Haig 1974

OBSERVATIONS ON THE LITHODID CRABS OF PERÚ, WITH DESCRIPTION OF TWO NEW SPECIES

JANET HAIG

Reprinted from BULLETIN OF THE SOUTHERN CALIFORNIA ACADEMY OF SCIENCES
Vol. 73, No. 3, November 1974
pp. 152–164
Made in the United States of America

OBSERVATIONS ON THE LITHODID CRABS OF PERÚ, WITH DESCRIPTION OF TWO NEW SPECIES

JANET HAIG [1]

ABSTRACT: Eight species of Lithodidae (Crustacea, Decapoda, Anomura) are reported from deep water off Perú. Two are described as new and a third is illustrated for the first time. The other five species, which were briefly cited from Peruvian waters (del Solar, 1972), are discussed in more detail. Attention is drawn to morphological changes that take place with growth in family Lithodidae. Distribution of the tropical component of the west American lithodids is discussed.

The Lithodidae are a family of anomuran crabs, some of them of large size, which inhabit the littoral zone and depths to at least 2400 m. The family comprises more than 50 species, including such economically important forms as the Alaska king crab, *Paralithodes camtschaticus* (Tilesius), in the north Pacific, and the centolla, *Lithodes antarcticus* Jacquinot, off southern Chile and Argentina. Until recently no lithodids were known from Peruvian waters.

In recent years the Instituto del Mar del Perú (IMARPE) has been conducting investigations in deep water, particularly on crustaceans of potential economic importance. Since late 1970 E. M. del Solar, scientific advisor for IMARPE, has collected material of eight species of Lithodidae aboard "SNP–1," "Wiracocha," and the Japanese trawler "Challua japic." Samples of these, which were sent to me for identification by del Solar, form the basis of this report.

Two of the species were previously undescribed. A third was described by Benedict (1895) from a specimen collected at an unspecified locality by the U.S. Fisheries vessel "Albatross"; it is illustrated for the first time in this paper. The other five species were described by Faxon (1893) from material collected by the "Albatross" in the eastern Pacific between 07°31′30″ N and 05°26′ 20″ N; they were listed, with the first Peruvian records, by del Solar (1972).

The presence of Lithodidae in Perú had been recognized earlier on the basis of unidentified fragments taken from the stomach of "cachalotes" (sperm whales). A ninth Peruvian species is represented by legs and part of the carapace of one such specimen, which is housed in a whaling museum at Tierra Colorada to the south of Paita; del Solar believes it to be a *Lithodes* (del Solar, 1972: 6, and pers. comm.). I have seen a photograph of this crab and agree that it bears a general resemblance to *Lithodes*. However, examination of the rostrum (if present) and the abdomen might prove it to belong to *Neolithodes*. *Neolithodes diomedeae* (Benedict) is reported from Chile and from México and is therefore to be expected in Peruvian waters.

Measurements given in this report, except where there is a statement to the contrary, refer to the length of the carapace. All measurements were taken to 0.5 mm using a dial caliper. Specimens, including holotypes of the two new species, are in the collections of the Allan Hancock Foundation (A. H. F.). This paper is contribution No. 351 from the Allan Hancock Foundation.

Lithodes Latreille, 1806

Lithodes Latreille, 1806: 39. Type species by monotypy: *Cancer maja* Linnaeus. Bouvier, 1896: 10, 20.

Carapace spiny; rostrum generally prominent and armed with spines. Antennal acicle (scaphocerite) either well developed, rudimentary, or lacking. Walking legs considerably longer than greatest width of carapace. Second (basal) abdominal somite with median plate fused to lateral plates, and usually with laterals fused to marginal plates; on abdominal somites 3–5, median plate replaced by a membranaceous area covered with calcified platelets; lateral plates of somites 3–5 distinct and paired; marginal plates of somites 3–5 distinct and variable in number, present on both sides in males, on right side only in females.

Lithodes panamensis Faxon, 1893

Lithodes panamensis Faxon, 1893: 166; Faxon, 1895: 50, pl. 10 figs. 1, 1 a–c; Bouvier, 1896: 24; del Solar, 1972: 5, 14.

[1] Allan Hancock Foundation, Univ. Southern California, Los Angeles, California 90007.

Diagnosis: Carapace covered with low, warty protuberances; two pairs of spines on gastric region, two spines on each branchial region, a pair on cardiac and a pair on intestinal region; lateral spines consisting of outer orbital, anterolateral, hepatic, and three branchials. Gastric and branchial regions very convex, defined by deep depressions. Rostrum strongly inclined upward, terminating in a median and two lateral spines; ventral process long but not visible in dorsal view. Antennal acicle long, rudimentary, or absent. Abdominal plates covered with low tubercles; basal (second) somite with a distinct suture on each side separating marginal plate from fused median and lateral plates.

Previous records: 07°31'30" N, 79°14' W, 458 fms [837 m] (Faxon, 1893, 1895). 03°48' S, 81°22' W, 680 m; 07°59' S, 80°22' W, 760–800 m; latitude of Pisco [13°44' S], from stomach of a sperm whale; 17°34' S, 71°55' W, 850 m (del Solar, 1972).

Material examined: Ovigerous female; off Perú, 07°59' S, 80°22' W; 760–800 m, hard bottom; November 1971; E. M. del Solar on trawler "Challua japic."

Measurements: Length of carapace excluding rostrum, 100 mm; maximum width of carapace excluding lateral spines, 108 mm; length of right, third walking leg: merus, 78 mm; carpus, 44 mm; propodus, 70.5 mm; dactyl, 45.5 mm.

Remarks: My specimen agrees well with the description and illustration of the holotype, a female 79 mm long excluding the rostrum. A few minor differences were noted. The three terminal rostral spines are more elongate than the rostral spines of the type; the proximal portion of the rostrum is also longer and advanced beyond the eyestalks. A pair of small spines on the cardiac region of the carapace was not mentioned by Faxon, although his illustration, perhaps erroneously, shows a median spine in that area. The lateral hepatic spines are much larger than they appear in the illustration of the holotype. On each antennal peduncle there is a rudimentary, conical acicle, instead of the long, slender one occurring on the right peduncle in the type.

A specimen collected by del Solar at 17°34' S, has a carapace 190 mm long and measures 970 mm between the tips of the extended legs (del Solar, 1972: 14).

Lithodes wiracocha, new species

Figure 1

Lithodes n. sp.: del Solar, 1972: 14.

Description: Carapace a little longer than broad; surface and all margins densely covered with small, sharp spinules, some of the marginal ones tending to become enlarged. Gastric region bearing two pairs of short, stout spines, and separated from cardiac region by a deep, transverse depression. Cardiac region well defined, with a pair of small spines. Branchial regions separated from cardiac region by deep, oblique grooves; each branchial region with a well developed spine opposite sulcus separating gastric and cardiac regions. Intestinal region with a pair of small spines. Outer orbital angle marked by a long, slender spine; a shorter one at anterolateral angle; a long, strong marginal hepatic spine; three lateral branchial spines, the most anterior one largest, others not much larger than a few enlarged, laterally situated surface spinules.

Dorsal portion of rostrum inclined upward, with two terminal spines and a pair of median lateral spines; proximal half densely covered with minute spinules to base of median spines; ventral process rather short and not visible in dorsal view, covered proximally with minute spinules.

