*

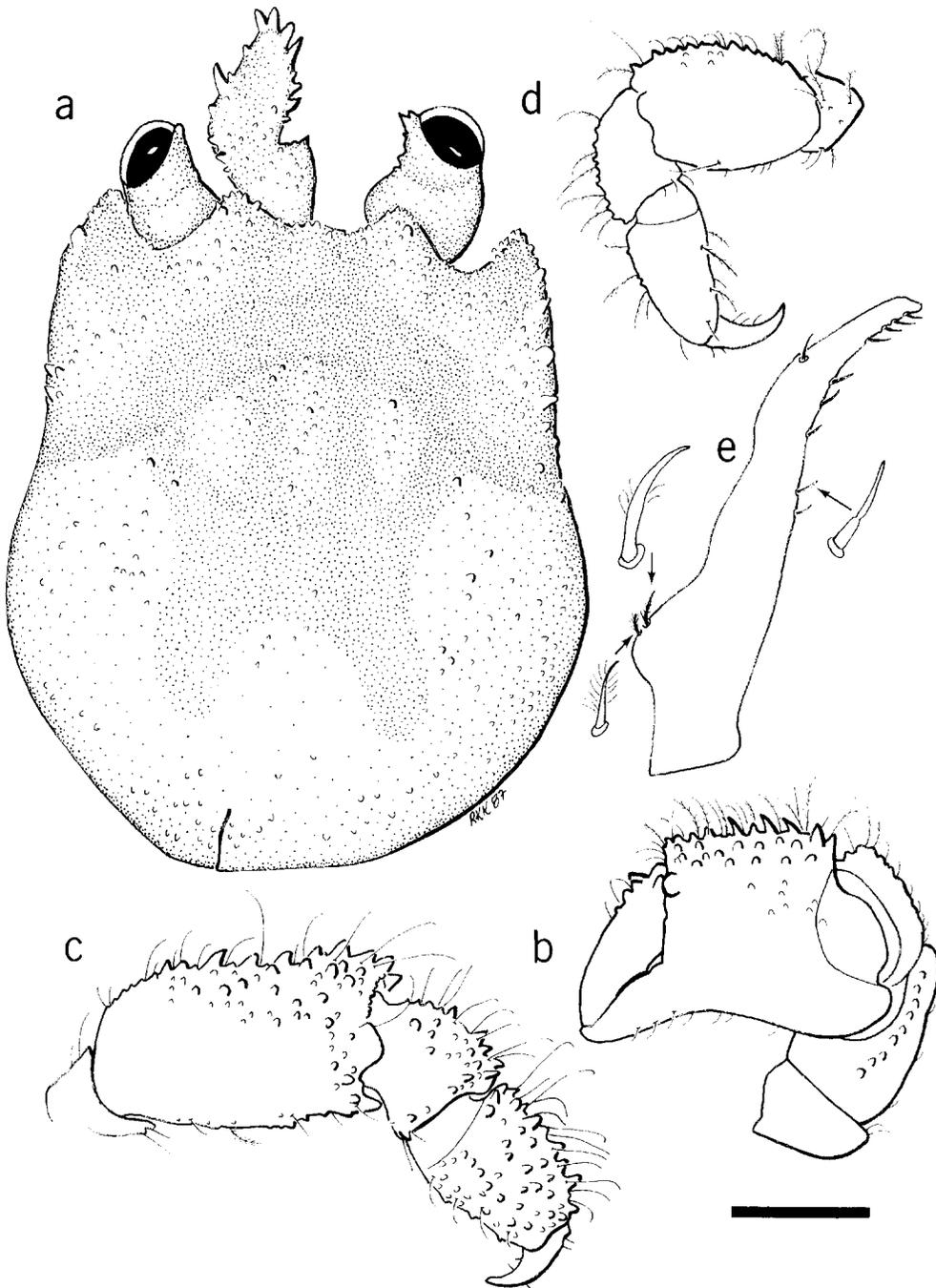


Figure 4. *Opecarcinus granulatus* (Shen). ♂, Holotype. (Christmas Island: BMNH 1911.8.15.2): a, carapace (dorsal view); b, left P-1; c, right P-2; d, left P-5; e, PLP-1 (outer view). Scale: a-d = 0.5 mm; e = 0.3 mm.

*tus* because the two were fairly similar and they were found in the same locality. The latter argument was based on the type locality of *C. granulatus* being Christmas Island and Edmondson (1933a) having recorded *C. crescentus* from Christmas Island. However, Edmondson was referring to Christmas Island (now = Kiriritimati) in the Pacific, whereas the type locality for *C. granulatus* is Christmas Island in the Indian Ocean. Shen (1936) did not specify the ocean of the type locality for *C. granulatus*, but the label with the holotype reads "Xmas Island, Indian Ocean." Fize and Serène (1957) asserted that the relative lack of carapace ornamentation in Shen's *C. granulatus*, as compared to male *O. crescentus* that they observed, could be attributed to differences in size, smaller specimens generally being less ornate. However, the male *O. crescentus* figured herein (Fig. 2) is about the same size as the holotype of *O. granulatus* (carapace lengths—2.1 and 2.2 mm, respectively) and shows quite different carapace ornamentation. Other differences, including the position of the cornea on the eyestalk, anterolateral in *O. granulatus* versus terminal in *O. crescentus* and the pattern of depressions on the posterior carapace, inverted "U"-shaped in *O. granulatus* versus "H"-shaped in *O. crescentus*, would not seem to be size related and strengthen the argument for separation of the two species.

*Hosts/Habitats.*—Agariciidae: *Gardineroseris planulata*, *Leptoseris* sp., and *Pavona explanulata*. Host of the holotype was not recorded. On Guam this species was collected from embayments, habitats of relatively high productivity. It has been collected at depths of 8–82 m.

*Distribution.*—Known from Christmas Island (Indian Ocean) and Guam.

### *Opecarcinus aurantius* new species

Figures 5, 6

*Material Examined.*—Holotype: GUAM: Cetti Bay; reef on south side of bay; 6 m; 30 Nov 1984; HAP 412; on *Pavona minuta* Wells, 1954; ♀ (ov); USNM 234266. Paratypes: GUAM: Fouha Bay; south wall of channel; 7, 9 m; 6, 26 Apr 1984; HAP 194, 212; on *P. minuta*; 2 ♀. Cetti Bay; same collection data as holotype; 3 ♀ (ov); USNM 234267. POHNPEI (Ponape): Ant Atoll [06°47'N, 157°58'E]; in lagoon on patch reef on northeast side of channel at Matenpita; 4.5 m; 23 Nov 1984; PHAP 349; on *P. minuta*: 1 ♀, 1 ♂; USNM 234268.

*Size Range.*—Females, 2.0 × 1.7 to 3.4 × 2.9; ovigerous females, 2.5 × 2.0 to 3.4 × 2.9; male, 2.9 × 2.2.

*Type Data.*—Holotype: ♀ (ov), 3.3 × 2.7; USNM 234266. Type locality: Cetti Bay, Guam [13°19'N, 144°39'E]. Paratypes: Several females and males as listed in material examined.

*Description.*—Adult female (Holotype, Fig. 5): Carapace 1.2 [1.2–1.3] times longer than wide. Anterior 1/3 of carapace moderately deflected, not sharply set off from posterior carapace, with transverse depression extending from frontal margin, across protogastric region, to ALA, not extending to epibranchial margin of carapace. Posterior carapace with shallow H-shaped depression at cardio-intestinal region. Transverse section of carapace at midlength evenly convex overall, with many subequal conical tubercles, sparse setae subequal and shorter than tubercles. Carapace surface ornamented with many conical, rounded tubercles and granules, largest at midcarapace, diminishing markedly posteriorly. Anterolateral margins of carapace having conical tubercles much smaller than those on anterior carapace, ALA lacking prominent tubercle. IOA marked with tubercle, barely inflated, partially elevated above ALA, not reaching apex of latter. Front concave, granulate, having prominent median tubercle, width about 0.5 [0.4–0.5] that at ALA, latter about 0.5 [0.5–0.7] that of greatest carapace width. Orbit shallow, broadly V-shaped, margin tuberculate.

