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Four new species of the family Lithodidae (Decapoda: Anomura) from the collections of the National Museum of Natural History, Smithsonian Institution

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Abstract

Four new species of lithodid crab were identified in the collections of the National Museum of Natural History, Smithsonian Institution. These include three species of the genus *Paralomis*: *P. nivosa* from the Philippines, *P. makarovi* from the Bering Sea, and *P. alcockiana* from South Carolina; and one new species of the genus *Lithodes*, *L. galapagensis*, from the Galapagos archipelago. Two of these species, *P. nivosa* and *P. makarovi* were part of a collection of previously unidentified lithodid samples from the Albatross expeditions of 1906–1908. *Paralomis makarovi* may have been misidentified as *P. multispina* Benedict, 1894, or *P. histrix* (De Haan, 1844) in other collections owing to superficial similarities in carapace ornamentation and overlapping distributions.

Key words: king crab, *Lithodes*, *Paralomis*, Albatross expedition, new species, Anomura, Lithodidae

Introduction

The family Lithodidae Samouelle, 1819, is a commercially important group of crustaceans inhabiting subtidal waters at high latitudes, as well as the deep sea in most of the world's oceans (Hall & Thatje 2009). The family consists of 109 species described to date; most of these belonging to the deep-sea genera *Lithodes* Latreille, 1806 (20 species), and *Paralomis* White, 1856 (57 species) (Zaklan 2002; Macpherson & Chan 2008; Spiridonov *et al.* 2006).

The National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM) currently curates over 700 samples belonging to the family Lithodidae — 684 of which are identified to species level. Several of the unidentified samples were collected in the early part of the 20th century by the U.S. Bureau of Fisheries steamer, "Albatross".

The number of described species of the genus *Paralomis* has increased in recent decades (Takeda & Bussarawit 2007). We are beginning to understand the incredible diversity of deep-water forms at depths typically 500–1500 m.

No species of *Paralomis* have been previously reported from the Philippines, although the Albatross 1908–09 expedition to this region also yielded the holotype of *Paralomis ochthodes* Macpherson, 1988a, from the Gulf of Boni, about 1300 km to the south. In addition, *P. seagranti* Eldredge, 1976 and *P. haigae* Eldredge, 1976, were described from Guam, and *P. danida* Takeda & Bussarawit, 2007, was described from Thailand. Several species of *Paralomis*, including *P. dofleini* Balss, 1911, are known from Taiwan and Japan (Macpherson & Chan 2008; Takeda 1985; Takeda 1990; Takeda 1980; Sakai 1971; Sakai 1987).

The diversity of the family Lithodidae in the North Pacific is notably high, with most of the 14 lithodid genera being represented there. Only two species of *Paralomis* have been reported from the Bering Sea, namely *P. multispina* (Benedict, 1894) and *P. verrilli* (Benedict, 1894) (Sakai 1971). In this region, species of

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Paralomis have been encountered at depths of around 1500 m, whereas most other members of the Lithodidae in the North Pacific are found intertidally, based on data from the USNM holdings.

Several species of *Paralomis* are encountered in the Caribbean Sea: *P. cubensis* Chace, 1939, *P. pectinata* Macpherson, 1988b and *P. serrata* Macpherson, 1988b, and *P. arethusa* Macpherson, 1994. None are recorded in the waters off South Carolina, and the closest described species from the Atlantic coast of the USA is *P. bouvieri* Hansen, 1908 (see Macpherson 1988b) at 1460 m off the coast of Virginia.

To date, no specimen of Lithodidae has been recorded from the Galapagos Islands. The genus *Lithodes* is typically found between 200 and 1000 m, and it has been recorded from several locations in the Pacific Ocean — particularly around the islands chains of the western Pacific (Hall & Thatje 2009). The species of *Lithodes* occurring nearest to the Galapagos Islands are *L. wiracocha* Haig, 1974, and *L. panamensis* Faxon, 1893 from the coastal waters off Equador and Peru (Haig 1974).

Materials and methods

All specimens remain in the collections of the USNM. Measurements given are of carapace length (CL) excluding the rostrum. Terminology follows Macpherson (1988b).

Systematic account

Family Lithodidae Samouelle, 1819

***Paralomis alcockiana* n. sp.**
(Figs 1, 2)

Material examined. South Carolina: 31°20'N, 79°05'W, 1995, 570 m: male holotype, CL 44 mm (USNM 269032), S. Carolina Department of Natural Resources.

Etymology. This new species is named after Alfred W. Alcock, 19th century British carcinologist, and Fellow of the Royal Society who reported on the findings of the HMS Investigator in the Indian Ocean.

Description of holotype. Carapace about as long as broad; irregularly hexagonal and angular in outline (Fig. 1a). Surface covered in smoothly elliptical, raised tubercles becoming somewhat more acute towards anterolateral margins; some tubercles enlarged and more acute, with clustered rings of smaller tubercles at base (Fig. 1b). Gastric regions with five enlarged tubercles, largest in the centre of region. Cardiac region with four enlarged tubercles in a quadrilateral pattern. Branchial region with three enlarged tubercles. (Positions of enlarged tubercles corresponding to dorsal spines in other species of *Paralomis* such as *P. formosa* Henderson). Under magnification, all tubercles with irregular arrangements of very short setae, as seen in *Paralomis cubensis* (Fig. 1d).

No regions particularly inflated above dorsal surface, although gastric region slightly inflated in comparison to branchial and cardiac regions. Grooves delimit cardiac region, forming triangle in advance of posterior margin. Small anterior spine present on pterygostomian region, as typical of genus.

Median rostral spine nearly straight, surpassing length of ocular peduncle; ventral surface deeply keeled, bearing several small denticulate spinules (Fig 2a). Paired dorsal spines diverging at level of cornea; both spines much shorter than ventral spine (Figs 2a, b). Dorsally, base of rostrum covered with more or less acute tubercles. Base of the rostrum wide, partially obscuring bases of ocular peduncles in dorsal view.

External-orbital and anterolateral spine similar in size, shorter than ocular peduncle (Fig. 1a). Several irregularly spaced spines (10+) of varying size on lateral margins of anterior half of carapace. Posterior lateral margins with acute tubercles.

Ocular peduncles covered with short spines, and one larger spine disto-dorsal near cornea (Fig. 1c). Antennal acicle broad, with one large central spine, 4 or 5 long spines on outer border and 4 spines of similar length on inner border.