Eyestalks short, somewhat constricted at about middle, and unarmed, with cornea situated laterally and ventrally. Second segment of antennal peduncle with several spines on its outer side, the most distal one large and elongate and reaching end of penultimate (fourth) segment; acicle rudimentary, conical.

Chelipeds subequal in length, but right somewhat stouter than left; small, thornlike spines, disposed in longitudinal rows, on merus, carpus, and chela; spines somewhat enlarged on ventral surface of ischium. Walking legs long and slender; ischium, merus, carpus, and propodus covered on all sides by longitudinal rows of thorny spines, these a little larger dorsally and ventrally; dactyl with several rows of spines reaching almost to tip.

Abdominal plates, and platelets of somites 3–5, densely covered with sharp spinules. Basal abdominal somite with a median pair of small spines; a narrow, spinule-free line on each side in position of suture which separates marginal from fused median and lateral plates in a few species of *Lithodes*, but in this case no actual suture visible. Lateral plates of left side edged with numerous long, sharp spines, many themselves bearing two or three spinules along each side; marginal plates of right side drawn out into still longer compound spines.

Previous records: 03°48' S, 81°22' W, 680 m; 07° 59' S, 80°22' W, 800 m (del Solar, 1972).

Material examined: Holotype, ovigerous female. A.H.F. 712; 12 mi. SW Banco de Mancora, Perú: 620 m, mud bottom; 15 March 1971; E. M. del Solar on trawler "Wiracocha."

Measurements: Length of carapace excluding rostrum, 103.5 mm; rostrum, 16 mm; maximum width of carapace excluding lateral spines, 97 mm; length of right, third walking leg: merus, 78 mm; carpus, 48.5 mm; propodus, 79 mm; dactyl, 47 mm.

Etymology: From Tici Wiracocha, the creator god of Inca mythology, and his namesake, the trawler "Wiracocha" aboard which the holotype was col-

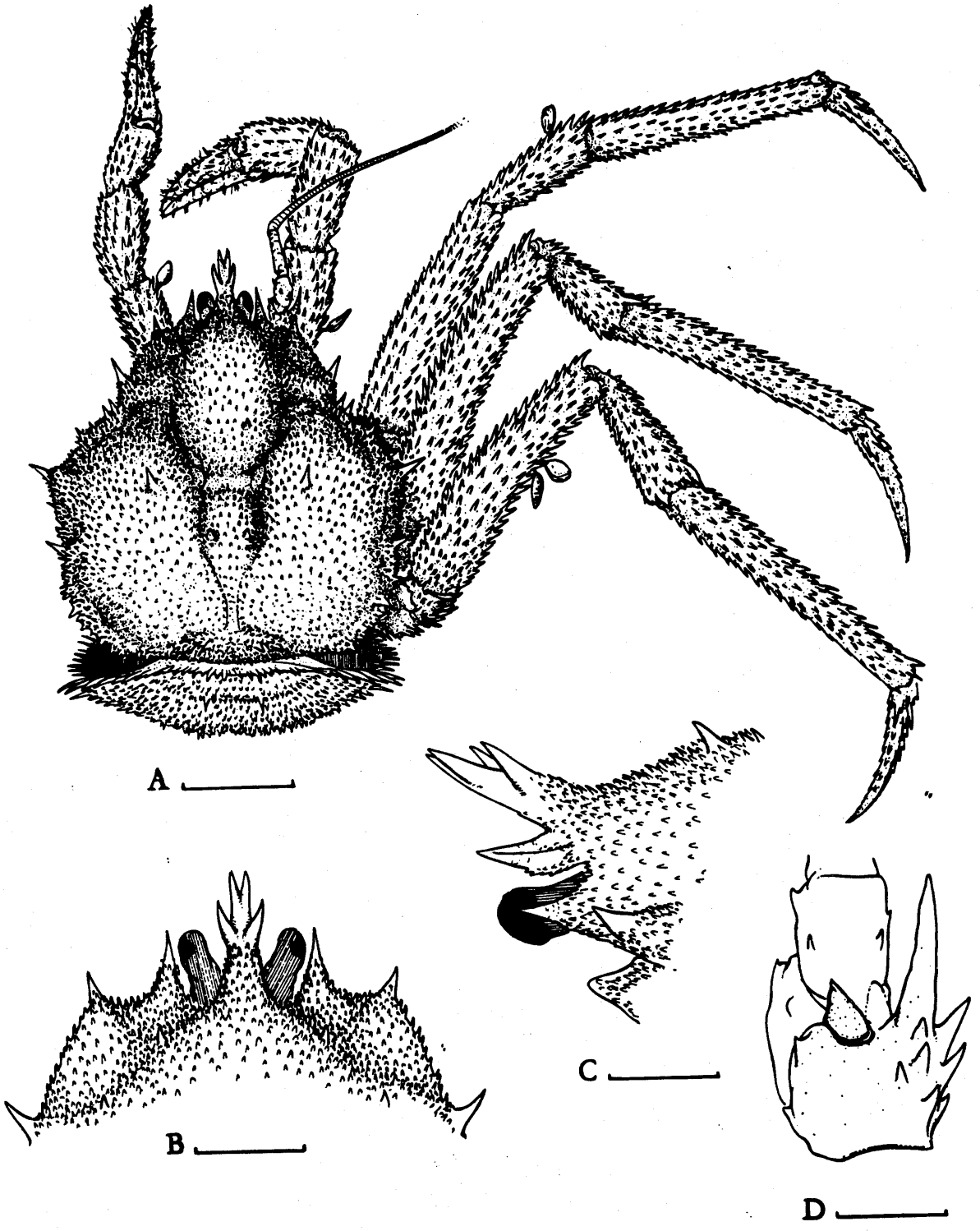

Figure 1. Lithodes wiracocha, new species, holotype. A, animal in dorsal view; B, anterior part of carapace, dorsal view; C, same, lateral view; D, right antennal peduncle. Scale A = 30 mm; B = 15 mm; C = 10 mm; D = 5 mm.

lected. To be treated as a noun in apposition to the generic name.

Remarks: This species is distinguished from all other described *Lithodes* by the dense spinulation of the carapace and walking legs. As in *L. murrayi* Henderson (a southern hemisphere species) and *L. tropicalis* A. Milne-Edwards, the rostrum is inclined upward and bifurcate at the tip. *Lithodes panamensis* Faxon also has an upturned rostrum, which however is trifurcate at the tip; Faxon's species is further distinguished from *L. wiracocha* by the pronounced convexity of the gastric and branchial regions of the carapace. The dorsal portion of the rostrum of *L. antarcticus* Jacquinot, which inhabits the southern part of the South American continent, is shorter than the ventral process and the latter is clearly visible in dorsal view.

Several stalked barnacles are attached to the chelipeds and walking legs of the holotype; these have not yet been identified.

Del Solar (1972: 15) reported a specimen with a span of 1.07 m between the tips of the extended legs. An equivalent measurement on the holotype is only 0.58 m.

Paralomis White, 1856

Paralomis White, 1856: 134. Type species by monotypy: *Lithodes granulosa* Jacquinot. Bouvier, 1895: 185; Bouvier, 1896: 12, 21.

Leptolithodes Benedict, 1895: 484. Type species not designated.

Pristopus Benedict, 1895: 486. Type species not designated.