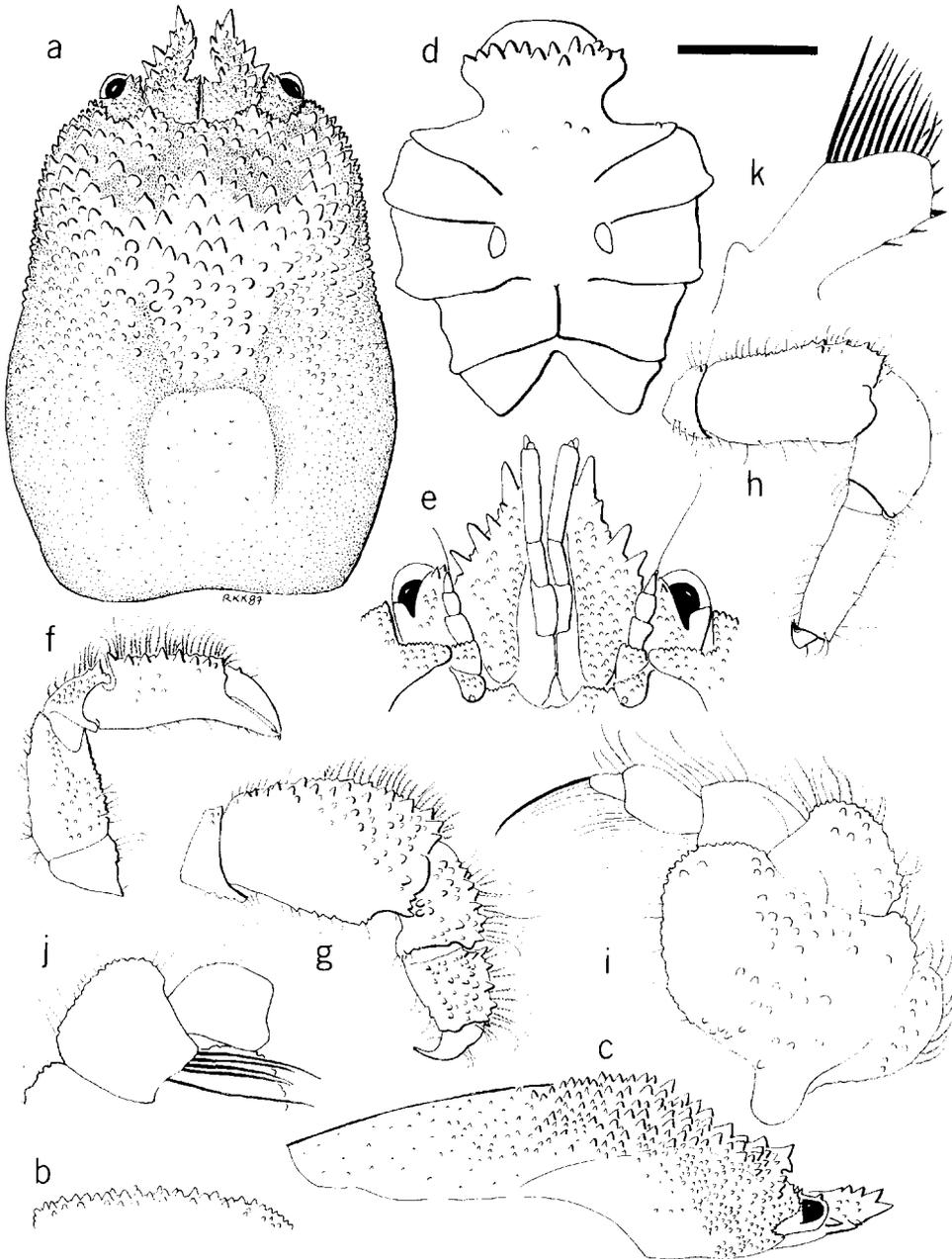


Figure 5. *Opecarcinus aurantius*, new species, ♀, Holotype. (Guam: USNM 234266): a, carapace (dorsal view); b, carapace (transverse section at midlength); c, carapace (lateral view); d, thoracic sternites; e, eyes, antennules (ventral view); f-h, right P-1, P-2, P-5; i, MXP-3 (outer view); j, MXP-3 (inner view of merus); k, MXL-1 (outer view). Scale: a, c, d = 1 mm; b = 1.3 mm; e = 0.6 mm; f-h = 0.8 mm; i, j = 0.5 mm; k = 0.2 mm.

Basal segment of antennular peduncle oblique, not inflated mesially, with distal projection having apex of angled lateral lobe not reaching tip of eyestalk; dorsal surface slightly concave, covered with rounded tubercles and granules; margin with 7–8 [5–8] spines, those of distal margin larger than those of mesial margin. In ventral view, distal projection tapering sharply anteriorly, length 3.0 [2.9–3.0] times width; distal margin subequal in length to lateral margin; surface concave with many granules.

Eyestalk mostly exposed dorsally. Cornea terminal, in dorsal view, occupying  $\frac{2}{5}$  length of stalk, dorsal margin evenly concave, lateral margin extending to or just beyond level of ALA.

Mesial margin of ischium of MXP-3 coarsely crenulated; lateral margin of merus weakly produced distally, mesial margin with 4–5 plumo-denticulate setae. Mesial margin of MXL-1 with 3 stout simple setae, lower margin with 2 stout simple setae; outer surface lacking setae.

Sternite of P-1 with transverse row of 13 [8–13] conical tubercles at midlength, with few granules posteriorly. Sternite of P-2 smooth, lacking tubercles at lateral margin. Gonopore oval, lateral margin lacking anterior hood.

Manus of P-1 2.8 [2.4–2.8] times longer than high. Dactylus shorter than dorsal margin of palm, with proximal tubercle dorsally; cutting edges of fingers entire. Dorsal margin of palm with conical tubercles along entire length, larger on proximal half; outer surface of palm flat with few granules proximally. Dorsal margin of carpus with prominent tubercle distally. Merus shorter, taller than manus, ventral margin densely granulate.

Merus of P-2 1.5 [1.4–1.6] times longer than high, dorsal margin evenly convex, entire length with conical tubercles, slightly larger distally; ventral margin straight, with few angled tubercles, moderately emarginate distally; distoventral angle produced having 1 larger, 2 smaller tubercles, outer surface with various conical, rounded tubercles on distodorsal  $\frac{1}{3}$ , lacking elevated transverse row of tubercles distoventrally. Propodus 1.0 [0.9–1.1] times longer than high; dorsal margin shorter than that of carpus.

Merus of P-5 1.7 [1.4–1.9] times longer than high, dorsal margin slightly concave with fine tubercles proximally, convex with larger tubercles distally; ventral margin relatively straight, entire; distoventral angle obtuse, lacking tubercle. Dorsal margin of carpus entire. Propodus 2.3 [2.0–2.4] times longer than high, dorsal margin entire.

Adult male (Fig. 6): Similar in form to female, carapace lacking larger tubercles, having many smaller tubercles and granules. IOA lacking prominent tubercle, extending beyond ALA. Eyestalk longer than in female; cornea terminal, lateral margin extending beyond ALA. P-1 more robust than in female; manus length 1.7 times height. Dorsal margin of dactylus with many angled tubercles proximally, cutting edge with low tooth proximally; dactylus slightly shorter than dorsal margin of palm, latter with larger conical tubercles on proximal  $\frac{1}{2}$ , many smaller tubercles distally; ventral margin of palm with serrations. Dorsal margin of merus of P-2 straight, with various conical tubercles along entire length; ventral margin straight with many subequal angled tubercles along entire length. Dorsal margin of merus of P-5 with many smaller tubercles; ventral margin with few tubercles; dorsal margin of carpus with tubercles. Sternite of P-1 with 10 rounded tubercles. PLP-1 with stout simple setae at proximomesial angle.

*Color.* — Adult female: Anterior carapace white, rest opaque with scattered whitish areas, with overall light orange tint. ALA, IOA red-orange. Eyestalk opaque with red-orange tint; cornea bright rust, may have black line proximally. Antennule

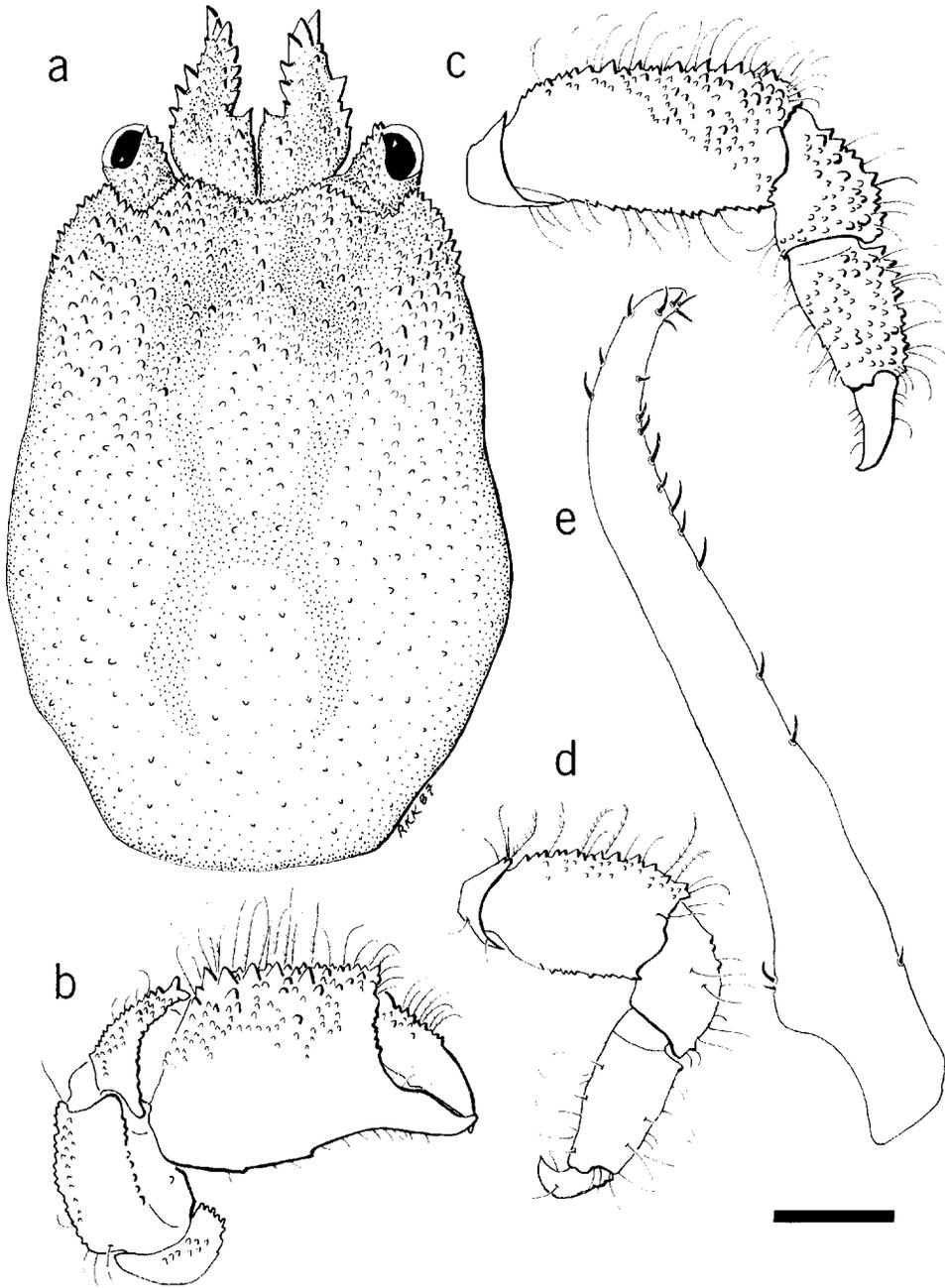


Figure 6. *Opecarcinus aurantius*, new species, ♂, Paratype. (Pohnpei: USNM 234268): a, Carapace (dorsal view); b–d, Right P-1, P-2, P-5; e, PLP-1 (outer view). Scale: a–d = 0.5 mm; e = 0.2 mm.

base rust. Dorsal P-2 matches anterior carapace, eyestalk, and antennules. Color of some specimens may have more orange than holotype. Male: Similar to female, anterior carapace bright white, posterior carapace red-orange.

*Comparison.*—See “Discussion” section.

*Etymology.*—From the Latin “aurantium,” meaning orange, in reference to the prevalent color found on these crabs.

*Hosts/Habitats.*—Agariciidae: *Pavona minuta*. Collected at depths to 9 m from habitats of relatively high productivity; river embayments at Guam and an atoll lagoon at Pohnpei.