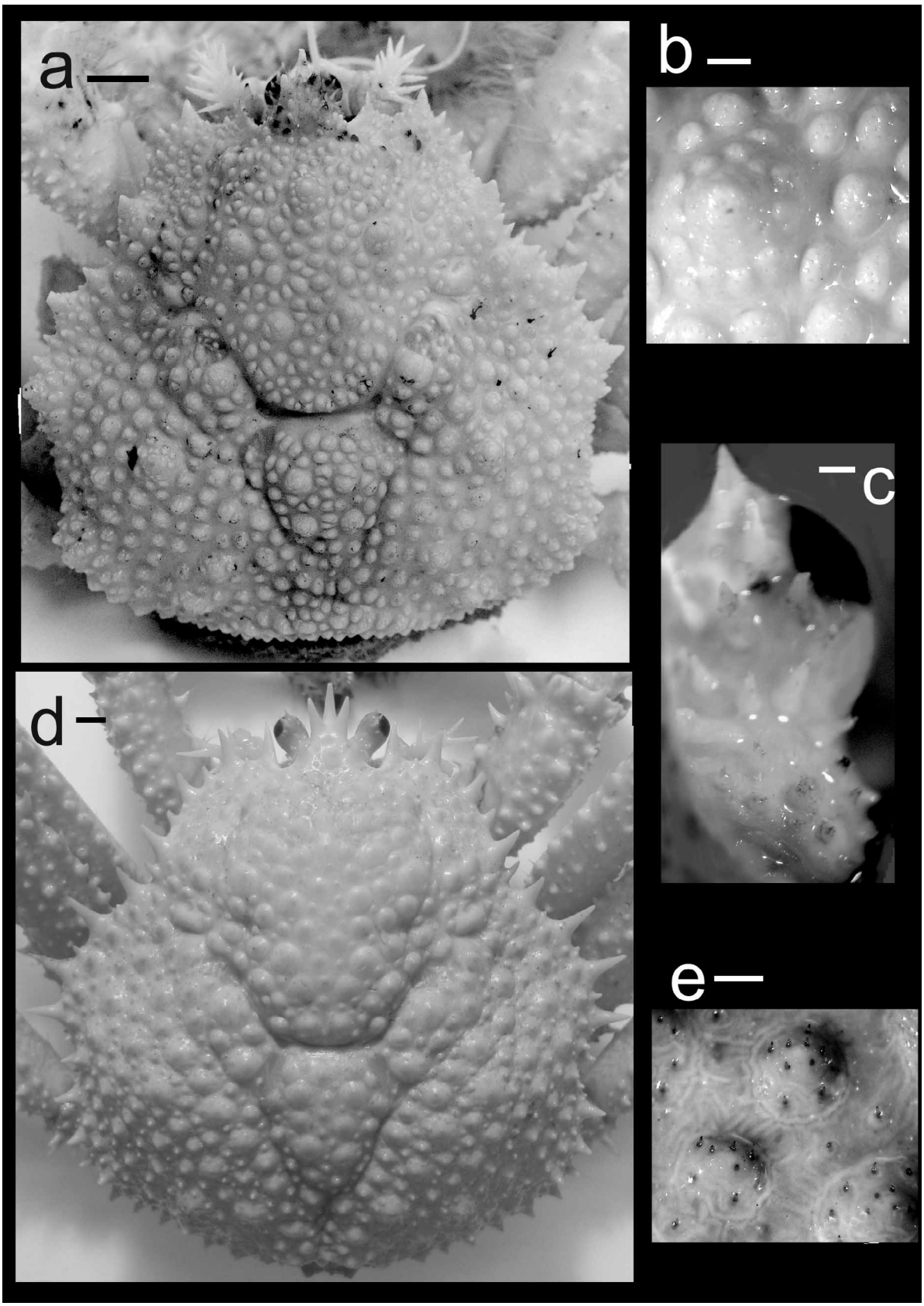

FIGURE 1. *Paralomis alcockiana* **n. sp.** a–c: male holotype, 44 mm CL (USNM 269032), South Carolina: 31°20'N, 79°05'W, 570 m. (a) carapace, dorsal. (b) carapace ornamentation, dorsal. (c) part of ocular peduncle visible below rostrum, dorsal. *Paralomis cubensis* Chace. d, e: Male, 46 mm CL (USNM 213542) (d) carapace, dorsal. (e) carapace ornamentation, dorsal. Scale bar = 5 mm for a, d; 1 mm for b, c, e.

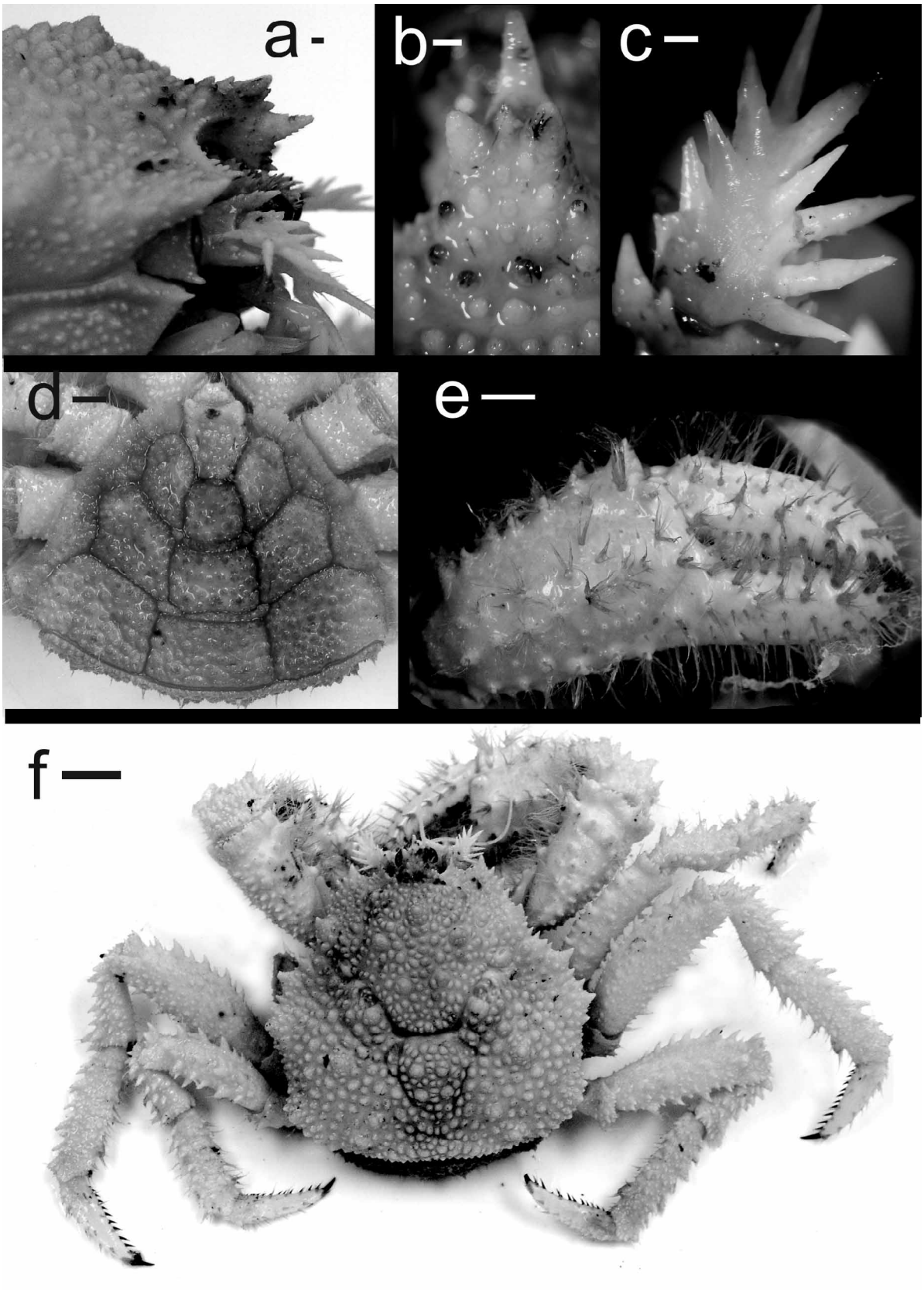

FIGURE 2. *Paralomis alcockiana* **n. sp.** a–f: male holotype, 44 mm CL (USNM 269032), South Carolina: 31°20’N, 79°05’W, 570 m. (a) anterior carapace, lateral. (b) rostral spines, dorsal. (c) right antennal acicle, dorsal. (d) abdomen. (e) right chela, lateral. (f) whole organism, dorsal. Scale bar = 1 mm for a–c; 5 mm for d–f.

Cheliped merus with numerous spiniform tubercles dorsally and on outer surface, larger distally, and one large spine distally on inner surface. Chela with numerous tufts of long yellow setae covering palm and fingers of both hands.