Carapace with spines, tubercles, or other ornamentation according to the species; rostrum short and generally armed with spines. Antennal acicle (scaphocerite) well developed, usually triangular and armed with several spines on margins. Second (basal) abdominal somite fused into a single plate; median plate of somites 3–5 entire; lateral plates of somites 3–5 distinct and paired; in males, marginal plates usually fused to laterals, at least in part, on somite 3 and distinct on somites 4 and 5; in females, marginal plates of somites 3–5 present on right side only.

Paralomis longipes Faxon, 1893

Paralomis longipes Faxon, 1893: 165; Faxon, 1895: pl. 9; Bouvier, 1896: 25; del Solar, 1972: 5, 14.
Leptolithodes longipes: Faxon, 1895: 48.

Diagnosis: Carapace and abdomen thickly covered with small, blunt tubercles, each encircled by a ring of short, stiff setae; a median spiniform tubercle on anterior part of gastric region; anterolateral and outer orbital spines sometimes enlarged, other laterals (hepatic and three or four branchials) short. Gastric, cardiac, and branchial regions well defined, protuberant; grooves defining sides of cardiac region becoming indistinct posteriorly and not continuing to posterior margin of carapace. Rostrum terminating in a median inferior and two lateral superior spines; dorsally a median spinule at base of latter pair, and one or two lateral spinules on each side; ventral surface with a protuberance bearing one or two spinules. Antennal acicle with several long, slender spines. Walking legs very long, prismatic, with longitudinal rows of strong, thornlike spines.

Previous records: 05°26′20″ N, 86°55′ W, 770 fms [1410 m] (Faxon, 1893, 1895). 07°59′ S, 80°22′ W, 760–800 m; 16°29′ S, 73°33′ W, 1300 m (del Solar, 1972).

Material examined: Male; off Perú, 07°59′ S, 80°22′ W; 760–800 m, hard bottom; November 1971; E. M. del Solar on trawler "Challua japic."

Measurements: Length of carapace excluding rostrum, 106 mm; rostrum, 14 mm; maximum width of carapace, 117 mm; length of right, third walking leg: merus, 101 mm; carpus, 56 mm; propodus, 99 mm; dactyl, 76.5 mm.

Remarks: Faxon's description and illustration were based on a male 84 mm long including the rostrum. My specimen differs in only a few details. The outer orbital and anterolateral spines are no larger than the other lateral spines, whereas they are enlarged in the illustrated type. In the Peruvian specimen there are two distinct spinules on each side of the rostrum proximal to the terminal pair of spines. The acicle of the left antenna has six spines and that of the right antenna eight; Faxon described and figured only five spines on an acicle of the male type.

Numerous stalked barnacles are attached to the chelipeds and walking legs.

Paralomis aspera Faxon, 1893

Paralomis aspera Faxon, 1893: 164; Faxon, 1895: pl. 8; Bouvier, 1896: 26; del Solar, 1972: 5, 14.
Leptolithodes asper: Faxon, 1895: 47.

Diagnosis: Carapace and abdomen thickly covered with papillae or tubercles, each encircled by a ring of stiff setae; no surface spines; a sharp outer orbital and anterolateral spine, and four or five lateral branchial spines. Gastric, cardiac, and branchial regions well defined and prominent. Rostrum short, indistinctly tripartite, multispinose, lower part armed with as many as five spines. Antennal acicle with several spines on each margin and one on both upper and lower side near base. Walking legs of moderate length, stout, densely spinose.

Previous records: 07°06′15″ N, 80°34′ W, 695 fms [1270 m] (Faxon, 1893, 1895). 03°48′ S, 81°20′ W, 560 m (del Solar, 1972).

Material examined: Male (juvenile); off Perú; 1971; E. M. del Solar.

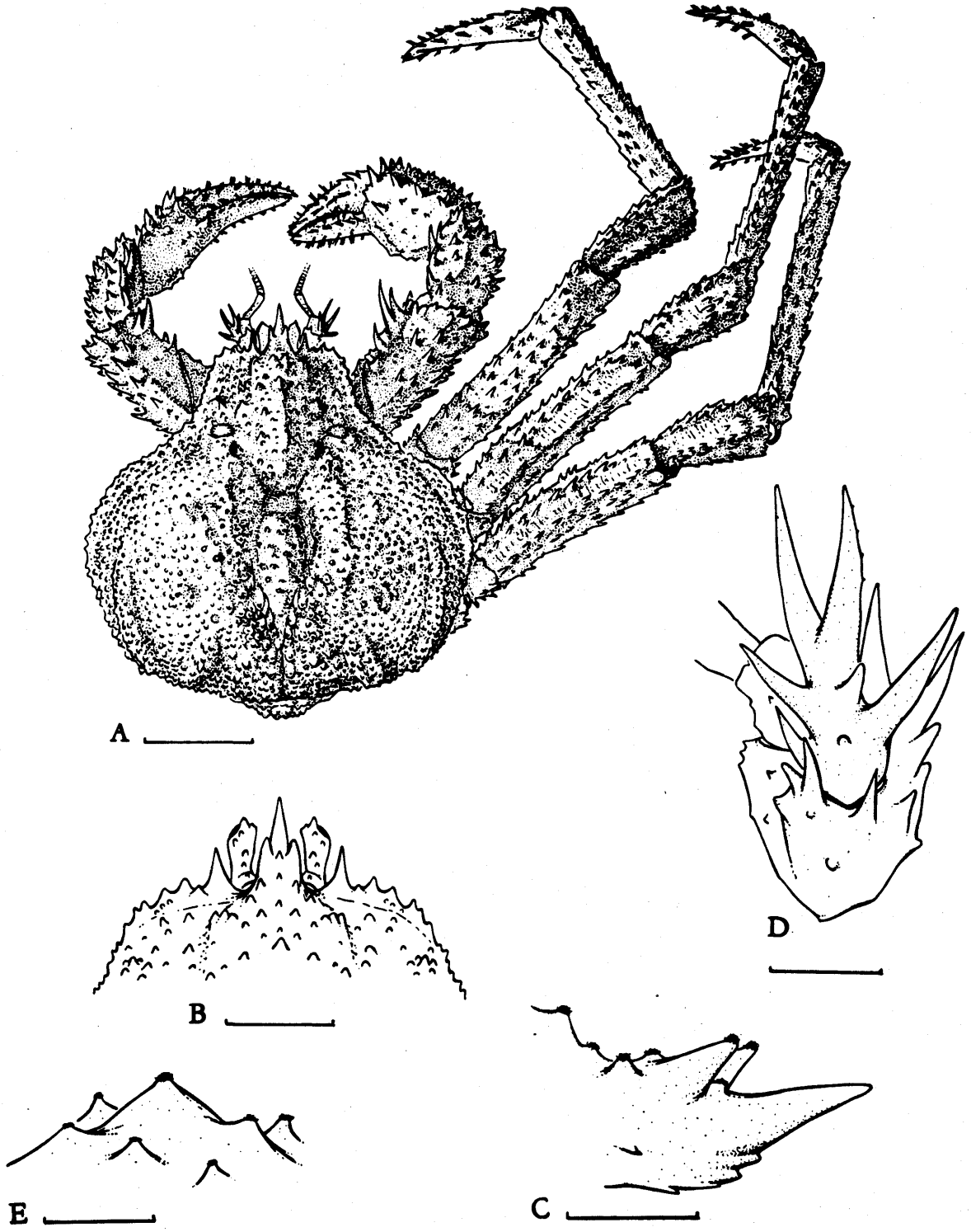

Figure 2. *Paralomis papillata* (Benedict). A, animal in dorsal view; B, anterior part of carapace; C, rostrum, lateral view; D, right antennal peduncle; E, tubercles of carapace. Scale A = 30 mm; B = 15 mm; C = 6 mm; D = 4 mm; E = *ca.* 7 mm.