*Distribution.*—Known from Guam and Pohnpei.

### *Opecarcinus lobifrons* new species

Figures 7, 8

*Troglocarcinus (Troglocarcinus) crescentus*—Garth, 1965: 8, figs. 3–6 [Clipperton Is.].

*Pseudocryptochirus crescentus*—Garth and Hopkins, 1968: 41 (in part).

*Material Examined.*—Holotype: GUAM; Tanguisson Pt.; reef front; 3 m; 25 May 1984; HAP 226; on *Gardineroseris planulata*; 1 ♀; USNM 234269. Paratypes: GUAM; Tanguisson Pt.; same collection data as holotype; 1 ♀; USNM 234270. Tanguisson Pt.; reef front; 2 m; 7 Feb 1984; HAP 067; on *G. planulata*; 1 ♀, 1 ♂; USNM 234271; 2 ♀ (ov). Agaña Bay; 300 m north of boat basin channel; reef front; 9 m; 3 Feb 1984; HAP 061; on *G. planulata*; 1 ♀, 1 ♂. Agat Bay; 0.9 km north of Facpi Pt. [13°20'N, 144°38'E]; reef front; 7 m; 8 Mar 1984; HAP 161; on *G. planulata*; 2 ♀ (ov), 1 ♂. CLIPPERTON IS. [10°17'N, 109°13'W]; NE Transect; 78 ft [24 m]; 27-VIII-1958; Coll. C. Limbaugh; [host not recorded]; 1 ♀; AHF 2777-01.

*Size Range.*—Females, 2.4 × 1.9 to 4.6 × 3.8; ovigerous females, 2.4 × 1.9 to 2.6 × 2.0; males, 2.1 × 1.6 to 2.4 × 1.9.

*Type Data.*—Holotype: ♀, 2.9 × 2.3; USNM 234269. Type locality: Tanguisson Pt., Guam [13°33'N, 144°49'E]. Paratypes: several males and females as listed in material examined.

*Description.*—Adult female (Holotype, Fig. 7): Carapace length 1.2 [1.2–1.3] times width. Anterior ¼ of carapace slightly deflected, not sharply set off from posterior carapace, with transverse depression restricted to protogastric region. Posterior carapace with inverted U-shaped depression at cardio-intestinal region. Transverse section of carapace at midlength evenly convex overall with scattered variously sized conical tubercles, moderately setose with setae subequal, slightly longer than tubercles. Carapace surface with scattered rounded and conical tubercles, largest just anterior to midlength, decreasing sharply in size posteriorly to fine granules; posterolateral margins rounded. Anterolateral margins with few larger conical tubercles, ALA lacking prominent tubercle. IOA marked with tubercle, inflated, entirely elevated above level of and extending beyond ALA. Front concave, lacking prominent tubercle, with many rounded tubercles; width 0.4 [0.4–0.5] that of carapace at ALA, latter 0.6 [0.7] greatest carapace width. Orbit shallow, broadly J-shaped, margin tuberculate.

Basal segment of antennular peduncle oblique, not inflated mesially, with distal projection having apex of angled lateral lobe not reaching tip of eyestalk; dorsal surface scanty concave with many smaller tubercles; margin with 7–8 [7–8] spines, those of distal margin larger than those of mesial margin. In ventral view, basal segment tapering anteriorly, length 2.3 [2.4–2.6] times width; distal margin shorter than lateral margin; surface convex with scattered granules, most near mesial margin.

Eyestalk partially exposed dorsally. Cornea terminal, in dorsal view, occupying

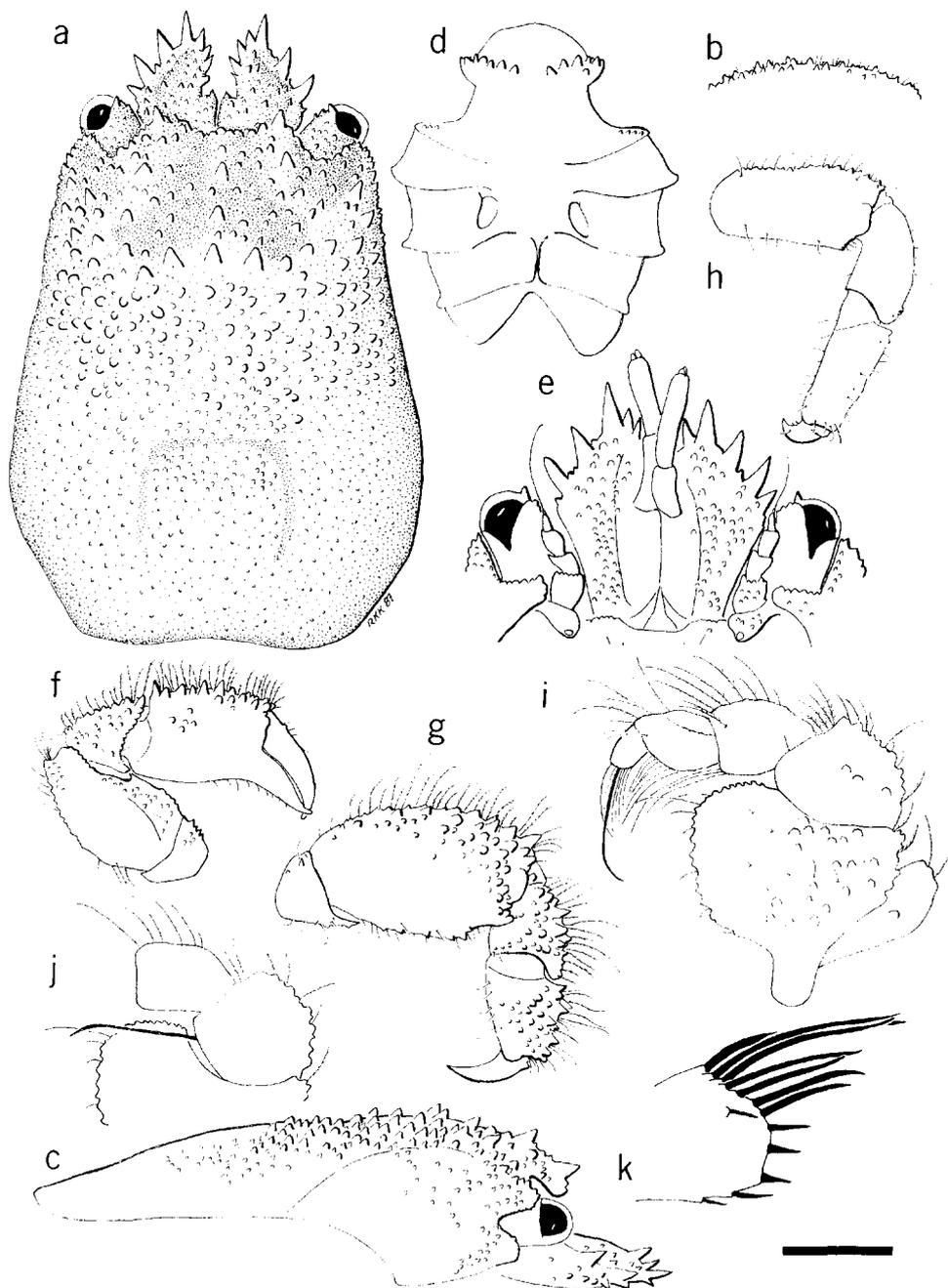


Figure 7. *Opecarcinus lobifrons*, new species, ♀, Holotype. (Guam: USNM 234269): a, carapace (dorsal view); b, carapace (transverse section at midlength); c, carapace (lateral view); d, thoracic sternites; e, eyes, antennules (ventral view); f-h, right P-1, P-2, P-5; i, MXP-3 (outer view); j, MXP-3 (inner view of merus); k, MXL-1 (outer view). Scale: a, c, f-h = 0.6 mm; b = 1 mm; d = 0.8 mm; e = 0.5 mm; i, j = 0.3 mm; k = 0.1 mm.

$\frac{2}{5}$  length of stalk, dorsal margin evenly concave, lateral margin extending just beyond ALA.

Mesial margin of ischium of MXP-3 coarsely crenulated; lateral margin of merus weakly produced distally, mesial margin with 1 plumo-denticulate seta. Mesial margin of MXL-1 with 3 stout simple setae, lower margin with 2 stout simple setae; outer surface with 1 stout serrate seta not exceeding mesial margin.

Sternite of P-1 with transverse row of 12 [8–13] rounded [conical] tubercles at midlength, none posteriorly. Sternite of P-2 smooth, lacking tubercles at lateral margin. Gonopore oval, lateral margin lacking anterior hood.

Manus of P-1 2.1 [1.8–2.1] times longer than high. Dactylus slightly shorter than dorsal margin of palm, with proximal tubercle dorsally; cutting edges of fingers entire. Dorsal margin of palm with conical tubercles along entire length, largest on proximal  $\frac{1}{2}$ ; outer surface of palm flat with few rounded tubercles proximally. Dorsal margin of carpus with prominent tubercle distally. Merus shorter, taller than manus, ventral margin irregularly tuberculate.

Merus of P-2 1.6 [1.4–1.6] times longer than high; dorsal margin slightly convex, with various conical tubercles, largest on distal  $\frac{1}{4}$ ; ventral margin relatively straight, with several angled tubercles, gently emarginate distally; distoventral angle produced into prominent tubercle; outer surface with many granules, rounded tubercles on distodorsal  $\frac{1}{3}$ , with elevated transverse row of tubercles distoventrally. Propodus 1.1 [1.0–1.1] times longer than high, dorsal margin shorter than dorsal margin of carpus.

Merus of P-5 1.9 [1.6–2.1] times longer than high; dorsal margin with smaller angled tubercles along entire length, with few larger conical tubercles distally; ventral margin straight, entire; distoventral angle with small tubercle; outer surface smooth. Dorsal margin of carpus with few smaller tubercles distally. Propodus 2.5 [1.8–2.2] times longer than high; dorsal margin entire.