Merus of pereiopod 3 a little over half carapace length, and about four times as long as high, rectangular in cross-section. Several rows of spines on dorsal anterior margin and ventral posterior margin. Posterior, dorsal and ventral surfaces of merus covered with acute tubercles. Two rows of spines on dorsal surface of carpus, larger on anterior row. Propodus with one row of dorsal spines and one row of ventral spines; covered in acute tubercles. Dactylus ventral margin with row of long black needle-like spines, and one black spine at tip; dorsal margins with a few spines near the articulation with propodus; with tufts of long yellow setae.

Abdomen covered with tubercles smaller than on dorsal surface. Marginal plates expanded and fused on each of abdominal segments 3–5; marginal plates fused to lateral plates on segment 3 (Fig. 2d).

Remarks. *Paralomis alcockiana* n.sp. shares many characteristics with *P. cubensis*, which is found in the Gulf of Mexico and Caribbean Sea (Chace 1939) at similar depths to the new species. Some differences are listed in Table 1. The most notable distinguishing feature is the presence, in *P. alcockiana*, of some enlarged conical tubercles surrounded by a ring of smaller rounded tubercles (Fig. 1b).

TABLE 1. Key diagnostic differences between *Paralomis alcockiana* and two similar species.

	P. alcockiana **n. sp.** (Figs 1, 2).	*P. cubensis* Chace, 1939	*P. arethusa* Macpherson, 1994
Carapace outline	Irregularly hexagonal.	Circular in juveniles. Pyriform in adults.	Hexagonal.
Spinulation of lateral margins of carapace	Several irregularly spaced spines (10 +) of varying size on lateral margins of anterior carapace. Posterior lateral margins with acute tubercles.	More than 20 spines of different sizes spaced evenly around anterior and posterior margins	Three spines on each side of anterior margins, several small tubercles on posterior margins.
Spinulation of eyestalks	Several small spines or conical tubercles, largest terminal, extending well beyond cornea.	Several small spines or conical tubercles, largest terminal, extending well beyond cornea.	One distodorsal spine.
Antennal acicle	Broad; one large central spine, 4 or 5 long spines on outer border and 4 spines of a similar length on inner border.	4–6 spines, terminal pair longest, forming a fork. One spine proximal of inner spine of terminal pair and a fourth still more proximal on outer margin.	Large central spine not overreaching antennal peduncle; 2 spines on outer border. Inner border smooth.
Walking leg spinulation	Covered with irregular rows of spines and acute tubercles.	Covered with irregular rows of spines and acute tubercles.	Comb-like sets of spines on merus and carpus. Similar to *P. serrata* and *P. pectinata* from the Gulf of Mexico. Distinguishes all three in this group from *P. alcockiana*.

Paralomis alcockiana is similar in shape to *P. arethusa* from the Barbados accretionary prism, a species known only from a juvenile specimen of 18 mm CL. Although comparison is difficult between different growth stages (Ingle & Garrod 1987), some key diagnostic differences are listed in Table 1.

Paralomis alcockiana is somewhat similar to *P. inca* Haig, 1974, from Peru, and *P. grossmani* Macpherson, 1988b, from French Guiana, but under magnification, the setal coverage of the dorsal tubercles is very different. *Paralomis alcockiana* has rounded tubercles sparsely covered with a few short setae; *P. inca* has rounded or conical tubercles, densely covered with short setae on their apices; and *P. grossmani* has a distinct ring of longer setae around the apex of the tubercles on its dorsal surface. There are also differences in the shape of the carapace. *P. grossmani* is longer and thinner than *P. alcockiana*, especially in the anterior region, and has the gastric region inflated to a much greater level. *P. inca* has its posterior half very much expanded, in contrast to *P. alcockiana* which has a roughly hexagonal outline.

***Paralomis makarovi* n. sp.**
(Figs 3, 4)

Material examined. Bering Sea: Bowers Bank, 54°30'N, 179°17'E, Albatross station 4772, 4.06.1906, 629 m: male holotype, CL 23.8 mm; 3 male paratypes, CL 15–25 mm; 3 female paratypes. CL 12–23 mm (all USNM 1122582).

Etymology. This new species is named after V.V. Makarov, the author of an influential 1938 monograph on lithodid biogeography.

Description of the holotype. Carapace pear-shaped; rounded posteriorly, and longer than wide. Dorsal surface covered uniformly by conical spines, each with band of long setae half-way along length (Fig. 4c) No spines dorsally or laterally notably longer than any other — no prominent spine at apex of gastric or branchial regions. Gastric region rounded and more prominent than branchial and cardiac regions, which are relatively sunken. Grooves only partially delimiting regions.

Median spine of rostrum strongly curved upward, and without secondary spinules or tubercles on ventral surface; one pair of dorsal spines, and one pair of spinules at their base. Rostrum not pedunculated, such that dorsal spines do not surpass cornea in dorsal view (Figs 3f, 4f).

Spines on the lateral margins of carapace of similar size to those on dorsal surface; spines on frontal margin subequal, much shorter than eyestalk; 10–13 spines on each side of anterolateral margin; hepatic spines barely enlarged relative to others.

Ocular peduncles with long spine above cornea, and a few smaller spines along its length. Several setae above cornea (Fig. 3c).

Second peduncular segment of antenna with moderately-sized spine on outer angle, and small spine on inner angle. Antennal acicle longer than ocular peduncle, consisting of one central spine, with 2 or 3 long outer spines and 2 or 3 smaller inner spines; all spines with several setae (Fig. 3g).

Cheliped carpus with several spinules on medial face, without crest of large spines. Chelae with few spinules on dorsal border of palm, and several clusters of brush-like setae.

Merus of pereiopods 2–4 with 4 or 5 ill-defined rows of spines of various sizes; each row with 6 spines of a similar size to those on carapace. Dactylus of pereiopods 2–4 unarmed dorsally except for one at articulation and row of dark needle-like spines ventrally. Claw of dactylus recurved, with several clumps of setae.

Abdomen with marginal plates of segments 3–5 not separated from lateral plates, atypical of genus (Fig. 3d); surface of plates without spines, but with low tubercles and several clusters of setae.

Variations. With the exception of the abdominal asymmetry typical of this family, no notable differences are observed between the males and the females. All individuals agree closely with the holotype.

TABLE 2. Key diagnostic differences between *Paralomis makarovi*, *P. aspera* and *P. chilensis*.

	Paralomis makarovi **n. sp.** (Figs 2, 3)	*Paralomis aspera* Faxon	*Paralomis chilensis* Andrade
Carapace outline	Pear-shaped; rounded posteriorly. Longer than wide.	Pentagonal; as broad as long.	Pear shaped; broader than long.
Antennal acicle spinulation	One central spine, with 2 or 3 long outer spines and 2 or 3 smaller inner spines. All spines with several setae.	At least 7 fully developed spines, on inner and outer faces of the acicle.	Acicle with many spines above and below the plane.
Cheliped palms	Chelae with a few spinules on dorsal border of palm, and several clusters of brush-like setae	Thickly set with strong spines.	Thickly set with strong spines; fingers with no spines.
Abdomen	Surface of plates with low tubercles and several clusters of setae	Plates bear spines similar to those on the dorsal surface of carapace.	Plates bear spines similar to those on the dorsal surface of carapace.
Carapace regional differentiation	Poorly defined regions.	Well defined gastric, cardiac and branchial regions.	Strong definition of all regions.