Measurements: Length of carapace including rostrum, 75 mm; maximum width of carapace, 75 mm; length of right, third walking leg: merus, 30 mm; carpus, 20 mm; propodus, 27 mm; dactyl, 24 mm.

Remarks: The above diagnosis was derived from the description and illustration of the holotype, a female 122 mm long including the rostrum. The much smaller Peruvian specimen shows striking differences in the surface ornamentation. Each papilla of the carapace and abdomen is raised on a stalk, the whole forming a blunt-tipped (papilliferous) spine; at the base of the papilla is the ring of setae described and figured by Faxon. Toward the carapace margins, and on the chelipeds and walking legs, these spines become more elongate and in many, particularly those of the walking legs, the terminal papilla is tipped with a minute, sharp, corneous spinule. Comparison of a good series of specimens of different sizes would be of interest. Increase of size of individuals is probably accompanied by a gradual reduction of the surface armature from elongate, papilliferous spines bearing setae at the base of the papilla to low, papilliferous tubercles on the carapace and abdomen, these still retaining a ring of setae, and to spines of the usual kind on carapace margins and pereiopods.

The rostrum in the Peruvian specimen is multispinose as in the type, but shorter and more symmetrical. The eyes have two strong terminal spines, one dorsal and one mesial, extending well beyond the cornea, and there are about twelve smaller spines on the dorsal surface of the eyestalk. All these spines have a ring of setae below the papillose tip.

Faxon (1893: 165) mentioned that the type was "infested with a huge *Peltogaster* 36 mm in breadth." My specimen also bears a large abdominal sacculinid, in this case 34 mm across.

Paralomis papillata (Benedict, 1895)

Figure 2

Leptolithodes papillatus Benedict, 1895: 485.
Paralomis papillata: Bouvier, 1896: 25.

Diagnosis: Carapace and abdomen thickly covered with small, papilliform tubercles, each bearing stiff setae over summit; no surface spines; outer orbital spine well developed, lateral margins otherwise with small tubercles only. Branchial regions more protuberant than gastric and much more so than cardiac; grooves defining sides of cardiac well defined, meeting at posterior end of this region and continuing as a single deep groove to posterior margin of carapace. Rostrum terminating in a median inferior and two lateral superior spines, latter pair not reaching end of eyes; ventral surface with an unarmed or minutely spinulate protuberance. Antennal acicle with several long, slender spines. Walking legs very long, prismatic, with longitudinal rows of tubercles and short, stout spines.

Previous records: "Off Lower California, or perhaps south of that region" (Benedict, 1895).

Material examined: Male; off Perú, 06°31′ S, 81°01′ W; 712–744 m, mud and hard sand; 17 May 1971; E. M. del Solar on R/V "SNP–1."

Measurements: Length of carapace excluding rostrum, 100 mm; rostrum, 12 mm; maximum width of carapace, 112 mm; length of right, third walking leg: merus, 64 mm; carpus, 40.5 mm; propodus, 63 mm; dactyl, 55 mm.

Remarks: Del Solar's collection includes two closely allied but distinct species, both of which agree in most respects with the original description of *Paralomis papillata*. Since no illustration of that species was ever published, it was necessary to compare material of both Peruvian forms with the holotype. Photographs of the type, provided by Henry B. Roberts, confirm the identity of the above specimen with Benedict's species.

The type (USNM 18536), which was collected by the "Albatross," is the ecdysal cast of a large male. It is accompanied by the following information: "No label but with spns. from off lower Cal." According to Mr. Roberts the length of the carapace with rostrum is 118 mm, length of the rostrum 10 mm, and breadth of the carapace 130 mm.

My specimen agrees very closely with the type. The carapace is not quite so broad in proportion to its length. The ventral side of the rostral protuberance is minutely denticulate, while in the type this area is practically smooth. Both acicles are similar in structure to the left acicle of the holotype; but in the type specimen the right acicle has a strong terminal spine, and three lateral and two mesial spines which are considerably shorter.

The Peruvian specimen has a few stalked barnacles attached to the walking legs; these are neither so large nor so numerous as those found on the A.H.F. specimens of *Paralomis longipes* and *Lithodes wiracocha*.

Paralomis inca, new species

Figures 3 and 4

Description (Adults): Carapace a little broader than long, covered with tubercles of different sizes each bearing a cluster of very short, stiff setae over summit. Gastric region moderately convex, some of