Adult male (Fig. 8): Similar in form to female, depression on anterior carapace extends to epibranchial regions; carapace relatively flat with fewer tubercles. IOA marked with spine, not inflated, extending beyond level of ALA. Eystalk stockier than in female; cornea terminal, lateral margin extending to or just falling short of ALA. P-1 manus more robust than in female, 1.5 times longer than high. Dorsal margin of dactylus with few conical tubercles dorsally, cutting edge with low tooth proximally; dactylus shorter than dorsal margin of palm, latter with few larger tubercles proximally, many rounded tubercles distally; ventral margin of palm entire. Dorsal margin of merus of P-2 scarcely convex, with various conical tubercles; ventral margin scarcely convex with few angled tubercles. Dorsal margin of P-5 convex with smaller angled tubercles on distal  $\frac{3}{4}$ ; ventral margin straight, entire. Sternite of P-1 with 6–8 tubercles. PLP-1 with plumose setae at proximo-mesial angle.

*Color.*—Adult female: Anterior carapace bright white, posterior carapace with clear band laterally having many fine black chromatophores and overall red-orange hue. Eystalks clear with red-orange tint, corneas red. Antennule base red-orange around margin, brownish mesially. P-2 clear with fine white lines becoming densely packed distally. P-3 to P-5 clear dorsally with irregular orange lines, thicker distally. Male: Anterior carapace white, posterior brownish with blue spots near anterior edge of brown area. Corneas pink.

*Comparison.*—See “Discussion” section.

*Remarks.*—Garth (1965) noticed that the Clipperton specimen differed from typical specimens of *O. crescentus*. This material was examined by Serène who (in

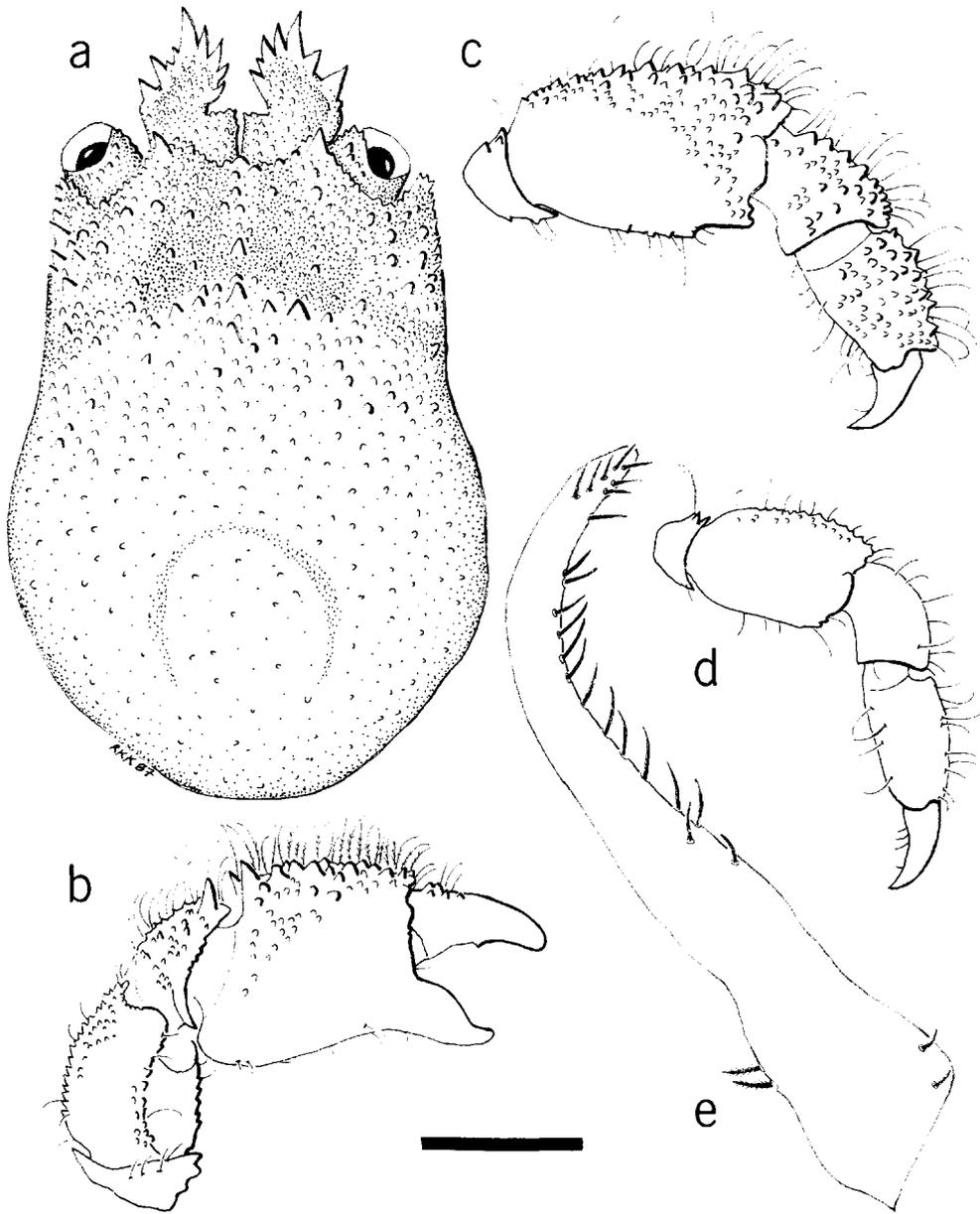


Figure 8. *Opecarcinus lobifrons*, new species, ♂, Paratype. (Guam: USNM 234271): a, carapace (dorsal view); b-d, right P-1, P-2, P-5; e, PLP-1 (outer view). Scale: a-d = 0.5 mm; e = 0.2 mm.

Garth, 1965) stated that the differences were age-related. I disagree. The main features separating *O. lobifrons* from *O. crescentus*, the extent of the IOA beyond the ALA and the restricted anterior depression, are consistent among all of the specimens of the two species that I have examined, regardless of size. However, these features are exaggerated in the Clipperton specimen of *O. lobifrons*. I have not seen the dried specimens discussed and figured by Garth (1965: 10, figs. 4-6).

*Etymology.*—From the Latin “lobus,” elongated projection, in combination with “frons,” forehead, in reference to the extension of the front of the carapace beyond the level of the anterolateral angles of the carapace; a noun in apposition.

*Hosts/Habitats.*—Agariciidae: *Gardineroseris planulata*. On Guam, collected from open water reef front areas to a depth of 9 m. The host of the Clipperton Island specimen, collected at 24 m, was not recorded. The coral fauna of Clipperton Island does not seem to be well documented. Two species of *Pavona*, *P. gigantea* Verrill and *P. explanulata* were listed by Durham and Barnard (1952). Of interest is the record of *P. ponderosa* Gardiner at Cocos Island (Durham, 1962). *P. ponderosa* is now considered a junior synonym of *G. planulata* (see Veron and Pichon, 1980), thus the known host of *O. lobifrons* occurs in eastern Pacific waters.

*Distribution.*—Known from Guam and Clipperton Island.

### *Opecarcinus peliops* new species

Figures 9, 10

*Material Examined.*—Holotype: POHNPEI: Pakin Atoll; reef front south of Mant Is.; 3 m; 19 Nov 1984; PHAP 302; on *Pavona duerdeni*; ♀; USNM 234272. Paratypes: Same location and host species as holotype; 3–6 m; 19 Nov 1984; PHAP 299, 303; 1 ♀ (ov), 1 ♂; USNM 234273/4.

*Size Range.*—Females, 2.1 × 1.8 to 3.3 × 2.9; ovigerous female, 2.1 × 1.8; male, 2.0 × 1.6.

*Type Data.*—Holotype: ♀ (ov), 3.3 × 2.9; USNM 234272. Type locality: Pakin Atoll, Pohnpei [07°04'N, 157°48'E]. Paratypes: One female (ov), one male as listed in material examined.

*Description.*—Adult female (Holotype, Fig. 9): Carapace 1.2 times longer than wide. Anterior 1/3 of carapace moderately deflected, not sharply set off from posterior carapace, with shallow transverse depression extending from frontal, across protogastric region, to ALA, not reaching epibranchial margin of carapace. Posterior carapace with central H-shaped depression. Transverse section of carapace at midlength evenly convex overall with many subequal conical tubercles, moderately setose with setae subequal, much longer than tubercles. Carapace surface ornamented with erect conical tubercles, largest at midcarapace, smaller tubercles anteriorly; posterior half of carapace with round granules diminishing in size and number posteriorly. Anterolateral margins with few erect conical tubercles, ALA lacking prominent tubercle. IOA marked with tubercle, slightly inflated, elevated above and extending to apex of ALA. Front slightly concave, with larger median tubercle, width 0.4 that of ALA, latter 0.6 that of greatest carapace width. Orbit shallow, broadly U-shaped, margin with few tubercles.

Basal segment of antennular peduncle transverse, not inflated mesially, with distal projection having apex of angled lateral lobe extending beyond eyestalk; dorsal surface slightly concave with few granules; margin with 7–9 [11] subequal spines. In ventral view, basal segment broadening anteriorly, length 2.1 times width; distal margin shorter than lateral margin; surface flat with scattered granules.

Eyestalk mostly exposed dorsally. Cornea terminal; in dorsal view, occupying 1/3 length of stalk, dorsal margin irregularly sinuous, lateral margin of cornea extending beyond ALA.

Mesial margin of ischium of MXP-3 coarsely crenulated; lateral margin of merus weakly produced distally, mesial margin with 4 stout plumo-denticulate setae. Mesial margin of MXL-1 with 3 stout simple setae, lower margin with 1 stout simple seta; outer surface with 1 pappose seta, exceeding mesial margin.