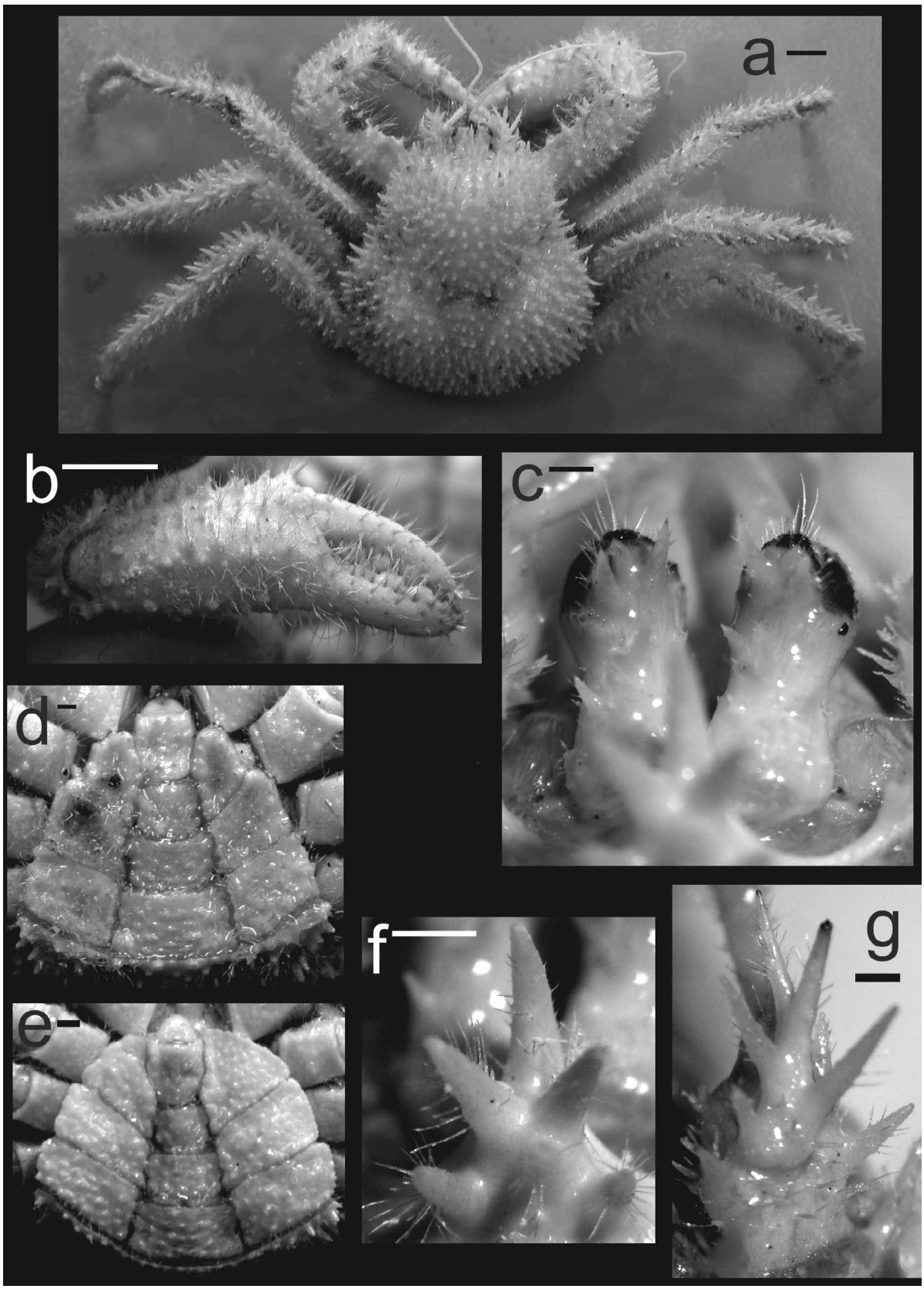

FIGURE 3. *Paralomis makarovi* **n. sp.** a–d, f–g: male holotype, 23.8 mm CL (USNM 1122582) , Bering Sea, Bowers Bank, 54°30'N, 179°17'E, 629 m. e: female paratype 24 mm CL (USNM 1122582). (a) whole organism, dorsal. (b) right chela, lateral. (c) ocular peduncles, dorsal. (d) male abdomen. (e) female abdomen. (f) rostral spines, dorsal. (g) antennal acicle, dorsal. Scale bar = 5 mm for a, b; 1 mm for c–g.

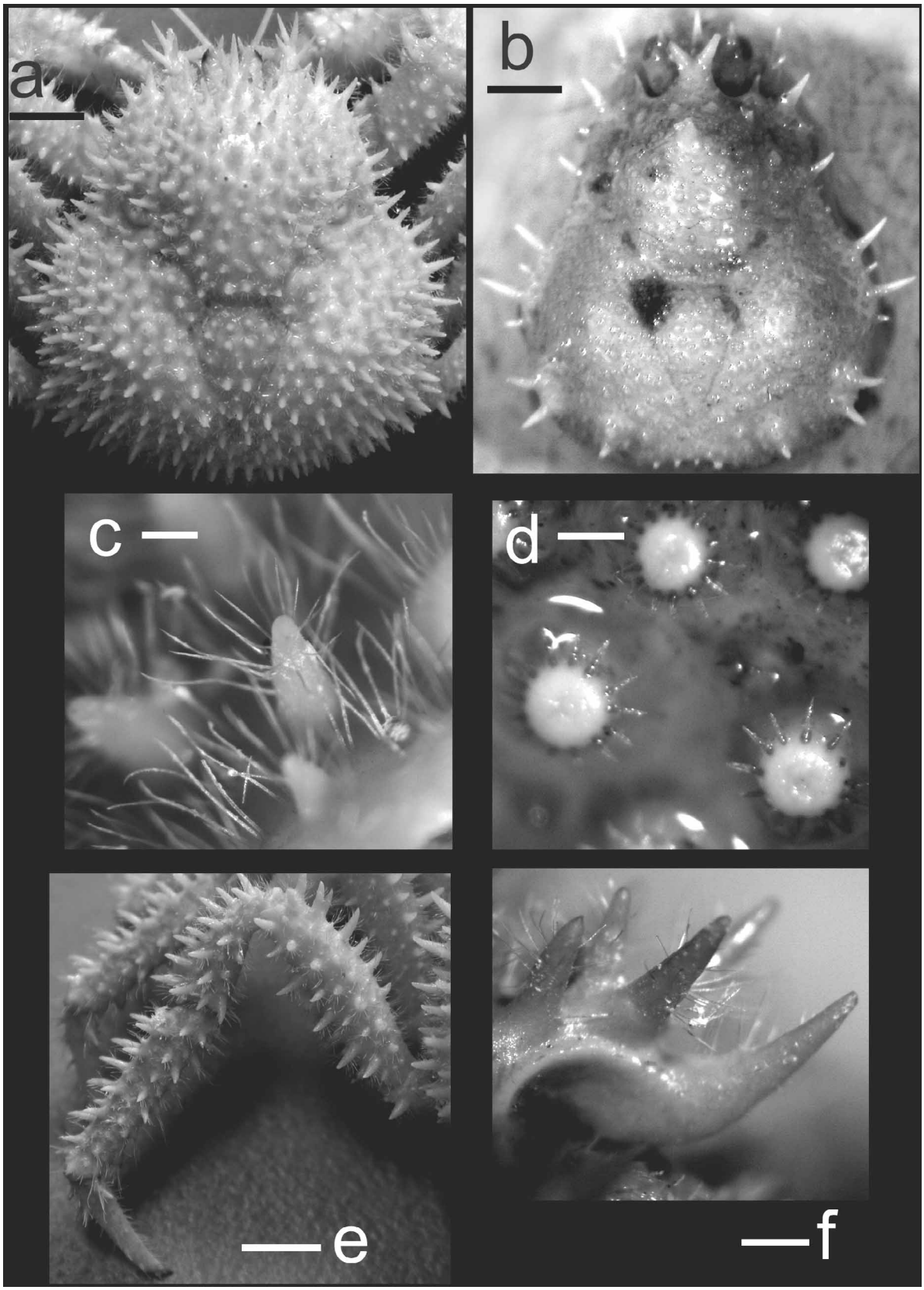

FIGURE 4. *Paralomis makarovi* **n. sp.** a, c, e, f: male holotype, 23.8 mm CL (USNM 1122582), Bering Sea, Bowers Bank, 54°30'N, 179°17'E, 629 m. (a) carapace, dorsal. (c) dorsal carapace spines, lateral. (e) left pereiopod 4, posterior. (f) rostrum, lateral. *Paralomis multispina* Benedict. b, d: USNM 18592, female, 20 mm CL. (b) carapace, dorsal. (d) mid-branchial carapace ornamentation, dorsal. Scale bar = 5 mm for a, b, e; 1mm for c, d, f.