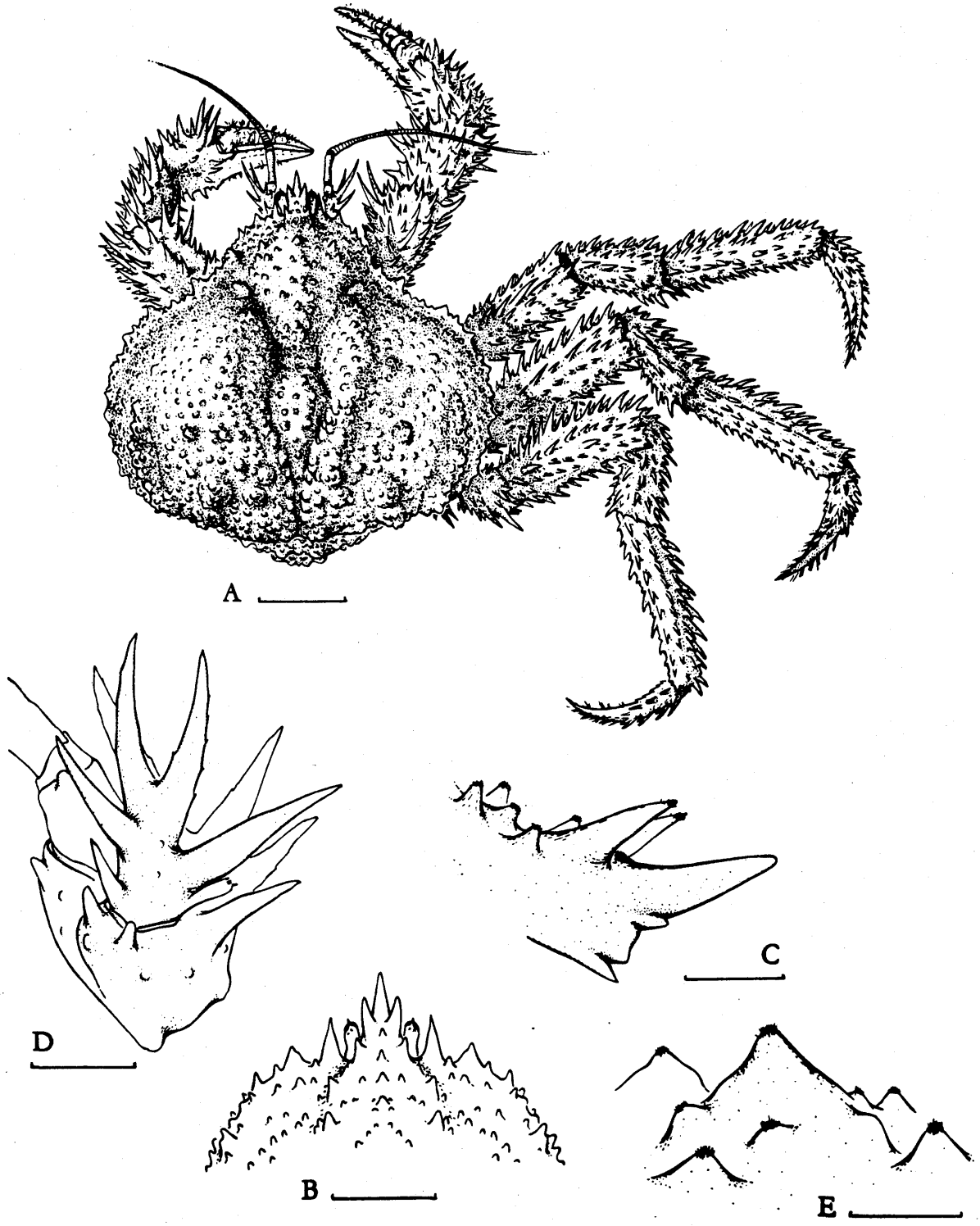

Figure 3. Paralomis inca, new species, holotype. A, animal in dorsal view; B, anterior part of carapace; C, rostrum, lateral view; D, right antennal peduncle; E, tubercles of carapace. Scale A = 27 mm; B = 15 mm; C and D = 4 mm; E = *ca.* 5 mm.

its tubercles small and rounded, others larger, conical, with papilliform or pointed tip (latter type almost spiniform in largest individuals, definitely so in smallest adult). Cardiac region separated from gastric by a deep, rectangular depression; with several conical tubercles and smaller, rounded ones. Branchial regions more protuberant than gastric and much more so than cardiac, separated from latter region by distinct grooves joining at its posterior end and continuing as a single deep groove to posterior margin of carapace; branchials with both large and small tubercles as on other regions, and also with scattered swellings each bearing several small tubercles, a few of latter tending to become spiniform. A number of large, low, pustulous tubercles grouped on posterior part of carapace near midline. Outer orbital angle marked by a sharp spine; lateral margins otherwise with large and small tubercles, some of the larger ones spiniform.

Rostrum terminating in a median inferior and two lateral superior spines, latter pair reaching or surpassing end of eyes; dorsally a median tubercle just proximal to superior pair of spines, and a pointed tubercle on either side at base; underside of inferior spine with a large, distinctly spinulate protuberance.

Eyestalks armed with a few spinules dorsally, largest one terminal and extending beyond cornea. Second segment of antennal peduncle with three or four strong spines laterally, distal one reaching onto terminal segment of peduncle. Acicle with two very strong spines, both appearing to be terminal and of about equal length; also a strong lateral spine and one or two lateral spinules, two strong mesial spines, and two or three very small dorsal spinules.

Chelipeds subequal in length, but right slightly stouter than left. All segments with strong, thornlike spines, each bearing short setae at tip. Walking legs long, prismatic, with longitudinal rows of strong, thornlike spines and short, pointed tubercles, these setiferous as elsewhere on body.

Abdomen covered with small tubercles, conical or papilliform and setiferous at summit.

(Juvenile): Carapace covered with long, slender spines, each with a tuft of long, flexible setae at and near tip; tip rounded and with a minute corneous spinule. A number of longer, stouter spines occurring as indicated on figure 4A; these sharp-tipped with rudimentary setae. Median area of posterior part of carapace with pustulous tubercles of different sizes; most of these raised on short, stout stalks and thus almost mushroomshaped. Spinulation of chelipeds and walking legs as in adults, but spines proportionately longer and more slender; terminal setae in a long tuft. Abdomen densely covered with long, slender spines, each tipped with a tuft of long, flexible setae.

Material examined: Holotype, ovigerous female, A.H.F. 718; off Perú, 06°31.5′ S, 81°01.5′ W; 712–744 m, mud and hard sand; 17 May 1971; E. M. del Solar on R/V "SNP–1."

Paratype, male (juvenile); 12 mi SW Banco de Mancora, Perú; 620 m, mud bottom; 15 March 1971; E. M. del Solar on trawler "Wiracocha."

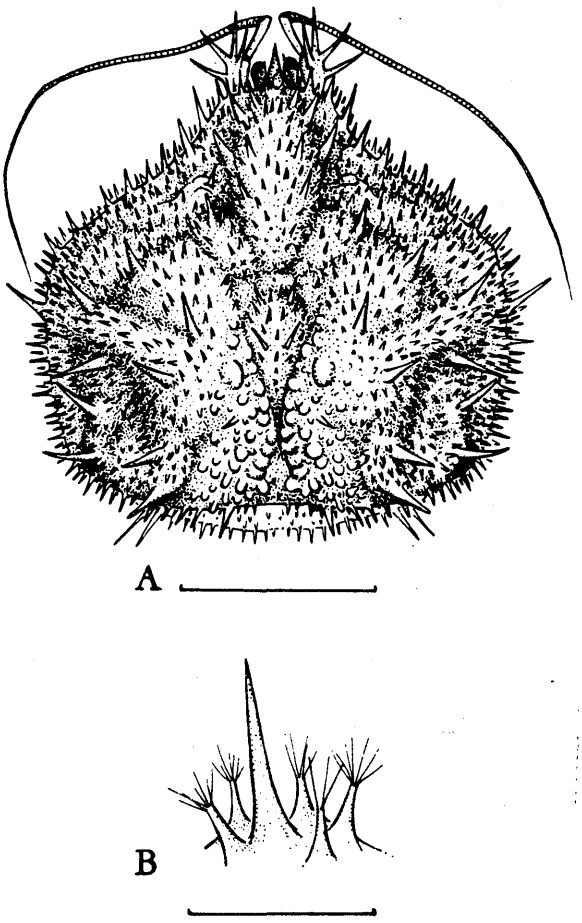

Figure 4. Paralomis inca, new species, juvenile paratype. A, carapace; B, carapace spines. Scale A = 30 mm; B = *ca.* 5 mm.

Paratypes, male and ovigerous female; off Perú, 07°59′ S, 80°22′ W; 760–800 m, hard bottom; November 1971; E. M. del Solar on trawler "Challua japic."

Measurements in mm: The measurements for the (holotype), a female, and two males, respectively, are as follows: length of carapace excluding rostrum, (108.0), 93.5, 80.0, 69.0; rostrum, (13.0), 10.0, 10.5, ———; maximum width of carapace, (123.0), 109.0, 93.0, 69.0; length of right, third walking leg – merus, (53.0), 50.5, 47.0, 38.0; carpus, (37.0), 35.0, 31.0, 21.5; propodus, (50.0), 48.0, 44.0, 28.5; dactyl, (43.0), 41.5, 40.0, 26.5.

Etymology: As a noun, "Inca" can refer either to an emperor or chief of Perú in the days before the Spanish Conquest, or to a member of the dominant tribe; as an adjective, of or pertaining to the Incas or their empire. Here it is to be considered to be a noun in apposition to the generic name.