Sternite of P-1 with transverse row of 6 rounded tubercles at midlength, few smaller tubercles along anterolateral margins, 2–3 rounded tubercles posterolater-

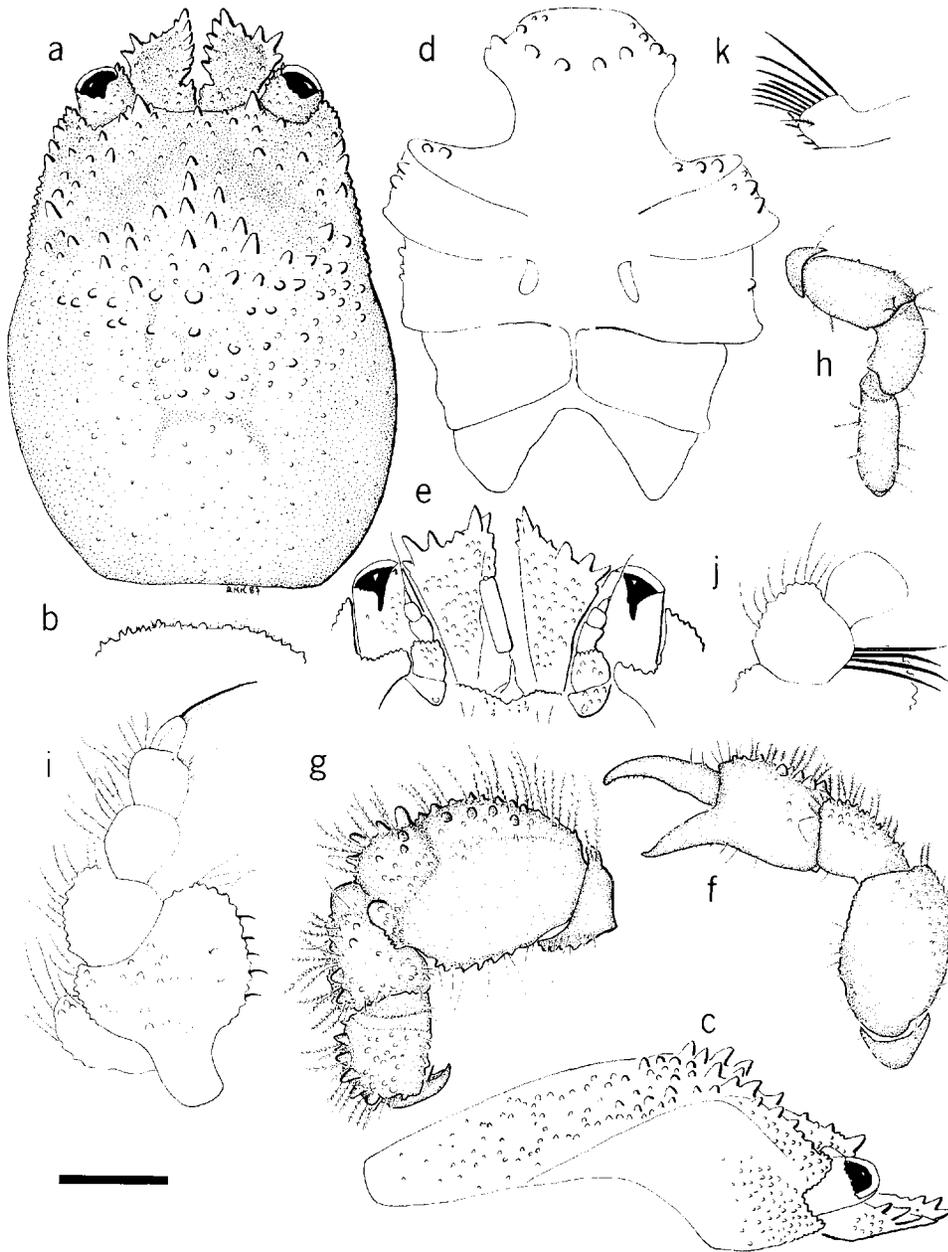


Figure 9. *Opecarcinus peliops*, new species, ♀, Holotype. (Pohnpei: USNM 234272): a, carapace (dorsal view); b, carapace (transverse section at midlength); c, carapace (lateral view); d, thoracic sternites; e, eyes, antennules (ventral view); f, g, left P-1, P-2; h, right P-5 (from paratype); i, MXP-3 (outer view); j, MXP-3 (inner view of merus); k, MXL-1 (outer view). Scale: a, c-h = 0.5 mm; b = 1 mm; i, j = 0.3 mm; k = 0.2 mm.

ally. Sternite of P-2 smooth, with tubercles at lateral margins. Gonopore oval, lateral margin lacking anterior hood.

Manus of P-1 1.8 [1.9] times longer than high. Dactylus slightly longer than dorsal margin of palm, with proximal tubercle dorsally; cutting edges of fingers entire. Dorsal margin of palm with erect conical tubercles on proximal  $\frac{1}{2}$ , smaller rounded tubercles distally; outer surface of palm flat with few granules proximally. Dorsal margin of carpus lacking larger tubercle distally. Merus as long as, taller than manus.

Merus of P-2 1.5 times longer than high; dorsal margin convex with transverse notch distally and rounded tubercles proximal to notch, prominent blunt tubercles distal to notch; ventral margin convex with few conical tubercles, abruptly emarginate distally; distoventral angle produced into 3 subequal tubercles; outer surface with few scattered tubercles on distodorsal  $\frac{1}{3}$ , lacking elevated transverse row of tubercles distoventrally. Propodus 1.1 times longer than high, dorsal margin shorter than that of carpus.

Merus of P-5 (from paratype) 1.7 times longer than high; dorsal margin with few smaller tubercles; ventral margin convex, entire; distoventral angle with small tubercle; outer surface smooth. Dorsal margin of carpus entire. Propodus 1.7 times longer than high; dorsal margin entire.

Adult male (Fig. 10): Carapace similar to female, much less tuberculate. IOA marked with spine, slightly exceeding apex of ALA. Eyestalk as in female; cornea terminal, lateral margin exceeding ALA. P-1 more robust than female, manus 1.4 times longer than high. Dorsal margin of dactylus with few tubercles proximally, cutting edge entire; dactylus about as long as dorsal margin of palm, latter elevated above level of joint with dactylus, with few smaller tubercles; ventral margin of palm entire. Dorsal margin of merus of P-2 straight with larger conical tubercles along entire length; ventral margin slightly convex with angled tubercles on distal  $\frac{1}{2}$ . Dorsal margin of merus of P-5 slightly convex with few angled tubercles; ventral margin relatively straight with few angled tubercles. Sternite of P-1 with 4 tubercles. PLP-1 with long simple seta at proximomesial angle.

*Color.*—Adult female: Carapace white with two curved longitudinal opaque bands posteriorly; with fine, irregular fluorescent orange and black lines on most of carapace; may have black, orange, and blue spots; transverse groove opaque; external orbital angle red-orange. Eyestalk opaque with red-orange tint; cornea with black outer ring, bright, light blue center. Carpus of P-1 similar to eyestalk, dorsal margin of manus yellow-white with light blue spots. P-2 similar to carapace. Male: Carapace bright white, transverse groove opaque. Eyestalk opaque with irregular black marks and red-orange tint; cornea bright blue.

*Comparison.*—See “Discussion” section.

*Etymology.*—From the Greek “pelios,” black and blue, in combination with “ops,” eye, in reference to the peculiar eye color of the females.

*Hosts/Habitat.*—Agariciidae: *Pavona duerdeni*. Collected from areas of rich coral growth at depths of 3–6 m in nutrient-poor reef front waters off small atolls.

*Distribution.*—Known only from Pohnpei.

### *Opecarcinus pholeter* new species

Figures 11, 12

*Material Examined.*—Holotype: GUAM: Cetti Bay; on isolated patch reef in middle of bay; 14 m; 30 Nov 1984; HAP 410; on *Pavona explanulata*; ♀ (ov); USNM 234275. Paratypes: BELAU: Nge-

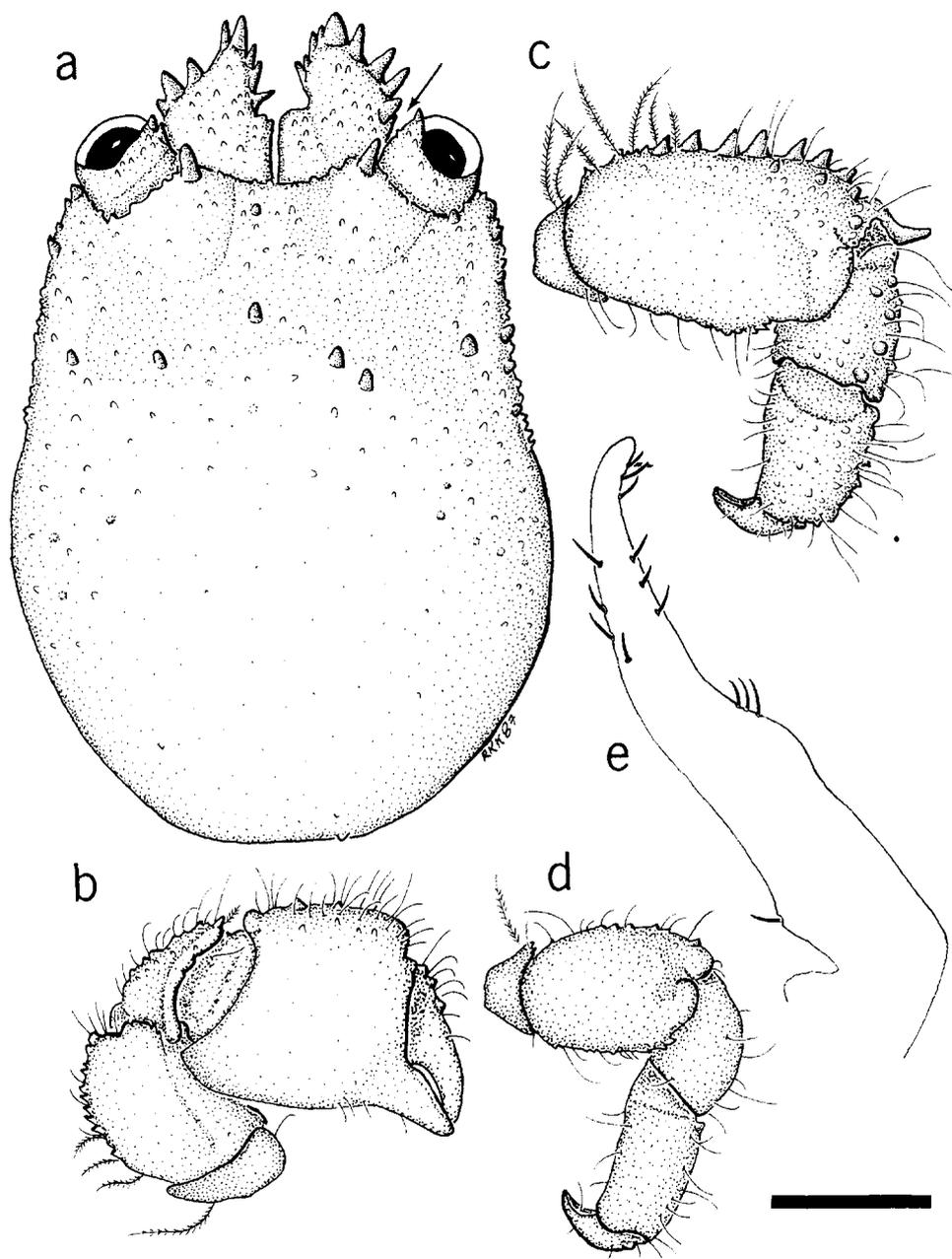


Figure 10. *Opecarcinus peliops*, new species, ♂, Paratype. (Pohnpci: USNM 234273); a, carapace (dorsal view, arrow points to spine on IOA); b-d, right P-1, P-2, P-5; e, PLP-1 (outer view). Scale: a-d = 0.5 mm; e = 0.2 mm.