Remarks. Several species of *Paralomis* have the dorsal part of their carapace covered in dense, uniform spines. Under magnification, however, the structure of the spines is similar only to *P. aspera* and *P. chilensis* from the coast of South America, both of which have conical spines with a band of long setae half way along the length. Diagnostic differences between these species are set out in Table 2.

Paralomis makarovi has a geographic proximity to *P. multispina* and *P. verrilli*. A uniform coverage of spines on the carapace and on the pereiopods, with no dorsal spine more prominent than any other easily distinguishes *P. makarovi* from *P. verrilli*. Specimens of *P. multispina* of a similar size to the types of *P. makarovi* (Fig. 4b) have been studied, and they are distinguished by the following features:

- No enlarged spine on the apex of the gastric region of *P. makarovi*, whereas a large spine is found in this position on all *P. multispina*, and is especially prominent in smaller specimens.
- Dorsal spines in *P. makarovi* conical, with a band of long setae half way down the spine. *P. multispina* has blunt spines with a single ring of short setae at the expanded apex (Figs 4c, d).
- *P. multispina* also has several long lateral spines on the carapace, whereas *P. makarovi* has none particularly more prominent than any other.
- A pedunculation of the base of the rostrum is found in *P. multispina*, and not in *P. makarovi*.

It is quite likely that specimens belonging to *P. makarovi* have been found previously, but misidentified as *P. multispina*. The equivalent growth stages of these two species are, however, substantially different (Figs 4a, b). Juvenile *P. histrix*, from Japan, also has a carapace covered with spines, but its spines are very long and are without setae. *Paralomis histrix* also has long spines on the abdomen, whereas the abdomen of *P. makarovi* lacks spines. *Paralomis bouvieri* Hansen, 1908, from the Northern Atlantic seems quite close to this species, except that spines have long setae eminating in a cluster from the apex in similar sized specimens.

***Paralomis nivosa* n. sp.**
(Figs 5, 6)

Material examined. Philippines: Palawan passage 10°57’45”N, 118°38’15”E, 27.12.1908, 685 m: female holotype CL 30 mm, collected on the 1907–1908 ‘Albatross’ expedition to the Philippines (USNM 1122581).

Etymology. This species is named *nivosa*, which is the Latin for snow-like or snowy. The name alludes to the fact that the carapace is angular and resembles a snowflake in dorsal view.

Description of holotype. Carapace angular in outline, with distinct angle at hepatic region (Fig. 6a). Gastric and branchial regions of similar size and moderately convex; cardiac region slightly sunken in comparison. Inflated whelt towards posterior of branchial regions and at medial entrance to cervical groove. Intestinal region flattened to posterior margin. Surface of carapace covered in low, rounded tubercles, each with a thick ring of short setae around sides and rounded non-setose apex (Fig. 5b). A few instances of clustered tubercles on gastric and cardiac regions. No spines or particularly prominent tubercles on dorsal surface. Lateral edges rounded and covered with similar ornamentation as dorsally. Five sharp spines on anterolateral portion of carapace: two on anterior margin; one on hepatic region, and two on anterior branchial margin. No spines on posterior or posterolateral branchial margin.

Rostrum pedunculate and wide, almost covering eyestalks in dorsal view. Base of rostrum dorsally covered in tubercles, similar to rest of dorsal carapace. Two short, sharp spines at end of this rostral prominence, at level of corneae. Median spine of rostrum extending beyond corneae; slightly keeled ventrally, and strongly curved upward (Figs 6b, d).

Eyestalks with several dorsal spines, one very long and extending past cornea (Fig 6e). Antennal acicle long, with one long medial spine, five long outer spines, and four short spines on internal surface. Several spinules on dorsal surface of acicle. All spines with uniform coverage of short setae along their length.