Remarks: *Paralomis inca* and the closely allied *P. papillata* share a number of characters, includ-

ing the swollen branchial regions defined by grooves which enclose the sunken cardiac region and extend as a single deep groove to the posterior margin of the carapace; the lack of well developed spines on the lateral margins, aside from the outer orbital spine; armature of the carapace consisting of conical or papilliform tubercles with setae over the summit (not forming a ring below the summit as in *P. longipes* and *P. aspera*); and walking legs long and prismatic, with a row of spines on each longitudinal ridge. This combination of characters distinguishes both species from all other members of the genus. The tubercles of the carapace of *P. inca* are much less uniform in size and shape than they are in *P. papillata;* the lateral superior spines of the rostrum are longer, and the ventral protuberance of the median spine is more strongly spinulate; the walking legs are proportionately shorter, and their spines are longer, slenderer and more numerous.

The 69 mm juvenile male is an ecdysal cast. Many of the spines of the carapace are bent near the tip or in the distal half, with the bent spines oriented in no particular direction; this condition may be due to the soft state of the integument. The dorsal portion of the rostrum is missing. The rather startling difference in appearance between juvenile and adults is duplicated in *P. aspera* Faxon, as I have noted earlier, and probably in other species of *Paralomis* as well. Distinctions between species of this genus are based in large part on the form of the surface ornamentation, but little consideration has been given to changes in this ornamentation that may take place with growth.

Del Solar (1972: 14) listed "*Paralomis* sp." from 06°31′ S, 81°01′ W in 712–744 m. This record might refer to either the new species or *P. papillata*, which were collected together at that locality.

Lopholithodes Brandt, 1848

Lopholithodes Brandt, 1848 [July]: 174. Type species by monotypy: *Lopholithodes mandtii* Brandt.

Echinocerus White, 1848 [November]: 47. Type species by monotypy: *Echinocerus* (*Lithodes*) *cibarius* White [= *Lopholithodes mandtii*].

Ctenorhinus Gibbons, 1855: 48. Type species by monotypy: *Ctenorhinus setimanus* Gibbons [= *Lopholithodes mandtii*].

Echidnocerus: Bouvier, 1896: 12, 21.

Carapace tuberculate, broader than long, anterior part of branchial margin extended laterally to cover base of walking legs; rostrum short, armed with spiniform tubercles. Antennal acicle (scaphocerite) triangular, with row of spines on margins. Carpus of chelipeds with a prominent lobe on inner margin, sometimes covering mouthparts; chelipeds and walking legs fitting neatly together when folded, and sometimes folding under carapace. Second (basal) abdominal somite fused into a single plate; median plate of somites 3–5 entire; lateral plates of somites 3–5 distinct and paired; in males, marginal plates distinct or fused to laterals on somite 3, distinct on somites 4 and 5; in females, marginal plates of somites 3–5 present on right side only.

Lopholithodes diomedeae (Faxon, 1893)

Echinocerus diomedeae Faxon, 1893: 164; Faxon, 1895: pl. 7 figs. 3, 3 a, b.

Paralomis diomedeae: Faxon, 1895: 46.

Echidnocerus diomedeae: Bouvier, 1896: 27.

Lopholithodes diomedeae: del Solar, 1972: 5, 14.

Diagnosis: Carapace tuberculate; anterolateral margins irregularly toothed. Rostrum short, with three spines or sharp tubercles, one median inferior and two paired superior. Antennal acicle with four or five spines on each margin. Carpus of chelipeds with inner lobe toothed on margin; outer margin with an unarmed crest. Walking legs longer than chelipeds and longer than greatest width of carapace; on first pair, anterior margin of carpus with an entire crest, of propodus with crest along proximal half and two or three teeth distally; on second and third pairs, carpus and propodus toothed along anterior margin.

Previous records: 07°31′30″ N, 79°14′ W, 458 fms [837 m]; 07°21′ N, 79°35′ W, 511 fms [935 m] (Faxon, 1893, 1895). 03°48′ S, 81°22′ W, 680 m; 10°01′ S, 79°10′ W, 830 m (del Solar, 1972).

Material examined: Male; off Perú, 10°01′ S, 79° 05′ W; 830 m, hard mud bottom; 19 May 1971; E. M. del Solar on R/V "SNP-1."

Measurements: Length of carapace excluding rostrum, 101 mm; rostrum, 9 mm; maximum width of carapace, 128 mm; length of right, third walking leg: merus, 56 mm; carpus, 38 mm; propodus, 39 mm; dactyl, 47 mm.

Remarks: Faxon described this species from two female specimens. My male differs from the description and illustration of the larger, 64 mm type in having the various articles of the chelipeds and walking legs more elongate.

The genus *Lopholithodes* contains two other species, *L. mandtii* Brandt and *L. foraminatus* (Stimpson), both from the temperate north Pacific. In those species the walking legs are about as long as the chelipeds and shorter than the greatest width of the carapace, and all the pereiopods are modified to fold under the carapace, the inner marginal crest of the carpus of the chelipeds covering the mouthparts and the whole forming a boxlike structure. In *Lopholithodes diomedeae*

the legs are long and do not fold beneath the carapace, and the chelipeds are elongate enough so that the carpal crest cannot cover the mouthparts. In the Peruvian specimen, the first male to be reported, the marginal plates of the third abdominal somite are almost completely fused with the lateral plates. In this character *L. diomedeae* is closer to *L. foraminatus* than to *L. mandtii*, in which the marginal plates are distinct on the third abdominal segment of males.

In the original description, Faxon (1893) placed this species in *Echinocerus* and compared it with *E. foraminatus* Stimpson; later (1895) he changed his mind as to its affinities and allied it with *Paralomis granulosa* (Jacquinot). Bouvier (1896) retained it in *Echinocerus* (with spelling *Echidnocerus*) alongside *E. cibarius*, *E. setimanus* (both = *mandtii*) and *E. foraminatus*. *Lopholithodes* has since been shown to have priority over *Echinocerus*, so the correct name for Faxon's species is *Lopholithodes diomedeae*. It was reported for the first time in this combination by del Solar (1972), for whom I had provided an identification.

Glyptolithodes Faxon, 1895

Glyptolithodes Faxon, 1895: 42. Type species by monotypy: *Rhinolithodes cristatipes* Faxon.

Carapace with a large, conical prominence on gastric region, one on each posterolateral margin, and two on posterior margin; a prominent, crescentic, rounded ridge on each branchial region, enclosing cardiac region in a deep fossa; rostrum conical, with a short, laterally compressed ventral process. Antennal acicle (scaphocerite) triangular, margins spined. Walking legs flattened, nearly spineless, margins lobed or dentate. Second (basal) abdominal somite fused into a single plate; median plate of somites 3–5 entire; lateral plates of somites 3–5 distinct and paired; in males, marginal plates partially fused to laterals on somite 3 and distinct on somites 4 and 5; in females, marginal plates of segments 3–5 present on right side only.

Glyptolithodes cristatipes (Faxon, 1893)

Figure 5

Rhinolithodes cristatipes Faxon, 1893: 163; Faxon, 1895: pl. 7 figs. 2, 2 a–c; Bouvier, 1896: 27.

Glyptolithodes cristatipes: Faxon, 1895: 43; del Solar, 1972: 5, 13.

Rhinolithodes (*Glyptolithodes*) *cristatipes*: Bahamonde, 1967: 3, pl. 1.