ruktabel Is.; patch reef between Ngeruktabel and rock island directly south of MMDC; 3 m; 2 Jul 1984; PHAP 041; on *P. explanulata*; 1 ♀ (ov), 1 ♂; USNM 234276; 2 m; 3 Jul 1984; PHAP 057; on *P. explanulata*; 1 ♀ (ov), 1 ♂. Ngeruktabel Is.; north shore, cove at west end of main rock island group; 3 m; 23 Jul 1984; PHAP 195; on *Leptoseria yabei* (Pillai and Scheer, 1976); 2 ♂; USNM 234277; PHAP 196; on *P. explanulata*; 1 ♀. GUAM: Agat Bay; Taleyfac Channel; north wall of channel; 3-4

m; 20 Mar 1984; HAP 178, 179; on *P. explanulata*; 1 ♀ (ov); AHF; 3 ♂ (2 ov). Fouha Bay; south side of bay on wall of channel; 6 m; 6 Apr 1984; HAP 193; on *P. explanulata*; 1 ♀, 1 ♂; 8 m; 26 Apr 1984; on *P. explanulata*; 1 ♂. Cetti Bay; same collection data as holotype; 1 ♀ (ov), 2 ♂.

*Size Range*.—Females, 2.4 × 2.1 to 5.6 × 4.6; ovigerous females, 3.9 × 3.4 to 5.6 × 4.6; males, 1.4 × 1.2 to 4.2 × 3.4.

*Type Data*.—Holotype, ♀ (ov), 5.6 × 4.6; USNM 234275. Type locality: Cetti Bay, Guam [13°19'N, 144°39'E]. Paratypes: Several females and males as listed in material examined.

*Description*.—Adult female (Holotype, Fig. 11): Carapace 1.2 [1.1–1.3] times longer than wide. Anterior 1/3 of carapace slightly deflected, not sharply set off from posterior carapace, with transverse depression extending from frontal area, across protogastric region, to ALA and epibranchial regions. Posterior carapace with 3 longitudinal depressions extending from gastric to cardiac region, covered with round granules decreasing in size posteriorly. Transverse section of carapace at midlength relatively flat overall, each 1/3 slightly concave, with scattered variously sized conical tubercles, moderately dense unequal setae mostly shorter than tubercles. Carapace surface covered with conical tubercles, largest at midlength. Anterolateral margins with few conical tubercles, ALA lacking prominent tubercle. IOA with spine, slightly inflated, totally elevated above level of and extending to apex of ALA. Front concave lacking larger median tubercle, with few granules, width 0.5 [0.4–0.5] that of carapace at ALA, latter 0.6 times greatest carapace width. Orbit deep, broadly V-shaped, margin with few tubercles.

Basal segment of antennular peduncle slightly oblique, not inflated mesially, with distal projection having apex of lateral lobe reaching apex of eyestalk; dorsal surface scarcely concave with scattered conical tubercles; margin with 6–7 [5–8] spines, those of distal margin larger than those of mesial margin. In ventral view, basal segment tapering anteriorly, length 2.6 [2.5–2.7] times width; distal margin longer than lateral margin; surface flat with scattered granules.

Eyestalk partially exposed dorsally. Cornea anterolateral, in dorsal view, occupying 1/4 length of stalk, dorsal margin evenly concave, lateral margin not reaching ALA.

Mesial margin of ischium of MXP-3 finely crenulated; lateral margin of merus strongly produced distally, mesial margin with 6 plumo-denticulate setae. Mesial margin of MXL-1 with 5 stout simple setae, lower margin with 4–5 stout simple setae; outer surface with 2 stout serrate setae, not exceeding mesial margin.

Sternite of P-1 with transverse band of 22 [15–20] rounded tubercles of various sizes at midlength, several rounded tubercles postero-laterally. Sternite of P-2 granular [smooth], with tubercles at lateral margin. Gonopore elliptical, lateral margin having anterior hood.

Manus of P-1 2.5 [2.1–2.5] times longer than high. Dactylus shorter than dorsal margin of palm, with proximal tubercle dorsally; cutting edges of fingers entire. Dorsal margin of palm with few conical tubercles on proximal 1/2, smaller tubercles distally. Dorsal margin of carpus with prominent spine distally. Merus shorter, taller than manus, ventral margin densely covered with angled tubercles.

Merus of P-2 1.6 [1.4–1.7] times longer than high; dorsal margin slightly convex, having various conical tubercles, largest on distal 1/4; ventral margin convex; with angled tubercles, gently emarginate distally; distoventral angle produced into single ventral tubercle with 3 smaller tubercles dorsal to it; outer surface with many rounded tubercles on distodorsal 1/2, with elevated transverse row of tubercles distoventrally. Propodus 1.2 [1.1–1.2] times longer than high, dorsal margin shorter than that of carpus.

Merus of P-5 1.6 [1.4–1.8] times longer than high; dorsal margin convex, with smaller angled tubercles along entire length; ventral margin relatively straight,

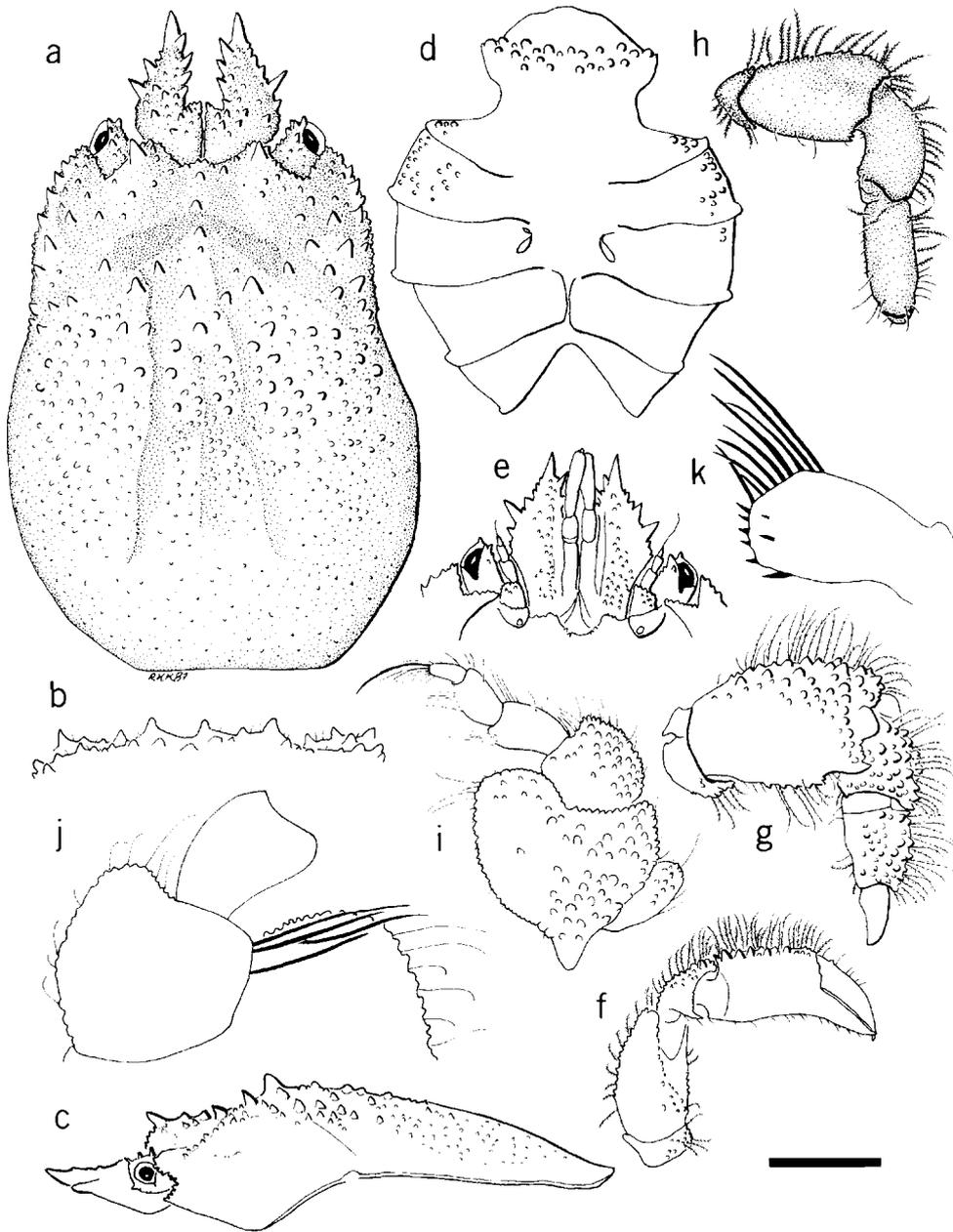


Figure 11. *Opecarcinus pholeter*, new species, ♀, Holotype. (Guam: USNM 234275): a, carapace (dorsal view); b, carapace (transverse section at midlength); c, carapace (lateral view); d, thoracic sternites; e, eyes, antennules (ventral view); f-h, right P-1, P-2, P-5; i, MXP-3 (outer view); j, MXP-3 (inner view of merus); k, MXL-1 (outer view). Scale: a-h = 1 mm; i = 0.5 mm; j, k = 0.2 mm.

entire; distoventral angle with small tubercle; outer surface smooth with few tubercles near dorsal margin. Dorsal margin of carpus entire. Propodus 2.1 [1.9–2.2] times longer than high; dorsal margin entire.