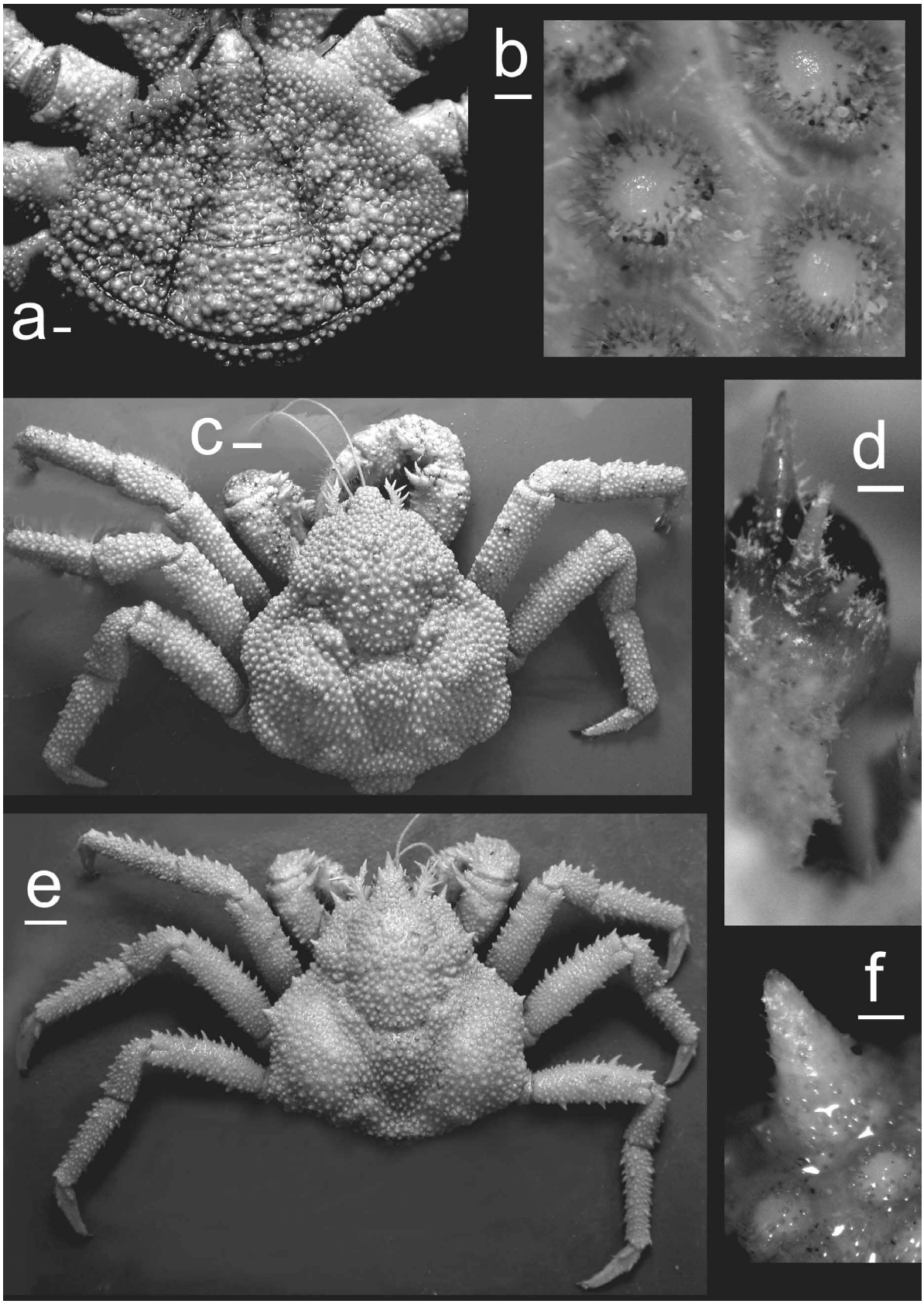

FIGURE 5. *Paralomis nivosa* **n. sp.** a, b, d–f: female holotype, 30 mm CL (USNM 1122581), Philippines, Palawan passage, 10°57'45"N, 118°38'15"E, 685 m. (a) abdomen. (b) mid-branchial carapace ornamentation, dorsal. (d) part of right ocular peduncle visible below rostrum, dorsal (e) whole organism, dorsal. (f) carapace lateral spine, dorsal. *Paralomis haigae* Eldredge. e: female 43.8 mm CL (MNHN-Pg4274), Samoa. (e) whole organism, dorsal. Scale bar = 1 mm for a–d; 5 mm for e, f.

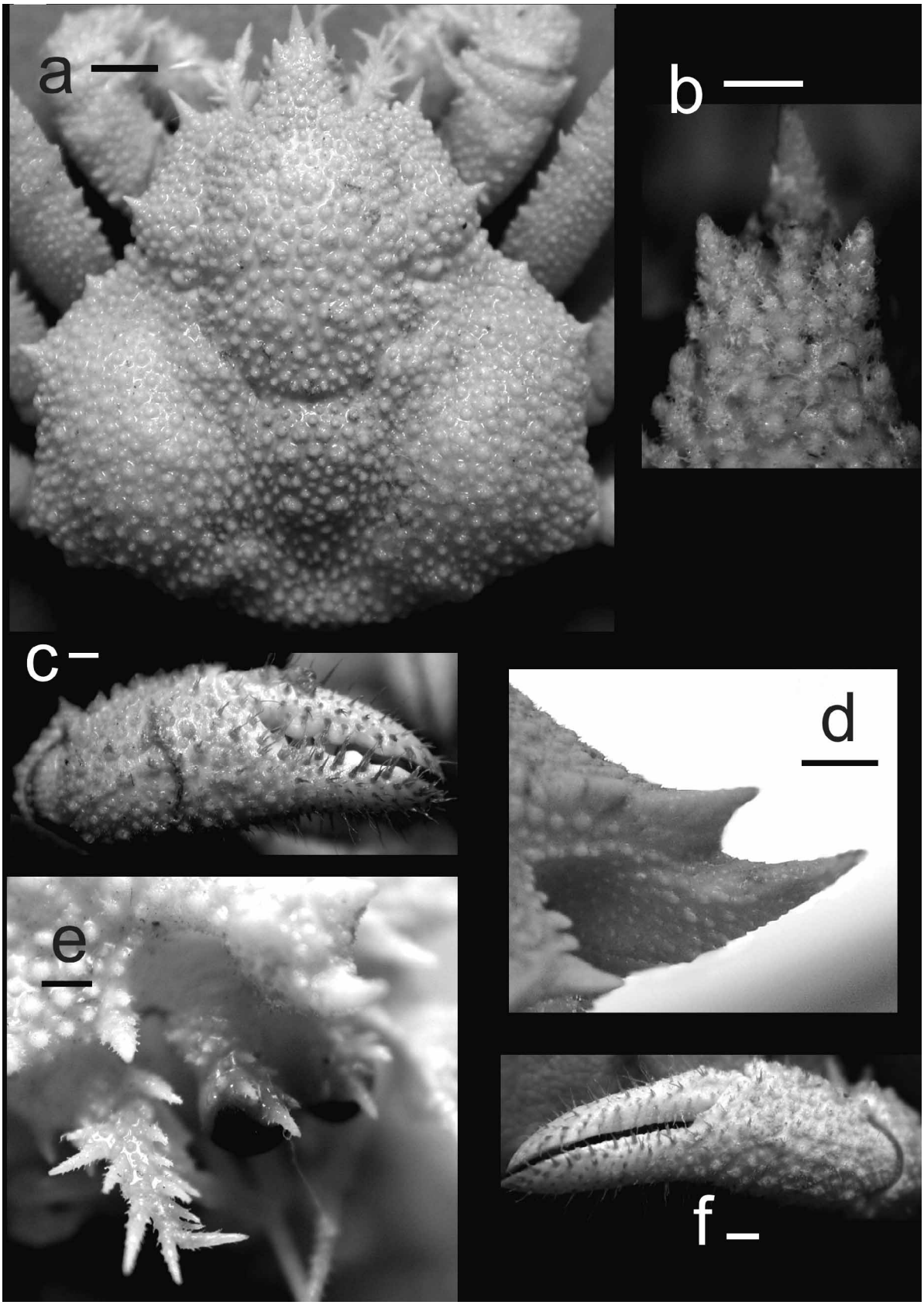

FIGURE 6. *Paralomis nivosa* **n. sp.** a–f: female holotype, 30 mm CL (USNM 1122581), Philippines, Palawan passage, 10°57'45"N, 118°38'15"E, 685 m. (a) carapace, dorsal. (b) rostral spines, dorsal. (c) right chela, lateral. (d) rostrum, lateral. (e) antennal acicle, frontal. (f) left chela, lateral. Scale bar = 5 mm for a; 1 mm for b–f

Cheliped carpus with a series of 4 enlarged spines on internal angle and a few tubercles on other surfaces. Very few spinules on surface of chelae palms, none on fingers. Fingers with row of clusters of setae external to cutting surfaces, and several setae on mobile finger.

Pereiopods uniformly covered with tubercles, with some prominent sharp spines as on lateral margins. Merus of pereiopod 4 about half carapace length and 1.5 times length of propodus, with rounded cross-section. Five prominent spines on dorsal anterior edge, and several sharp spinules on ventral posterior edge of walking leg meri. Sharp spinules covering carpus and propodus. Dactylus slightly shorter than propodus and compressed in cross-section. One or two spines in articulating region, but smooth surfaces elsewhere. With 5 short, black needle-like spines on ventral side of dactylus, as well as several tufts of setae.

Abdomen of holotype female asymmetrical, although with very little 'right-hand skew' — telson almost in line with body axis (Fig. 5a). Mid portion of second abdominal segment prominent in dorsal view. Medial and paired lateral plates on each abdominal segment 3–5. Marginal plates on left side separate from lateral plates. Surface of abdominal plates with low tubercles similar to those found dorsally.

Remarks. The dorsal ornamentation in *Paralomis nivosa* n.sp. is very similar to *P. haigae* Eldredge, 1976 (Fig 5c), and *P. dofleini* Balss, 1911 and this feature allies these three species within *Paralomis*. This specimen is a small adult; 30 mm in carapace length. Direct comparison with similar sized specimens of *P. haigae* and *P. dofleini* have been made at the USNM and Muséum National d'Histoire Naturelle, Paris (MNHN).

- *P. nivosa* has several sharp spines on the lateral borders, dorsally on the rostrum, and on the legs. There is no indication of any spines laterally in *P. haigae* or *P. dofleini*, with the exception of one on the anterior margin. No specimens of *P. haigae* studied have spines dorsally on the rostrum.
- The outline of the carapace *in P. nivosa* is quite angular, whereas in *P. haigae*, the carapace is more rounded.
- The rostrum in *P. haigae* and *P. dofleini* has a wide base, which ends in a blunt prominence above a short, straight ventral spine. In *P. nivosa*, the ventral spine is very prominent and curved upward.