Diagnosis: Carapace broader than long, covered with small granules; outer orbital and anterolateral angles with a small, blunt tooth; anterolateral (anterior branchial) margin with a few conical tubercles or teeth; prominences on carapace as described in generic diagnosis; cardiac fossa open posteriorly. Rostrum short, conical, unarmed dorsally; ventral process denticulate anteriorly, not visible in dorsal view. Antennal acicle with a terminal spine and with two to four spinules on each margin. Carpus of chelipeds flattened, outer margin cristate and sometimes cut into two or three lobes, inner margin with crest expanded and cut into dentiform lobes or armed with several sharp teeth. Walking legs longer than greatest width of carapace in adults; anterior margin of merus, carpus, and propodus cristate, crests entire or cut into two to several lobes; posterior margin of those articles dentate. Abdomen tuberculate.

Previous records: 07°09′45″ N, 80°50′ W, 322 fms [590 m] (Faxon, 1893, 1895). S of Banco de Mancora, Perú, 400 m; 03°51′ S, 81°18′ W, 800 m; 07° 42′ S, 80°26′ W, 693 m (del Solar, 1972). Off Iquique, Chile, depth unrecorded; 25°11′ S, 70°31′ W, 245–266 m (Bahamonde, 1967).

Material examined: Female (juvenile); S of Banco de Mancora, Perú, 03°51.3′ S, 81°18.2′ W; 795–800 m, mud bottom; 11 January 1971; E. M. del Solar on R/V "SNP-1."

Female; off Perú, 06°31.5′ S, 81°01.5′ W; 712–744 m, mud and hard sand; 17 May 1971; E. M. del Solar on R/V "SNP-1."

Male; off Puerto Chicama, Perú, 07°42′ S, 80°26′ W; 693 m, rocky bottom; 2 March 1971; E. M. del Solar on R/V "SNP-1."

Measurements: Length of male carapace excluding rostrum, 79.5 mm; rostrum, 6 mm; maximum width of carapace, 98 mm; length of right, third walking leg: merus, 44.5 mm; carpus, 28 mm; propodus, 38 mm; dactyl, 37.5 mm. Length of female including rostrum, 89.5 mm. Length of juvenile including rostrum, 27 mm.

Remarks: The original description of this species was based on a juvenile male specimen. The juvenile collected by del Solar is larger than the 16.5 mm holotype, but agrees closely with it. Adults, on the other hand, show a number of differences, some of which were pointed out by Bahamonde (1967), who reported six large specimens from off Iquique and Taltal, Chile. The carapace is broader than long instead of about as long as broad; the setae which decorate its lateral prominences in juveniles are absent in adults. There are three or four spines, instead of two, on each margin of the antennal acicle. The walking legs are much longer than the carapace width, and the various articles of these legs are proportionately more elongate than they are in juveniles.

On the illustrated specimen (Fig. 5A) the artist has depicted an abnormally small (probably regenerating) third walking leg. The third walking

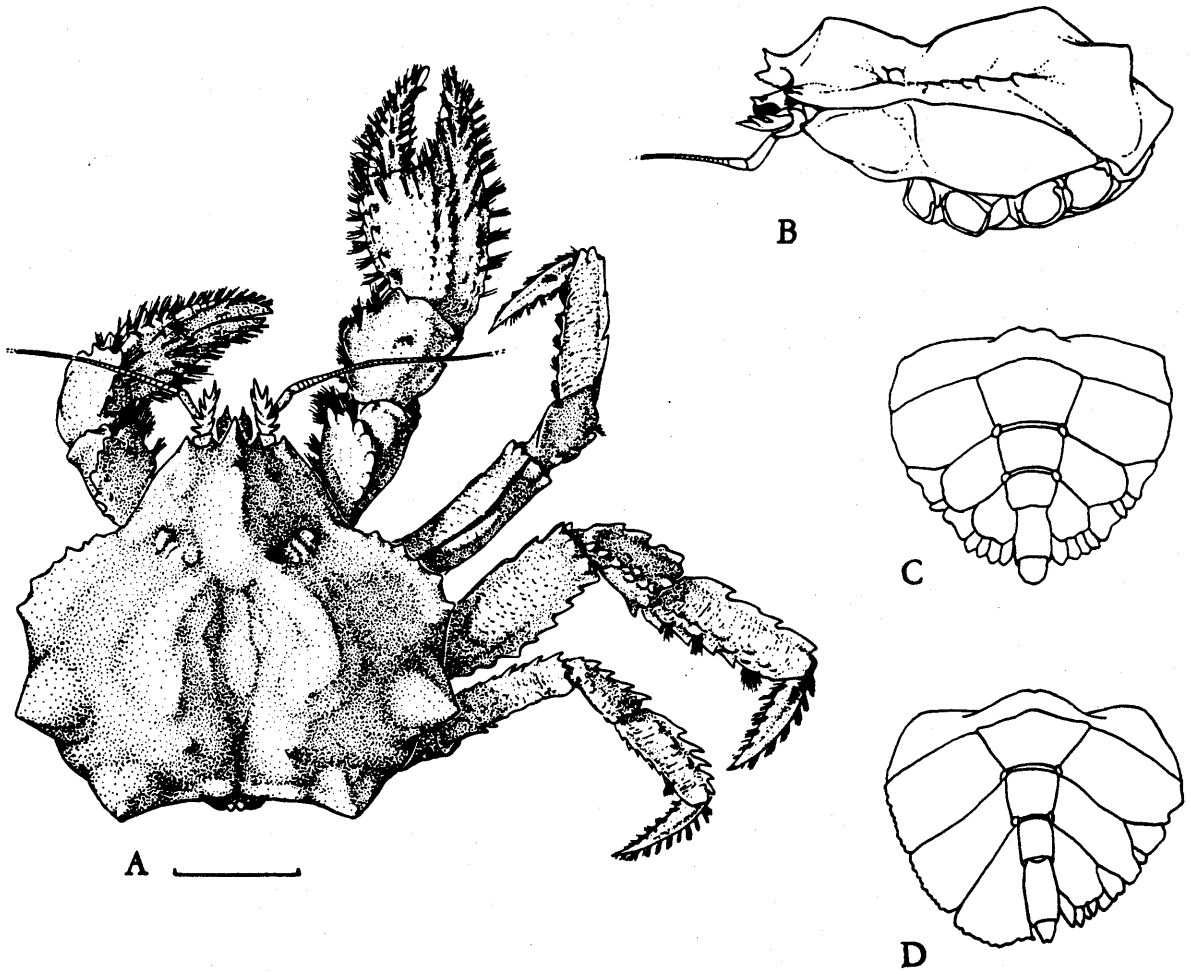

Figure 5. Glyptolithodes cristatipes (Faxon). A, male in dorsal view; B, same specimen, carapace in lateral view; C, abdomen of male; D, abdomen of female. Scale A = 30 mm.

legs are normally about the same size as the other two pairs.

The abdomen of the 89.5 mm female bears a sacculinid 45 mm across.

In his original description of this species, Faxon (1893) referred it provisionally to *Rhinolithodes* Brandt. Later he examined material of *R. wosnessenskii* Brandt and concluded that the two species are generically distinct. Characters by which he distinguished *Glyptolithodes* from *Rhinolithodes* (Faxon, 1895: 43) include the form of the rostrum and legs and of the cardiac region, which is elevated and spherical in *R. wosnessenskii*, the type species of *Rhinolithodes*. Bouvier (1896), who evidently did not know of Faxon's 1895 work, failed to mention *Glyptolithodes* and retained *G. cristatipes* in *Rhinolithodes*, a genus characterized by having the marginal plates of abdominal segments 3–5 completely fused with the corresponding lateral plates (Bouvier, 1895: 187; 1896: 21). This is true of both sexes, as I have confirmed by examination of a male and a female *R. wosnessenskii* in the collections of the Allan Hancock Foundation. The very different structure of the abdomen in *G. cristatipes* (Fig. 5 C, D) confirms Faxon's opinion that his species belongs to a separate genus.