Adult male (Fig. 12): Carapace overall similar to female, showing similar pattern of depressions, generally less tuberculate, those present smaller than in female. IOA with blunt tubercle, exceeding apex of ALA. Basal segment of antennule relatively shorter than in female. Eystalk as in female; cornea anterolateral, lateral margin extending to or just beyond ALA. P-1 proportionally more robust than in female, manus 1.6 times longer than high. Dorsal margin of dactylus with many angled tubercles proximally, cutting edge with low tooth proximally; dactylus slightly shorter than dorsal margin of palm, latter with smaller tubercles along entire length, lacking larger tubercles; ventral margin of palm entire. Dorsal margin of merus of P-2 slightly convex with larger conical tubercles on distal  $\frac{1}{2}$ ; ventral margin straight with few angled tubercles. Dorsal margin of merus of P-5 convex with smaller angled tubercles along entire length; ventral margin relatively straight, entire. Sternite of P-1 with transverse band of 20 variously sized conical, rounded tubercles. PLP-1 with plumose setae at proximomesial angle.

*Color.* — Adult female: Anterior carapace off-white, transverse groove dark amber. Posterior carapace opaque with alternating bands of amber, infused with fine, irregular black spots, and bands of white chromatophores (8 white, 9 amber bands). Eystalk opaque to off-white; cornea red-brown. Walking legs opaque proximally with fine black-line network and amber tint, rimmed with off-white. Male: Similar to female.

*Comparisons.* — See “Discussion” section.

*Etymology.* — From the Greek “pholeter,” one who lurks in a hole; a noun in apposition.

*Hosts/Habitat.* — Agariciidae: *Pavona explanulata* and *Leptoseris yabei*. All were collected at depths of 2–14 m from areas of relatively high productivity. The Belau specimens were collected in the lagoon next to a high island (Ngeruktabel). The Guam specimens were collected from embayments into which nutrient-laden rivers empty.

*Distribution.* — Known from Guam and Belau.

### *Opecarcinus sierra* new species

#### Figure 13

*Material Examined.* — Holotype: GUAM: Agat Bay; Taleyfac Channel, from wall on north side of channel; 3 m; 20 Mar 1984; HAP 177; on *Pavona varians*; ♀ (ov); USNM 234278. Paratypes: GUAM: Luminao Reef; mid reef flat; 1 m; 20, 27 Oct 1984; HAP 350, 366; on *P. divaricata*, *P. venosa*; 2 ♀ (ov). Apra Harbor: Hotel Reef; 1 m; 31 Jan 1984; HAP 046; on *P. venosa*; 2 ♀ (ov). Apra Harbor: Sasa Bay [13°27'N, 144°41'E]; harbor side of large patch reef; 2.5 m; 15 Mar 1984; HAP 166; on *P. varians*; 1 ♀ (ov); USNM 234279. Apra Harbor; Western Shoals; [13°27'N, 144°39'E]; west slope of shoals; 21 m; 15 Mar 1984; HAP 169; on *P. divaricata*; 1 ♀ (ov). Agat Bay; same collection data as holotype; 4 ♀ (ov). Cocos Lagoon: southwest corner of lagoon just inside barrier reef; 1.5 m; 6 Mar 1984; HAP 148; on *P. venosa*; 2 ♀ (ov); USNM 234280.

*Size Range.* — Oviparous females, 2.2 × 1.9 to 3.5 × 2.8.

*Type Data.* — Holotype: ♀ (ov), 2.3 × 1.8; USNM 234278. Type locality: Agat Bay, Guam [13°24'N, 144°39'E]. Paratypes: Several females as listed in material examined.

*Description.* — Adult female (Holotype, Fig. 13): Carapace 1.3 [1.2–1.4] times longer than wide. Anterior  $\frac{1}{4}$  of carapace strongly deflected, not sharply set off from

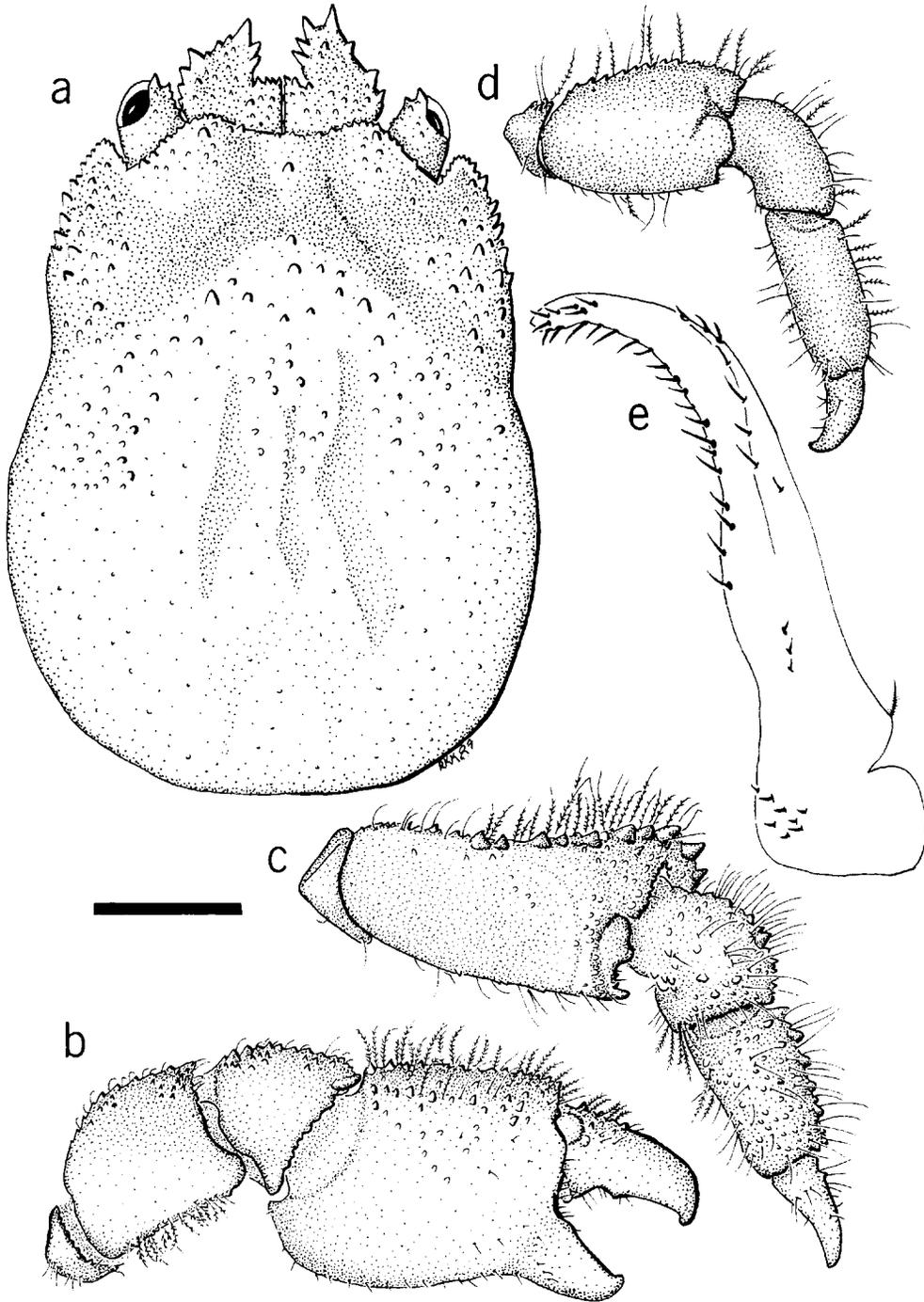


Figure 12. *Opecarcinus pholeter*, new species, ♂, Paratype. (Guam: USNM 234276): a, carapace (dorsal view); b-d, right P-1, P-2, P-5; e, PLP-1 (outer view). Scale: a-d = 1 mm; e = 0.3 mm.

posterior carapace, with transverse depression restricted to protogastric region. Posterior carapace with H-shaped depression at cardio-intestinal region. Transverse section of carapace at midlength convex overall with many conical tubercles, moderately dense setae subequal, shorter than tubercles. Carapace surface with many conical tubercles anteriorly, largest at midlength, posterior surface with rounded tubercles diminishing in size and number posteriorly. Anterolateral margins with few larger tubercles, ALA lacking prominent tubercle. IOA marked with tubercle, inflated, entirely elevated above and extending to apex of ALA. Front concave, margin with many subequal conical tubercles, lacking prominent median tubercle; width 0.5 that of ALA, latter 0.6 [0.6–0.7] that of greatest carapace width. Orbit deep, broadly V-shaped, margin tuberculate.

Basal segment of antennular peduncle transverse, not inflated mesially, with distal projection having apex of angled lateral lobe extending beyond tip of eye-stalk; dorsal surface slightly concave, with few rounded tubercles, margin with 11–12 [9–14] subequal spines. In ventral view, basal segment broadening distally, length 2.5 [2.2–2.5] times width; distal margin shorter than lateral margin; surface convex, covered with granules.

Eyestalk mostly exposed dorsally. Cornea terminal, in dorsal view, occupying  $\frac{1}{3}$  length of stalk, dorsal margin evenly concave; lateral margin extending to or just beyond apex of ALA.

Mesial margin of ischium of MXP-3 coarsely crenulated; lateral margin of merus strongly produced distally, mesial margin with 2 plumo-denticulate setae. Mesial margin of MXL-1 with 5, lower margin with 4, stout simple setae; outer surface lacking setae.

Sternite of P-1 with 7 [7–10] larger conical tubercles in single row at midlength, with 10 [0–9] granules posteriorly. Sternite of P-2 smooth, with tubercles at lateral margin. Gonopore oval, lateral margin lacking anterior hood.

Manus of P-1 2.3 [2.3–2.6] times longer than high. Dactylus shorter than dorsal margin of manus, with proximal tubercle dorsally; cutting edges of fingers entire. Dorsal margin of palm with smaller conical tubercles along entire length, slightly larger proximally; outer surface of palm flat with several granules proximally. Dorsal margin of carpus lacking prominent spine distally. Merus shorter, taller than manus; ventral margin with few tubercles.

Merus of P-2 1.3 [1.3–1.5] times longer than high; dorsal margin evenly convex, with conical tubercles along entire length, largest on distal  $\frac{1}{2}$ ; ventral margin relatively straight, with angled tubercles, moderately emarginate distally; distoventral angle produced into tubercle; outer surface with many rounded tubercles on distodorsal  $\frac{1}{2}$ , with elevated transverse row of tubercles distoventrally. Propodus 1.0 [1.0] times longer than high, dorsal margin as long as that of carpus.