***Lithodes galapagensis* n. sp.**
(Figs 7, 8)

Material examined. Galapagos Archipelago: Johnson Sea-Link II Cruise station 3101, Cabo Douglas, Fernandina Island, 00°17'30"S, 091°39'36"W, 17.07.1998, 648m: male holotype, CL 114 mm; female paratype, CL 84 mm, Seymour Island, 00°21'42"S, 090°15'00"W, 25.07.1998, 740 m (all USNM 1122586).

Etymology. This species is named after its type locality, the Galapagos Islands.

Description of the holotype. Carapace roughly pyriform in outline (Fig. 7d); as wide as long when measured at maximal width of carapace. Dorsal regions well defined; covered uniformly with small spinules more or less acute at apex, without setae (Fig. 7b). Gastric region convex and slightly more inflated than branchial and cardiac regions. One pair of slender spines 7 mm in length, emanating from the mid part of this region — level with hepatic spines on lateral margin. Spinules sparse on apex of gastric region and very few around base of prominent spines. Cardiac region depressed and separated from gastric region by smooth, wide, and saddle-shaped groove. Cardiac region depressed anteriorly, and more inflated posteriorly around single pair of long, slender spines in this region. A pair of acute spinules directly anterior to this pair. Triangular cardiac region separated from branchial regions by grooves which converge posteriorly, and then diverge close to the margin to describe posterior of branchial regions. Branchial regions each with single long, slender spine at apex; a few large, acute spinules posteriorly. A pair of conical spines in intestinal region almost on posterior margin.

Exterior orbital spine just surpassing length of eyestalks; anterolateral spine about equal in length or slightly smaller. Hepatic spines slightly inflated at base, with long slender spine reaching 20 mm. Two spines

on anterior portion of each branchial lateral margin, and several much smaller, conical spines interspersed between them and on posterolateral margins.

Rostrum with long, straight median projection rising dorsally from surface of carapace and terminating in pair of spines. Mid way along length of median projection emanate a pair of dorsal lateral spines of about the same length as terminal bifurcation. Base of rostrum narrow, without granulation. Ventrally, with long, smooth spine curving gently upward, terminating approximately at level of corneae.

Eyestalks prominent and without granulation, but with crenulation of dorsal edge of the corneal margin (Fig. 8b).

Second segment of antennal peduncle with long slender spine on exterior aspect. Antennal acicle reduced to very small conical process.

Cheliped merus and carpus with several strong spines on terminal border and poorly defined rows of short spines on dorsal, interior and exterior surfaces. Palm with several poorly defined rows of short spines on dorsal border and two rows on exterior surface leading to articulation with movable finger. Fingers 0.4 × total length of right hand, and 0.5 of left hand. Fingers bearing few tufts of short setae.

Walking legs long and slender. Merus of pereiopod 3 about 0.8 × length of carapace, and 0.2 × as high as long. Covered densely with spinules on dorsal/posterior surface, and smooth on ventral surface (Fig. 7c). Two or three rows of larger conical spines along length of merus and long spine on terminal border. Carpus of walking legs with spinulation on dorsal surfaces and smooth ventral surfaces, as well as two very long spines at proximal and distal ends of dorsal border. Propodus sparsely covered with irregular rows of spinules. Dactyli of walking legs over half length of merus and equal to length of carpus; very sharp, slender spines on dorsal border to tip; few or no spines on ventral border; no tufts of setae present.

Abdomen of a form typical of *Lithodes*, with nodules in the medial portion of segments 3–5; separate marginal and lateral plates well-calcified (Fig. 8f). Second abdominal segment with medial and lateral plates fused; marginal plates almost joined or with suture visible. Surface of abdominal plates with several warty tubercles on edges but no spines decorating surface.

Variations. The female paratype of this species is slightly smaller than the male. It differs from the holotype in having less acute spinules on the dorsal surface, and the less prominent spines on the proximal and distal angles of the walking-leg carpi.

Remarks. This species is distinguished from all other members of this genus, except *Lithodes wiracocha* Haig, from Peru, in that it has carapace and dorsal surface of the walking legs densely covered in spinules. This species differs from *L. wiracocha* in the following ways:

- The spines on the dorsal surface are less dense in *L. galapagensis* than in *L. wiracocha*.
- The walking legs of *L. galapagensis* have spinules only on the dorsal and not on the ventral surfaces of the walking-leg segments, whereas *L. wiracocha* has densely packed spinules covering the surface of all segments.
- In the holotype, and somewhat on the paratype of *L. galapagensis*, certain spines on the dorsal surface and on the walking legs are very long and slender, unlike the stout conical spines in *L. wiracocha*.
- The rostrum of *L. galapagensis* is very long and slender — similar in this respect to *Lithodes megacantha* Macpherson, 1991 from the central Pacific; however, the rostrum of *L. wiraconcha* is rather stout in comparison.
- There are no acute spinules on the dorsal base of the rostrum in *L. galapagensis*, whereas spines cover the proximal part of all of the lateral spines in *L. wiracocha*.
- No spines on the surface of the abdominal plates in *L. galapagensis*. Instead, plates are covered with low tubercles.

Other species close to this location include *Lithodes panamensis* Faxon from Panama and Peru, and *Lithodes santolla* Macpherson (1988b), from Patagonia, both of these are readily distinguishable from the present species because of the peculiar spination of *Lithodes galapagensis* in which a dense coverage of acute spinules are combined with the few very long spines and long rostrum.