REMARKS ON DISTRIBUTION

Bouvier (1896) showed that the Lithodidae, a family adapted to cold and temperate waters, originated in the North Pacific and underwent tropical submergence during its migration southward along the Pacific coast of the Americas. On that coast it re-emerged at about 42° S, from which latitude southward it is represented by

Lithodes antarcticus Jacquinot and *Paralomis granulosa* (Jacquinot) in the littoral and to depths of about 150 and 100 m, respectively. The deep-water, tropical component of this fauna first became known when Faxon (1893) described *Lithodes panamensis*, *Paralomis longipes*, *P. asper*, *Lopholithodes diomedeae*, and *Glyptolithodes cristatipes* from between 07°31′30″ N and 05°26′ 20″ N, in 590 to 1410 m. Shortly afterwards, Benedict (1895) described *Paralomis papillata* from a specimen collected at an unrecorded depth and an uncertain locality, probably off México.

Rathbun's (1910) pioneer compilation of the decapod Crutacea of Perú included no Lithodidae, because at that time practically no exploration of the deep sea had been made in Peruvian waters. This situation continued to exist until very recently, when the investigations of IMARPE (del Solar, 1972) yielded all five of Faxon's species as well as *Paralomis papillata* (Benedict) and the two new species described in the present report. *Glyptolithodes cristatipes* was recorded from Chile at 25°11′ S by Bahamonde (1967), who noted that fragments of two undetermined species, a *Paralomis* and a *Leptolithodes* [=*Paralomis*], have been taken from stomachs of sperm whales captured in Chilean waters. *Lithodes panamensis* and *Glyptolithodes cristatipes* are known to occur off northern México (unpublished records). Thus, although much deep-water exploration of the Pacific American coast remains to be done, a general picture of the "tropical component" of the Lithodidae is becoming clearer: it consists of at least eight benthonic species and, considered as a unit, reaches its northern limit in tropical México but penetrates the temperate Chilean waters to the south.

Faxon (1895: 51) reported small, indeterminable juveniles of "two more species of *Lithodes*" from the collections of the "Albatross" off tropical western America. One of these, taken between 16°33′ N and 0°04′ S in 1207 to 1847 m, belongs to *Neolithodes* A. Milne-Edwards and Bouvier, 1894. *Neolithodes diomedeae* (Benedict) was described off southern Chile from 42° 36′ S and 45°35′ S in 2454 and 1920 m, respectively, and has since been reported from 23°39′ N in 1382 m (Parker, 1964: 163). Until more is learned about the genus in the eastern Pacific, it is impossible to say whether Faxon's specimens belong to *N. diomedeae* or to another, as yet undiscovered form. As I complete the final draft of this report, E. M. del Solar informs me (pers. comm.) that he has found a juvenile *Neolithodes* from Peruvian waters, and that he intends to investigate its status and that of the possible *Neolithodes* taken in Perú from the stomach of a sperm whale (see introduction).

A deep-water species of *Lithodes* and two of *Paralomis* occur in the northeast Pacific and at least as far south as southern California; they are not well known from the southern part of their range, which may overlap to some extent the range of the tropical group of lithodids. Faxon's second undetermined *Lithodes* (Faxon, 51, pl. 10 fig. 2), a juvenile collected at 21°19′ N, is perhaps a very small specimen of *L. couesi* Benedict, whose reported range is Bering Sea to San Diego, California.

ACKNOWLEDGMENTS

I am pleased to acknowledge the help I received from several sources, without which this study could never have been completed. Enrique M. del Solar not only furnished the specimens on which it was based, but provided information on additional Peruvian material as well as constant encouragement. Henry B. Roberts provided photographs and information on the holotype of *Paralomis papillata* (Benedict). A subvention from the Sociedad Nacional de Pesqueria of Lima, Perú, made possible the illustrations, which are the work of Jerry J. Battagliotti.

LITERATURE CITED

Bahamonde, N. 1967. *Rhinolithodes* (*Glyptolithodes*) *cristatipes* Faxon frente a la costa chilena (Crustacea, Decapoda, Anomura, Lithodidae). Not. Mens. Mus. Nac. Hist. Nat., Santiago, 136: 3–7.

Benedict, J. E. 1895. Descriptions of new genera and species of crabs of the family Lithodidae, with notes on the young of *Lithodes camtschaticus* and *Lithodes brevipes*. Proc. U.S. Nat. Mus., 17:479–488.

Bouvier, E.-L. 1895. Recherches sur les affinités des *Lithodes* & des *Lomis* avec les Paguridés. Ann. Sci. Nat., Zool., (7) 18:157–213.

———. 1896. Sur la classification des Lithodinés et sur leur distribution dans les océans. Ann. Sci. Nat., Zool., (8) 1:1–46.

Brandt, J. F. 1848. Die Gattung *Lithodes* Latreille nebst vier neuen ihr verwandten von Wosnessenski entdeckten, als Typen einer besondern Unterabtheilung (Tribus Lithodea) der Ed-

wards'schen Anomuren. Bull. Phys.-Math. Acad. Imp. Sci. St. Petersbourg, 7:171–176.

del Solar, E. M. 1972. Addenda al catálogo de Crustáceos del Perú. Inf. Inst. Mar Perú, 38: 1–21.

Faxon, W. 1893. Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California . . . by the U.S. Fish Commission steamer "Albatross," during 1891. . . . VI. Preliminary descriptions of new species of Crustacea. Bull. Mus. Comp. Zool., Harvard Univ., 24:149–220.

———. 1895. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands . . . by the U.S. Fish Commission steamer "Albatross," during 1891. . . . XV. The stalk-eyed Crustacea. Mem. Mus. Comp. Zool., Harvard Univ., 18:1–292.

Gibbons, W. P. 1855. [Description of a new genus and species of crab.] Proc. California Acad. Sci., 1:48–49.

Latreille, P. A. 1806. Genera crustaceorum et insectorum secundum ordinem naturalem in familias disposita, iconibus exemplisque plurimis explicata. Vol. 1. Paris and Strasbourg. xviii + 302 pp.

Milne-Edwards, A., and E. L. Bouvier. 1894. Troisième campagne du yacht l'*Hirondelle*, 1887. *Neolithodes*, genre nouveau de la sous-famille des Lithodinés. Bull. Soc. Zool. France, 19:120–122.

Parker, R. H. 1964. Zoogeography and ecology of some macro-invertebrates, particularly mollusks, in the Gulf of California and the continental slope off Mexico. Vidensk. Medd. Dansk Naturh. Foren., 126:1–178.

Rathbun, M. J., 1910. The stalk-eyed Crustacea of Perú and the adjacent coast. Proc. U.S. Nat. Mus., 38:531–620.

White, A. 1848. Description of *Echinocerus cibarius*, a new species and subgenus of Crustacea. Proc. Zool. Soc. London, 16:47–49.

———. 1856. Some remarks on Crustacea of the genus *Lithodes*, with a brief description of a species apparently hitherto unrecorded. Proc. Zool. Soc. London, 24:132–135.

Accepted for publication March 29, 1973.