Merus of P-5 1.5 [1.4–1.6] times longer than high; dorsal margin lined with subequal angled tubercles; ventral margin straight, entire; distoventral angle produced into tubercle; outer surface with few rounded tubercles distally near dorsal margin. Dorsal margin of carpus entire. Propodus 2.3 [1.9–2.4] times longer than high; dorsal margin entire.

Male: Unknown.

*Color.*—Adult female: Posterior carapace off-white, posterior branchial regions solid brown with mix of orange and brown; or with 7 longitudinal black bands. Anterior carapace off-white, anterior depression dark brown. Cornea dark red.

*Comparisons.*—See “Discussion” section.

*Etymology.*—From the Spanish “sierra,” mountains with a craggy skyline, in

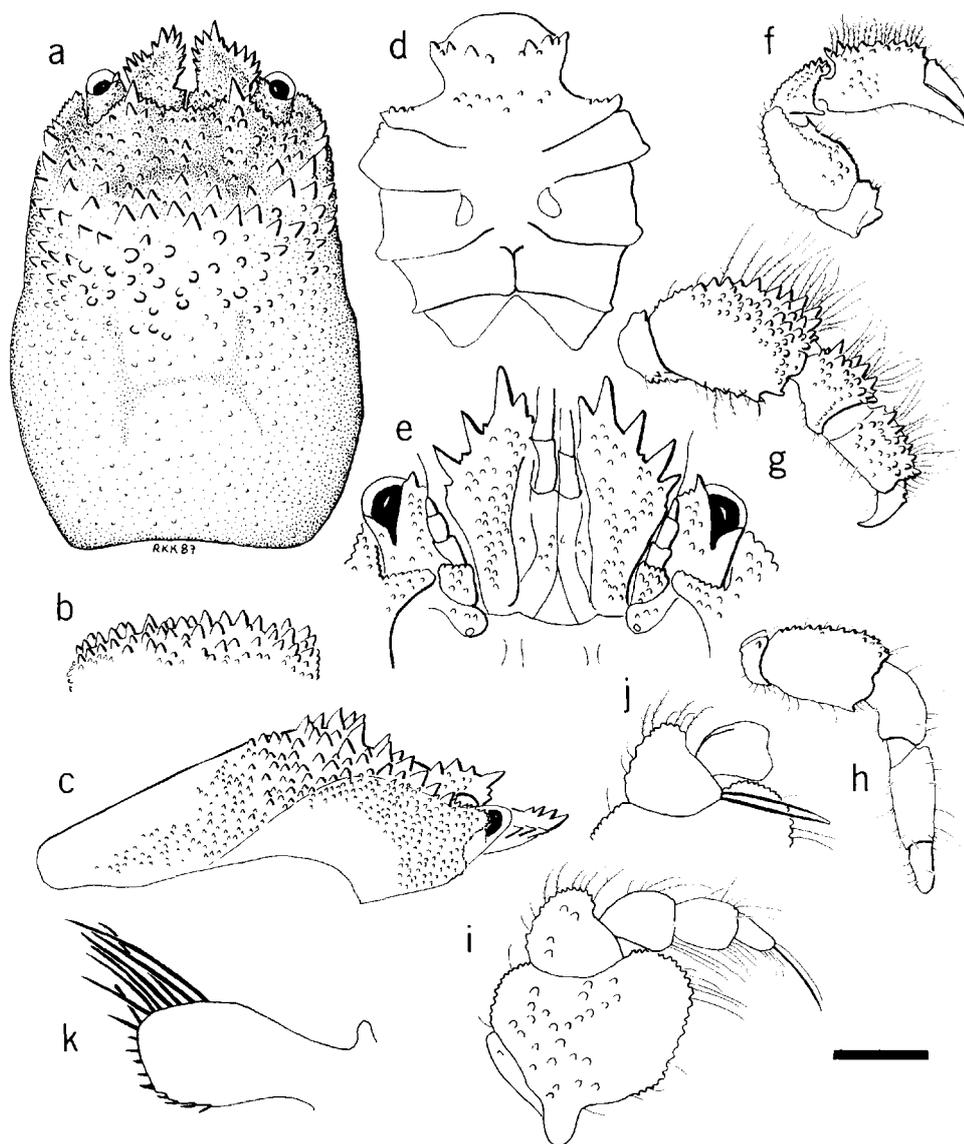


Figure 13. *Opecarcinus sierra*, new species, ♀, Holotype. (Guam: USNM 234278): a, carapace (dorsal view); b, carapace (transverse section at midlength); c, carapace (lateral view); d, thoracic sternites; e, eyes, antennules (ventral view); f-h, right P-1, P-2, P-5; i, MXP-3 (outer view); j, MXP-3 (inner view of merus); k, MXL-1 (outer view). Scale: a, c, d, f-h = 0.5 mm; b = 0.8 mm; e = 0.3 mm; i-k = 0.2 mm.

reference to the appearance of the carapace in transverse section; a noun in apposition.

*Hosts/Habitats.*—Agariciidae: *Pavona varians*, *P. divaricata*, and *P. venosa*. Collected from relatively high productivity areas such as river embayments, lagoons, and from a barrier reef flat at depths to 21 m.

*Distribution.*—Known only from Guam.

## DISCUSSION

*Comparisons.*—Orientation of the cornea on the eyestalk can be used to separate the species of *Opecarcinus* into two groups. The cornea is oriented anterolaterally in *O. hypostegus*, *O. granulatus*, and *O. pholeter*, whereas it is terminal in *O. crescentus*, *O. aurantius*, *O. lobifrons*, *O. peliops*, and *O. sierra*. Among the first three species, *O. hypostegus*, an Atlantic species, can be distinguished from the other two by having the distal margin of the basal segment of the antennule longer than the lateral margin; the opposite is true for *O. granulatus* and *O. pholeter*. The latter two species can be differentiated by the condition of the dorsal margin of the carpus of leg P-5; it is tuberculate in *O. granulatus* and smooth in *O. pholeter*. Also, the posterior carapace of *O. pholeter* has 3 longitudinal depressions as compared to the broad, inverted U-shaped depression of *O. granulatus*.

Among species having a terminally situated cornea, the orientation of the basal segment of the antennule, oblique in *O. aurantius* and *O. lobifrons*, as compared to transverse in *O. crescentus*, *O. peliops*, and *O. sierra*, divides those species into two groups. The extent of the IOA separates *O. lobifrons*, in which it extends beyond the apex of the ALA, from *O. aurantius* in which it does not exceed the apex of the ALA. *O. peliops* has a notch distally on the dorsal margin of the merus of leg P-2 and the dorsal margin of the cornea is irregularly sinuous, thereby distinguishing it from *O. crescentus* and *O. sierra* in which the dorsal margin is not notched and the dorsal margin of the cornea is evenly concave. The latter two species can be separated by the marked convexity of the carapace and restriction of the anterior depression from the epibranchial region in *O. sierra* versus the relatively flat carapace and the extension of the anterior depression to the epibranchial region in *O. crescentus*.

Color pattern is useful in distinguishing the species. Cornea color is distinctive for three species; black and blue in *O. peliops*, bright rust in *O. aurantius*, and red-orange in *O. granulatus*. The other four Pacific species of *Opecarcinus*, in which the dominant cornea color is red, can be distinguished by color patterns of the carapace. *O. lobifrons* has a bright white carapace with a red-orange hue posteriorly, but lacks dark bands. The remaining three have off-white carapaces; *O. crescentus* has four black longitudinal bands posteriorly, *O. sierra* has seven black bands (or may be solid brown) posteriorly, and *O. pholeter* has nine amber bands posteriorly. Live color has not been reported for *O. hypostegus*.

*Hosts.*—The Pacific species of *Opecarcinus* may be restricted to corals of the family Agariciidae. All of the material examined here, for which the host was recorded, occurred on agariciid corals. All literature records for the Pacific species list agariciid corals as hosts, except the questionable record of Takeda and Tamura (1983) as mentioned previously. *Opecarcinus hypostegus* occurs on siderastreid, as well as agariciid, corals in the Atlantic (Kropp and Manning, 1987; Scott, 1987).

Of the five extant genera of agariciid corals in the Pacific, species of *Opecarcinus* occur on three; *Gardineroseris* Scheer and Pillai, *Leptoseris* Milne Edwards and Haime, and *Pavona* Lamarck. The absence of *Opecarcinus* on *Coeloseris* Vaughan may be an artifact of collection bias. *Coeloseris* is known from Nicobar to New Caledonia (Veron and Pichon, 1980), a region from which there are few gall crab records. That *Opecarcinus* has not yet been found on *Pachyseris* Milne Edwards and Haime is noteworthy. *Pachyseris* is widespread, occurring from Madagascar to Samoa (Ditlev, 1980), and has affinities with two gall crab-inhabited genera, *Gardineroseris* and *Pavona* (Veron and Pichon, 1980). It occurs in Guam (Randall and Myers, 1983) where it is fairly common (pers. obs.). During my field studies in Micronesia I examined over 100 colonies of *Pachyseris* for the presence of gall

crabs and did not find any. Reasons for the absence of gall crabs on *Pachyseris* are not immediately obvious.

Two species of *Opecarcinus*, *O. aurantius* on *Pavona minuta* and *O. peliops* on *P. duerdeni*, each may be restricted to a single host species. Each of the other species of *Opecarcinus* occurs on several host coral species.

*Distribution.*—*Opecarcinus* is the only cryptochirid genus known to have representatives in the three major ocean basins. *O. hypostegus* occurs from the western to central Atlantic (Kropp and Manning, 1987). *O. granulatus* occurs in the easternmost Indian Ocean and in the western Pacific. The absence of *Opecarcinus* from the main Indian Ocean basin may be a result of a collection deficiency as gall crabs are not well-represented in general decapod collections. Two species (*O. crescentus* and *O. lobifrons*) occur in the eastern as well as the western Pacific, thus having distributions not interrupted by the purported East Pacific Barrier (discussed by Vermeij, 1978). All gall crab species known from the eastern Pacific, *Hapalocarcinus marsupialis* Stimpson is the third, also occur in the western Pacific. Four species of *Opecarcinus*, *O. aurantius*, *O. peliops*, *O. pholeter*, and *O. sierra*, occur only on the Pacific Plate or the islands on its western margin. However, all are newly described and may not represent true Pacific Plate species (see Springer, 1982), as further studies may increase their known distributional ranges.

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