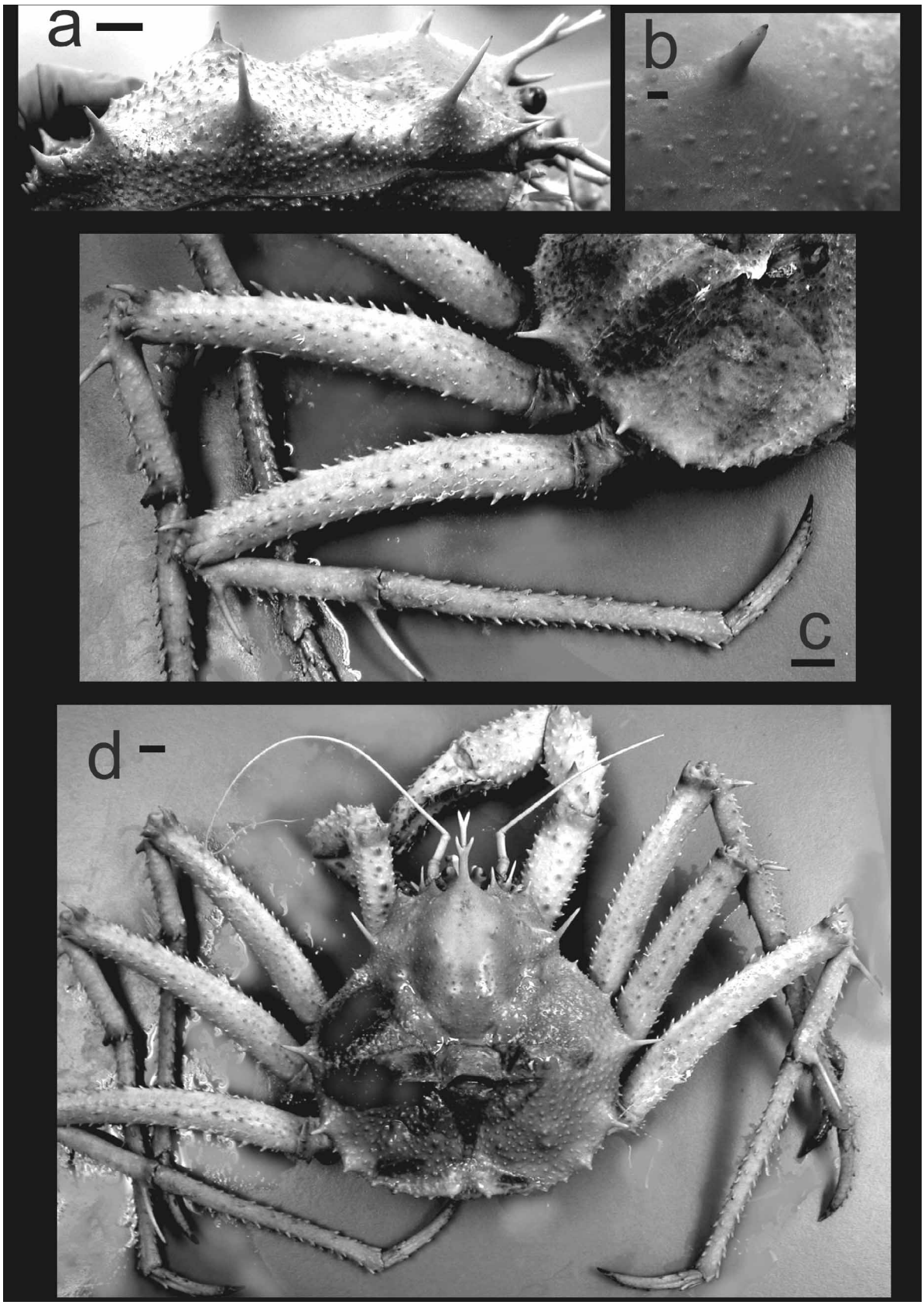

FIGURE 7. *Lithodes galapagensis* **n. sp.** a–d, male holotype, 114 mm CL (USNM 1122586), Galapagos Archipelago, Cabo Douglas, Fernandina Island, 00°17'30"S, 091°39'36"W, 648 m. (a) carapace, lateral. (b) dorsal carapace spine, lateral. (c) left walking leg 3, posterior. (d) whole organism, dorsal (note damage to carapace on the left branchial region). Scale bar = 10 mm for a, c, d; 1 mm for b.

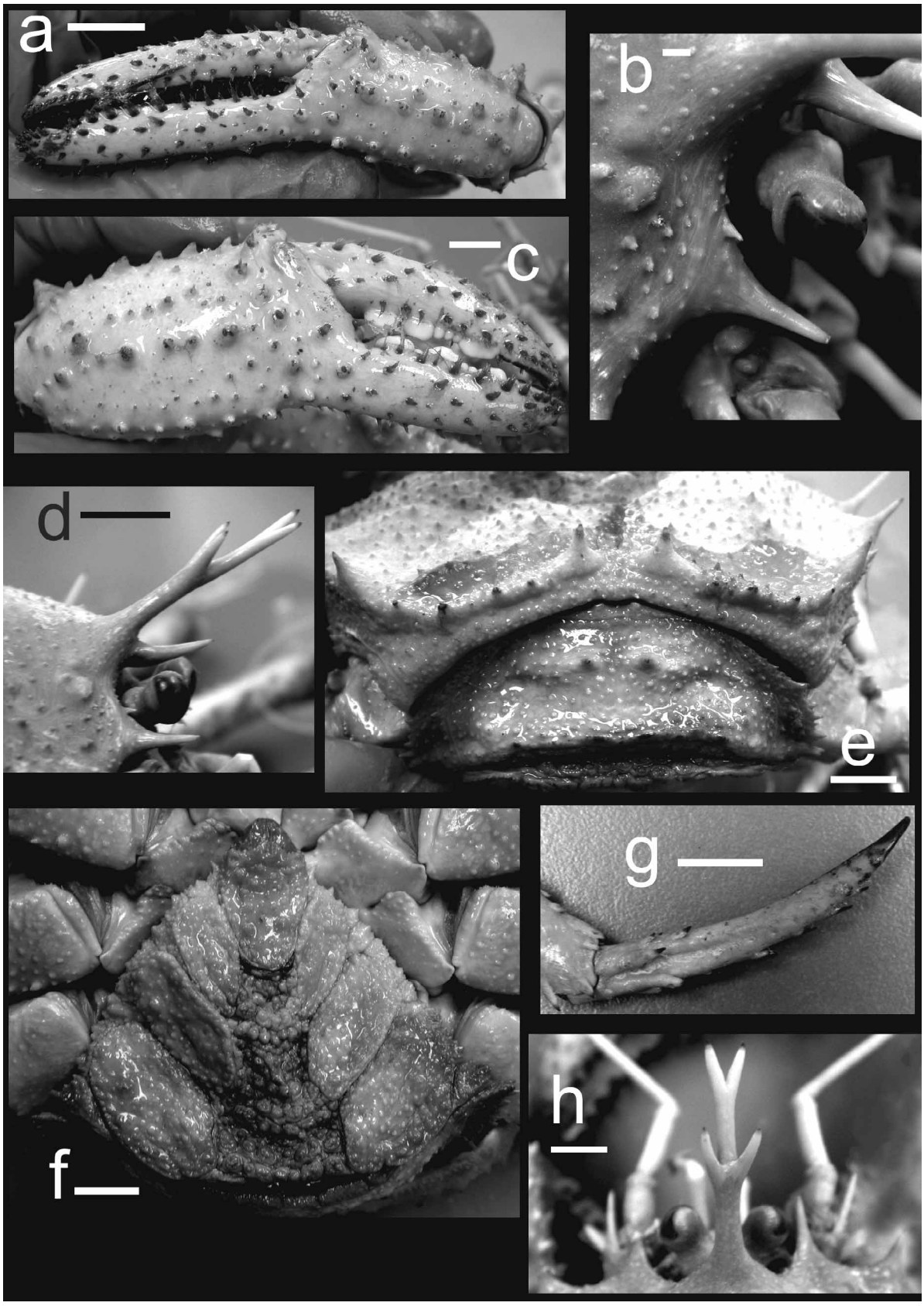

FIGURE 8. *Lithodes galapagensis* **n. sp.** a–h, male holotype, 114 mm CL (USNM 1122586), Galapagos Archipelago, Cabo Douglas, Fernandina Island, 00°17'30"S, 091°39'36"W, 648 m. (a) left chela, lateral. (b) ocular peduncle, frontal. (c) right chela, lateral. (d) anterior carapace, lateral. (e) second abdominal segment, posterior. (f) abdominal plates. (g) dactylus 3rd walking leg, posterior. (h) rostral spines, dorsal. Scale bar = 10 mm for a, c–h; 1 mm for b.

Discussion

The discovery of these species adds to the considerable number belonging to the genera *Lithodes* (now 21 species), and *Paralomis* (now 60 species). These genera have representatives in most areas of the world's oceans, and species numbers in different oceans probably reflects the more on the intensity of sampling in that locality than actual level of biodiversity. Especially in *Paralomis*, the highest species counts are found along the western coast of South America (9 species), and around Japan (10 species). A gap in knowledge is present around eastern Africa (and much of the Indian Ocean), and the Southern Ocean. The four species of *Paralomis* in the northern and central Indian Ocean are known only from their respective type localities. Only *P. birsteini* Macpherson 1988a and *P. stevensi* Ahyong & Dawson 2006, are known from the Southern Ocean above 60°S (Thatje *et al.* 2005, 2008). The full extent of diversity in *Paralomis* can only be found by an increase in sampling effort and reporting of novel morphotypes.

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